Australian Tactical Loads and their Operational Impacts

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Australian Tactical Loads and their Operational Impacts

Dr Rob Orr (PhD, PHTY, BFET, TSAC-F, ADFPTS)
Background

- From the early Assyrian spearman of antiquity (circa 800 B.C.), soldiers have been required to carry external loads consisting of weaponry, equipment and food (Orr, 2010; Knapick et al., 2012:2004)

- Downstream effects of these loads have been shown to impact on the tactics of warfare, cause injury and reduce fighting force size (Lee, 2007; Breen, 2002; Lothian, 1921)
HISTORICAL CONTEXT – MILITARY

(Orr, 2010: Orr et al., 2015)
CURRENT CONTEXT – AUSTRALIAN ARMY

On Operations (2001-2010)

- **PO loads**
  - $M = 28.4 \pm 10.0$ kg
  - Heaviest mean load in 2008 ($M = 36.9 \pm 10.8$ kg)

- **MO loads**
  - $M = 56.7 \pm 15.3$ kg
  - Heaviest mean load in 2009 ($M = 65.1 \pm 16.3$ kg)

- **OVERALL loads**
  - $47.7 \pm 21.0$ kg, (mean range over 10 years = 40.7 kg to 50.9 kg),

(Orr et al., 2015)
CURRENT CONTEXT – AUSTRALIAN ARMY

• Approximate relative load carried by Roman Legionnaires = 56%
• Australian Soldiers in East Timor = 56%
• US Soldiers in Afghanistan = 57%
ABSOLUTE VS RELATIVE LOADS

- Currently female soldiers carry lighter absolute loads than male soldiers but only slightly heavier relative loads

<table>
<thead>
<tr>
<th></th>
<th>ABSOLUTE LOADS*</th>
<th>RELATIVE LOADS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEMALE: $M = 26.4 \text{ kg}$</td>
<td></td>
<td>$M = 43%$</td>
</tr>
<tr>
<td>MALE: $M = 39.0 \text{ kg}$</td>
<td></td>
<td>$M = 47%$</td>
</tr>
<tr>
<td>$p=.045$</td>
<td></td>
<td>$p=.55$</td>
</tr>
</tbody>
</table>

ABSOLUTE VS RELATIVE LOADS

• Currently lighter soldiers carry the same absolute loads as heavier soldiers but heavier relative loads

ABSOLUTE LOADS

Light 20%: $M = 34.7$ kg

Heavy 20%: $M = 35.7$ kg

$\rho= .902$

RELATIVE LOADS

Light 20%: $M = 49\%$

Heavy 20%: $M = 36\%$

$\rho= .0509$

HISTORICAL CONTEXT – LEO

http://2.bp.blogspot.com/-xH5ILURzFMO/l1l6wRbEgAI/AAAAAAAAEpc/54yapn_tbtE/s1600/Curious+Black+%26+White+Photographs+of+The+Police+Officers+from+1890–1930+(28).jpg


https://bond.edu.au/tru
HISTORICAL CONTEXT – LEO

- Police are becoming Christmas trees

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

HISTORICAL CONTEXT - LEO

• Increasing levels of threat
**HISTORICAL CONTEXT – AUSTRALIAN LEO**

<table>
<thead>
<tr>
<th>ILAV type (A-C) &amp; Normal station wear (N)</th>
<th>ILAV Weight (kg)</th>
<th>Duty load Complete (kg)</th>
<th>Total load including officer weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.12 ± 0.65*</td>
<td>11.53 ± 0.77‡</td>
<td>88.03 ± 20.49</td>
</tr>
<tr>
<td>B</td>
<td>3.54 ± 0.70*</td>
<td>11.01 ± 1.01‡</td>
<td>87.51 ± 20.60</td>
</tr>
<tr>
<td>C</td>
<td>3.24 ± 0.48*</td>
<td>10.77 ± 1.16‡</td>
<td>87.27 ± 20.66</td>
</tr>
<tr>
<td>N</td>
<td>NA</td>
<td>8.69 ± 0.68</td>
<td>85.19 ± 20.24</td>
</tr>
</tbody>
</table>

* Significantly different (p<0.05) between vests:
‡ Significantly different (p<0.001) from normal station wear

(Orr et al., 2016)
CURRENT CONTEXT – AUSTRALIAN LEO

<table>
<thead>
<tr>
<th>ILAV type</th>
<th>FEMALE ILAV + Duty Loads (kg)</th>
<th>MALE ILAV + Duty Loads (kg)</th>
<th>FEMALE %BW</th>
<th>MALE %BW</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>10.80</td>
<td>11.18</td>
<td>16.43</td>
<td>13.91</td>
</tr>
<tr>
<td>C</td>
<td>10.24</td>
<td>11.22</td>
<td>15.60</td>
<td>13.95</td>
</tr>
<tr>
<td>N</td>
<td>8.68</td>
<td>8.70</td>
<td>13.20</td>
<td>10.92</td>
</tr>
</tbody>
</table>

*p=0.225

*p=0.009

(Orr et al., 2016)
• The LEO study found female officers carried the same absolute loads compared to the male officers.
• However, when expressed as a percentage of their body weight, female officers carried significantly more relative load than male officers.

