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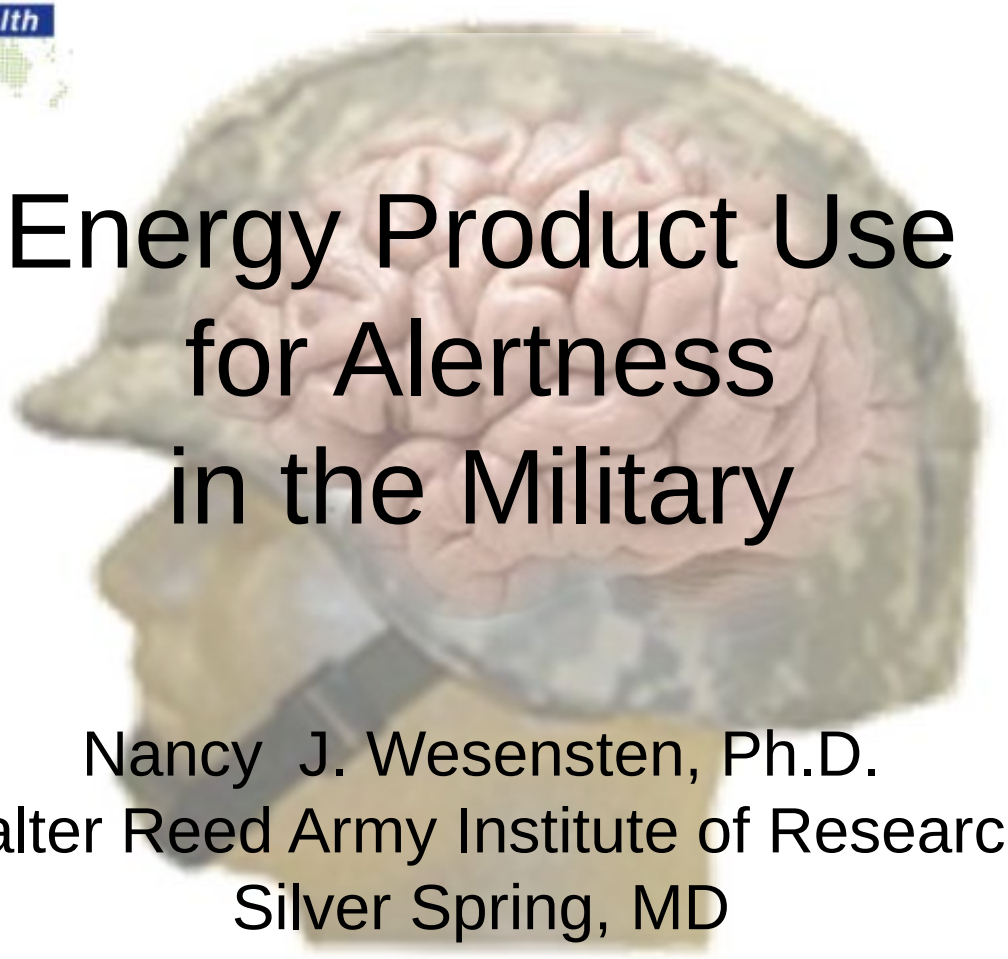
Soldier Health • World Health



Energy Product Use for Alertness in the Military

Nancy J. Wesensten, Ph.D.
Walter Reed Army Institute of Research
Silver Spring, MD

Sleep in the Deployed Environment

6. On average, how many hours of sleep do you get per day?

- O 4 or fewer
- O 5
- O 6
- O 7
- O 8 or more

AVG Obtained = 5.5 Hrs

5. How many hours of sleep do you need per day in order to feel well-rested?

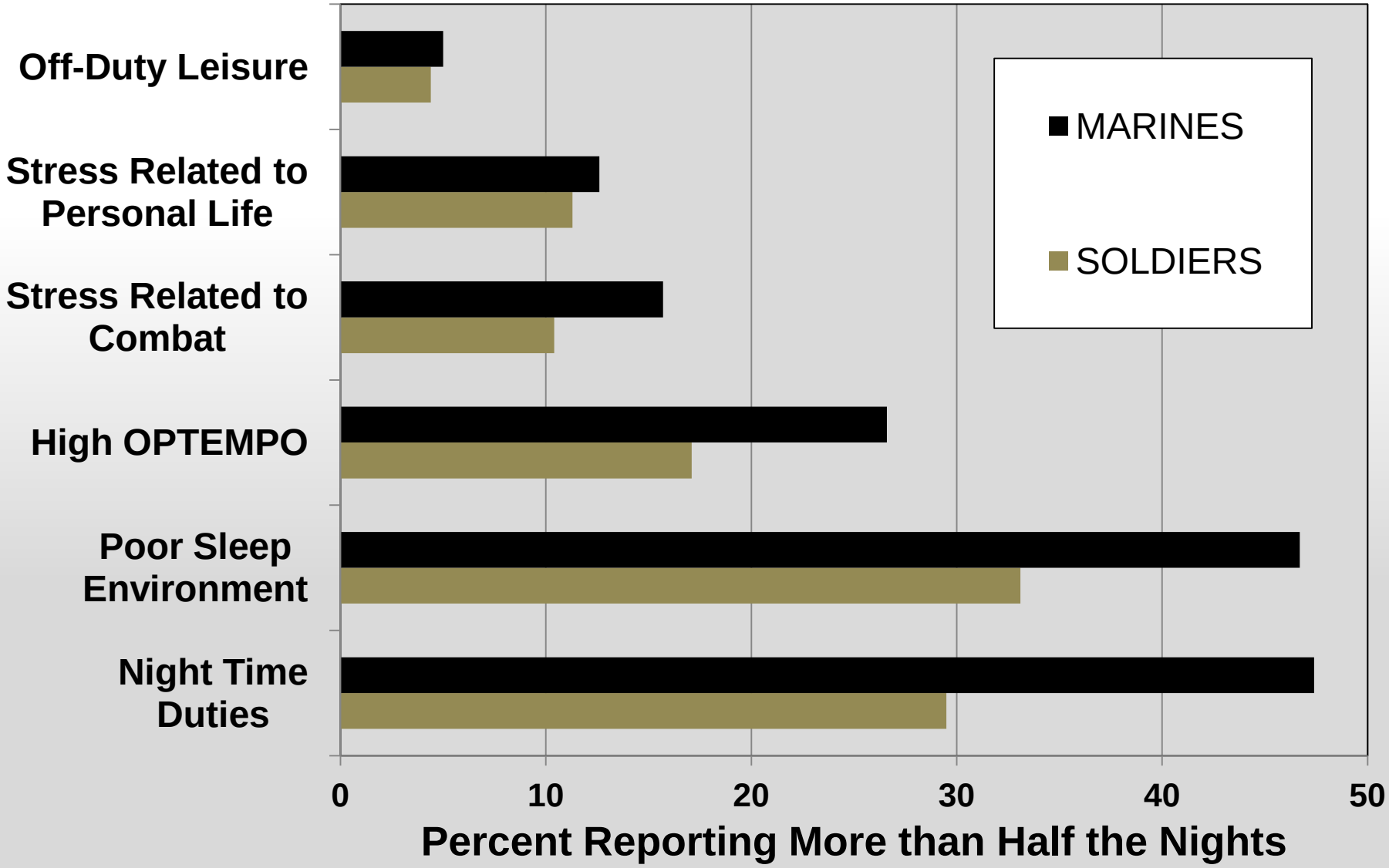
- O 4 or fewer
- O 5
- O 6
- O 7
- O 8 or more

