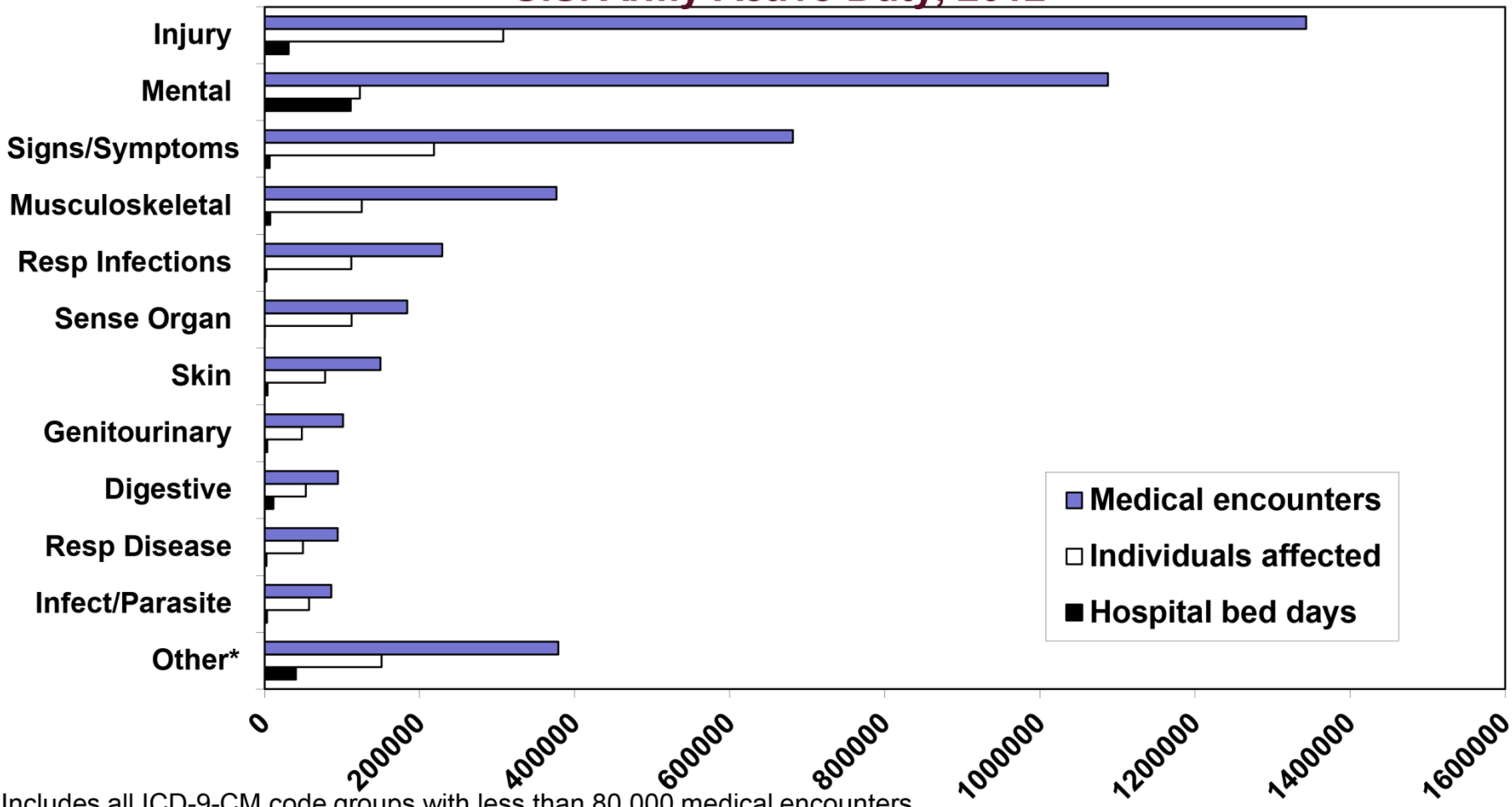
Association of Health Behaviors and Risk Factors for Injury: A Study of Military Personnel

Magnitude of the Problem:

