

# Sleep Apnoea, Sleepiness, and the Workplace

Walter McNicholas MD

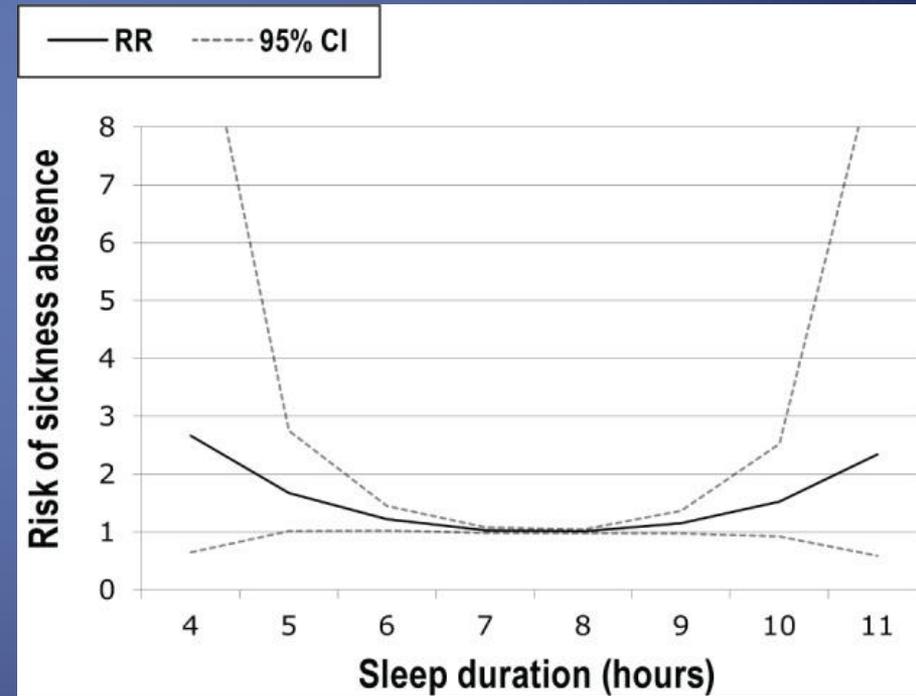
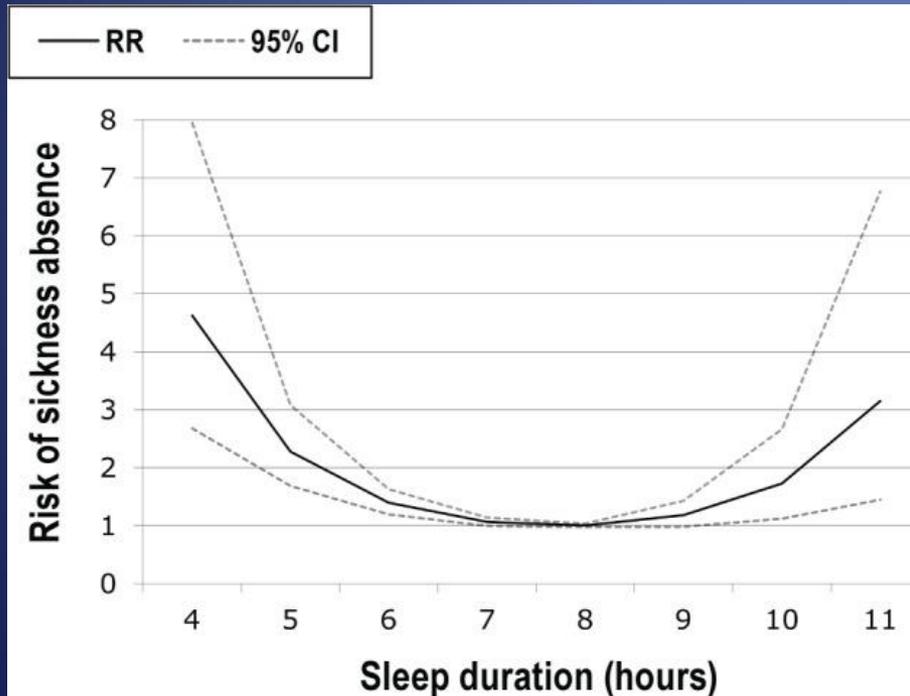
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**Chair, EC Transport Directorate  
Working Group on “Driving and  
Sleep Apnoea”**

