Monitoring Energy Cost Using a Wireless Patch Type Sensor Module with Embedded Algorithm

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Outline

- Introduction
- Overview of system
  - Patch type sensor module
  - Embedded algorithm
- Experiments
  - Experiment design
  - Real-time monitoring HR and MI
- Results
- Conclusion
High technique, young adults obsessed with electronic entertainment and have very less exercise in lifestyle.

Excess body fat, will increase the risk of chronic disease.

System has considerable weight and mask required.
Methods

- Heat rate sensor
  - can be effected by emotion.

- Movement sensor
  - Not accurate on lift or cycling.

- Combined heart rate and movement sensor
  - For more accuracy.
Patch Type Sensor Module

6.6 cm by 3.7 cm, 41g
Embedded Algorithm

- Management
  - Team List
  - Member
  - Member Registration
- Monitoring
  - Select Team
  - Save Start Stop
  - Interval
  - Lab Time
  - Data Display
- Analysis
  - Calendar
  - Data View
- Setting
  - Resolution Setting
  - Picture Path
  - File Path
  - HR/MI Zone

[Image of a computer interface with data tracking and analysis features]
Experiments Design

Subject
- avoided substantial physical exercise & smoking
- after breakfast at least 1h earlier

Warm-up

Walking and running 400 meters for each test in the school playground

Recovery

HR&O$_2$-intake
# Experiment Set Up

<table>
<thead>
<tr>
<th></th>
<th>Men (n=20)</th>
<th>Women (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Range</td>
</tr>
<tr>
<td>Age (years)</td>
<td>26±2.1</td>
<td>24~27</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>169±6.7</td>
<td>167~180</td>
</tr>
<tr>
<td>Body Weight (kg)</td>
<td>65.2</td>
<td>59~70</td>
</tr>
<tr>
<td>BMI, kg·m⁻²</td>
<td>22.8±7.1</td>
<td>20.3~23.6</td>
</tr>
</tbody>
</table>
The average of HR was 102bpm during walking and 144bpm during running.

The average MI is 9.5 count·min\(^{-1}\) during walking and 49.75 count·min\(^{-1}\) during running.
Principle for caloric expenditure:

Foodstuff + O₂ ----> Heat + CO₂ + H₂O
(Indirect Calorimetry)  (Direct Calorimetry)

EE(kcal/min) = VO₂ × Energy cost of Oxygen
             (about 5kcal/liter)
Results

Bland-Altman is statistical method for assessing agreement between two methods of clinical measurement.
Conclusion

- The integrated sensor was available and reliable for estimating the physical energy expenditure in free-living environment.

- It slightly overestimates EE during walking (17.4%) and underestimates EE during running (25.2%).

- And the embedded algorithm with software has been developed.

- In future work, the verities of activities will be increased and applied to a real free-living environment.
Thank You!