Descriptive Epidemiology of Musculoskeletal Injuries in the Military

Mita Lovalekar, MBBS, PhD, MPH

*Neuromuscular Research Laboratory
Department of Sports Medicine and Nutrition
University of Pittsburgh
Pittsburgh, PA
Background

- Injuries and injury-related musculoskeletal conditions are common in Military populations
- The first step in the public health model as applied to injury prevention is to describe the burden of injuries
Warrior Human Performance Research at the University of Pittsburgh
Purpose

The purpose of this presentation is to describe the epidemiology of injuries among two groups of Military personnel who participated in the WHPRC (Warrior Human Performance Research Center) research at the University of Pittsburgh:

– Army 101st Airborne (Air Assault) Division Soldiers
– Naval Special Warfare Naval Special Warfare Sea, Air, and Land Operators
Learning Objectives

- Identify the frequency of musculoskeletal injuries that occur among
  - Army 101st Airborne (Air Assault) Division Soldiers
  - Naval Special Warfare Sea, Air and Land Operators
- Describe common types of musculoskeletal injuries in these subjects
Methods

- Source of data - Musculoskeletal injuries recorded in the subjects’ medical records
- Musculoskeletal injuries were described and classified according to their frequency, anatomic location, anatomic sub-location, cause, type, activity during injury, onset, mechanism, and potential for prevention
- Injuries that occur during a one year period
- Data were collected using the UPitt-MED (University of Pittsburgh Military Epidemiology Database), by a clinician trained by University of Pittsburgh faculty
Methods

• Subjects:
  – Army 101st Soldiers (N = 451)
    • Age = 27.6 ± 6.2 years (mean ± SD)
    • Height: 1.8 ± 0.1 meters
    • Weight: 81.9 ± 13.8 kilograms
  – NSW SEAL Operators (N = 210)
    • Age = 28.1 ± 6.0 years
    • Height: 1.8 ± 0.1 meters
    • Weight: 85.4 ± 9.3 kilograms
**Methods**

- Injury Definition
  - An unintentional musculoskeletal injury is an injury to the musculoskeletal system (bones, ligaments, muscles, tendons, etc.) that, if occurring after enlistment, resulted in alteration in tactical activities, tactical training, or physical training for a minimum of one day, regardless if medical attention was sought.
  - This includes conditions such as sprains, strains, and fractures (broken bones), but not hernias, contusions (bruises), or lacerations (cuts).
Assessments

Overview
Demographics
Medical History
Injury History
Nutrition
Training Habits
Weight & Body / Food
Dietary Supplements
Supplement Details
Lab Data
Report

Actions
Save & Continue
Save & Go Home
Cancel & Go Home
Cancel & Log Out

Help
User Guide
Change Password
Request Assistance

Injury - SWCC200

Location and Type
Which side of the body was injured?
- Left
- Right
- Bilateral
- Midline
- Not Applicable
- Other

Anatomical Location:
- Lower extremity
- Upper extremity
- Torso
- Spine
- Head / Face
- Unspecified

Sub-location 1:
- Cervical
- Thoracic
- Lumbar pelvic
- Other

Injury Type:
- Disc injury
- Fracture
- Degenerative joint disease
- Laceration / puncture / wound
- Nerve
- Sprain
- Stress fracture
- Lumbar compression fracture
- Pain / Soreness / ache
- Other

Sub-location 2:
- Quadratus lumborum
- Paraspinals
- Outlets
- Other

Grade:
- 1
- 2
- 3

Describe injury:
Deadlift 225 felt pull in lower back when lifting, used straps rather than grip

