Injury Prevention in Paralympic Athletes: 
An epidemiological review of unintentional and intentional injuries

Yetsa A. Tuakli-Wosornu, MD, MPH
Assistant Clinical Professor, Yale School of Public Health
Associate Physiatrist, Yale Department of Orthopaedics and Rehabilitation
IOC Working Group for the Prevention of Harassment and Abuse in Sport
IPC Welfare Officer and Medical Committee Member, 2014-18
Outline

- Describe the Contemporary Paralympic Movement
- Epidemiology of Unintentional and Intentional Injuries
- On-going Gaps in Knowledge and Prevention Preparedness
Outline

Describe the Contemporary Paralympic Movement

Epidemiology of Unintentional and Intentional Injuries

On-going Gaps in Knowledge and Preparedness
Language and culture are interdependent

One is a reflection of the other and language often reflects long-held but evolving societal beliefs
### Language used to describe sport for persons with impairment has evolved

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Synonyms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disabled</td>
<td>(of a person) having a physical or mental condition that limits movements, senses, or activities</td>
<td>handicapped, incapacitated</td>
</tr>
<tr>
<td>Adapt(ed)</td>
<td>(something) made suitable for a new use or purpose; modified; adjusted to new conditions</td>
<td>modified, altered, changed, adjusted, converted, redesigned, reshaped, revamped, rejigged, redone</td>
</tr>
</tbody>
</table>
In 2016, ‘Para’ was put forth by the IPC as the preferred terminology (2016).

Para
/prər/ (from Greek pará, meaning beside, adjacent to; distinct from but analogous to; in combinations often meaning amiss, irregular and denoting alteration or modification)

Seminar Questions:

1. Rebecca’s dog Dilly (an 8 month old Chihuahua) is missing and she decided to put up posters in her area offering anyone who finds her dog, a reward of £50.

   This morning whilst jogging in Hyde Park, Bill sees the poster and phones Rebecca, as last night on his way home from work, he found the dog hiding under a bench on the street.

   What type of contract is this and can Bill claim the reward of £50?

2. X and Y promised each other to pay Z. Y dies. Can Y’s executors be sued by Z?
The difference between ‘Para’ and ‘Adapted’

Sport that has been modified or adapted from its original form i.e. wheelchair basketball, wheelchair tennis

All independent, self-governing sports for persons with impairment, whether or not an able-bodied equivalent exists
Sports represent a critical health strategy for persons with impairment

Risk of lifestyle-related disease

Not Impaired

Impaired

4 X


Benefits are well-documented (in contrast to the risks)

- Improved energy balance
- CVD prevention
- Improved bone health
- Improved mental health
- Reduced health care costs

Life purpose, self-acceptance and autonomy

Personal health and care giver needs


Images: wikimedia.com
Para Rowing is one of 23 Paralympic sports

Eligible impairment categories:
- Impaired muscle power
- Atheotosis
- Impaired passive ROM
- Hypertonia
- Limb deficiency
- Ataxia
- Visual impairment

Features of the sport:
- Debuted at the 2008 Games.
- There are 4 boat classes, and in the all events, races were 1,000m (now 2K). The equipment (boat, etc.) is adapted to the athletes.

No. of competitors at the Rio Games: 88
Governing body: World Rowing

https://www.paralympic.org/
Our lab attempts to help fill injury-related research gaps in Para sport science

<table>
<thead>
<tr>
<th>Study Design</th>
<th>Topic</th>
<th>Outcome(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre- Post- survey</td>
<td>More than just a Game: Using Sport to Promote Social Inclusion and Disability Awareness at Yale</td>
<td>Yale athletes’ (+/- students’) implicit and explicit attitudes towards athletes with disabilities</td>
</tr>
<tr>
<td>Secondary data analysis</td>
<td>Sport-related Injuries In Elite Para Powerlifters: A Prospective Analysis Of 1410 Athlete-days At The Rio 2016 Summer Paralympic Games</td>
<td>Sport-related injury incidence rate and injury proportion during the 7 day competition period at the 2016 Paralympic Games</td>
</tr>
<tr>
<td>Review</td>
<td>Acute and Chronic Musculoskeletal Injury in Para Sport: A Critical Review</td>
<td>Summary of global musculoskeletal injury epidemiology data</td>
</tr>
<tr>
<td>Case report</td>
<td>A Low-Cost, High-Quality Wheelchair Training Roller for Athletes with Impairment in Low-Resource Settings: Concept Design for Manufacture</td>
<td>Prototype design for manufacture</td>
</tr>
<tr>
<td>Review</td>
<td>Intentional Injury in Para Athletes: A State-of-the-art Review</td>
<td>Summary of global harassment and abuse epidemiology data</td>
</tr>
</tbody>
</table>
Outline

