Nocturnal Awakenings, Sleep Dissatisfaction, and Risk of Falls in Older Adults

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Outline

1. Description of two cohorts of older adults:
   SOF and MrOS Sleep Studies
2. Define actigraphic measures of nocturnal awakenings (NA)
3. Examine correlates of NA:
   - Correlations with subjective measures of sleep dissatisfaction (SD)
   - Correlations with other characteristics (age, comorbidities, etc)
4. NA and subjequent risk of falls
   - NA with and without subjective SD

Cohort #1: Study of Osteoporotic Fractures (SOF)

- Large prospective study coordinated by the San Francisco Coordinating Center
- Participants recruited from population-based listings at four US clinical centers
- 10,366 women aged 65 and older
  - *9,704 Caucasian women recruited in 1986-88*
  - *662 African American women recruited in 1997-98*

Cohort #1: SOF Visit 8 (2002-3)

- **Specific aims related to consequences of sleep disturbance in older women, including:**
  - ***Risk of falls and fractures***
  - ***Risk of total and cause-specific mortality***
  - ***Cognitive and physical function***
- **In-clinic examination and interview**
- **Objective assessment of sleep using actigraphy in 3,052 women aged 70 and older**

Cohort #2: Osteoporotic Fractures in Men (MrOS)

- **Multi-center prospective observational study examining incidence and predictors of osteoporotic fractures in older men**
- **Participants recruited from population-based listings at six US clinical centers**
- **5,995 men aged 65 and older enrolled in 2000-2002**
- ***Ancillary study: Outcomes of Sleep Disorders in Older Men funded by NHLBI (MrOS Sleep Study)***

Cohort #2: MrOS Sleep Ancillary Study

- Subset of 3135 men from the MrOS cohort
- Examinations performed between 2003-05, including
  - In-clinic examination and interview
  - Single night, in-home overnight polysomnography
  - Wrist actigraphy for a mean of five consecutive 24-hour periods (minimum three 24-hour periods)
- 3058 with actigraphy data

Baseline Characteristics

	Women	Men
Age, yrs, mean (SD)	83.6 (3.8)	76.4 (5.5)
BMI, kg/m^2, mean (SD)	27.0 (5.0)	27.2 (3.8)
Caucasian, %	89.35	89.98
≥ 1 med condition, %	44.9	41.4
Depressed*, %	11.9	6.7

Actigraphy

- **Sleep-Watch-O®, Ambulatory Monitoring, Inc.**
  - ***uses piezoelectric sensor to detect movements***
  - ***graphical display of activity patterns***
  - ***scoring algorithms distinguish sleep/wake states***
- **Worn on non-dominant wrist for a minimum of 72 hrs**
- **Analyses done using data collected in digital integration mode, scored using UCSD algorithm**
- **Sleep diary used to assist in editing**

Defining Nocturnal Awakenings based on Actigraphic Estimates of Sleep*

Number of long-wake episodes:

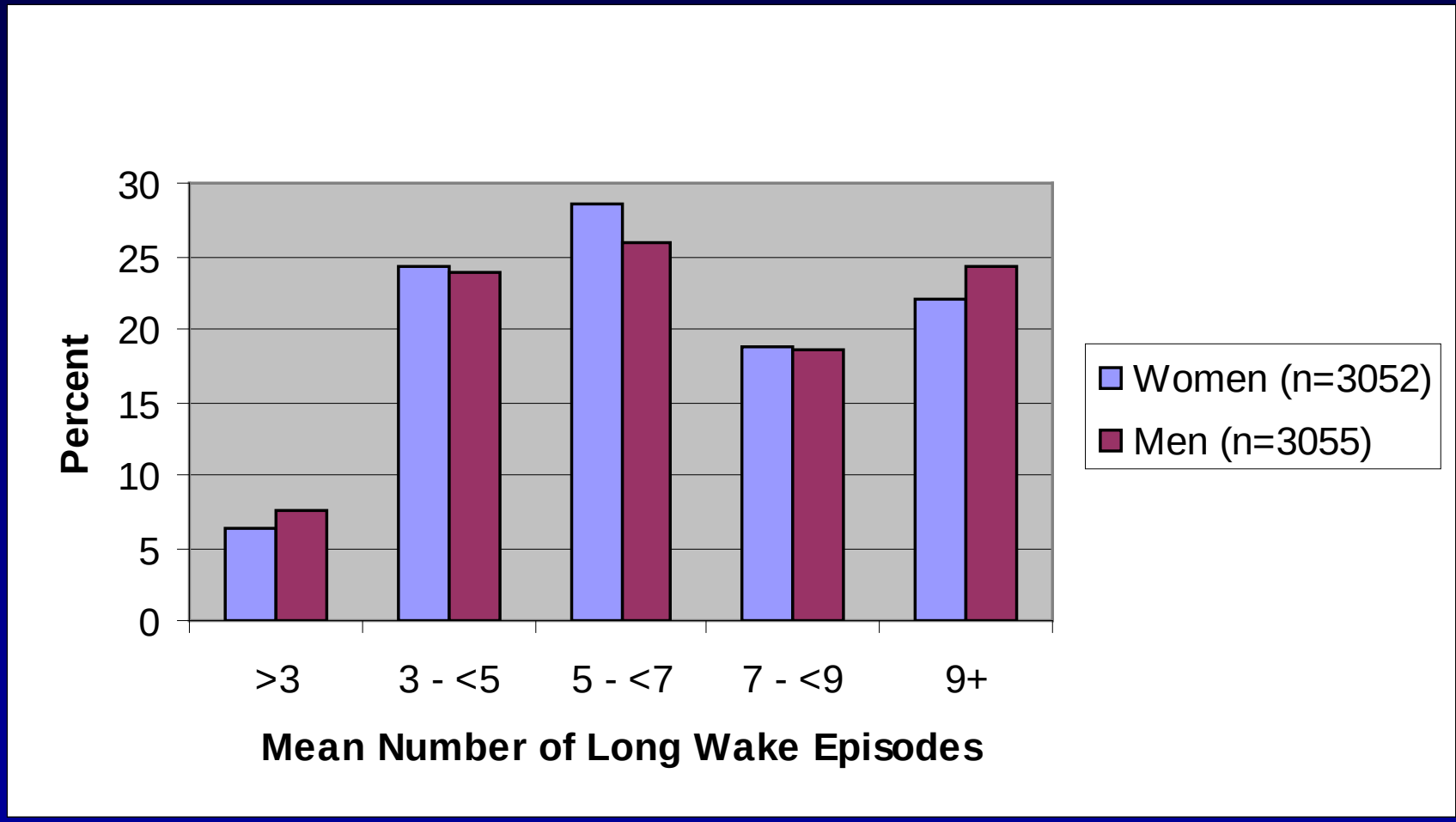
Number of wake episodes of ≥ 5 minute duration during the sleep period

Average duration of wake episodes (minutes)

