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Effects of probiotic yogurt on performance, respiratory and digestive systems of young adult female endurance swimmers: a randomized controlled trial

Nahid Salarkia[1], Leili Ghadamli[2], Farid Zaeri[3], Leila Sabaghian Rad[4]

Department of Food and Nutrition Policy and Planning Research, National Nutrition and Food Technology Research Institute, Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

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Abstract

Background: To determine the effects of probiotic yogurt on performance and health status of young adult female endurance swimmers.

Methods: In a randomized controlled trial, 46 endurance swimmers girls with mean age of 13.8 ±1.8 years, weight of 48.6±7.5kg and height of 159±5.6cm, were studied. Subjects were randomly assigned into two groups, receiving either 400 ml probiotic yogurt (intervention group) or ordinary yogurt (control group) daily for 8 weeks. At the beginning and at the end of the study, the 400-m free swimming record was done and the Harvard Step test was employed to measure VO_2max. Statistical analysis of the data was performed using SPSS software. This trial has been registered with IRCT ID of IRCT2012122311849N1.

Results: Average changes in the records of the intervention and control groups were 3.9 and 0.5 seconds, respectively (p= 0.22). The intervention group complained of dyspnea for 2.4 days and the value for the control was 4.4 days (p=0.024). Values for ear pain were 0.5 and 1.6 days (p=0.008) respectively. The average number of episodes of respiratory infection in the intervention group was 0.9 day, which was statistically fewer than that in the control group (1.4 days), P=0.009.

Conclusions: A reduction in the number of episodes of respiratory infections and duration of some symptoms such as dyspnea and ear pain was observed. Due to the reduction in upper respiratory tract infections of the athletes following intake of probiotic yogurt, improvement in VO2max is possible.

Keywords: Probiotics, Yogurt, Athletic performance, Respiratory infections, Gastrointestinal diseases, Swimming.

Introduction

Elite athletes undertaking severe and intense exercises may suffer from an increased risk of upper respiratory tract infections and gastrointestinal symptoms (1-7). It is important for athletes to stay healthy during training period and competition but illnesses such as upper respiratory tract infections and gastrointestinal symptoms can seriously impair athlete's performance to train (8). It is also known that intensive exercise and strenuous physical training causes a rise in chronic exhaustion and a decrease in athlete's efficiency (9,10). Impaired athletic performance and fatigue in

1. **(Corresponding author)** Research Assistant, Dept. of Food and Nutrition Policy and Planning Research, National Nutrition and Food Technology Research Institute, Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran. n_salarkia@hotmail.com, nahidsalarkia@gmail.com
2. MSc in Nutrition Sciences, Shahid Beheshti University of Medical Sciences, International Branch, Tehran, Iran. leylee61@yahoo.com
3. Assistant Professor, Dept. of Biostatistics, Faculty of Paramedical Sciences, Shahid Beheshti University of Medical Sciences, Iran. fzayeri@yahoo.com
4. Assistant Professor, Islamic Azad University, Science and Research Branch, Tehran, Iran. layla_sab@yahoo.com

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well trained athletes and its relation to infections and decreased mucosal immunity has been reported (11). Based on reports, 89% of presentations of elite athletes were associated with the viral or bacterial upper respiratory tract infection (12).

Illness during training and competition may negatively affect athletic performance (13). Therefore, identifying strategies to improve host resistance and minimizing the risk of illnesses that may compromise athletic performance, is necessary.

Probiotic bacteria being defined as live food ingredients occur naturally in fermented food products such as yogurt (14). Probiotics may improve athlete's efficiency by maintaining healthy gastrointestinal tract function, reducing susceptibility to illnesses such as acute infectious diarrhea and its associated symptoms, enhancing host resistance to upper respiratory tract infections and improved immune function (1,14–17).

Many studies have been made on the beneficial effects of the probiotics for human health including effects on gastrointestinal tract function and diseases, immune response, hyperlipidemia, hypertension, and allergic conditions within such groups as children, infants, adults and the elderly (8, 12, 18, 19). Although, there is an increasing interest in the effect of probiotics on the incidence of respiratory tract infections (18), few studies have been carried out on the role of probiotics in the improvement of athletes' capability during exercise period and competitions (8, 11). The initial investigations in athletes have thus far not been convincing (8).

This study was performed on elite athletes, who are more susceptible to infection. This study was carried out to determine the effect of receiving probiotic yogurt on the status of respiratory and digestive system of young adult female swimmers in summer training period.

Methods

Subjects: The studied subjects were 46 female endurance swimmers aged between 11 to 17 years who had taken part in the national 400 and 800 meter crawl swimming competitions of 2009. Subjects had exercise for three times a week. The swimming distance was 3800 meter in 2 hour and 30 minutes for each session. Inclusion criteria were being healthy and having the 400 meter crawl swimming time less than 6 min. and 20 Sec (20). Exclusion criteria included acute gastrointestinal symptoms such as: diarrhea, vomiting and stomachache and intake of antibiotics within the past two months before the study.

