

## COMPARISON OF VEGETABLES AND FRUIT CONSUMPTION FREQUENCY BY ATHLETES BEFORE AND AFTER MARATHON

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### ABSTRACT

**Background.** One of the prerequisites to achieve high sports scores is to ensure the proper supply of nutrients. Both deficiency and excess of these components can cause malfunctions of bodies in athletes, which adversely affects their health and performance.

**Objective.** Comparison of the frequency of intake of groups of vegetables and fruits, being sources of vitamins and minerals, by marathon runners in periods before and after the long-distance run.

**Material and Method.** The frequency of fruit and vegetable consumption by marathoners was analyzed among women (n = 105) and men (n = 87) aged between 19 and 73 years, before and after running competition. The Block's questionnaire was used to evaluate the consumption of groups of vegetables and fruits (leafy, root and cruciferous vegetables, as well as stone, berry and tropical fruits). Their consumption was assessed on a point scale.

**Results.** Sufficient vegetable and fruit intake was found in about 55% of the marathon runners. Diets of about 20% of the respondents were poor in fruits and vegetables. Higher fruit and vegetable intake was reported in both men and women after the marathon compared to the pre-run period.

**Conclusion.** Daily food rations of about 1/4 of the surveyed marathoners provided insufficient amounts of fruits and vegetables, and daily food rations of about 20% of the athletes were poor in these products. After the marathon, the consumption of vegetables and fruits improved in 15% of the surveyed women and in 10% of the men compared to the pre-marathon period.

**Key words:** *marathon runners, dietary behaviors, vegetables, fruits*

### STRESZCZENIE

**Wprowadzenie.** Jednym z warunków osiągnięcia wysokich wyników sportowych jest zapewnienie odpowiedniej podaży składników odżywczych. Zarówno niedobry, jak i nadmiary tych składników pokarmowych mogą powodować zaburzenia funkcjonowania organizmu sportowca, co niekorzystnie wpływa na zdrowie i osiągnięte wyniki sportowe.

**Cel.** Porównanie częstotliwości spożycia warzyw i owoców, stanowiących źródło witamin i składników mineralnych, przez maratończyków w okresach przed i po biegu długodystansowym.

**Materialy i metody.** Analizowano częstotliwość spożycia warzyw i owoców przez maratończyków: kobiety (n=105) i mężczyzn (n=87) w wieku od 19 do 73 lat w okresach przed i po biegu. Użyto kwestionariusza Block'a do oceny spożycia grup warzyw i owoców (warzyw liściastych, korzeniowych, krzyżowych, owoców pestkowych, jagodowych i tropikalnych). Oceniono spożycie tych produktów w skali punktowej.

**Wyniki.** Wystarczające spożycie warzyw i owoców stwierdzono u około 55% badanych maratończyków. Diety około 20% badanych osób były ubogie w warzywa i owoce. Wyższe spożycie warzyw i owoców wykazano zarówno u kobiet, jak i u mężczyzn w okresie po maratonie w porównaniu do okresu przed biegiem.

**Wnioski.** W około 1/4 badanej grupy maratończyków stwierdzono niewystarczające spożycie warzyw i owoców w całodziennej racji pokarmowej, a całodzienne racje pokarmowe około 20% sportowców były ubogie w te produkty. Po maratonie stwierdzono poprawę spożycia warzyw i owoców u 15% badanych kobiet i 10% mężczyzn w porównaniu do okresu przed biegiem długodystansowym.

**Słowa kluczowe:** *maratończycy, zachowania żywieniowe, warzywa, owoce*

## INTRODUCTION

One of the prerequisites to achieve high sport scores is the appropriate supply of nutrients, i.e. protein, fats, carbohydrates, vitamins, macro- and micronutrients. Both their deficiency and excess can cause malfunctions of the bodies in athletes, which can have adverse effects on their health and sports performance [5, 9, 14].

Studies of nutritional patterns of groups of athletes have demonstrated that these patterns are usually poor and that common dietary mistakes include: too low energy intake and unproportionate contents of most nutrients, including vitamins and minerals. Systematic physical effort and multiple loads the athletes are exposed to while on unbalanced diet may induce dietary deficiencies. This may in turn cause micro-damages to muscles as well as adverse metabolic transformations in the body, leading to among others, incorrect ratio between fatty tissue and lean tissue mass that affect athlete's tolerance to physical strain. Dietary deficiencies may diminish motor and concentration capabilities, disturb regeneration processes, and cause higher susceptibility of an athlete to fatigue and body overload. In addition, inappropriate nutrition increases the risk of malnutrition, dehydration, and the likelihood of mild and serious injuries [7, 8, 11, 12].

