Short Communication

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Estonian Female Fitness Athletes Sweeteners Consumption Sweeteners in Fitness

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ABSTRACT

Background: In fitness the proportional development and toned state of body is evaluated. Fitness athletes monitor balance of macronutrients and calories in their diet, so the usage of low-calorie sweeteners and products sweetened with artificial sweeteners is rising. It is recommended to treat sweeteners with caution. The aim of study was to identify sweeteners consumption habits of 35 Estonian female competing fitness athletes.

Methods: A questionnaire was used. Descriptive statistics, t-test, or Exact test where applied for comparison of studied groups ($p<0.05$).

Results: Approximately⅔ of participants consume sweeteners (stevia 73.1% of participants, sucralose 69.2%, aspartame 50%) and sweetened products (bars, BCAAs, puddings, protein powders and flavour drops) on a daily basis and on average 2–3 times per day. Sweetener-users compared to non-users ($p=0.015$) find sweeteners healthier than sugar; consume as an alternative to table sugar due to their low calorific value (88.5%) and for suppressing sugar craving (80.8%) more during competition period. Although participants are aware of health risks associated with sweeteners, they still believe that they are safe in reasonable amounts.

Conclusion: In conclusion, sweeteners are popular alternative among Estonian female fitness athletes.

Short Communication

Fitness as a competitive sport has developed from natural body building and its popularity is increasing rapidly [1]. Although the evaluation criteria vary slightly depending on categories of competition (fitness, body fitness, bikini-fitness, wellness-fitness, fit model and physique), the integrity and harmony of the competitor's body is generally considered, which essentially means evaluating the body's proportions, muscle development, general appearance and performance through mandatory poses [2]. During the off-season period, athletes consume more calories than are being burned, which is necessary to increase muscle mass and maintain energy for training. During the competition period, the reduction of body fat mass begins, maintaining as much muscle mass as possible and bringing out the muscle separation. Athletes have calorie deficit, as the proportion of carbohydrates is reduced, and protein consumption remains the same or increases [3]. However, there are still no specific dietary recommendations for body building and fitness athletes [4]. Additives (incl sweeteners), also known as e-substances, are substances added to food or food supplements for technological purposes [5].

Sweeteners (also called "non-nutritious", "high intensity" and also "low calorie" sweeteners) have a sweet taste (200 to 13,000 times sweeter than sucrose) with a minimum of calories [6]. By 2020, a lot of conflicting information about sweeteners safety has accumulated. On one hand, sweeteners are described to have a weight-loss effect due to their low caloric content; they have been considered a safe supplement in the diabetic menu

[7]. Nevertheless, some studies have shown that continuous consumption of sweeteners can lead to weight gain [8-10]; neurotoxicity to brain [11,12]; metabolic problems such as glucose intolerance and intestinal microbiota disturbance [13]. As table sugar is rich in calories, fitness athletes have started to use using sweeteners instead of table sugar, honey, and other types of sugar14. Unfortunately, there are lack of studies that reflect the consumption of sweeteners among athletes, mostly there have been studied consumption of food supplements and nutrition in general [3,14]. The aim of the study was to clarify the consumption habits of sweeteners (products enriched with sweeteners; consumption frequency; the seasonality of the consumption) among Estonian fitness female athletes. Based on the above, we assumed that female fitness athletes consume sweeteners or products enriched with sweeteners mostly during the competition period, while being in calorie deficient and body fat mass is reduced, to suppress sugar craving.

Materials and Methods

Competing Estonian adult female fitness athletes filled in the electronic questionnaire (January 2020). The average time to fill in the questionnaire was 10–15 minutes, the questionnaire did not contain sensitive personal data and could be discontinue at any time. The questionnaire (via electronic system: connect.ee) was sent to all Estonian female fitness athletes (n=135). The software program Sigma Plot for Windows version 11.0 (GmbH Formation, Germany) was used. Results are presented as means with standard deviation (SD), or percentages. Continuous data were compared with the t-test and categorical with the $\chi 2$ or Fisher Exact test, as appropriate. $P < 0.05$ was considered statistically significant. Free-form responses were grouped and systematized. The study was approved by the Ethics Committee for Human Research of the University of Tartu (protocol no. 293 / T-5, 05.06.2019).

