The Effect of Physical Activity on Salivary IgA Level in 6 to 16 Years Old Children

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Abstract

Background: IgA is the first line of defense in the mucous membranes. The secretion of salivary IgA depends on many factors including physical activity. The aim of this study was to detect the effects of physical activity on salivary IgA concentration in normal children.

Methods: This interventional study was conducted on 24 healthy children who were visited in Society oriented clinic of Zanjan University of medical sciences. Salivary samples were collected in three times; at the beginning of the study, one hour after 30 minutes of exercising and finally after three weeks of moderate exercises. The data were analyzed by SPSS software through statistical tests.

Results: This study included 12 girls (50%) and 12 boys (50%), with the mean age of 11.37 ± 2.9 years. The mean concentration of salivary IgA (sIgA) level at the baseline, one hour and three weeks after exercise were 51.99±10.44, 83.66±62.26 and 74.38±33.36 *μg/ml* respectively. We found significant rising in the sIgA after exercises. However, we didn't find significant difference in sIgA levels after one hour and 3 weeks of exercises.

Conclusion: The sIgA level increases after an acute exercise and slowly declines with the continuation of exercise however it is still above the basic level after 3 weeks. Therefore exercises might have beneficial effect on immune regulation and prevention of infections among children.

Keywords: Athletes, Children, Exercise, Immunoglobulin A, Saliva

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Introduction

Secretory IgA is the first line of defense in the mucous membranes . It is synthesized by subepithelial plasma cells and is present in saliva, GI tract, upper and lower respiratory system, urogenital tract and tears. It plays a significant role in agglutination, neutralization and inhibits the adhesion of microorganisms[1,2]. It seems that, the concentration of salivary IgA (sIgA) as a marker of mucosal immunity have reverse correlation with respiratory tract infections[3], which are one of the most frequent infections in children[4].

Saliva is a specific body fluid which contains 99.5% water, 0.3% protein, and 0.2% inorganic and organic substances and constantly washes the mucous membranes of the respiratory and gastrointestinal tracts[5]. Its secretion is regulated by autonomous nervous system. The physical activity may reduce saliva secretion by stimulating the sympathetic nervous system and the hypothalamic-pituitary adreno-cortical axis[6]. The secretion of sIgA is influenced by several factors such as stress, hormonal changes and exercise[1,6].

The exact role of exercise on the concentration of sIgA is a matter of debate. Many studies have shown that during prolonged physical activity sIgA concentration does not increase or decease[7-9]. However, short term or moderate exercise may increase the salivary concentration of IgA[2,10]. The type, duration and intensity of physical activity may affect sIgA concentration[11,12]. Most of previous studies have been performed on athletes. Considering that the short term exercise may increase sIgA in non-athletic children, this study was conducted on normal children aged 6-16 years old to detect the effects of physical activity on sIgA concentration in our population.

Materials and Methods

This interventional study was conducted on 24 healthy 6 to16 years old children whom were visited in Society oriented clinics of Zanjan University of Medical sciences. They were selected by simple randomization from volunteer families. Children with any chronic disease, allergies, stress, anxiety, and the history of taking medicines (anti epileptics, penicillamine, and non-steroidal anti-inflammatory drugs) in 4 weeks before the intervention were excluded from the study. The intervention was explained to the children and their families and the written informed consent was signed by them. All cases were examined by a physician and their demographic data (age and gender), past medical history, drug history and the history of regular exercise were recorded in a pre-prepared questionnaire. The height, weight and Body Mass Index (BMI) were determined and recorded.

At the beginning of the intervention, the samples from participants' saliva were taken by spitting out and then samples were collected in a glass tube. Then we asked the children to run for half an hour or until the heart rate increases by 20 percent and the saliva samples were recollected for the second time, one hour after that. Finally, after 3 weeks of daily regular moderate exercises we collected the third sample in the same way. The researcher had a close supervision on the participants' physical activities. In each step the samples were collected in a glass tube and centrifuged at 3000 rpm for 15 minutes and stored at - 20°*C* until the time of assay. The sIgA levels were determined by ELISA method (Dia Metra, Milano, Italy).

Data were analyzed using SPSS software Version 16.0. The Descriptive data are presented as mean value±SD. The sIgA levels in three steps were analyzed by using Mann-withney, kurskal-wallis and Freidman test for age, sex and BMI. Any p value of <0.05 was considered significant.

