How to minimize infection risk in athletes?

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Outline

- Do elite athletes have a better immunity?
- Brief introduction to the immune system
- Exercise and the risk of infection?
- How does heavy exercise affect immunity?
- How to prevent infection?
Elite athletes with better immunity?

New Asian Queen of ultra-marathon
What’s happened?

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Normal circulation

Inflammation
Acute inflammation

Mechanisms against infections
White blood cells

Immunity

Antigen Processing
Macrophage
T cell
B cell
Bacteria

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**Cellular immunity**

- Pathogen engulfed by macrophage.
- Macrophage displays antigens on surface and stimulates T cell.
- Helper T cell stimulates cytotoxic T cell.
- Cytotoxic T cell attacks infected cells.
- Foreign antigen and perforin induced lesion.
- Infected cell lyses.

**Humoral immunity**

1. Pathogens enter tissues through a wound.
2. Attacked by macrophages at the infected site.
3. Antigens of the pathogens are displayed on the surface of the macrophage.
4. Helper T cells have receptors that recognize and bind to the antigens on the macrophage.
5. Most plasma cells secrete antibodies that bind to antigens on infected cells.
6. Each plasma cell secretes more than 2000 antibodies per second in the blood. Memory B cells and antibodies remain in the blood and respond to future invasions by the same pathogens.
7. B cells can bind to antibodies directly.
8. B cells help T cells bind to antigens on B cells.
9. T cells release chemicals that cause B cells to produce clones of plasma cells.
The Th1/Th2 cytokine balance

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Are athletes susceptible to infection?

- Respiratory infections seemed to progress toward pneumonia after intense exercise and competitive sport (Cowles, 1918).
- Some athletes experience high rates of certain illness, such as infectious
  - Mononucleosis (Foster et al. 1982)
  - Upper respiratory tract infection (URTI; e.g. common cold, sore throat, middle ear infection) (Douglas and Hason 1978).

Is URTI popularly happened in athletes?

- Up to 47% during the two weeks after a 56-km ultramarathon (Peter and Bateman 1983)
- 40% of marathon runners in the two months before and 12% of runners in the week after a marathon (Nieman et al 1990)
- 68% of runners after a 90-km ultramarathon (Peters et al. 1993)
- 50% of runners in the week after a marathon (Castell et al. 1996)
- 40% of elite swimmers during four weeks of intensified training (Mackinnon and Hopper 1996).
Athletes & better immunity? _ 1

Runners reporting URTI symptoms

Percentage of runners reporting episodes of upper respiratory tract infection (URTI) during the week after the 1987 Los Angeles Marathon (Nieman et al. 1990)

Athletes & better immunity? _ 2

Training load & relative risk of URTI

Training load (running distance per week) and relative risk of upper respiratory tract infection (URTI) in the two months prior to the 1987 Los Angeles Marathon (Nieman et al. 1990)
Exerciser and stretchers reporting either 0, 1, 2 or 3 episodes of cold infection over the 12-month observation period (Chubak et al. 2006)

Total number of days with upper respiratory symptoms (URS) over the 12-week observation period across physical fitness and exercise frequency tertile (Nieman et al. 2011)
The number of days with symptoms of URTI in a group of mildly obese, young women randomly assigned to either 15 weeks on moderate exercise training or no exercise. The exercise group participated in brisk walking training for 45 min, 5 days a week at 60% HRR. (Nieman et al. 1990)

Relative risk of upper respiratory tract infection (URTI) across habitual physical activity quartiles (Matthews et al. 2002)
Regular moderate Ex & URTI?  

**EX and immune responses**

The cumulative skin test score in a group of triathletes following a triathlon race, and, a group of triathletes who did not compete in the race and a group of moderately trained individuals (Bruunsgaard et al. 1997)

**J-shaped model _ EX & URTI risk**

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Factors contribute to incidence _1

Prolonged (> 90 minutes) hard bouts of exercise may depress immune function

- Blood glucose ↓
- Muscle glycogen ↓
- Interleukin-6 ↑
- Stress hormones ↑
- Free radicals ↑

Depression of immune cell functions

Increased risk of infection

Factors contribute to incidence _2

Factors contributing to increased susceptibility to infection in athletes

- Increased exposure to pathogens
  - Lung ventilation
  - Skin abrasions
  - Foreign travel
  - Crowds

- Physiological stress
- Psychological stress
- Environmental stress
- Lack of sleep
- Inappropriate Diet

Increased susceptibility to infection

Immunodepression
Open window hypothesis


How long is the window opened?  

How long is the window opened? _ 2


How long is the window opened? _ 3

Outline

Do elite athletes have a better immunity?

Brief introduction to the immune system

Exercise and the risk of infection?

How does heavy exercise affect immunity?

How to prevent infection?

Does acute illness affect performance?

- In athletes, decrements in performance have been associated with
  - Subclinical viral infection and prolonged recovery after viral infection (Maffulli et al. 1993)
  - Aerobic exercise capacity during prolonged submaximal work (Danial et al., 1985)
  - Muscular strength (Danial et al., 1985; Friman et al. 1977).
- Protein degradation and impairments of protein synthesis or energy metabolism during illness may limit exercise capacity as well as long-term adaptations to exercise training (Friman and Ilback 1992).
Are there practical considerations?

- Illness needs time to recover.
- Impaired strength and exercise capacity during viral infection may lead to musculoskeletal injury in athletes who attempt to continue training at high intensity during illness (Simon 1987).
- Viral illness with systemic involvement (e.g. fatigue, fever, muscle aches, enlarged lymph nodes) requires one month for complete recovery before resumption to intense training (Roberts 1986).
- Above the neck rule (Budgett 1990).
  - Symptoms above the neck: continue EX and reduce workload
  - Symptoms below the neck: stop EX

How to prevent infection? _ 1

- Avoid sick people
- Awareness of vulnerability
- Minimise infectious agents
- Good personal hygiene
- Avoid getting a dry mouth
- Never share drink bottles
How to prevent infection? _ 2

Avoid training > 2 h

Minimize immuno-suppression

6% CHO drinks 2.5ml/kg/20min

Monitor mood fatigue & soreness

Balanced diet

Adequate sleep > 7 h

How to prevent infection? _ 3

EX tolerance is reduced

Training & infection

Isolate infected team member

Increase severity duration

Decrease training volume

Above the neck principle
How to fill in URTI questionnaire

- Do you think that you are suffering from a common cold or flu today?
  - Fill in the circle if your answer is YES ○
  - If yes, please complete all the questions below:
  - Please indicate your response by filling in one circle for each of the following symptoms:

How to interpret

- No symptom=0, mild symptom=1, moderate symptom=2, severe symptom=3
- First criterion: any consecutive two-day total symptom score > 14.
- Second criterion: fill the first circle $\geq$ 3 consecutive days.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>None at all</th>
<th>Degree of discomfort</th>
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<tbody>
<tr>
<td></td>
<td>Mild</td>
<td>Moderate</td>
</tr>
<tr>
<td>Sneezing</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Headache</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Malaise (feeling generally unwell)</td>
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<td>○</td>
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<tr>
<td>Nasal discharge (runny nose)</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Nasal obstruction (blocked nose)</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Sore throat</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Cough</td>
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<tr>
<td>Chilliness</td>
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感謝聆聽

Q & A

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