Primer on the Contemporary Paralympic Movement

Epidemiology of Unintentional and Intentional Injuries

On-going Gaps in Knowledge and Preparedness
Acute and Chronic Musculoskeletal Injury in Para Sport: A Critical Review

Yetsa A. Tuakli-Wosornu, MD, MPHa,*, Evgeny Mashkovskiy, MD, PhDb, Taylor Ottesen, BS, Mark Gentry, MA, MLSc, Daniel Jensen, DPT, Nick Webborn, MB BS, FFSEM, MSCf

KEYWORDS
- Injury epidemiology
- Musculoskeletal injury
- Paralympic sport
- Para athlete
- Review

https://doi.org/10.1016/j.pmr.2018.01.014
1047-9651/18 © 2018 Elsevier Inc. All rights reserved.
Medline, Embase, CINAHL*, and Web of Science
n = 993

Studies Screened
n = 871

Duplicates Removed
n = 122

Excluded Based On Title and/or Abstract
n = 697
- Wrong Outcomes
- Wrong Study Design
- Wrong Study Population
- Non-English
n = 127

Studies Assessed For Fulltext Eligibility
n = 174

Studies Included
n = 47

Summary of search results
*Cumulative Index to Nursing and Allied Health
General injury trends in summer and winter Para sports

Para athletes who use wheelchairs sustain upper extremity injuries in high percentages.

Ambulant Para athletes sustain lower extremity injuries in high percentages.
In contrast to able-bodied athletes, the upper extremity is the most commonly injured anatomic area.

**Risk factors:**
- Increased age
- Spinal cord injury
- Shoulder muscle imbalance
Injury severity and chronicity

Acute traumatic injuries / Catastrophic injuries
- Bone fractures
- Traumatic brain injury
- Ligament ruptures
- Tendon tear

Chronic overuse injuries / Minor injuries
- Tendon degeneration
- Muscle contusions
- Skin abrasions
- Sunburn
- Decubitus ulcers
Differences in injury epidemiology based on gender and pre-participation behaviors

Male and female summer Para athletes typically have similar overall injury rates.

Mandatory periodic health evaluations may result in reduced overall injury rates, and improved performances.

Polish scientists compared health practices before and after the London 2012 and Rio 2016 Games.
Injury risk varies by sport and season

During the summer Paralympic Games, the highest incidence of injury was reported in Football 5-a-side, where lower extremity injuries predominated.

During the winter Paralympic Games, the highest injury incidence was reported in the Para Alpine Skiing/Snowboarding category. Among all winter sports, upper and lower extremity injuries occurred with similar frequency.

Overall injury incidence rate at the Sochi 2014 winter games was 2 X higher than the IIR at the London summer games.
In contrast to non-disabled athletes, seated athletes use the shoulder as a weight-bearing joint

*Traditional shoulder*

- Non weight bearing
- Increased degrees of freedom
- Multiple planes of motion
- Decreased stability
- High risk of overuse injury

*Wide variety of functional movements for sport and daily life*
Athletes who are daily manual wheelchair users place shoulders under abnormally high loads.

- Weight shifts
- Pressure relief lifts
- Transfers
- Propulsion
- Start/stop maneuvers

Implications for decisions around conservative vs. aggressive treatment?
Somewhat surprisingly, there is a dearth of data related to overuse injuries (shoulder or otherwise) in Para rowers.

**RESEARCH ARTICLE | Case Studies in Physiology**

Exercise-induced diaphragm fatigue in a Paralympic champion rower with spinal cord injury

© Nicholas B. Tiller, Thomas R. Aggar, Christopher R. West, and Lee M. Romer

1Academy of Sport and Physical Activity, Faculty of Health and Wellbeing, Sheffield Hallam University, Sheffield, United Kingdom; 2Centre for Human Performance, Exercise and Rehabilitation, College of Health and Life Sciences, Brunel University London, Uxbridge, United Kingdom; 3Division of Sport, Health and Exercise Sciences, Department of Life Sciences, Brunel University London, Uxbridge, United Kingdom; and 4ICORD, Vancouver, British Columbia, Canada

**2011**

Rib stress fracture in a male adaptive rower from the arms and shoulders sport class: case report

Tomislav Smoljanović, Ivan Bojanić, Courtney L. Pollock, and Radovan Radonić

1Department of Orthopaedic Surgery, University Hospital Center Zagreb, School of Medicine, University of Zagreb, Zagreb, Croatia
Somewhat surprisingly, there is a dearth of data related to overuse injuries (shoulder or otherwise) in Para rowers.

