Shift work and Associated Health Outcomes in Police Officers

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Total Worker Health Symposium

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Shift Work and Policing
POLICE
DETECTIVE

Ongoing Epidemiological Study

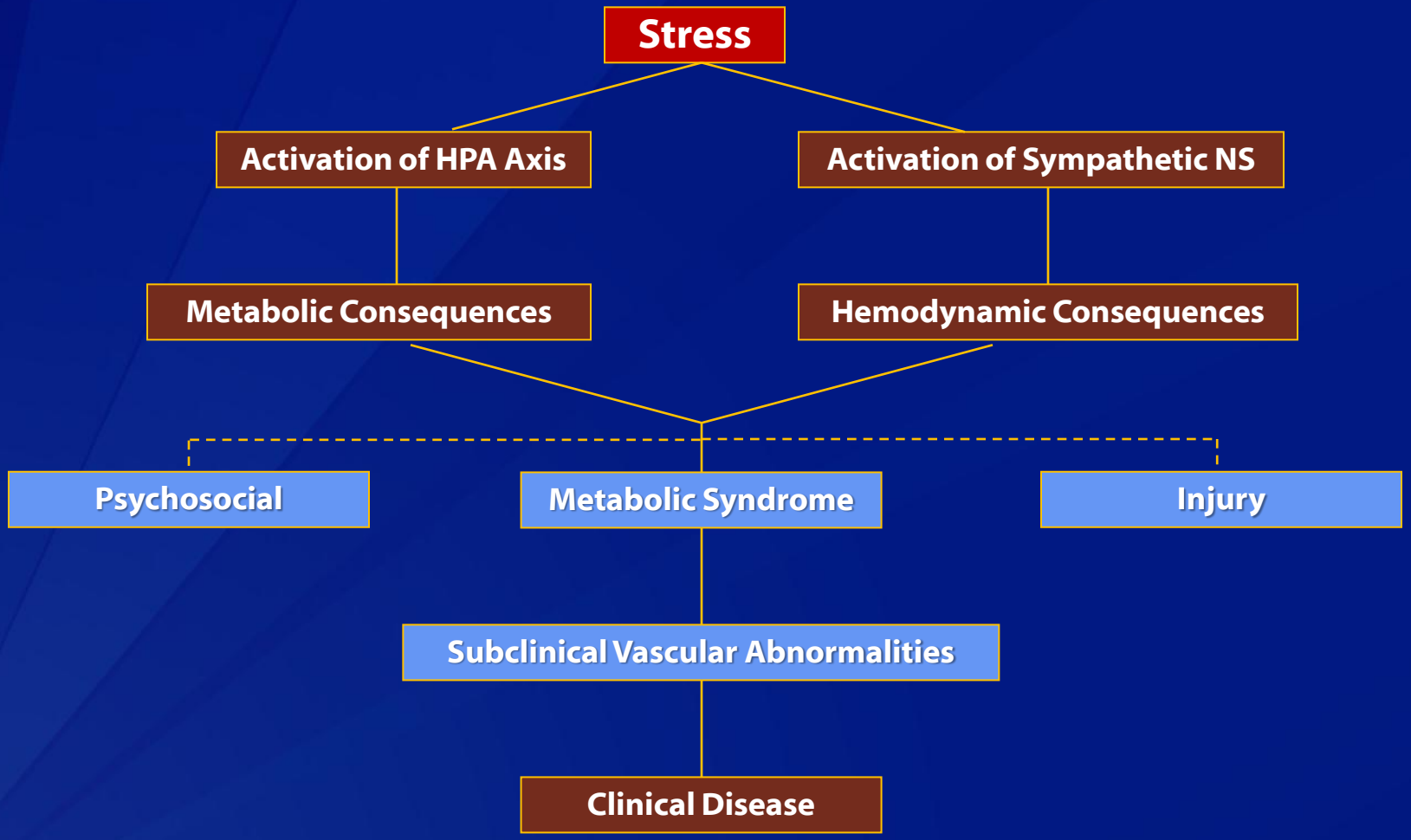
- **Buffalo Cardio-metabolic Occupational Police Stress (BCOPS) Study**
  - Establish a working methodology, protocol, and design for the first ever population-based stress study that would identify preliminary descriptive patterns of response concerning
    - biomarkers of stress
    - subclinical cardiovascular disease (CVD)
    - body composition indicators
    - associated psychosocial factors

    in the high stress occupation of police work

Background and Rationale for BCOPS Study

- **CVD remains the most frequent cause of death**
  - Much has been learned about traditional risk factors, yet a large proportion of CVD is attributable to other causes
- **Stress is common in the workplace, yet difficult to measure**
  - Considered a non-traditional CVD risk factor
- **Police work considered a highly-stressful occupation**
  - Higher all-cause and CVD mortality than expected
  - Relatively understudied population
  - 794,000 police officers in the US, projected to rise to 853,000 officers by 2020