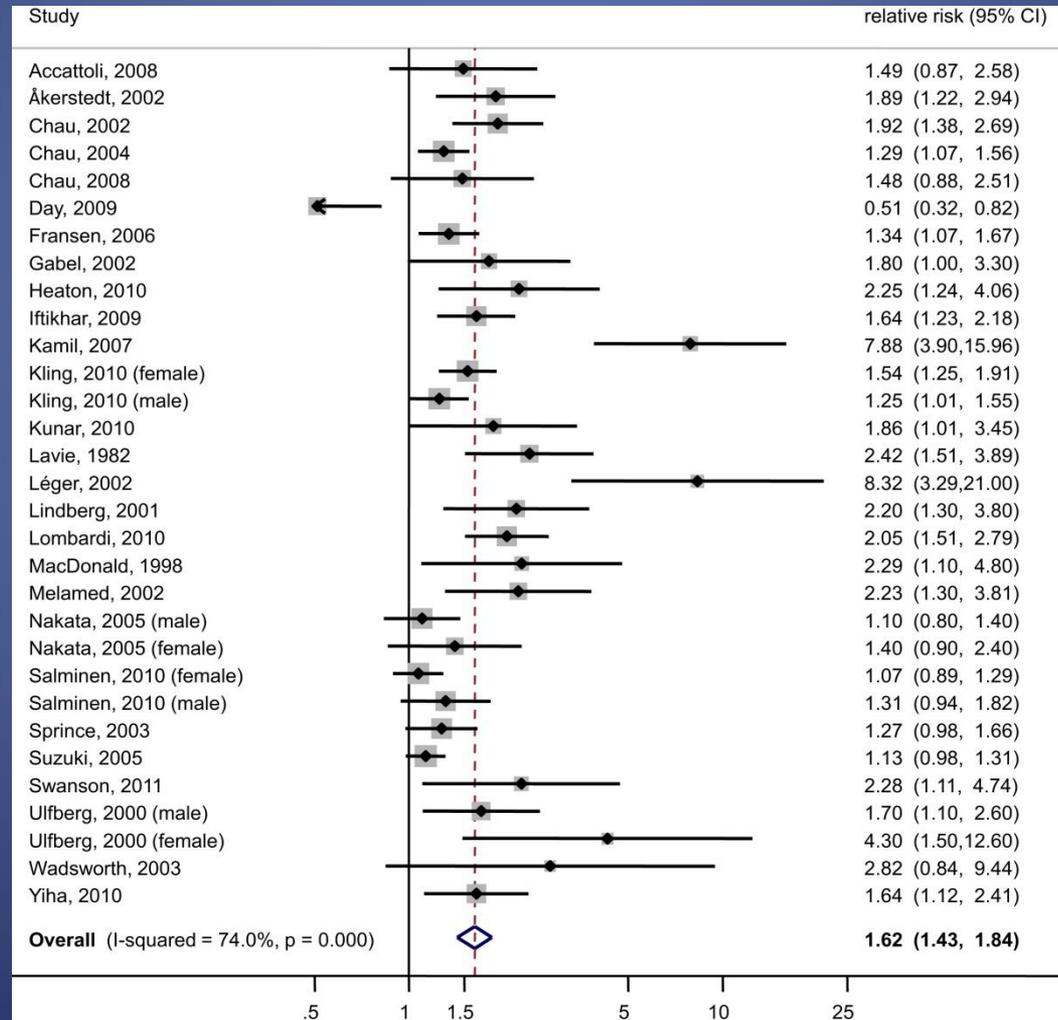


# Sleep and Sickness Absence: A Nationally Representative Register-Based Follow-Up Study. [Lallukka](#), *Sleep* 2014



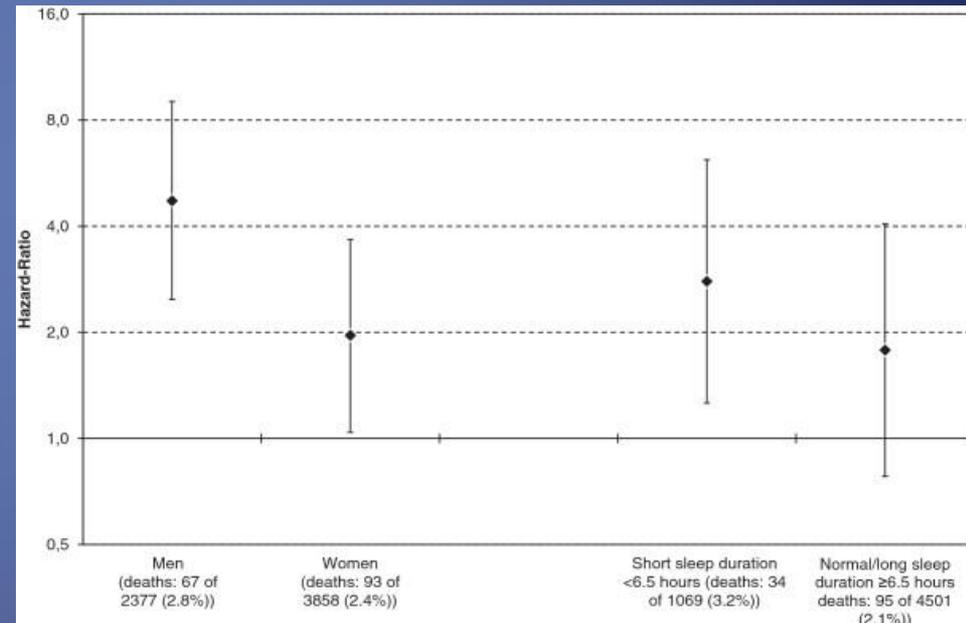
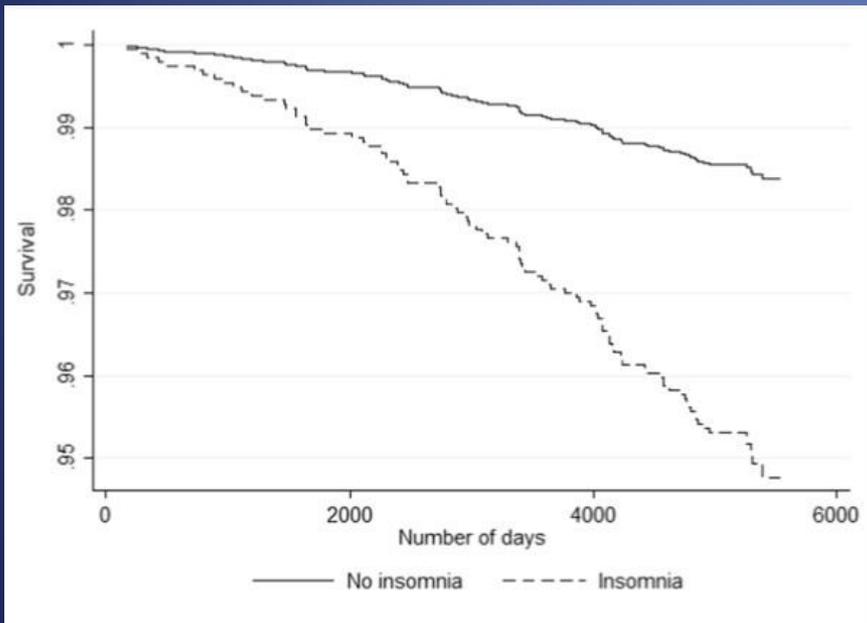
# Sleep problems and work injuries: A systematic review and meta-analysis.

