Results of a Two-Year Sleep Health Study with National Guard Disaster Responder Medical Personnel

Denise Smart, DrPH, MPH, BSN, RN (LtCol, retired)
Associate Professor
Washington State College of Nursing
dsmart@wsu.edu

This study was funded by TriService Nursing Research Program.
Presenter has no other conflicts of interest.
Disclaimers

The views expressed are those of the presenters and do not reflect the official views or policy of the Department of Defense or its Components.

The information of content and conclusions do not necessarily represent the official position or policy of, nor should any official endorsement be inferred by, the TriService Nursing Research program, Uniformed Services University of the Health Sciences, the Department of Defense, or the U.S. Government.

The voluntary, fully informed consent of the subjects used in this research was obtained as required by 32 CFR 219 and DODI 3216.02_AFI40-402.
Background

• Sleep is critically important for human functioning
• Chronic sleep loss can cause long-term health problems
• Acute sleep loss impairs cognitive performance (errors, accidents etc.)
• National Guard medical personnel are required to respond to disasters that could severely restrict their sleep
• A better understanding of the extent and nature of sleep restriction during disaster preparedness exercises will guide interventions that protect our service members and civilians.
Lessons from Sleep Science

• Sleep loss interferes with our ability to deal with complex, stressful situations.
• Fatigue impairs cognitive functioning, narrows perception, increases hostility, and elevates anxiety.
• Medical errors are currently the third leading cause of death in the US.
• Fatigue contributes to 70% of medical errors.
• Interventions are critical.
March 2014 landslide engulfed 49 homes and other structures. 42 adults and children died. Ages 4 months to 91 years.

More than 70 members of the Washington National Guard formed a grid-based surface in search and recovery efforts from the west side of the Oso landslide. (Photo by Spc. Matthew Sisler)
National Guard Disaster Response

California - Wildfires
Houston, TX-flooding-hurricane
Louisiana-flooding, hurricane
Oklahoma-tornados, bombing

#Texas #StateGuard shelter teams sheltered over 6,189 evacuees in 118 shelters across the state. #TMDHarvey #Harvey
Problem

- National Guard personnel have dual lives: civilian and military
  - Civilian work/rest/life can impact military roles
  - Must be “ready” at all times for military activation
    - What does “Ready” mean?
    - Involves decision-making choices
- Sleep research
  - Measuring decision-making in the field
  - Limit disruption of military training mission
  - Select appropriate proxies for pilot study
  - Select appropriate critical skills assessment modality
Two Year Study

1) Recruitment (thus sample size) limited by Congress and National Guard Bureau changes in allocated personnel.

2) Critical Skills Assessment
   a) Development of questions
   b) Piloting questions with proxies

3) Baseline sleep health
   a) Self-reported sleep health questionnaire—same as used by Troxel et al. (RAND Corporation) in 2015 published study
   b) Sleep diaries

4) Actigraphy-Readiband

5) Karolinska Sleepiness Scale—self-reported sleepiness

6) Travel before each disaster training exercise to apply Readiband
   a) National Guard personnel only available before or on weekend

7) Collection of Readiband devices
   a) In person or via mail
Method

**Design**: Longitudinal repeated measures design

**Participants**: N=77 (two Air Force Bases)-90+% recruitment of qualified participants

**Procedure**: Wrist actigraphy was used to objectively monitor sleep:

1. ~7-day baseline period
2. 2-day transition period
3. 5-day disaster training period

**Materials**: Readiband v3 by Fatigue Science

**Analysis**: Differences in sleep over time were analyzed using generalized linear mixed (GLM) models
Methods

Measures:

• RAND Self-report survey (demographics, military history)
• Sleep health
  • Actigraphy (civilian baseline, transition, during)
    • Baseline reflects usual civilian work-life patterns
    • Transition period was weekend before military training exercise
    • During exercise reflects military expectations of mission
• Self-reported Karolinska Sleepiness Scale (KSS)
  How sleepy do you feel right now?
  1=extremely alert to 9=extremely sleepy
Wrist Actigraphy

- Non-invasive and objective measure of sleep
- 92% accurate compared to polysomnography
- Readiband by Fatigue Science is FDA approved
- Algorithms calculate sleep quantity, quality, and “cognitive effectiveness” (calculated based on prior sleep, time since last sleep, and time of day)
Investigators’ Challenge

• Making medical decisions during mass casualty events, disaster events, & in field settings can be impacted by sleep quality & quantity.

