Adaptive Sports: Advances in Technology and Benefits to Rehabilitation and Reintegration

Rory A. Cooper, PhD
School of Health and Rehabilitation Sciences
Department of Rehabilitation Science & Technology
And
Rehabilitation Research and Development Service
Department of Veterans Affairs
“Adversity causes some men to break, and others to break records.”

- Inscription on the gym of the U.S. Olympic Training Center

Paralympic Video
Biographical

Cooper has life back on track

By Jon Hastings

Rory Cooper, left, competing with Tim Daves in the Central Coast Marathon last December, has returned to running and studying after a near-fatal accident in Germany.

Rory Cooper was paralyzed from the chest down in an accident in Germany in March. He had just missed the 2013 Boston Marathon.

A day after the race, Cooper was in a wheelchair at the finish line of the 2013 Boston Marathon. He was one of the first runners to reach the finish line, just ahead of the number one woman in the race.

He and his wife, Beth, were watching the race when the bomb exploded. They both felt a jolt, and then the race was stopped.

Rory Cooper was taken to a hospital in Boston, where he was treated for his injuries. He quickly recovered and returned to running and studying.

Rory Cooper is a junior at the University of Pittsburgh and is majoring in psychology. He is an avid runner and has competed in several marathons, including the Boston Marathon and the New York City Marathon.

His wife, Beth, is also a runner and is a physical therapist at the University of Pittsburgh. She is training to compete in the Boston Marathon later this year.

Cooper has life back on track after a near-fatal accident in Germany.
WIDE RANGE OF ADAPTIVE SPORTS
Social Identity reconstruction

Patients “with traumatic limb loss construct new post-injury bodies and social worlds by focussing on their relationships with other patients, clinicians.”

(Messinger, 2009)

• The necessity to transition from battlefield to hospital bed.
• Keep the linkages to military affiliation alive and well to support performance. Regimental and branch ties are key to this (Peterson, 2008).
• Tendency to identify as a “person in need” will hinder return to work in the future. Not a patient, but a soldier on a mission.
• Small gestures can achieve good results.
Rehab is a stepping stone not an end in itself

• Danger of becoming an inactive service member or Veteran once rehab is completed.

• The social identity of an injured soldier will only be truly healed once he is able to be a productive member of his unit or successful as a Veteran:
  – Sport;
  – Adventure training;
  – Readiness training; and
  – Redeployment.
What do we know about living with physical impairment?

Life with impairment is affected by:

- Level or degree of impairment
- Severity or complexity of impairment
- Other medical conditions at or after injury
- Age at injury
- Duration since injury
- Family history
- Lifestyle behaviors (exercise, diet, stress, smoking, alcohol use, weight)
- Access to environmental and human services and supports (sports and recreation)
- Income and insurance
What do we know (suspect) from research?

- Exercise benefits people with physical impairment
- Health, employment, education, and income influence health and participation
- People must be engaged and motivated
- Technology and accessibility can make a large positive impact
- There are severe disparities in access to technology, programs, knowledge, and appropriate healthcare
- Sports/recreation assist with adjusting to new self-image, and promote positive perceptions by others (promote inclusion) – Do not become risk adverse.
- Sports/recreation can improve ADL/iADL skills, and communication with family/friends.
Sports and Recreation are Important Modalities of Rehabilitation

- The more our life is filled with things that interest us, the higher our satisfaction with our quality of life (Kielhofner, 1985).
- Since these volitional factors influence choice about action and behavior they have a key role in enabling an individual to adapt to disability and re-engage in life (Kielhofner, 1985).
Acceptance and Inclusion

- Recreation is a valuable strategy for inclusion in activities that are culturally valued (Buning, 1996).

- Sports and recreation creates an arena for continuing the gains of medical rehabilitation:
  - challenging personally held ideas about disability and handicap
  - testing out a new self-concept that includes acceptance of disability (Schlein et al., 1997)
Social Interaction and Athlete Development

- Sports build a sense of confidence and acceptance of disability (Cooper, 1990)
- Teamwork provides opportunities for learning about abilities and adaptations on and off the court.
Barriers to Exercise: Physical and Psychological

- Barriers Experienced by Able-Bodied
- Availability of Programs
- Availability of Equipment
- Transportation
- Accessibility
- Functional Limitations (Cardio-respiratory system)
- Psychological (Depression)
Sports and Recreation Opportunities

• Lack of opportunity and information about adaptive fitness make it more likely that these same individuals will fall to the negative health consequences of inactivity, repetitive strain injury and obesity (Taylor et al., 1998, Rimmer et al., 1996, Heath and Fentem, 1997)
Sport and Recreation Across the Life-Span

