

# Patterns of Allergic Reactivity and Disease in Olympic Athletes

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**Objective:** Because the Sydney Olympic Games were being held in the spring, we wished to examine the prevalence of allergic disorders in the Australian Olympic and Paralympic athletes and to examine patterns of allergic reactivity and medication use for the treatment of allergic symptoms.

**Design:** A survey case series of Australian Olympic and Paralympic athletes.

**Setting:** Screening was conducted on team processing days.

**Participants:** Prospective members of the Australian Olympic and Paralympic teams.

**Intervention:** A questionnaire seeking information on the presence of allergic disorders, symptoms, family history, and medication use was administered. Skin-prick tests (SPT) for sensitivity to common aeroallergens was performed.

**Outcome measures:** Athletes were classified as atopic or non-atopic, and patterns of reactivity were examined according to sporting category.

**Results:** Of the athletes, 56% had a positive SPT to at least 1 allergen, with 34% reacting to at least 1 seasonal allergen. There was no significant association between skin test reactivity and sporting category.

Of the athletes, 37% had allergic rhinoconjunctivitis (AR/C), whereas 24% had seasonal allergic rhinoconjunctivitis (SAR/C).

Approximately one-third of all those with AR/C had a history of asthma, whereas approximately one-fifth had a history of atopic dermatitis.

Swimmers were most likely to have asthma, AR/C, and positive skin tests to any allergen.

Very few athletes with self-reported AR/C took any medication to relieve their symptoms.

**Conclusions:** Allergic disorders are common among athletes from all sports. The known impact of AR/C on quality of life necessitates that it be screened for and managed appropriately.

**Key Words:** allergic athletes, allergic rhinoconjunctivitis, atopy, medication use in athletes, Olympics

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## INTRODUCTION

The rising prevalence and the impact on quality of life of conditions such as allergic rhinoconjunctivitis (AR/C) have received much attention in recent years. Allergic diseases lead to significant morbidity and impair many aspects of quality of life.<sup>1</sup> The peak incidence of AR/C occurs in the teens to early twenties, the age range of many elite athletes. Elite athletes seeking top performance at events such as the Olympic Games may be particularly affected by the adverse effects of untreated AR/C.

Although there is much written about the athlete with asthma and exercise-induced bronchospasm, there are relatively few studies addressing the presence and management of other allergic diseases in elite athletes. This was a particularly relevant issue leading into the Sydney Olympic Games because they were only the second in the last century to be held in the springtime. (The other springtime Olympics were held in Melbourne in 1956. These Games were staged in the late spring and no records regarding pollen levels or the impact on athletes exist.)

For the 6 years from the time Australia won the bid to host the 2000 Olympic Games to the beginning of the event, we performed daily pollen counts at the major Olympic sites in Sydney. Analysis of these data showed that pollen counts during Olympic and Paralympic competition periods were at levels capable of causing symptoms in pollen-sensitive individuals.<sup>2</sup> Therefore, athletes with allergies needed to be aware of this risk so that they could take the necessary precautions to minimize the impact of allergic symptoms on their ability to perform.

There are little data available on the prevalence of seasonal allergic rhinoconjunctivitis (SAR/C) in elite athletes. In 1997 and 1998, we undertook a study to screen elite athletes for the presence of SAR/C. Two hundred and fourteen elite athletes were interviewed and underwent skin-prick testing (SPT). This study has been published.<sup>3</sup> In brief, results of the screening showed that 59% of screened athletes were SPT positive to at least 1 allergen used in the SPT battery. When this was combined with a symptom history of allergic

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rhinoconjunctivitis (AR/C), 41% of athletes had AR/C (symptoms plus positive SPT to at least 1 allergen); 29% had SAR/C (symptoms of AR/C in the spring and early summer and a positive SPT to at least 1 seasonal allergen).

On the basis of these findings, and in conjunction with the Australian Institute of Sport (AIS), the Australian Olympic Committee (AOC), and the Australian Paralympic Committee (APC), we decided to extend our previous research by screening the Australian Olympic and Paralympic teams in 1999. The aim of the present study was to confirm the high prevalence of allergic rhinoconjunctivitis in a group of elite athletes and to examine patterns of allergic reactivity and medication use for the treatment of allergic symptoms.

## MATERIAL AND METHODS

### Ethics Approval

The AIS Ethics Committee and the Medical Commissions of both the AOC and APC approved the study.

