

Performance Point

Pollution in Beijing:

Concerns and Strategies to Optimize Performance

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Beijing is located in the North China Plain just south of the Gobi Desert and typically experiences high humidity, heat, sand storms in the spring and industrial pollution in the summer. Athletes from all nations will have to cope with these factors. This Performance Point will discuss how pollution affects athletes and strategies that can be employed by Canadians to optimize performance and facilitate a podium finish.

The Air Pollution Index is used as a method of determining the magnitude of air pollution for a specific time frame. An API score of 50 $\mu\text{g}/\text{m}^3$ is considered high. The average API in Beijing from 2002-2006 was $\sim 80 \mu\text{g}/\text{m}^3$.

There are several pollutants of concern for athlete in Beijing:



Downtown Beijing in the late afternoon.

Oxides of Nitrogen (NO₂) – Principally caused by cars and electrical utilities NO₂ has increased in Beijing by 50% over the last 10 years and can cause an increase in airway resistance.

Ozone (O₃) – Caused by a photochemical reaction of excess NO₂ and hydrocarbons. Ozone irritates the airways of the lungs, increasing the symptoms of those suffering from asthma and lung diseases.

Particulate Matter (PM₁₀) – These particles are generated by combustion sources (power plants and cars) as well as coarse dust particles. With a diameter less than 10 μm these particles can penetrate into the upper respiratory tract and amplify asthma symptoms and even trigger asthma symptoms in non-asthmatics.

Sulfur Dioxide (SO₂) – Typically caused by power stations burning fossil fuels. Even moderate concentrations may result in a decrease in lung function in asthmatics. Sulfur dioxide pollution is considered more harmful when particulate and other pollution concentrations are high.

These pollutants most commonly manifest themselves as symptoms of exercise induced Bronchospasm. These include wheezing, coughing, labored breathing and loss of breath sensations.

The magnitude of the effect of pollution on performance is still unclear. While Beijing City and Olympic officials will be addressing the problem using various means it is uncertain whether or not this will be enough to significantly reduce the pollution.

Satellite data reveals Beijing as the air pollution capital of the world (The Guardian, 2005).

Part of the preparations in Beijing leading up to the 2008 Olympics include improving the air quality and increasing the number of 'Blue Sky' days. However, at present the air in the city of Beijing is currently highly polluted. Acute exposure to air pollution including increased levels of ambient nitrogen dioxide (NO₂), particulate matter smaller than 10 μm (PM₁₀) and ozone (O₃) has been clearly associated with increased airway resistance. For athletes, this may place challenges on the efficiency of ventilation and gas exchange (i.e. breathing). In fact, PM₁₀ has been shown to cause bronchospasms in both asthmatics and non-asthmatics. Long-term exposure to air pollutants may also promote the development of asthma, particularly in outdoor sports where exercise increases the breathing rate and hence the amount of contaminated air that enters the lungs. Preliminary testing on Beijing's air quality and its effects on athletes traveling from Canada to compete indicates that the conditions compromise lung function and performance. However, plenty of time exists to identify susceptible athletes and to create pro-active plans which may be effective in alleviating the impact of pollution and sustaining quality of performance.

Quick Fact: 4-10% of the general population experience symptoms of exercise-induced Bronchospasm; in athletes this can be as high as 20-30%

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Potential strategies to deal with pollution

- Identify athletes belonging to sensitive sub-groups by clinically evaluating them with a eucapnic voluntary hyperpnoea (EVH) test or pharmaceutical challenge (methacholine/histamine). These are a non-exercising challenge protocols accepted by the World Anti-Doping Agency (WADA) as confirmation that an athlete has EIB (exercise induced bronchospasm). This test is available through the Canadian Sport Centre Pacific Performance Lab.
- Ensure appropriate athlete Therapeutic Use Exemptions (TUE) are in place
- Baseline data should be collected for all teams/athletes prior to and during pre-games trips to Beijing to determine susceptible individuals
- When athletes are in Beijing, monitor air quality daily and adjust timing and/or location of training if necessary (morning is typically best)
- Avoid contact with second-hand smoke as it contains carbon monoxide which binds to hemoglobin and can reduce oxygen carrying capacity by 3% which translates to a 3-4% decrement in VO₂max. Carbon monoxide is also slow to leave the system, i.e. need to breathe clean air for eight hours!

Dietary supplements

Air pollutants are toxic to the lung and have the common feature of causing oxidative stress. Oxidative stress occurs when there is an imbalance between oxidants (or free-radicals) and antioxidants. The damage arising from the abnormal oxidative activity causes inflammation and altered lung function including increased non-specific airway hyper responsiveness and increased airway resistance. It has been suggested that boosting dietary antioxidant intake (vitamin E and C, pro-vitamin β -carotene) may elevate the plasma concentrations of these antioxidants above the normal range yielding a protective effect. Dietary fish oil supplementation has also been suggested to have a protective effect on suppressing exercise induced bronchoconstriction in elite athletes due to its anti-inflammatory properties. Responses to dietary supplements are likely variable between individuals and the effects on performance have not yet been well documented. Thus, a pro-active approach would be to evaluate in 2007 how some anti-oxidants may attenuate compromised lung function while in Beijing.

We do not want to panic, but historically the air quality in Beijing is poor and this pollution presents respiratory challenges for athletes. Though we are not entirely sure of the effects of pollution on elite athletes or just how polluted the conditions in Beijing will be we can hope for the best but should be prepared for the worst. Talk with your PacificSport physiologists to determine what strategies will be optimal for you.



Construction of the Bird's Nest Stadium through the haze.

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