Potential Health Consequences of Stress



BCOPS Study Partnerships

State University of New York at Buffalo, Department of Social and Preventive Medicine

University of South Carolina

Wayne State University

West Virginia University

U.S. Department of Justice, National Institute of Justice

NIOSH

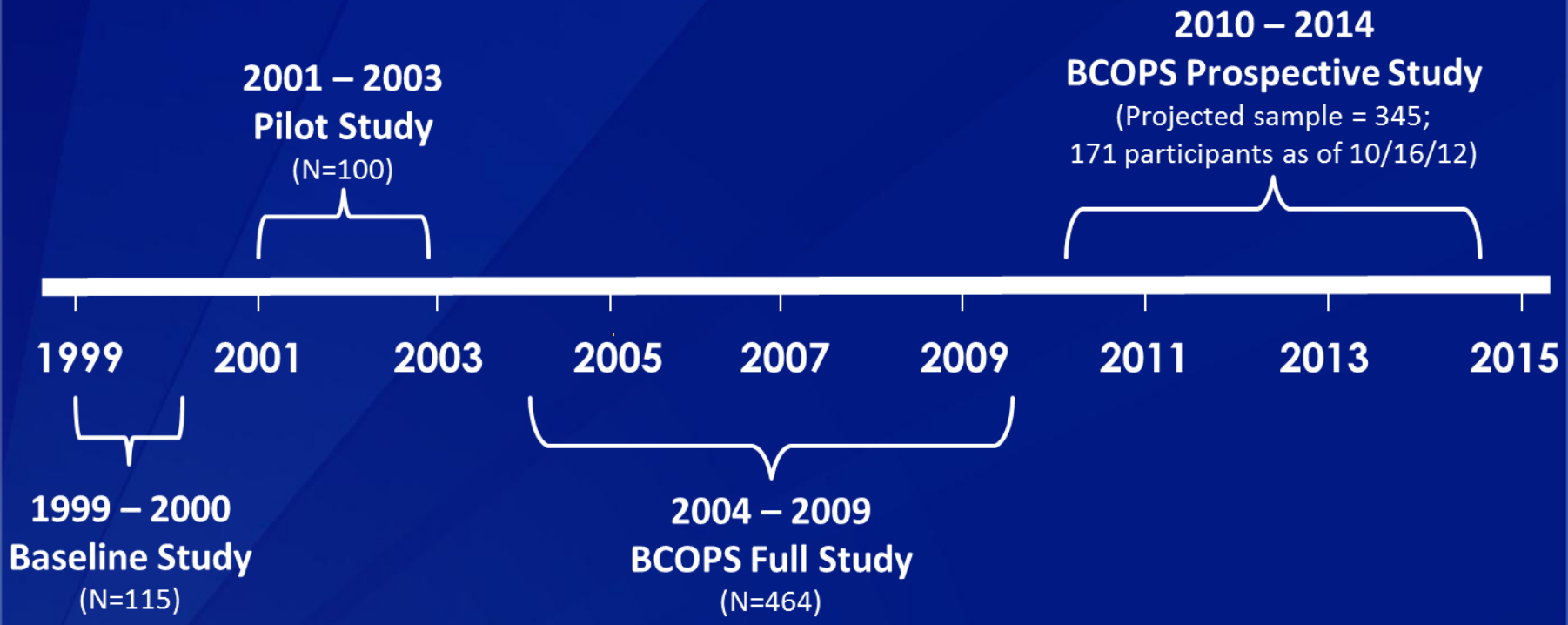
Washington State University

University of Georgia

University of Wisconsin

University of Calgary, Centre for Sleep and Human Performance

BCOPS Study Design and Timeline



Population-based cross-sectional observational study with a *prospective future*.

Full Study Exam Components
(2004–09, N=464, 6 hours)

- **Demographic & Lifestyle**
  - Smoking, alcohol, diet
  - Physical activity, sleep
- **Psychosocial**
- **Anthropometry**
  - BMI, waist, abdominal height
- **DEXA**
  - % body fat, lean tissue, bone density
- **Blood pressure**
- **Salivary cortisol**
- **Subclinical CVD measures**
- **Blood collection**
  - Metabolic & lipid panel
  - Glucose
  - Hemoglobin A1c
  - Insulin
  - C-reactive protein
  - CBC
  - Buffy coat
  - Frozen aliquots
- **Actigraphy**
- **Shift & hours worked**
- **Injury**

Description of Payroll Data

- **As of May 23, 1994, the paper-based system became an electronic system**
- **Daily records of activities available for each participant from 1994–2010**
  - Shift worked
  - Regular work hours
  - Court work hours
  - Overtime work hours
  - Leave
- **~3 million records**