AVG Needed = 6.3 Hrs

RECOMMENDED = 7--8 Hrs per 24

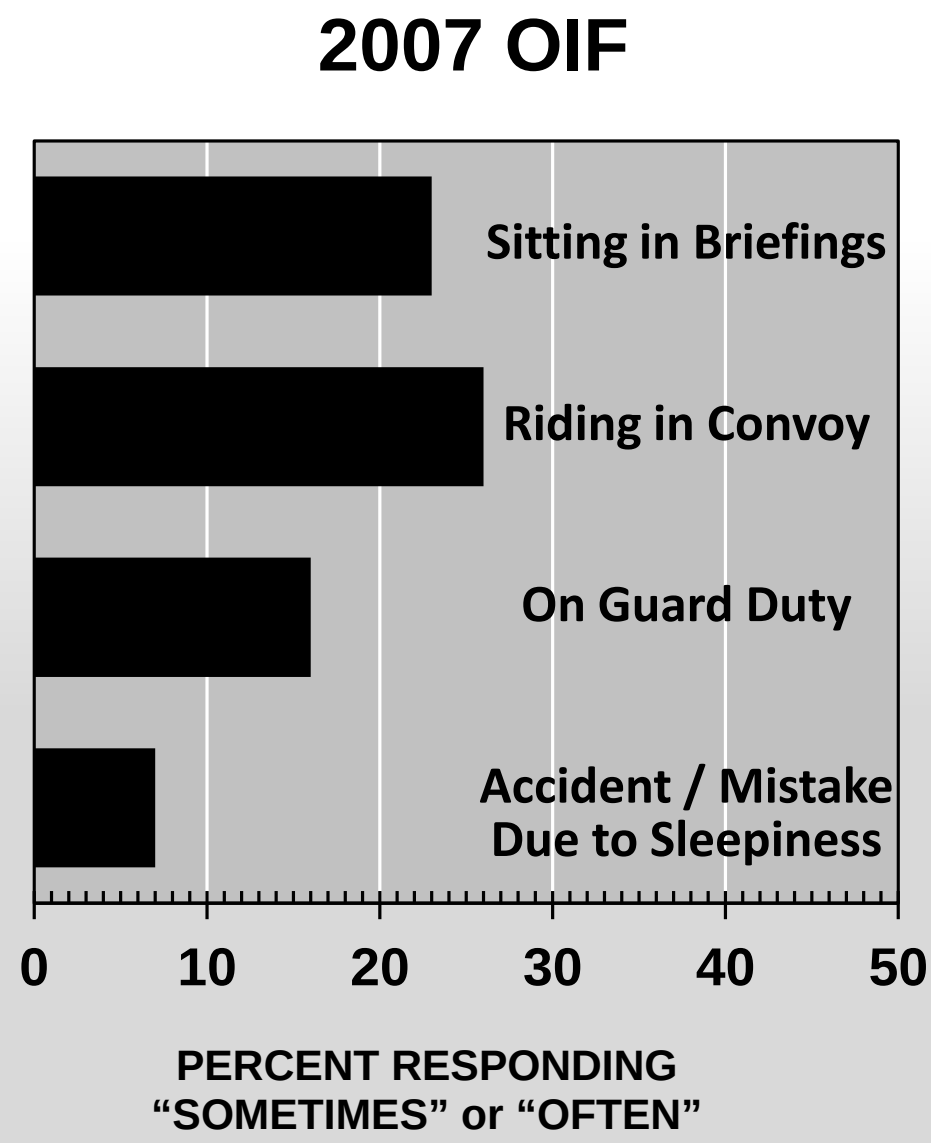
From Mental Health Advisory Team (MHAT) 7 Survey OEF JUL—AUG 2010

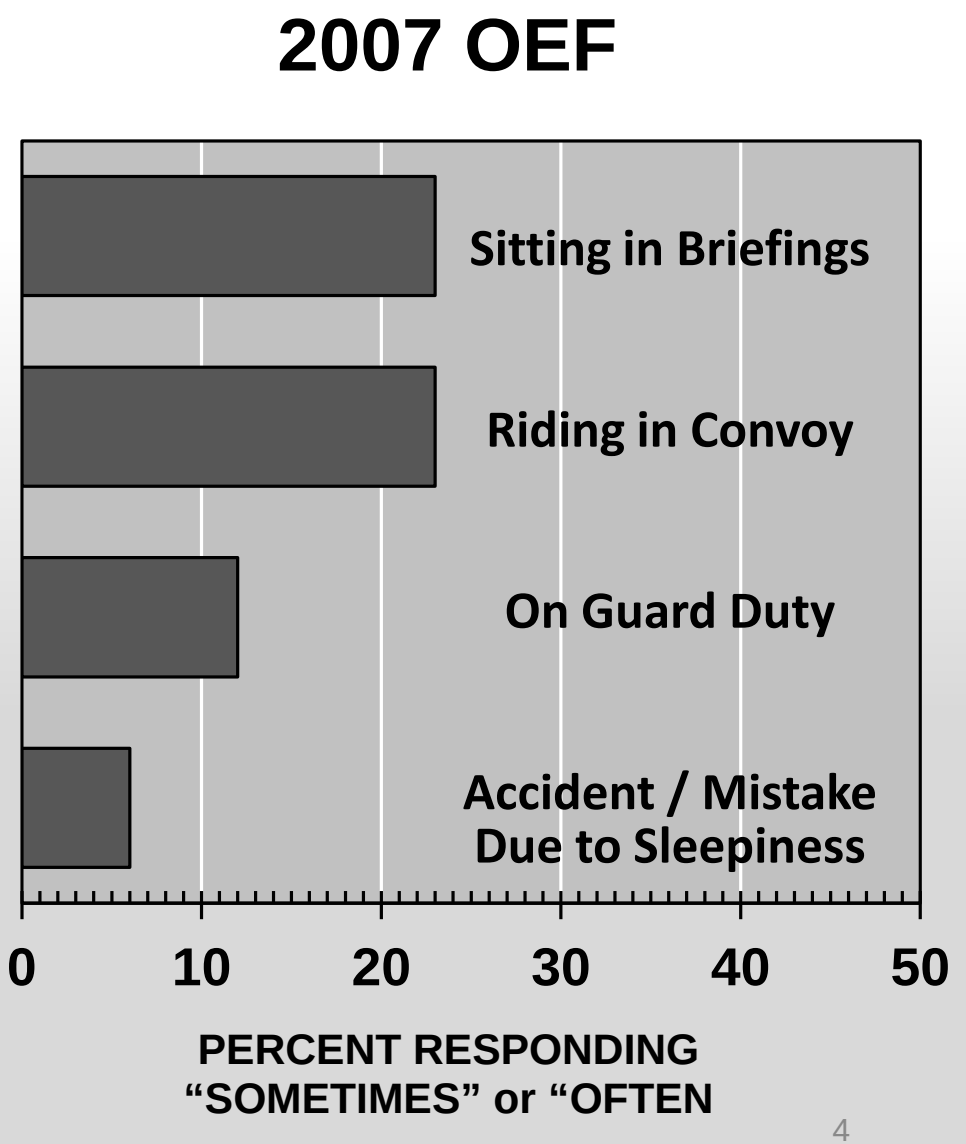
What is Interfering with Sleep?



