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Is orienteering associated with allergic rhinitis in adolescents?

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ABSTRACT

BACKGROUND: Allergic rhinitis (AR) is a disease that reduces athletic performance. Environmental allergen exposure is higher in outdoor sports (such as orienteering) than indoor sports. The main purpose of this study was to investigate the AR frequency in orienteers comparing with indoor athletes.**METHODS:** Sixty adolescent athletes (33 orienteers, 27 basketball players) enrolled this prospective study. AR diagnosis was made by both history (ISAAC questionnaire) and physical examination. Nasal endoscopy was performed to observe objective findings (concha hypertrophy, mucosal paleness, serosity, septum deviation, adenoid hypertrophy). Epidermal prick test, pulmonary function test, total IgE and serum eosinophil levels were also assessed.**RESULTS:** AR was diagnosed in 21 (35%) athletes. 14 (42.4%) were orienteers and 7 (25.9%) were basketball players ($P=0.144$). Endoscopic findings and skin test positivity were also seen at higher percentages in orienteers with no significance. Training age (sport duration), total IgE levels and skin test positivity were significantly higher in rhinitic orienteers than non-rhinitic orienteers ($P=0.046$, $P=0.0001$, and $P=0.004$, respectively).**CONCLUSIONS:** Although adolescent orienteers had some higher allergic parameters than indoor athletes, they were not found more susceptible to AR. It seems that the frequency of AR increases with longer training age in orienteering sport. This study is the first report about AR in adolescent orienteers. Future researchs should more focus on comparing allergic conditions between outdoor and indoor sports.(Cite this article as: Selcuk OT, Eraslan A, Filiz S, Renda L, Selcuk NT, Eyigor H, *et al*. Is orienteering associated with allergic rhinitis in adolescents? J Sports Med Phys Fitness 2017;57:1045-50. DOI: 10.23736/S0022-4707.16.06347-7)**Key words:** Allergic rhinitis - Athletes - Adolescent - Sports.

Allergic rhinitis (AR) is the most common allergic airway disease. Development of its is under the influence of environmental and genetic factors.^{1, 2} IgE-mediated immune response against allergens is responsible for the symptoms consisting of itching of nose and throat, nasal obstruction, rhinorrhea (runny nose), sneezing, anosmia, post nasal drip, cough, headache and ocular symptoms associated with allergic conjunctivitis.^{1, 3} AR affects 10-20% of the general population and is more frequent in children and adolescents than in adults.¹ When compared to general population, higher prevalences of rhinitis (between 13.3% and 48.6%)

were reported in field surveys or clinical trials carried out on athletes.⁴ A rhinitis prevalence of 26.2% was reported in a recent study performed in one of the largest population of athletes ever studied.⁵ Although annual cost of a patient with AR is relatively low in comparison with other chronic diseases, the high prevalence of AR makes it a more expensive disease.⁶ Besides affecting the social life, school and work success, AR has also negative effects on sportive performance.⁷ Airflow dynamics that changed by nasal obstruction and mouth breathing could potentially affect the physical activity and sleep quality of the athletes.⁸

Environmental allergen exposure is higher in outdoor sports (such as track and field sports, marathon, cross-country running, cycling, trekking) than indoor sports. Orienteering is also an outdoor sport that athletes have to run from start to finish by visiting a number of control points with the help of a map and compass. There are four official disciplines: foot, mountain bike, ski, and trail orienteering.⁹ To date, there is no data about orienteers with AR in the literature. Therefore, the aim of this study was to investigate the frequency of AR in adolescent orienteers comparing with indoor basketball players.

Materials and methods

The study was designed prospectively and performed at Antalya Education and Research Hospital, in the departments of Ear Nose Throat, Sports Medicine, Pediatric Allergy-Immunology and Pulmonology. Approval for the study was granted by the Local Ethics Committee of Antalya Education and Research Hospital. Notification about the procedures, benefits and risks involved in this study was made to the subjects and their parents. Informed consent form was signed by parents of all the athletes before inclusion in the study.

Thirty-three licensed orienteers who consecutively referred to Sports Medicine polyclinic were included in the study. As a control group, 27 licensed basketball players were enrolled. During the interdisciplinary process, the information of which sport an athlete was performing was kept secret by Sports Medicine specialist and the other researchers were blinded to the sport type.

