Reducing the effects of airline travel

Troy Flanagan, USSA Sport Science
INTRODUCTION

1. What exactly is going on inside the aircraft cabin?
2. What does this do to your athletes’ bodies when they fly?
3. How do you minimize the effects of air travel?
What exactly is going on inside the aircraft cabin?

THE ENVIRONMENT
**Pressure and Oxygen**

- Large planes usually fly at 30,000 ft
- Decreased pressure = hypoxic environment
- Cabin pressure is set by the crew/automated
- Cabin pressure reduces the partial pressure of oxygen = equivalent to you standing at 10,000 ft
- This reduces your levels of oxygen down in your blood to ~93%
Temperature & Humidity

• Humidity in the cabin is between 5-20% &
• Temperature has been found to range between 17.4–26.8°C (24 flights)
• Humidity = ground air + passenger vapor
• Humidity decreases as the flight goes on

CO₂

• CO₂ is primarily from passengers
• Higher than health standards recommend for buildings, but not a significant problem
Ozone

- Ozone is at its highest concentration at 30,000 ft
- May come into the cabin if there is no carbon filter
- Particularly during storms
- New Scientist, 2008:

William Nazaroff of the University of California at Berkeley in the US and colleagues monitored ozone levels on 76 international and domestic flights. On four domestic flights, ozone levels exceeded federal limits of 100 parts per billion.”

“international flights did not get anywhere near federal limits”
Cabin air ventilation:

1. Outside air continuously enters engine where it is compressed. It then passes through cooling packs to a mixing chamber.

2. Outside air entering the mixing chamber is mixed with recirculated air that has been cleaned with high efficiency filters. The filters are similar to those used in critical wards of hospitals. The makeup of air in the mixing chamber is approximately 50% outside, 50% recirculated.

3. Air from the mixing chamber is then supplied to the cabin from overhead outlets on a continuous basis.

4. As outside air enters the airplane, it is being continuously exhausted.
Airborne Germs

- Bacteria, viruses and fungi
- Sources = ground air + crew + passengers
- Temperature and humidity affects levels of contaminants
- Low humidity is better for viruses
- Newer recirculating air systems remove less viruses these days
- (HEPA filters remove particles down to 0.3 microns – viruses range from 0.01 – 0.5 microns)
What does this do to your athlete’s bodies when they fly?

THE EFFECTS
Humidity:
Dehydration
Upper respiratory Tract Irritation

Pressure:
Respiratory Alkalosis
Loss of sodium from body
Reduced ability to stay hydrated

Infection:
Primarily viral and common cold

Immobility:
Stiffness
Less blood flow

Ozone:
Respiratory Immune system
(less likely)
How do you minimize the effects of air travel?

STRATEGIES
Humidity:
- Pre Flight Hydration
- During Flight Hydration

Pressure:
- Sodium Supplementation prior to and during the flight

Infection:
- Immune system supplements
- Taper prior training prior to flight
- Keep warm
- Sleep (time zone)

Immobility:
- Stretching
- Walking
- Compression garments

Nutrition:
- Healthy Snacks
Supplements

Strategy:
Sodium Supplementation

Immune boosters:
Multivitamin
Avoid!

- Caffeine Products
- Alcohol
- Excessive Water Consumption
- Sleeping Tablets (DVT risk)
QUESTIONS
Minimizing the effects of Jetlag

Lesli Shooter
USSA Sport Science
How does it occur?
What are some symptoms?
What can be done to minimize the negative effects?

JETLAG
What is jetlag?

