Daily Measurements of Fatigue & Sleep During a Full Offshore Rotation.

Implications for Fatigue Risk Management Programs

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Disclaimer

We declare no conflict of interest.

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The (Dutch) Offshore Environment

- 2-weeks offshore/ 2-weeks of leave
- 12-hour (day-) shifts 7am-7pm
- Remote location (Dutch Central North Sea Sector)
- Exposure to maritime and industrial hazards

Problem

- Fatigue is one of the major health & safety risk factors offshore
- Construct of fatigue is not well understood (e.g. cause & etiology)
- Multi-causal phenomenon
- Consequences can be severe

Piper Alpha Disaster, 1988


Deep Water Horizon Disaster, 2010

* U.S. Chemical Safety and Hazard Investigation Board. Investigation report volume 3 drilling rig explosion and fire at the Macondo well. 2016; Report No.: 2010-10-I-OS.

Aims

1. To investigate the course of fatigue & sleep parameters during a full offshore rotation

2. To identify possible fatigue risk prone periods during a full offshore rotation

Overall goal

→ To help improve current (offshore) fatigue risk management programs

Method

- Prospective cohort study (4 weeks; 1 rotation)
- N= 4 platforms (3 NL; 1 UK)
- N= 49 offshore workers (contractors & permanent staff)
  - Inclusion criteria: 2 full weeks of offshore work
  - Exclusion criteria: none

- Investigated constructs
  - Fatigue (Reaction times & Sleepiness)
  - Sleep (Actigraphy recordings)

Measures

Objective Devices

- Actigraphy (MotionWatch 8®, Camntech) → Sleep
  - Time in bed (TIB)
  - Sleep latency (SL)
  - Sleep efficiency percentage (SE_p)
- PVT-B: 3-minute Psychomotor vigilance task (Joggle Research®) – bi-daily → Fatigue

Subjective Self-reports

- KSS: Karolsinka Sleepiness Scale– bi-daily → Sleepiness

Study Timeline

	Pre (1 week)	Offshore (2 weeks)				Post (1 week)
		Days: 1-2	Days: 3-9	Days: 10&11	Days: 12-14	
Actigraphy: - TIB - SL - SE_p						
KSS: Sleepiness						
PVT-B: RT						

*Periods 1 & 3 have some scientific evidence.

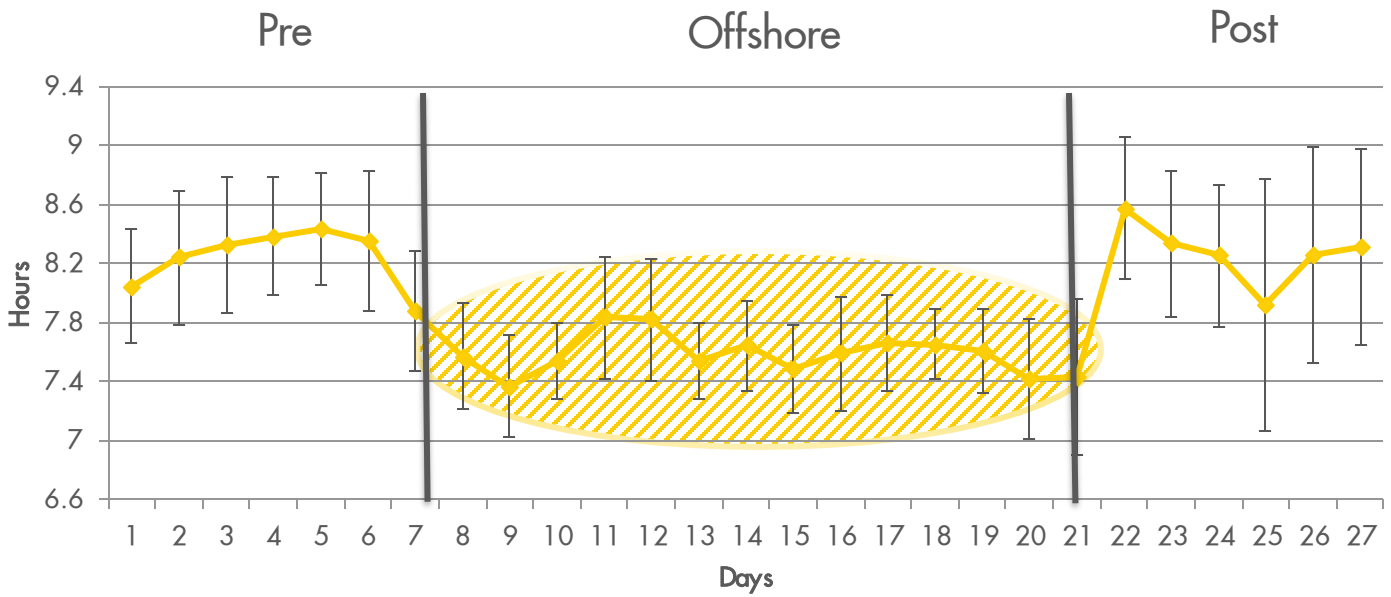
*Day 1 was excluded from the analysis due to low response