Results

Altogether 35 (26%; 20-50y) athletes filled the questionnaire. The desire to achieve the goals (54.3%); ensure the development of the body, desire to keep in shape and achieve a nifty ideal physical body (34.3%); previous training experience and interest in training (22.9%) were the main reasons for starting with fitness. The general data of study group in comparing sweeteners users (74.3%) and non-users are presented in (Table 1). The subjects` fitness experience was normally distributed and in comparing sweetener users in different experience groups (>3.4y, n=13 vs <3.4y, n=22), there were no differences; 76.9% vs 72.7%, respectively. Fitness athletes characterize sweeteners or sugar substitutes mainly as calorie-free or low-energy substances (28.6%); sweet taste enhancers (28.6%); alternatives to sugar (22.9%); chemical/ artificial substances (11.4%); sugar craving suppressants (11.4%). Users (n=26) consider sweeteners to be a necessary component for a fitness competitor. They believe, that sugar craving can be satisfied and better flavoring of food during the dieting (e.g., curd, coffee, etc.; 65.4%); sweeteners allow to eat more real food due to the low caloric content (fills the stomach; 50%); and permits psychologically easier keep fit without special diet (30.8%). On the other hand, non-users (n=9) consider sweeteners unnecessary, as they can increase sugar craving and general appetite (44.4%); are not healthy (e.g., disrupt intestinal microbiome; 44.4%); and not safe (33.3%).

Table 1: General data and opinions about sweeteners of all study group and comparatively of sweetener users and non-users.

Subject	Answer options	All; n=35	User; n=26	Non-user; n=9	p=
Age (year): mean; SD		33.3; 6.8	32,4; 5.7	35.9; 9.0	NS
Years of training: mean; SD		3.4; 2.1	3.4; 2,0	2.8; 2.5	NS
Competition period (month): mean; SD		4.5; 2.8	4.4; 2.6	4.6; 3.4	NS
Off-season period (month): mean; SD		6.9; 2.5	6.6; 2.3	7.8; 3.1	NS
Competition category (%)	Bikini-fitness	74.3	76.9	66.7	NS
	Body fitness	14.3	15.4	11.1	NS
	Fit model	11.4	11.5	11.1	NS
	Wellness-fitness	8.6	7.7	11.1	NS
	Fitness	2.9	0	11.1	NS
Opinion: Sweeteners necessity in fitness (%)	Not necessary	25.7	7.7	77.8	0.024
	Supporting	62.9	76.9	22.2	0.006
	Considered necessary	11.4	15.4	0	NS
Preferences (%)	Prefers a sweetener	42.9	57.7	0	0.004
	Prefers a sugar	17.1	11.5	33.3	NS
	No preference	40.0	30.8	66.7	NS
Opinion: Sweetener is healthier than sugar (%)	No	51.4	42.3	77.8	NS
	Yes	34.3	46.2	0	0.015
	Equivalent	14.3	11.5	22.2	NS