From Joint Mental Health Advisory Team (J-MHAT) 7 Survey OEF JULY—AUG 2010

Consequences of Insufficient Sleep





Reported Energy Drink Use – 2010 (deployed)

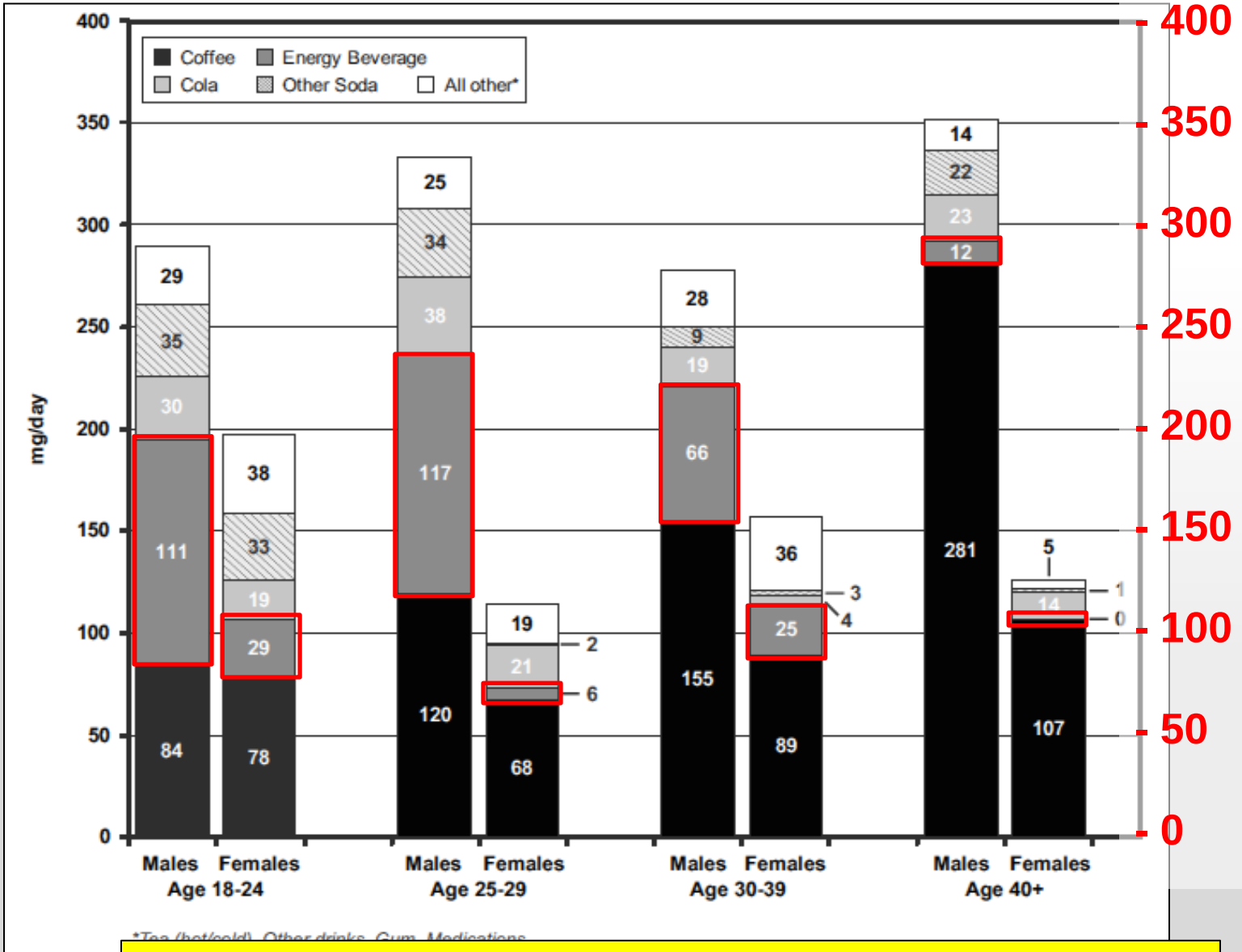
TABLE 2. Daily Energy Drink consumption reported by service member and rank during a combat deployment **(N = 988)**

Energy drinks per day	All service members† No.	(%)	
0	545	(55.2)	55.2
1	192	(19.4)	74.6
2	114	(11.5)	86.1
3	65	(6.6)	92.7
4	26	(2.6)	95.3
≥5	46	(4.7)	100.0

Energy drinks	Junior enlisted (E1–E4) No.	(%)	Senior enlisted (E5–E9) No.	(%)	Officer/Warrant officer No.	(%)
0	385	(54.8)	142	(56.6)	17	(51.5)
1	139	(19.8)	41	(16.3)	12	(36.4)
2	83	(11.8)	27	(10.8)	4	(12.1)
3	50	(7.1)	15	(6.0)	0	—
4	17	(2.4)	9	(3.6)	0	—
≥5	29	(4.1)	17	(6.8)	0	—

From Toblin et al Morbidity and Mortality Weekly 61(44) (2012) 895-898. Based on J-MHAT-7 Survey Afghanistan 2010.

Reported Caffeine Use - 2007



*Tea (hot/cold), Other drinks, Gum, Medications

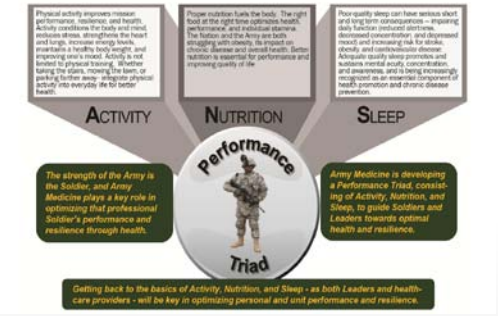
Figure. Da
source for
males. You

From Lieberman et al., 2012 N = 990 respondents (total eligible population = 504,433 in 2007). 11 locations: 9 US installations + 2 overseas sites (out of 35 sites surveyed).

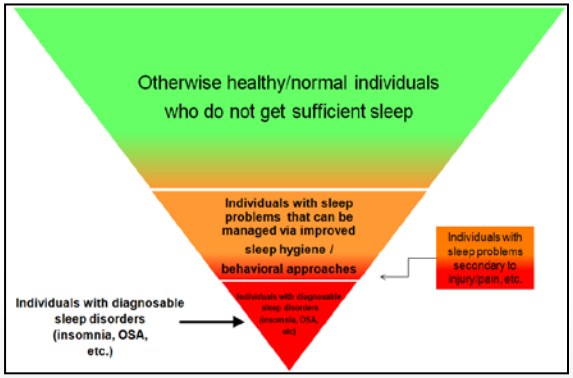
Is CAFFEINE / ENERGY DRINK USE
really the problem?