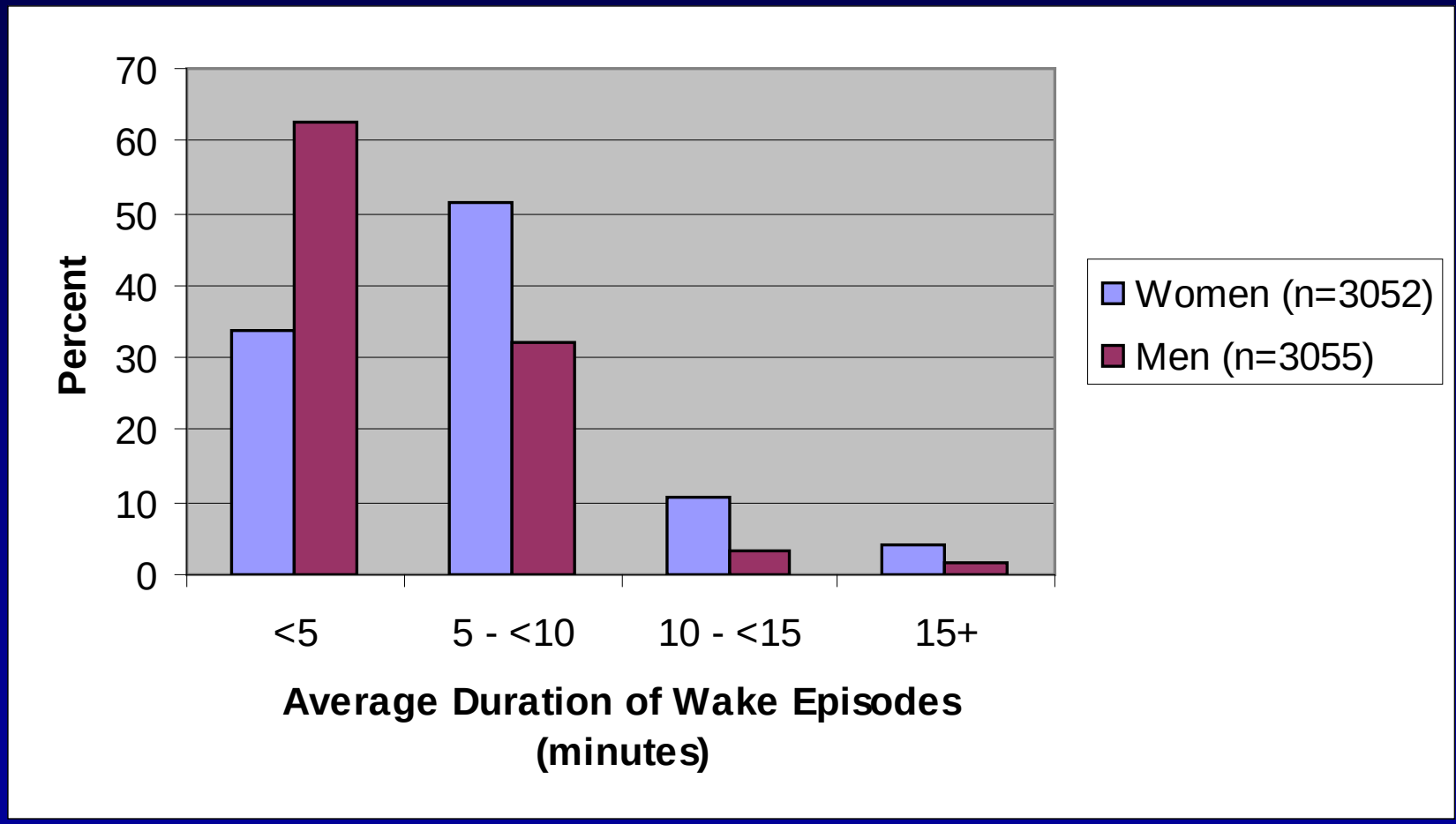
Duration of longest wake episode (minutes)

