Health Needs of Shift Workers

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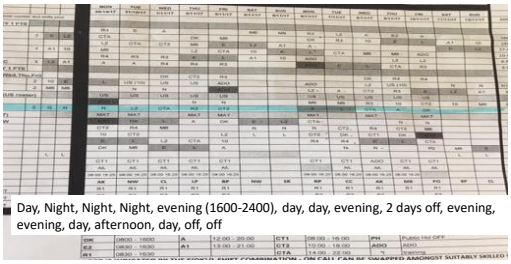
Structure of talk

1. **Epidemiology** of shift work
2. **Health risks** of shift work
3. **Mechanism** of shift work related chronic disease and accidents
4. **Interventions** to reduce shift work related health risk

Case 1

- 55 year old man
  - Radiographer at public hospital
  - Shiftwork
  - Falling asleep at night shift
  - Cant sleep during the day
- Obese, hypertension, dyslipidaemia, snores.
- FHx Father died colon cancer aged 61 years

Roster



Day, Night, Night, Night, evening (1600-2400), day, day, evening, 2 days off, evening, evening, day, afternoon, day, off, off

Shift work: Epidemiology

- Shift work defined: work time outside conventional hours.
- 29% workers in the US have work time arrangements outside of 0600-1800.
- 15% workers in EU work nights at least once a month

Alterman et al. Am J Ind Med. 2013
Sixth European Working Conditions Survey 2015

Inadequate sleep costs

- 39.8% Adult Australians experience some form of inadequate sleep
- Total cost of inadequate sleep in 2016-2017 was $66.3 billion
- >1 person dies each day as a result of MVA or work place accident from inadequate sleep

Asleep on the job, Cost of Inadequate sleep in Australia https://www.sleephealthfoundation.org.au. Accessed Oct 2017

Shift work: Health risks

- Shift work disorder
- Cardio-metabolic
- Cancer
- Accidents

Shift work: Health risks

- **Shift work disorder**
- Cardio-metabolic
- Cancer
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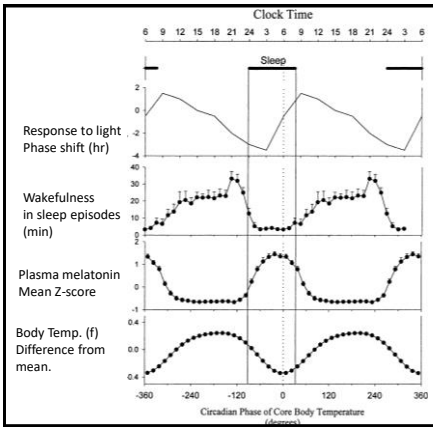
Shift Work Disorder (SWD)

Clinical circadian rhythm disorder.

- Difficulty initiating sleep and waking up
- Excessive sleepiness during night shift.
- Chronic >3 months

- 32% of night shift workers meet minimum criteria for SWD.

Drake et al. Sleep 2004
ICSD 3rd edition 2014



Dijk and Lockley. J Appl Phys 2002

Individual resilience to shift work

- Some people more affected by night shift then others (task specific)
- Genetic makeup
  - Long PER 3 gene have a morning preference
  - Have an earlier circadian phase
  - Lack of adaption to night shift

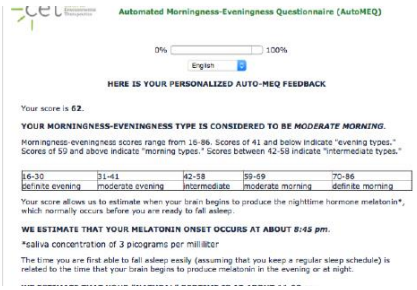
Dijk et al. Sleep Med rev 2009.

Eveningness Morningness questionnaire

Approximately what time would you get up if you were entirely free to plan your day?

How easy do you find it to get up in the morning (when you are not awakened unexpectedly)?

Horne and Ostberg Int J Chrono Bio 1976



Automated Morningness-Eveningness Questionnaire (AutoMEQ)

0% 100%

English

HERE IS YOUR PERSONALIZED AUTO-MEQ FEEDBACK

Your score is **62**.

YOUR MORNINGNESS-EVENINGNESS TYPE IS CONSIDERED TO BE *MODERATE MORNING*.

Morningness-eveningness scores range from 16-86. Scores of 41 and below indicate "evening types." Scores of 59 and above indicate "morning types." Scores between 42-58 indicate "intermediate types."

16-30	31-41	42-58	59-69	70-86
definite evening	moderate evening	intermediate	moderate morning	definite morning

Your score allows us to estimate when your brain begins to produce the nighttime hormone melatonin*, which normally occurs before you are ready to fall asleep.