### Aerobiological Monitoring

An aerobiological study monitoring the 6 years prior to the Olympic Games was performed at the 3 major Olympic venues—Homebush, Blacktown, and Penrith—and these results have been published elsewhere.<sup>2</sup>

For this report, aerobiological monitoring at the main Olympic site at Homebush, NSW, is reported from 1997 onward.

### Athlete Survey

The survey of Olympic and Paralympic athletes was conducted during 1999 and with permission from the AOC and APC; this was done as part of the team processing days of both organizations. These days were conducted to obtain information from athletes hopeful of Olympic/Paralympic selection and to prepare athletes with a series of briefing sessions. They were held over a period of weeks at various locations.

Athletes were asked to participate in the SAR/C screening as part of their processing day. Participation was voluntary. Written informed consent was obtained from all athletes or their parents/guardians (if applicable).

A questionnaire was administered to each athlete by the study staff. This sought information on demographic details, a family history of asthma, atopic dermatitis (eczema) or AR/C, a personal medical and allergy history [including a history of asthma and atopic dermatitis (eczema)], and any medication use. In particular, athletes were asked detailed questions about the occurrence and timing of symptoms of AR/C. Specific responses to questions on the presence and timing of nasal blockage, sneezing, nasal discharge, and itching were sought. Ocular symptoms, including tearing, itching, redness, and swelling, were also examined.

### Skin Tests

Allergy tests, using the prick test method with the Bayer Quintest (Bayer, West Haven, CT)<sup>4</sup> were performed. Eight allergen extracts (*Dermatophagoides pteronyssinus*, Alternaria, 7 grass mix, *Plantago lanceolata*, Cupressus, Platanus,

Acacia, and Casuarina-Hollister Stier, Spokane, WA) and 2 controls (histamine dichloride 10 mg/mL and glycerosaline) were used. Allergens chosen are those commonly used in Australian populations. The pollen allergens were chosen on the basis of their frequency of detection in pollen surveys in this region. A positive skin test was defined as a wheal of >3 mm in the presence of a negative glycerosaline control. Atopy was defined as the presence of 1 or more positive skin tests and a personal or family history of 1 or more of the following—asthma, atopic dermatitis (eczema), and AR/C.<sup>5</sup>

Athletes were classified as having AR/C if they had at least 1 positive skin test and 2 symptoms of rhinoconjunctivitis. SAR/C was defined as at least 1 positive skin test to a seasonal allergen and at least 2 symptoms of AR/C occurring in the spring/early summer.<sup>6</sup> All athletes who had a positive SPT were told of their diagnosis at the time of testing. They were given a record of their SPT result and a letter for their team/local doctor explaining the SPT result.

Participating athletes represented a large number of sporting groups. We examined for associations between each sporting category and particular allergic disorders or sensitization patterns. To examine whether certain forms of training and environment were more likely to lead to sensitization to particular allergens, we grouped the various sports into 4 categories according to where the sporting activity and training were conducted: indoor, water-based; indoor, nonwater-based; outdoor, water-based, and outdoor, nonwater-based. Patterns of reactivity to different allergens were examined between these categories. In addition, we examined associations between those in endurance sports (long distance runners, cyclists, rowers, and swimmers) compared with speed and power (high-intensity, short duration) athletes. In this latter category, athletes came from a number of sports—basketball, beach volleyball, boxing, canoe slalom and sprint, fencing, hockey, judo, powerlifting, rugby, sailing, soccer, table tennis, tennis, softball, tae kwon do, volleyball, water polo, weightlifting, and wrestling.

### Statistical Methods

The Statistical Package for Social Scientists (SPSS) for Windows Version 11 (Chicago, IL) software was used to analyze the data. Associations between the presence of atopy and the pattern of allergen reactivity and sporting category were quantified using odds ratios (OR), and their 95% confidence intervals (CI) were obtained by logistic regression analysis. Two-tailed tests with a significance level of 5% were used throughout.

## RESULTS

### Aerobiological Survey

The average pollen counts for the Homebush site for 3 preceding years are shown in Figure 1. This graph highlights the peak of pollen levels in the period immediately prior to Olympic competition with persistence during the time of Olympic and Paralympic competition.

