SPORT INJURIES IN SCI PATIENTS

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Assistant Professor in Orthopaedics
University Hospital of Patras

Definition of “Disability”

“Those who are confined to a wheelchair, deaf, blind, or missing a limb, those who have only one of a paired set of organs, or those with behavioral, emotional and psychological disorders that substantially limit a major life activity.”

Types Of Disabilities

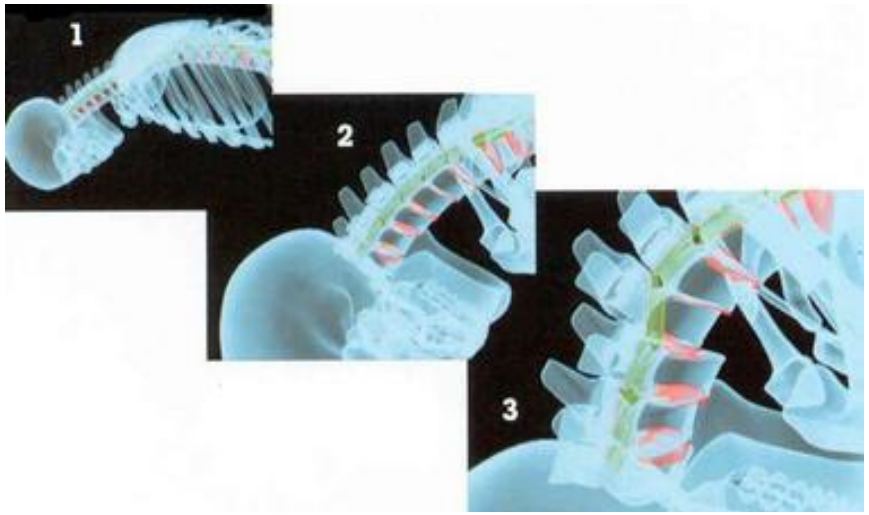
CONGENITAL

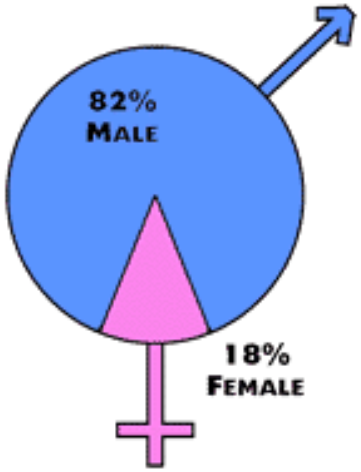
- Amputees
- Spina Bifida
- Cerebral Palsy
- Erbs Palsy
- Muscular Dystrophy
- MS / ALS
- Visual / Hearing

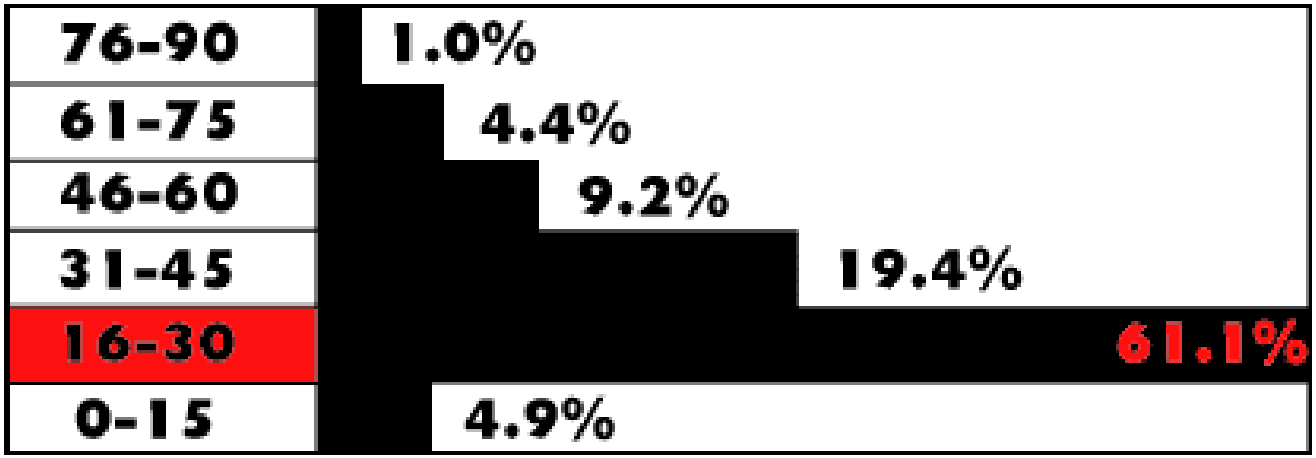
ACQUIRED

- Amputees
- **SCI**
- TBI
- Polio/ Post Polio
- Myopathies
- CVA
- Visual / Hearing