The aim of this study was to compare the frequency of intake of groups of vegetables and fruits, being sources of vitamins and minerals, by marathoners in the periods before and after the long-distance run.

## MATERIAL AND METHODS

The study was conducted in 192 persons, who participated in a marathon in Wrocław. It was a cross-sectional study with convenience sampling. The participants were asked to complete a questionnaire regarding the frequency of intake of vegetables and fruits being the main sources of vitamins and minerals in their diet. The survey was conducted in the months of May to August 2013. Women represented 54.7% and men 45.3% of the group. The mean age of women was 32.7 years (range: 20–57 years), whereas that of men was 35.1 years (range: 19–73 years). The frequency of intake of groups of fruits and vegetables was determined using a Block's questionnaire developed for the needs of the NHANES II survey and used in many countries [1, 13]. The questionnaire allowed collecting data about the usual frequency of consumption of leafy, root and cruciferous vegetables as well as stone, berry and tropical fruits. The frequency of intake of these products was evaluated using a 5-point descriptive scale with numerical values assigned:

- less than once a week - 0 pts., about once a week - 1 pt., 2-3 times a week - 2 pts., 4-6 times a week - 3 pts., every day - 4 pts. [1].

The frequency of intake of the group of fruits and vegetables was expressed in a point scale (0-24 pts.).

Three groups of respondents were distinguished based on the sum of points achieved:

- persons with sufficient intake of vitamins and minerals (>18 pts.);
- persons with insufficient intake of vitamins and minerals (6-18 pts.);
- persons whose diet is poor in vitamins and minerals (< 6 pts.).

The statistical analysis of results was conducted using Statistica 10.0. package. Mean values of traits assigned to categories of the frequency of intake were compared with *Kruskal-Wallis* test. Letters a – b in tables denote significant differences between mean values in rows at  $p \leq 0.05$ , whereas ns – denotes insignificant differences.

## RESULTS

The mean body mass of women before the marathon accounted for 62.4 kg (range: 50–95 kg), whereas after the marathon – for 60 kg (range: 48–86 kg). In the case of men, the respective values were as follows: 81.7 kg (range 63–112.7 kg) and 78.6 kg (range 55–92.6 kg).

Table 1 summarizes the frequency of intake of 6 groups of vegetables and fruits by the surveyed women (n=105) and men (n=87). Statistically significant differences were found in the frequency of intake of most of the analyzed food products being the main dietary sources of vitamins and minerals in both women and men between the pre- and post-marathon periods. A higher frequency of consumption of root and cruciferous vegetables and of stone and berry fruits by women was demonstrated in the post-marathon than in the pre-marathon period. After the long-distance run, the number of women declaring consumption of root and cruciferous vegetables 4-6 times a week increased by ca. 13% compared to the pre-marathon period. The frequency of intake of stone fruits increased after the marathon (to more than 4 times a week) in ca. ¼ of the surveyed women. Before the marathon, everyday consumption of berry fruits was declared by 11% of the women, whereas after the run – by 31% of the women. Before the marathon, the consumption of berry fruits 4-6 times a week was declared by 29% whereas after the marathon – by 38% of the women. No changes were found in the frequency of intake of leafy vegetables and tropical fruits by the surveyed women depending on the training period (before or after marathon).

After the marathon, the number of men who declared consumption of leafy vegetables 4-6 times a week increased statistically significantly (by 15%) compared to the pre-marathon period. Before the long-distance run, a low intake of stone and berry fruits (once a week or less frequently) was declared by 36% and 29% whereas after the marathon by only 17% and 9% of the surveyed men, respectively. After the marathon, an increase (by

12%) was noted in the number of men consuming stone fruits 2-3 times a week, compared to the pre-marathon period. Before the marathon, the consumption of berry fruits 4-6 times a week was declared by 24% while after the marathon by 37% of the male marathon runners.

No changes were found in the frequency of intake of cruciferous and root vegetables and tropical fruits by the surveyed men depending on the training period (before or after marathon).