Uehli. *Sleep Med Rev* 2014

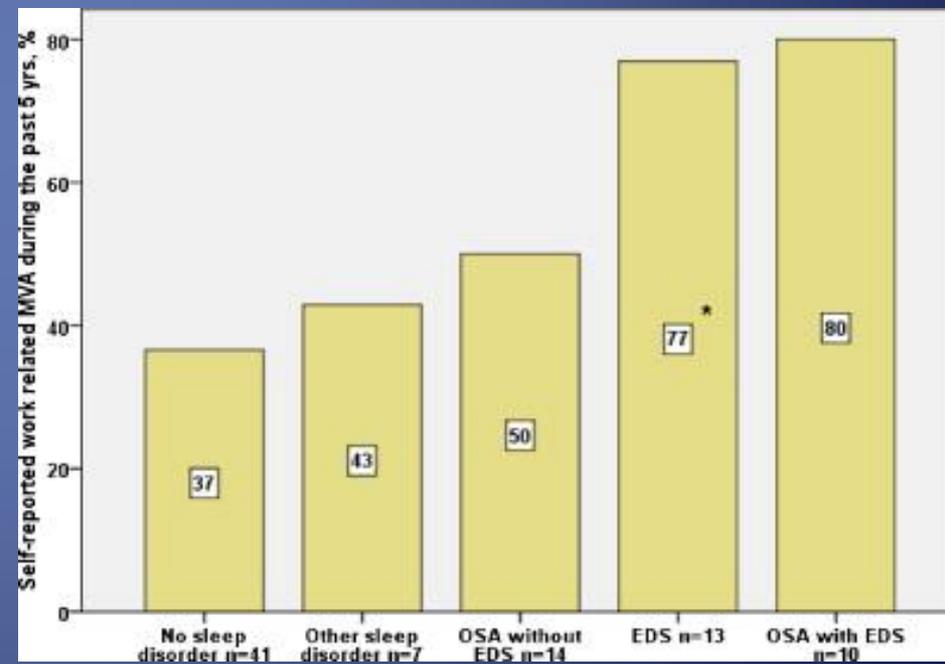
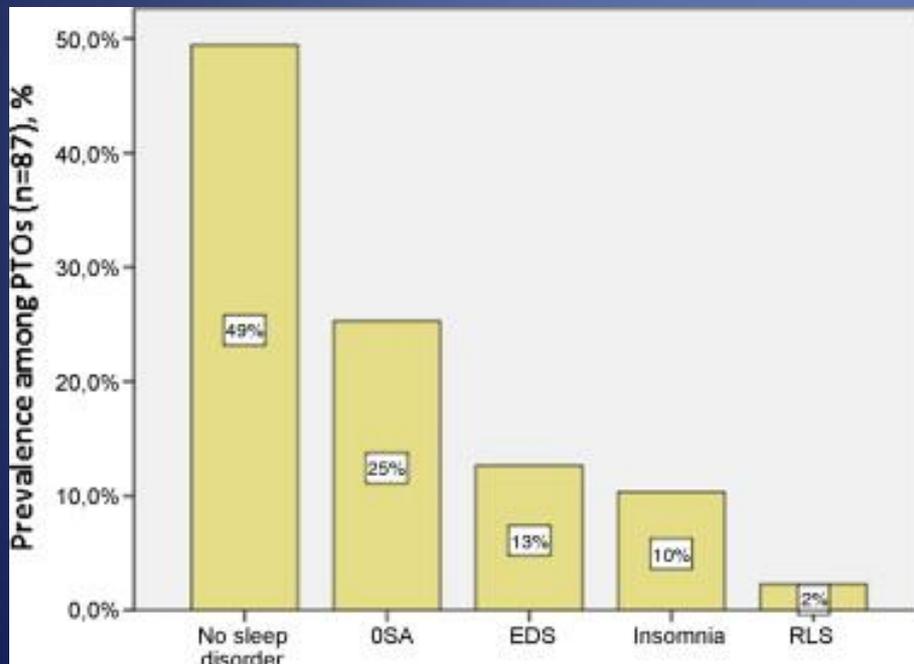


# Midlife insomnia and subsequent mortality: the Hordaland health study.

Sivertsen, *BMC Public Health*. 2014



# Impaired vigilance and increased accident rate in public transport operators is associated with sleep disorders. [Mahssa Karimi. Accident Analysis & Prevention, 2013](#)

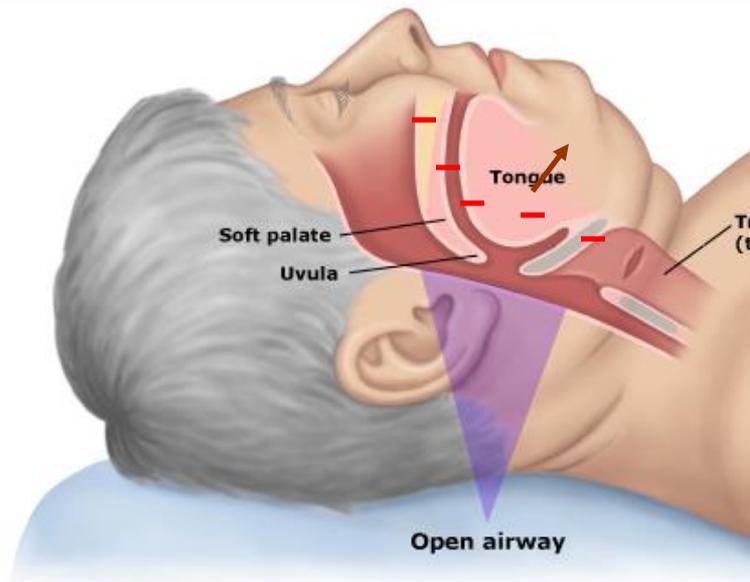


# Obstructive sleep apnoea syndrome

- Recurring apnoea during sleep, usually due to obstruction of the oropharynx
- One of the most prevalent chronic respiratory disorders: most common among males 40-59 years.
- Usually defined in terms of frequency of breathing disturbances during sleep ( $> 5/\text{hour}$ ), associated with daytime symptoms, particularly sleepiness.
- Substantial genetic basis ( $\sim 40\%$  of variability); typically brought to the surface by the development of obesity.
- Although most patients with sleep apnoea snore, only a small proportion of snorers have sleep apnoea.
- OSAS is an important risk factor for cardiovascular disease, particularly hypertension ( $\sim 50\%$ ).