Athletes under 10 years old or older than 18 years old, and whose training ages were less than 1 year were not included in the study. Any athletes with recent upper respiratory tract infection (viral rhinitis etc.), nasal polypsis, systemic disease, regular drug usage and history of nasal or nasopharyngeal surgery were excluded. AR diagnosis was made by a medical evaluation in which history and physical examination were in accord. A Turkish version of International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire was used to evaluate history of symptoms.¹⁰ Complete ear, nose and throat examination was performed to all the athletes. Nasal and nasopharyngeal endoscopic intervention was applied by a 4-mm-diameter 0° endoscope (Karl Storz, Hopkins II, Germany) without administering any local anesthetic agents or sedatives. Endoscope was used by the same

ENT physician (O.T.S.). Inferior turbinates, nasal septum, nasal mucosa and presence of serous secretions were evaluated. Adenoid tissue size was evaluated according to the classification of Parikh *et al.*¹¹

Measurements of FVC, FEV₁ and FEV₁/FVC were performed by using spirometer (ZAN-GPI-3.00, nSpire Health Inc., Longmont, CO, USA). The number and percentage of eosinophil in the complete blood count (Coulter lyse SIII diff lytic reagent; LH780, Beckman Coulter, Brea, CA, USA), and total IgE levels (Siemens NLatex IgE mono; BN II System, Siemens Healthcare, Erlangen, Germany) were assessed.

Epidermal prick tests (EPT) were performed by the same nurse in a standardized manner and evaluated by Pediatric Allergy and Immunology physician. A total of 13 allergen solutions (Allergopharma® standard prick test solutions), including the negative and positive control, were employed. Saline and histamine were included as negative and positive controls respectively. Allergens and positive/negative controls were applied to the volar surface of the forearm epidermally. The allergens used included plants (verdure, cereal, weed, trees, pine and olive), epithelial tissues of animals (feather, cat, dog), fungal spores (mixture of *Alternaria*, *Cladosporium*, *Penicillium*, *Aspergillus*) and mites (*D. farinae*, *D. pteronyssinus*). When the positive control edema was >3 mm with no reaction in the negative control, the case was considered positive in the EPT.

Statistical analysis

Data were analyzed using the SPSS v. 18.0 software package. Continuous variables were stated as mean and standard deviation, categorical variables were stated as percentages and frequency distribution. The comparison of continuous variables between independent groups was performed using Student's *t*-test or Mann-Whitney U test in accordance with normality testing (Kolmogorov-Smirnov test). Comparison of categorical data was performed using the Fisher's exact test. A two-sided P value <0.05 was considered statistically significant.

Results

Comparisons of the clinical and demographic results between the groups are shown in Table I. Orienteering group comprised 21 males and 12 females with a mean

TABLE I.—Comparison of orienteering and basketball groups.

	Orienteering (N.=33)	Basketball (N.=27)	P value
Sex (M/F)	21/12	14/13	0.255
Age (years)	14.1±2.3	13.4±1.6	0.253
Body Mass Index (kg/m ²)	19.3±2.2	21.7±3.0	0.001*
Training age (years)	2.4±1.4	3.1±1.6	0.087
Familial atopy	15 (45.5%)	10 (37.0%)	0.347
FVC (%)	84.7±13.1	82.7±9.6	0.516
FEV ₁ (%)	97.4±14.6	96.0±11.6	0.949
FEV ₁ /FVC (%)	113.4±4.5	113.8±3.6	0.691
Number of eosinophil (/mm ³)	163.3±177.3	151.4±97.7	0.437
Percentage of eosinophil (%)	2.3±1.6	1.9±1.3	0.413
Total IgE (IU/mL)	114.1±135.3	162.6±283.6	0.852
Concha hypertrophy	26 (78.8%)	16 (59.3%)	0.087
Mucosal paleness	18 (54.5%)	11 (40.7%)	0.211
Serous discharge	11 (33.3%)	10 (37.0%)	0.488
Septum deviation	13 (39.4%)	9 (33.3%)	0.416
Adenoid hypertrophy	13 (39.4%)	7 (25.9%)	0.205
Epidermal prick test positivity	16 (48.5%)	10 (37.0%)	0.265
Allergic rhinitis	14 (42.4%)	7 (25.9%)	0.144

Values are presented as mean±SD or as number (percentage), where not otherwise specified.

age of 14.1±2.3 years. Basketball group comprised 14 males and 13 females with a mean age of 13.4±1.6 years. Mean body mass index of the orienteers (19.3±2.2 kg/m²) was significantly lower than that of the basketball players (21.7±3.0 kg/m²) (P=0.001). Mean training age was shorter in orienteers (2.4±1.4 years) compared to basketball players (3.1±1.6 years), and familial atopy was positive in 45.5% of orienteers and 37.0% of basketball players. These differences were not significant.

