Comparing the work and rest hours of United States Navy Sailors with existing maritime regulations

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The Military Climate: Doing More with Less

Really? We're changing to a nine-to-five rotation?

Yep, deploy in September, back in May.
Life at sea!
Life at sea!
Life at sea!
Life at sea!
Life at sea!
Life at sea!
Navy Personnel

- Officers: 17%
- Enlisted: 83%

- Male: 84%
- Female: 16%

Age Distribution:
- 25 or younger: Officers (50%), Enlisted (25%)
- 26 to 30: Officers (10%), Enlisted (20%)
- 31 to 35: Officers (10%), Enlisted (20%)
- 36 to 40: Officers (10%), Enlisted (20%)
- 40 or older: Officers (5%), Enlisted (25%)
• The US military indoctrinates healthy US adults into a culture of sleep deprivation that persists throughout their careers.

• Like other shiftworkers, members of the military frequently exhibit “circadian scarring” and often engage in “binge sleeping.”

• Based upon scientific findings from research on both civilian and military populations, these sleep practices are associated with decreased performance and long term health consequences.
A Comparison of Sleep between Brown University Students and Cadets at USMA, West Point

Note: Brown University data were collected on the Class of 1992 (Fall 1988 – Spring 1990 using self-report. USMA data were collected using actigraphy on the Class of 2007 Fall 2003 – Spring 2005 (Miller, Shattuck, & Matsangas, 2010).
...and continues throughout their careers

Even **non-deployed** military sleep fewer hours than civilians

Average Hours of Sleep per Day

- **Mysliwiec et al. (2012)**
  - 725 Army, Navy, Air Force

- **Krueger & Friedman (2009)**
  - 10,441 civilians

- **< 5**: 42%, 8%
- **6**: 27%, 21%
- **7**: 21%
- **8**: 31%
- **> 9**: 33%
Sleep - Naval Operations

Note 1: Blue bars indicate actigraphic sleep, gold bars are self-reported sleep.
Note 2: Number centered on each bar refers to study sample size.
Note 3: Horizontal lines indicate one standard deviation.

Last update: Mar 2017
Watch schedules

Circadian (24 hour)

2-section
- 6/6
- 12/12

3-section
- 4/8
- 8/16

4-section
- 3/9
- 6/18

Non-Circadian

3-section
- 5/10

4-section
- 5/15

Workday includes duties other than watchstanding. Other watchbills may be implemented by the command.
Actigram of a typical work/rest pattern at sea
Problem Statement

- Crewmembers in the United States Navy (USN)
  - Work long hours with limited opportunities to sleep
  - Are habitual shiftworkers
    - Shifts result in circadian misalignment equating to an 15 or 20-hour day
  - Have no weekends or time for recovery

Study goals

- Compare the work and rest patterns of USN crewmembers with existing maritime regulations
- Investigate the association between the watchstanding schedule and the level of compliance with existing maritime fatigue regulations
• Retrospective analysis of pre-collected data (N=184)
  – USS NIMITZ (CVN-68) Reactor Department (RX)
    • June 2014: 69 crewmembers using the 5hr-on/10hr-off schedule
    • November 2014: 115 RX crewmembers using the 3hr-on/9hr-off schedule
  – Sleep was assessed with wrist-worn actigraphy and daily activity logs
• Activity log information aggregated in
  – Work and Rest by day (midnight to midnight)

• Work time
  – Watch periods, ship duties, maintenance, training, and service diversion

• Rest
  – Personal time, sleep, and meals
Maritime working standards

For seafarers

Maritime Labour Convention (MLC)
- Work \(\leq 14\) hours/24-hour period
- Rest \(\geq 77\) hours/7-day period

United States Code (USC)
- Work \(\leq 36\) hours/3-day period
- Rest \(\geq 56\) hours/7-day period

US Navy regulations

Navy Availability Factor (NAF)
- Work \(\leq 81\) hours/7-day period

Navy Standard Work Week (NSWW) – obs.
- Sleep \(\geq 56\) hours/7-day period

USN does not have a regulation dedicated to work/rest times (except aviation)
Results

• Participants
  – Predominantly young (25.0±3.72 years of age)
  – Male (80%)
  – Enlisted (95%)
• Crewmembers worked ≥14 hours/day for 21% of their workdays
• On a weekly basis, crewmembers
  – Worked ≥72 hours for 75% of their 7-day periods
  – Worked ≥81 hours for 53% of their 7-day periods
  – Rested <77 hours for 23% of their 7-day periods
  – Slept<56 hours (~8-hours/day) for 64% of the 7-day periods
• From actigraphy: Crewmembers working on the 5/10 schedule slept on average 6.88±0.93 hours/day, compared to 6.68±0.95 hours of sleep for their 3/9 peers.
Non-compliance rates by work hours criterion

Vertical lines denote the Standard Error of the Mean.
Non-compliance rates by rest/sleep hours criterion

Non-compliance rate refers to % of crewmembers
Vertical lines denote the Standard Error of the Mean
• This study compared the compliance of crewmembers’ work/rest hours with existing regulations. Overall, non-compliance rates were high, up to 88% of the crew!
• Results highlight how crewmembers work long hours with limited opportunities to rest.
• The watchstanding schedules of the crewmembers had a significant impact on the compliance rates.
• In the absence of specific Navy regulations to manage work and rest schedules, the US Navy should consider using standard maritime regulations that include guidance for optimal management of work/rest/sleep patterns.
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NPS Crew Endurance Resource Website  
http://my.nps.edu/web/crewendurance
Factors Leading to Disrupted Sleep at Sea

Psychological-Pharmacological
- Stress, anxious thoughts
- Harassment from leadership, crewmembers
- Caffeine, energy drinks
- Nicotine

Environmental
- Ship motion
- External noise
- Smells
- Temperature extremes

Berthing Compartment Habitability
- Lack of privacy
- Internal noise
- Temperature
- Light in the compartment

Organizational
- Irregular sleep schedules
- Watch schedules
- Long work hours
- Duties/operational commitments