After the 2-Minute Step Test in Athletes with Intellectual Disability

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Normative ranges for oxygen saturation (O2Sat) have been established for individuals:
- In good health
- Of various ages
- With several disease conditions

O2Sat has not been routinely documented in persons with intellectual disability (ID) unless they have a disease condition which would predicate its assessment.
Specific Aim

- To evaluate O2Sat in Special Olympics athletes for and following a submaximal exercise test
- To assess changes in O2Sat across:
  - Age
  - Gender
  - Sport Intensity
  - Special Olympics (SO) Global Region
  - Country Development Level
  - Level of competition (World vs Non-World Games)
Oxygen saturation (O2Sat) levels measure the degree to which hemoglobin contained in the red blood cells has bonded with oxygen molecules that have been taken in by the lungs.

- This is a measure of oxygen available in blood that is deliverable to organs and tissues.

- Available oxygen allows the body to perform necessary functions most effectively and efficiently.
• Arterial blood gases (ABG) is a direct measure of how efficiently the lungs are bringing oxygen into the blood stream and removing carbon dioxide.
  • ABGs are an invasive test with blood being drawn from an artery.

• Pulse oximetry is an indirect measure of O2Sat.
  • This process is noninvasive and painless.
  • A finger is inserted into a device where a red light measures the redness of the blood pulsing through.
  • The oximeter measures the hemoglobin providing a MEAN SATURATION PERCENTAGE (SPo2).
Methods

• If O2Sat is LOW:
  • Hypoxemia occurs
  • Body cannot get enough O2 to function
  • This low O2 can cause illness and tissue death

• Common causes of hypoxemia (low O2Sat):
  • Anemia
  • Pneumonia
  • Lung Disease

• Some environmental conditions change O2Sat:
  • Altitude will LOWER O2Sat
  • Strenuous exercise will ELEVATE O2Sat
• The submaximal stress test utilized was the 2-Minute Step in Place test.

• This test is a standard test in Healthy Athletes FUNfitness.
• This test is performed by physical therapists (PTs), or students of physical therapy under the direction of a PT.
• O2Sat was measured in the seated position.
  • Immediately prior to the exercise test to set a baseline
  • Immediate post-exercise test to note impact of testing
  • 2 minutes post-exercise test to assess recovery

• Fingertip pulse oximetry was used to measure O2Sat.
Methods

- A Decision Tree developed by FUNfitness Team and SO Medical Director guided decisions regarding those whose O2Sat was below 95%.

Is O2 Saturation 95% or GREATER?
  - Yes: Continue with Aerobic Testing
  - No: Is O2 Saturation between 90-94%?
    - Yes: Complete Referral Form AND send to Games Medical Team for assessment
    - No: Is athlete exhibiting signs or symptoms of respiratory distress or hypoxemia (shortness of breath, cyanosis, restlessness, coughing, wheezing, stupor, dizziness, apnea, Cheyne-Stokes respiration, increased blood pressure, tachycardia)
    - Yes: Continue Aerobic Test but monitor O2 Saturation
    - No: Continue Aerobic Test but monitor O2 Saturation
Methods

• The Step Test was performed by 34,175 athletes

• The O2Sat values were recorded between 2007-2015 at World Games events

• Athletes ranged in age from < 20 years to > 61 years
Findings:
O2Sat by Gender/Age

• No significant differences in O2Sat was noted by gender for pre, post, or 2 minute post readings

• All readings were consistent across age until 40 years.
• Readings began to decline >41 years, but declined more steeply >61 years.

• The Odds of readings <95% were 3x greater for athletes >61 years
## Findings: O2Sat by AGE

### Pre-exercise O2Sat

<table>
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<tr>
<th>%</th>
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### Post-Exercise O2Sat

#### Final o2 saturation

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### 2 Minute Post O2Sat

#### Post-exercise o2 saturation

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<td>23</td>
<td>4.7%</td>
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</table>
Findings: O2Sat by Sport Intensity

• LIGHT, MEDIUM, OR HARD levels of intensity were defined by:
  • Research literature of CDC and ACSM
  • Ratio of exercise metabolic rate (MET) charts
    • Light < 3.0 METs
    • Medium 3.0 – 6.0 METs
    • Hard > 6.0 METs
  • Expert input by Sports Department staff

• Level of intensity had no significant influence on the O2Sat.
Findings:
O2Sat by SO Region

• The percentage of athletes with readings >95% was highest (91-96% of readings) in East Asia, Europe Eurasia, Middle East North Africa, North America.