Results

This study included 12 girls (50%) and 12 boys (50%) aged between 6 and 16 years, with the mean(± SD) age of 11.37 ± 2.9 years. The demographic data are shown in table 1.

Table 1. demographic data of participating children

	Variable	Mean ±SD	Min	Max
Boys	Weight	46.28±21.26 *kg*	18 *kg*	76 *kg*
	Height	142.75±24.28 *cm*	112 *cm*	180 *cm*
	BMI	21.72 ±7.30 *kg/m²*	14.03 *kg/m²*	26.06 *kg/m²*
	Age	11.7 ±3.43 y/o	6 y/o	16 y/o
Girls	Weight	46.69 ± 14.06 *kg*	27 *kg*	68 *kg*
	Height	149.42 ± 15.785 *cm*	124 *cm*	167*cm*
	BMI	20.46 ± 3.89 *kg/m²*	15.09 *kg/m²*	26.01 *kg/m²*
	Age	11.8 ±2.15 y/o	7 y/o	14 y/o

The mean (± SD) concentration of sIgA according to exercise are summarized in table 2.

Comparison of mean sIgA levels by paired T test showed a significant increase in second sIgA levels compared to the first sIgA (p value<0.001) and there is also a significant increase of third sIgA compared to the first sIgA (p value 0.007). However the differences between second and third sIgA were not significant (Table 3).

The relations between mean levels of first sIgA (before exercise), second sIgA (after 30 min of exercise) and the third sIgA (after 3 weeks of exercise) based on age, gender and BMI are shown in table 4.

By using Mann-withney test, the first sIgA level (the basal level before exercise) showed significant difference between two age groups (p value=0.011), (Table 1). But the second and third sIgA levels did not differ significantly with age (p value=0.107 and 0.144 respectively).

By Using the Friedman test we concluded that second sIgA levels compared to first sIgA were significantly increased in both age groups (p values of 0.002 and 0.029 for younger than 10 years and older than 10 respectively) but the changes of second sIgA compared to third sIgA were not significant for these age groups. when we compared the three levels of sIgA simultaneously in both age groups by using Friedman test, we found a significant increasing trends in sIgA levels in 2 groups (p=0.032 in younger than 10 years and p=0.001 in older than 10 years). This changing trend means that sIgA peaks after an acute exercise and with the continuation of exercise

Table 2. mean concentration of sIgA in three steps

	Mean ± SD	Minimum	Maximum
IgA1st (before exercise)	51.99 ± 10.44*	5	95
IgA2nd (after 30 min of exercise)	83.66 ± 62.26	5.3	119.2
IgA3rd(after 3 weeks of exercise)	74.38 ± 33.36	4	120

*sIgA levels are described in µg/ml

Table 3. Pair wise comparing of sIgA concentration in three phases of study

	*Mean	SD	p value
Second sIgA &First sIgA	52	24.97	0.001>
	83.7	26.6	
Third sIgA &First sIgA	52	24.9	0.007
	74.4	33.4	
Third sIgA &Second sIgA	83.7	26.6	0.101
	74.4	33.4	

*sIgA levels are described in µg/ml

Table 4. The relations between mean levels of first sIgA, second sIgA and third sIgA with age, gender and BMI

		** IgA1 st Mean ± SD	p value IgA1 st	IgA 2nd Mean ± SD	p value IgA2nd	IgA 3rd Mean ± SD	p value IgA3rd
Age	>10y	62.58±(21.00)	0.011	91.00±(19.02)	0.107	81.87±(29.40)	0.144
	<10y	34.33±(21.224)		71.42±(33.68)		61.91±(37.52)	
Gender	Female	49.71±(24.32)	0.810	89.567±(13.59)	0.620	82.30±(25.32)	0.400
	Male	54.27±(26.35)		77.758±(34.94)		66.47±(39.36)	
BMI*	Under weight	45.76±(26.31)	0.644	76.143±(40.38)	0.892	61.09±(39.62)	0.401
	Normal weight	50.50±(20.83)		88.114±(13.90)		85.86±(24.63)	
	Over weight	57.39±(27.74)		85.810±(23.03)		75.66±(33.94)	

*Body mass Index. BMI ranges are underweight: <18.5 *kg/m*^{2}, normal weight: 18.5 to 25, overweight: 25 to 30, **sIgA levels are described in *µg/ml*

slowly declines, however it is still above the baseline after 3 weeks.