*All variables reflect average daily experience

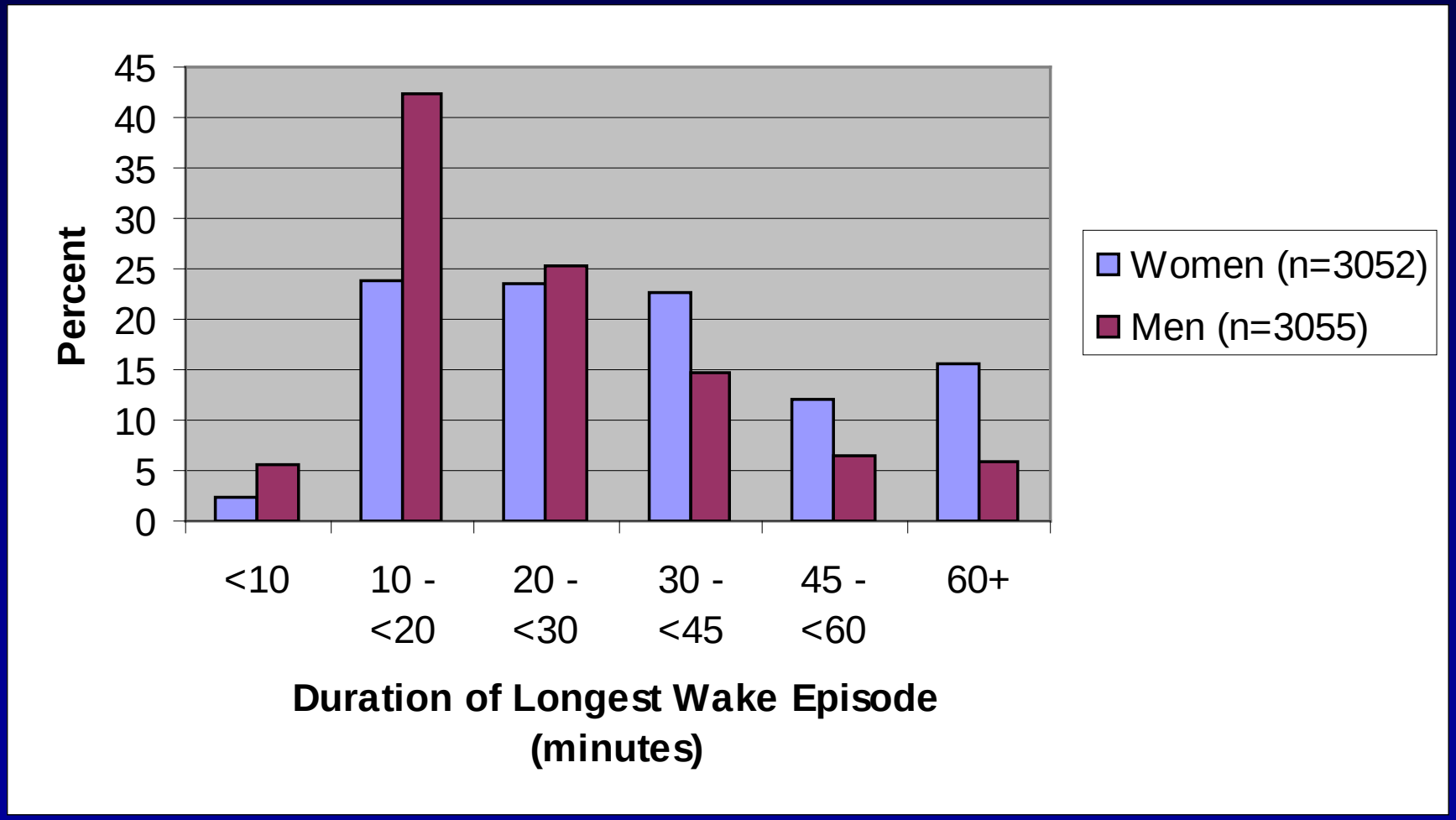
Distribution of Long Wake Episodes in Older Women and Men



Distribution of Average Duration of Wake Episodes (in minutes)



Distribution of Duration of Longest Wake Episode (minutes)



Mean Duration (minutes) of Wake Episodes and % Sleep Dissatisfaction in Older Women

	< 5	5 to <10	10 to <15	15+
PSQI > 5	42.2	56.0	57.6	59.9*
DIMS[1]	15.6	21.6	20.3	27.3*
Early AM awakening	43.0	48.6	52.4	46.2*
Sleep Medication Use	11.9	14.8	16.6	14.4
Epworth Score > 10	9.8	10.8	14.9	14.4**
<6 hours sleep per 24 hours	9.3	12.6	15.5	19.9*

[1] Difficulty initiating or maintaining sleep * p < .01 **p < .05

Mean Duration (minutes) of Wake Episodes and % Sleep Dissatisfaction in Older Men