Onset:
- Acute
- Chronic (lasting more than 6 months)
- Other

Recurrent injury?
- First time
- Recurrent
- Other
<table>
<thead>
<tr>
<th>Activity Type</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Training</td>
<td>Boxing, Fast Roping, Obstacle Course, Weight Lifting, Other, BCT</td>
</tr>
<tr>
<td>BUDS</td>
<td>Fishing, Running, Wrestling</td>
</tr>
<tr>
<td>Tactical Training</td>
<td>Boating, Explosives/Munitions, Machinery/Tools, Small Arms, Wrestling</td>
</tr>
<tr>
<td>BCT</td>
<td>Other Military Operation, Command and Control</td>
</tr>
<tr>
<td>Combat</td>
<td>Boating, Explosives/Munitions, Machinery/Tools, Small Arms, Combat</td>
</tr>
<tr>
<td>Occupational Tasks</td>
<td>Loading weapon, Unloading weapon, Occupational Tasks</td>
</tr>
<tr>
<td>Recreational Activity / Sports</td>
<td>Basketball, Boxing, Football, Mixed Martial Arts, Running, Swimming,</td>
</tr>
<tr>
<td>WRESTLING</td>
<td>Boating, Cycling, Hunting, Rugby, Skiing, Weight Lifting</td>
</tr>
<tr>
<td>Other</td>
<td>Other, Not Specified / Other</td>
</tr>
<tr>
<td>Motor Vehicle Accident</td>
<td>Military Motor Vehicle, Personal Motor Vehicle</td>
</tr>
<tr>
<td>Pedestrian / Cyclist</td>
<td></td>
</tr>
<tr>
<td>Not Specified / Other</td>
<td>Other, Not Specified / Other</td>
</tr>
</tbody>
</table>
Injury Data Description

• Injury frequency/incidence
• Anatomic location
• Anatomic sub-location
• Activity when injury occurred
• Injury cause
• Injury type
• Preventable injuries
• Injury onset and mechanism
Injury Data Description

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Injury Frequency/Incidence

Army 101st Soldiers

- 133 injuries among 451 Army 101st Soldiers during a one year period
- Frequency: 29.5 injuries/100 subjects/year
- Incidence: 20.0 injured subjects/100 subjects/year

NSW SEAL Operators

- 63 injuries among 210 NSW SEAL Operators during a one year period
- Frequency: 30.0 injuries/100 subjects/year
- Incidence: 21.0 injured subjects/100 subjects/year
**Injury Data Description**

- Injury frequency/incidence
- **Anatomic location**
- Anatomic sub-location
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Injury Anatomic Location

Army 101st Soldiers
Number of injuries = 133

- Upper extremity: 21.1%
- Lower extremity: 60.2%
- Spine: 15.8%
- Torso: 3.0%

NSW SEAL Operators
Number of injuries = 63

- Upper extremity: 38.1%
- Lower extremity: 34.9%
- Spine: 23.8%
- Torso: 3.2%

Percent of injuries by anatomic location
Injury Data Description

• Injury frequency/incidence
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• Anatomic sub-location
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# Anatomic Sub-location

<table>
<thead>
<tr>
<th>Injury anatomic location</th>
<th>Anatomic sub-location</th>
<th>Army 101st Soldiers</th>
<th>NSW SEAL Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number of injuries (percent)</td>
<td>Number of injuries (percent)</td>
</tr>
<tr>
<td><strong>Lower extremity</strong></td>
<td>Hip</td>
<td>4 (3.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td></td>
<td>Knee</td>
<td>20 (15.0)</td>
<td>5 (7.9)</td>
</tr>
<tr>
<td></td>
<td>Ankle</td>
<td>23 (17.3)</td>
<td>6 (9.5)</td>
</tr>
<tr>
<td></td>
<td>Thigh</td>
<td>7 (5.3)</td>
<td>5 (7.9)</td>
</tr>
<tr>
<td></td>
<td>Lower leg</td>
<td>14 (10.5)</td>
<td>3 (4.8)</td>
</tr>
<tr>
<td></td>
<td>Foot and toes</td>
<td>12 (9.0)</td>
<td>3 (4.8)</td>
</tr>
<tr>
<td><strong>Upper extremity</strong></td>
<td>Shoulder</td>
<td>11 (8.3)</td>
<td>15 (23.8)</td>
</tr>
<tr>
<td></td>
<td>Elbow</td>
<td>2 (1.5)</td>
<td>0 (0.0)</td>
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<tr>
<td></td>
<td>Wrist</td>
<td>6 (4.5)</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td></td>
<td>Upper arm</td>
<td>1 (0.8)</td>
<td>2 (3.2)</td>
</tr>
<tr>
<td></td>
<td>Forearm</td>
<td>0 (0.0)</td>
<td>3 (4.8)</td>
</tr>
<tr>
<td></td>
<td>Hand and fingers</td>
<td>8 (6.0)</td>
<td>3 (4.8)</td>
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<tr>
<td><strong>Spine</strong></td>
<td>Cervical</td>
<td>1 (0.8)</td>
<td>3 (4.8)</td>
</tr>
<tr>
<td></td>
<td>Thoracic</td>
<td>5 (3.8)</td>
<td>4 (6.3)</td>
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<tr>
<td></td>
<td>Lumbopelvic</td>
<td>14 (10.5)</td>
<td>8 (12.7)</td>
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<tr>
<td></td>
<td>Other</td>
<td>1 (0.8)</td>
<td>0 (0.0)</td>
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<tr>
<td><strong>Torso</strong></td>
<td>Chest</td>
<td>2 (1.5)</td>
<td>2 (3.2)</td>
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<tr>
<td></td>
<td>Abdomen</td>
<td>2 (1.5)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>133</strong></td>
<td><strong>63</strong></td>
</tr>
</tbody>
</table>
Injury Data Description

