

Sleep and Falls

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Significance: Falls in older adults

- Falls occur in approximately a third of community-dwelling older adults each year¹
 - >50% of institutionalized elders fall each year²
- A major cause of functional impairments due to fractures and other injuries²
- Mortality risk increased among frequent fallers
 - 9-year mortality risk increased by 60% in older white women³
 - Risk may be even greater in older men⁴

1. Carroll NV et al. J Manag Care Pharm 2005;11:307–16. 2. Tinetti ME et al. J Am Geriatr Soc 1995;43:1214–21. 3. Sylliaas H et al. Eur J Epidemiol 2009; 24(7): 351-5. 4. Nakada TA et al. Acad Emerg Med 2015; 22(6): 708-13.

Significance: Falls in older adults

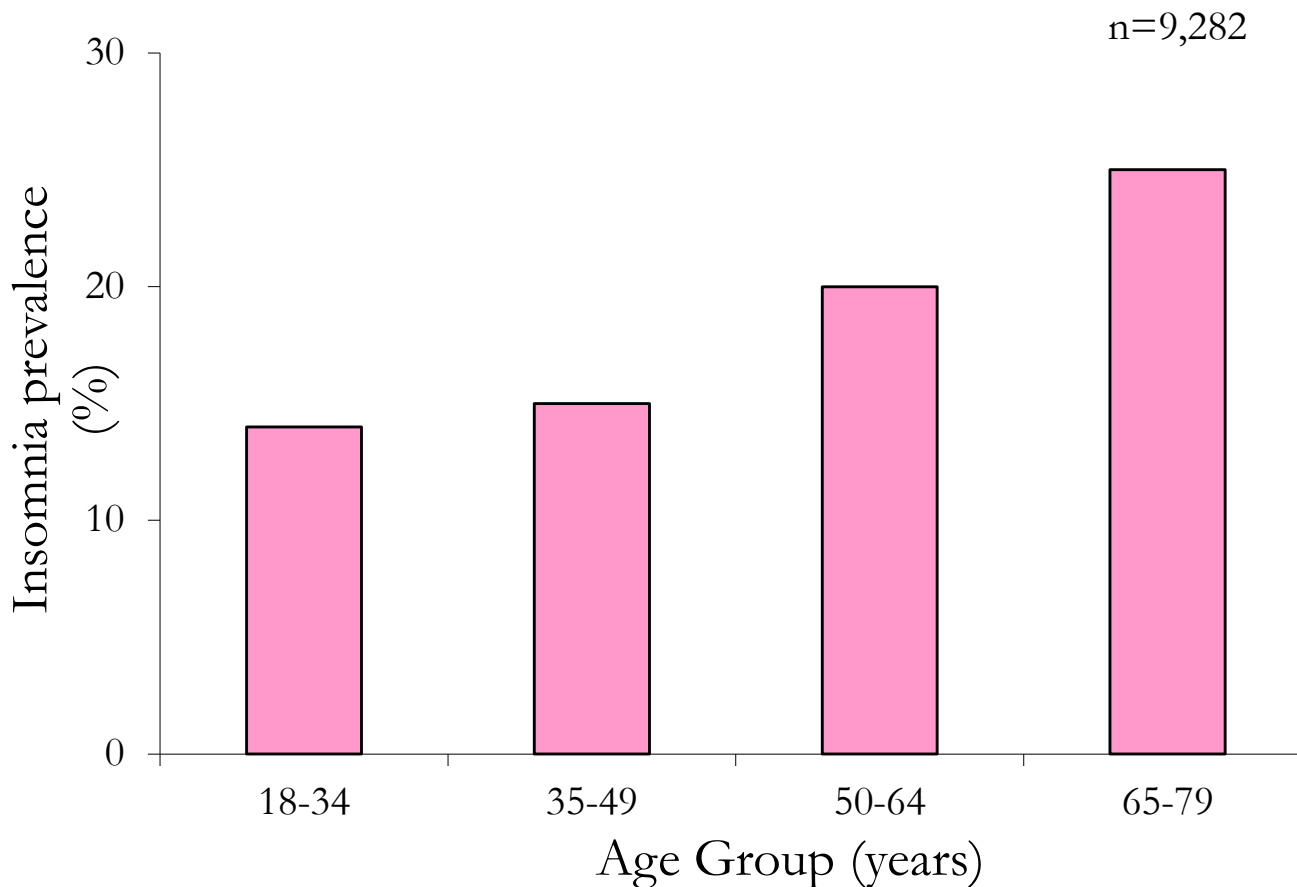
- Causes of falls are multifactorial
 - Poor balance & reaction time/gait problems (e.g. in those with postural hypotension)
 - Frailty
 - Urinary incontinence
 - Effects of medications (e.g. hypnotics, antidepressants)
 - *Sleep problems??*
- Sleep may represent a modifiable behavior to target for reducing risk of falls in older adults