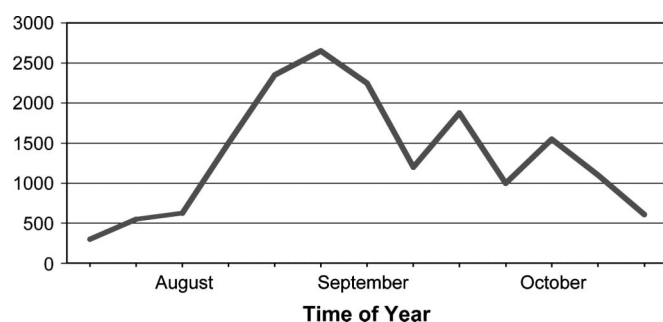


**FIGURE 1.** Number of pollen grains per cubic meter of air is shown for the spring period. Counts are averaged over 3 years and expressed as mean weekly total pollen counts. The Olympic and Paralympic competitions were held from 15-9-2000 to 1-10-2000 and 18-10-2000 to 29-10-2000, respectively.

### Athlete Survey

During screening at the Olympic and Paralympic team processing days 977 (725 Olympic, 252 Paralympic) athletes from 34 different sports were screened. This was 88% of all athletes attending the processing days. The remainder declined to participate. No data were collected on the 12% who were not screened. As expected, there were no significant differences between the Olympic and Paralympic groups, so all analyses were performed on the combined group. The mean age of screened athletes was 29 ( $\pm 6$ ) years, with 51% being male.

Table 1 summarizes the allergic history of the screened athletes.

### SKIN TESTS

Of athletes, 37% met the criteria for AR/C and 24% met study criteria for SAR/C. Of athletes, 56% had a positive SPT to at least 1 allergen, with 34% reacting to at least 1 seasonal allergen. *D. pteronyssinus* was positive in 46% and *Alternaria* was positive in 7% of those with positive SPT. This is in keeping with the pattern of skin test reactivity seen in Australian populations. There was no significant association between skin test reactivity and whether an athlete performed indoors or outdoors. The relationship between SPT result and history of symptoms of AR/C is shown in Table 2.

Table 3 shows the relationship between the coexistence of AR/C with asthma and atopic dermatitis (eczema). Approximately one-third of all those with AR/C had a history of asthma, whereas approximately one-fifth had a history of atopic dermatitis (eczema).

Patterns of allergic disorder and skin test reactivity were compared according to broad sporting category. The results of this analysis are summarized in Table 4. Athletes participating

**TABLE 1.** Details of Allergic Disorders from History

|                            |     |
|----------------------------|-----|
| Family history of allergy  | 42% |
| Asthma                     | 23% |
| Eczema (atopic dermatitis) | 11% |
| Rhinoconjunctivitis        | 53% |

**TABLE 2.** Relationship Between Skin-Prick Test (SPT) Results and Presence or Absence of Symptoms

|                   | Number of Athletes | SPT Positive to any 1 Allergen (%) | SPT Positive to at least 1 Seasonal Allergen (%) |
|-------------------|--------------------|------------------------------------|--------------------------------------------------|
| Positive symptoms | 516 (53%)          | 70                                 | 46                                               |
| Negative symptoms | 464 (47%)          | 40                                 | 19                                               |
| TOTAL             | 980                | 56                                 | 34                                               |

in indoor and aquatic sports were more likely to report asthma. Of these, swimmers were the most likely to have asthma. Endurance athletes were more likely to have asthma (questionnaire-based only); those competing in speed and power events were less likely. Aquatic athletes were most likely to be atopic compared to nonaquatic athletes. When all groupings were compared, swimmers were most likely to have asthma, AR/C, and positive skin tests to any 1 allergen ( $p = 0.007$ ; OR 2.0; CI 1.2–3.2). There were no other statistically significant associations between athlete groupings apart from the aquatic athletes. In addition, there were no significant differences between athlete groups (endurance or power/speed athletes) for sensitization to various allergens.

Medication history was carefully examined with the questionnaire. Very few athletes with self-reported AR/C took any medication to relieve their symptoms (Table 5). Antihistamines were used by fewer than 10% of those with AR/C, whereas intranasal steroid sprays were used less often. More athletes used medication for asthma than they did for AR/C symptoms. There was no difference between those with SAR/C compared with those with perennial AR/C.

### DISCUSSION

The unique features of geography and climate at the various Olympic Games locations impose a range of challenges for athletes looking for top performance in their particular sport. In Mexico City, altitude stresses were very important and athletes needed time to acclimatize there before competition. The Los Angeles games posed important questions regarding the effect of high air pollution and high humidity as particular stressors. The Sydney Games, being spring games, raised questions about the possibility of the impact of seasonal allergic disease on athlete performance.