- Injury frequency/incidence
- Anatomic location
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- Injury cause
- Injury type
- Preventable injuries
- Injury onset and mechanism
Activity When Injury Occurred

Army 101\textsuperscript{st} Soldiers
Number of injuries = 133

- Unknown: 42.9%
- Physical training: 29.3%
- Tactical training: 6.8%
- RAS: 5.3%
- MVA: 5.3%
- Other: 10.5%

NSW SEAL Operators
Number of injuries = 63

- Unknown: 22.2%
- Physical training: 19.0%
- Tactical training: 7.9%
- RAS: 12.7%
- MVA: 1.6%
- OT: 11.1%
- Other: 22.2%
- Combat: 3.2%

RAS: Recreational activity/ sports
OT: Occupational tasks
MVA: Motor Vehicle Accident

Percent of injuries by activity when injury occurred
Injury Data Description

- Injury frequency/incidence
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# Injury Cause

<table>
<thead>
<tr>
<th>Cause of Injury</th>
<th>Army 101st Soldiers</th>
<th>NSW SEAL Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Injuries (percent)</td>
<td>Number of Injuries (percent)</td>
</tr>
<tr>
<td>Crushing</td>
<td>0 (0.0)</td>
<td>3 (4.8)</td>
</tr>
<tr>
<td>Direct Trauma</td>
<td>12 (9.0)</td>
<td>4 (6.3)</td>
</tr>
<tr>
<td>Fall</td>
<td>8 (6.0)</td>
<td>4 (6.3)</td>
</tr>
<tr>
<td>Landing</td>
<td>5 (3.8)</td>
<td>2 (3.2)</td>
</tr>
<tr>
<td>Lifting</td>
<td>7 (5.3)</td>
<td>5 (7.9)</td>
</tr>
<tr>
<td>Marching</td>
<td>5 (3.8)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Running</td>
<td>18 (13.5)</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>Twist/Turn/Slip (no fall)</td>
<td>5 (3.8)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Other</td>
<td>11 (8.3)</td>
<td>6 (9.5)</td>
</tr>
<tr>
<td>Unknown</td>
<td>62 (46.6)</td>
<td>38 (60.3)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>133</strong></td>
<td><strong>63</strong></td>
</tr>
</tbody>
</table>
Injury Data Description

- Injury frequency/incidence
- Anatomic location
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## Injury Type

<table>
<thead>
<tr>
<th>Injury type</th>
<th>Army 101st Soldiers</th>
<th>NSW SEAL Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of injuries (percent)</td>
<td>Number of injuries (percent)</td>
</tr>
<tr>
<td>Bursitis</td>
<td>1 (0.8)</td>
<td>2 (3.2)</td>
</tr>
<tr>
<td>Contusion</td>
<td>1 (0.8)</td>
<td>0 (0.0)</td>
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<tr>
<td>Chondromalacia/patellofemoral pain</td>
<td>6 (4.5)</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>Degenerative joint disease</td>
<td>1 (0.8)</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>Disc injury</td>
<td>1 (0.8)</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>Fracture</td>
<td>7 (5.3)</td>
<td>7.0 (11.1)</td>
</tr>
<tr>
<td>Impingement</td>
<td>0 (0.0)</td>
<td>3 (4.8)</td>
</tr>
<tr>
<td>Inflammation – IT band</td>
<td>4 (3.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Inflammation – Plantar fascia</td>
<td>3 (2.3)</td>
<td>2 (3.2)</td>
</tr>
<tr>
<td>Inflammation – Shin splints</td>
<td>3 (2.3)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Inflammation - Other</td>
<td>1 (0.8)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Labral tear</td>
<td>1 (0.8)</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>Nerve</td>
<td>1 (0.8)</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>Pain / spasm / ache</td>
<td>39 (29.3)</td>
<td>12 (19.0)</td>
</tr>
<tr>
<td>Periostitis</td>
<td>1 (0.8)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Sprain</td>
<td>29 (21.8)</td>
<td>7 (11.1)</td>
</tr>
<tr>
<td>Strain</td>
<td>19 (14.3)</td>
<td>13 (20.6)</td>
</tr>
<tr>
<td>Stress fracture</td>
<td>1 (0.8)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Tendonitis / tenosynovitis / tendonopathy</td>
<td>2 (1.5)</td>
<td>6 (9.5)</td>
</tr>
<tr>
<td>Other</td>
<td>8 (6.0)</td>
<td>2 (3.2)</td>
</tr>
<tr>
<td>Unknown</td>
<td>1 (0.8)</td>
<td>3 (4.8)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>133</strong></td>
<td><strong>63</strong></td>
</tr>
</tbody>
</table>
Injury Data Description