Or are ATTITUDES about SLEEP the problem?
(i.e., What is the Driver?)

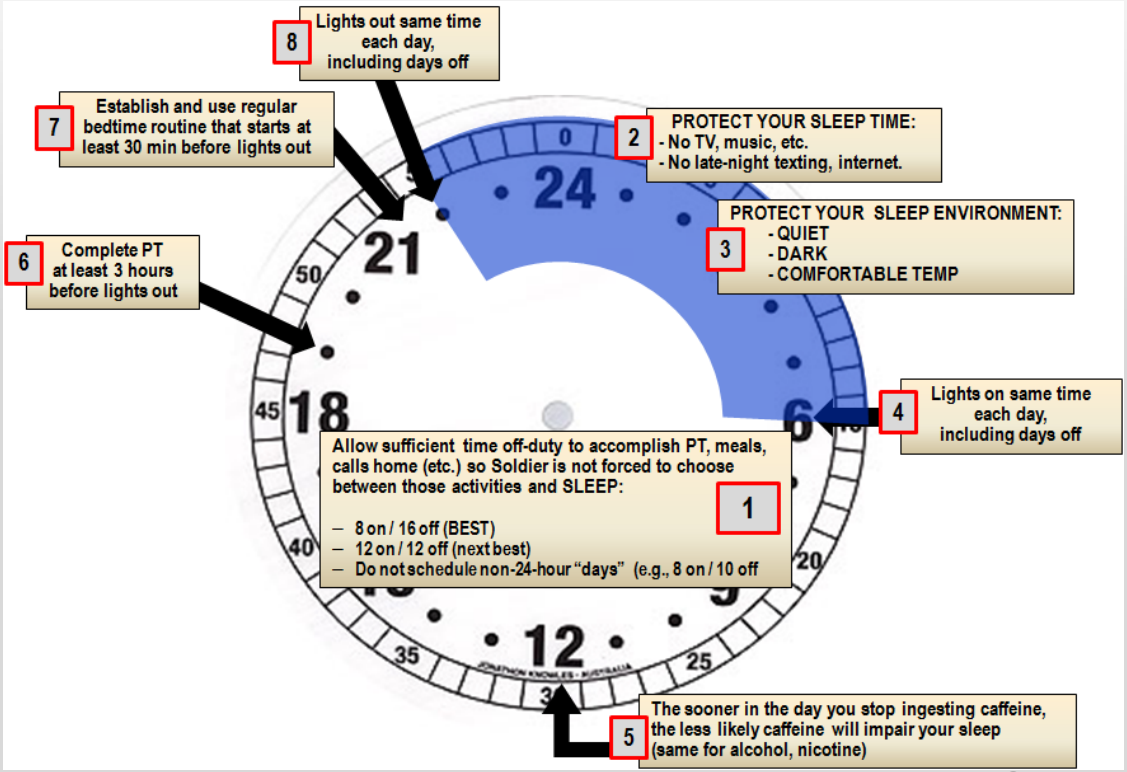
TSG Performance Triad Strategic Approach: Transform Mindset



"I can get by with 4-5 hours of sleep" →
"Sleep is a critical commodity that my Soldiers and I must have."



- **Inform** = What does "healthy sleep" look like?
- **Educate (1)** = Behaviors that foster healthy sleep (sleep hygiene) **+ How to use caffeine**
- **Educate (2)** = Signs of more serious sleep problems



Army Guidance: Consistent with FM 6-22.5

Sustained Ops (no sleep):	▪200 mg @ ~ 0000 ▪200 mg again @ 0400 and 0800 h, if needed ▪Use during daytime (1200, 1600) only if needed
Night Ops with Daytime Sleep:	▪200 mg @ start of night shift ▪200 mg again 4 hours later ▪Last dose: at least 6 hrs away from sleep period
TEMPORARILY RESTRICTED SLEEP (6 or fewer hrs of sleep)	▪200 mg upon awakening ▪200 mg again 4 hours later ▪Last dose: at least 6 hrs away from sleep period

From: Field Manual 6-22.5 (2009), Combat and Operational Stress Control Manual for Leaders and Soldiers. Chapter 4, Sleep Deprivation.

Table 4-3. Using caffeine under various conditions of sleep deprivation

Condition under which caffeine is used	*Guidelines for use*
Sustained operations (no sleep).	• 200 mg starting at approximately midnight. • 200 mg again at 0400 hours and 0800 hours, if needed. • Use during daytime hours only if needed. • Repeat for up to 72 hours.
Night shifts with daytime sleep.	• 200 mg starting at beginning of nighttime shift. • 200 mg again 4 hours later. • Last caffeine dose: no less than 6 hours before sleep (for example, last dose at 0400 hours if daytime sleep is anticipated to commence at 1000 hours).
Restricted sleep.	• 200 mg upon awakening. • 200 mg again 4 hours later. • Last caffeine dose: no less than 6 hours before sleep.

What Does Caffeine Content Look Like?