- Sports can improve cardiovascular fitness among PWD. (Cooper et al., 2001)

- Opportunities for healthy sport and recreation are expanding (slowly)

- Adapting healthy life-style including activity is important. (SCI Clinical Practice Guidelines, 2005)
PARALYMPICS

COUNTRY PARTICIPATION

ATHLETE PARTICIPATION


Number of Countries:
- 1960: 0
- 1964: 0
- 1968: 0
- 1972: 0
- 1976: 0
- 1980: 5
- 1984: 15
- 1988: 30
- 1992: 60
- 1996: 100
- 2000: 150
- 2004: 200
- 2008: 250

Number of Athletes:
- 1960: 5
- 1964: 10
- 1968: 15
- 1972: 20
- 1976: 25
- 1980: 30
- 1984: 35
- 1988: 40
- 1992: 45
- 1996: 50
- 2000: 55
- 2004: 60
- 2008: 65
National Veterans Wheelchair Games

- Started in 1981 at the Richmond, VA Medical Center.
- Largest annual wheelchair sporting event.
  - 550-600 participants each year
  - Create a model for accessibility (physical, community, accepting)

- Classes
  - Model after old ISMG and NWAA

- Divisions
  - Novice
  - Open
  - Masters
Super - G

- Premier event at NVWG
  - Qualification required
  - Open competition
- Highlight mobility skills
- Use “extreme sport” model
  - Make attractive to audience
- Set higher mobility goals
National Disabled Veterans Winter Sports Clinic

- Promote rehabilitation and reintegration through overcoming emotional, mental and physical challenges
  - Show possibilities despite and beyond their impairments
- Provide instruction for a broad range of disabilities
- Allow every participant to experience success
- Broad array of equipment available, and constant development
- Fitting and modification on-site
Warrior Games Objective

- To elevate abilities through athletic competition for wounded, injured, and ill service members and veterans by providing as focal event to empower the incorporation of athletics into military wounded warrior programs.

- The Warrior Games serve as an introduction to Paralympic sports for injured service members by inspiring recovery, physical fitness, and promoting opportunities for growth and achievement.

- Warrior Transition Unit physical activity and sports participation has increased >25% in the past three years.
Axle Manufacturer Default

Axle 2” Forward
Wheelchair Racing Technique

- Gloves
  - Soft
  - Rigid
- Wheels
  - Disc
  - Spoked
- Pushrims
  - Coating
  - Size
- Frame
  - Fit
- Steering Gear
  - Turns

- Stroke technique
  - Sprint (1st 3 strokes)
  - Turns
  - Distance (back swing)
- Drafting
  - Reduce energy ~1/3
- Passing
  - Hopping
  - Blocking
- Tactics
Shot Put
Field Events

NBC Video
## Data logging: Basketball

Mean (standard deviation) Total Distance, Speed, Stops and Starts, and Activity Time per game by Basketball Classification

<table>
<thead>
<tr>
<th>Class</th>
<th>Distance (m)</th>
<th>Speed (m/s)</th>
<th>Stops</th>
<th>Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (n=3)</td>
<td>2585.43 (1492.16)</td>
<td>1.50 (0.17)</td>
<td>210.17 (49.12)</td>
<td>30.70 (13.56)</td>
</tr>
<tr>
<td>II (n=8)</td>
<td>2768.46 (959.18)</td>
<td>1.45 (0.08)</td>
<td>240.94 (64.66)</td>
<td>31.01 (8.70)</td>
</tr>
<tr>
<td>III (n=9)</td>
<td>2631.82 (1231.86)</td>
<td>1.49 (0.19)</td>
<td>248.61 (63.60)</td>
<td>29.49 (10.23)</td>
</tr>
<tr>
<td>Overall Group Average (n=20)</td>
<td>2679.52 (1103.66)</td>
<td>1.48 (0.13)</td>
<td>239.78 (60.61)</td>
<td>30.28 (9.59)</td>
</tr>
</tbody>
</table>
# Data Logging: Rugby

Mean (standard deviation) Total Distance, Speed, Stops and Starts, and Activity Time per game by Rugby Classification

