

Evaluation of Allergic Diseases, Symptom Control, and Relation to Infections in a Group of Italian Elite Mountain Bikers

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Abstract

Objectives: This study estimates the prevalence of allergic diseases in a group of Italian elite mountain bikers, compares the prevalence of infectious episodes between allergic and nonallergic athletes, and evaluates asthma and rhinitis symptom control in allergic athletes. **Design:** Two hundred twenty-six Italian nonsmoking mountain bikers received by mail the Allergy Questionnaire for Athletes (AQUA) and completed it. The RhinAsthma Patient Perspective (RAPP) questionnaire was sent to the 108 participants with a positive AQUA score and 104 returned the questionnaire. **Methods:** Athletes with an AQUA score ≥ 5 or < 5 were defined AQUA+ (allergic) or AQUA- (nonallergic), respectively. RhinAsthma Patient Perspective questionnaire total score ≥ 15 was indicative of a poor control of symptoms. **Results:** Of the 226 athletes, 47.8% were AQUA+, whereas 52.2% were AQUA-. A higher number of AQUA+ athletes reported frequent upper respiratory tract infections (URTIs) and herpes labialis than AQUA- athletes ($P < 0.001$), and the prevalence of URTI was greater in the subgroup of AQUA+ athletes who trained ≥ 3 hours per session. According to RAPP questionnaire score, 21.1% of AQUA+ mountain bikers had a poor control of asthma and rhinitis symptoms. **Conclusions:** Our study shows a high prevalence of allergy among Italian elite mountain bikers whose asthma and rhinitis symptoms are poorly controlled in about a fifth of the sample. Allergic athletes, mainly those training more than 3 hours per session, are at higher risk of URTI and herpes labialis. Screening programs to detect allergic diseases and to evaluate symptom control in athletes should be strongly encouraged.

Key Words: athletes, exercise training, upper respiratory tract infections, herpes labialis, bronchial asthma, allergic rhinitis

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INTRODUCTION

Airway allergic diseases including rhinitis and asthma are reported to occur more frequently in athletes than in the general age-matched population.¹ In particular, swimmers, boxers, and athletes practicing winter sports have a higher frequency of rhinitis ranging from 27% to 74%.^{2,3} Likewise, asthma is significantly more common in elite athletes, especially in swimmers but also in track and field athletes.^{4,5} Estimates of the prevalence of allergic diseases in athletes may depend on the diagnostic method used; however, independently from the methodology adopted (questionnaires, skin prick test, and blood sampling for specific IgE), the prevalence

of allergic diseases in athletes seems to be on the rise.⁶ Bonini et al⁷ developed the Allergy Questionnaire for Athletes (AQUA), consisting of 25 selected scored questions, which was validated in 128 professional soccer players who underwent an accurate medical history, physical examination, skin prick testing, and/or specific IgE determination. An AQUA score ≥ 5 showed a high predictive value to identify athletes with allergic diseases with a sensitivity of 58.3% and specificity of 97.1%.⁷

Upper respiratory tract infections (URTIs) are common in the general population, prevalently among elderly subjects and in immunocompromised patients.^{8–11} Several studies have documented a higher prevalence of URTIs in endurance athletes, including runners,^{12,13} cyclists,¹⁴ cross-country skiers,¹⁵ and swimmers.¹⁶ High-intensity and prolonged exercise training can alter systemic and mucosal immunity, and may increase the risk of developing URTI; however, a direct evidence of infections in athletes after endurance events has never been documented.¹⁷ It has been hypothesized that symptoms suggestive of URTI can also be due to other causes, in particular allergic disorders. A recent study showed that during endurance exercise, an unbalance between the immune tolerance and the inflammatory/hypersensitive processes leads to allergic phenomena, supporting the “noninfectious” hypothesis.¹⁸ Furthermore, the treatment of athletes with topical anti-inflammatory medications has been shown to reduce the incidence of symptoms suggestive of URTI.¹⁹

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The compliance to pharmacological treatment for allergic disorders from athletes is often unsatisfactory due to the supposed negative effects on physical performance or concerns about the World Anti-Doping Agency restrictions.²⁰ The degree of asthma and rhinitis symptom control is not routinely measured in endurance athletes, although the well-known risk related to the undertreatment of these diseases.²¹

In this study, we aimed to evaluate, in a broad sample of elite mountain bikers, the prevalence of allergic diseases, the difference in infectious episode rates between allergic and nonallergic athletes in relation to the intensity of the exercise training, as well as, in the subgroup of allergic athletes, the level of asthma, and rhinitis symptom control.