	< 5	5 to <10	10 to <15	15+
PSQI > 5	39.3	50.5	61.5	77.6*
DIMS[1]	7.6	12.5	18.3	18.4*
Early AM awakening	58.5	65.0	67.3	69.4*
Sleep Medication Use	11.3	12.8	15.4	18.4
Epworth Score > 10	11.0	15.2	21.2	22.5*
<6 hours sleep per 24 hours	8.7	13.2	15.4	26.5*

[1] Difficulty initiating or maintaining sleep

* $p < .01$

Correlates of Mean Duration (minutes) of Wake Episodes in Older Women

	< 5	5 to <10	10 to <15	15+
Age (yrs), mean	83.1	83.7	84.2	83.9*
Non-caucasian race, %	6.3	12.1	14.5	18.2*
BMI (kg/m^2), mean	26.5	27.2	27.4	28.7*
1+ med condition, %	36.2	46.6	57.0	60.6*
Depressed, %	9.4	12.4	15.5	15.2*

*p < .01

Correlates of Mean Duration (minutes) of Wake Episodes in Older Men

	< 5	5 to <10	10 to <15	15+
Age (yrs), mean	75.9	77.1	77.5	79.1*
Non-caucasian race, %	9.7	11.0	7.7	10.2
BMI (kg/m^2), mean	26.7	27.7	29.6	30.7*
1+ med condition, %	37.5	47.4	46.2	61.2*
Depressed, %	5.2	8.9	10.6	12.2*

*$p < .01$

Follow-up for Falls

- Self-reported falls and fractures during the preceding 4-month interval collected by tri-annual postcard
- Follow-up > 98% complete in both cohorts
- Among those with actigraphy, during the first year after the sleep visit:
  - 431 (14.3%) men and 546 (18.4%) women suffered 2 or more falls

Actigraphic Sleep Parameters and Risk of Falls: Previous Results in Older Women*

- Number of long wake episodes is not associated with risk of falls
- Women with 120+ minutes of wake after sleep onset (WASO) have 32% higher risk of 2+ falls compared to those with fewer minutes of WASO (OR=1.32; 95% CI=1.01 – 1.71)
- Total sleep time, sleep efficiency are strongly associated with risk of falls