In the present study we found that 37% of athletes screened had AR/C, whereas 24% suffered from SAR/C. Although high, these figures agree with those obtained by

**TABLE 3.** Relationship Between Allergic Disorders

|                                            | Allergic Rhinoconjunctivitis (n = 360) | Seasonal Allergic Rhinoconjunctivitis (n = 236) |
|--------------------------------------------|----------------------------------------|-------------------------------------------------|
| Positive asthma history (n = 23% of total) | 130 (36%)                              | 82 (35%)                                        |
| Positive eczema history (n = 11% of total) | 62 (17%)                               | 48 (20%)                                        |

**TABLE 4.** Correlation Between Presence of Asthma and Sporting Category

|                                    | <i>P</i><br>Value | Odds<br>Ratio | 95%<br>Confidence<br>Interval |
|------------------------------------|-------------------|---------------|-------------------------------|
| Asthma                             |                   |               |                               |
| Indoor vs outdoor                  | 0.01              | 1.5           | 1.1–2.0                       |
| Aquatic vs nonaquatic              | 0.007             | 1.5           | 1.1–2.1                       |
| Endurance athletes vs others       | 0.03              | 1.4           | 1.0–1.95                      |
| Speed and power athletes vs others | 0.03              | 0.7           | 0.5–1.0                       |
| Swimmers vs nonswimmers            | <0.001            | 2.5           | 1.7–3.8                       |

others in studies of the Australian population.<sup>7</sup> In our previous survey of elite athletes<sup>3</sup> 59% of 214 had a positive skin test to at least 1 allergen. In the present study, 56% were positive to at least 1 allergen. The incidence of SAR/C is also very similar in the athletes surveyed in both studies—24% in the present group compared with 29% in the 1997 study.

The coexistence of asthma and AR/C was examined. No objective measure of lung function or of bronchial hyperactivity (BHR) was used in this study; however, the athletes were questioned carefully regarding the presence of symptoms suggestive of asthma, physician-diagnosed asthma, and the use of asthma medication. Because these athletes were to be part of the Olympic/Paralympic teams, they had been carefully screened, so a positive history for asthma was more likely to be correct in this group than in other groups.<sup>8,9</sup> Furthermore, 25% admitted to bronchodilator use, whereas 23% gave a positive response to having asthma (figures in close agreement).

Of 458 (47%) athletes who were atopic, 38% had a history of asthma (as indicated earlier) compared with 11% of athletes who were nonatopic. A diagnosis of AR/C and asthma coexisted in 36% of screened athletes. According to the Australian Bureau of Statistics, the prevalence of asthma in Australia in all ages is 11.3%. Therefore, in this athlete population there is a higher prevalence of asthma than in the general population. The prevalence of atopy in this group is similar to that found in the general Australian population.<sup>10</sup> The reason for this difference cannot be ascertained from the present study. One possibility is that certain sports and the intense training involved may in some manner promote the development of BHR and asthma.

**TABLE 5.** Medication Use by Screened Athletes with Allergic Rhinoconjunctivitis (AR/C) and Seasonal Allergic Rhinoconjunctivitis (SAR/C)

| Medication                | Athletes with<br>AR/C (%)<br>n = 360 | Athletes with<br>SAR/C (%)<br>n = 236 |
|---------------------------|--------------------------------------|---------------------------------------|
| Antihistamines            | 8                                    | 11                                    |
| Other oral decongestants  | 0.6                                  | 0.8                                   |
| Intranasal corticosteroid | 7                                    | 6                                     |
| Other nasal sprays        | 0.5                                  | 0.8                                   |
| Bronchodilators           | 26                                   | 25                                    |
| Inhaled corticosteroids   | 16                                   | 14                                    |

A small number of investigators have reported previously on the prevalence of allergic disorders in elite athletes.

Fitch<sup>11</sup> conducted a review of medical records of Australian Olympic athletes competing in the 1976 and 1980 Games. He found approximately 20% in both teams suffered from allergic diseases—9% asthma and 8% allergic rhinitis. However, this study relied on a retrospective analysis of athletes' medical records, with no objective measures applied, so it almost certainly suffers from under reporting.

Helbling et al<sup>12</sup> surveyed 2961 Swiss athletes in 1990. This was a questionnaire survey mailed to participants. The authors report a 70% response rate. No indication of the types of questions asked is given. Of those athletes responding, 16.8% indicated they had hay fever, which is similar to the figure for the general Swiss population. Although the prevalence of AR/C was higher in Australian athletes, the finding that the rates were similar to that described in the respective general populations of the 2 countries is a common finding between the 2 studies.