1 piece =
100 mg

1 packet (10 mints) =
70 mg

1 squirt (½ tsp) =
60 mg

1.7 gm
= 44 mg

2 oz =
200 mg

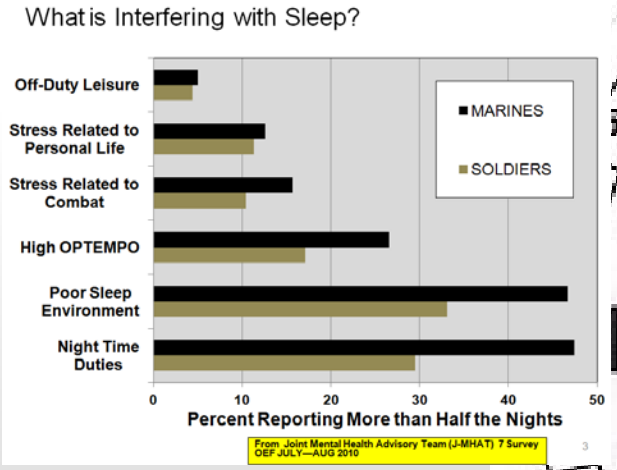
12 oz =
50 mg

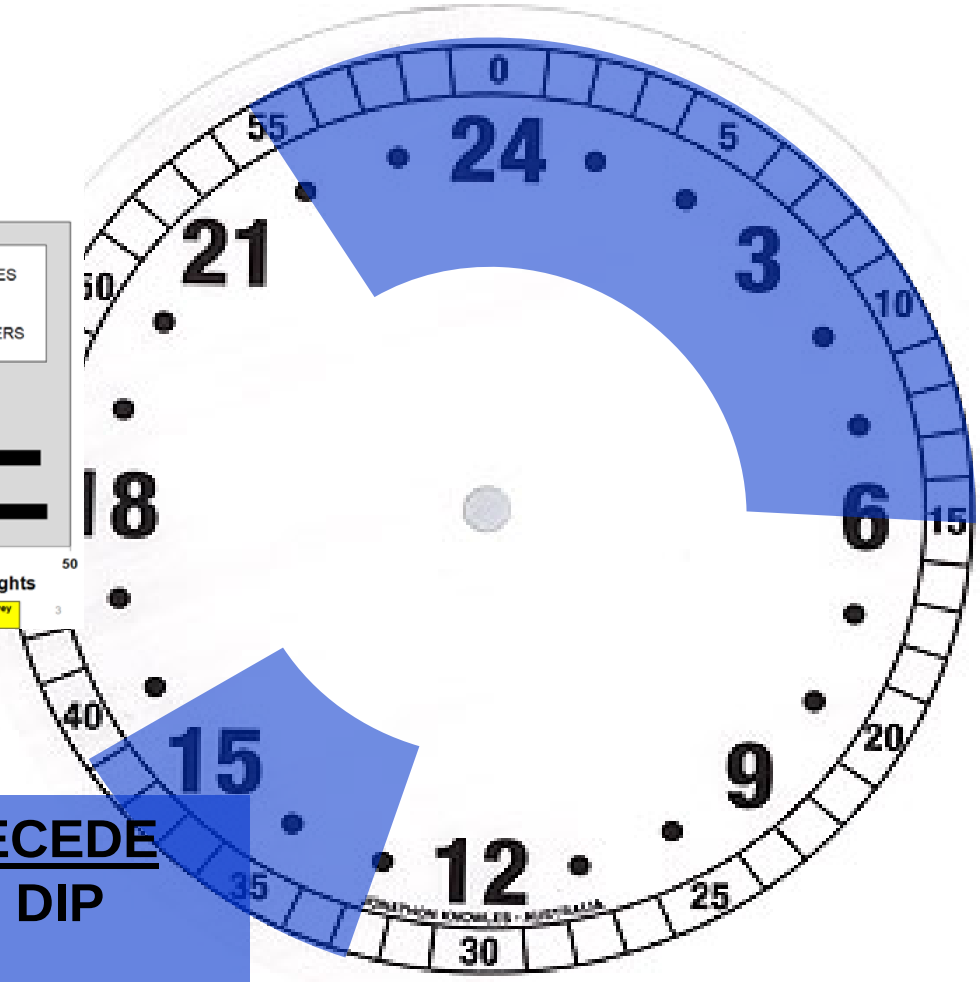
16 oz =
330 mg

16 oz =
160 mg

Caffeine Dosing: Timing is Everything

DAY WORK



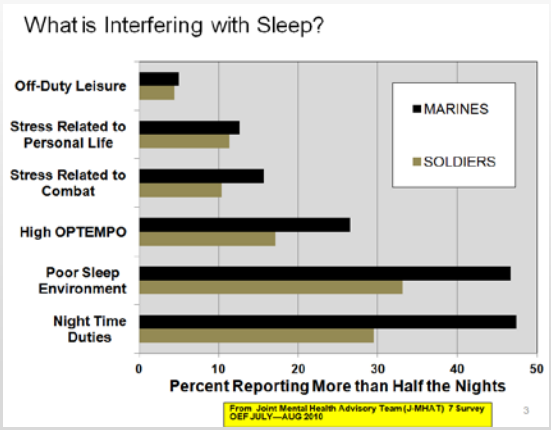


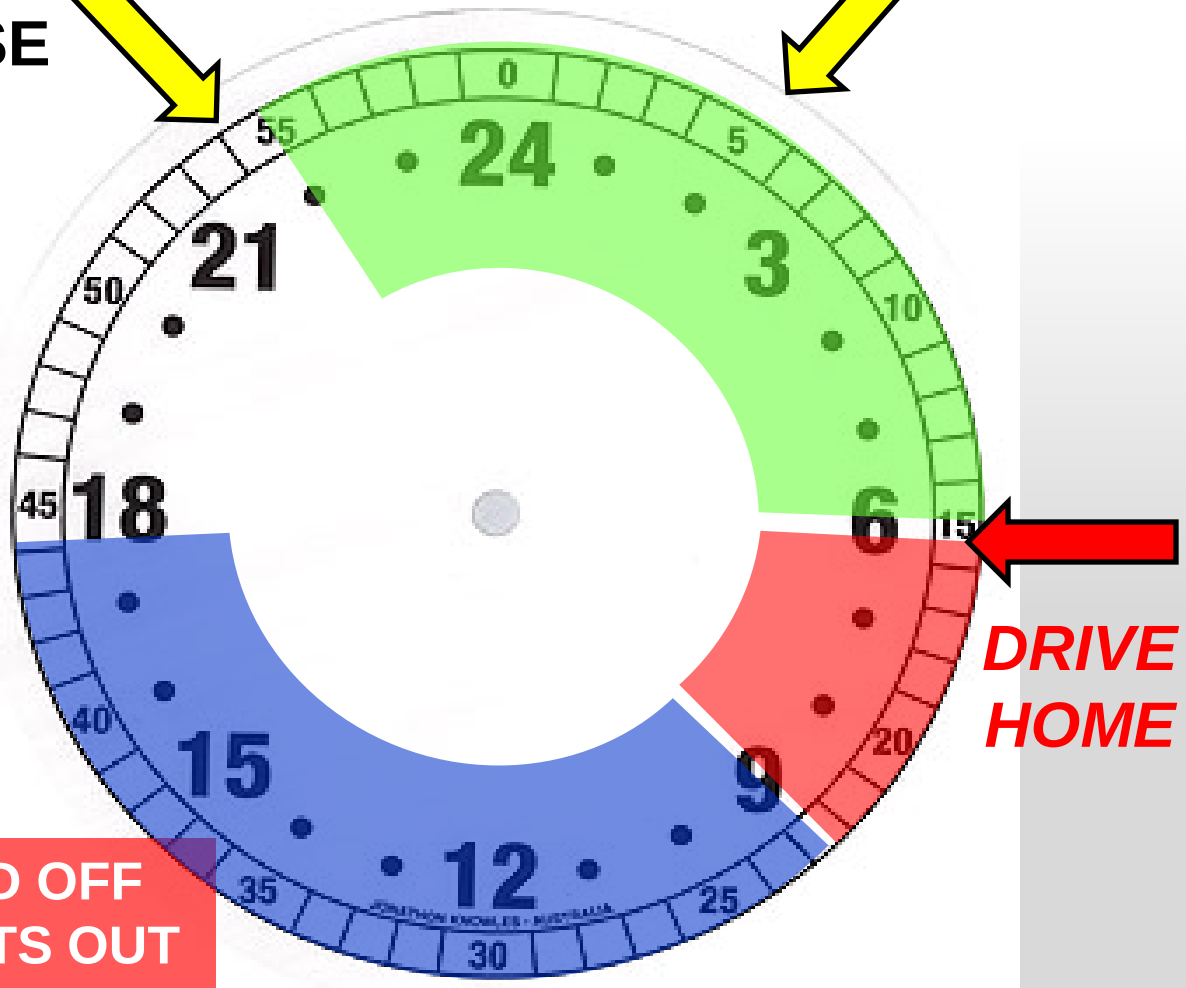
FIRST DOSE

LAST DOSE TO <u>PRECEDE</u>
MID-AFTERNOON DIP
and
BACKED OFF FROM
NIGHTTIME LIGHTS OUT
"AS FAR AS POSSIBLE"