- Injury frequency/incidence
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- Injury cause
- Injury type
- Preventable injuries
- Injury onset and mechanism
Preventable Injuries

- Injury definition ("Preventable" Injury)
  - An unintentional injury that may be reduced through injury prevention programs
  - Examples include
    - Inversion ankle sprain sustained while walking/running on uneven terrain
    - Low back strain that occurred while lifting a load onto a truck
    - Overuse injuries (e.g. stress fracture, ITBS, tendinopathy, etc.)
    - Noncontact knee sprain during cutting or landing
Preventable Injuries

• Army 101st Soldiers:
  – Fifty two musculoskeletal injuries (52/133, 39.1% of injuries) were potentially preventable by an injury prevention training program
  – The frequency of preventable musculoskeletal injuries was 11.5 injuries per 100 subjects per year

• NSW SEAL Operators:
  – Twenty four musculoskeletal injuries (24/63, 38.1% of injuries) were potentially preventable by an injury prevention training program
  – The frequency of preventable musculoskeletal injuries was 11.4 injuries per 100 subjects per year
Injury Data Description

• Injury frequency/incidence
• Anatomic location
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• Injury type
• Preventable injuries
• Injury onset and mechanism
Injury Onset and Mechanism

Army 101st Soldiers

- Injury onset:
  - Acute: 89/133, 66.9%
  - Chronic: 13/133 = 9.8%
  - Unknown: 31/133 = 23.3%

- Mechanism of injury:
  - Non-contact: 76/133 = 57.1%
  - Contact: 13/133 = 9.8%
  - Unknown: 44/133 = 33.1%

NSW SEAL Operators

- Injury onset:
  - Acute: 35/63, 55.6%
  - Chronic: 11/63 = 17.5%
  - Unknown: 17/63 = 27.0%

- Mechanism of injury:
  - Non-contact: 29/63 = 46.0%
  - Contact: 8/63 = 12.7%
  - Unknown: 26/63 = 41.3%
# Summary

<table>
<thead>
<tr>
<th></th>
<th>Army 101st Soldiers</th>
<th>NSW SEAL Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury frequency</td>
<td>29.5 injuries/100 subjects/year</td>
<td>30.0 injuries/100 subjects/year</td>
</tr>
</tbody>
</table>
| Anatomic location | LE: 60.2%  
UE: 21.1% | UE: 38.1%  
LE: 34.9% |
| Sub-location | Ankle: 23/133 = 17.3% | Shoulder: 15/63 = 23.8% |
| Activity, Cause data | Missing: 42.9%, 46.6% | Missing: 22.2%, 60.3% |
| Injury type | Pain/ spasm/ ache: 39/133 = 29.3%  
Sprain: 29/133 = 21.8% | Strain: 13/63 = 20.6%  
Pain / spasm / ache: 12/63 = 19.0% |
| Preventable injuries | 39.1% | 38.1% |
Conclusions

- Musculoskeletal injuries, especially those affecting the ankle, knee, shoulder and lumbo-pelvic region of the spine, occur frequently among Military personnel.
- Many of these injuries are potentially preventable.
References


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  – Army: This work was supported by the U.S. Army Medical Research and Materiel Command under award number W81XWH-06-2-0070/W81XWH-09-2-0095/W81XWH-11-2-0097. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Department of Defense, or U.S. Army Medical Research and Materiel Command
  – NSW: This work was supported by the Office of Naval Research #N00014-11-1-0929. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Department of Defense, Office of Naval Research, or Naval Special Warfare Command

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Thank you