Note: NS – not significant

Some users (11.5%) and non-users (22.2%) consider sweeteners and table sugar to be equivalent, as both are harmful to health and both should be consumed moderately. Some non-users (77.8%) consider table sugar to be better than sweeteners because they have experienced the harmful effects of sweeteners (e.g. gases, malaise, signs of poisoning). Female fitness athletes use sweeteners mostly during the competition period (46.2%; to satisfy the sugar craving, while providing a minimum of extra calories compared to table sugar) and on a daily basis (65.4% of users, in mean 2.7 (±1.3) times a day). The three most common sweeteners in the products are steviol glycosides (stevia; E 960; 73.1%); sucralose (E 955; 69.2%), and aspartame (E 951; 50%). The consumption is higher in competition period (46.2%) and lower in off-season period (19.2%). 34.6% use them irrespective of the season. The most consumed products containing sweeteners are bars, BCAAs, protein puddings, protein powders, calorie-free taste drops and calorie-free soft drinks; and favorite brands – Barebells, Tere (Estonian dairy industry), Coca-Cola Zero, Huxol, Myprotein and Nocco. Opinions on the safety of sweeteners in the two study groups are presented in (Figure 1). Both non-users and users believe that the consumption of sweeteners may cause health risks (including over-consumption), but they are safe consuming in small quantities.

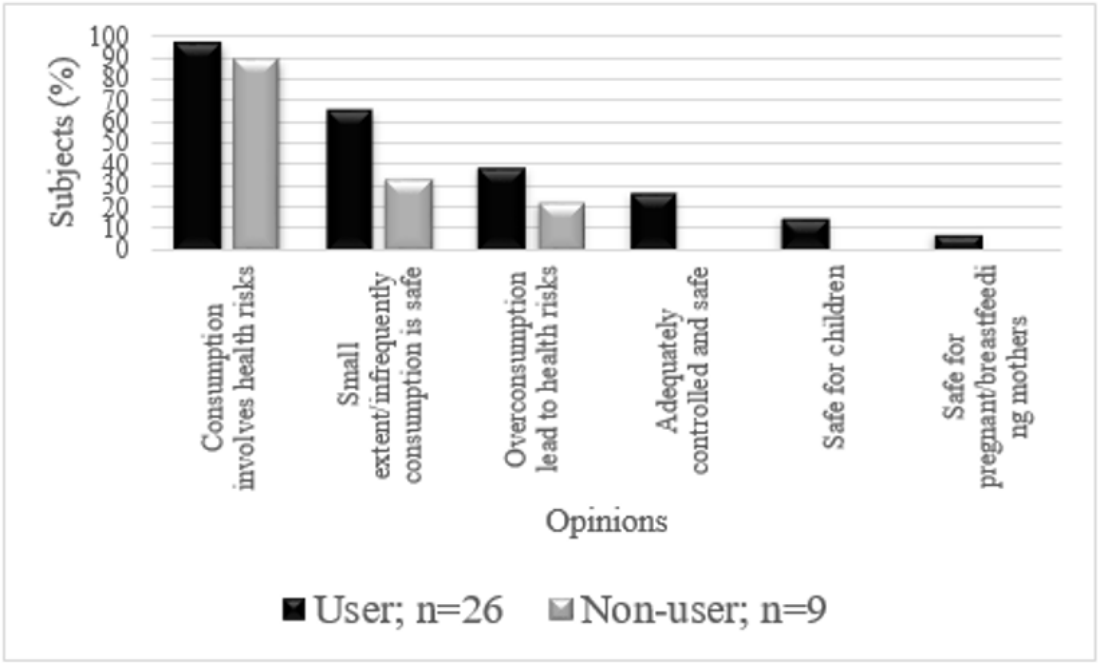

Figure 1: Subjects' assessment of the safety of sweeteners (no statistical differences between groups).

Only users state that sweeteners are controlled and safe and can be consumed by both children and pregnant/breastfeeding mothers.

Discussion

The results of this study showed that three-quarters of participants consume sweeteners and products that are enriched with them quite frequently especially in competition period; confirm the results of the previous study of Chappell, et al [14]. Professional athletes competing in fitness consume more food supplements than amateurs, while the former may benefit from the sponsorships of food supplement companies. In this way, companies' products are advertised on social media [14]. Unfortunately, based on the results of our study, it is not possible to say whether the consumption of sweeteners is in any way related to sponsorships. The average off-season of Estonian fitness athletes is similar to British fitness competitors [14] and lasts 6.9 months. Thus, the pre-competition diet is long-term and the consumption of protein in this time period has increased 4. During of a high-protein diet, an increased appetite for sweets in women has been found [15]. In consequence, the athletes` sugar craving and the desire to satisfy it by consuming sweeteners is understandable. Some athletes noticed that sweeteners actually increase overall appetite, as confirmed in a study by Davidson et al8. Thus, the use of sweeteners is not justified and is more of a self-deception.