We did not find any significant association between sIgA levels and the genderby Mann-withney test (Table 4). The second sIgA compared to first sIgA significantly increased (p=0.007) in both sexes by using the Friedman test. When comparing the first and third sIgA, the increase was significant for girls (p=0.018), while the increase of third sIgA compared to second sIgA was significant for boys (p=0.042). When simultaneously comparing the three levels of sIgA using Friedman test, we found a trend of significant changes of sIgA levels in both sexes (p=0.003 for girls and p=0.001 forboys).We did not find any significant relation between any first, second and third sIgA levels and BMI using the Kurskal-Wallis test, but the Friedman test showed that second sIgA levels compared to first sIgA were increased in both overweight and normal BMI groups (p=0.016, p=0.033; respectively). The changing trend of sIgA, when simultaneously comparing the three levels of sIgA using Friedman test, showed a significant increase in both overweight and normal group (p=0.018 in both groups). It means that the effect of exercise in sIgA levels is not seen in lower BMI children.

Discussion

This study showed that the mean concentration of salivary IgA levels for 14 non-athletic 6-16 years old children was 51.99±10.44 *μg/ml* of saliva. A significant increase happened in second sIgA level (30 minutes after exercise) in comparison with the first sIgA level (before exercise) and also a significant increase happened in third sIgA level (3 weeks after exercise) compared with the first sIgA. However the differences between second and third sIgA were not significant.

Many studies have shown that sIgA levels were increased after moderate to acute physical activity in athletes[9,13-16]. A study by Mckune on 11 non athletic adult males showed that sIgA secretion rate increased by 3.5 fold after the second session of running[14]. They suggested that moderate exercise increased the levels of TGF–β and eccentric exercise might have anti inflammatory effect by tissue damage and can be responsible for the synthesis of sIgA[14]. The increase of sIgA levels in their study was higher than our study. The difference may be due to the age of participants and/or different type of exercise used in these two studies. A study by Farzanaki and colleagues on female gymnasts aged 11-13 years demonstrated that sIgA levels increased immediately after the exercise[7]. This study is consistent with ours showing a significant rise after acute exercise. The ages of participants in these two studies are similar but in our study the cases were selected from normal non-athletic children. One of the factors that might affect the initial assessment of the outcome is the salivary flow rate. In a study from Taiwan on adult athletes, the sIgA concentration immediately increased after 5000 m competitive running race, but the secretion rates of sIgA were not significantly increased. It seems to be due to a significant reduction in saliva secretion cause by dehydration[2]. Although the limitation of our study was the lack of measurement of saliva flow rate but the reduction of saliva secretion usually occurs in cases of strenuous exercise which was different from our study design.

On the other hand, a study of Li from Taiwan on 8 adult males with the mean age of 21.3 years showed that 2 hr of cycling had no significant effect on sIgA[17]. Similar results were observed in some other researches[18,19]. Different results from different studies can be due to different age groups, type of exercises and the intensity of the physical activities used in each study. We did not found any significant difference between the second and the third sIgA levels that might be due to the influence of sympathetic nervous system on salivary IgA secretion rate. According to an investigation by Proctor *et al*, the secretion of sIgA caused by the increase in transcytosis is not dose dependent when reaching a specific threshold[20]. The study from Taiwan showed that although cycling had increased plasma adrenaline levels, the levels of salivary IgA and salivary flow rate have not changed, sothe concept of threshold was proposed to be the cause[17].

In the current study, we found a significant association between the first sIgA level and the age, which is similar to the results of previous studies[21,22]. In female cases, acute exercise was more effective for promoting sIgA level, while it continued to have a greater effect on sIgA among males if exercise continued. A similar result was observed in the study from Taiwan

that showed the levels of sIgA were higher among females, however in contrarily it remained the same in our study after the competitive race[2]. This may be explained by different age group of two studies and a better collaboration of boys at home for continuing exercise in our study .It should also be considered that long-term immune responses might be different between both sexes[23].

The most important benefit of our study is using normal children from surrounding community with moderate level of physical activities.

Conclusion

The sIgA level increases after an acute exercise but this increase is not remaining the same in comparison with that after one hour and 3 weeks. So we recommend further study to evaluate the effect of Physical activity on decreasing the frequency of respiratory tract infection through out an increas in sIgA level that in turn it promotes better immunity.

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Conflict of Interest

The authors declare that there is no conflict of interest

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