There was no difference in spirometric values between the groups. In the orienteers, mean values of eosinophil number, eosinophil percentage and total IgE were 163.3±177.3/mm³, 2.3±1.6% and 114.1±135.3 IU/mL, respectively; in the other group, they were 151.4±97.7/mm³, 1.9±1.3% and 162.6±283.6 IU/mL, respectively. Comparisons were not significantly different.

In the endoscopic examination, inferior concha hypertrophy, mucosal paleness, septum deviation and adenoid hypertrophy were present at higher rates in the orienteers than in the basketball players, but differences were not significant.

Positive EPT to at least one allergen was recorded in 48.5% of orienteers and in 37.0% of basketball players. Despite higher positivity in orienteers, there was no statistically significance. Skin test positivity according to the allergen type was not significantly different between

TABLE II.—Comparison of epidermal prick test positivity between the groups.

Allergen	Orienteering (N.=33)	Basketball (N.=27)	P value
Verdure	8	6	0.464
Cereal	7	5	0.536
Weed	4	4	0.352
Tree 1 (<i>Salicaceae</i>)	4	4	0.352
Tree 2 (<i>Cupressaceae</i>)	5	4	0.483
<i>Pinus sylvestris</i>	5	4	0.483
<i>Olea europaea</i>	6	6	0.237
Feather	2	3	0.274
Cat	3	6	0.004*
Dog	4	3	0.562
Fungus	1	1	0.631
Mite 1	5	2	0.438
Mite 2	3	3	0.420

TABLE III.—Comparison of orienteers with and without allergic rhinitis.

	AR-positive (N.=14)	AR-negative (N.=19)	P value
Sex (M/F)	5/9	12/7	0.619
Age (years)	14.6±2.3	13.7±2.3	0.358
Body Mass Index (kg/m ²)	19.2±2.3	19.4±2.2	0.577
Training age (years)	2.9±1.4	2.1±1.3	0.046*
Familial atopy	8 (57.1%)	6 (42.9%)	0.211
FVC (%)	86.0±12.2	83.7±13.9	0.733
FEV ₁ (%)	98.2±13.8	96.8±15.5	0.843
FEV ₁ /FVC (%)	113.2±5.7	113.6±3.6	0.986
Number of eosinophil (/mm ³)	210.7±255.1	128.4±76.5	0.627
Percentage of eosinophil (%)	2.9±2.2	1.8±0.9	0.199
Total IgE (IU/mL)	215.8±155.7	39.1±32.7	0.0001*
Concha hypertrophy	12 (85.7%)	14 (73.7%)	0.348
Mucosal paleness	9 (64.3%)	9 (47.4%)	0.271
Serous discharge	5 (35.7%)	6 (31.6%)	0.547
Septum deviation	5 (35.7%)	8 (42.1%)	0.497
Adenoid hypertrophy	5 (35.7%)	8 (42.1%)	0.487
Epidermal prick test positivity	11 (78.6%)	5 (26.3%)	0.004*

Values are presented as mean±SD or as number (percentage), where not otherwise specified.

AR: Allergic rhinitis.

*Statistically significant difference.

the groups, except the sensitivity to cat which is an indoor allergen (Table II).

As a result of the AR investigation, 21/60 athletes (35.0%), 14/33 orienteers (42.4%) and 7/27 basketball players (25.9%) were diagnosed with AR (P=0.144).