Helenius et al<sup>13</sup> studied asthma and BHR in summer-event athletes and compared results with those obtained in a group of controls. This study included the performance of SPT for determination of atopy as a risk factor for asthma. The control group consisted of nonathlete medical students. Participants answered an allergy-specific questionnaire checked by personal interview and had an SPT with 10 common allergens. In this respect, data collection was similar to that in the present study. Atopy was found in 48% of the athletes and in 36% of controls (not significant) and was associated with increased BHR and current asthma compared with nonatopic controls. Helenius defined atopy as a positive skin test to at least 1 allergen, whereas the definition applied in the present study included a positive skin test with the presence of a positive personal or family history of allergic disease. This latter definition of atopy is widely accepted.<sup>5</sup> By Helenius' criteria, 56% of our subjects would be classified as atopic.

Although no particular sporting group showed specific patterns of allergen sensitization, some interesting associations emerged. Swimmers were more likely to have asthma, positive SPT, and AR/C than any other group, whereas endurance athletes were more likely to have a history of asthma; speed and power athletes were least likely to give such a history. Whether the finding of increased rates of atopy and asthma in swimmers in the present study is a result of factors associated with this particular sport such as exposure to chlorinated atmospheres, or whether more atopic individuals take up swimming than other forms of competition, requires further, prospective study. This is a particularly interesting question in the Australian setting, where for years there has been a swimming program targeted to children with asthma so many have trained to achieve an elite level in the sport.

Patterns of prevalence of allergic disorders within athlete groups have been examined by others. Zwick et al<sup>14</sup> examined 14 competitive swimmers and 14 matched controls to look for evidence of greater allergic sensitization in those exposed for long periods to chemicals associated with chlorinated swimming pools. They demonstrated greater aeroallergen sensitization and BHR in swimmers compared with controls.

Langdeau et al<sup>15</sup> investigated a group of 150 athletes with a questionnaire, SPT, and methacholine challenge to investigate the prevalence of BHR in top-level athletes. They found a much higher prevalence of BHR in athletes compared with control subjects, particularly in swimmers and, to a lesser extent, in those involved in winter sports. Prevalence of atopy was high in all athlete groups, with 76% showing at least 1 positive SPT, although this did not differ from the control group. The high prevalence of increased BHR in swimmers in this study is in agreement with the results of Zwick et al.<sup>14</sup>

Helenius et al<sup>13</sup> studied 214 track and field athletes and found that 17% of long distance runners, 8% of speed and power athletes, and 3% of controls had a physician diagnosis of asthma.

An important finding was the undertreatment of symptoms of AR/C in the study group, and, in particular, there was a very low rate of use of prophylactic medication. Of the athletes identified by screening, only 7% with SAR/C treated their symptoms with intranasal corticosteroids and 8% with antihistamines. This contrasts with a study by Borres et al.<sup>16</sup> that assessed the incidence of AR/C by questionnaire in 5938 16 to 17-year-old Swedish school students. They found that 24% of those surveyed claimed to have a history of AR/C; of those, 76% reported they treated their symptoms with medication. Fifty-five percent used non-sedating oral antihistamines, 14.5% used intranasal corticosteroids, and 38% used either sodium cromoglycate or levocabastine. The results from this study show remarkably higher medication use for the treatment of AR/C than we found in the athlete study. In Helbling's study<sup>12</sup> of athletes, 59% used medication during the pollen season.

The 2 reasons for low rates of treatment use in our study were under recognition of symptoms and their cause and a reluctance to use medication for fear of breaching "banned medication" rules. This latter reason was not applicable in the Borres study.

## CONCLUSION

Atopy and the presence of allergic disorders are common among top-level athletes from all sporting categories. Although asthma is well recognized and well managed in this group, there is a lack of recognition of the presence of AR/C and, consequently, this condition is under treated. In this study, as in others, swimmers were more likely to be atopic and to have allergic symptoms than other sporting groups. Whether this is a function of preselection into a sport usually better tolerated by those with asthma or whether it is as a result of long periods of exposure to chemicals associated with chlorinated pools cannot be answered in this study.

The known impact of AR/C on quality of life and therefore, most probably, on training and performance of athletes, necessitates that this condition be screened for and managed appropriately.

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