This study was approved by the University Human Research Review Committee and the National Nutrition and Food Technology Research Institute Ethics Committee. This study has been registered in the IRCT website with the ID of IRCT20121223 11849N1.

Procedures: In this randomized controlled trial the subjects were randomly assigned into two groups as follows: group 1) Receiving 400 ml of probiotic yogurt containing 4×10^{10} cfu/ml (Colony forming unit per millimeter) comprising of Lactobacillus Acidophilus SPP, Lactobacillus Delbrueckii Bulgaricus, Bifidobacterium Bifidum, and Streptococcus Salivarus Thermnophilus, (n=23) and group 2) Receiving similar dose of ordinary yogurt, as a control (n=23).

The 400 meter free swimming record was conducted, and Harvard step test was also employed to measure VO_2max .The athlete stepped up and down off a 41cm high bench for 3 minutes at a rate of 22 steps/minute. On finishing the test the number of heart beats was counted for 15 seconds. The number of beats was multiplied in 15 seconds by 4 to give the "step test pulse rate". This final value was used to assess the athlete's VO_2max in ml/kg/min (21). This test was performed at the beginning and at end of week eight. All subjects were asked to record the digestive symptoms (such as stomachache, vomiting and diarrhea), respiratory infections (such as rhinitis, fever, sore throat, cough, chest

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Table 1. Mean of anthropometry data and exercise distance in subjects, at the beginning of the study.

Index	Study group		p
	Probiotic n=23 (Mean±SD)	Control n=23 (Mean±SD)	
Age (year)	13.7±1.9	14.0±1.8	0.636
Weight (kg)	46.7±6.3	50.4±8.3	0.097
Height (cm)	158.3±5.1	159.9±6.2	0.328
Exercise distance (m)	11358.7±152.0	11436.9±139.2	0.075

Table 2. Mean of the change rate of performance indices in subjects.

Index's change rate	Study group		p
	Probiotic n=23 (Mean±SD)	Control n=23 (Mean±SD)	
400 m crawl swimming record (min-sec)	-0.039±0.09	-0.005±0.02	0.222
VO2max ($ml/kg^{-1}.min^{-1}$)	0.56±096	0.01±055	0.022

Table 3. Average duration of respiratory infections based on study groups in subjects.

Duration of exposure respiratory infections(day)	Study group		p
	Probiotic n=23 (Mean±SD)	Control n=23 (Mean±SD)	
Rhinitis (day)	3.2±2.5	4.3±3.0	0.268
Fever (day)	0.5±0.7	1.0±0.9	0.152
Sore throat (day)	0.8±0.9	1.8±1.7	0.08
Cough (day)	2.0±2.4	2.9±3.3	0.348
Dyspnea (day)	2.4±2.6	4.4±2.8	0.024
Ear pain (day)	0.5±0.9	1.6±1.7	0.008

ailing breath by sound, ear pain), the extent of exercise per meter, the intake of medicine, and quantity of the consumed foodstuff product which had been recommended, on the provided questionnaires, daily. The subjects were advised to refrain from other probiotic products which were outside the project plan.

Statistical analysis: Statistical analysis of the data was performed using SPSS version 17 (Chicago, IL, USA). Data was presented as mean with standard deviation (SD). Data were checked for normality. The differences between the groups were tested using the t test as a parametric and Mann Whitney U test as a nonparametric test. Comparisons between the 2 groups was performed using 2-sided statistical tests. Differences were considered significant at $p< 0.05$.

Results

The mean age, weight and height of subjects were 13.8 ±1.8 years, 48.6±7.5 kg and 159 ±5.6 cm, respectively. Mean of anthropometry and the extent of exercise per meter, has been shown in Table 1. Table 2 shows the average change in the performance indices including 400 m crawl swimming record and VO2max in subjects during the study. The average changes in the records of the intervention and control group were 3.9±0.09 and 0.5±0.02 seconds, respectively (p= 0.22). On the other hand, the change in VO_2max in the intervened group was 0.56±0.096, and in the control group was 0.01±0.55, $ml/kg^{-1}.min^{-1}$; that was statistically significant in both groups (p=0.02). Table 3 shows the average duration of respiratory infections in subjects. On the average, the intervention group complained of dyspnea, as a symptom of respiratory infection, for 2.4±2.6 days; the

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Table 4. Average duration of digestive disorders based on study groups in subjects.

Duration of exposure digestive disorders	Study group		p
	Probiotic n=23 (Mean±SD)	Control n=23 (Mean±SD)	
Diarrhea(day)	1.0±1.5	1.2±1.3	0.394
Vomiting(day)	0.8±0.9	1.0±1.5	0.981
Stomachache(day)	1.4±1.3	2.0±1.1	0.102

Table 5. Average number of episodes of respiratory infections and digestive problems in subjects.