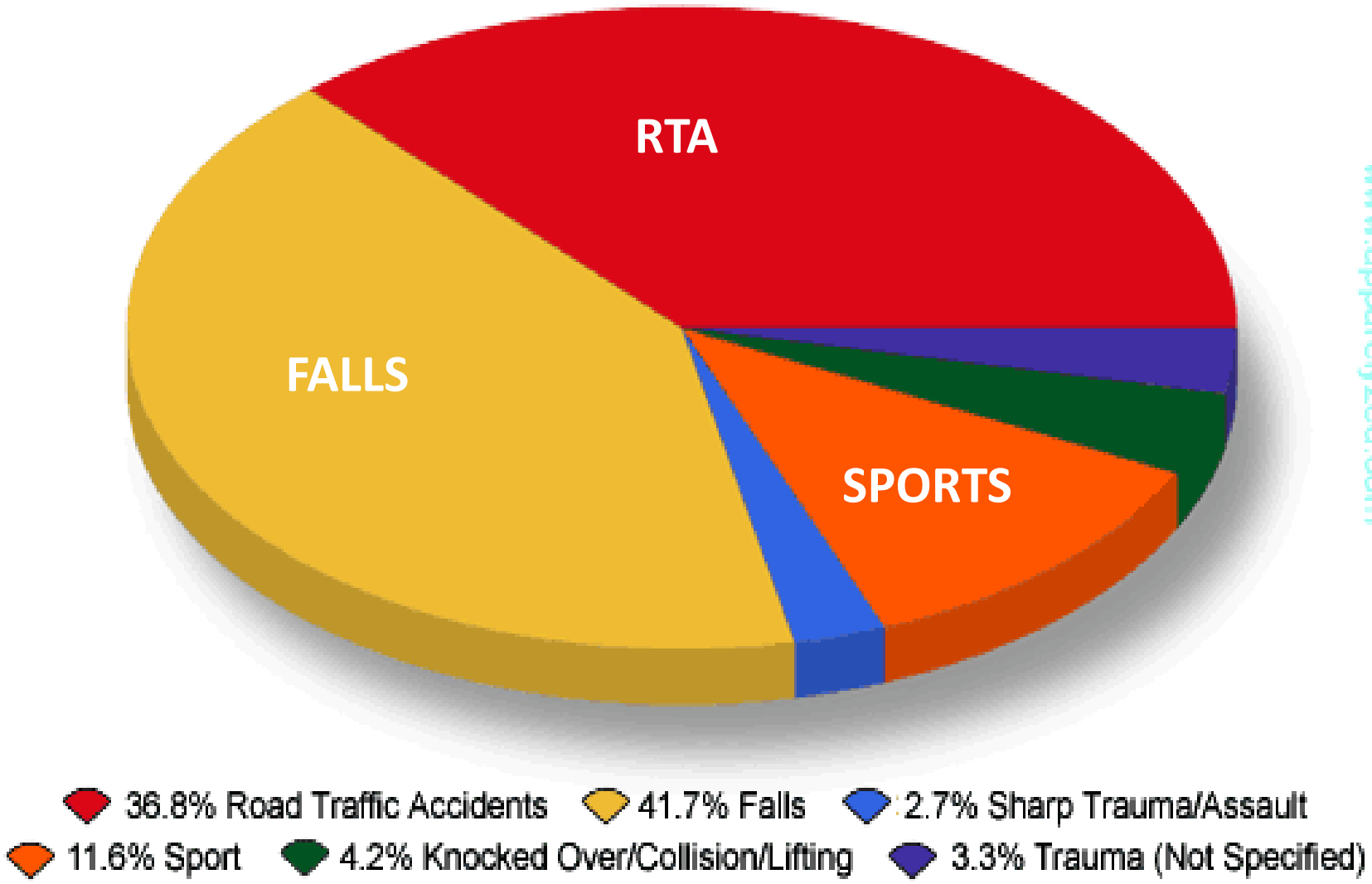
Spinal Injury





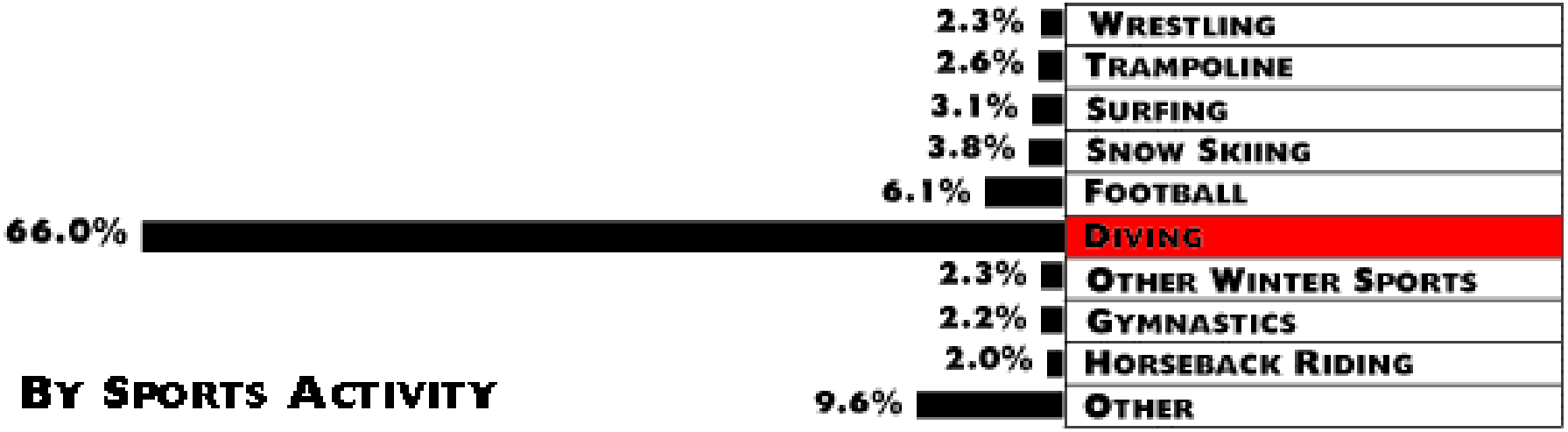


Causes of Spinal Cord Injuries



SCI in sports

11.6%



Spinal Cord (2012) 50, 452–456

www.nature.com/sc

ORIGINAL ARTICLE

Sport, free time and hobbies in people with spinal cord injury

P Sale[1,6], F Mazzarella[2,6], MC Pagliacci[3], S Aito[4], M Agosti[5] and M Franceschini[1]

Table 2 Outcome variables increased at follow-up (univariable analysis) (*n*=403)[a]

	Attendance of friends, relatives, colleagues	*Hobby*	*Outdoors mobility*	*Sport*
Increased	68.2%	50.6%	52.1%	45.5%
		Median (increased–decreased), P-value[b]		
Age, years	(35.0–43.0), 0.002	(34.0–42.0), 0.001	(32.0–44.0), <0.0001	(31.0–36.0), 0.045
Perceived QoL score	(5.0–7.0), <0.0001	(4.0–7.0), <0.0001	(4.0–7.0), <0.0001	(3.0–6.0), <0.0001
		OR (95% CI), P-value[c]		
Level of lesion, para		1.5 (1.1–2.3), 0.042	2.3 (1.5–3.5), <0.0001	2.5 (1.5–4.3), <0.0001
ASIA (Dis.), C+D+E				1.9 (1.2–3.1)
Bowel continence, yes	2.2 (1.4–3.6), 0.001	1.6 (1.1–2.6), 0.042	3.0 (1.6–5.0), <0.0001	2.5 (1.4–4.6), 0.003
Car-driving ability, yes	2.0 (1.3–3.2), 0.003	3.9 (2.4–6.2), <0.0001	7.9 (4.7–13.4), <0.0001	11.2 (4.6–27.3), <0.0001
Studying and working people, yes	1.9 (1.2–2.9), 0.005	1.9 (1.3–2.9), 0.001	4.4 (2.9–6.7), <0.0001	2.4 (1.5–4.0), <0.0001

403 patients, 83.4% male; 39% was tetraplegic

How physically active are people with SCI?

ORIGINAL ARTICLE

Leisure Time Physical Activity in a Population-Based Sample of People With Spinal Cord Injury Part I: Demographic and Injury-Related Correlates

Kathleen A. Martin Ginis, PhD, Amy E. Latimer, PhD, Kelly P. Arbour-Nicitopoulos, PhD, Andrea C. Buchholz, PhD, Steven R. Bray, PhD, B. Catharine Craven, MD, Keith C. Hayes, PhD, Audrey L. Hicks, PhD, Mary Ann McColl, PhD, Patrick J. Potter, MD, Karen Smith, MD, Dalton L. Wolfe, PhD

From SHAPE-SCI study (n=693) evaluating leisure time physical activity (LTPA) in people with SCI:

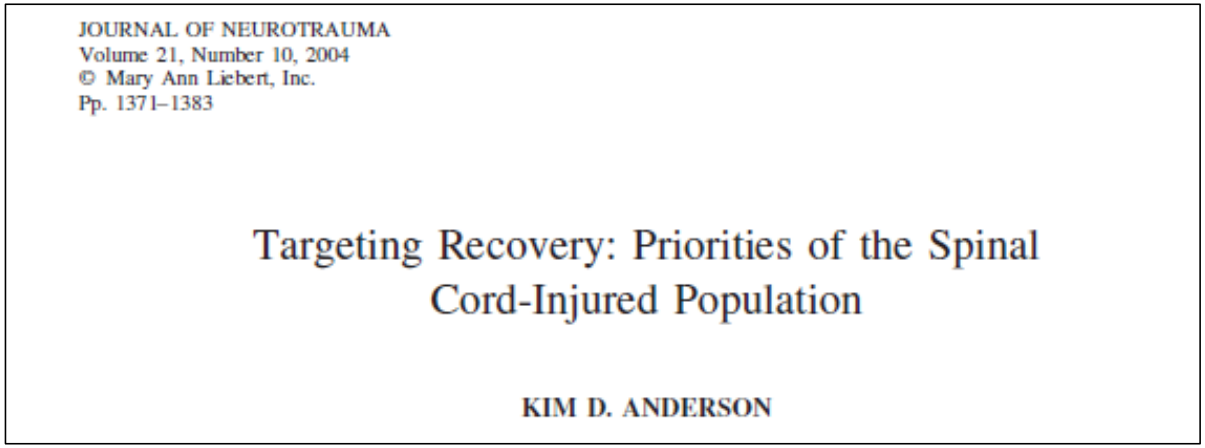
50% of adults with SCI engage in no LTPA whatsever!

Spinal Cord Injured Athletes

- **Motor loss**
- **Sensory loss**
  - Pressure sores
  - Lack of awareness of injury
- **Loss of autonomic control**
  - Bladder
  - Bowel
  - Sweating
- **Effects on cardiac function in exercise**
  - (T1-4 sympathectomises)
- **Respiratory function**

- Temperature control
- Dehydration
- UTI / stones
- **Autonomic dysreflexia** (at or above T6)

Is exercise an important therapeutic priority for individuals with SCI?



JOURNAL OF NEUROTRAUMA
Volume 21, Number 10, 2004

Pp. 1371–1383

Targeting Recovery: Priorities of the Spinal Cord-Injured Population

KIM D. ANDERSON

- **Surveyed 681 individuals with SCI**
- **96.5% of respondents considered exercise to be an important aspect of functional recovery**
- **Of this 96.5%, almost 20% did not have access to exercise**

Strength training benefits

- Increase Bone Mineral Density
- Improve Glucose Metabolism
- Reduce Resting Blood Pressure
- Avoid Muscle Loss
- Reduce Body Fat
- Reduce Arthritic Pain
- Reduce Low Back Pain

Affective benefits

- Enhances Self Esteem, Confidence, Independence
- Positive attitude towards physical activity and active lifestyle.
- Enhances Socialization
- Relieves Stress
- Emotional Stability

ORIGINAL CONTRIBUTION

Influence of Sport Participation on Community Integration and Quality of Life: A Comparison Between Sport Participants and Non-Sport Participants With Spinal Cord Injury

Sonja A. McVeigh, BSc, MD, FRCPC[1]; Sander L. Hitzig, MA[2]; B. Cathy Craven, MD, MSc, FRCPC[3]

Sport participants were **4.75** and **7.00** times as likely to have high CIQ and QoL scores.