Para sailing and rowing
Overuse rib stress injury was reported in a single Croatian Para athlete, and authors speculate that this unique injury is potentially due to complete reliance on the upper extremity and torso in certain classes of high-level spinally injured rowers, in addition to high force transmission through certain areas of the body during rowing.77–79
Outline

Primer on the Contemporary Paralympic Movement

Epidemiology of Unintentional and Intentional Injuries

On-going Gaps in Knowledge and Preparedness
FISA and other international sport organizations are increasingly recognizing the importance of Safe Sport

Safe Sport:

An athletic environment that is free from all forms of harassment and abuse
FISA and other international sport organizations are increasingly recognizing the importance of Safe Sport

<table>
<thead>
<tr>
<th>Consensus statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Olympic Committee consensus statement: harassment and abuse (non-accidental violence) in sport</td>
</tr>
</tbody>
</table>

Margo Mountjoy, Celia Brackenridge, Malia Arrington, Cheri Blauwet, Andrea Carska-Sheppard, Kari Fasting, Sandra Kirby, Trisha Leahy, Saul Marks, Kathy Martin, Katherine Starr, Anne Tiivas, Richard Budgett


Central concept: a power differential anchors every form of harassment and abuse in sport

Power inequity sets the stage on which maltreatment (a.k.a. intentional violence) can take place; psychological abuse is at the core


Images: google.com
Athletes with disabilities are at particularly high risk of intentional harm (± daily self-care needs)

Athletes with disabilities

- Youth with impairments (athletes and non-athletes) have 2-3 X increased risk of psychological, physical and sexual abuse compared to able-bodied peers
- Responsibilities among entourage may become blurred, assumptions about and exploitation of athletes' care needs (communication, travel, logistics) make them vulnerable

No surprise:


Quantitative data specific to Para athletes remains sparse
Non-accidental Harms in Athletes with Impairment: A State-of-the-art Review

<table>
<thead>
<tr>
<th>Journal:</th>
<th>British Journal of Sports Medicine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manuscript ID</td>
<td>bjsports-2018-099854.R2</td>
</tr>
<tr>
<td>Article Type:</td>
<td>Review</td>
</tr>
<tr>
<td>Date Submitted by the Author:</td>
<td>n/a</td>
</tr>
</tbody>
</table>
| Complete List of Authors: | Tuakli-Wosornu, Yetsa; Yale University School of Public Health, Chronic Disease Epidemiology
Sun, Qisi; Yale University School of Medicine
Gentry, Mark; Yale University School of Medicine, Harvey Cushing/John Hay Whitney Medical Library
Ona Ayala, Kimberly; Yale University School of Medicine
Doolan, Fiona; University of Dublin Trinity College School of Medicine
Ottesen, Taylor; Yale University School of Medicine
Caldwell, Blake; University of Colorado Boulder Department of Electrical Computer and Energy Engineering
Naushad, Nida; Yale University School of Medicine
Huang, Patrick; Yale University School of Medicine
Kirby, Sandi; University of Winnipeg, |
| Keywords: | Violence, Sports, Review, Protection, Disability |
Medline, Embase, CINAHL*, and Web of Science
n = 2245

Studies Screened
n = 2134

Duplicates Removed
n = 111

Excluded Based On Title and/or Abstract
n = 2033
- Wrong Outcomes
- Wrong Study Design
- Wrong Study Population
- Non-English
n = 93

Studies Assessed For Fulltext Eligibility
n = 101

Studies Included
n = 8

Figure 1. Summary of search results
*Cumulative Index to Nursing and Allied Health
# Study characteristics (n=8)