Statistical Analysis

- Linear Mixed Models
- Generalized Linear Mixed Models

→ Mean daytime scores were calculated for KSS and PVT-B measures

*Results Sleep Parameters



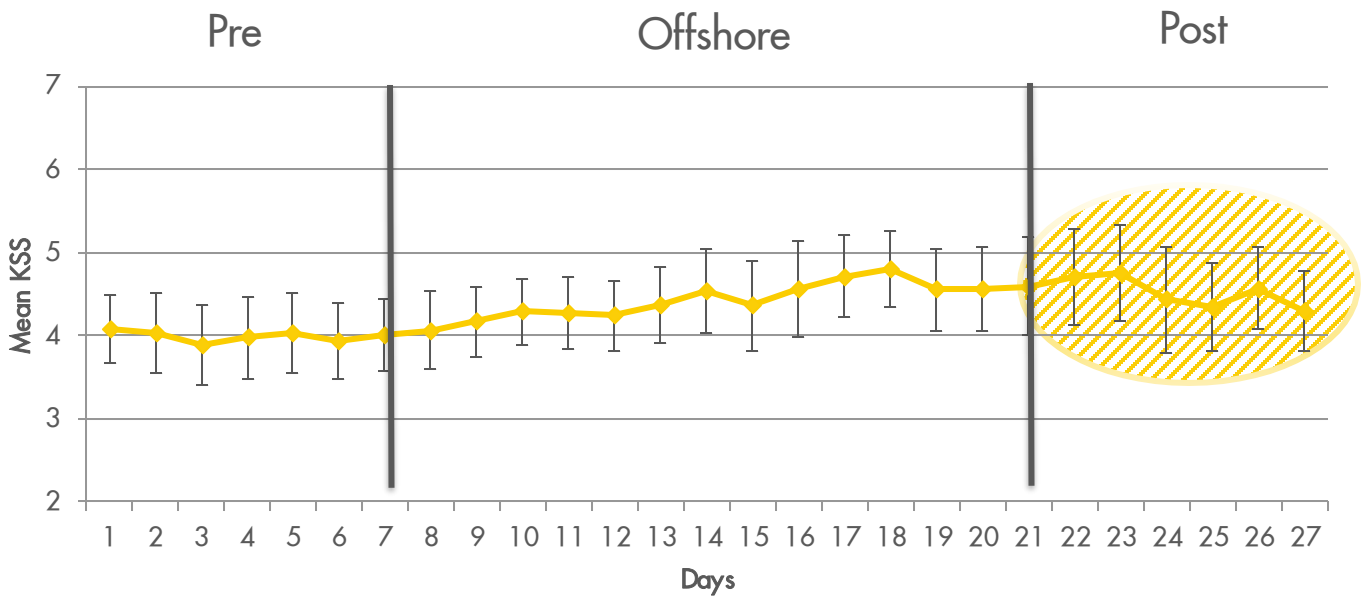
Mean differences (min):

- Pre: 38.6 (22.81 - 54.48)
- Post: 36.9 (11.63 - 62.15)

- Time in Bed (TIB) was significantly shorter in the offshore period. No differences during offshore periods.
- Sleep Latency (SL) & Sleep Efficiency Percentage (SE_p) no significant differences.