Defining Shift Work

- **Shift for each date was derived using records classified as regular time and the start time of the work**
  - Shift start times
    - Day - 4:00 am through 11:59 am
    - Afternoon - 12:00 pm through 7:59 pm
    - Midnight - 8:00 pm through 3:59 am

Derivation of Hours Worked Per Week

- **Total hours worked was computed from 1994 to exam date separately for each activity**
  - Regular time, court time, and overtime
- **Time interval (in years) was computed from 1994 to date of exam or last date of work history**
- **Total hours for each activity was standardized to a weekly basis**

Identifying Dominant Shift

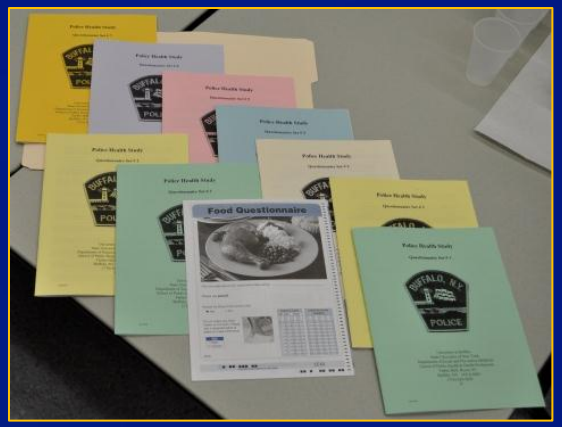
- **Dominant shift was defined as the shift in which an officer spent the largest percentage of his/her regular time from 1994 to exam date**
- **Total regular time hours was partitioned by shift**
  - Day
  - Afternoon
  - Midnight
- **Percent of hours at each shift was computed to identify the officer's dominant shift**

Psychosocial

- Depression (CES-D)
- PTSD
- Suicide Ideation
- Perceived Stress
- Police Incident Survey
- Spielberger Police Stress
- Life Events
- Personality
- Social Support
- Coping
- Resiliency Scale

Sleep

- Self-reported sleep duration
- Pittsburgh Sleep Quality Index (PSQI)
- Apnea screen