(Orr et al., 2016)
**CURRENT CONTEXT – AUSTRALIAN LEO (TOU)**

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute load carried (kg)</td>
<td>22.8 ± 1.8</td>
<td>20.6-25.6</td>
</tr>
<tr>
<td>Relative load carried (%BW)</td>
<td>25.9 ± 4.0</td>
<td>21.2-28.8</td>
</tr>
</tbody>
</table>

(Carbone et al., 2014; Carlton et al., 2014)
SEX DIFFERENCES IN LC INJURIES


• Mean ARA population over 2 years = 24,876 personnel
  • Female n= 2441 (10%): Male n= 22435 (90%)

• 401 reported injuries associated with load carriage
  • Female n=40 (10%): male n= 361 (90%)
  • RR = 1.02 (95% CI 0.74 to 1.41)

• SPI
  • Female n=6 (15%): male n= 23 (6%)
  • RR of SPI = 2.40 (95% CI 0.98 to 5.88)
IMPACTS ON PERFORMANCE - MARKSMANSHIP

• Decrements in performance:
• Reduced performance
  • Survey of 218 soldiers on operations

(Orr et al., 2013)
IMPACTS ON PERFORMANCE - MARKSMANSHIP

- Distance to centre of target
  - DCOT
- Horizontal shot spread
  - X-Dispersion
- Vertical shot spread
  - Y-Dispersion

Carbone et al., 2014
IMPACTS ON PERFORMANCE - MARKSMANSHIP

• Mobility Task

Carbone et al., 2014
• Marksmanship

Carbone et al., 2014
IMPACTS ON PERFORMANCE - MARKSMANSHIP

• No significant difference when TL

Orr et al., Unpublished

https://bond.edu.au/tru
IMPACTS ON PERFORMANCE - MARKSMANSHIP

• Visual Analogue Scale (VAS)

Orr et al., Unpublished
IMPACTS ON PERFORMANCE - MARKSMANSHIP

- Perceived significant improvement in marksmanship when TL
  - Primary – VAS +3.00 ± 2.53 (p = 0.016)
  - Secondary – VAS +2.83 ± 2.93, (p = 0.039)

- Correlations between perceptions of load carriage impacts on performance and actual marksmanship scores
  - Primary: Short move: $r = -0.347$, (p = 0.500) and mobility task: $r = -0.401$ (p = 0.431)
  - Secondary: Short move: $r=-0.631$ (p = 0.179) and mobility task: $r = -0.306$, (p = 0.555)

Orr et al., Unpublished
IMPACTS ON PERFORMANCE - MARKSMANSHIP

• GD police (n=11)
  • Average marksmanship scores (p=.118)
  • ILAV B – smallest SD,
    • ILAV A: a negative impact, -2.1 (95% CI -5.5 to +1.3)
    • ILAV B: a positive impact, +2.7 (95% CI +0.4 to +5.0)
    • ILAV C: a negative impact, -1.7 (95% CI -4.4 to +0.9)
    • Normal station wear: a positive impact, +1.4 (95% CI -2.2 to +5.0)

Schram et al., unpublished
Schram et al., unpublished
IMPACTS ON PERFORMANCE - MOBILITY

• Decrements in performance:
  • ↓ Mobility
    • Impeded mission success (Breen 2000)
IMPACTS ON PERFORMANCE - MOBILITY

- Victim Drag (10m)
- Police Vehicle Exit and Sprint

<table>
<thead>
<tr>
<th>Condition</th>
<th>Victim Drag</th>
<th>Vehicle Exit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ILAV A</td>
<td>5.74±0.28</td>
<td>3.49±0.94</td>
</tr>
<tr>
<td>ILAV B</td>
<td>5.47±0.23</td>
<td>3.41±0.87</td>
</tr>
<tr>
<td>ILAV C</td>
<td>5.50±0.38</td>
<td>3.40±1.06</td>
</tr>
<tr>
<td>N</td>
<td>5.56±0.43</td>
<td>3.41±0.85</td>
</tr>
</tbody>
</table>

Schram et al., unpublished
# IMPACTS ON PERFORMANCE - MOBILITY

Carlton et al., 2014

<table>
<thead>
<tr>
<th></th>
<th>Unloaded</th>
<th>Loaded</th>
</tr>
</thead>
<tbody>
<tr>
<td>10m sprint (sec)</td>
<td>2.40 ± 0.22</td>
<td>2.46 ± 0.15</td>
</tr>
<tr>
<td>10m dummy drag (sec)</td>
<td>6.89 ± 0.44</td>
<td>7.79 ± 0.75*</td>
</tr>
<tr>
<td>Total time (sec)</td>
<td>9.29 ± 0.53</td>
<td>10.25 ± 0.77*</td>
</tr>
</tbody>
</table>

* Indicates statically significant differences between unloaded and loaded, p<0.01.
ENCAPSULATION

• Loads for both LEO and Army are increasing
• Female soldiers carry lighter absolute but similar relative loads
• Female LEO carry similar absolute but heavier relative loads
• There are differences in injuries sustained based on sex
• There are different impacts of load on marksmanship (primary / secondary weapon)
• Soldiers think load reduces marksmanship, LEO varies but appear accurate
• Load impacts on mobility – but the load may need to reach a threshold
Australian Tactical Loads and their Operational Impacts

References avail on request from tru@bond.edu.au

Australian Government
Department of Defence
Science and Technology

4th International Congress on Soldiers’ Physical Performance
28 November - 1 December 2017
Melbourne Australia

https://bond.edu.au/tru