• Finding the best tool to measure critical skills is an on-going challenge
  • Must be skill specific
  • Must be valid & reliable
  • In military field settings, need to consider impact of research on mission.
Pilot Study to Select & Evaluate Critical Skills Questions

Questions selected based on exact skills set for military medical personnel
Medics- Basic Life Support questions
RNs, NP, PAs- Adult and Pediatric Medication questions
Large pool of questions
Reviewed by 4 Civilian RNs (MN and PhD) and 2 Military Officer RNs (with advanced degrees)
Initial selection of medication questions were based on ability to perform calculations without a device/calculator, paper/pen
Questions piloted with RN-B and DNP nursing students over 2 semesters.
Overview of Sleep Study Research with Air National Guard Medical Personnel

Disaster response mission
Goal: to evaluate, describe sleep health of medical personnel who have civilian jobs and perform military roles in National Guard.

Overview of sleep study
• Pilot study of critical skills and proxies (BSN and DNP students) for military medics and medical personnel (RNs, PA, NP, MN, Pharmacists, CRNA) - Development of Critical Skills Assessment Component of study
• Completion of Rand** self-reported sleep survey
• Wearing of Readiband to record actigraphy data
• Sending critical skills questions and KSS (Karolinska sleepiness scale) question 4 times/day during disaster training exercises
## Participant Demographics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Base 1 (n=37)</th>
<th>Base 2 (n=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional licensure:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MD</td>
<td>1 (2.7%)</td>
<td>1 (2.5%)</td>
</tr>
<tr>
<td>PA</td>
<td>3 (8.1%)</td>
<td>3 (7.5%)</td>
</tr>
<tr>
<td>CRNA/RN</td>
<td>8 (21.6%)</td>
<td>7 (17.5%)</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>2 (5.4%)</td>
<td>1 (2.5%)</td>
</tr>
<tr>
<td>No licensure</td>
<td>23 (62.2%)</td>
<td>28 (70.0%)</td>
</tr>
</tbody>
</table>

| Military rank:       |              |              |
| Officer              | 13 (35.1%)   | 15 (37.5%)   |
| Enlisted             | 24 (64.9%)   | 25 (62.5%)   |
### Participant Military History

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Base 1 (n=37)</th>
<th>Base 2 (n=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td><strong>Number of OCONUS deployment:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never deployed</td>
<td>17 (46.0%)</td>
<td>16 (40.0%)</td>
</tr>
<tr>
<td>1 – 3</td>
<td>17 (46.0%)</td>
<td>18 (45.0%)</td>
</tr>
<tr>
<td>4 – 7</td>
<td>2 (5.4%)</td>
<td>5 (12.5%)</td>
</tr>
<tr>
<td>8 or more</td>
<td>1 (2.7%)</td>
<td>1 (2.5%)</td>
</tr>
<tr>
<td><strong>Months home since recent deployment:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 months or less</td>
<td>1 (5.0%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>12 – 18 months</td>
<td>0 (0.0%)</td>
<td>1 (4.2%)</td>
</tr>
<tr>
<td>More than 18 months</td>
<td>19 (95.0%)</td>
<td>23 (95.8%)</td>
</tr>
</tbody>
</table>
## Results: Participant Sleep Patterns

*(Self-reported Sleep Health)*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Base 1 (n=37)</th>
<th>Base 2 (n=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Work pattern:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day Shift</td>
<td>24 (64.9%)</td>
<td>33 (82.5%)</td>
</tr>
<tr>
<td>Variable Shifts</td>
<td>13 (35.1%)</td>
<td>7 (17.5%)</td>
</tr>
<tr>
<td><strong>Time go to bed:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20:00-&lt;21:00</td>
<td>0 (0.0%)</td>
<td>4 (10.0%)</td>
</tr>
<tr>
<td>21:00-&lt;22:00</td>
<td>4 (10.8%)</td>
<td>13 (32.5%)</td>
</tr>
<tr>
<td>22:00-&lt;23:00</td>
<td>13 (35.1%)</td>
<td>13 (32.5%)</td>
</tr>
<tr>
<td>23:00-&lt;00:00</td>
<td>16 (43.2%)</td>
<td>8 (20.0%)</td>
</tr>
<tr>
<td>00:00-01:00</td>
<td>4 (10.8%)</td>
<td>2 (5.0%)</td>
</tr>
<tr>
<td><strong>How long to fall asleep:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 mins</td>
<td>4 (10.8%)</td>
<td>2 (5.0%)</td>
</tr>
<tr>
<td>5-&lt;10 mins</td>
<td>6 (16.2%)</td>
<td>4 (10.0%)</td>
</tr>
<tr>
<td>10-&lt;20 mins</td>
<td>16 (43.2%)</td>
<td>11 (27.5%)</td>
</tr>
<tr>
<td>20-&lt;30 mins</td>
<td>4 (10.8%)</td>
<td>8 (20.0%)</td>
</tr>
<tr>
<td>&gt;30 mins</td>
<td>7 (18.9%)</td>
<td>15 (37.5%)</td>
</tr>
</tbody>
</table>