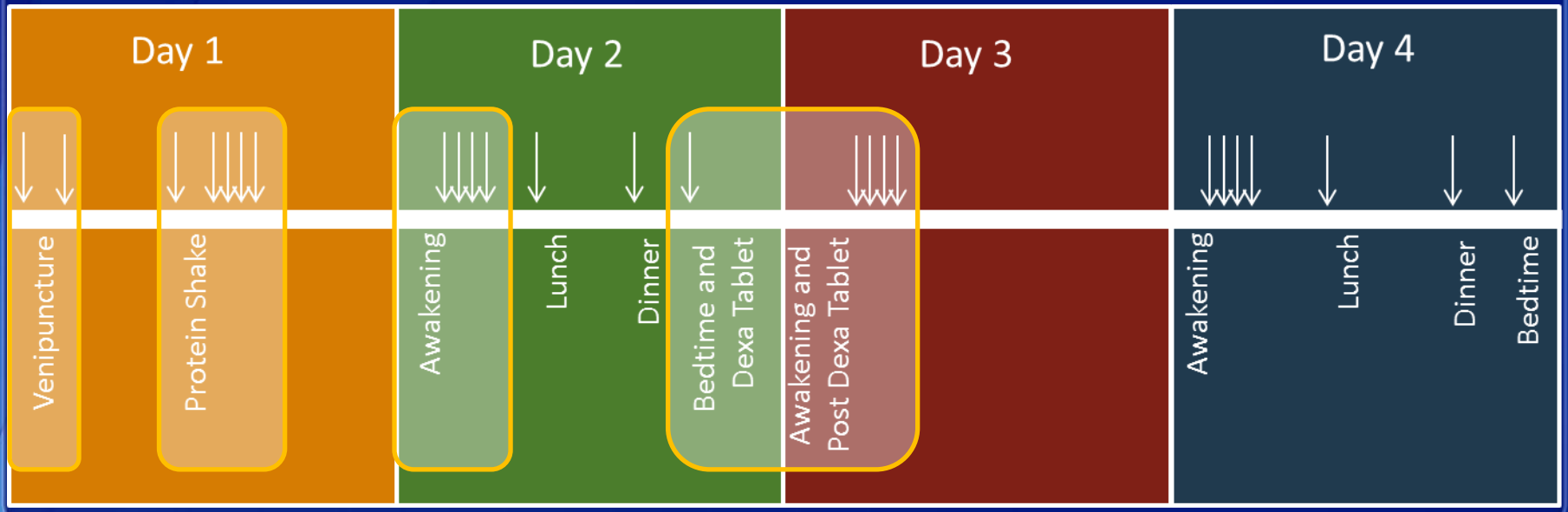
Metabolic Syndrome Criteria

Component	Cutpoint	
	Men	Women
Abdominal Obesity		
Waist Circumference	≥ 102 cm	≥ 88 cm
Elevated Triglycerides		
Serum Triglyceride Level *or*	≥ 150 mg/dL	
Self-Report Medication	Fibrates or Nicotinic acid	
Reduced HDL-Cholesterol		
Serum HDL-C *or*	< 40 mg/dL	< 50 mg/dL
Self-Report Medication	Fibrates or Nicotinic acid	
Glucose Intolerance		
Fasting Serum Glucose *or*	≥ 100 mg/dL	
Self-Report Medication	Anti-Diabetic Medication	
Hypertension		
Systolic Blood Pressure *or*	≥ 130 mm Hg	
Diastolic Blood Pressure *or*	≥ 85 mm Hg	
Self-Report Medication in Hypertensives	Anti-Hypertensive Medication	

2005 American Heart Association and National Heart, Lung, and Blood Institute Criteria

Physiologic Measure of Stress: Salivary Cortisol

- **Standardized collection of 18 samples, some officers provide an additional 7 samples**
  - Day 1 samples collected in Clinic
  - Days 2-4 collected at Home
- **Response patterns assessed following 4 challenges**



Methods

- **Three examinations**
  - Baseline 1999–2000 (n=115)
  - Pilot 2001–2003 (n=100)
  - Full 2004–2009 (n=464)
- **Analysis of variance and covariance**
  - Trends in physiological, psychological, and behavioral measurements across shift
- **Poisson regression**
  - Prevalence or incidence ratios were estimated by shift

Study Population, 2004–09
(N=412)

- **Average age: 41.0 years**
- **Gender: 20% women**
- **Race/ethnicity:**
  - 20.0% African-American
  - 3.2% Hispanic-American
  - 76.8% European-American
- **Average years of police service: 14.6**

Mean Levels of CVD Risk Factors by Gender, Full Study

Characteristic	Men (N=305)	Women (N=107)
BMI (kg/m^2)	30.3 (4.2)	26.0 (4.7)
Current smoking (%)	13.2	26.7
SBP (mm Hg)	122.3 (11.3)	116.5 (13.3)
DBP (mm Hg)	78.5 (10.1)	74.3 (9.6)
Metabolic syndrome (%)	33.7	8.6

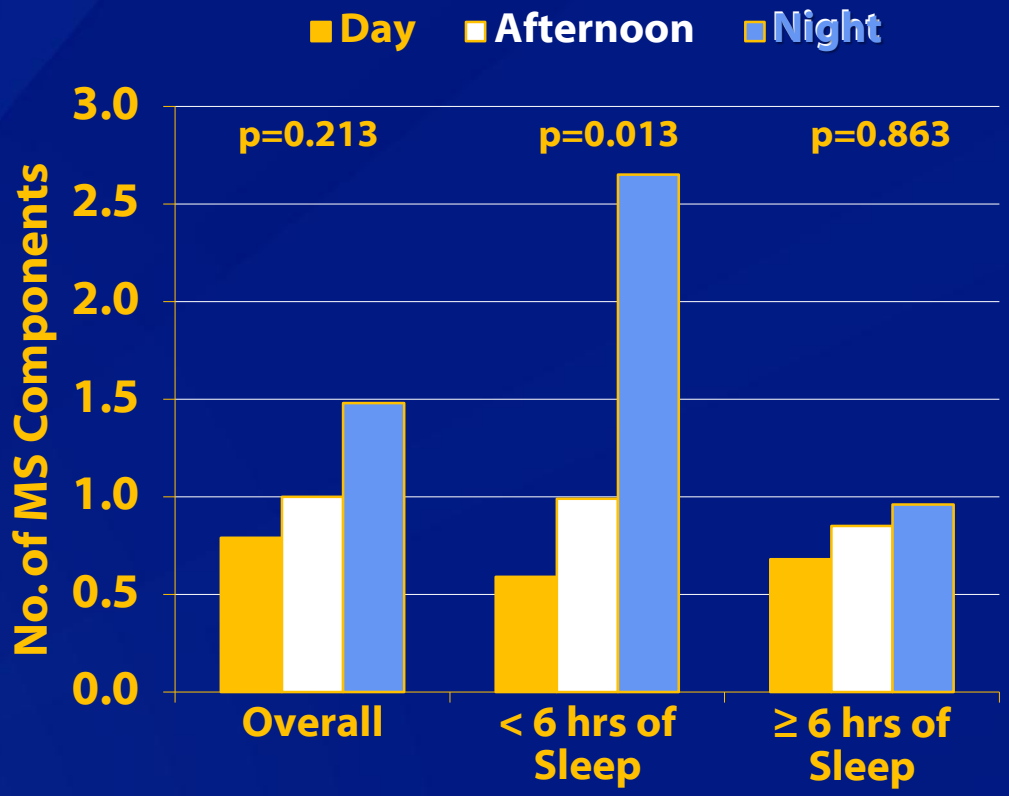
Values in parentheses are standard deviations.