Individuals who participated in sports prior to SCI were more likely to participate in sports post-SCI.

Participation in sports after SCI is associated with increased community integration and QoL and should be recognized as an **adjunct to current SCI rehabilitation programs**

J Spinal Cord Med. Apr 2009;32(2):115–124

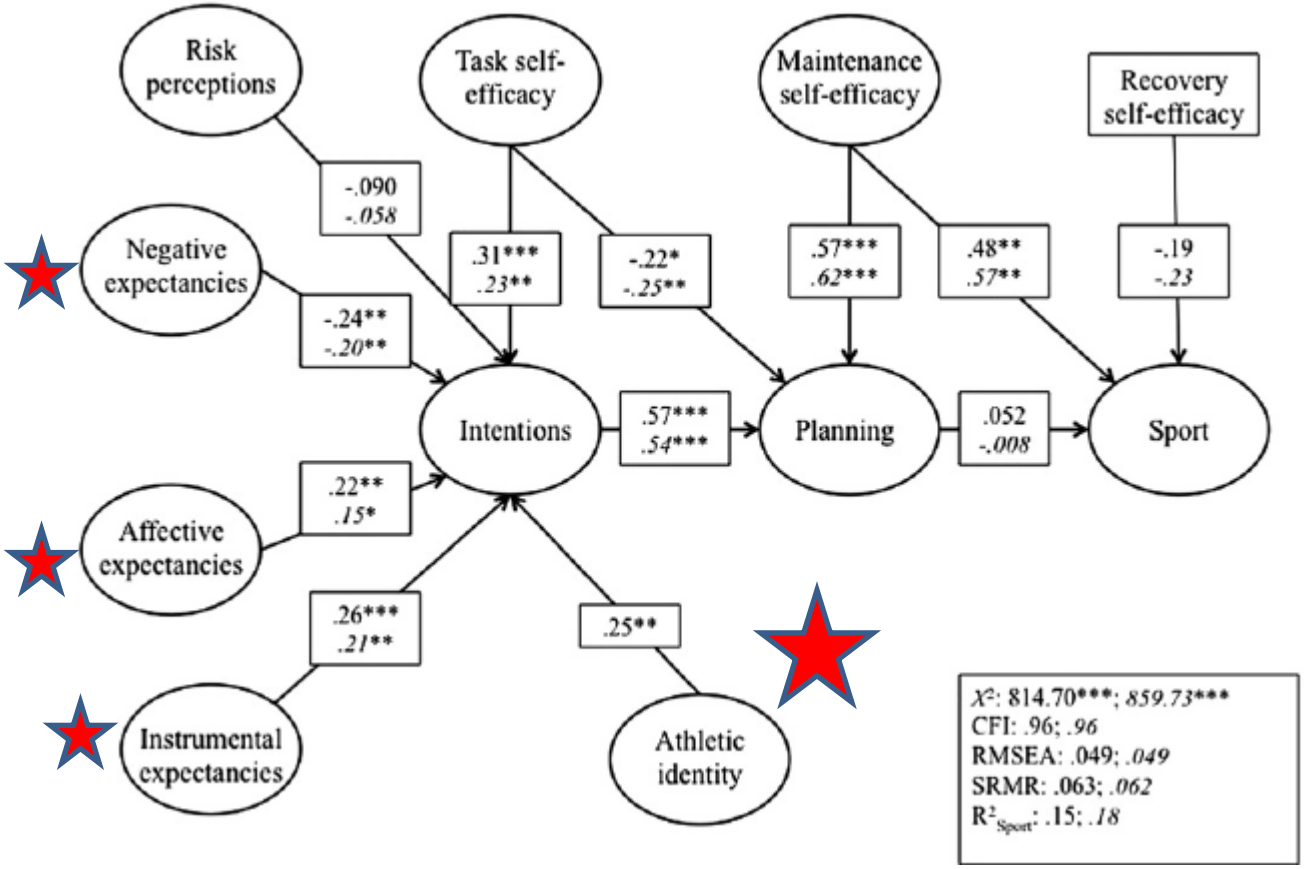
I act, therefore I am: Athletic identity and the health action process approach predict sport participation among individuals with acquired physical disabilities

Marie-Josée Perrier [a,*], Shane N. Sweet [a], Shaelyn M. Strachan [b], Amy E. Latimer-Cheung [a]

Psychology of Sport and Exercise 13 (2012) 713–720

Health Action Process Approach (HAPA) model

Athletic identity is the extent to which people identify themselves as athletes



ELSEVIER

Disability and Health Journal 5 (2012) 140–150

Disability and Health Journal

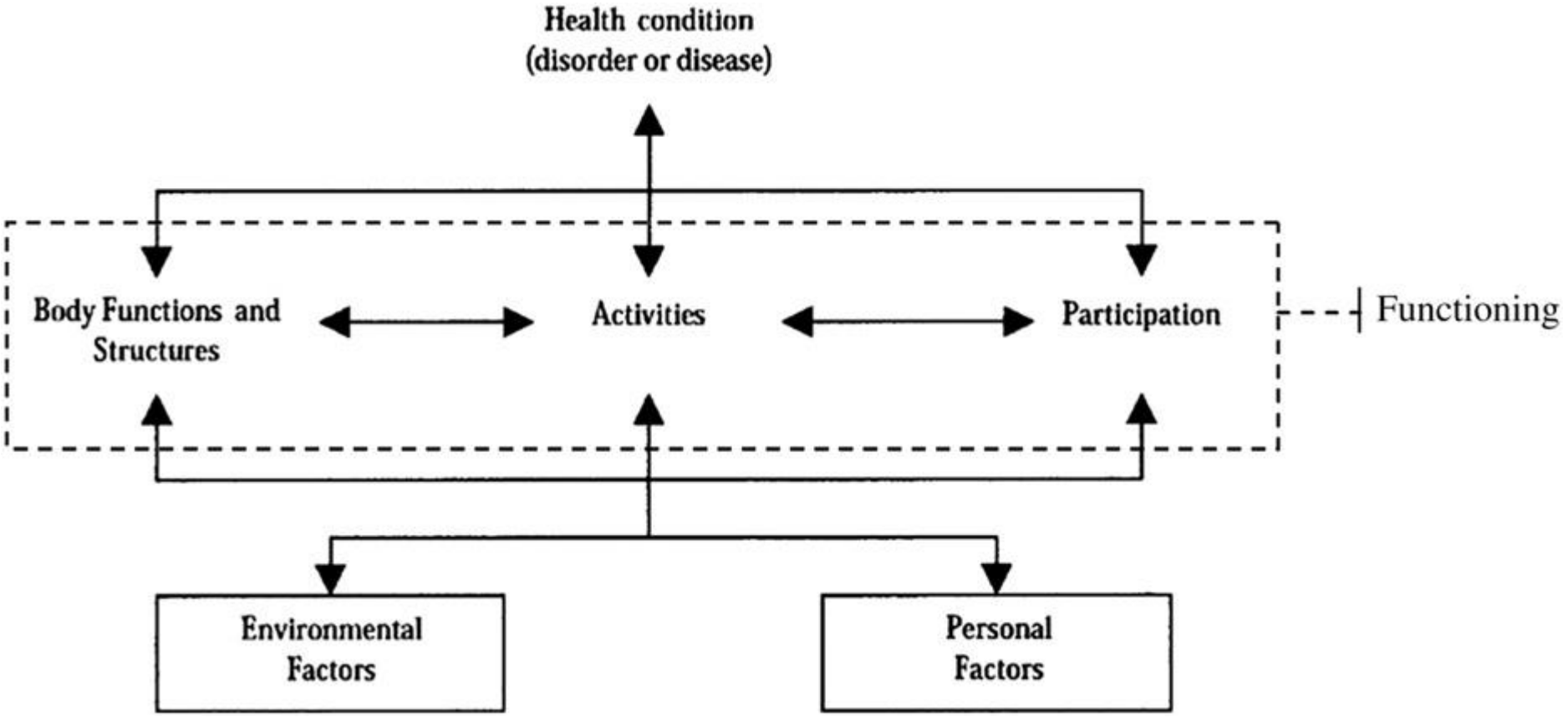
www.disabilityandhealthjnl.com

Review

Correlates and determinants of physical activity in persons with spinal cord injury: A review using the International Classification of Functioning, Disability and Health as reference framework

Christine Fekete, Ph.D.*, and Alexandra Rauch, B.Sc.