Relative Burden of Injuries and Diseases, U.S. Army Active Duty, 2012



*Includes all ICD-9-CM code groups with less than 80,000 medical encounters
Diagnosis group Injury contains both injury and musculoskeletal related injuries
Data source: Defense Medical Surveillance System, 2013; Prepared by Army Institute of Public Health, Injury Prevention Program

Background

Injury Consequences:

•Approximately half of all deaths, disabilities, and outpatient medical visits within the United States Army appear to be due to accidental injuries[1]

•Injury-related medical costs and lost manpower pose a financial burden to the U.S. Army [2-4]

•Injury related Limited duty prevents Soldiers from returning to work/training

•Therefore, injuries compromise military readiness

[1] Knapik, J. J et al. (2004) [2] Jones, B. H et al. (1999). [3] Knapik, J.J., et al. (2001). [4] Jones S.B., et al. (2008).

Pictures from http://www.defenseimagery.mil

Training related injuries during basic combat training

•Knapik et al (2001)
•Population: 756 men and 456 women enrolled in Army Basic Combat Training (BCT)
•Women had twice the injury risk compared to men
•Majority of Injuries involved lower body and low back for Men (83%) and Women (87%)

•Injury Risk – Multivariate Analysis
- •Lower levels of physical activity (Men only)
- •Low aerobic endurance
- •Fewer push up capacity during Army Physical Fitness Testing (APFT)
- •Smoking

• Several Studies have found similar results in Army Basic Training:
- •Kowal (1980), Bensel (1982), Jones (1984), Bell (1988), Canham(1995), Knapik (2000), Knapik (2003)

Injuries in Active Duty Army Infantry

- **Grier et al, 2010 (unpublished data)**

- Subjects: 1,393 Soldiers from a Combat Team in an Infantry Division
- Self-reported injuries (12 months)
- Top 3 Injury Types:
  - Strain/Sprain (45%)
  - Broken/Fracture Bone (14%)
  - Pain (6%)

- Top 3 Activities causing injury:
  - Running(28%)
  - Walking, Hiking or Marching (16%)
  - Exercising (16%)

- Several Studies have found similar results in Active Duty units:
  - Knapik (2007), Reynolds (1994),Jones (1993)

Musculoskeletal injuries in Soldiers deployed to Afghanistan

- Roy et al 2012
- 593 Soldiers
- 45% reported an injury in the past 12 months
- Injury risk factors
  - Older age and Higher enlisted rank
  - Women
  - Months deployed
  - More time spent standing
  - Long strength training sessions
  - heavy loads worn
  - Heavy/more frequent lifting tasks

- Most common injury diagnoses:
  - Sprain/strain 33%
  - Bruise 8%
  - Pinched nerve 6%
- Activities Associated with Injury:
  - Lifting/Carrying 10%
  - Patrols on foot (walking) 10%
  - Physical training 9%

Purpose

- To examine injury rates and associated risk factors in a U.S. Army Active Duty population

- Minimal data on injuries and associated risk factors among deploying Active duty U.S. Army Soldiers

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Methods

•Population:
- •Male Active Duty Soldiers in a Light Infantry Brigade (October/November 2010)

• Data collected in survey:
- •**Demographic Data**
  - •Age
  - •Rank
- • **Physical training (Unit and Personal)**
- • **Physical fitness (APFT scores)**
- • **Smoking**
- • **Body Mass Index (BMI)**
- • **Injuries**
  - •Type (sprain, fracture, etc)
  - •Body part
  - • Cause/Activity
  - • Injury severity (Limited Duty)

• Data Analysis:
- •Multivariate Logistic Regression to assess risk of injury

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Results

- **Surveys administered: 2,287 men**

- **Demographic:**
  - Mean age: 26.7 years ± 6.0 (17-50 range)
  - 48% BMI 25.0-29.9 kg/m^2 (overweight)
  - 14% BMI ≥ 30.0 kg/m^2 (obese)
  - 48% Smoke Cigarettes

- **Injuries:**
  - 42% reported at least 1 injury in past 12 months
  - 57% placed on limited duty profile
    - 36% of them were on limited duty for 30 days or more