Shift Work and Sleep

- **Night shift work was significantly and independently associated with snoring and decreased sleep duration**
  - 44% more likely than day or afternoon workers to have inadequate sleep and 26% more likely to snore *(Policing 2007;30:215-227)*

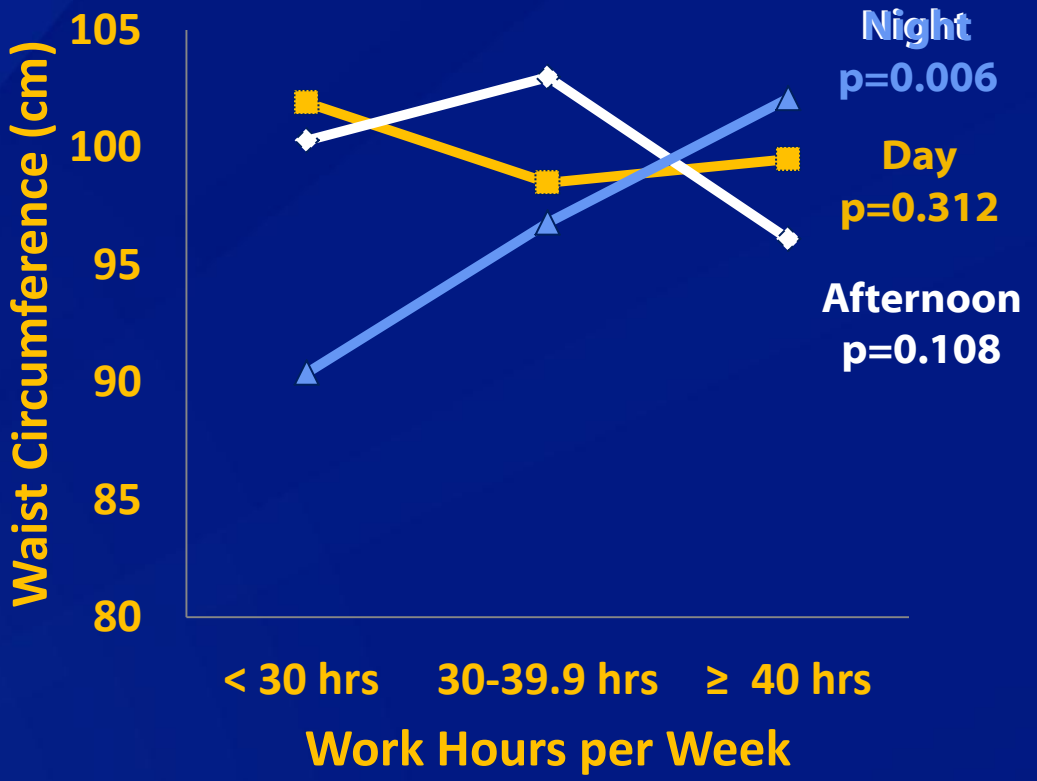
Shift Work and Metabolic Syndrome

Officers who worked nights and had <6 hrs. sleep had a 4-fold greater number of metabolic syndrome components than officers working the day shift.
(Arch Environ Occup Health 2009;64:194-201)