- The effect of traveling through time zones on the body's natural biorhythms.
- Circadian rhythms: body temperature regulation, endocrine (gland and hormone) function, airway function, and kidney (renal) function.
- Suprachiasmatic nucleus.
6pm – Urine Output Peaks

9pm, Pain Sensitivity Heightens

2am, Hormonal Levels Rise

Noon, HR, Blood Pressure Increase

6am, HR, Blood Pressure Increase

3pm, Respiratory Rate Peaks

4pm, Body Temp Blood Pressure Rise
Recognize the Symptoms

- Drowsiness during the day at new local time
- Trouble sleeping at night
- Feeling less able to concentrate or motivate oneself
- Irritability
- Headaches
- Stomachaches
- Minor coordination problems and reduced physical performance
- Loss of appetite and general bowel irregularities
“Feelings” of jetlag are related to:

- Sleep deprivation
- Dehydration
- Stasis
- Altered, inadequate or problematic food provision
- Altered biorhythms resulting in upset sleep patterns altered hormonal production, liver function, etc
Minimize the effects

- Understand what is happening
- Take preventative measures:
  - Before the journey
  - During the flight
  - Upon reaching your destination
Before the Journey

- **Plan** for travel well in advance to reduce stress
- **Sleep** as normal or a little more if possible
- Adopt a **positive mental attitude** before getting on the plane (“passive” mindset)
- **Hydrate** prior to check-in (48 hr prior)
- **Eat well** prior to departure and avoid heavy or “unknown” foods
- Perform low intensity **exercise** within 24 hr prior to departure
- Arrange for any stopover to be **comfortable**
During the Flight

- Take some **roughage** (e.g. apples) to eat
- Drink 8-16 oz of water or fruit juice **per hour of flight**
- Change watch to **time at destination**
- Retain a **positive attitude**
- Seating
- Earplugs / eyeshades
Upon Arrival

- **Hydrate!**
- **Adjust mealtimes** to destination time (avoid spicy meals)
- Perform some **light aerobic exercise outside**
- **Avoid heavy training** for first couple of days but **stay active** during the day
- **Avoid caffeine** after midday for first 2 – 3 days
- **Stay awake** until 9pm local time
- **Avoid sleeping** during the day (limit naps < 60min)
- **Socialize** and fit in with local time
- **Keep curtains slightly open** in hotel room for light
Understand what is happening to you
Don’t let it get to you
Take all of the preventative measures you can

REVIEW
QUESTIONS?
Reducing the effects of altitude

Justin Carlstrom, USSA Sport Science
Recovery and Altitude

I. Definitions
II. Acute Effects
III. Chronic Effects
IV. Training/Competing
V. Monitoring Athletes
VI. Implications and Suggestions
**What elevation is “altitude?”**

<table>
<thead>
<tr>
<th>Partial pressure of oxygen</th>
<th>Death Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9,000 m (29,527 ft)</td>
</tr>
<tr>
<td></td>
<td>8,000 m (26,246)</td>
</tr>
<tr>
<td>Limiting factor of exercise</td>
<td>7,000 m (22,965 ft)</td>
</tr>
<tr>
<td></td>
<td>6,000 m (19,685 ft)</td>
</tr>
<tr>
<td>&gt; 3000 ft performance can suffer</td>
<td>5,000 m (16,404 ft)</td>
</tr>
<tr>
<td></td>
<td>4,000 m (13,123 ft)</td>
</tr>
<tr>
<td></td>
<td>3,000 m (9,842 ft)</td>
</tr>
<tr>
<td></td>
<td>2,000 m (6,561 ft)</td>
</tr>
<tr>
<td></td>
<td>1,000 m (3,280 ft)</td>
</tr>
<tr>
<td></td>
<td>0 m</td>
</tr>
</tbody>
</table>

**Extreme Altitude**

**Very High**

**High Altitude**

**Sea Level**

- Partial pressure of oxygen
- Limiting factor of exercise
- > 3000 ft performance can suffer
↑Altitude = ↓\( P_iO_2 = \downarrow O_2 \) saturation
What are the acute/immediate effects?

- Breathing rate increases
- Dehydration
- Appetite suppression
- Sleep disturbances
What are the acute/immediate effects?

Altitude = \( \downarrow P_iO_2 \)

- Hypoxia
- Increased Neural Stimulation
- Increased Breathing Rate
- \( \uparrow \) Excretion of bicarbonate and ammonium
  - \( \uparrow \) Excretion of water
  - \( \uparrow \) Dehydration

Sleep Disturbances
What are the chronic/long term effects?