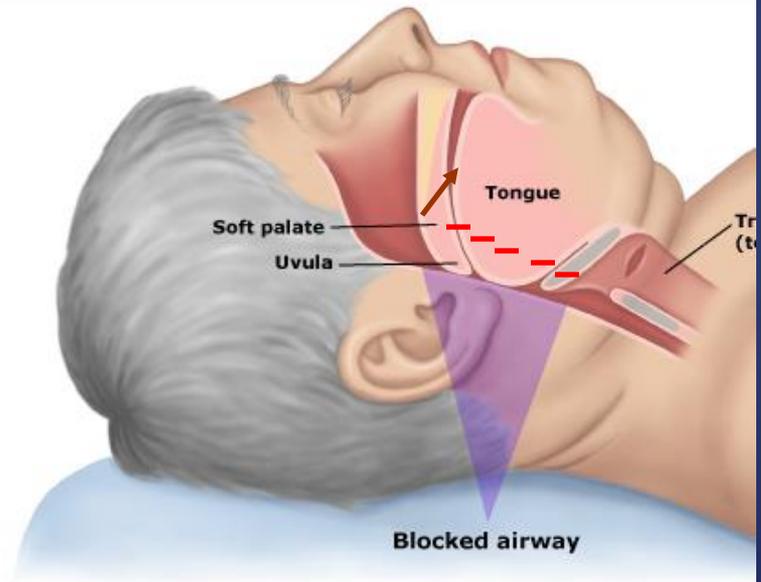
# Mechanisms of obstructive apnoea

## Normal airway during sleep



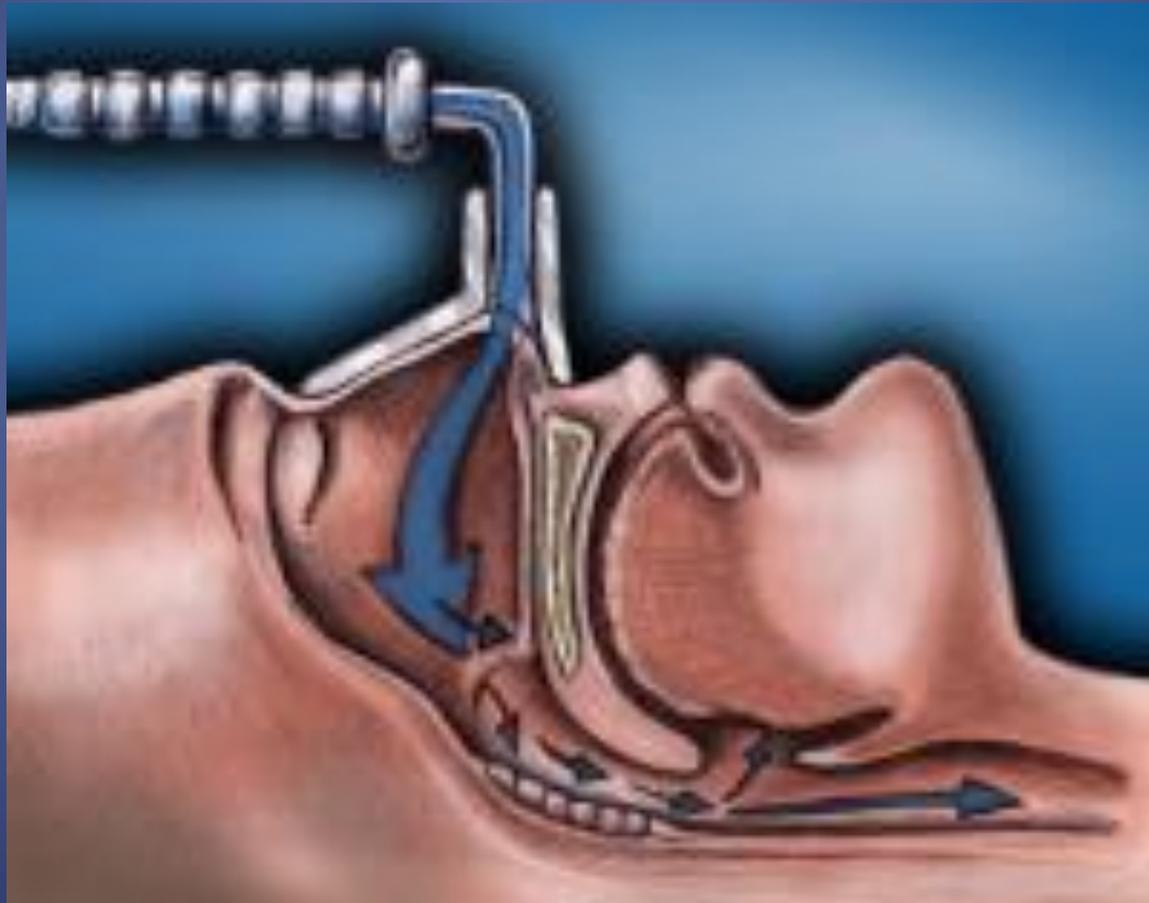
This figure shows how the tongue, uvula, and soft palate (with the upper airway) should normally look in a person who is sleeping.

## Sleep apnea



This figure shows how the upper airway can become blocked in people with obstructive sleep apnea.