Significance: Sleep and Falls

- Insomnia and other sleep problems increase with advancing age
- Evidence suggests increased fall risk in older adults with sleep problems
- ***Controversy***: is it the sleep problem, or medications (e.g. hypnotics) used to treat the sleep problem that is responsible for increased fall risk?
 - Most studies have not examined the *independent* effects of disturbed sleep and medications used to treat sleep

Prevalence of insomnia symptoms by age group

Large-scale community survey of non-institutionalized American adults, aged 18–79 years¹



1. Foley DJ et al. Sleep 1995;18:425–32.

Sleep characteristics and history of falling in Australian nursing home residents¹

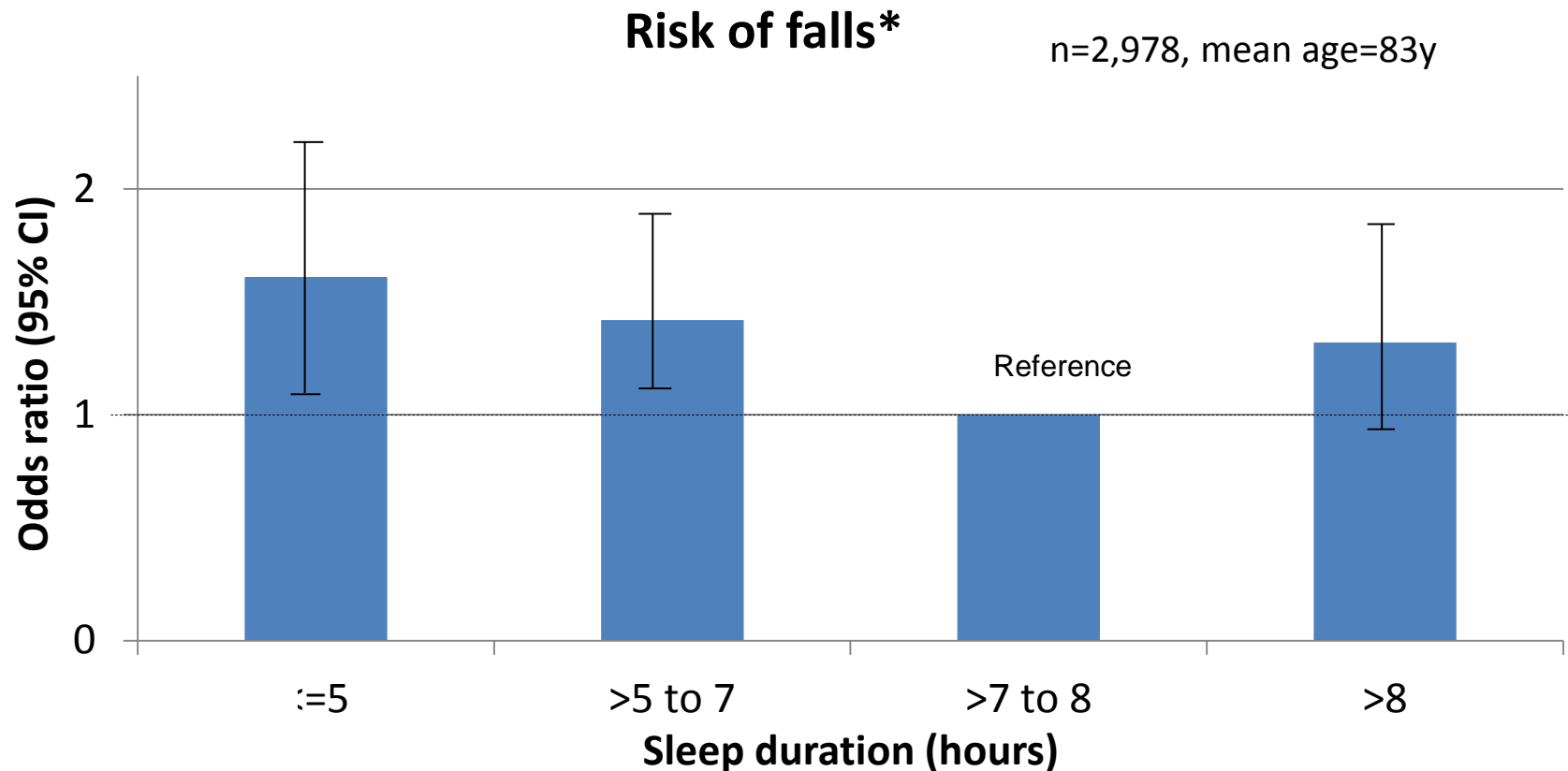
- n=150 nursing home residents
- Mean age 81 years, 66% female
- 44% fallers, 56% nonfallers during 1 year
- In multivariate models that accounted for use of hypnotic medications and other fall risk factors, only significant contributor to risk of falls:
 - *self-reported poor or very poor sleep quality* (OR=3.2, 95% CI 1.04-10.0; p=.04)
 - Hypnotic use and sleepiness (ESS) were not associated with greater risk of falls