METHODS

Several Italian sporting teams from North, Middle, and South Italy were involved in the recruitment of mountain bikers, who were mainly specialized in “cross-country” and “marathon” disciplines. To be included in the study, athletes had to be nonsmokers, aged more than 18 years, involved in professional sport activities for at least 5 years, and with the participation to at least 20 competitions during the previous year. A total of 288 Italian athletes of mountain bike, representative of all Italian regions and meeting the inclusion criteria, were invited to take part to this cross-sectional study. Sixty-two refused to participate, whereas 226 gave their consent, received by mail the Italian version of the AQUA questionnaire and completed it, with a participation rate of 78.5%. Moreover, the RAPP questionnaire was sent to the 108 participants with a positive AQUA score, despite 4 athletes did not return it (Figure 1). Data were treated in respect of privacy and ethical requirements.

AQUA questionnaire consists of 25 questions. The first 3 concern the characteristics of training sessions (frequency, duration, and outdoor/indoor); questions from 4 to 16 investigate the presence of previous diagnosis or symptoms suggestive of asthma, rhinitis, conjunctivitis, or other allergic diseases; questions from 17 to 22 are related to the use of drugs, to smoking habits, and investigate the awareness/concern of athletes about world antidoping agency restrictions (www.wada.ama.org); questions from 23 to 25 regard the susceptibility to upper airway and herpes labialis infections. Questions from 4 to 16 (except for number 14) determine a score. A final result equal or higher than 5 is used to distinguish between allergic and nonallergic athletes in view of its positive predictive value.⁷ Athletes with an AQUA score ≥ 5 or < 5 were defined AQUA+ (allergic) or AQUA- (nonallergic), respectively. Demographic information was collected through the questionnaire.

The RAPP questionnaire assesses the impact of asthma and allergic rhinitis symptoms on the daily life in the last 2 weeks. The questionnaire, validated in the Italian language by Braido et al,²³ consists of 8 questions; each answer receives a score from 1, no impact, to 5, the worst possible impact on quality of life. A total score ≥ 15 has the best predictive value for poor control of diseases with a specificity of 84.6% and a sensitivity of 88.3%.

Continuous variables were reported as mean and SD and compared using the Student *t* test. Categorical variables were reported as number and percentage and compared with the χ^2 or Fisher exact test as indicated. Two separate multivariable logistic regression models were used to evaluate the independent association of AQUA status and training groups with URTI and herpes labialis prevalence, as dependent