# Continuous Positive Airway Pressure (CPAP)

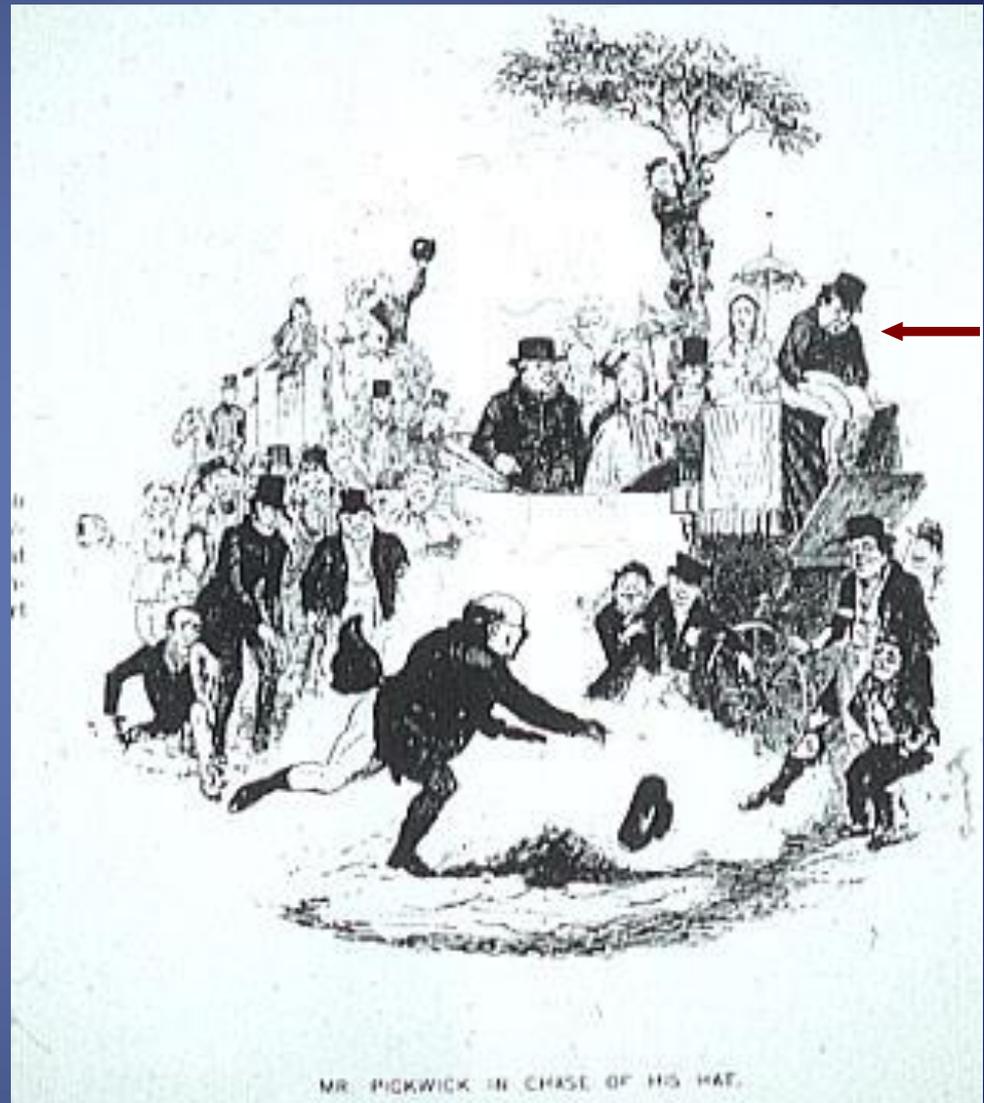


# Epidemiology of sleep apnoea

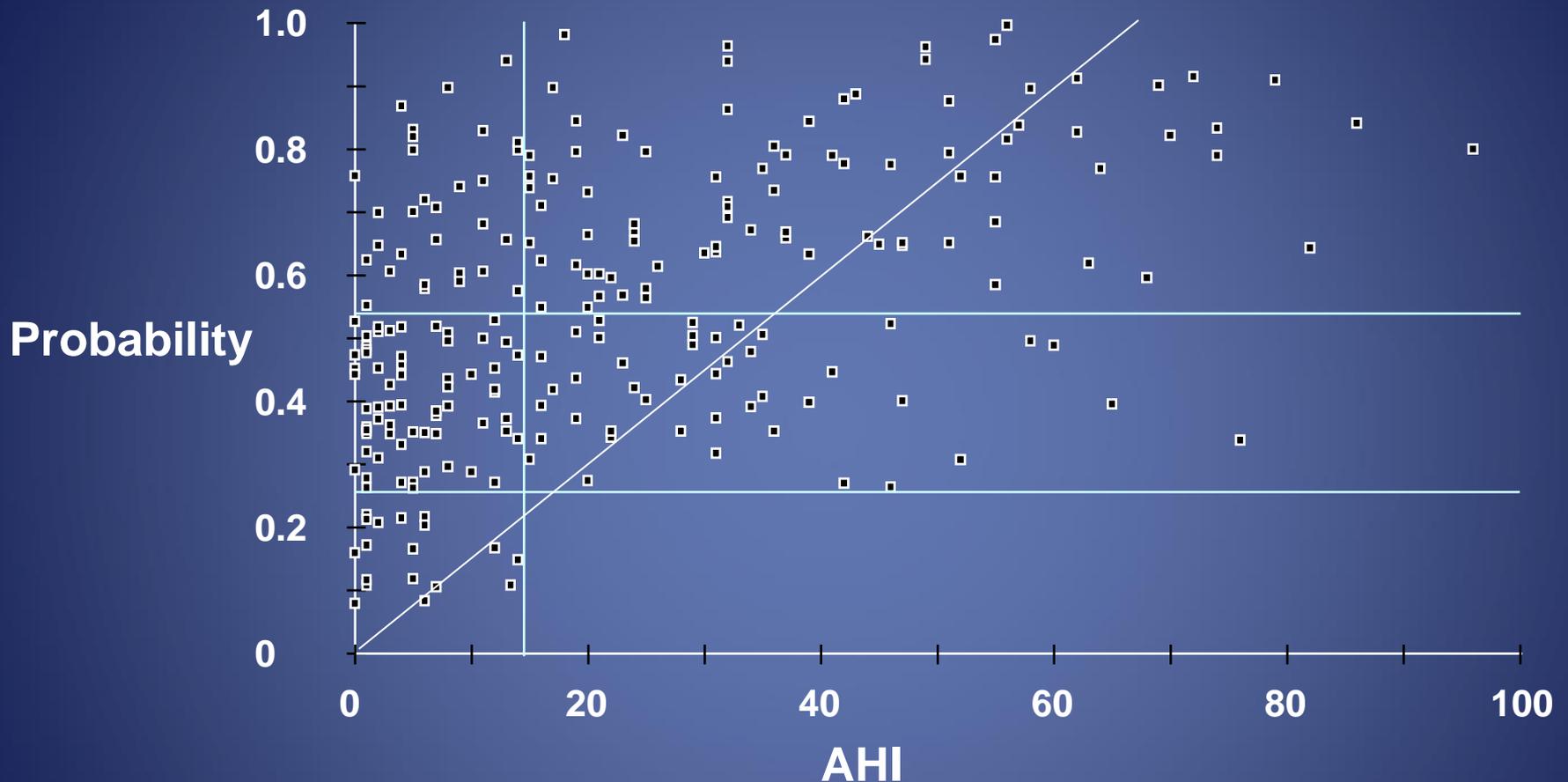
- Measured by evaluating cessation/reduction of breathing during sleep
  - Apnoea/Hypopnoea Index (AHI)
  - Normal  $<5$  events/hour of sleep
  - The clinical syndrome (OSAS) combines clinical features with AHI
- Approx 25% adult males have AHI  $>5$
- Approx 4-9% of adult males have
  - AHI  $> 5$  and symptoms of OSAS
  - AHI  $>15$
- Intimate relationship with obesity
  - Should not be viewed as the cause of OSAS

Early Descriptions  
of Sleep Apnoea:  
*Charles Dickens.*

“The Fat Boy Joe”



# Correlation of AHI with clinical features



Clinical probability of OSAS based on history and examination compared with AHI obtained from full overnight PSG studies in 250 consecutive patients referred to SVUH with suspected OSA. *Deegan ERJ 1996.*

# Diagnostic Challenges in OSAS

- Current diagnostic criteria pose major resource problems related to overnight investigation.
- Not practical to perform PSG (or even in-lab monitoring) in every suspected case.
- Need to establish most cost efficient modalities of investigation - will likely involve home monitoring for most patients.

# Home or Laboratory assessment?

## Laboratory

### ■ Advantages:

- Greater sophistication of recordings
- On-line monitoring (only applies if technician in attendance)

### ■ Disadvantages:

- Unfamiliar environment
- Cost factor (particularly if technician present throughout the night)

# Home or Laboratory assessment?

## Home

- Advantages:
  - Familiar environment
  - Cost benefit v lab studies – factor in failed studies
- Disadvantages:
  - Lack of on-line monitoring of recordings
  - Difficulty in patient set-up

***Thus, robust, simple and reliable recordings a priority  
– Major area of current research.***

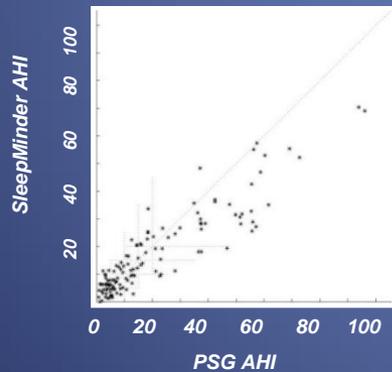
# SleepMinder™ : a “no touch” monitor for sleep and breathing evaluation



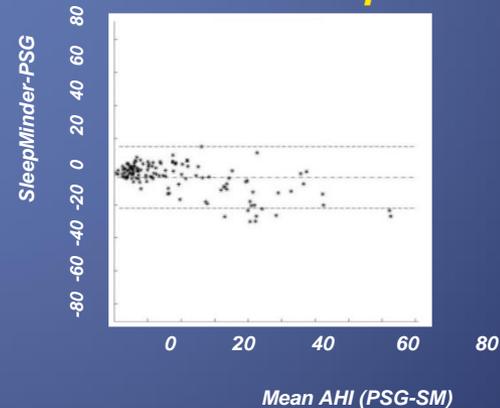
Signals based on  
electromagnetic waves  
(Radar)

AHI Estimation vs PSG:

*Correlation = 91%*



*Bland-Altman plot*



# Implications of OSAS for the Patient

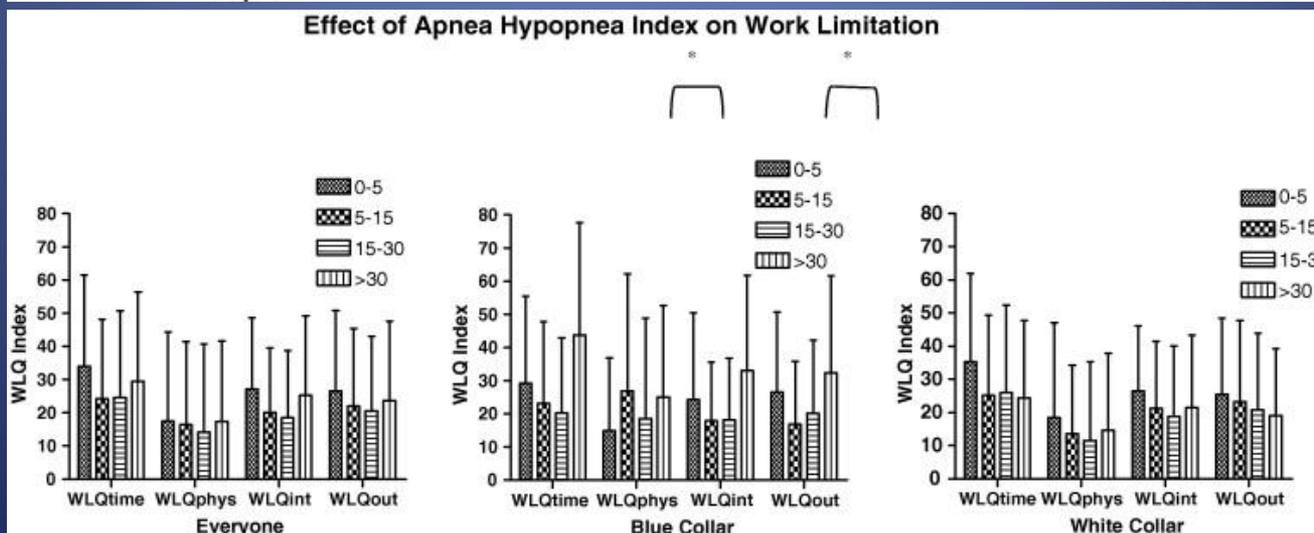
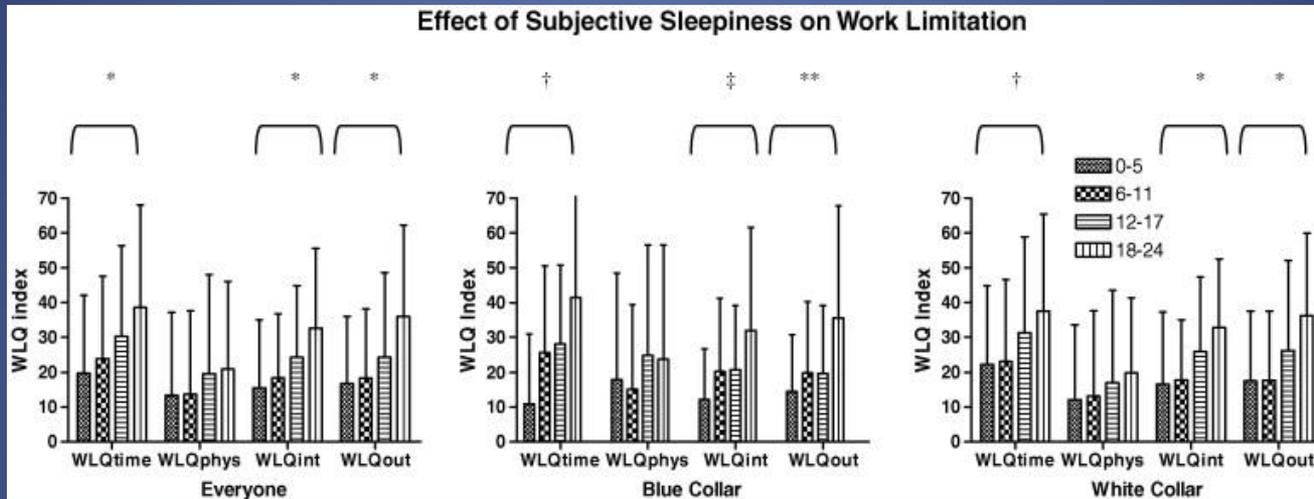
- Educational achievement
  - children with OSAS suffer decreased academic performance, inattention, behavioural disturbance Hansen, J Clin Child Psychol (1997)
- Job prospects
  - affected by low academic achievement and impact of neuropsychological/cognitive impairment
  - promotional opportunities

# Implications of OSAS for the Patient

- Work performance
  - sleepiness
  - Neuropsychological/cognitive impairment
  - particularly affects sedentary occupations
  - accident risk
- Quality of life
  - sleepiness, fatigue
  - mood/depression
  - marital relationships
  - physical symptoms - headache, nocturia, heartburn etc.

# Impact of obstructive sleep apnea and daytime sleepiness on work limitation.

*Mulgrew. Sleep Med 2007*



# Economic and Health Resource Implications of Sleep apnoea

- Potential for reduced economic productivity
- Impact of accidents
- Cost of investigation and treatment
- Complications of condition
  - principally cardiovascular

# Implications of OSAS for the Community

- Productivity at work
- Accident risk

# Implications of OSAS for the Community

- Work performance and productivity
  - Limited data available on the direct effects of sleepiness
  - **Shift work** (Dinges, Akerstedt, J Sleep Res, Suppl 2, 1995)
    - Performance errors and accidents at work are most frequent at night
    - May relate to circadian biological rhythms rather than sleepiness *per se*.
    - However, EEG studies of train drivers/ airline pilots reveal periods of sleep on the job during night shifts.