Self-reported sleep and nap habits predict risk of falls and fractures¹

- Older women who reported taking daily naps were...
 - 32% more likely to experience two or more falls during the subsequent year of follow-up (OR=1.32; 95% CI=1.03-1.69)
 - 33% more likely to suffer a hip fracture during 6 years of follow-up (OR=1.33; 0.99-1.78)
- Long sleep duration (>10 hours per 24 hour period) was also associated with increased hip and non-spine fracture risk
- *Results persist after accounting for benzodiazepine use*

n=8,127

Actigraphic measures of nightly sleep duration and risk of falls in older women¹ (SOF)



1. Stone KL et al. Arch Int Med 2008; 168(16): 1768-75.

* Falls were ascertained by tri-annual questionnaire. 549 women (18.4%) suffered 2+ falls during approximately one year after sleep assessment. Results adjusted for age, race, BMI, depression, exercise, instrumental activities of daily living, comorbidities, cognitive function, and use of benzodiazepines and antidepressants.

Actigraphic measures of sleep and risk of falls in older women¹ (SOF), additional results

- Results between sleep duration and fragmentation and risk of falls were unchanged by adjustment for benzodiazepine use
- Use of short-acting benzodiazepine use was associated with increased risk of frequent falls, even after accounting for objectively measured sleep
 - OR=1.53, 95% CI=1.00–2.32
- Use of long-acting benzodiazepines was not associated with increased risk of frequent falls, but use was less common and study power may have been an issue

Sleepiness, Urinary Incontinence, and Falls in Older Women¹

- 782 ambulatory, community-dwelling women aged 75 to 86 (Australian study, subjects selected at random from the electoral roll)
- Collected subjective data on daytime sleepiness, night-time sleep problems, urinary incontinence and falls (retrospective, past year)
- In multivariate analysis, significant risk factors for falls:
 - Urge incontinence: OR=1.76; 95% CI 1.29 – 2.41
 - Abnormal daytime sleepiness: OR=2.05; 1.21 – 3.49

State-of-the-Art Knowledge

- Non-vertebral fractures and dislocations increased after initial prescription for hypnotics¹:
 - Large retrospective cohort study.
 - Community-based HMO members with initial prescription for zolpidem, alprazolam, lorazepam, or diazepam identified from pharmacy databases
 - Rates of hospitalization for fracture compared before and after prescription