Caffeine Dosing: Timing is Everything

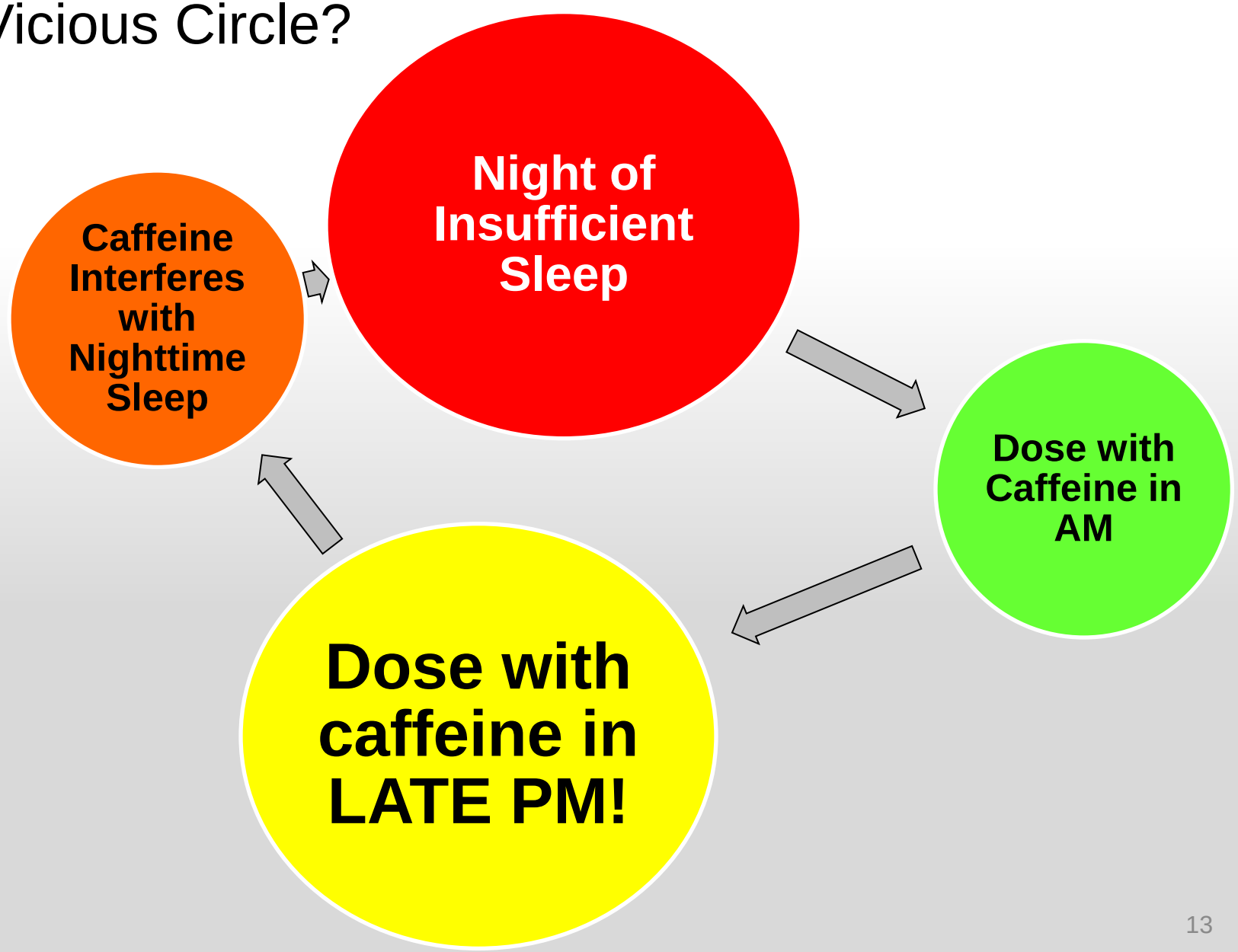
NIGHT WORK





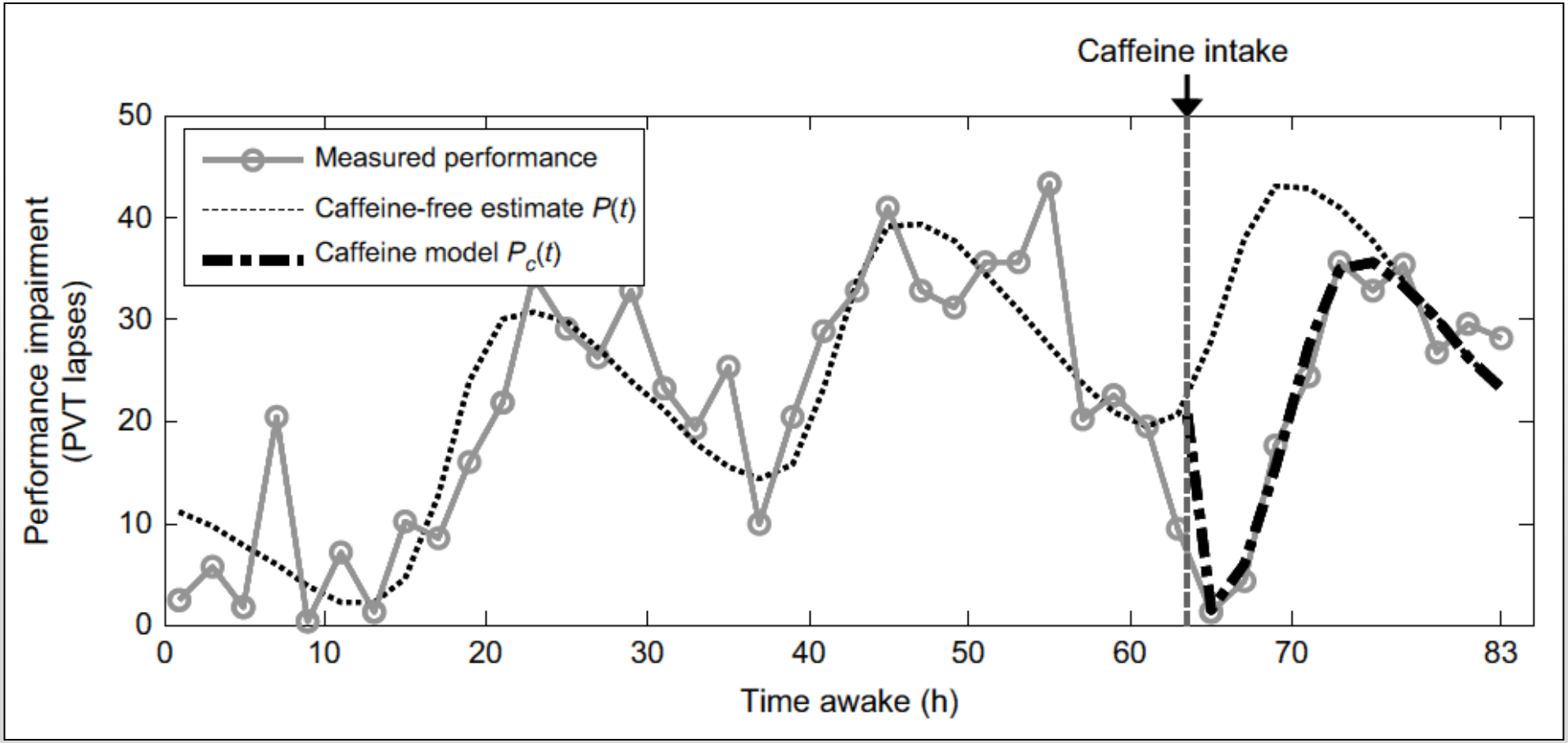
LAST DOSE BACKED OFF FROM DAYTIME LIGHTS OUT "AS FAR AS POSSIBLE"

Caffeine Dose Creep (a.k.a. “TOLERANCE”): A Vicious Circle?