Swiss Paraplegic Research, Guido A. Zäch Institute, 6207 Nottwil, Switzerland



Role of sports medicine team

- Medical Examinations
- Prevention of Injury
- Diagnosis of Disease
- Treatment
- Awareness
- Medical Classifications

Categories of Disabled Athletes

- Amputations
- Blind or Visually Impaired
- Cerebral Palsy
- Deaf or Hearing impaired
- Intelligently Impaired
- **Spinal Cord Injuries**
- Les Autres – (Those who do not fit in the above categories)

Competition

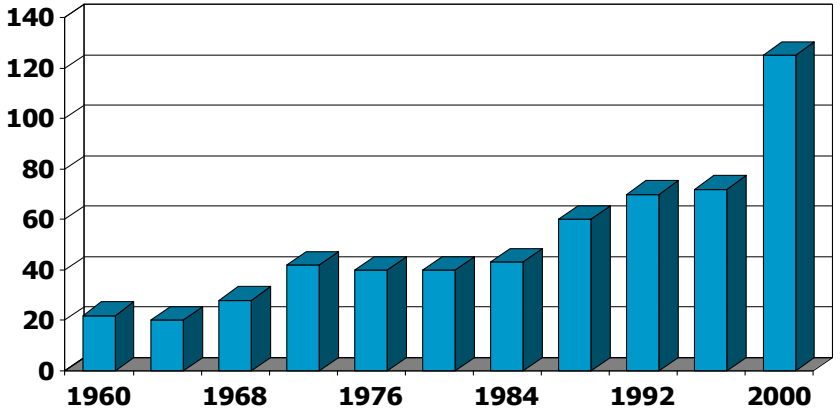
- Local, regional, national and international
- **Paralympics Games**
- Deaflympics
- Special Olympics (Intelligently Impaired)

History of the Paralympic Games

- 1948 Guttman's Stoke Mandeville Games in the UK – 'taking part' -16 athletes
- 1960 First 'Paralympic games in Rome with 23 countries and 400 athletes
- 1988 First true linked Modern Paralympic games in the same venue as the Olympic Games (Seoul)
- 2000 Sydney Paralympics 127 countries and 4000 athletes took part with global TV coverage of 1.1billion.

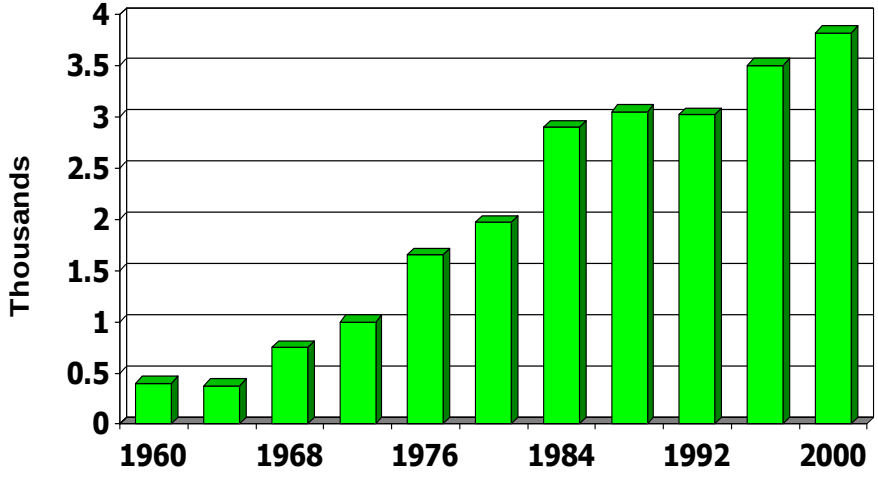
The increasing Global participation

- **2004 Paralympic games**
- Cumulative TV audience worldwide 1.862 billion



Number of countries

- **2008 Paralympics**
- 140 countries
- Global cumulative audience of 3.8billion



Number of competitors

Paralympic summer sports programs

- Archery
- Boccia
- Cycling
- Equestrian
- Football 5-a-side
- Football 7-a-side
- Goalball
- Judo
- Powerlifting
- Rowing
- Sailing
- Shooting
- Swimming
- Table Tennis
- Volleyball (sitting)
- Wheelchair basketball
- Wheelchair fencing
- Wheelchair rugby
- Wheelchair tennis


© The Sports Museum of Finland


ARATHON 2000

Paralympic Winter sports

- Alpine Skiing
- Biathlon
- Cross Country Skiing
- Ice Sledge Hockey
- Wheelchair Curling

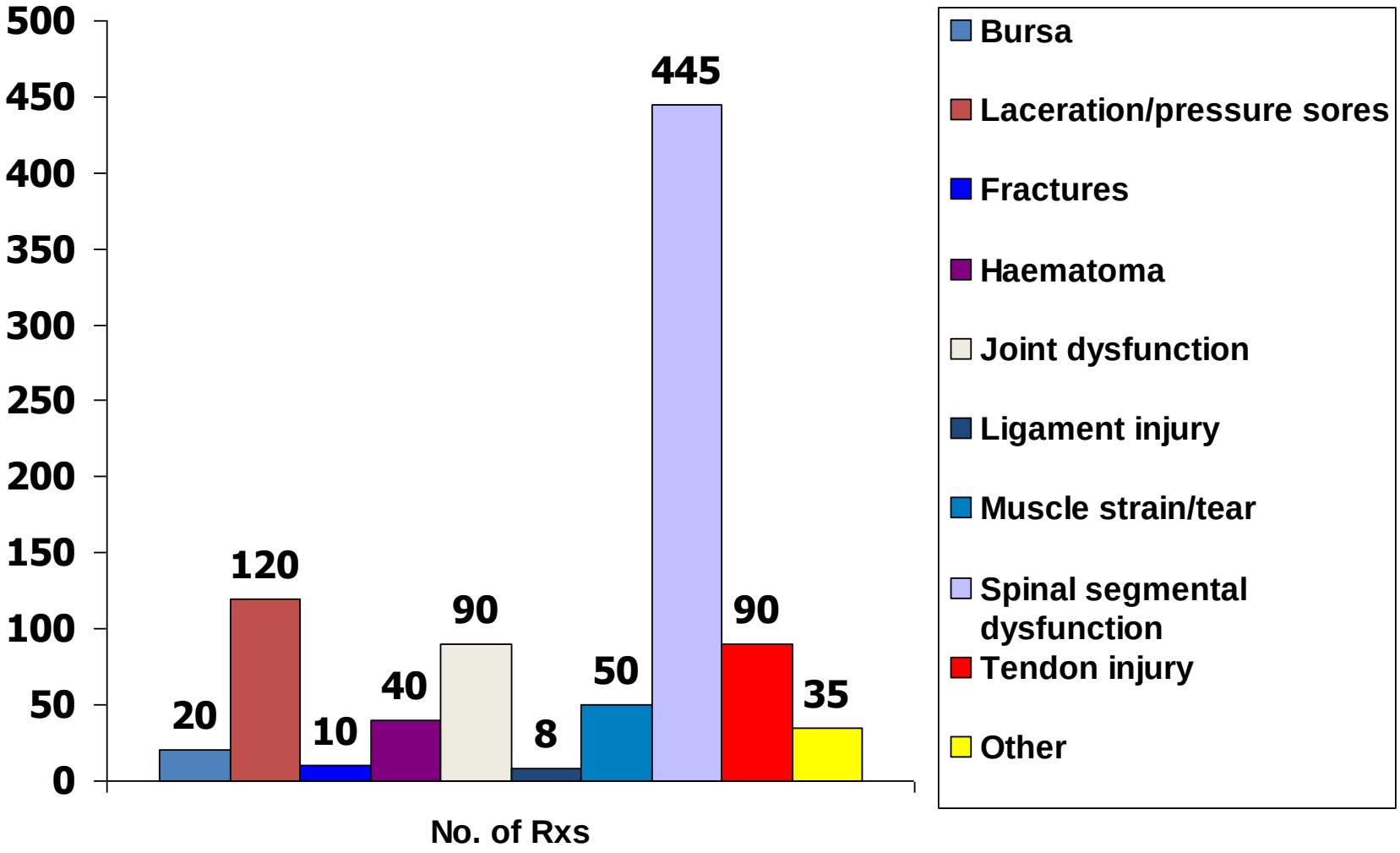
Recreation sports

What should we expect when treating disabled athletes?