Comparisons of the clinical and demographic results between orienteers with and without AR are shown in Table III. Mean training age was significantly higher in the orienteers with AR (2.9±1.4 versus 2.1±1.3 years, P=0.046) (Figure 1). Total IgE levels and EPT positiv-

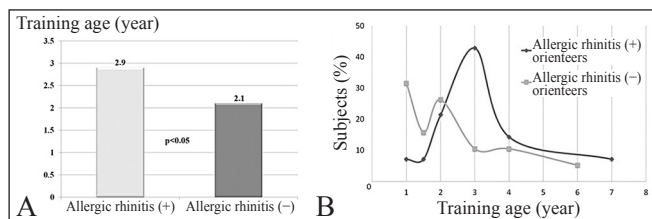


Figure 1.—A) Mean training age of orienteers with and without allergic rhinitis; B) quantitative distribution of orienteers according to training age.

ity were also significantly higher in rhinitic orienteers than non-rhinitic orienteers ($P=0.0001$ and $P=0.004$, respectively).

Discussion

Studies defining some infections (such as hepatitis-B, chlamydia, bartonella, borreliosis, tularaemia) in orienteers are available in the literature.^{12, 13} Linde¹⁴ stated that Danish elite orienteers had reported more upper respiratory tract infection (URTI) episodes than nonathlete controls. Johansson¹⁵ reported that the incidence of uncomplicated colds was significantly higher in elite junior orienteers than elite seniors, despite more training amount in the senior group. Immune functions of Swedish elite orienteers were examined in a study, and no immunological disturbance with regard to myocarditis was found compared to the runners and skiers.¹⁶ As seen, almost all studies in the literature were carried out about immune-defense against infections encountered in orienteers, and they did not mention about immuno-allergy.

In recent years, orienteering sport has been popular in Antalya via national and international orienteering events.^{9, 17} Antalya is an important destination for outdoor activities, and a leading tourism center of Turkey with historical, geographical and cultural features. The city is located in the Mediterranean region of the country which has a subtropical climate, 60% forest cover and rich plant diversity. However, these botanical and climatic conditions bring about plenty of environmental allergen exposure. A study reported that grass, cereal mixtures, olive and mites were responsible for allergic rhino-conjunctivitis in Antalya.¹⁸ In another study, the highest frequency of AR (27.7%) was found in Antalya among the cities in Turkey.¹⁹ We found a relatively higher AR frequency (35%) in this study which conducted on an adolescent athletic population in Antalya.

This value is within the range of 13.3-48.6% rhinitis frequency which previously defined in the athletes.⁴ There is only one study in the literature reporting AR prevalence in adolescent athletic population among the Mediterranean countries (Italy). Macucci *et al.*²⁰ conducted a study on 352 athletes (aged between 7 and 14 years) from different sporting clubs. They administered questionnaire and spirometry at training centers of the athletes and reported a 22.1% prevalence of AR.

AR symptoms may cause deteriorative impacts on life quality and school performance of children and adolescents.⁶ Besides obvious symptoms associated with AR, hidden symptoms (poor-quality sleep, fatigue, reduced cognitive functions, weak athletic performance) may be seen in the athletes.^{3, 7, 21} The incidence of AR is clearly higher in athletes than in general population.^{4, 8} How can this situation be explained? Transition of the allergens into the respiratory system increases with the increase of breathing frequency during an exercise session. Apart from this, athletes who frequently train and compete in outdoor environment are repeatedly exposed to airborne allergens. Kellberger *et al.*²² reported that sensitization to outdoor allergens was more important than sensitization to indoor allergens for AR development in adolescents. Boulet *et al.*²³ suggested that indoor allergens was strongly associated with asthma, while pollens was associated primarily with rhinitis. Outdoor athletes are also at greater risk for rhinitis because of other environmental risk factors, such as cold and dry air, pollutants.²⁴ The term “cold-induced rhinorrhea” (also known as the “skier’s nose”) was firstly described by Silvers.²⁵ This discomfort occurs through increased cholinergic activity after cold exposure, and is characterized by rhinorrhea, nasal congestion and sneezing. The “runner’s nose” is another phenomenon which results from dehydration, altered bloodflow and impaired mucociliary clearance in nasal mucosa, and a rebound increase in nasal secretion.^{26, 27} Pollutants in outdoor environments (factory fumes, vehicle exhaust gases, sulphur dioxide, ozone, nitrogen dioxide etc.) reduce the air quality and hamper to perform sports safely.^{4, 27}

Despite their longer training age, basketball players had lower AR frequency (25.9%) than orienteers (42.4%) in this study. Whereas, rhinitic orienteers had significantly longer training age than non-rhinitic orienteers. The development of allergic sensitization shows age-related increase in atopic children.²⁸ As the train-

ing age increases in an outdoor sport, allergen-induced stimulation will be triggered more frequently. It seems that training age is a more important definition for outdoor sports compared to indoor sports in which environmental allergen exposure is at low levels.