## SUMMARY

<table>
<thead>
<tr>
<th>Year of publication</th>
<th>2013-17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of evidence</td>
<td>100% (n=8) Level 4</td>
</tr>
<tr>
<td>Study design</td>
<td>37.5% (n=3) Quantitative, 62.5% (n=5) Mixed methods</td>
</tr>
<tr>
<td>Study location</td>
<td>37.5% (n=3) U.S., 37.5% (n=3) U.K., 12.5% (n=1) Australia, 12.5% (n=1) Netherlands/Belgium</td>
</tr>
<tr>
<td>Study setting</td>
<td>50% (n=4) Non-school based recreational sports setting (club, camp, community center), 25% (n=2) Regional- National- or International-level tournament, 25% (n=2) School-based recreational sports setting (team, gym class)</td>
</tr>
<tr>
<td>Maltreatment studied</td>
<td>Bullying (including cyberbullying), neglect, sexual abuse, physical abuse, psychological and emotional abuse, verbal abuse, ostracism, pranks like hiding things and creating hazards</td>
</tr>
<tr>
<td>Population(s)</td>
<td>Youth and adults with a wide range of physical impairments (VI, PI) age 9-50; parents/grandparents of II athletes</td>
</tr>
</tbody>
</table>

### *Levels of Evidence*

1. RCT
2. Prospective case control (i.e. cohort) study comparing two groups
3. Retrospective i.e. uncontrolled comparison study
4. Cross-sectional studies and case series (questionnaires, surveys), no reference standard
5. Expert opinion

### Type(s) of Maltreatment

1. Bullying 6. Financial abuse
2. Hazing 7. Physical abuse
3. Neglect 8. Psychological and emotional abuse
4. Sexual harassment
5. Sexual abuse
Select results

2016 Tine Vertommen. *Child Abuse Neglect.* Interpersonal violence against children in sport in the Netherlands and Belgium

5% (302) of 6,042 18-50 year-old citizens surveyed had participated in disability youth sport. **Disability was a predictor for both physical and sexual violence.** Among those having participated in disabled sports, prevalence estimates were remarkably high for all three types of violence: **prevalence of psychological violence was 49.7%, physical violence 32.4%, sexual violence (33.5%).** Odds ratio for physical violence was 3.2 and odds ratio of sexual violence was 2.9.


10 parents and grandparents of children 8+ year old who participated in *Special Olympics Maryland* completed a questionnaire on bullying prevalence, demographics, athlete's use of electronic devices, and then participated in in-depth interviews about the athlete's vulnerability, exposure to aggressive offenders, and specifies about their child's online behavior. **Cyberbullying was common and tolerated for the sake of friendship.**

2017 Lynne McPherson. *J Australian Social Work.* Secrecy surrounding the physical abuse of child athletes in Australia

A mixed methods research design produced 107 survey responses and 10 in-depth interviews with young adult citizens, age 18-25, asked to describe their experiences in sport as a child. **More than a third of the respondents described experiences of overtraining, being forced to train when injured or of direct physical violence.**
Conclusion

Bullying and other forms of emotional harm perpetrated against young, recreational, visually impaired athletes have received the majority of coverage in the extant literature. However, the true depth and breadth of non-accidental harms in Para athletes remains unknown. This literature gap is concerning, as

https://mc.manuscriptcentral.com/bjsm

Troy Whitley Medical Library
Ona Ayala, Kimberly; Yale University School of Medicine
Doolan, Fiona; University of Dublin Trinity College School of Medicine
Ottesen, Taylor; Yale University School of Medicine
Caldwell, Blake; University of Colorado Boulder Department of Electrical Computer and Energy Engineering
Naushad, Nida; Yale University School of Medicine
Huang, Patrick; Yale University School of Medicine
Kirby, Sandi; University of Winnipeg,

Keywords: Violence, Sports, Review, Protection, Disability
Outline

- Primer on the Contemporary Paralympic Movement
- Epidemiology of Unintentional and Intentional Injuries
- On-going Gaps in Knowledge and Preparedness
Evidence-based injury prevention in Para athletes