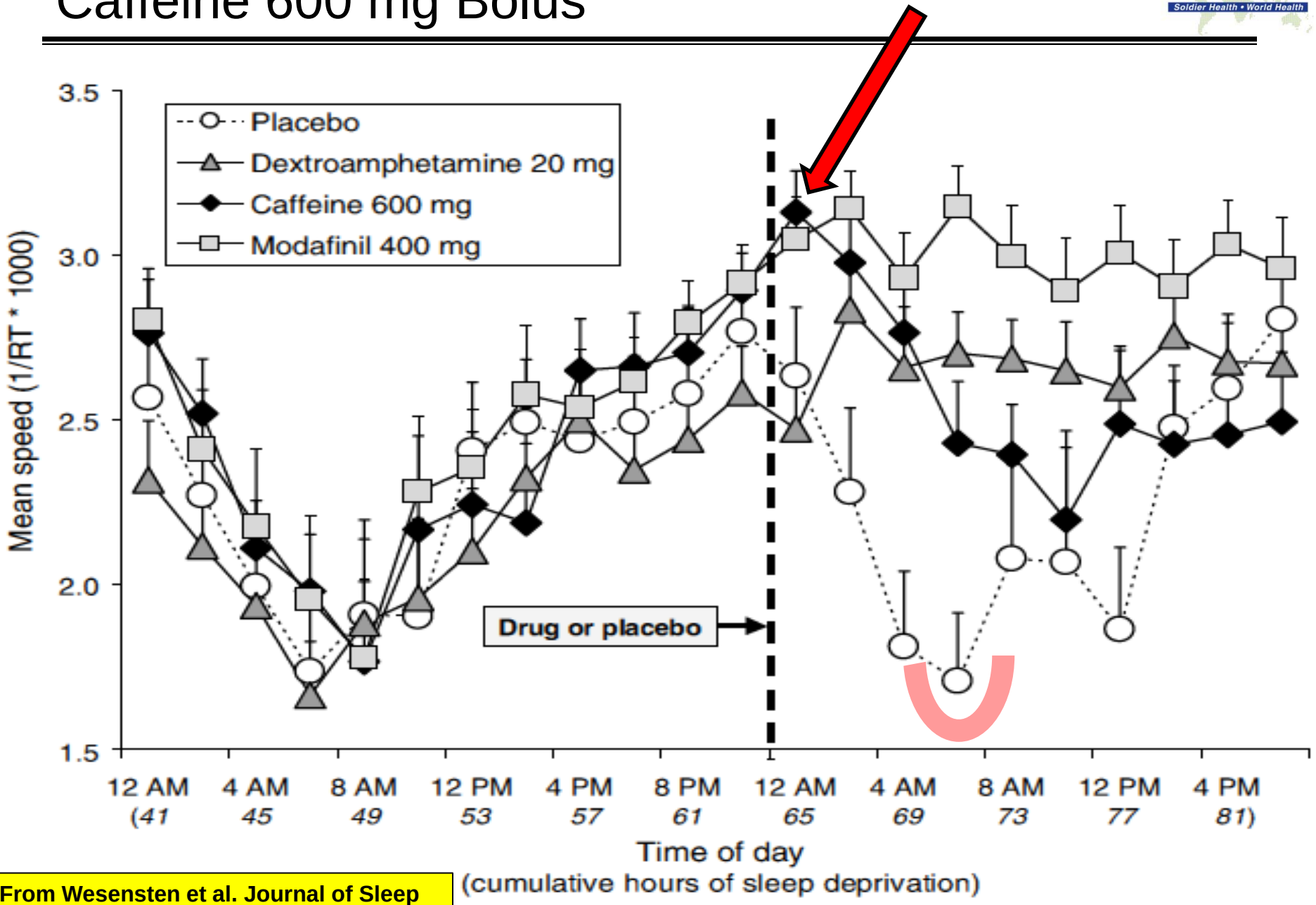
“AS FAR AS POSSIBLE?”

Estimate / Predict (Model) Caffeine Effects



From Ramakrishnan et al. Journal of Theoretical Biology 319 (2013) 23–33.

Caffeine 600 mg Bolus



From Wesensten et al. Journal of Sleep Research 14 (2005) 255-266.

Adverse Effects – Inherently Limit "Abuse?"

Table 3 Frequency of symptoms at each post-drug session

	Nervousness				*Excitation*				*Aggressive Feelings*				*Headache*			
Time	*PLA*	*C600*	*D20*	*M400*	*PLA*	*C600*	*D20*	*M400*	*PLA*	*C600*	*D20*	*M400*	*PLA*	*C600*	*D20*	*M400*
00:35 AM	1	4	1	0	1	4	1	2	0	2	0	0	1	0	0	1
2:35 AM	0	4	3	0	0	4	**5**	**5**	1	2	0	1	1	1	0	2
4:35 AM	0	3	1	1	0	0	**5**	0	1	1	0	0	1	1	0	1
6:35 AM	0	2	1	1	0	0	1	0	0	0	0	0	2	0	0	1
8:35 AM	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
10:35 AM	0	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0
12:35 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
14:35 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1
16:35 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1
18:35 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

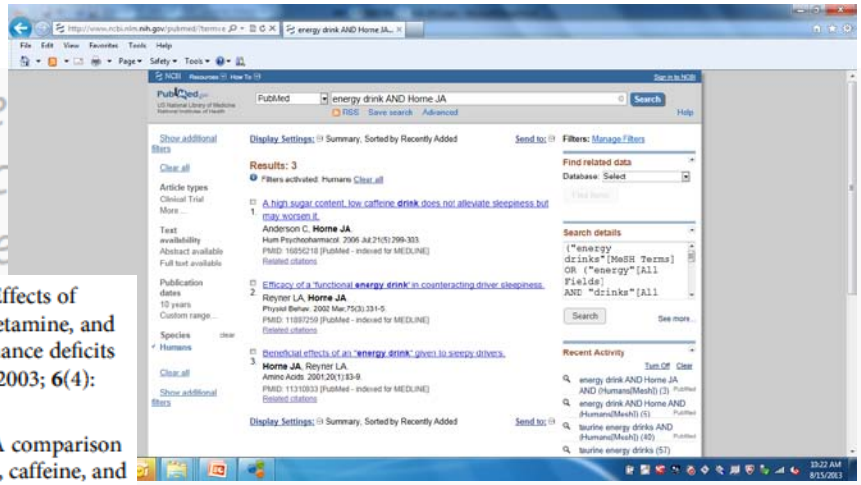
	Happiness				*Pain in stomach or abdomen*				*Dry mouth*				*Pounding heart*			
Time	*PLA*	*C600*	*D20*	*M400*	*PLA*	*C600*	*D20*	*M400*	*PLA*	*C600*	*D20*	*M400*	*PLA*	*C600*	*D20*	*M400*
00:35 AM	0	2	1	1	1	2	1	0	2	3	2	0	0	3	1	0
2:35 AM	1	2	5	3	4	2	0	1	2	4	6	2	0	4	**5**	2
4:35 AM	0	0	1	1	1	1	1	0	1	2	4	2	0	2	3	1
6:35 AM	0	0	1	0	0	2	1	1	0	0	2	1	0	2	2	3
8:35 AM	0	0	0	0	0	1	1	2	1	0	5	2	0	0	4	0
10:35 AM	0	0	0	0	0	1	0	0	0	0	3	1	0	0	4	1
12:35 PM	1	0	1	0	0	0	0	0	0	0	2	0	0	0	3	0
14:35 PM	0	0	0	0	0	1	0	0	0	0	3	0	0	0	2	1
16:35 PM	0	1	0	0	0	1	0	0	0	0	2	0	0	0	2	1
18:35 PM	0	0	1	0	0	0	0	0	0	0	1	0	0	0	2	0