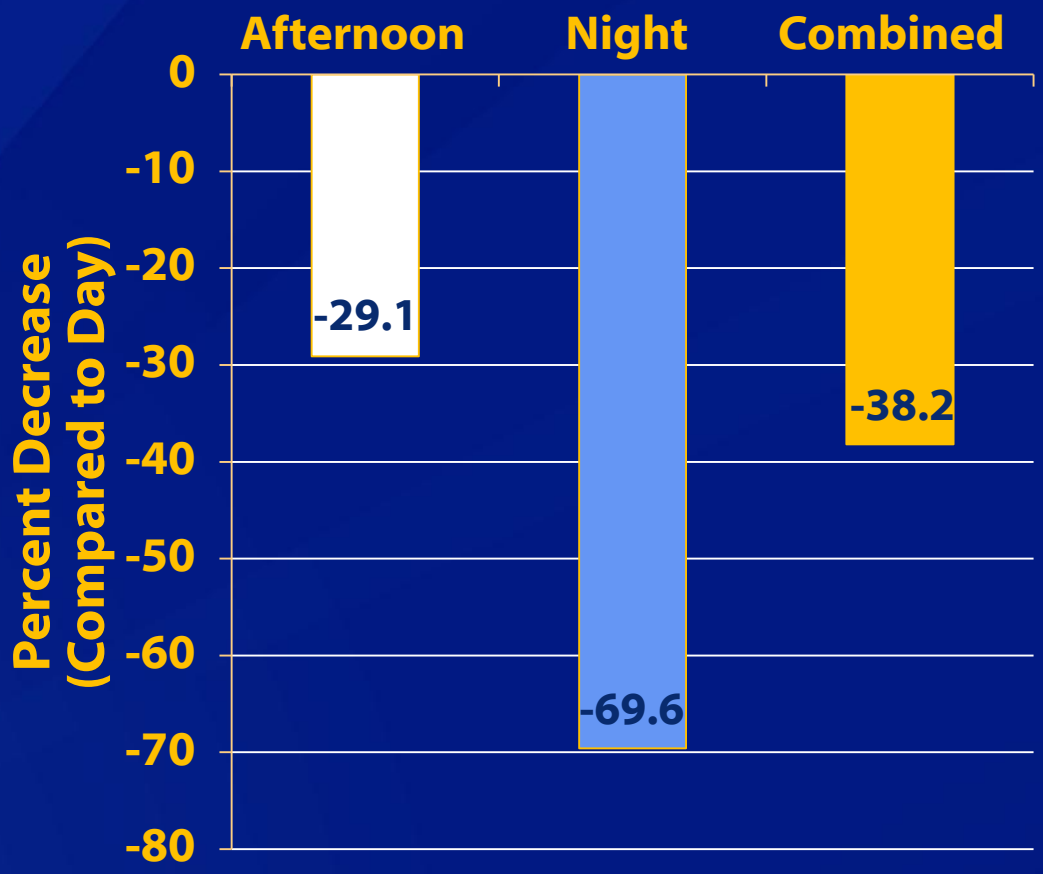
Shift Work and Adiposity

Among males on night shift, longer work hours were associated with larger waist circumference and higher body mass index. *(JOEM 2012;54:1374-1381)*



Shift Work and Awakening Cortisol

Short-term awakening cortisol patterns for night and afternoon shift officers were diminished compared to day shift officers. *(Chronobiol Int 2011;28:446-457)*



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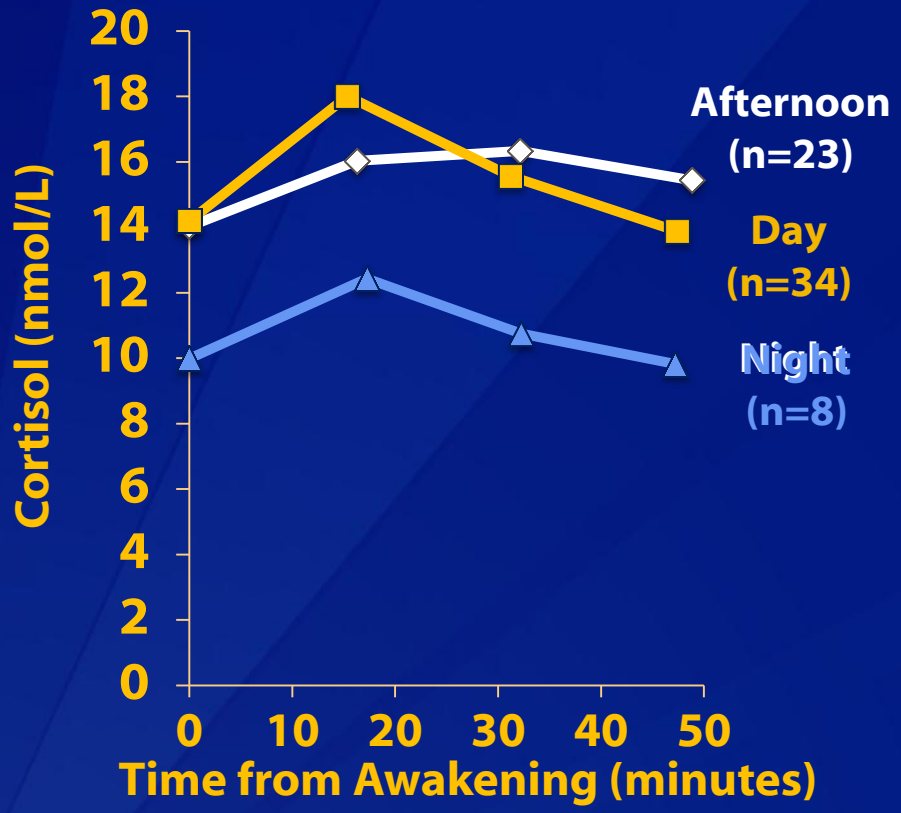
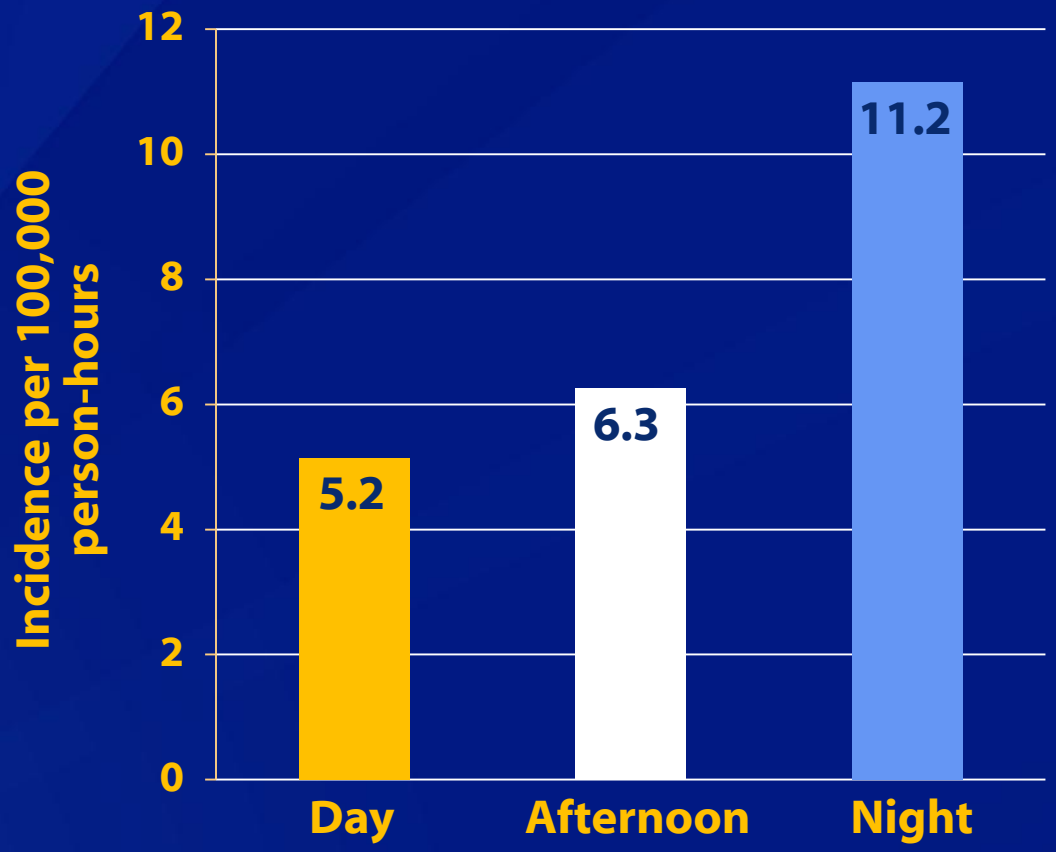