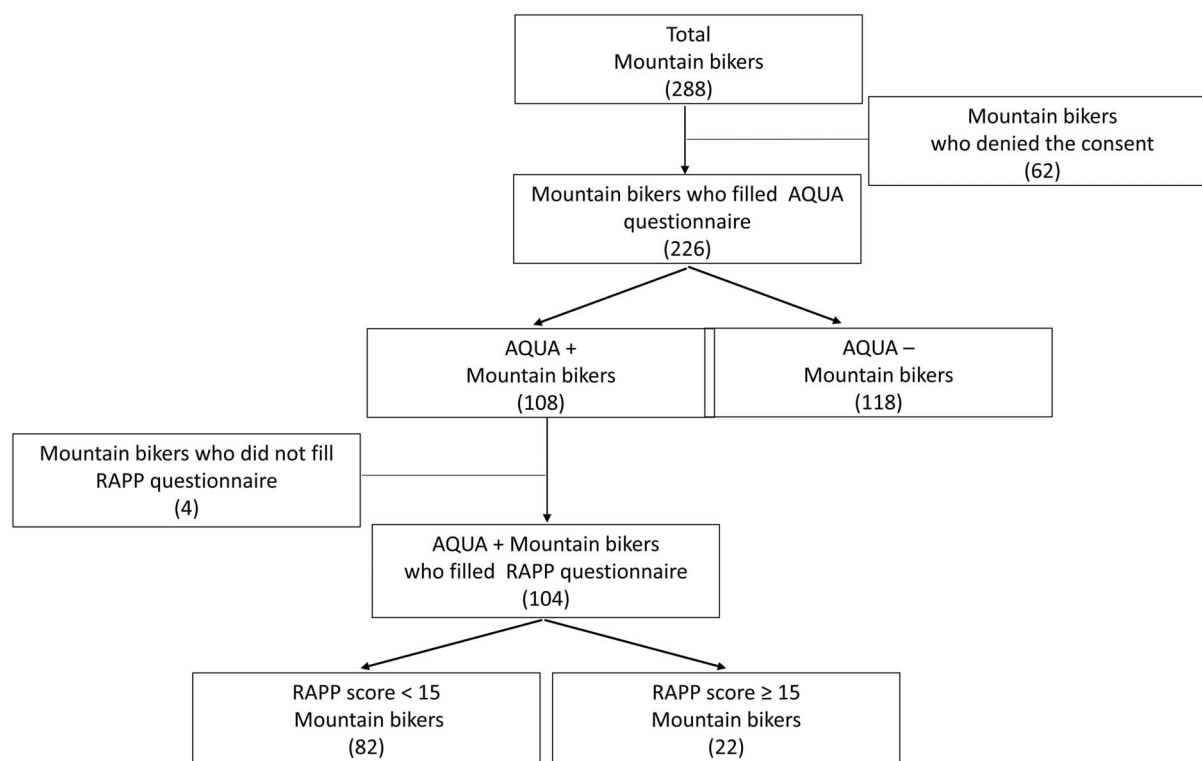


Figure 1. Study flow chart.

variables to estimate odds ratio and 95% confidence interval. In the 2 models, the interaction between AQUA status and training groups was also evaluated and retained in the model if significant. All tests were two-tailed, and a P -value <0.05 was considered statistically significant. Data were analyzed using R software 3.3.1 (R foundation for Statistical Computing, Vienna, Austria).

RESULTS

Two hundred twenty-six athletes of mountain bike returned the filled questionnaire, 217 men and 9 women, with a mean age of 39.0 ± 7.9 years. No statistically significant difference in age and sex between AQUA+ and AQUA- athletes was observed (Table).

Of the 226 athletes, 47.8% (108 of 226) were AQUA+, meanwhile 52.2% (118 of 226) were AQUA- (Figure 1). The

distribution of questions used to calculate AQUA score is described in a **Supplemental Digital Content** (see Table S1, <http://links.lww.com/JSM/A193>). Among the Italian mountain bike study group, 66 (29.3%) athletes reported a previous diagnosis of bronchial asthma; in particular, 6.1% of asthmatic athletes were AQUA-, whereas 93.9% were in the AQUA+ group. Furthermore, 64 (28.3%) athletes reported a diagnosis of rhinitis (6.25% were AQUA- and 93.75% were AQUA+) (Table S1).

When we evaluated the characteristics of training, we observed that almost all AQUA+ and AQUA- (95%) athletes trained more than 3 times a week, but a significant lower percentage of AQUA+ athletes reported to practice more than 3 hours for each training session ($P < 0.01$, Table).

Regarding the use of drugs, only a single AQUA- athlete reported the use of drugs during the last week in comparison with 45 (42.9%) AQUA+ mountain bikers; however, more

TABLE. Entries Are Absolute Number and Percentage

Characteristic	All	AQUA-	AQUA+	P
Age, yr (mean $\pm$ SD)	39.03 $\pm$ 7.9	39.4 $\pm$ 8.6	38.7 $\pm$ 7.24	0.54
Sex				
Female	9 (4.04)	6 (5.17)	3 (2.80)	0.37
Male	214 (95.96)	110 (94.83)	104 (97.20)	
AQUA questions:				
1. How many times a week do you train?				
Up to 3 times	10 (4.42)	5 (4.24)	5 (4.63)	
More than 3 times	216 (95.58)	113 (95.76)	103 (95.37)	0.87
2. Every training session usually last				
1-3 hours	55 (24.34)	20 (16.95)	35 (32.41)	
More than 3 hours	171 (75.66)	98 (83.05)	73 (67.59)	<0.01
18. Are you afraid that antiallergic and/or respiratory drugs may worsen your performances or make you infringing antidoping regulations?				
No	35 (15.63)	15 (12.82)	20 (18.69)	
Yes	189 (84.38)	102 (87.18)	87 (81.31)	0.23
22. Did you use any drug during the last week?				
No	176 (79.28)	116 (99.15)	60 (57.14)	
Yes	46 (20.72)	1 (0.85)	45 (42.86)	<0.001
23. Do you frequently suffer from URTI?				
No	137 (61.16)	95 (80.51)	42 (39.62)	
Yes	87 (38.84)	23 (19.49)	64 (60.38)	<0.001
If yes, these infections are more frequent during overtraining periods?				
No	3 (3.45)	1 (4.35)	2 (3.12)	
Yes	84 (96.55)	22 (95.65)	62 (96.88)	>0.99
24. Do you suffer for recurrent labial herpes?				
No	146 (65.18)	93 (78.81)	53 (50.00)	
Yes	78 (34.82)	25 (21.19)	53 (50.00)	<0.001
25. How many times in the last year you could not train because of infections?				
Never	104 (46.63)	84 (71.19)	20 (18.87)	
1-3 times	113 (50.45)	34 (28.81)	79 (74.53)	
More than 3 times	7 (3.13)	0 (0.00)	7 (6.60)	<0.001