Table 1. Frequency of intake of vegetables and fruits by the surveyed athletes (n=192) in the pre- and post-marathon periods

Frequency of intake of vegetables and fruits	Women (n=105)			Men(n=87)		
	before marathon	after marathon	p≤0.05	before marathon	after marathon	p≤0.05
Leafy vegetables						
less than once a week	5	2	ns	3	3	ns
about once a week	8	5	ns	9	7	ns
2-3 times a week	12	8	ns	25	15	a-b
4-6 times a week	45	51	ns	24	37	a-b
every day	35	39	ns	26	25	ns
Root vegetables						
less than once a week	10	6	ns	1	1	ns
about once a week	22	12	a-b	3	1	ns
2-3 times a week	14	17	ns	18	15	ns
4-6 times a week	33	47	a-b	26	28	ns
every day	26	23	ns	39	42	ns
Cruciferous vegetables						
less than once a week	8	2	ns	6	3	ns
about once a week	20	9	a-b	10	5	ns
2-3 times a week	26	28	ns	17	20	ns
4-6 times a week	31	43	a-b	24	29	ns
every day	20	23	ns	30	30	ns
Stone fruits						
less than once a week	5	3	ns	11	5	a-b
about once a week	15	4	a-b	20	10	a-b
2-3 times a week	31	18	a-b	20	30	a-b
4-6 times a week	32	49	a-b	24	30	ns
every day	22	31	a-b	12	12	ns
Berry fruits						
less than once a week	4	3	ns	12	3	a-b
about once a week	20	12	a-b	13	5	a-b
2-3 times a week	38	17	a-b	29	32	ns
4-6 times a week	31	40	a-b	21	32	a-b
every day	12	33	a-b	12	15	ns
Tropical fruits						
less than once a week	15	12	ns	12	10	ns
about once a week	29	32	ns	37	36	ns
2-3 times a week	31	28	ns	21	24	ns
4-6 times a week	19	21	ns	12	13	ns
every day	11	12	ns	5	4	ns

a-b statistically significant differences at p≤0.05

ns- not statistically significant differences

Table 2. Evaluation of the intake of vegetables and fruits in the surveyed groups of athletes (n=192) in the pre- and post-marathon periods

Intake of vegetables and fruits	Women (n=105) %			Men (n=87) %		
	before marathon	after marathon	p≤0.05	before marathon	after marathon	p≤0.05
sufficient	50.5	65.7	a-b	48.3	58.6	a-b
insufficient	23.8	18.0	ns	25.3	26.5	ns
poor	25.7	16.2	a-b	26.4	14.9	a-b

a-b statistically significant differences at  $p \leq 0.05$

ns- not statistically significant differences

Table 2 presents results of the assessment of vegetable and fruit consumption by the athletes. In diets of ca. 21% of the women and 26% of the men, on average, the intake of vegetables and fruits was insufficient irrespective of the training period (before and after the marathon). After the marathon, sufficient intake of these products was noted in diets of 65.7% of the women and 58.6% of the men, whereas in the period of intensive training before the long-distance run – in diets of only ca. 50% of the marathon runners. Before the marathon, poor intake of vegetables and fruits was demonstrated in over ¼ of the surveyed athletes, whereas after the marathon diets of only 15-16% of the women and men were poor in these products.

## DISCUSSION

Nutritional pattern and diet-related nutritional status may significantly affect the physical performance in endurance disciplines. An important element in nutrition of athletes and persons undertaking regular physical activity is the amount and type of ingested carbohydrates which may be provided with vegetables and fruits. Currently, the recommended amount of carbohydrates supplied with diet of long-distance runners should range from 6 to do 10 g/kg body mass/day and in the pre-competition period should provide 60-70% of energy. This allows increasing physical performance by 2-3% [2].

Improper intake of vegetables and fruits – being main sources of vitamins, minerals, and carbohydrates - by athletes was demonstrated in studies conducted by other authors. A survey carried out among 100 athletes, including 50 professional sportsmen (associated and representing sports clubs located in the Kujawsko-Pomorskie Province) and 50 amateur sportsmen, demonstrated that the consumption of vegetables few times a day was declared by 48% of the professionals and 41% of the amateurs, whereas the same frequency of fruit intake was declared by 68% of the professional athletes and by 72% of the amateurs. Improper practices were also demonstrated in the consumption of meals before and after trainings [8].

According to guidelines of rational nutrition for professional athletes and physically-active persons, vegetables should be provided in every meal, whereas fruits should be consumed 2-3 times a day as they provide vitamins, and minerals. In the study conducted by *Ostachowska-Gqsior* [11], the knowledge of the above guidelines was confirmed in ca. 30% of the 105 persons attending fitness clubs every day.