*Preliminary results

*Results Sleepiness



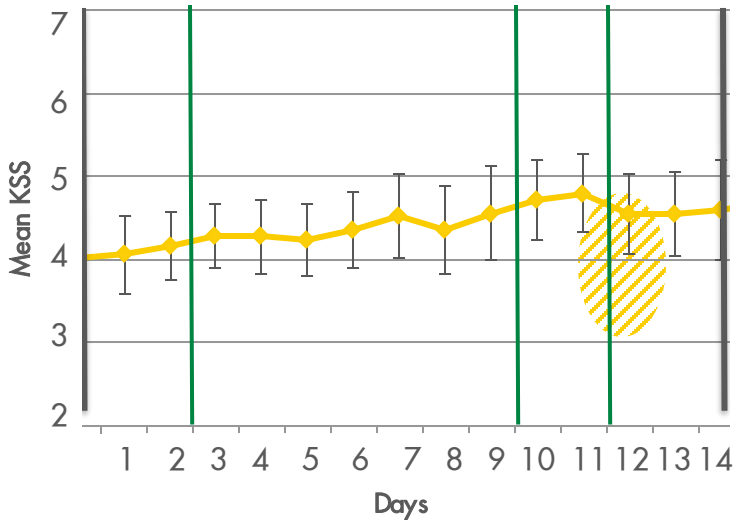
- Sleepiness (KSS) was significantly higher in post offshore periods
- On average, low KSS scores (KSS<6)

Mean differences:

- Offshore: .38 (.16 - .60)
- Post: .40 (.16 - .64)

*Preliminary results

*Results Sleepiness (Offshore)



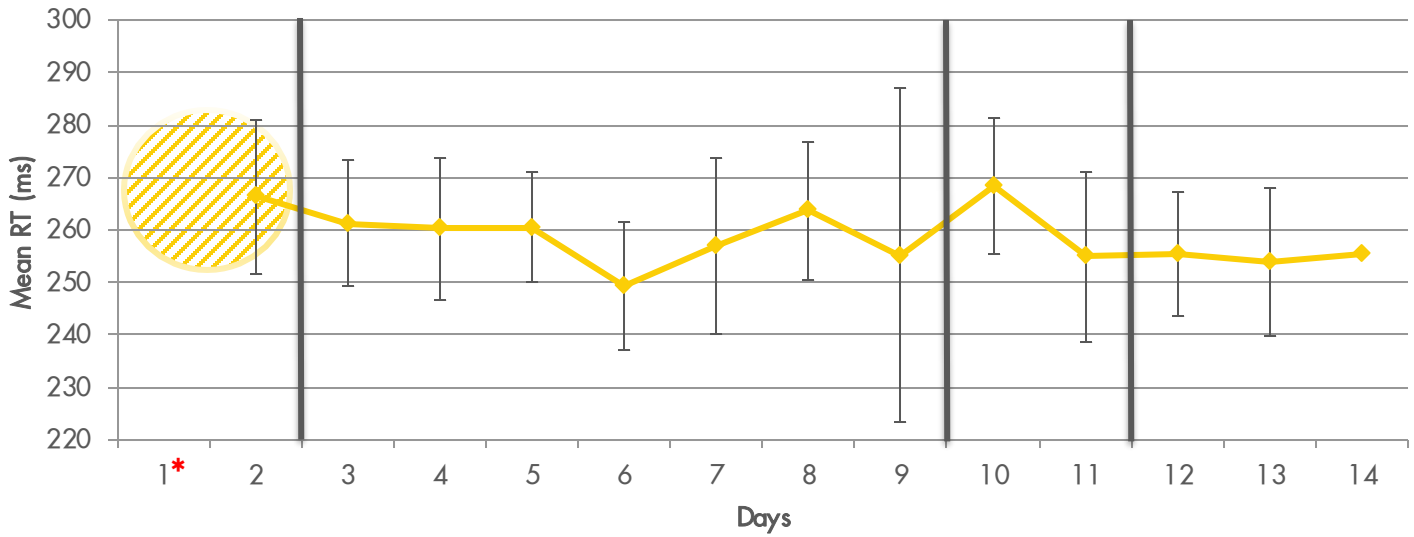
- KSS significantly higher on offshore days 10&11