WE ESTIMATE THAT YOUR MELATONIN ONSET OCCURS AT ABOUT *8:45 pm*.

*saliva concentration of 3 picograms per milliliter

The time you are first able to fall asleep easily (assuming that you keep a regular sleep schedule) is related to the time that your brain begins to produce melatonin in the evening or at night.

Shift work: Health risks

- Shift work disorder
- **Cardio-metabolic**
- **Cancer**
- **Accidents**

Shift work increases risk of disease compared with day work.

- Myocardial infarction (HR 1.23)
- Stroke (HR 1.05)
- Type 2 Diabetes Mellitus (HR 1.09-1.4)
- Colorectal cancer (HR 1.32)
- Prostate cancer (HR 1.24)
- Breast cancer (HR 1.01-1.21)
- All cause mortality (HR 1.04)

Kecklund and Axelsson. BMJ 2016

Mechanism of shift work related chronic disease and accidents

- Short Sleep hypothesis
- Behavioral hypothesis
- Physiological stress hypothesis
- Gut hypothesis

Sleep is shorter and more disturbed

Mean sleep duration

- 5 hr 51 min: Day sleep after night shift
- 6 hr 37 min: Sleep before early morning shift
- 8 hr 02 min: Sleep after evening shift

- Similar risk of chronic disease associated with short sleep (4-7 hours) and disturbed sleep (insomnia)

Pilcheret al Sleep 2000
Akerstedt et al. Physiol beh 2007
Kecklund and Axelsson. BMJ 2016

Behavioral hypothesis

Shift workers compared with daywork

- Eat at the wrong circadian phase
- Eat more carbohydrates and less fruit.
- Increased alcohol consumption (OR 1.12) and possibly smoking
- More light at night (carcinogen?)

Physiological stress hypothesis

- Circadian misalignment leads to disruption of regulatory hormones and increase in stress hormones
  - Sleep- growth hormone, testosterone, prolactin (
  - Cortisol, melatonin (circadian)
- Short sleep associated with hypertension, dyslipidaemia and insulin resistance
- Altered Immune function
- Increase in oxidative stress in animals

Depner et al Curr Diab Rep 2014
Villafuerte et al. Oxi Med Cell Longev 2015

Gut hypothesis

- Fecal transplant from obese to non-obese mice causes obesity in recipient mice independent of of changes in diet
- Altered intestinal microbial communities associated obesity and type 2 diabetes in humans
- The influence of sleep?
  - Circadian misaligned mice have altered gut bacteria
  - 3-5 week sleep deprived rats develop bacterial invasion though to be from the gut
  - Jet lagged humans higher Firmicutes carriage (resolves).

Ley et al Nature 2006
Reynolds et al. Sleep Med Rev 2017

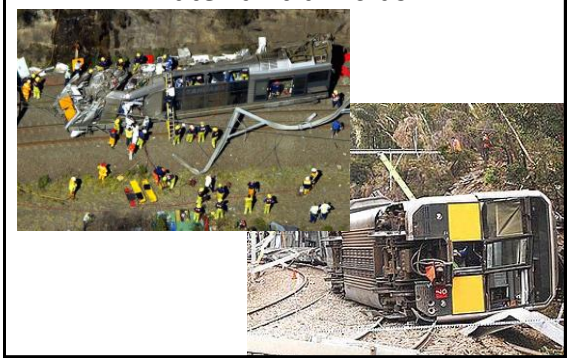
Fatigue related accidents

Chernobyl disaster

Exxon Valdez Oil spill

Challenger shuttle explosion

Waterfall train crash

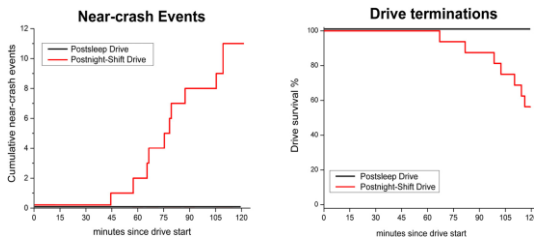


Accidents

- Shift works leads to worse performance and errors.
- Junior doctors have been shown to increase motor vehicle crashes on the commute home from a long night shift.