1. Finkle WD et al. J Am Geriatr Soc.2011; 59: 1883-1890.

Hypnotics Prescriptions and Fracture¹: Rate Ratio Post-treatment Compared to Pre-treatment

	Zolpidem	Alprazolam	Lorazepam	Diazepam
N	10,857	20,429	42,080	16,372
Non-vertebral fractures				
Rate Ratio	2.55	1.14	1.53	1.97
95% CI	(1.78 - 3.65)	(0.80 - 1.64)	(1.23 - 1.91)	(1.22 - 3.18)
p-value	<.001	0.42	<.001	0.01
Hip fractures				
Ratio Ratio	3.11	1.46	2.05	2.03
95% CI	(1.96 - 4.91)	(0.91 - 2.35)	(1.58 - 2.66)	(1.03 - 4.00)
p-value	<.001	0.1	<.001	0.04

1. Finkle WD et al. J Am Geriatr Soc.2011; 59: 1883-1890.

State-of-the-Art Knowledge, continued

- Nonbenzodiazepine Sleep Medications and Fractures in Nursing Home Residents¹:
 - Case-crossover study
 - 15,528 long-stay US nursing home residents, age 50+
 - Hip fracture documented in Medicare claims data (2007-2008)
 - Odds ratios for hip fracture compared exposure to meds during 0=29 days prior, compared with 60-89 and 120-149 days before (control periods).

1. Berry SD et al. JAMA Intern Med. 2013; 173(9): 754-761.

Nonbenzodiazepines and Fractures in Nursing Home Residents¹

- Nonbenzodiazepine drug use 0-29 days before hip fracture increased risk by 66% (OR=1.66; 95% CI 1.45 – 1.90)
- Greater increase in risk observed for new prescriptions (OR=1.90; 1.60 – 2.26)
- Greater increase in those with urinary incontinence, and those requiring minimal supervision to transfer.

1. Berry SD et al. JAMA Intern Med. 2013; 173(9): 754-761.

State-of-the-Art Knowledge, continued

- Nocturnal hypoxemia is related to increased risk of falls and fractures among older men¹:
 - Older men with 10% or more of sleep time at O₂ saturation of 90% or below had 43% increase in risk of experiencing 2+ falls in the subsequent year
 - 30-40% increase in risk of non-spine fracture among those with greater levels of nocturnal hypoxemia
- Sleep apnea may be another sleep disorder (other than insomnia/short sleep) related to increased fall risk.

1. Cauley JA et al. J Am Geriatr Soc. 2014; 62(10):1853-9.

Knowledge Gaps

- Does improving sleep result in fewer falls?
 - Which insomnia treatments offer best ‘balance’ for older adults in terms of improved sleep with fewest side effects
 - Do newer hypnotics (e.g. nonbenzodiazepines) result in decreased fall risk compared to benzodiazepines?
- What are the primary mechanisms linking disturbed sleep with risk of falls?
 - Although we have some good candidates (e.g. frailty, balance, hypnotic use, urinary incontinence, comorbidities), there is still no concrete evidence

Knowledge Gaps, continued

- Besides insomnia, what other sleep disturbances are related to increased fall risk, and what are the mechanisms?
 - Altered circadian rhythms?
 - Sleep apnea?
 - Restless legs syndrome?
- Extending findings to falls resulting in injury such as fractures

Research Opportunities

- Testing whether sleep interventions are effective in reducing the risk of falls in older adults
 - Comparative effectiveness studies of alternative insomnia treatments for insomnia/sleep problems in older adults, with falls as a major outcome
 - Especially testing hypnotics vs cognitive behavioral therapy and other non-pharmacological treatments
- Observational studies with comprehensive assessment of sleep (objective and subjective) *and* well-characterized for medication use, urinary incontinence, and other potential mediating factors

Research Opportunities, continued

- More comprehensive characterization of the falls outcome, to help understand mechanisms:
 - Night-time falls vs daytime falls
 - Circumstances of falls
 - Did a fracture or other injury result?