- Increased RBC production
- Increased buffering capacity
  - Iron
  - Protein
  - Calories
  - Fluids
- Fatigue
- Muscle atrophy

4-6 weeks
Recommendations for training/competing at altitude

Prior to travel:
• Acclimatization (4 weeks)
• Rested and healthy
• Iron status
• Hydration

Upon arrival:
• Train smart, recover well
• Increase fluid intake
• Increase caloric intake
Monitor athletes while training/competing at altitude

- O2 Saturation
- Heart Rate
- Diary (1 – 5)
  - Sleep (amount/quality)
  - Diet
  - Soreness
  - Physical
  - Mental
- Urine?
- Responders/Non-responders
## Summary of responses to altitude

<table>
<thead>
<tr>
<th></th>
<th>Acute</th>
<th>Chronic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Respiratory</strong></td>
<td>↑ breathing</td>
<td>↑ breathing (stabilized)</td>
</tr>
<tr>
<td></td>
<td>↓ Hb saturation</td>
<td>↓ Hb saturation (stabilized)</td>
</tr>
<tr>
<td></td>
<td>↓ Blood-tissue diffusion</td>
<td>↓ Blood-tissue diffusion</td>
</tr>
<tr>
<td><strong>Cardiovascular</strong></td>
<td>≤ Submax SV</td>
<td>↓ SV</td>
</tr>
<tr>
<td></td>
<td>↑ Submax HR</td>
<td>↑ Submax HR</td>
</tr>
<tr>
<td></td>
<td>↑ Submax CO</td>
<td>↓ Submax CO</td>
</tr>
<tr>
<td></td>
<td>↓ Max HR</td>
<td>↓ Max HR</td>
</tr>
<tr>
<td><strong>Hematologic</strong></td>
<td>↓ Plasma Volume</td>
<td>PV remains decreased</td>
</tr>
<tr>
<td></td>
<td>↑ Hematocrit</td>
<td>↑ RBC production</td>
</tr>
<tr>
<td></td>
<td>↑ Viscosity</td>
<td>No change</td>
</tr>
<tr>
<td><strong>Metabolic</strong></td>
<td>↑ Lactate at given wkld</td>
<td>↓ Submax lactate</td>
</tr>
<tr>
<td></td>
<td>↓ Lactate at max</td>
<td>↓ Lactate at max</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td>↓ VO₂ max</td>
<td>↓ VO₂ max</td>
</tr>
</tbody>
</table>
What can we do?

- **Hydration**
  - Prior to arrival
  - Upon arrival
- **Nutrition**
  - Calories
  - Protein
  - Iron supplementation
- **Rest and Recovery**
- **Sleep**
- **Monitor and adjust training**
QUESTIONS?
Altitude as an Ergogenic Aid

- Live High/Train Low
- What are the options?
  - Terrestrial
  - Room conversions/tents
  - Intermittent Hypoxic Training
  - Hyperoxic Training
Summary of Best Practices

Stage One: Prior to using “altitude”

1. Two weeks of HR and O2 sat monitoring
2. Full blood test
   - CBC
   - Metabolic profile
   - Zinc
   - Vit B12
   - Cortisol
   - Testosterone
   - Creatine Kinase
3. Athlete must be:
   - Healthy
   - No signs of excessive fatigue
   - Normal blood test
   - Normal response to training for at least 2 weeks
Summary of Best Practices

Stage Two: Acclimatization to Training & Altitude at Night
1. 4 weeks to introduce the tent progressively and monitor response
2. Increase normal hydration by 500mL – 1L
3. Based on blood tests, supplement with iron
4. Increase protein by 10% and overall cals/CHO by 10%
5. Record daily log and training log

Stage Three: Continued Monitoring Recommendation During Tent Use
1. Record first morning HR, O2 sat, illness/injury logs
2. Once/week, record HR for one full night of sleep (hard and easy day)
3. Adjust training as needed