Athletes can be easily screened for AR diagnosis. AR is diagnosed with the concordance between the history and physical examination.³ The diagnosis can be supported by other diagnostic tools such as nasal endoscopy.¹ Although nasal endoscopy need not routinely be used for the evaluation of all patients,²⁹ it is useful to objectively observe the endonasal findings with a bigger range of view and details in AR.^{1, 30} Concha hypertrophy, serous discharge and mucosal paleness are common findings in AR.³¹ However, these findings are not specific only for AR, and were at high frequency in both rhinitic and non-rhinitic athletes in our study. Septum deviation and adenoid hypertrophy are mechanical blockage factors of the upper respiratory tract in the pediatric population.^{1, 11} Especially adenoid hypertrophy may show AR like symptoms in children and adolescents. Immunological structure of adenoid tissue can change with inhalant allergens in atopic individuals.³² However, a study conducted with nasal endoscopy showed the presence an inverse correlation between adenoid hypertrophy and AR.³³ In our study, AR had meaningful relationship neither with adenoid hypertrophy nor with septum deviation.

In the EPT results of this study, adolescent orienteers were not found more sensitive to allergenic plants and other allergens. Although there was no difference between outdoor and indoor athletes, significant difference was found between skin tests of athletes with AR and without AR. EPT is widely used to demonstrate the presence of allergen-specific IgE in the skin and highly correlated with allergic symptoms.^{1, 34} In order to detect that the sensitization is against which allergen(s), EPT can easily be applied in athletes who newly diagnosed with AR.

In blood samples, total IgE levels were significantly higher in rhinitic orienteers and were overlapping with skin test results. But in recent years, "serum allergen-specific IgE" has been recommended rather than serum total IgE for allergy screening.^{1, 30} Moreover, Bonini *et al.* have reported that a microarray technology provides a useful additional diagnostic tool for assessment of serum specific IgE in poly-sensitized athletes.³⁵ In this

study, we evaluated the allergen-specific IgE by skin test instead of serum test. Although both skin test and serum test have similar diagnostic properties for allergen-specific IgE, skin test has a lower cost, and results immediately in a visible way to the patient/family.³⁴ The number and percentage of eosinophils showed no value in our results. In conclusion, the combination of history, physical examination and skin test offered the optimal model to determine an athlete's sensitization in this study. Other immunologic parameters did not contribute significantly.

To our knowledge, this prospective and blinded study is the first report concerning AR in adolescent orienteers. There is no information in the literature about this. Another feature of the study is that it gives clue about the relationship between AR and duration of outdoor sports.

Limitations of the study

There are also some limitations of the study. Firstly, there was no information about AR presence before sporting life of the athletes. Secondly, the number of athletes was limited. It resulted from our strict inclusion criteria. Most of the orienteers admitted to the Sports Medicine polyclinic were not adolescent. Parents of some adolescents did not sign the informed consent form. Also, some orienteers were not included the study due to viral rhinitis, or short training age (<1 year) in which sports related sensitization is probably immature. We found only one similar study in the literature conducted by clinical assessment tools. Bonini *et al.*³⁶ clinically examined Italian pre-Olympic athletes and found no difference in terms of rhinitis prevalence between the athletes exercising outdoor (N.=54) and indoor (N.=42). Besides the approximate sample size, our study had a similar result that outdoor athletes were not more susceptible to AR than indoor athletes. It seems difficult to provide large number of subjects for these type clinical trials, unlike only allergy questionnaire-based field studies.

Conclusions

AR is common in athletes and may impair life quality and athletic performance. As in Antalya example, it is obvious that the geographic and climatic conditions

affect the presence of AR in athletes. Skin test is a useful method to identify the allergen(s) responsible for the AR symptoms of an athlete. AR was diagnosed in 35% of the athletes in this study, and its frequency was not different between outdoor (orienteers) and indoor athletes (basketball players) although some allergic parameters showed higher outcomes in orienteers. This study also demonstrated that rhinitic orienteers had a longer training age than non-rhinitics. It seems that there is a positive association between AR and the duration of orienteering sport. More studies are needed to compare allergic diseases between outdoor and indoor athletes.

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