New Data for an Updated Youth Compendium

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Overview

- Compendia History
- Compendium Challenges in Youth
- JPAH Special Issue
- Research Highlights
- Future Directions
Mission: accelerate progress in reducing childhood obesity

A partnership of 4 leading research funders to address the problem of childhood obesity in America.

- Centers for Disease Control and Prevention (CDC)
- National Institutes of Health (NIH)
- Robert Wood Johnson Foundation (RWJF)
- U.S. Department of Agriculture (USDA)

www.nccor.org
Developed for epidemiologic studies

- **1987-1989:** First used in SAFE Study (U of MN)
- **1993:** Version 1 published (468 activities)
- **2000:** Version 2 published (604 activities)
- **2008:** Youth Compendium published (244 activities)
- **2011:** Version 3 published (821 activities)
- **2012:** YEE Working Group
- **2016:** Youth Compendium: JPAH Special Issue

1. Determine unit of energy cost to be used in Youth Compendium and how to handle age-related changes in energy expenditure

2. Obtain new energy expenditure values from existing published literature

3. Obtain new energy expenditure values from new and unpublished data
Which energy expenditure metric should be used?
Resting Metabolic Rates of Children 4-17 y of age

- Each data point represents a mean & SD for one of 79 studies of children.
- Data from Robert McMurray

RMR = 3.6887 - 0.978ln(age)
R² = 0.5781
Challenges in the Youth Compendium

- 65% of youth compendium values were based on adult data.

- Adult MET vs. Youth MET
  - **Adult MET:**
    - \( RMR = 3.5 \text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} = (1.0 \text{ kcal} \cdot \text{kg}^{-1} \cdot \text{h}^{-1}) \)
  
  - **Youth MET:**
    - \( RMR = \text{Activity energy expenditure/measured resting energy expenditure} \)
    - \( RMR = \text{Activity energy expenditure/Schofield equation estimate} \)
Exploring Metrics for Express Energy Expenditure of Physical Activity in Youth (McMurray et al, 2015)

http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130869
What new data are available from published studies?
Systematic Literature Review

• Dr. Kate Ridley (first author of 2008 Youth Compendium) led this project.

• Goals
  • locate published studies
    • Before & after 2008 Compendium
  • widen the age range to all children and adolescents aged < 18 y
  • expand the databases used to search for relevant studies.
Systematic Literature Review

- 2 searches
  - (CINAHL; Cochrane library; EMBASE; Medline; Proquest; PsychINFO; SCOPUS; SportDiscus; and Web of Science)

- Searches returned 18,513 and 3,408 hits
  - 11,606 after duplicates removed
  - All abstracts were reviewed for inclusion/exclusion
    - Authors were contacted for clarification and missing data as needed.
  - $n = 91$ studies included for data synthesis

- Descriptive and quantitative data were extracted from full text

- Quality Assurance
  - ~40% of studies were double coded
Systematic Literature Review

- 71 studies not included in 2008 Youth Compendium
- 347 new unique mean energy costs values

<table>
<thead>
<tr>
<th>Activity Category</th>
<th>Number of mean energy cost values</th>
<th>% of total new data points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active video games</td>
<td>79</td>
<td>22.8%</td>
</tr>
<tr>
<td>Sedentary screen time</td>
<td>61</td>
<td>17.6%</td>
</tr>
<tr>
<td>Lying/sitting/standing quietly</td>
<td>44</td>
<td>12.7%</td>
</tr>
<tr>
<td>Simulated sports/games</td>
<td>39</td>
<td>11.2%</td>
</tr>
<tr>
<td>Dance/aerobics/calisthenics/gymnastics</td>
<td>27</td>
<td>7.8%</td>
</tr>
<tr>
<td>Active outdoor play</td>
<td>18</td>
<td>5.2%</td>
</tr>
<tr>
<td>Chores</td>
<td>15</td>
<td>4.3%</td>
</tr>
<tr>
<td>Reading/writing/academic pursuits</td>
<td>15</td>
<td>4.3%</td>
</tr>
<tr>
<td>Sedentary play</td>
<td>15</td>
<td>4.3%</td>
</tr>
</tbody>
</table>

Note: remaining ~ 10% of activities spread across remaining activity categories.
How can we solicit new data?
Call for Papers

**Purpose:** To gather unpublished data to inform the updated compendium

- Call in Fall 2015
  - *Required:* Assess EE with indirect or whole-room calorimetry

- Submission deadline December 31, 2015

- Accepted: 17 manuscripts
  - From 4 countries
Highlights in the Special Issue

- ~250 activities reported
- Ages range from 3-18 y
- Sample sizes vary from 11-209 participants

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample Size</th>
<th>Age Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>5-12</td>
</tr>
<tr>
<td>2</td>
<td>28</td>
<td>3-6</td>
</tr>
<tr>
<td>3</td>
<td>37</td>
<td>5-15</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
<td>3-6</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>27</td>
<td>9-11</td>
</tr>
<tr>
<td>7</td>
<td>24</td>
<td>10-17</td>
</tr>
<tr>
<td>8</td>
<td>105</td>
<td>7-13</td>
</tr>
<tr>
<td>9</td>
<td>28</td>
<td>10-11</td>
</tr>
<tr>
<td>10</td>
<td>36</td>
<td>9-18</td>
</tr>
<tr>
<td>11</td>
<td>119</td>
<td>3-5</td>
</tr>
<tr>
<td>12</td>
<td>53</td>
<td>9-15.5</td>
</tr>
<tr>
<td>13</td>
<td>178</td>
<td>8-18</td>
</tr>
<tr>
<td>14</td>
<td>106</td>
<td>6-18</td>
</tr>
<tr>
<td>15</td>
<td>32</td>
<td>4th-5th grade</td>
</tr>
<tr>
<td>16</td>
<td>209</td>
<td>6-18</td>
</tr>
<tr>
<td>17</td>
<td>57</td>
<td>5-12</td>
</tr>
</tbody>
</table>
Summary: Special Issue