De Coordovaet al. Work 2006
Barger et al NEJM 2005

Near crash events and drive terminations in post night-shift drives



Lee et al. PNAS. 2016

Interventions to reduce shift work related health risk

- Organizational countermeasures
  - Rosters
- Individual countermeasures
  - Light
  - Napping
  - Medication
  - Sleep disorders
  - Other risk factors

Organizational countermeasures

Previous studies have shown shift work negatively impacted sleep, health and work performance. Generic picture: Thinkstock

VIC NEWS

Melbourne intensive care doctors to have rosters allocated according to healthy body clock

Brigid O'Connell, Health reporter, Herald Sun
July 6, 2017 10:20pm
Subscriber only

Organizational countermeasures

- Rostering
  - Forward rostering (Days ➔Evenings➔Nights)
  - Slow rotating (3+ days in same shift)
  - >11 hours recovery between shifts
  - Avoid long weekly working week (<60 hours)
  - Avoid long work shifts (<10 hours)

Kecklund and Axelsson. BMJ.2016

Individual countermeasures

Aim

1. Understand that elimination of shift work will resolve symptoms
2. Improve daytime sleep
3. Improve alertness at night
4. Circadian re-alignment strategies

Individual countermeasures

Aim

1. **Understand that elimination of shift work will resolve symptoms (letter to employee)**
2. Improve daytime sleep
3. Improve alertness at night
4. Circadian re-alignment strategies
5. Screening and risk factors management

Individual countermeasures

Aim

1. Understand that elimination of shift work will resolve symptoms
2. **Improving daytime sleep**
3. Improving alertness on night shift
4. Circadian re-alignment strategies
5. Screening and risk factors management

Sleep hygiene

- Sleep hygiene
  - Bedroom is really dark
  - Cool bedroom temperature
- Anchor sleep
  - Two bouts sleep
  - Initial 4 hour anchor sleep
  - Total of 7-9 hours total sleep

Benzodiazepines and Z-drugs

- Few studies
  - Zolpidem, temezepam increased day time sleep by 30-60 min in shift workers
  - May not eliminate night shift sleepiness

Morgethaler et al. Sleep 2007
Walsh et al. Sleep 1991

Melatonin

- Meta-analysis of 7 RCTS (n=263)
- 1-3mg melatonin improves total sleep time
- Taken 30 minutes prior to desired sleep time
- May not improve alertness during night shift

Liira et al. Cochrane Database Syst Rev 2014

Individual countermeasures

Aim

1. Understand that elimination of shift work will resolve symptoms
2. Improve daytime sleep
3. **Improving alertness on night shift**
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Naps

- naps before or during night shift may improve performance and alertness during the shift.
- Systematic review concluded naps were of limited benefit during night shift
- <60 minutes to avoid deep sleep and sleep inertia

Morgenthenthaler et al. Sleep 2007
Ruggiero et al. Biol Res Nurs 2014

Sleep pods

Caffeine

- Can improve alertness in a RCT of naps and caffeine in 56 shift workers
- Small amounts (75-100mg caffeine/1 cup coffee) throughout the night
- Care caffeine not effect daytime sleep

Scweitzer et al. Sleep 2006
Ker et al. Cochrane 2010

Modafinil and Armodafinil

- Approved for shift work disorder but not on PBS
- Two RCT (n=572) armodafanil 150mg taken 30-60 minutes before night shift improved subjective sleepiness c/w placebo. (variable)
- Also small RCT improved performance on a driving simulator.
- Headache, Nausea, rare: Stephen-Johnson

Liira et al. Cochrane Database Syst Rev 2014
Czeisler et al. NEJM 2005
Howard et al. J Clin Psychopharmacol. 2014

Individual countermeasures

Aim

1. Understand that elimination of shift work will resolve symptoms
2. Improve daytime sleep
3. Improving alertness on night shift
4. **Circadian re-alignment strategies**
5. Screening and risk factors management

Timed bright light

- 2000-10,000 lux
- May improve alertness and shift circadian rhythms
- Light exposure 4 x 20minute to throughout shift
- Light-blocking glasses in the morning 6-11am

Morgentheler et al. Sleep 2007

Screening and risk factors management

- Ensure uptodate for screening
  - Colorectal cancer
  - Breast cancer
  - Prostate cancer
- Control cardiovascular risk factors
- Identify obstructive sleep apnoea
- Drowsy driving

Case 1: 55 year old radiographer

- Roster pattern that minimizes fatigue
- Individual countermeasures
  - Anchor sleep
  - Light
  - Melatonin
- Improving night time alertness (if risks)
- Screen for OSA and colon cancer
- Tight control CVS risk factors

Conclusions

- Shift work is common
- Shift work is associated with sleep disturbance, cardio-metabolic disease, cancer and accidents.
- Roster patterns, improving sleep and alertness and managing risk factors may reduce these risks.