- The great worry amongst therapists and doctors is that injuries and illness will be very high or unduly complex

- Patterns of injury vary a little with the different sports
  - more upper limb injuries in wheelchair users
  - increase in lower limb trauma in visually impaired athletes

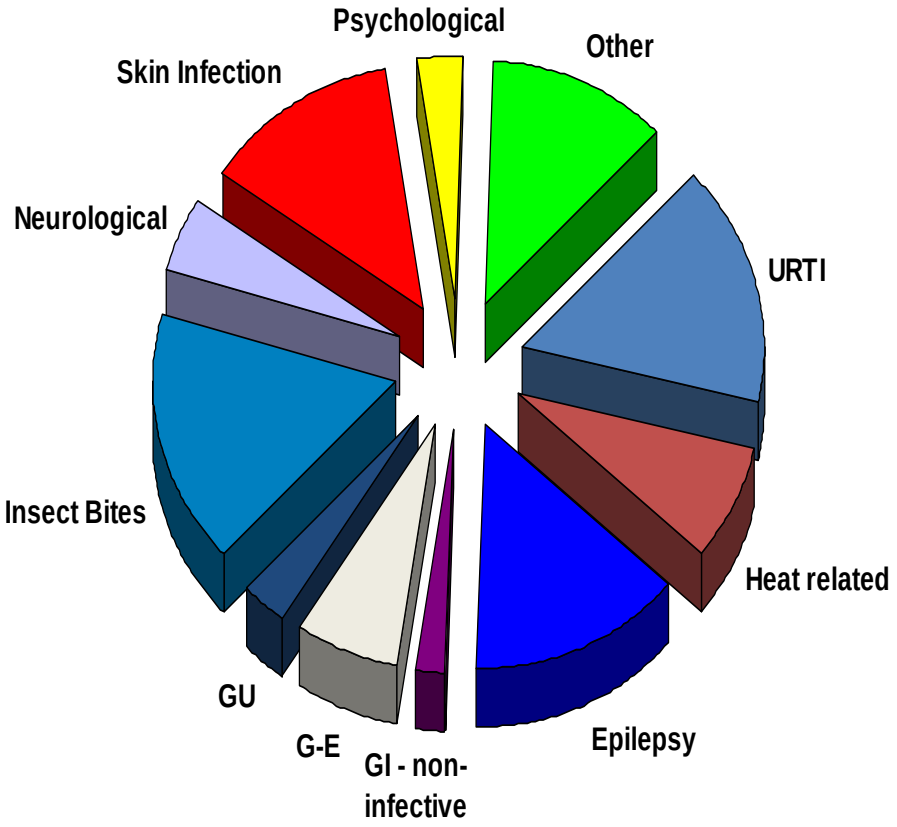
Musculo-skeletal Injuries in disabled athletes



- Nick Webborn – BPA data on file Athens Paralympics

Illness in disabled athletes

- Co-morbidities
- Pressure sore management
- UTI
- Autonomic dysfunction



Type of Injuries (wheelchair athletes)

Wheelchair propulsion

- Shoulder and wrist pain
- Entrapment neuropathies

Sport related

- Basketball (70%)
- Racing (60%)

Acute trauma

- concussions
- fractures
- sprains

Overuse

- Sprains, tendinitis
- Shoulder impingement

Secondary problems due to disability

- Autonomic Dysreflexia
- Heat intolerance-Thermoregulation
- Low bone mineral density
- Urinary tract infection
- Skin breakdowns, ulcers, pressure

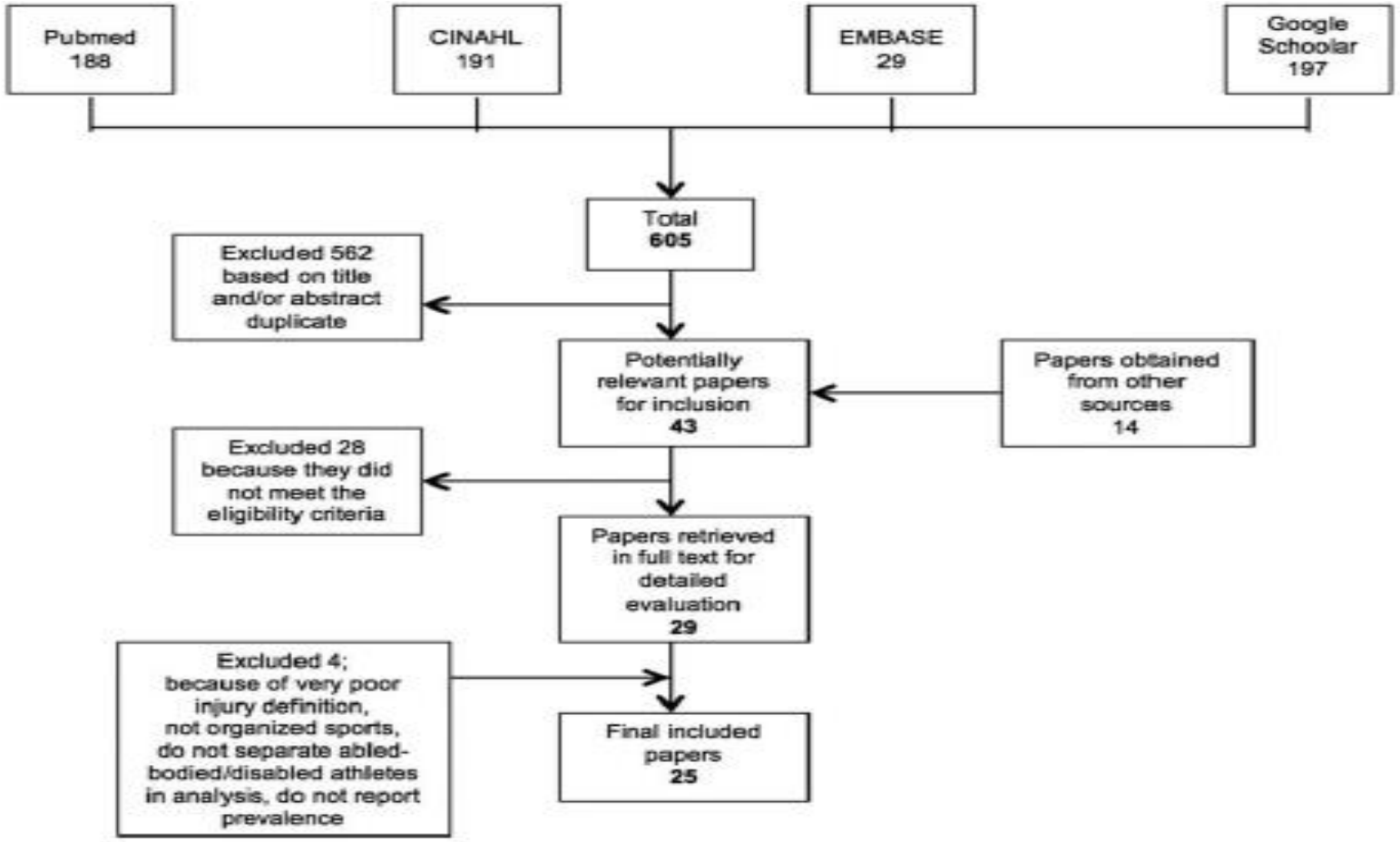
Scand J Med Sci Sports 2014: ••: ••–••
doi: 10.1111/sms.12175