Athletes consume supplements for health-related reasons [16]. As to be obese is not healthy [17] and unacceptable for fitness, we could believe, that participants of our study desired to limit calories and thereby fat accumulation in the body. In addition, the use of supplements has been reported to boost the immune system and improve physical performance [16]. Also, sweeteners flavor food, and it satisfies the sugar craving without adding calories. The association between weight loss or maintenance and increased sweetener intake has previously been shown by Drewnowski and

Rehm [18]. However, in addition to sweet taste, energy content is needed to improve physical performance. It means that cheating on the body with a sweet-tasting sweetener does not help to improve performance [19]. Participants of our and Karimian and Esfahan's [16] study believe that sweeteners and food supplements are harmful to the body and this is largely in line with the results of studies on the health safety of various sweeteners [20-22]. Most products consumed by fitness athletes contain stevia, which is considered a quite safe choice due to its natural origin [23]. Although there are insufficient data on certain health effects [24], there may be some positive effects on fitness athletes. For example, consumption of whey protein powder sweetened with stevia in endurance training period increase muscle mass and strength compared to consumption of unsweetened whey protein [25]. In 1990s, the use of stevia as a sweetener in foods has been inhibited by its bitter aftertaste and significantly more expensive production compared to aspartame, sucralose, or saccharin.

At the moment, however, stevia is constantly being developed and its taste is being improved [26]. As people have also become more aware of nutrition and health [27], currently, preferences among both non-athletes and, according to this study, athletes have rapidly shifted to more natural products, such as stevia as a sweetener. As a result, consumers also influence the market and thus the sweeteners in products. Our study showed that a few participants had experienced negative effects of sweeteners, such as intoxication, malaise, and gastrointestinal unpleasant symptoms. Although studies of sucralose [22,28] and aspartame [11-13,29] reflect potential health risks, these sweeteners are most consumed by Estonian fitness athletes. The situation is similar in Ireland [30] and Italy [31]. Based on literature [32], it can be assumed that in the food industry it is cheaper to use sweeteners instead of sugar when sweetening foods. In addition to their low cost, the preference for the use of sucralose and aspartame may also come from a sucrose-like taste. Due to the heat resistance of sucralose, it can also be used in a wider range of products than, for example, aspartame, which is less heat resistant [33]. Which sweeteners are most present in athletes' menus probably depends on which sweeteners are used in the products currently on the market?

Although number of participants consume sweeteners a daily basis and consciously replace table sugar with them, most of them are still aware of the dangers of sweeteners. Whether the consumption of sweeteners by Estonian fitness female athletes remains in reasonable amounts depending on the sweetener, i.e. below the maximum recommended amounts set by the FDA, remains questionable. The limitation of the study is rather small number of participants. Still, the results could provide a basis for the Bodybuilding and Fitness Association to develop education programs and also to advise coaches/athletes.

Conclusion

Sweeteners are consumed daily due to their low caloric content and satisfaction of sugar craving among Estonian female fitness athletes slightly more during the competition period. The hypothesis according to which female fitness athletes consume more sweeteners or products enriched with sweeteners during the competition period to satisfy their sugar craving, was confirmed.

Conflict of Interest

All the authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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Authors Contribution

Each author (Anete Mootse, Anna-Liisa Tamm, Ülle Parm) has:

1) substantial contributions to the conception or design of the work;

2) contribution to revising it critically for important intellectual content;

3) final approval of the version to be published;

4) agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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