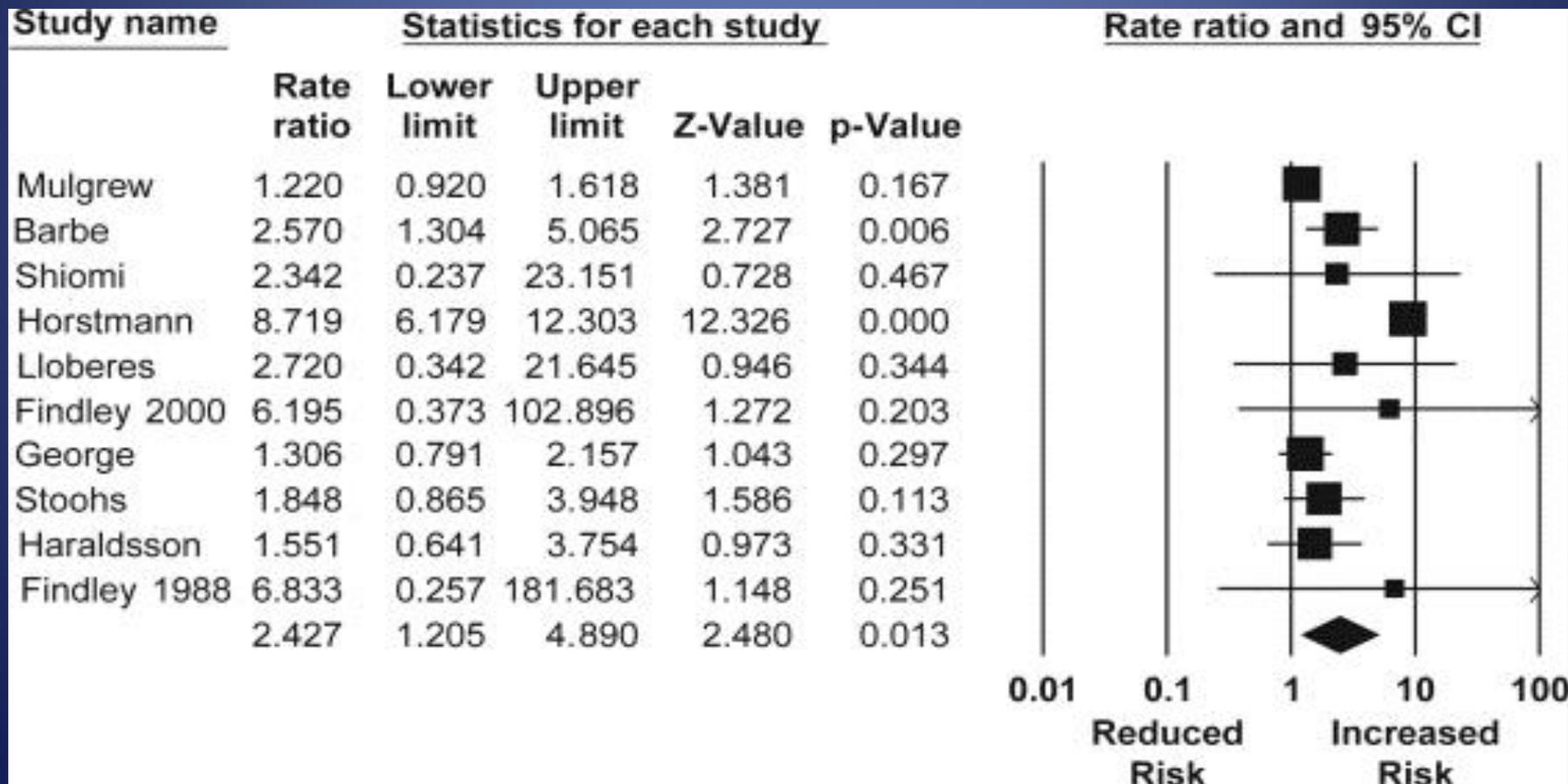
# Implications of OSAS for the Community

- Work performance and productivity
  - Junior doctors who work long hours - equivocal results re effects on performance, but most show impairment after long hours (Leung, J Occup Med, 1992)
  - Cost of fatigue/sleepiness induced accidents and production loss exceeds \$2 billion per yr in USA
  - research needed re direct effects of sleepiness/OSAS in the workplace.

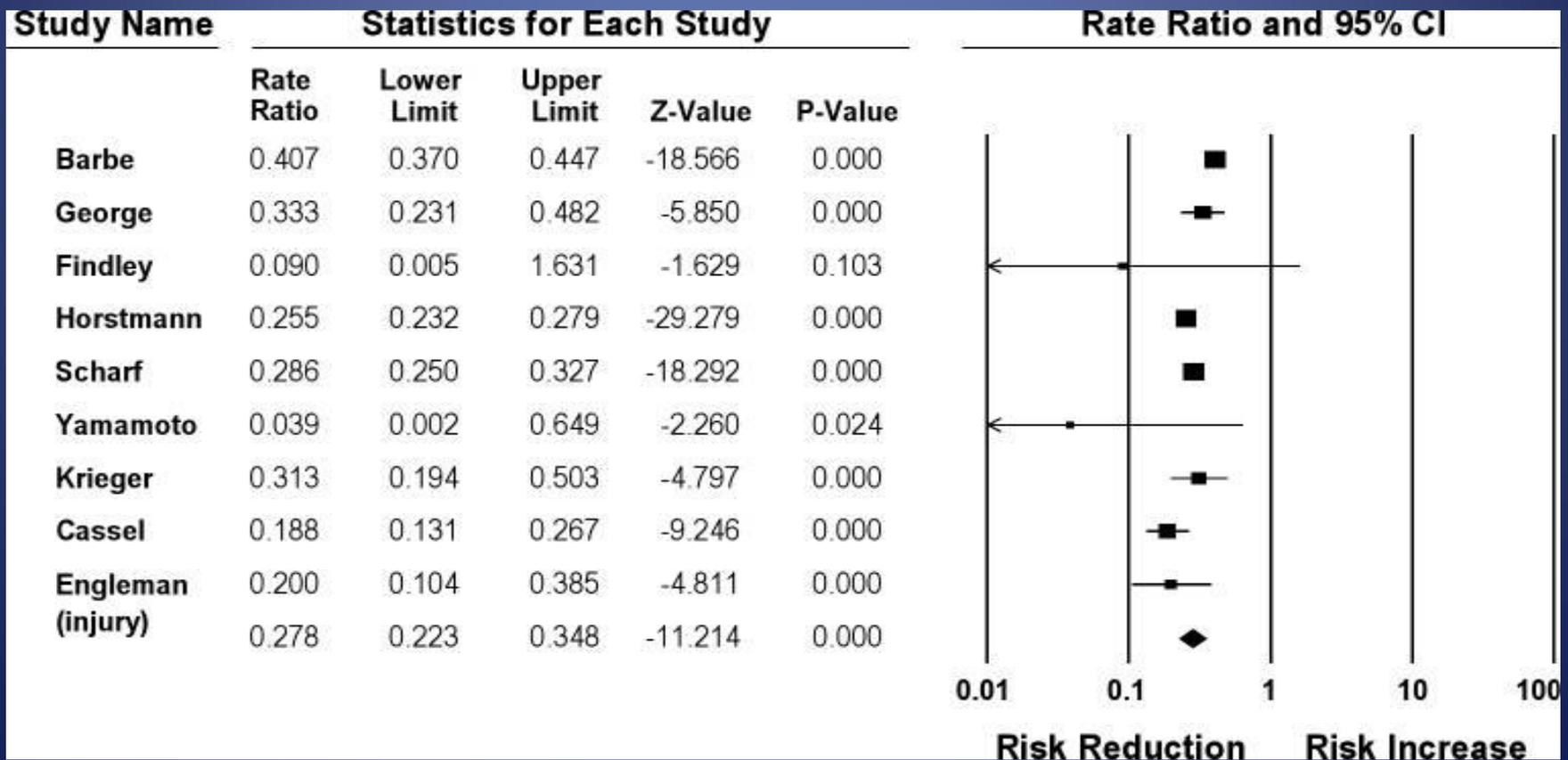
# Fatigue/Sleepiness and Driving

- 20-25% of highway motor vehicle accidents can be attributed to fatigue/sleepiness
- Sleep apnoea is the most prevalent medical disorder associated with sleepiness