SCANDINAVIAN JOURNAL OF
MEDICINE & SCIENCE
IN SPORTS

Review

Sports-related injuries in athletes with disabilities

K. Fagher[1], J. Lexell[1,2,3]



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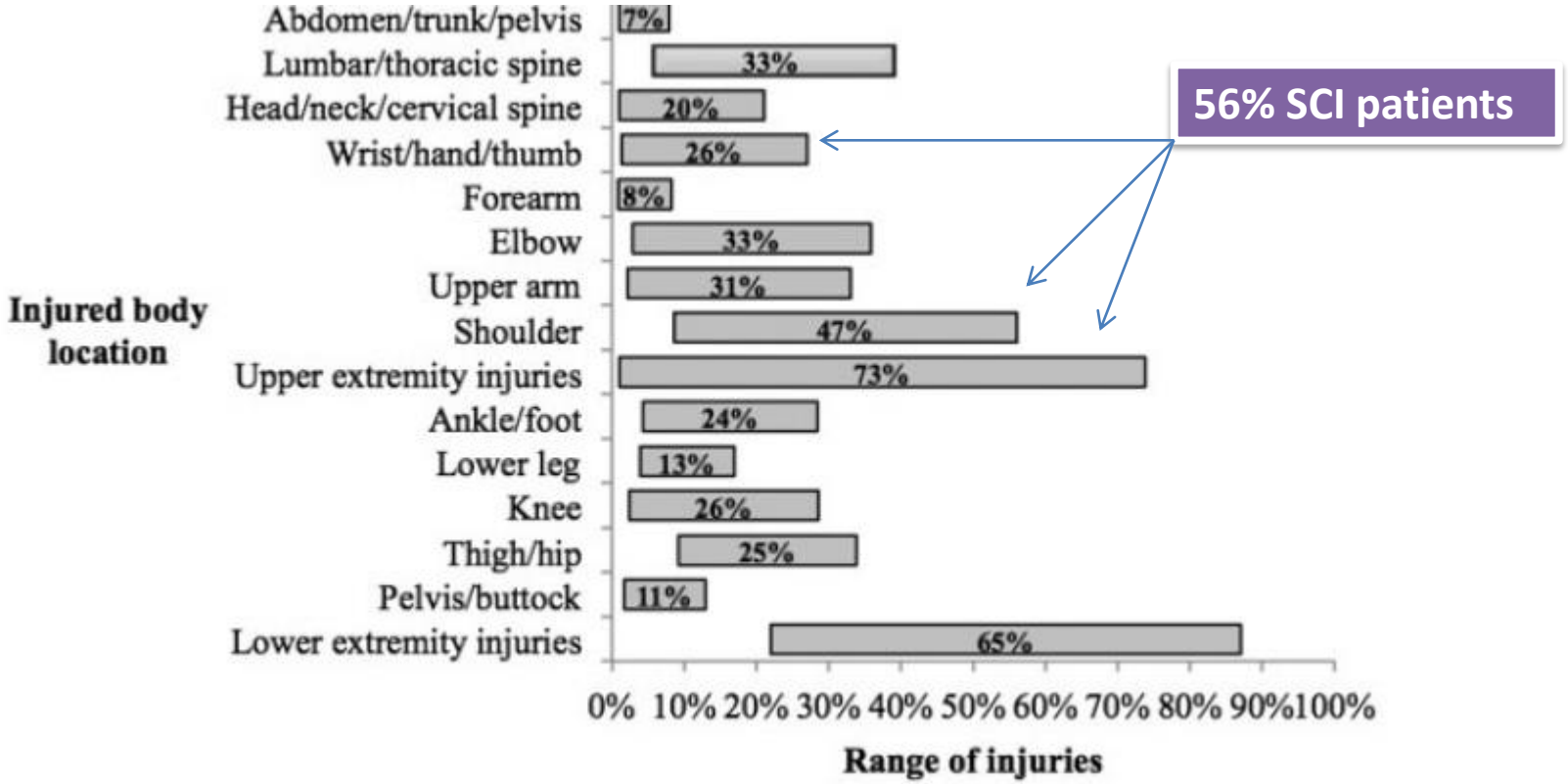


Wheelchair injuries

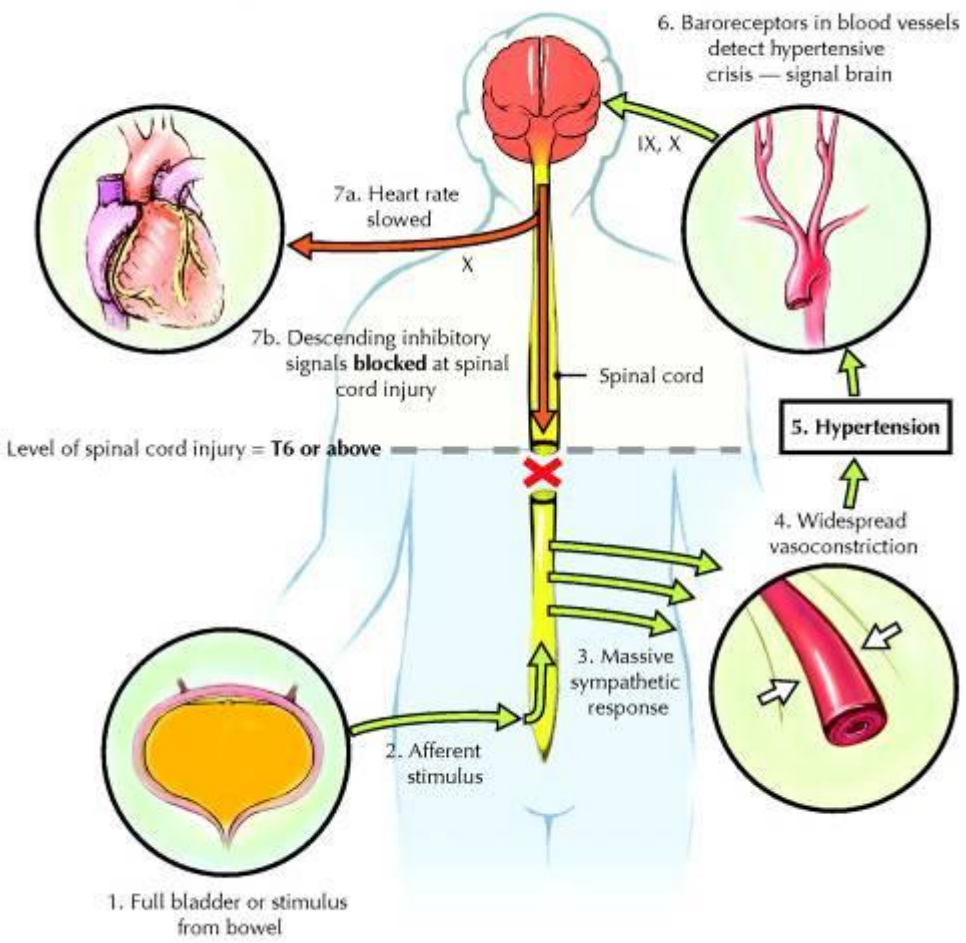
- Limited research
- Increase injury rate with increased participation.
- No relationship between disability type, classification, or sex.
- Temperature regulation and pressure sores particular to SCI.

aul O'Hara, a veteran with quadriplegia from Scranton, PA, pproaches the finish line in the 100 m race. (Photo by Curt Beamer)

Dysreflexia

BP↑

HR↓



Sensory (pain) impulses enter the cord below lesion and sympathetic nervous system responds to local spinal reflexes with an excessive discharge which is uncorrected by feedback loop.

Signs & Symptoms

- Headache.
- Nasal congestion.
- Blurred vision.
- spots in visual fields.
- Profuse **sweating** and **flushing** of the skin above the level of the lesion, especially in the face, neck, and shoulders

- Bradycardia
- Elevated blood pressure
- Cardiac arrhythmias

Why is it important?

- Autonomic dysreflexia has been regarded as a medical emergency because of the severe rises in blood pressure that can occur with recorded values in excess of 300 mmHg.

- Reported complications in the medical literature include seizures, cerebral haemorrhage, cardiac arrhythmia and death.

- In the hospital setting it is treated as a medical emergency.

Causes of Autonomic Dysreflexia

- Unintentional
  - ✓ UTI
  - ✓ Blocked catheter
  - ✓ Constipation
  - ✓ Urinary calculi
  - ✓ Anal fissure
  - ✓ Skin infection or injury
  - ✓ Pressure area
- Intentional
  - × Clamping catheter.
  - × Tight leg straps.
  - × Genital trauma.
  - × Prolonged sitting in racing chair
  - × **“Boosting”**

‘Boosting’

- **intentional induction of autonomic dysreflexia among quadriplegic athletes for performance enhancement”**
  (tight leg straps, full bladder, sharp objects)

- Belief that boosted state could be controlled.
- Treadmill exercise capability improved.
- Increase in simulated race times of **9.7%** in ‘boosted state’. -
- Equivalent in able-bodied performance :
  - 1 second off 100m record.
  - 4 seconds off 400m record.
  - 12 minutes off marathon record.