	Racing heartbeat				*Tremors*				*Nausea*				*Jitteriness*			
Time	*PLA*	*C600*	*D20*	*M400*	*PLA*	*C600*	*D20*	*M400*	*PLA*	*C600*	*D20*	*M400*	*PLA*	*C600*	*D20*	*M400*
00:35 AM	0	3	1	2	1	**8**	1	0	0	4	2	0	1	**8**	0	1
2:35 AM	0	**5**	3	1	1	3	1	2	0	**5**	1	0	0	**7**	**6**	2
4:35 AM	1	2	2	1	1	3	2	3	0	**4**	1	**5**	0	**5**	**6**	2
6:35 AM	0	1	1	1	1	1	1	2	0	**5**	0	**5**	0	2	2	1
8:35 AM	0	0	1	1	0	0	1	1	0	3	3	4	0	2	2	1
10:35 AM	0	0	1	1	0	0	1	1	0	2	2	3	0	1	3	0
12:35 PM	0	0	1	0	0	1	0	0	0	3	2	2	0	0	1	0
14:35 PM	0	0	1	1	0	0	1	0	0	2	1	3	0	0	2	0
					0	0	1	0	0	3	1	0	0	0	2	0
					0	0	1	0	0	2	2	0	0	0	3	0

ebo (PLA) are given in bold. PLA,placebo; C600,caffeine 600 mg; D20,dextroamphetamine 20 mg;

From Wesensten et al. Journal of Sleep Research 14 (2005) 255-266.

Concerns about Energy Drinks In Particular: A Straw Man?



[26] Watanabe A, Kato N, Kato T. Effect of creatine on mental fatigue and cerebral hemoglobin oxygenation. *Neurosci Res* 2002; **42**: 279–85.

[27] Rae C, Digney AL, McEwan SR, Bates TC. Oral creatine monohydrate supplementation improves brain performance: a double-blind, placebocontrolled, cross-over trial. *Proc R Soc Lond B* 2003; **270**: 2147–50.

[28] McMorris T, Harris RC, Howard AN, et al. Creatine supplementation, sleep deprivation, cortisol, melatonin, and behavior. *Physiol Behav* 2007; **90**: 21–8.

[29] Rawson ES, Lieberman HR, Walsh TM, et al. Creatine supplementation does not improve cognitive function in young adults. *Physiol Behav* 2008; **95**: 130–4.

[30] McMorris T, Harris RC, Swain J, et al. Effect of creatine supplementation and sleep deprivation, with mild exercise, on cognitive and psychomotor performance, mood state, and plasma concentrations of catecholamines and cortisol. *Psychopharmacology* 2006; **185**: 93–103.

[37] Magill RA, Waters WF, Bray GA, et al. Effects of tyrosine, phentermine, caffeine D-amphetamine, and placebo on cognitive and motor performance deficits during sleep deprivation. *Nutr Neurosci* 2003; **6**(4): 237–46.

[38] Waters WF, Magill RA, Bray GA, et al. A comparison of tyrosine against placebo, phentermine, caffeine, and d-amphetamine during sleep deprivation. *Nutr Neurosci* 2003; **6**(4): 221–35.

[39] Mahoney CR, Castellani J, Kramer FM, et al. Tyrosine supplementation mitigates working memory decrements during cold exposure. *Physiol Behav* 2007; **92**(4): 575–82.

evaluation of the evidence-based findings in these articles was then conducted. With the exception of some weak evidence for glucose and guaraná extract, there is an overwhelming lack of evidence to substantiate claims that components of EDs, other than caffeine, contribute to the enhancement of physical or cognitive performance.

Mahoney and Lieberman (2012). Ch 12 pp 199-208 In Wesensten Sleep Deprivation, Stimulant Medications, and Cognition.

Summary / Conclusions

- Bulk of evidence supports safety / efficacy of appropriate caffeine use:
  - Dose
  - Timing
- Virtually no evidence to support efficacy of other energy drink components (but no clear safety concerns, either)
- SOLUTION: preach SMART CAFFEINE USE
  - Informed labeling to REDUCE inadvertent caffeine intake
  - Education on appropriate dosing
- MAIN SOLUTION: Practice what we preach: **PROMOTE HEALTHY DAILY SLEEP AMOUNTS**

RESEARCH GAPS

GENERAL PUBLIC KNOWLEDGE:

? What is an effective DOSE (do scientists AGREE on an effective dose?) for me?

? How much caffeine (CONTENT) in a given product?

? How should I TIME caffeine use?

SCIENTIFIC AGENDA:

? Long-term RECOVERY SLEEP consequences of chronic caffeine use (no free lunch?)

- Sleep History (Amount + Timing)
- Caffeine / Nicotine / Oral birth control use history (+ liver enzyme polymorphisms)
- Adenosine receptor + other functional polymorphisms
- Crossover v. Parallel groups design + study N (statistical power)
- **Repeatability of "executive function" tests (lab-based tests of "risk-taking")**
- Timing of caffeine dosing relative to circadian trough, test administration

Caffeine Use During Chronic, Restricted Sleep

WALTER REED Army Institute of Research
Soldier Health • World Health

- Total of 48 healthy adult men and women 18-39 years of age (n = 24 CAFFEINE; n = 24 PLACEBO)
- Full in-lab polysomnography and electrocardiography monitoring

STUDY DAY	PRIOR NIGHT TIME in BED (HOURS)	CAFFEINE 200 MG or PLACEBO
1	10 (2100—0700)	n/a
2	10 (2100—0700)	n/a
3	10 (2100—0700)	n/a
4	10 (2100—0700)	n/a
5	10 (2100—0700)	n/a
6	5 (0200—0700)	0700, 1100
7	5 (0200—0700)	0700, 1100
8	5 (0200—0700)	0700, 1100
9	5 (0200—0700)	0700, 1100
10	5 (0200—0700)	0700, 1100
11	8 (2300—0700)	n/a
12	8 (2300—0700)	n/a
13	8 (2300—0700)	n/a