<table>
<thead>
<tr>
<th>Class</th>
<th>Distance (m)</th>
<th>Speed (m/s)</th>
<th>Stops</th>
<th>Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 (n=1)</td>
<td>2271.20</td>
<td>1.08</td>
<td>271.50</td>
<td>35.25</td>
</tr>
<tr>
<td>1.0 (n=3)</td>
<td>2406.61 (1866.40)</td>
<td>1.11 (0.24)</td>
<td>262.67 (124.34)</td>
<td>33.27 (22.07)</td>
</tr>
<tr>
<td>1.5 (n=3)</td>
<td>2713.45 (548.23)</td>
<td>1.29 (0.06)</td>
<td>285.50 (2.62)</td>
<td>34.81 (5.61)</td>
</tr>
<tr>
<td>2.0 (n=4)</td>
<td>1904.90 (975.97)</td>
<td>1.22 (0.09)</td>
<td>262.50 (114.80)</td>
<td>26.32 (14.92)</td>
</tr>
<tr>
<td>2.5 (n=2)</td>
<td>2532.40 (489.74)</td>
<td>1.30 (0.27)</td>
<td>226.00 (80.61)</td>
<td>35.52 (0.38)</td>
</tr>
<tr>
<td>3.0 (n=3)</td>
<td>2976.47 (829.48)</td>
<td>1.71 (0.21)</td>
<td>185.00 (43.99)</td>
<td>30.49 (9.94)</td>
</tr>
<tr>
<td>3.5 (n=2)</td>
<td>1660.40 (333.61)</td>
<td>1.49 (0.16)</td>
<td>197.00 (70.71)</td>
<td>19.18 (5.45)</td>
</tr>
<tr>
<td>Overall Group Average (n=18)</td>
<td>2364.78 (956.35)</td>
<td>1.33 (0.25)</td>
<td>242.61 (80.31)</td>
<td>29.98 (11.79)</td>
</tr>
</tbody>
</table>
## Comparison – Sports/Community

<table>
<thead>
<tr>
<th>Variable</th>
<th>Community Based (n=52)</th>
<th>Basketball (n=20)</th>
<th>Rugby (n=18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance (meters)</td>
<td>2457.0 (1195.7)</td>
<td>2679.52 (1103.66)</td>
<td>2364.78 (956.35)</td>
</tr>
<tr>
<td>Velocity (m/s)</td>
<td>0.79 (0.19)</td>
<td>1.48 (0.13)</td>
<td>1.33 (0.25)</td>
</tr>
<tr>
<td>Stops and Starts</td>
<td>141.8 (60.0)</td>
<td>239.78 (60.61)</td>
<td>242.61 (80.31)</td>
</tr>
<tr>
<td>Activity Time</td>
<td>8.3 (3.3) Hours</td>
<td>30.28 (9.59) Mins</td>
<td>29.98 (11.79) Mins</td>
</tr>
<tr>
<td>Data Collection Period</td>
<td>24 Hours</td>
<td>Approx. 1 Hour</td>
<td>Approx. 1 Hour</td>
</tr>
</tbody>
</table>
Reducing Risk of Repetitive Strain Injuries

- Use lightweight wheelchair that fits
- Proper wheelchair propulsion technique
  - Smooth strokes, ↓force/frequency
  - Use “semicircular”, not “arc” stroke
- Improve shoulder muscle strength/balance
- Alter transfer technique (even level, side)
- Change equipment
  - Consider power “alternatives” to wheelchair
  - Use a sliding board
- Weight reduction
Importance of Fitting
Reducing Risk of Pressure Ulcers

- Typical changes with aging can ↑risk for pressure ulcers in SCI
  - Skin becomes thinner and less flexible with age
    - Vulnerable to shear → blisters and skin breakdown
- ↓ circulation → ↓blood flow to skin
- ↓ mobility → ↓pressure relief and blood flow to weight-bearing areas

- Pressure ulcer prevention:
  - Monitor wheelchair cushion
    - Type, placement, and inflation
  - Daily skin inspections
  - Take immediate action if skin breakdown develops
  - Get adequate nutrition
  - Prevent excess moisture
  - Don’t smoke!

- Proper use of powered seat functions
Base of Support

- Wheelchair Sports (Basketball, Rugby, Racing, Field Events)
  - Scapula is base of support
    - Requires shoulder girdle strength for stabilization and power.
Cross - Training

• Muscle balance, flexibility, strength
• Wheelchair athletes
  – Racing wheelchair vs. Hand-cycle
  – Swimming
Consumer Products (Universal Design)

- Mobile Phones
- Web-Sites
- Activity Monitors
- Gym Equipment
- Sports/Recreation Equipment
  - Example: Shooting sports
Links to Further Information

- [www.herlpitt.edu](http://www.herlpitt.edu)
- [www.science360.gov](http://www.science360.gov)
  - Science Of The Summer Olympics: Engineering for Mobility (July 2012)
Contact information

Rory A. Cooper
University of Pittsburgh
School of Health & Rehabilitation Sciences
Rehabilitation Science and Technology
5044 Forbes Tower
Pittsburgh, PA 15260 US
rcooper@pitt.edu
www.herl.pitt.edu
www.qolt.org

Adversity → Advantage

Action → Accomplishment