Autonomic Cardiovascular Control in Paralympic Athletes with Spinal Cord Injury

CHRISTOPHER R. WEST[1], SHIRLEY C. WONG[1], and ANDREI V. KRASSIOUKOV[1,2,3]

Neurological and autonomic level-dependent impairment in blood pressure regulation (SSR: sympathetic skin responses)

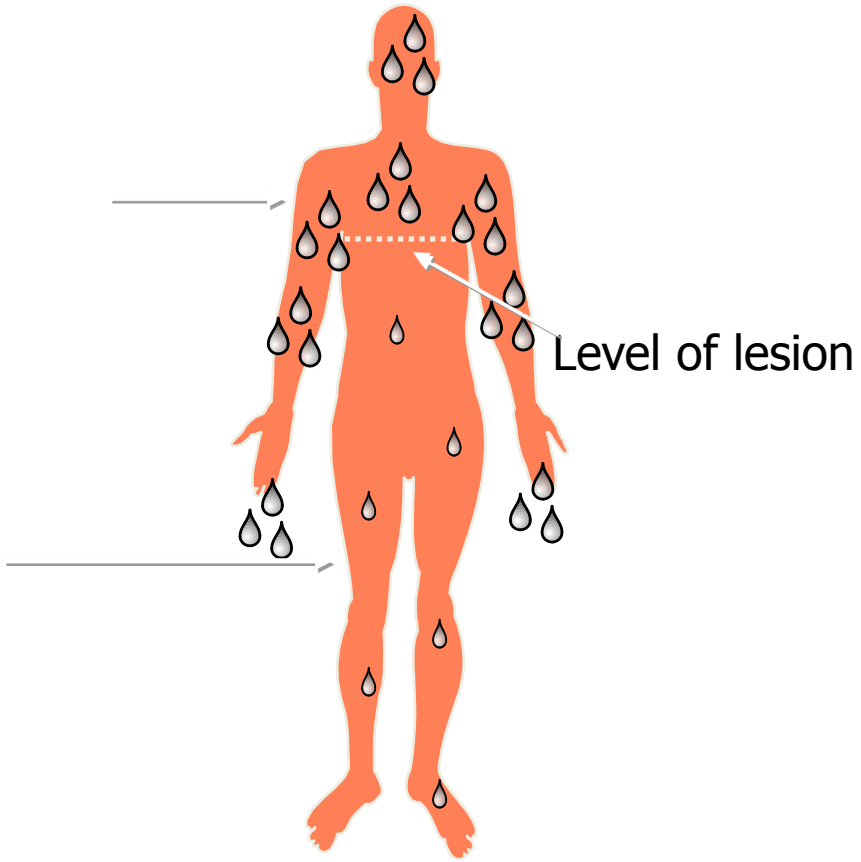
The highest injuries (cervical spine) and greatest disruption of SSR exhibit the most severe impairments in cardiovascular control.

Knowledge of the **degree of autonomic dysfunction** may improve the ability to predict individuals at risk and those who are most likely to gain a sporting benefit from boosting.

MEDICINE & SCIENCE IN SPORTS & EXERCISE®

Thermoregulation in SCI

- Above the lesion
  - sweating may be excessive (Sweat rate above level of lesion - can increase **x 6**)
  - Drips off - ineffective for heat loss
- Below the lesion
- Basal sweat rate is unaffected by activity or ambient temperature



Risks of heat to Wheelchair Athletes

- Increases in core temperature up to 40.5 deg.
- Increases in heart rate.
- Risk of dehydration still likely to occur.
- Risk of heat illness increased and impairment of athletic performance.
- Most affected athletes – Tetras (high lesion)
- **Symptoms**

Cramps, syncope, headache, nausea, dizzines

SPORT FOR ATHLETES WITH PHYSICAL DISABILITIES: INJURIES AND MEDICAL ISSUES

Heat Stress Level	Event	Indoor/Outdoor
High Risk (Level 3)	Athletics	Outdoor
	Cycling	Outdoor
	Equestrian	Outdoor
	Football	Outdoor
	Marathon	Outdoor
	Tennis	Outdoor
Intermediate Risk (Level 2)	Basketball	Indoor
	Goalball	Indoor
	Rugby	Indoor
	Swimming	Outdoor
	Table Tennis	Indoor
	Volleyball	Indoor
	Yachting	Outdoor
Low Risk (Level 1)	Archery	Outdoor
	Boccia	Indoor
	Lawn Bowls	Outdoor
	Powerlifting	Indoor
	Shooting	Outdoor

Managing thermoregulation

- Hydration strategies
- pre-cooling strategies
- interventions during competition
- Cooling vests, head and hand emersion
- use of fans

Pressure sores

- Unrelieved pressure
  - Greater than capillary pressure (32 mm Hg)
  - Ischemia / Hypoxia / Loss of Nutrients
  - Friction & Shear Forces
- Location
  - Ischium/Sacrum/Troch/Heel
- Incidence
    - SCI = 25% - 66%
- **Contributing Factors**

Contributing factors

- Insensate areas
- Atrophy / Loss of padding
- Improper seating devices
- Aerodynamic body positions
- Containment straps
- Splash guards / Brakes
- Falls/collisions

Available online at www.sciencedirect.com

ScienceDirect

Asia-Pacific Journal of Sports Medicine, Arthroscopy, Rehabilitation and Technology xx (2014) 1–5
www.apsmart.com

Original article

Factors associated with deep tissue injury in male wheelchair basketball players of a Japanese national team

Hirotaka Mutsuzaki [a,*], Kaori Tachibana [b], Yukiyo Shimizu [a], Kazushi Hotta [c], Takashi Fukaya [d], Mikio Karasawa [e], Eiji Ikeda [f], Yasuyoshi Wadano [g]

Deep tissue injuries in 45% of players

Spinal cord injuries and daily life use of wheelchairs more likely to develop injuries, particularly in the sacral region.

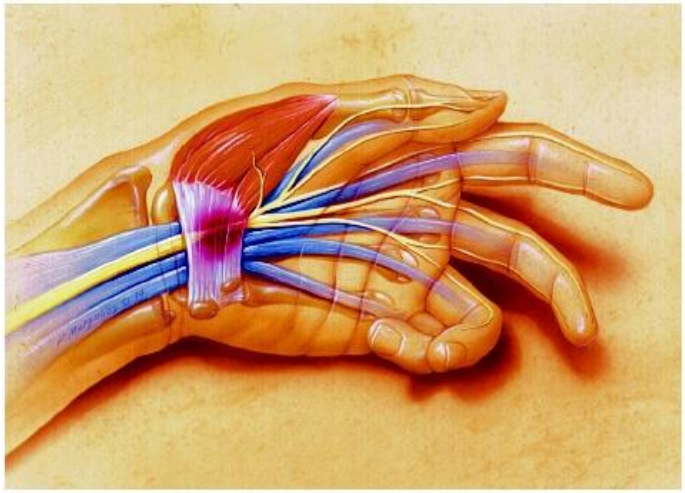
a periodic medical check is necessary for players to maintain their sporting life

Treatment- prevention

- Monitor skin closely
- Proper fitting
- Proper padding
- Friction reducing material on arms, chest wall, axilla
- Gloves

Nerve entrapments

- incidence of CTS (49% to 63%)
- Carpal Tunnel Syndrome increases with the length of time after the injury.
- 27% 1 - 10 years from injury
- 54% 11 - 20 years from injury
- 90% 31+ years from injury



  - Ulnar neuropathy at wrist
  - Ulnar neuropathy at elbow

Treatment

- usually conservative, involving rest, immobilization, and NSAID
- most wheelchair users will not undergo any of these treatments due to loss of independence and mobility.
- Usually the condition worsens to the point where surgery is necessary to release the transverse carpal ligament.
- ice to the wrists for 20 minutes at the end of each day
- flexibility/strengthening program for wrist flexion/extension.
- gloves

Relation Between Median and Ulnar Nerve Function and Wrist Kinematics During Wheelchair Propulsion

Michael L. Boninger, MD, Bradley G. Impink, BSE, Rory A. Cooper, PhD, Alicia M. Koontz, PhD

Arch Phys Med Rehabil Vol 85, July 2004

Greater wrist flexion and extension increased pressure in the carpal canal

Clinicians should consider advising manual wheelchair users to take **long smooth strokes** when propelling a wheelchair as a possible way to reduce the risk of injury.

Concussions

- Traumatic Brain Injury (TBI)
  - Wear proper protective equipment
  - More common in rugby, basketball and racing
  - Ensure all equipment is maintained and safe
    - Wheelchairs and anti-tip bars

Concussions

Maddock's questionaire is a quick simple and practical tool which can be administered either on-field or on the sidelines.

