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Fatigue Management Seminar

FAR 117 Fitness for Duty and Responsibilities
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Fatigue – What is it?

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I will not discuss off-label use and/or investigational use in my presentation, nor any specific data related to any funding sources.



FATIGUE DEFINED

- Physiological state of decreased ability to maintain optimal mental and/or physical function (Brown, 1994; Petrilli et al., 2006)
- Results from the interacting effects of time awake, time of day, and time on task (Belenky et al., 2014; Brown, 1994; Petrilli et al., 2006)
- Trait-like individual differences in response to all three factors (Philip et al., 2006; Van Dongen, Vitellaro, & Dinges, 2005; Williamson et al., 2011)
- Fatigue cannot be overcome through effort, motivation, or training
- Not possible to reliably self-assess fatigue levels and consequent performance impairment



WHAT IMPACTS FATIGUE

Time Awake

Sleep

AASM (Watson et al., 2015) and NSF (Hirshkowitz et al., 2015) concluded that 7-9 hours of sleep per night will sustain cognitive performance, health, and well-being relatively indefinitely

Wakefulness

The longer the continuous hours of wakefulness, the greater the degradation in performance and increase in fatigue and sleepiness that can only be alleviated fully with sleep



WHAT IMPACTS FATIGUE (CONT.)

Time of Day

Circadian Rhythm

- An approximately 24-hour sinusoidal rhythm that acts as a biological clock located in the brain, specifically the SCN (Belenky, Wu, & Jackson, 2011)
- SCN acts as a blue light detector, modulating the circadian rhythm by the light/dark cycle

Circadian Desynchrony (Jet Lag)

- Misalignment of the circadian rhythm within an externally imposed change in the 24-hour day
- Occurs when crossing multiple time zones (Graeber, 1988; Petrilli et al., 2006)
- Associated with sleep disruption, degraded performance, increased number of health complaints, and decreased feelings of well-being (Graeber, 1988; Petrie & Dawson, 1997; Petrilli et al., 2006)



WHAT IMPACTS FATIGUE (CONT.)

Time on Task

Workload

- Workload directly affects fatigue, which directly affects performance
- As workload increases, fatigue increases, leading to reduction in performance
- Little data quantifying workload and its interaction with time of day & time awake
- Biomathematical 2-process models do not include workload
- NASA Task Load Index (TLX) (Rubio et al., 2004) - Best workload metric for predicting performance



WHAT IMPACTS FATIGUE (CONT.)

Other Factors

Interindividual Variability

- Genetic makeup
- Morningness/eveningness

Undiagnosed sleep disorders

- OSA
- Insomnia

Alertness Aids

- Caffeine

Sleep Aids

- Melatonin



FATIGUE AND PERFORMANCE

- Fatigue directly affects performance such that as fatigue increases, there is a reduction in performance (Fan et al., 2017)
- Currently scientists do not know how quickly individuals recover from cumulative fatigue and performance degradation
- We do know performance recovery **does not** occur by:
 - 2nd recovery day when allowed 10 hrs time in bed (TIB) (Redwine et al, 2000)
 - 3rd recovery day when allowed 8 (Belenky et al., 2003; Banks, 2007) & 16 hrs TIB (Klerman & Dijk, 2005)
 - 5th recovery day when allowed 8 hrs TIB (Rupp et al., 2009)
- Performance **does** return to baseline levels after 7 recovery days when allowed 8 hrs TIB (Axelsson et al., 2008)



FATIGUE SYMPTOMS IN AVIATION

- Impaired decision-making capabilities
- Impaired mental flexibility
- Perseverating on a factor that is not useful in light of new information
- Lack of ability to communicate effectively
- Attentional lapses and slowed response time
- Lack of focus on factors that matter
- Poor memory
- Poor appreciation of useful alternative options
- Decisions influenced by emotion instead of strictly logic

(Caldwell, 2005; Harrison & Horne, 2000; Horne, 2012; Petrie & Dawson, 1997)



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OSA and Insomnia

OSA can be diagnosed at home with many pilots now using C-PAP or an oral appliance successfully, seeing immediately health benefits while retaining their jobs

OSA

- Due to respiratory impairment through blockage of airflow in the upper airway and collapse of airways that disturbs breathing during sleep and increased blood CO₂ levels (Belenky et al., 2011; Venner et al., 2019)
- Keeps an individual from obtaining high quality sleep (Balkin, Horrey, Graeber, Czeisler, & Dinges, 2011; George, 2007)
- Manifests in fragmented, non-recuperative sleep, causing excessive daytime fatigue/sleepiness/performance impairment (Adams, Strauss, Schluchter, & Redline, 2001; Belenky et al., 2011)
- Population at highest risk: overweight males at increased age

Insomnia

- Characterized by problems falling or staying asleep (early awakenings)
- Leads to:
 - 1) shorter sleep duration often causing prolonged sleep restriction
 - 2) fragmented (non-recuperative)/poor quality sleep
- Manifests in excessive daytime fatigue, sleepiness, and performance impairment