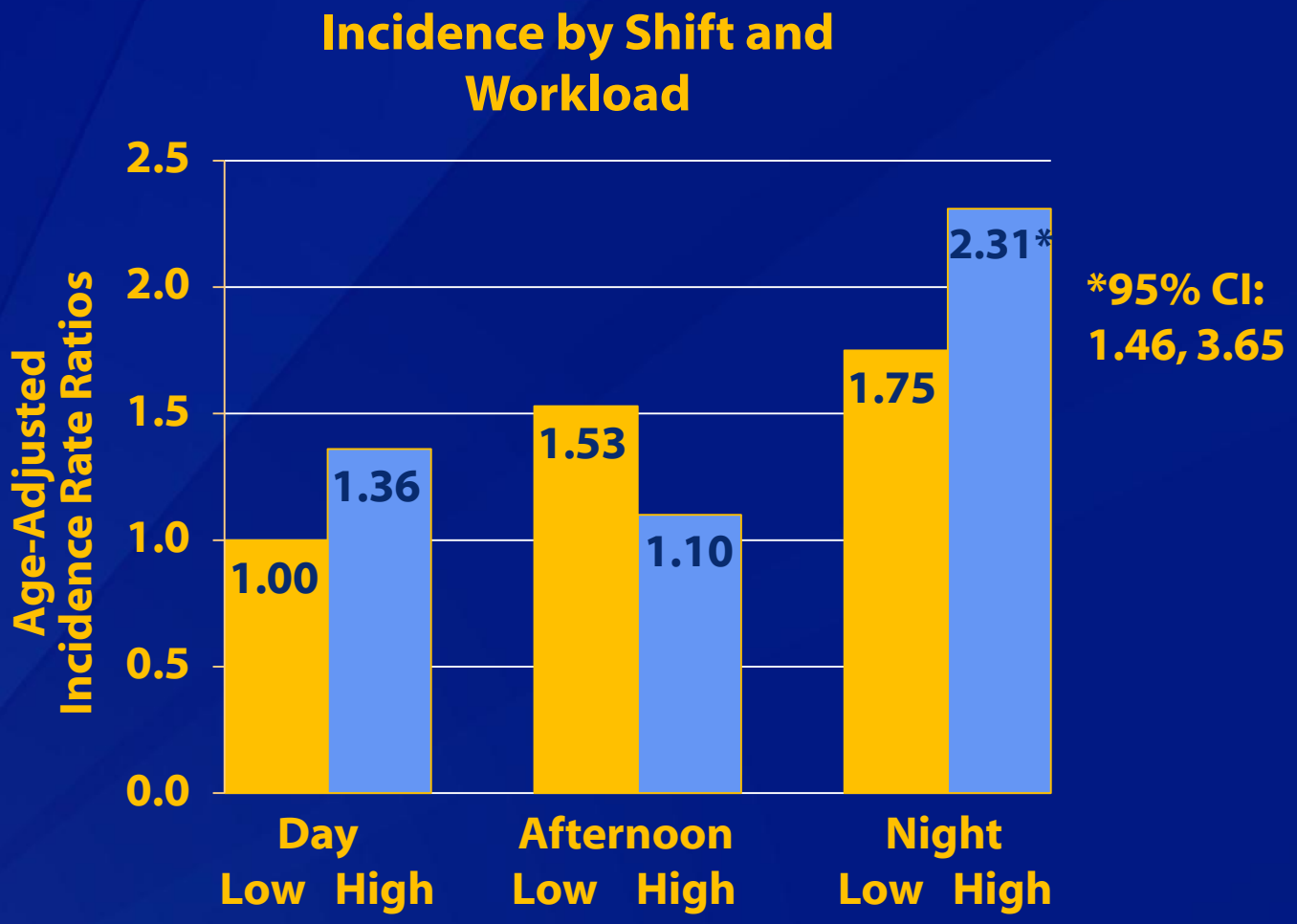
While awakening cortisol response patterns were similar for all shifts, night shift workers had a significantly diminished response pattern compared to afternoon and day shift workers. *(Ind Health accepted)*

