Circadian Rhythm Sleep Disorders in Practice

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1. Dijk DJ, von Schantz M., Timing and consolidation of human sleep, wakefulness, and performance by a symphony of oscillators. J Biol Rhythms, 2005 Aug;20(4)279-90.

2. International Classification of Sleep Disorders-2nd edition. American Academy of Sleep Medicine, 2005, 117-136.

3. Several studies have shown that shift workers are at significantly greater risk of work related accidents and injuries as well as automobile accidents:

   Average number of injuries 2-3 times higher during the first four days of the day and night shift

   - Chronobiol Int 1990

   Rotators twice the odds of falling asleep while driving to/from work and twice the odds of a reported accident or error related to sleepiness

   - Am J Public Health 1992

   Risk of injury 1.82 higher on night shift vs. morning shift self-paced work

   - Lancet 1994

   Distinct circadian pattern of accident frequency was observed

   - J Occup Med 1991

   (Additional studies below)

4. PRC for light: Jewett ME, Rimmer DW, Duffy JF, Klerman EB, Kronauer RE, Czeisler CA. Human circadian pacemaker is sensitive to light throughout subjective day without evidence of transients. Am J Physiol. 1997 Nov;273(5 Pt 2):R1800-9.

5. Entrainment of the Human Circadian System by Light. Duffy, Wright, J Biol Rhythms. 2005 Aug;20(4):326-38.

6. PRC for melatonin: A Lewy, Chronobio Int 9(5) 1992)

7. Melatonin for the blind: Sack, New England Journal of Medicine, 343, 2000

8. Additional information on Phase shifting: Duffy, Kronauer, Czeisler, Phase Shifting In Human Circadian Rhythms Journal of Physiology, 495, 1, 1996.

9. Dose response relationship between years of shift work and Heart Disease (504 men, 15 year study) - Scand J Soc Med Suppl 1989

   Coronary heart disease risk 1.51 higher among those working 6 or more years of rotating shifts (79,000 women) - Circulation 1995

10. Graveyard shift work associated with increased breast cancer risk (OR 1.6) (n=813 case, n=793 control) - S Davis et al, J Nat Cancer Inst 93(20) 2001

    Night shift work associated with increased breast cancer risk (RR 1.36) (n=78,562) (duration=10yrs) - E Schernhammer et al, J Nat Cancer Inst 93(20) 2001

11. Various GI problems:

    Moore-Ede, Richardson, Annu Rev Med 36, 1985 (Harvard)
    Vener et al, Chronobilogia 16(4) 1989 (NIH)
    Tuschen et al, Int J Epidemiol 23(2) 1994 (Denmark)
    Prunier-Poulmaire et al, Scand J Work Environ Health 24(3) 1998 (Paris)

12. Research continues to document evidence supporting this dangerous association in humans, from astronauts to medical interns:

    Odds ratios for reporting a motor vehicle crash and for reporting a near-miss incident after an extended work shift, as compared with a shift that was not of extended duration, were 2.3 (95 percent confidence interval, 1.6 to 3.3) and 5.9 (95 percent confidence interval, 5.4 to 6.3), respectively.

    - Czeisler C, N Engl J Med. 2005

    Documents evidence of significant sleep loss and disruption of circadian rhythms in astronauts and associated performance decrements during several space missions

    - Mallis M, Aviat Space Environ Med. 2005

13. Application of this CR information yields a significant competitive advantage by increasing productivity, decreasing accidents / injuries, decreasing liability, containing costs, and generally optimizing physical and cognitive performance:

    Bunn TL, Slavova S, Struttmann TW, Browning SR, Sleepiness/fatigue and distraction/inattention as factors for fatal versus nonfatal commercial motor vehicle driver injuries. Accid Anal Prev. 2005 Sep;37(5):862-9.

    Garbarino S, Mascialino B, Penco MA, Squarcia S, De Carli F, Nobili L, Beelke M, Cuomo G, Ferrillo F., Professional shift-work drivers who adopt prophylactic naps can reduce the risk of car accidents during night work. Sleep. 2004 Nov 1;27(7):1295-302.

    Folkard S, Lombardi DA, Tucker PT., Shiftwork: safety, sleepiness and sleep. Ind Health. 2005 Jan;43(1):20-3.

    Folkard S, Akerstedt T. Trends in the risk of accidents and injuries and their implications for models of fatigue and performance. Aviat Space Environ Med. 2004 Mar;75(3 Suppl):A161-7.

Kerin A, Aguirre A. Improving health, safety, and profits in extended hours operations (shiftwork). Ind Health. 2005 Jan;43(1):201-8.

Rajaratnam SM. Legal issues in accidents caused by sleepiness. J Hum Ergol (Tokyo). 2001 Dec;30(1-2):107-11.

Monk TH, Folkard S, Wedderburn AI. Maintaining safety and high performance on shiftwork. Appl Ergon. 1996 Feb;27(1):17-23.

Dijk DJ, Larkin W. Fatigue and performance models: general background and commentary on the circadian alertness simulator for fatigue risk assessment in transportation. Aviat Space Environ Med. 2004 Mar;75(3 Suppl):A119-21.

14. This link has been documented with disorders such as myocardial infarction, stroke, asthma, seizure disorder, sudden death, and acute aortic dissection, which have all demonstrated diurnal patterns of incidence:

MI increases by 40%
Cardiac death increases by 29%
Stroke increases by 49%
- Elliot, Am J Hypertension 14(9 pt 2) 2001
Vtach peaks
- Kozar, Pacing Clin Electro 26(3) 2003Acute Aortic Dissection (p<.001)
- Metha et al, Circulation 106(9) 2002
Asthma and seizures : common knowledge