Age is represented as mean $\pm$ SD.

than 80% of both AQUA+ and AQUA− declared to be worried to infringe antidoping regulations (Table).

Within the study group, 87 mountain bikers (38.8%) reported frequent URTIs, and 78 (34.5%) had a history of recurrent herpes labialis. A statistically significant higher percentage of AQUA+ athletes had frequent URTIs and herpes labialis compared with AQUA− athletes (79.6% vs 28.8%, $P < 0.001$; 49.0% vs 21.1%, $P < 0.001$, respectively, Table).

The majority (97%) of both AQUA+ and AQUA− athletes answered that the infectious episodes were more frequent during overtraining periods.

When we divided AQUA+ and AQUA− athletes on the basis of the average number of training hours per session, the prevalence of URTI was significantly higher in the subgroup of AQUA+ who trained more than 3 hours per session (Figure 2A), and the logistic regression model showed a significant interaction between AQUA status and training ($P = 0.011$, Table S2). However, for herpes labialis prevalence, no significant interaction was found between the 2 covariates ($P = 0.24$), and in the final model, only AQUA status was significantly positively associated ($P = 0.0001$, see Table S2, Supplemental Digital Content 2, <http://links.lww.com/JSM/A194>).

Among AQUA+ athletes who filled the RAPP questionnaire, 21.1% (22/104) achieved a score ≥ 15 , indicative of poor control of rhinitis and asthma symptoms.

DISCUSSION

In this study, we documented in a group of Italian elite mountain bikers, a reported higher prevalence of allergic diseases compared with the general population. Recent data from a sample of Italian adults (median age 35.2) documented the prevalence of asthma ranging from 8.3% to 12.5% and of allergic rhinitis from 24.4% to 29.0%.^{22,23} Conversely, 29.3% and 28.3% of the Italian mountain bikers reported a previous diagnosis of asthma and rhinitis, respectively.

Using the same methodology, the AQUA questionnaire, Bonini et al,⁷ in a cohort of professional soccer players, and Teixeira et al,²⁴ in marathon runners, found an allergy prevalence of 32% and 60.7%, respectively, whereas we observed a 47.8% AQUA positivity among Italian elite mountain bikers. The discrepancy between the prevalence data could be related to the different ventilatory pattern performed by athletes of diverse disciplines along with a different intensity of training and time exposure to irritants and allergens. Previous studies have shown that allergic airway diseases are more prevalent among athletes who practice sports of “endurance,” as well as outdoor sports, mostly in adverse weather conditions.¹⁹ The shift from nasal breathing to the buccal one, due to the high intensive training, can facilitate the development of allergic airway diseases through different mechanisms such as increasing the dehydration state and/or damaging the airways, allowing for, in such way, a major deposition of allergens in the respiratory tract.^{25–27} On the other hand, upper airway diseases in athletes may have a direct negative effect on the achievement and maintenance of the optimal athletic physical performance.^{28,29} Our data showing that AQUA+ mountain bikers report shorter training sessions than AQUA− athletes can be explained by the impairment in physical activities because of the allergic airway symptoms.

Particularly interesting are our findings of a higher prevalence of URTI and cold sores among AQUA+ athletes compared with

AQUA−, suggesting an increased susceptibility to infections of allergic mountain bikers. Our findings are in accordance with a previous study showing, in elite athletes with asthma and allergy, an abnormal T-cell subset profile with a significantly lower IFN- γ /IL-4 ratio that could predispose to infections.⁶ In the same way, the relationship between the incidence of symptoms suggestive of URTI and the duration of exercise performed by the Italian mountain bikers resembles the already described “J”-shaped curve, where sedentary individuals are at greater risk of infections than those who exercise moderately; however, extreme exercisers are at the highest risk.²⁹ Indeed, although a moderate exercise seems to have immunostimulant effects, an intense and regular exercise could cause a temporary impairment of the immune functions.^{30,31} However, our data show, for the first time, a potential interference between allergy and strenuous