Shift Work and Injury

Incidence of first injury was over 2-fold higher in night shift workers compared to day shift workers. *(Am J Ind Med 2012;55:217-227)*



Shift Work and Injury



*95% CI: 1.46, 3.65

Shift Work and Suicide Ideation

- **Policewomen**
  - Among women with higher depressive scores, prevalence of suicide ideation increased by 116% for every 10-unit increase in percentage of hours worked on day shift
    - Prevalence ratio 2.16 and 95% confidence interval (1.22–3.71)
- **Policemen**
  - Among men with higher PTSD scores, prevalence of suicide ideation increased by 13% with every 10-unit increase in the percentage of hours worked on afternoon shift
    - Prevalence ratio 1.13 and 95% confidence interval (1.00–1.22)

(Am J Ind Med 2008;51:758-768)

Benefits and Challenges of the Payroll Data

- **Benefits**
  - More objective than self-reported data
  - Rare in other studies
  - Longitudinal - allows for definition of variables prior to exam date
    - Example: ungrouped Poisson regression models to compute the incidence rate of injury or sick leave by shift work
- **Challenges**
  - Secondary data source
    - Time intensive to learn the specific characteristics of the data set and to clean for research purposes

Shift work and Associated Health Outcomes

- Sleep
- Metabolic syndrome
- Adiposity
- Awakening cortisol
- Injury
- Suicide ideation

Conclusion

- Daily payroll records provided objective shift work data and increased confidence in observed associations that identified adverse outcomes with night shift work
- Cross-sectional associations will inform hypotheses for longitudinal analysis
- Future prospective research will support optimal shift work policies

Future Directions

- **Further study of associations between shift work and adverse outcomes:**
  - Adiposity
  - Blood pressure
  - Cortisol
  - C-reactive protein
  - Diet
  - Heart rate variability
  - Psychosocial outcomes, depressive symptoms
  - Sleep
  - Sick leave

Thank you

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For more information please contact Centers for Disease Control and Prevention

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Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
E-mail: cdcinfo@cdc.gov Web: www.cdc.gov

Background for Cortisol

- Assessment of stress has generally relied on questionnaires
- Need for a non-invasive more quantitative measure of stress
- Salivary cortisol is known to be an excellent indicator of unbound serum concentration and may serve as a potential physiologic marker of stress
- Patterns of cortisol response may be more informative than a single measure in assessing how well the HPA axis is functioning

Why include cortisol measurements?

- Assess optimal approach for parameterizing the pattern of salivary cortisol response
- Evaluate associations between stress assessed by questionnaire and cortisol response
- Examine associations of cortisol response with measures of subclinical metabolic and cardiovascular disease

Cortisol Response Patterns

- **Normal**
  - Rapid increase with awakening
  - 2-4 fold increase after high protein meal
  - Progressive decline during day
  - Notable suppression by Dexamethasone
- **Chronic Stress**
  - Minimal increase with awakening
  - Diminished response to high protein meal
  - Less decline during day and less variability
  - Poor suppression by Dexamethasone

Subclinical CVD Measures

- Carotid wall thickness (atherosclerosis)
- Brachial reactivity (endothelial function)
- Heart rate variability (autonomic NS)
- Ankle-brachial index (PVD)