Mean differences:

- Days 1-2: -.53 (-.83 - -.24)
- Days 3-9: -.33 (-.59 - -.07)
- Days 12-14: -.16 (-.44 - .13)

*Preliminary results

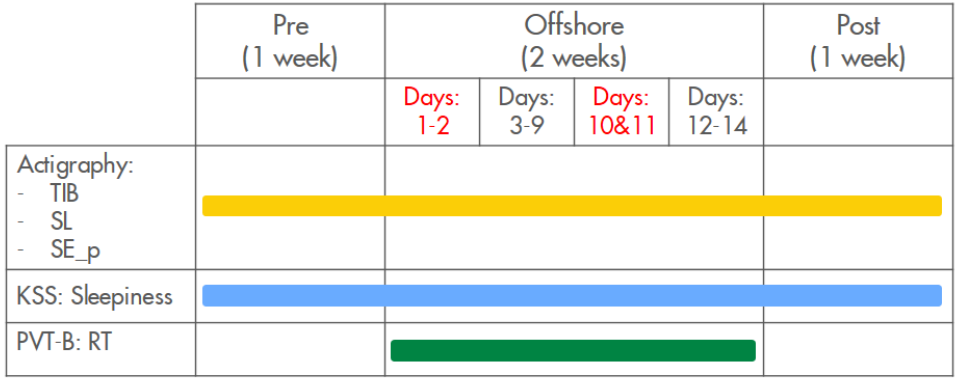
*Results Reaction Time



- PVT-B no overall significant differences between periods;
- But: Period 1 (days 1&2) had significantly slower scores compared to other periods

*Preliminary results

Discussion



Across the offshore rotation

1. Sleepiness (KSS) increased and peaked in post offshore period
   → suggestive for a potential fatigue prone period
   → Need for recovery
2. Shorter sleep duration during offshore shifts
   - Minimum requirement of 7-8 hours of sleep was attained
   - But: Shortened sleep lengths are likely related to sleepiness scores due to increased sleep pressure

During the offshore shift

3. Sleepiness peaked on days 10&11
   → suggestive for a potential fatigue prone period
4. Slower reaction time scores on days1&2
   → hectic offshore arrival; hand overs; novelty & learning effect of completing the PVT-B.

Implications

- Important to look at the whole offshore rotation (pre-, during and post offshore)
- **FRMPs should consider**
  - Accumulating sleepiness (subjective fatigue) scores during offshore rotations and shifts
  - Shortened sleep periods whilst offshore: Build up of sleep pressure
  - 3 Potential fatigue risk prone periods:
    - Offshore days 1&2: Hectic handover periods
    - Offshore days 10&11: Peak in sleepiness; lack of motivation
    - First few days back at home: Commuting hazards; Work-Family Conflicts

    → Incident reporting systems should incorporate more tailored questions towards fatigue risks (e.g. Day of offshore shift when incident occurred)
- More research needed to validate our findings and link fatigue prone periods to health & safety outcomes

Conclusions

1. The course of fatigue & sleep parameters during a full offshore rotation differed

2. 3 Possible fatigue risk prone periods during a full offshore rotation were identified

→ These findings are likely to improve current (offshore) fatigue risk management plans

Thank you

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