Results:

Table 2. Distribution of Self-Reported Injuries by Body Part/Location	
Body Part Injured	**n(%)**
Leg, Knee, Shin, Ankle & Foot	**437(45%)**
Upper/Lower Back & Shoulder	**193(20%)**
Multiple upper and lower body injuries	143(15%)
Arm, Elbow, Wrist & Hand	98(10%)
Hip & Pelvic Area	42(4%)
Head/Face & Neck	33(3%)
Chest/Abdominal Area	20(2%)
Other(Unidentified)	1(<1%)
Total	**967(100%)***

*Soldiers could list multiple body parts, so number of injuries is greater than number of Soldiers injured

Pictures from http://www.defenseimagery.mil

Results

Table 3. Distribution of Self-Reported Injuries by Activity	
Activity Causing Injury	**n(%)**
Exercising	**313(34%)**
Walking, hiking, or road march	**118(13%)**
Lifting or moving heavy objects	**104(11%)**
Sports	97(11%)
Motor vehicle	50(6%)
Repairing equipment/vehicles	48(5%)
Stepping or Climbing	38(4%)
Other	149(16%)
Total	**917 (100%)**

Table 4. Distribution of Self-Reported Injuries by Mechanism	
Mechanism of Injury	**n(%)**
Overexertion, strenuous, or repetitive movement	**352(39%)**
Fall, jump, trip, or slip	**295(32%)**
Struck by or against object/person	**130(14%)**
Environmental(heat or cold)	9(1%)
Fire, hot substance or steam	5(<1%)
Other	92(10%)
Total	**910 (100%)**

Results

Limited Duty Days

- 57% of Soldiers with Injuries were on Limited Duty
- Of those on Limited Duty, 36% were on Limited Duty for 30 days or more

-Soldiers on Limited Duty for 30 days or more:

-37% Occurred from Overexertion, strenuous, or repetitive movement

-36% from Exercising

-44% Leg, Knee, Shin, Ankle or Foot Injuries

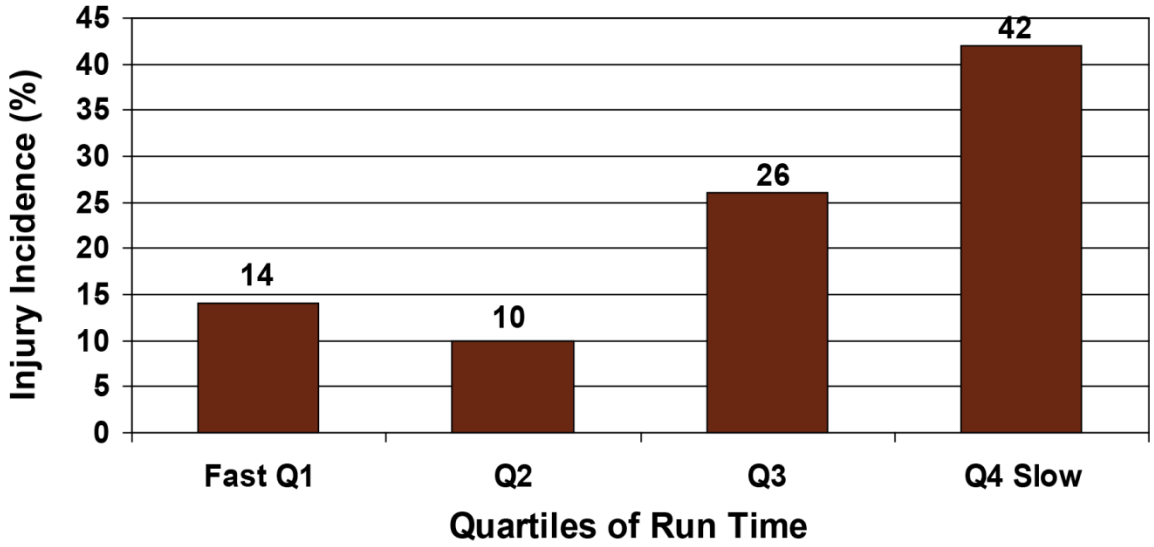
Results: Multivariate Analysis

Table 5. Multivariate Model of Injury Risk				
Variable	Variable Level	N	Odds Ratio(95% CI)	p-value
2 Mile Run (minutes and Fraction of a minute)	≤13.75min (Q4)	520	1.00	
	13.76-14.67 min (Q3)	488	1.20(0.90-1.60)	0.22
	14.68-15.75 min (Q2)	496	**1.47**(1.09-1.98)	0.01
	15.76 + min (Q1)	500	**1.88**(1.37-2.60)	<0.01
Smoker or Nonsmoker	No	1164	1.00	
	Yes	1094	**1.26**(1.03-1.54)	0.02
BMI	18.50-24.90 (normal)	853	1.00	
	≤18.49 (underweight)	11	1.78(0.43-7.29)	0.43
	25.0-29.9 (overweight)	1065	1.20(0.96-1.49)	0.11
	≥30 (obese)	313	**1.54**(1.08-2.19)	0.02

Discussion

- **Low Cardio-respiratory endurance**
  - Measured by performance on the APFT 2 mile run event
    - Similar Results also found in multiple studies:

Association of 2 mile Run Time and Injury Incidence in Basic Training



Ft. Jackson, 1984; N= 79, 8 weeks BCT
P-value for trend= .02
Median run time (mins) = 7.1
Jones BH et al. Am J Sports Med, 1993

Source: Jones BH. Body Composition & Physical Performance. National Academy Press, pp141-173, 1992

Discussion

- **Smoking**
  - Smokers were also more likely to experience an injury compared to non-smokers, similar results found in other studies:
    - Jones BH (1993)
    - Knapik JJ et al (2001)
    - Knapik JJ et al (2009)
    - Grier TL et al (2010)
  - Direct relationship between tobacco use and decreased bone density,
    - Could have contributed to higher proportion of fractured/broken bones in smoking population [NIH, 2011].
  - Smoking decreases healing time of fractures and wounds [Altarac M et al, 2011]
  - Cessation of tobacco smoking may help reduce injury risk
    - Decreased oxygen delivery and reduced bone density, can be reversed with smoking cessation [NIH, 2011][Hoffman KM et all, 2008].

*NIH Osteoporosis and Related Bone Diseases National Resource Center (2011) [15]Hoffman KM et al (2008)

Discussion

- **BMI (≥30 kg/m^2)**
  - High BMI is a known risk factor for injury. Similar results found in other studies:
    - Jones BH et al (1993)
    - Grier et al (2010)
  - The National Institutes of Health
    - Recommend maintaining a healthy weight in order to prevent sprains and strains[NIAMS, 2009][Ello-Martin JA, 2007].
  - Maintenance of healthy weight can be encouraged with interventions to improve dietary habits
    - Such interventions have shown to be successful in changing overall eating habits and weight loss when given appropriate support[Lanza E, 2001][Ello-Martin JA, 2007].

[20] National Institute of Arthritis and Musculoskeletal & Skin Diseases (2009)

Strengths & Limitations

- Strengths
  - Large Occupational cohort
  - Captures all injuries (reported and unreported)

- Limitations
  - Recall bias
    - 12 months for injury history
  - Response bias
    - Can choose to skip answers
    - Honesty

Conclusion

- Injury risk factors in this Army operational unit includes:
  - Higher BMI (≥30 kg/m^2)
  - Smoking
  - Lower aerobic fitness
  - Activities where falls, slips, or trips may be common.

- Implementation of countermeasures to improve aerobic fitness, reduce body fat, and prevent slips/trips/falls, should reduce the incidence of injuries in similar physically active populations.

Pictures from http://www.defenseimagery.mil

What Next?

- Continued research is needed to better the lives of our Soldiers and increase the overall physical readiness of the U.S. Army and similar populations while simultaneously preventing injuries

- Additional studies with the U.S. Army are in progress to assess similar infantry units, as well as following current units over time to observe and assess the effects of factors such as physical training alterations and lifestyle trends on risk of injuries.