<table>
<thead>
<tr>
<th>Unintentional Injury</th>
<th>Intentional Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What is known:</strong></td>
<td></td>
</tr>
<tr>
<td>- The upper extremity is the most commonly injured anatomic area in Para athletes</td>
<td></td>
</tr>
<tr>
<td>- Chronic overuse injuries are significantly more common than acute traumatic</td>
<td></td>
</tr>
<tr>
<td>- Among Para rowers, cases of diaphragmatic fatigue and rib stress injury have been reported</td>
<td></td>
</tr>
<tr>
<td>- Regular, periodic health evaluations may reduce injury rates in elite (i.e. Paralympic) Para athletes</td>
<td></td>
</tr>
<tr>
<td><strong>What remains unknown:</strong></td>
<td></td>
</tr>
<tr>
<td>- Epidemiology of shoulder and other joint injuries in Para rowers (especially in the weight-bearing shoulder)</td>
<td></td>
</tr>
<tr>
<td>- Nature and effectiveness of injury prevention programs in Para rowers at all levels of competition</td>
<td></td>
</tr>
</tbody>
</table>
Evidence-based injury prevention in Para athletes

<table>
<thead>
<tr>
<th>Unintentional Injury</th>
<th>Intentional Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is known:</td>
<td>What is known:</td>
</tr>
<tr>
<td>- The upper extremity is the most commonly injured anatomic area in Para athletes</td>
<td>- Athletes with impairment may be at up to 4 times increased risk of harassment and abuse in sport compared to able-bodied peers</td>
</tr>
<tr>
<td>- Chronic overuse injuries are significantly more common than acute traumatic</td>
<td>- Bullying among visually impaired, recreational Para athletes has been reported most commonly</td>
</tr>
<tr>
<td>- Among Para rowers, cases of diaphragmatic fatigue and rib stress injury have been reported</td>
<td></td>
</tr>
<tr>
<td>- Regular, periodic health evaluations may reduce injury rates in elite (i.e. Paralympic) Para athletes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What remains unknown:</th>
<th>What remains unknown:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Epidemiology of shoulder and other joint injuries in Para rowers (especially in the weight-bearing shoulder)</td>
<td>- True breadth and depth of intentional harms (harassment and abuse) in Para athletes, including Para rowers</td>
</tr>
<tr>
<td>- Nature and effectiveness of injury prevention programs in Para rowers at all levels of competition</td>
<td>- Risk factors for intentional harm in athletes</td>
</tr>
<tr>
<td></td>
<td>- Effectiveness of Safe Sport programs, including current grievance mechanisms, in Para rowers at all levels of competition</td>
</tr>
</tbody>
</table>
Evidence-based injury prevention in Para athletes

**What is known:**
- The upper extremity is the most commonly injured anatomic area in Para athletes.
- Chronic overuse injuries are significantly more common than acute traumatic injuries.
- Among Para rowers, cases of diaphragmatic fatigue and rib stress injury have been reported.
- Regular, periodic health evaluations may reduce injury rates in elite (i.e., Paralympic) Para athletes.

**What remains unknown:**
- Epidemiology of shoulder and other joint injuries in Para rowers (especially in the weight-bearing shoulder).
- Nature and effectiveness of injury prevention programs in Para rowers at all levels of competition.

**What is known:**
- Athletes with impairment may be at up to 4 times increased risk of harassment and abuse in sport compared to able-bodied peers.
- Bullying among visually impaired, recreational Para athletes has been reported most commonly.

**What remains unknown:**
- True breadth and depth of intentional harms (harassment and abuse) in Para athletes, including Para rowers.
- Risk factors for intentional harm in athletes.
- Effectiveness of Safe Sport programs, including current grievance mechanisms, in Para rowers at all levels of competition.
Evidence-based injury prevention in Para athletes

**Athlete and Entourage**
- Pre- and Rehabilitation exercises\(^1\)
- Pre participation physical exam
  (+/- specific shoulder girdle muscle balance assessment)
- PPE Ultrasound in high-risk Para athletes?

**Federation**
- Equipment regulations (if data indicate that injuries are related to equipment or lack thereof)

**Summary**

- **True wisdom is knowing what you don’t know.**
  
  - Confucius

- **Never, never be afraid to do what’s right, especially if the well-being of a person…is at stake.**

  - Martin L. King, Jr.

- **Society’s punishments are small compared to the wounds we inflict on our soul when we look the other way.**

- **Doing the right thing is not the problem. Knowing what the right thing is, that’s the challenge.**

  - Lyndon B. Johnson
Yale University
Taylor Ottesen, Blake Caldwell, Fiona Doolan, Mary Sun

FISA, World Rowing Federation
Jürgen M. Steinacker
Anne Heim

Safe Sport International
Celia Brackenridge, Kari Fasting, Sandra Kirby

International Olympic Committee
Working Group: Prevention of Harassment and Abuse in Sport

International Paralympic Committee
Medical Committee