• 3 studies included preschool-age youth (3-6 years)
  (Byun et al.; Großeck et al.; Puyau et al.)
  • Active video games
  • ball toss
  • standing art
  • tablet activity
  • cleaning up
  • treasure hunt
  • bicycle riding

• obstacle course
  • soccer
  • shooting baskets
  • puzzles
  • dance

• Some studies included a wide age range
  (Clevenger et al.; Ondrak & McMurray; Sasaki et al.; Schuna et al.; Trost et al.)
  • Trost et al. examined longitudinal modeling of energy expenditure
Summary: Special Issue

Trost et al., Developmental Trends in the Energy Cost of Physical Activities Performed by Youth.
Summary: Special Issue

- Wide range of activities covered
  - Sasaki et al. included 70 activities, many of which were children’s games
    - (e.g., Capture the Flag, Steal the Bacon, Monkey in the Middle, Scatter Ball)
  - Tennis practice and matches (Ondrak & McMurray)
  - Rollerblading and riding a scooter (Ridley & Olds)
  - Relay races (Clevenger et al.)
Summary: Special Issue

- Wide range of activities covered (cont’d.)
  - Radio gymnastics (Gao et al.)
  - Hopscotch (Innerd and Azevedo)
  - Playground games (MacIntosh et al.)
  - Hand weight exercises (Lee et al.)
  - Different playing modes of active video games (Barkman et al.)
Summary: Special Issue

- Different types of sedentary activities
  - Classroom instruction (Honas et al.)
  - Board games (Sasaki et al.)
  - Drawing (Innerd & Azevedo)
  - Reading (Lee et al.)
  - Playing handheld e-game (van Loo et al.)
  - Coloring (Schuna et al.)
  - Sorting beads and telephoning (Lau et al.)
Summary: Special Issue

- Different types of study purpose
  - Comparison of sex, age, and body size patterns in energy expenditure (Lee et al.)
  - Predictive validity of the ActivPal monitor (van Loo et al.)
  - Examination of classroom-based physical activity (Honas et al.)
Important Findings

1. Sedentary and low-intensity activities: Energy cost remained stable across age

2. Moderate-to-vigorous activities: Energy cost increased with age

3. Activities relying on motor skill performance or motivation: Energy cost varied with age

4. Sex differences in energy cost were often not apparent

5. BMI differences may play a role in energy cost for some activities
Working Group: Current Status

- Completed tasks
  - Chose a metric
    - Youth MET
  - Literature review

- Tasks underway
  - Determining best method to account for age
  - Imputation project
Future Directions

- Youth Compendium will be published late 2016-early 2017?

- Missing values in age groups for some activities
  - Imputation underway to assist

- Future research
  - May need to collect data on more activities specific to particular age groups
  - Robust process must be in place
<table>
<thead>
<tr>
<th>Activity</th>
<th>METs by Age Group&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6-9 years</td>
</tr>
<tr>
<td><strong>Sedentary</strong></td>
<td></td>
</tr>
<tr>
<td>Computer games</td>
<td>1.44</td>
</tr>
<tr>
<td>Television viewing</td>
<td>1.16</td>
</tr>
<tr>
<td><strong>Light-intensity</strong></td>
<td></td>
</tr>
<tr>
<td>Housework</td>
<td>2.92</td>
</tr>
<tr>
<td>Sweeping</td>
<td>3.44</td>
</tr>
<tr>
<td>Wii® Play</td>
<td>2.59</td>
</tr>
<tr>
<td><strong>Non-weight bearing</strong></td>
<td></td>
</tr>
<tr>
<td>Cycling ~10 mph</td>
<td>4.75</td>
</tr>
<tr>
<td><strong>Moderate- to vigorous-intensity</strong></td>
<td></td>
</tr>
<tr>
<td>Aerobics</td>
<td>3.38</td>
</tr>
<tr>
<td>Dance</td>
<td>3.19</td>
</tr>
<tr>
<td>Walk - 2 mph</td>
<td>3.34</td>
</tr>
<tr>
<td>Run - 4 mph</td>
<td>6.89</td>
</tr>
<tr>
<td><strong>Skilled</strong></td>
<td></td>
</tr>
<tr>
<td>Basketball</td>
<td>5.79</td>
</tr>
<tr>
<td>Rope Skipping</td>
<td>7.01</td>
</tr>
<tr>
<td><strong>ACTIVITY X</strong></td>
<td>3.75</td>
</tr>
</tbody>
</table>
**The Working Group**

**The Working Group on Youth Energy Expenditure:**
- Barbara Ainsworth, PhD, MPH (Arizona State University)
- David Bassett, PhD (University of Tennessee)
- David Berrigan, PhD (NCI)
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- Scott Crouter, PhD (University of Tennessee)
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- Robert McMurray, PhD (University of North Carolina)
- Karin Pfeiffer, PhD (Michigan State University)
- Stewart Trost, PhD (Queensland University of Technology)
- Kathleen Watson, PhD (CDC).
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- Russell R. Pate (University of South Carolina)
- Anne Rodgers (Science Writer)
- Tom Rowland, MD (Baystate Children’s Hospital)
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