In turn, a survey carried out by *Szczepańska* and *Spałowska* [12] among professional volleyball and basketball players demonstrated appropriate intake (few times a day) of vegetables in 10% of volleyball players and in 30% of basketball players, whereas sufficient intake of fruits was declared by 55% and 71% of volleyball and basketball players, respectively. Ca. 70-80% of the athletes declared to consume vegetables and fruits in the fresh form. Similar results were reported by *Nowacka* et al. [10], who showed everyday consumption of vegetables and fruits in only ca. 40% of the surveyed athletes practicing shooting sport and canoe slalom.

Endurance sports have become highly popular even among recreational runners. An increasing number of persons compete in marathons, half-marathons, and other forms of long-lasting physical activity. Runs, especially the long-distance ones, are perceived as a measure of physiological capabilities of an athlete body. Many studies have demonstrated a positive effect of nutrition on athlete performance [3, 5, 9].

*Durkalec-Michalski* [5] evaluated the effect of diet balancing on body composition and performance capability of a selected group of persons practicing running disciplines. The balancing and rationalization of the nutritional pattern during intensive trainings had a positive effect on: reduced content of fatty tissue, increased aerobic adaptation, and physical performance of the surveyed runners.

Vegetables and fruits are the main and very important sources of vitamins and minerals in a diet of athletes. At trainings, athletes are at risk of high losses of macro- and microelements which are excreted with sweat. In endurance sports, high significance is ascribed to an appropriate sodium to phosphorus ratio

which helps maintaining the correct water-electrolyte balance in the body, work of the cardiac muscle and skeletal muscles, transport of the energetic material (glucose), and transmission of nervous stimuli in the muscles. Also calcium and magnesium are needed for muscle contraction. Proper body functions under conditions of physical effort are ensured by iron that takes part in oxygen transport. In the case of athletes, deficiencies of minerals may induce muscle cramps, body exhaustion and acidification as well as debilitation of the skeletal system. Appropriate intake of vitamins, including mainly vitamin C and B group vitamins, is indispensable during heavy physical effort to enhance glycogen deposition in the liver (B1), to aid respiratory enzymes (B2) or to ensure apt metabolism of proteins, fats, and carbohydrates (B3, biotin, folacin). Fat-soluble vitamins (A, D, E, K) regulate calcium metabolism, provide protection against free radicals, and determine proper functions of muscles. Ill-balanced, excessive supplementation may have adverse effects on the absorption and metabolism of various nutrients and lead to disruption of an athlete body homeostasis [4, 6].

Athletes demands for energy and nutrients are higher than these of an average person. This requires on the one hand increasing the mass of daily food rations, but on the other hand providing meals low in volume and easily digestible. An optimal solution is to skillfully use dietary supplements to accelerate regeneration and increase body performance. Nutritional needs of athletes differ as affected by the duration and intensity of training as well as by the type of sports discipline they compete in. The appropriate choice of dietary supplements is essential to ensure, e.g. muscle mass boost, fat burning acceleration, body immunity increase, joint regeneration, and covering losses of vitamin and minerals in order to restore the metabolic balance [4, 6]. It needs to be emphasized that ca. 80% of athletes surveyed in this study declared the intake of dietary supplements in the form of concentrated vitamins and macro- and microelements to enrich their diets being poor and insufficient in fruits and vegetables.

Abnormalities observed in the frequency of intake of vegetables and fruits among athletes competing in running disciplines point to the necessity of nutritional education of this population.

## CONCLUSIONS

1. After the marathon, an improvement in the intake of vegetables and fruits was observed in 15% of the women and in 10% of the men, compared to the pre-marathon period. Sufficient intake of vegetables and fruits was found in ca. 55% of the surveyed marathon runners. The intake of

vegetables and fruits was insufficient in daily food rations of ca. ¼ of the studied marathoners and poor in these of ca. 20% of the athletes.

2. A statistically significantly lower intake of root and cruciferous vegetables as well as stone and berry fruits by women was demonstrated in the pre- than in the post-marathon period.
3. A statistically significantly lower intake of leafy vegetables and stone and berry fruits by men was demonstrated before the marathon compared to the post-run period.
4. Nutritional mistakes demonstrated in the study in the case of persons competing in endurance disciplines point to the necessity of modifying their nutritional patterns by increasing the consumption of vegetables and fruits.

## Conflict of interest

*The authors declare no conflict of interest.*

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