Questions asked on RAND Instrument
Results

• Participants averaged 7.16 hours of sleep per 24h period during the baseline measurement period using actigraphy. *Self-reported sleep diaries indicated an average of 7.9 hours (range 5-10 hours; SD 1.34).*

• Average baseline sleep quality was 85% and their cognitive effectiveness score was 91%.

• During the disaster exercise period, participants’ sleep duration dropped significantly to 5.9 hours (F=39.22 (1,74); p=<0.0001).
  • Range 3.4 hours to 9 hours
  • 43% (n=26)-6.1-7 hours sleep; 27% (n=16)= 5.1-6 %; 10% (n=6)-7.1-8+ hrs
  • 3% (n=2)- 3.4 hrs sleep and 17% (n=10)-4.1-5 hrs sleep

• During the disaster exercise period, cognitive effectiveness also dropped significantly to 87% (F=19.61 (1,58); p<0.0001).
Results: KSS and Quantity of Sleep

Figure 1c: Karolinska Sleepiness Scale (KSS)

Day (Time of Day)

- 6am
- 8pm

Average KSS

- August 2016
- Feb or April 2017 n=52 participants
- March or June 2017

Figure 2: Average Quantity (Hours) of Sleep

- Civilian Transition
- Daily
- During Exercise

Average Quantity (hours)

- August 2016
- Feb or April 2017
- March or June 2017
Results

Figure 1a: Average Normed Response Time*

*Includes correct responses only

Figure 1b: Accuracy
Results: GLMM Regression Analysis

Pooled Across Exercises (n=70 participants; 858 skills)

- **KSS associated with lower accuracy**
  - $F(df_1, df_2)=23.68 (1,856); \ p<0.001$
  - As KSS score increases, accuracy in responses decrease

- **Licensure** associated with higher accuracy
  - $F(df_1, df_2)=19.25 (1,57); \ p<0.001$
  - Officer vs Enlisted

- Increasing **age** associated with higher accuracy
  - $F(df_1, df_2)=5.50 (1,54); \ p=0.02$
  - Possibly reflecting professional/clinical expertise

- **Base 2** associated with higher accuracy
  - $F(df_1, df_2)=6.26 (1,64); \ p=0.01$

No significant associations with response time
Study Challenges

• Conducting research in a military field setting during actual exercises
  • very fluid environment

• Identification of a non-disruptive way to measure operation performance

• Cell service can be unreliable

• Consider measuring activity level

• Lesson in patience and adaptability within confines of study protocols & IRB approved methodologies
Implications

• For researchers:
  • Coordination of data collection under field conditions
  • Need for flexibility or alternate plan for data collection that is not dependent on WiFi connections

• For participants:
  • Practice good sleep hygiene before & during training and real-world disaster responses
  • For real world responses, safety is primary focus for service member as well as patients/victims

• For military commanders:
  • Consider rest & down time environments (noise, comfort)
  • Plan for longer rest/sleep periods

• For military nurses:
  • Sleep hygiene briefings 2-3 months and immediately before training & real-world responses
  • Assessing environment with recommendations to commanders if trends noted in field
  • Encourage service members who work night shifts in their civilian jobs to coordinate schedules with employers for time off to acclimate before planned disaster training exercises
Implications for Nursing Science

• National Guard medical personnel were significantly sleep restricted during a disaster training exercise and this significantly affected their cognitive effectiveness
• Disaster training exercises are likely to be a conservative estimate of real world disasters
• Given the connection between fatigue and medical errors, targeted interventions to improve sleep are critical
• The need to safeguard our service members and the civilians they protect is clear
Questions?

Research Team

Denise Smart, DrPH, BSN  
WSU College of Nursing (CON)

dsmart@wsu.edu

Tamara Odom-Maryon, PhD  
WSU CON

tmaryon@wsu.edu

Lois James, Ph.D.  
WSU CON

lois_james@wsu.edu

Stephanie Rowan, BSN, MN Lt. Col  
rowanS@uthscsa.edu
149 MDG, Joint Base San Antonio, TX

Amanda Roby, BSN, ARRP, NP- Major  
naroby07@gmail.com
141 MDG, Fairchild ARB, WA

