Load carriage for emergency responders

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Load Carriage for Emergency Responders
CONTENT:

• Load carriage context
• Risks associated with load carriage
• Risk enhancers
• Load carriage conditioning
FIREFIGHTER CONTEXT

- Context and scope of practice has changed

1770

http://upload.wikimedia.org/wikipedia/commons/thumb/6/66/Old_firefighters.jpg/220px-Old_firefighters.jpg

1879

http://upload.wikimedia.org/wikipedia/commons/4/43/Vintage_firefighters.jpg

2012

http://www.stacksplace.com/EMS/ffadd1.jpg
LAW ENFORCEMENT CONTEXT

1890s

1970s

2010


LAW ENFORCEMENT CONTEXT

2012

1970s

Spare magazine for Glock
OC spray
Radio
Handgun
Baton
Handcuffs
Handbag containing gun, baton and handcuffs

RADIO SPEAKER
CARABINER CLIP
PROTECTIVE VEST
EAR PIECE
POUCH
GUN
CUFFS
TASER AND CARTRIDGES

http://img.dailymail.co.uk/i/pix/2008/04_03/TabGunGirlLEWIS_468x715.jpg
SAR CONTEXT
SAR CONTEXT

Conolly et al., 2015

- Prolonged hiking with loaded backpack (30–50 lbs), helmet, and harness in mountainous terrain
- Litter loads can be in excess of 100 lbs
- Maintain squat or semi-squat position with around 17% BW load.
RISKS ASSOCIATED WITH LOAD CARRIAGE

• Injuries: Associated with a variety of injuries (from skin blistering to muscle, ligament, tendon, bone and nervous system injuries)

https://www.reddit.com/r/MedicalGore/comments/9s02i6/soldiers_feet_after_walking_around_in_tight_boots/
RISKS ASSOCIATED WITH LOAD CARRIAGE

- Some differences may exist between genders

Comparison of Reported Load Carriage Injuries Captured By Survey (1999-2010) and By OSCHAR (2009-2010)

<table>
<thead>
<tr>
<th>Body Site</th>
<th>Survey Data</th>
<th>OSCHAR Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper limb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper torso</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trunk (Abdominal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pelvis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower limb</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Percentage of Injuries

- Site of Injury
  - Head
  - Neck and Shoulder
  - Upper limb
  - Hand
  - Upper Torso
  - Abdomen
  - Back
  - Trunk andAbdominal locations
  - Hip
  - Thigh
  - Knee
  - Ankle
  - Forefoot
  - Gastrocnemius
  - Other specified multiple locations

Disaster & Emergency Management Conference 2021
RISKS ASSOCIATED WITH LOAD CARRIAGE

• No literature has been found to specially investigate load carriage injuries in SAR. However, **musculoskeletal injuries consisting of sprains, strains, fractures, and dislocations to shoulder, knee, ankle, and fingers** have been reported as injury natures and sites in SAR personnel (Conolly et al., 2015; Iserson, 1989).
RISKS ASSOCIATED WITH LOAD CARRIAGE

• Decrement in performance:
  – ↓ Mobility
    • Increased risk of trip and fall
    • Decreased ability to negotiate escape routes
RISK ENHANCING FACTORS

• ↑ in load weight = ↑ in the energy cost of standing, walking (forwards and backwards, up and down stairs) and running

• ↑ in speed of load carriage = ↑ in the energy cost of carrying given load (more than weight)? ↑ 0.5km/h = ↑ 10kg
RISK ENHANCING FACTORS

• ↑ in gradient of load carriage = ↑ in the energy cost of carrying given load (more than weight)?
  ↑ 1% = ↑ 10kg
RISK ENHANCING FACTORS

- Different terrains types will elicit different energy cost requirements
  
  *(road-light brush-heavy brush-sand)*
RISK ENHANCING FACTORS
• Differences in load placement will elicit differences in energy cost.
  – Weight on the feet more costly than the back
  – Thigh more costly that back (0.5kg ↑ cost by 3.5%)
  – Shoulder more costly than back
  – Hands around 2 x more costly than back*
RISK ENHANCING FACTORS

- Soule and Goldman (1969) found the cost of carrying a 7 kg load in the hands to be nearly twice that of carrying the load on the torso.
- Datta and Ramanathan (1971) observed a significantly higher (p<.05) cost of load carriage in the hands (mean of 6.96 KCAL/min) than on the back (mean of 5.27 KCAL/min).
RISK ENHANCING FACTORS

- Knapik et al., 2000
  - Load carriage times were significantly shorter when loads were carried in the hands (81 – 88%; p<.01) when compared to the innovative methods.
RISK ENHANCING FACTORS

• Unilateral v Bilateral Loads in the hand
  – Unilateral hand loading can:
    • increase hip muscle activity to twice that for the same load carried bilaterally (Neumann, Cook, Sholty, & Sobush, 1992),
    • cause gait asymmetry (Zhang, Ye, & Wang, 2010) and
    • potentially increase further energy expenditure (Datta & Ramanathan, 1971).
LOAD CARRIAGE CONDITIONING

• Concept is not new (Flavius Vegetius Renatus - Epitoma rei militaris)
• Common in military training but in SAR?
LOAD CARRIAGE CONDITIONING

Research by Orr et al. (2010) and Knapik et al., (2012) recommend:

- **F.I.T.T Formula (Frequency, Intensity, Time & Type)**
  - F. 7-10 days per load carriage session
  - I. To loads required at the *speeds and over the terrains* required
  - T. Duration of load carriage operations
  - T. Load carriage preferable, but combined resistance and cardio may be of some benefit
LOAD CARRIAGE CONDITIONING

- Specificity
Take Home Messages

• Load carriage reduces performance and can cause injuries = decreased operational success
• Load carriage is about more than the load weight, terrain type and grade, speed of movement and load position must be taken into account
• To minimise the risk of injury and increase the potential for operational success SAR personnel need to be conditioning to carry load
REFERENCES

REFERENCES


- Neumann DA, Cook TM, Sholty RL, et al. (1992). An electromyographical analysis of hip abductor muscle activity when subjects are carrying load in one or both hands. Physical Therapy, 72(3):207-17
REFERENCES

REFERENCES