- Which field are we at?
- Which team are we playing today?
- Who is your opponent at present?
- Which half/period is it?
- How far into the half is it?
- Which side scored the last touchdown/goal/point?

Any incorrect response indicates concussion and requires removal from the playing field for further medical evaluation

ORIGINAL ARTICLE

Arch Phys Med Rehabil Vol 93, February 2012

Concussions in Wheelchair Basketball

Karla K. Wessels, MS, ATC, Steven P. Broglio, PhD, ATC, Jacob J. Sosnoff, PhD

263 wheelchair basketball players

6.1% in current season.

Males: 5.82% during the current season, and

14.36% during their athletic career.

Female: 6.67% and **30.6%**

Women were 2.5 times more likely to sustain a concussion than men.

Shoulder problems

Shoulder pain is epidemic among persons with SCI

Occurs upon initiation of most upper-extremity activities of daily living, including :

- transfers to and from the wheelchair,
- wheelchair propulsion,
- pressure relief,
- reaching,
- dressing, exercise/**sport**,
- most self-care activities

Epidemiology

In patients with **paraplegia** shoulder pain increases at 5 years (30% to 50%) and 20 years (70%) after SCI. **63%** having rotator cuff injuries versus 15% of healthy control

In patients with **quadriplegia**, occurs early on in the acute phase (0 to 5 years after SCI) and is found in 78% of patients within the first **6 months** after SCI.

In 75% of patients, the term **"weight-bearing shoulder"** can hide real shoulder pathologies:

simple tendinitis, subacromial bursitis

rotator cuff tear, biceps tendinopathy

Arthritis, avascular necrosis of the humeral head

Biomechanics, pathophysiology

Motion represents a closed kinetic chain since the hand is fixed

The most mechanically demanding shoulder activities:

- wheelchair propulsion, sitting pivot transfers,
- push-up weight reliefs, sporting

Free propulsion: peak shoulder joint forces 46 N posterior and 14 N superior

Fast and inclined propulsion: peak vertical force increased > 360%, and the increase in posterior force and shoulder moments ranged from 107% to 167%.

ORIGINAL ARTICLE

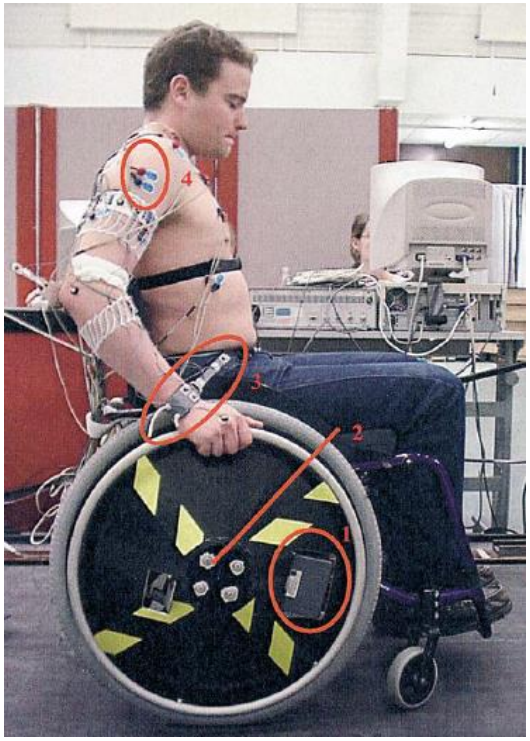
Mechanical Load on the Upper Extremity During Wheelchair Activities

Arch Phys Med Rehabil Vol 86, June 2005

Stefan van Drongelen, MSc, Lucas H. van der Woude, PhD, Thomas W. Janssen, PhD, Edmond L. Angenot, MD, Edward K. Chadwick, PhD, DirkJan H. Veeger, PhD

Peak shoulder and elbow moments were significantly higher for **weight-relief lifting** than for reaching, level propulsion, and riding on a slope

The high loads during ADL tasks might be a risk factor for overuse of the upper-extremity joint



Risk factors

- tetraplegia,
- duration of SCI,
- older age,
- higher body mass index,
- use of a manual wheelchair,
- poor seated posture,
- decreased flexibility, and
- muscle imbalances in the rotator cuff and scapular stabilizing muscles.

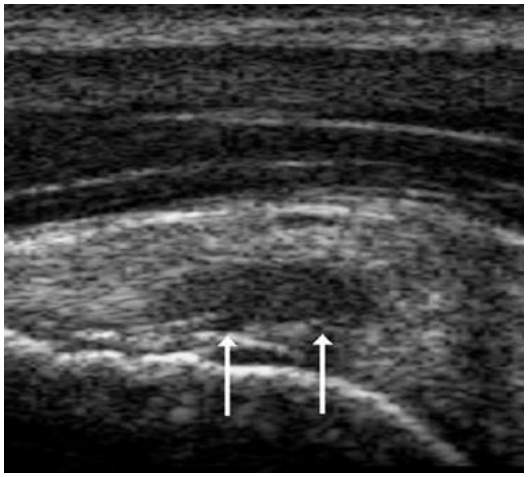
ORIGINAL ARTICLE

Shoulder Ultrasound Abnormalities, Physical Examination Findings, and Pain in Manual Wheelchair Users With Spinal Cord Injury

Steven W. Brose, DO, Michael L. Boninger, MD, Bradley Fullerton, MD, Thane McCann, MD, Jennifer L. Collinger, BSE, Bradley G. Impink, BSE, Trevor A. Dyson-Hudson, MD

Arch Phys Med Rehabil Vol 89, November 2008

The US findings were correlated with **age**, **duration** of SCI, and **weight** and showed a positive trend with the total Wheelchair User's Shoulder Pain Index (WUSPI).



absence of pain does not represent absence of shoulder pathology, and pain may be a marker for future shoulder pathology

Treatment

- Prevention
- Modification (wheelchair, sporting, activities, postural abnormalities)
- Conservative (rest, NSAIDs, corticosteroid injections, cold/heat, ultrasound application)
- Special exercise programs (stretching anterior and posterior shoulder and strengthening of scapular muscles and external rotators)
- Surgery

Rotator cuff surgery in persons with spinal cord injury: relevance of a multidisciplinary approach

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J Shoulder Elbow Surg (2014) ■, 1-9

38 shoulders in 28 patients.

At operation injuries were more severe than in preop evaluation

The mean satisfaction index in operated patients was 8.5 of 10.

Multidisciplinary approach (surgeon, physician, physiotherapist, and occupational therapist)

Checklist of preventive strategies to minimize shoulder pain in patients with SCI

Bringing the patient to the shoulder-level environment

Adapting the patient's home environment

Postural correction

Specific shoulder muscle strategies

Preventing weight gain and obesity

Preventing muscle fatigue

Endurance training

Advising against deleterious sporting activities (eg, bench press)

Using technical aids (eg, transfer board)

Elbow problems

17% of overuse injuries of the arm

Throwing and racquet sports

Lateral epicondylitis most common

medial epicondylitis,
cubital tunnel syndrome (ulnar nerve)
pronator teres syndrome (median nerve)

Wrist problems

Usually in wheelchair racing, racquet sports

Different types of tendinitis

De Quervain's Tenosynovitis
(In racing the wrist ends the propulsion in ulnar deviation)

Conclusions

Exercise and sport training in the disabled

Physical benefits

- general fitness
- cardiovascular conditioning
- cardiopulmonary endurance
- muscle strength
- flexibility
- postural control
- balance

Psychological benefits

- improved motivation
- self-confidence
- self-esteem,
- personal adjustment
- competitive spirit
- reduced anxiety
- reduced tendency to withdraw

Conclusions

- Safe environment
- Appropriate, well maintained equipment
- Individualization of training
- Warning signs of impending injury
- Warm-up, stretching, and cool-down
- Appropriate training prescription

(mode, duration, frequency, intensity, progression)

- Surgery when indicated

I act, therefore I am: Athletic identity and the health action process approach predict sport participation among individuals with acquired physical disabilities

Marie-Josée Perrier [a,*], Shane N. Sweet [a], Shaelyn M. Strachan [b], Amy E. Latimer-Cheung [a]

Psychology of Sport and Exercise 13 (2012) 713–720

Health Action Process Approach (HAPA) model

Athletic identity is the extent to which people identify themselves as athletes