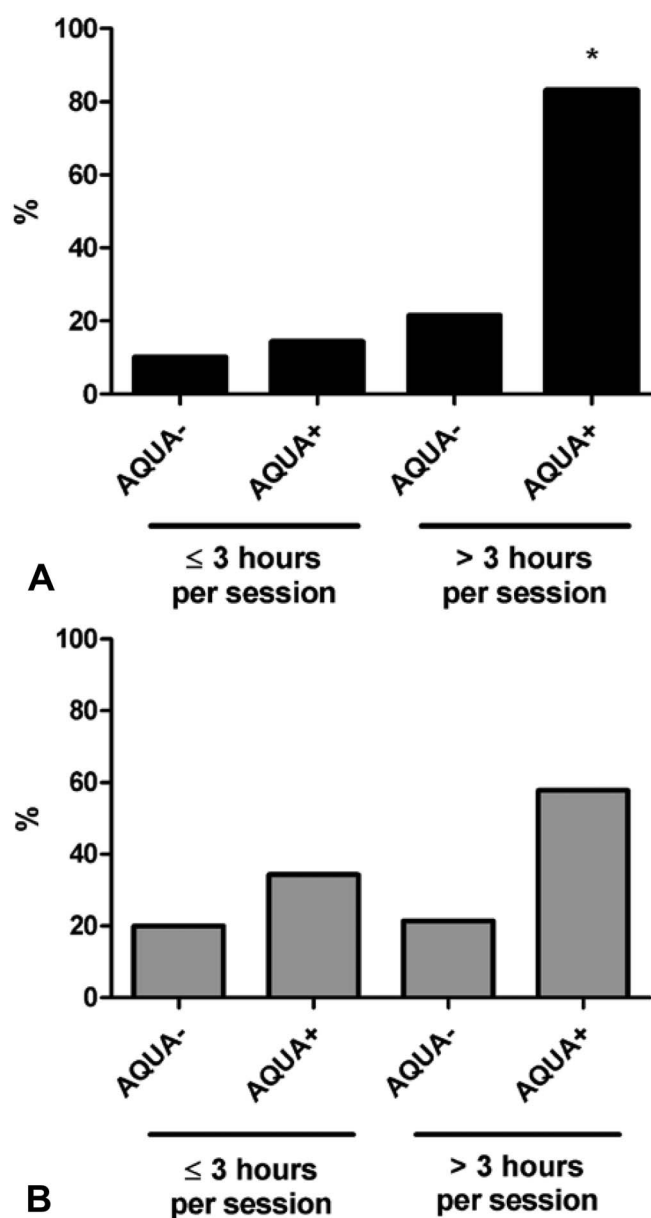


Figure 2. Prevalence of URTI (A) and herpes labialis (B) by AQUA questionnaire (AQUA+ vs AQUA−) and number of hours per session (≤ 3 vs > 3 hours). *Significativity ($P < 0.05$) of interaction between AQUA.

exercise in inducing URTI symptoms, so that the “infectious” and “allergic” hypotheses rather than being alternative can coexist. A shift of lymphocyte subpopulations toward a Th2 profile, induced by both physical exercise and allergic diseases, could have an impact on athletes increasing the risk of infections and allergic symptoms.^{16,32}

Finally, poor compliance to therapeutic plans by athletes, probably related to the fear that the therapy may worsen athletic performance or break the antidoping rules, may be responsible for the poor control of symptoms shown by the RAPP questionnaire in 21% of the mountain bike study group. Conversely, an optimal control of symptoms should be reached by all the allergic athletes, also considering the higher risk of infectious diseases documented in this category of subjects.

This study, however, has some important limitations. We included prevalently men and nonsmoking athletes; furthermore, the cross-sectional design could not reveal the real weight of potential risk factors in the development of respiratory infections. The lack of data on the subjects' allergy status, expressed as skin allergy tests or serum IgE, is another potential weakness, although AQUA questionnaire showed a high predictive value in identifying athletes with allergic disease. At last, we cannot exclude a selection bias in our study, although the participation rate is close to 80% that represent the lower limit to avoid a selection bias.³³

Our results strongly suggest the need of screening programs to detect allergy and to evaluate symptom control, particularly in athletes performing endurance disciplines in adverse weather conditions to lower the risk of infections.

CONCLUSIONS

Sports physicians should develop plans of allergy screening and of therapeutic management of allergic athletes, in accordance with the antidoping rules, to improve physical training of the athletes and to lower the risk of infections.

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