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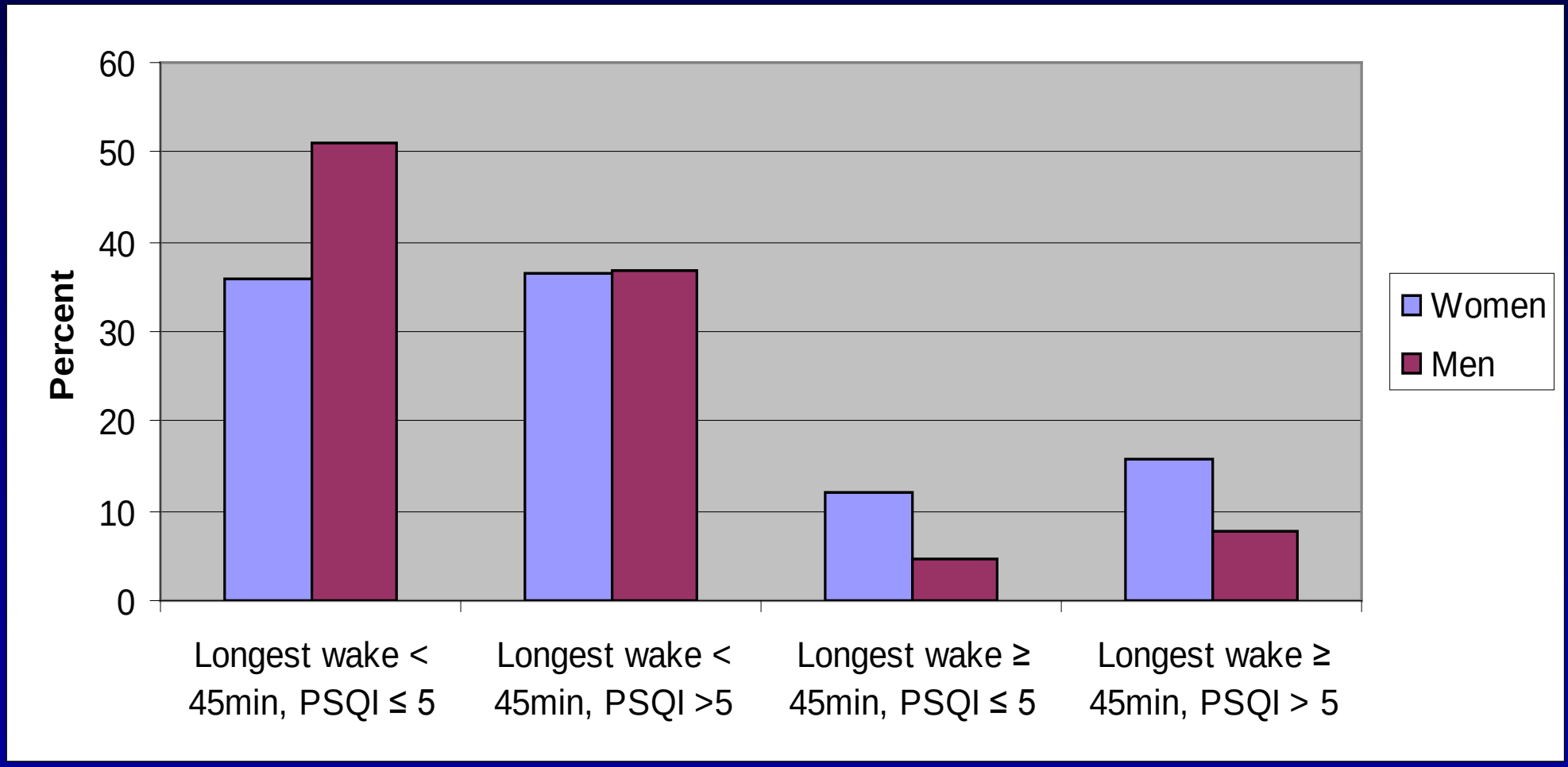
*Models adjusted for age, race, BMI, depression, exercise, IADL, medical conditions, possible dementia, use of benzodiazepines, antidepressants and antipsychotics.

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

Distribution of Composite Variable: Longest Wake Episode * PSQI



Objective NA/Subjective SD Composite Variable and Risk of Falls*

	Odds ratio (95% CI)	
	Women	**Men**
Longest wake < 45min, PSQI ≤ 5	1.0 (ref)	1.0 (ref)
Longest wake < 45min, PSQI >5	1.6 (1.3 - 2.0)	1.4 (1.1 - 1.8)
Longest wake ≥ 45min, PSQI ≤ 5	1.5 (1.1 - 2.1)	1.3 (0.8 - 2.2)
Longest wake ≥ 45min, PSQI > 5	1.8 (1.4 - 2.4)	2.4 (1.7 - 3.4)

*adjusted for age, race, clinic site and BMI

Conclusions

- **Measures of NA defined using actigraphy data are strongly correlated with subjective sleep dissatisfaction**
  - **However there is a relatively large subgroup who have objective NA but no SD, and vice versa**
- **NA (based on actigraphy) is strongly correlated with age, BMI, race (at least in women), depression, and comorbidities**
- **Older adults with NA *COMBINED WITH* subjective SD have the highest risk of falls (particularly true in older men)**

Future Directions

- Falls models: perform full adjustment for comorbidities, depression, etc
- Explore alternative composite exposure variables / modeling approaches that combine objective NA with subjective SD
- Exclude subjects with evidence of primary sleep disorders (e.g. sleep disordered breathing, PLMS, RLS)
- Compare similar aged men and women (stratified analyses in men)
- Examine NA identified from PSG (e.g. arousal index, sleep stage transitions)