• Percentages were lower in:
  • Asia Pacific (87-89%)
  • Africa (80-84%)
  • Latin America (75-80%)
Findings: O2Sat by SO Region

- Odds of <95% results of East Asia compared to Latin American athletes were:
  - Pre x8 higher odds
  - Post and 2 minute post were x5-7 higher odds

- Country developmental level mirrored Regional differences
  - Odds of readings <95% were 2x higher for athletes in low income countries
Findings: Participation Level (World vs. Non-World Games)

• World Games athletes had higher percentages of O2Sat (>95%) for all readings (93.1% -100%).

• Non-World Game athletes has lower percentages of all readings >95% (79.7% -93.7%).

• Non-World Game athletes also demonstrated greater declines in O2Sat with age, especially over the age of 61 years.
Findings: PRE EXERCISE
O2Sat and Participation Level

O2 Saturation Level among World Games Participants

- Potentially Hypoxic
- Low Oxygen Saturation
- Healthy

O2 Saturation Level among Non-World Games Participants

- Potentially Hypoxic
- Low Oxygen Saturation
- Healthy
Findings: POST EXERCISE O2Sat and Participation Level

O2 Saturation Level among World Games Participants

- Potentially Hypoxic
- Low Oxygen Saturation
- Healthy

O2 Saturation Level among Non-World Games Participants

- Potentially Hypoxic
- Low Oxygen Saturation
- Healthy
Findings: 2 Min POST EXERCISE O2Sat and Participation Level

O2 Saturation Level among World Games Participants

O2 Saturation Level among Non-World Games Participants

Potentially Hypoxic
Low Oxygen Saturation
Healthy

Findings: 2 Min POST EXERCISE O2Sat and Participation Level
Discussion - AGING

• Age did impact O2Sat, especially >61 years.

• In a healthy aging population at low or moderate altitude, O2Sat is in the lower levels of normal (94-100%).

• Age appeared to have a more significant impact on O2Sat in SO athletes than the general population.
• Region and country developmental level negatively impact O2Sat

• This information is not clear for the general population vs. those with ID

• Socioeconomic or environmental factors may play a larger role in these negative differences than the diagnosis of ID.
Discussion – PARTICIPATION LEVEL

• World Games athletes had higher values than Non-World Games athletes for all readings.

• Research in the general population suggests that training improves muscle efficiency, which might impact the utilization of available oxygen.

• This suggests that World Games athletes might be more fit and trained than Non-world Games athletes.

• These facts suggest the positive and protective impact of training and fitness on maintenance of O2Sat in all persons of any age.
• O2Sat dropped slightly immediately after exercise
  • This was noted ONLY in low and moderate exercise
  • In higher intensity exercise, O2Sat remained the same

• However, O2Sat recovered to levels higher than pre-exercise by 2 minutes post exercise.
  • Rates at 2 minutes post exercise >95% were 2% higher in all levels of exercise.

• These findings are consistent with patterns noted in those without ID suggesting that moderate to higher intensity exercise boosts O2Sat following exercise.
Discussion – SPORT INTENSITY

• Those with O2Sat <90 % maintained consistent values pre, post and 2 minutes post exercise regardless of exercise intensity.

• Respiratory disease is a common underlying cause of morbidity and mortality in persons with ID.
  • These lead to reduced exercise tolerance and QOL
  • There is also greater cardiorespiratory risk with exercise

• These complications can be exacerbated by exercise, suggesting the need for precautionary measures for those with cardiorespiratory conditions in performance of higher intensity exercise.
Discussion

• Limitations
  • Inconsistent exercise intensity during the Step Test.
  • No knowledge of medical conditions or diagnoses.
  • Confounded by other variables such as age and region.
  • Possible effects of altitude.

• Further Research Suggested
  • Impact of higher intensity exercise on O2Sat in those with ID.
  • Impact of moderate and high intensity exercise in persons with ID related to age and region.
Acknowledgements

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