Average number of episodes of problems	Study group		p
	Probiotic n=23 (Mean±SD)	Control n=23 (Mean±SD)	
Digestive disorders (number)	0.9±08	1.6±0.8	0.057
Respiratory infections (number)	0.9±0.8	1.4±0.6	0.009

value in the controls was 4.4±2.8 days (p=0.024). For ear pain, another symptom of respiratory infection, the value were 0.5±0.9 and 1.6±1.7 days (p=0.008). As shown in Tables 3 and 4, after 8 weeks of intervention, no significant difference was noted between the 2 groups with regard to the average duration of symptoms of respiratory infections including rhinitis, fever, sore throat, cough, and also digestive disorders such as diarrhea, vomiting and stomachache.

Table 5 presents average number of episodes of respiratory infection and digestive disorders in subjects. The average number of episodes of respiratory infection in the intervention group was 0.9±0.8 day, which was statistically fewer than that in the control group (1.4±0.6 days); the difference was statistically significant (p=0.009). In addition, the average number of episodes of digestive disorders was 0.9±0.8 in the intervention group and 1.6±0.8 in the controls that did not reach statistical significance (P=0.57). Average duration of symptoms of respiratory infections in the intervention group was 4.0±2.7 days which was not statistically fewer than that in the control group (5.4±3.3 days). Average duration of symptoms of digestive problems in the intervention and control group was 1.8±1.7 and 2.5±1.6 days, respectively. After 8 weeks of intervention, no significant difference was found between the 2 groups with regard to the average duration of symptoms of respiratory infection or digestive disorders.

Discussion

This study investigated the effect of probiotic yogurt on performance, status of respiratory and digestive system in young adult women endurance swimmers.

An important finding in this study was the reduction in the number of episodes of respiratory infections and in duration of some of its symptoms such as dyspnea and ear pain, following the consumption of probiotic yogurt. However, by consumption of such type of yogurt, the decrease in digestive disorders of the athletes did not appear meaningful. According to the results of the present study a non-significant decline in the records of 400 m crawl swimming was observed.

In a review of studies on probiotics, while probiotics have not been reported to directly affect athletic performance, probiotics help athletes avoid becoming ill from severe and intense exercises and increase the chances that athletes will stay healthy (1, 14).

In the present study, mean rate change of 400 m crawl swimming record before and after taking the probiotics yogurt was similar to results of Cox in 2007. In his study on twenty healthy elite male distance runners, he found a reduction in the number of

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days and severity of respiratory illness in a cohort of highly trained distance runners. He suggested that the effect of amount of yogurt consumed and the level of weekly training were more important among all factors (2).

According to the results of our study a significant increase in VO2max was observed which is similar to previous studies (22-24). Previous research have indicated a decrease in severity and duration of colds in both children (25,26) and adults (27). The present study confirms the previous findings that probiotics have similar effects in athletes in training.

In our study, the number of subjects with upper respiratory tract infections was lower than that observed in the previous studies on marathon runners (8, 28). This is possibly due to differences in the season of the study (summer vs. winter), age groups (14 vs. 40 years), type of sport (swimming vs. marathon) and intervention period.

Our findings on the average number of episodes of respiratory infection are in agreement with those of Heath et al (29). In our study the number of healthy days in the intervention group was higher than the control group; it was similar to previous studies (8). One possible explanation is that the present study has been carried out in summer, with a lower chance of colds and flu. Previous studies were carried out in wintertime (18, 19, 25,30).

However the Cox study on 20 healthy male long-distance runners to examine the effect of probiotic capsules containing Lactobacillus fermentum showed a significant reduction in the actual number of respiratory infections, the number of episodes in the probiotics group was less than half the corresponding number in the control group (2).

A statistically non-significant reduction in the number of days of digestive disorders included diarrhea, vomiting and stomachache was noted in the probiotic group. Improvement in health status of athletes following intake of probiotics have been reported by Cox and Nicols (2,14).

Conclusion

It is concluded that consumption of probiotic yogurt results in a reduction in the number of episodes of respiratory infections and in duration of some of its symptoms such as dyspnea and ear pain; the reduction in digestive disorders did not reach statistical significance. Intake of probiotic yogurt also resulted in a significant improved in VO_2max and a non-significant decline in the records of 400 m crawl swimming. Possibly, improvement in VO_2max is due to the reduction of upper respiratory tract infections (reduction in the number of episodes of respiratory infections and in duration of some of its symptoms) of athletes following intake of probiotic yogurt. The results also showed that the athletes who take probiotics stay healthier overall. It is necessary to plan the athlete's regimen carefully and to make sure they eat properly. We recommend further studies using a larger sample size, longer period time, different sexes and age groups, and different seasons to find the effects of probiotic on the health and performance of athletes.

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