# OSA and risk of motor vehicle crash. *Tregear, J Clin Sleep Med 2009.*



# CPAP reduces risk of motor vehicle crash among drivers with OSA. *Tregear Sleep. 2010*



# Common Characteristics of Sleepiness-Related Crashes

- Often associated with morbidity and mortality
- Tend to occur after midnight and in the midafternoon, which correspond with the 2 circadian periods of sleepiness and lowered performance
- Typically involve a single vehicle leaving the roadway
- Occur more often on high speed roads
- Sleepy drivers are less likely to take evasive action to avoid crashes
- Sleepy drivers are usually alone in the vehicle

# Factors which can increase the risk of RTA in Professional Drivers

- Not obtaining adequate sleep prior to driving
- Working long, irregular, or unreasonable schedules
- Inadequate sleep in truck sleeper berth
- Underlying medical conditions
- Inadequate rest facilities
- Economic pressures and incentives



# Additional factors relevant to HGV drivers

- Large vehicle mass
- High mileage exposure
- Lone driver, mainly motorway driving
- Injuries and property damage are more likely to be severe in the crashes



# European Commission

- Working Group on “Driving and Sleep Apnoea” established in 2012 by the EC Transport Directorate.
- Arose out of repeated contacts by experts with Transport Directorate in Brussels, particularly arising out of COST Action B26 on Sleep Apnoea.
- First meeting held in Brussels, September 2012
- Detailed work by 3 subgroups to develop practical recommendations for presentation in a formal report
- Group 1 and 2 drivers included
- Report completed: May 2013 – presented to the Transport Directorate Driving Licence Committee, June 2013

# Working Group Composition

**Walter McNicholas (Chair)**

**Zsuzsanna Bencs (HU)**

**Elke De Valck (BE)**

**Karl Franklin (SE)**

**Damien Leger (FR)**

**Stefan Dumitrache-Rujinski (RO)**

**Joanna Lever (UK)**

**Nicole Majery (LU)**

**Reinhard Mörz (AT)**

**Gennaro Palma (IT)**

**Genovaite Paulaskiene (LT)**

**Olli Polo (FI)**

**Martin Pretl (CZ)**

**Daniel Rodenstein (BE)**

**Jos Rooijackers (NL)**

**Karel Sonka (CZ)**

**Juris Svaza (LV)**

**Zoltan Szakacs (HU)**

**Joaquin Teran-Santos (ES)**

**Ildikó Urban-Frendl (HU)**

**Kathryn Anne Watts (UK)**

**Hans Günter Weeb (DE)**

**Members nominated by National Government Agencies; thus  
officially representing Member States in the process**

# Working Group Report: Key recommendations

- *Screening strategy*
  - Simply available subjective/objective data
  - May be most appropriate for Group 2 Drivers
- *Establish criteria for the provision of a driving license to OSAS patients*
  - Preclude driving certification of sleepy OSA drivers but permit in milder cases and those successfully treated
  - Stricter requirements for Group 2 drivers
- *Information and education on OSAS and its consequences*
  - Patients and healthcare personnel
  - Police officers, professional drivers, Transport Industry

# *Screening strategy*

- Simply available objective data, mainly anthropometric (BMI)
- Focused questions on the presence of recent MVAs, of symptoms and complaints frequently associated with OSA
- Questionnaire assessment of daytime sleepiness.
- May be most appropriate for Group 2 Drivers.

# Questionnaires

- Epworth Sleepiness Scale
- Berlin
- Stop-Bang

# Assessment of sleepiness/vigilance

- Epworth sleepiness score
  - Simple to perform but subjective and thus open to bias
- Sleep latency (MSLT)
  - Difficult and cumbersome to perform
- Maintenance of wakefulness:
  - MWT
  - Osler test (relatively easy to perform)
- Other tests of vigilance:
  - Driving simulators

# Screening for OSAS

- Gender
- Age
- Weight
- Height
- Did it already happen to you to doze off while driving?      YES      NO      DON'T KNOW
- Did you have a serious accident (with personal injuries or property damage) due to sleepiness in the last 3 years?  
DON'T KNOW      YES      NO
- Do you usually snore loudly almost every night?  
DON'T KNOW      YES      NO
- Have you been told your breathing stops during your sleep?  
DON'T KNOW      YES      NO
- Do you usually wake up refreshed after a full night sleep?      YES      NO      DON'T KNOW
- Please complete the questionnaire on usual daytime sleepiness, called the Epworth Sleepiness Scale, on the next page

# *Criteria for the provision of a driving license to OSAS patients*

- Stricter requirements for Group 2 drivers
- Preclude certification where the driver reports sleepiness while driving but permit certification in mild OSA (AHI <15) not associated with significant sleepiness, or where effective therapy is in place
- “Carrot and Stick” approach, but emphasise the “carrot”.

# *Information and education on OSAS and its consequences*

- Priority is to encourage safe driving, balance accident risk in sleepy drivers against encouragement of patients with OSA symptoms to seek medical attention with a view to diagnosis and treatment.
- Education of Police Officers on the possibility of sleepiness as a contributing factor - should improve the accuracy of official records and statistical information on accidents and sleepiness
- Professional drivers and Employers in Transport Industry

# General Principles

- All Drivers:
  - Since OSAS is effectively treated with CPAP, road safety is likely to be best served by encouraging drivers to be open and honest
  - Distinguish treated vs untreated OSAS in determining suitability to drive
- Group 2 Drivers:
  - Much greater impact on public safety
  - Higher level of requirement to retain licence
  - Screening may have a greater role (subjective/objective)

# Addition to Annex III – EU Directive, June 2014

## Mandatory Implementation by Member States - Dec 2015

- 11.2.** In the following paragraphs, a moderate obstructive sleep apnoea syndrome corresponds to a number of apnoeas and hypopnoeas per hour (Apnoea-Hypopnoea Index) between 15 and 29 and a severe obstructive sleep apnoea syndrome corresponds to an Apnoea-Hypopnoea Index of 30 or more, both associated with excessive daytime sleepiness
- 11.3.** Applicants or drivers in whom a moderate or severe obstructive sleep apnoea syndrome is suspected shall be referred to further authorised medical advice before a driving licence is issued or renewed. They may be advised not to drive until confirmation of the diagnosis
- 11.4.** Driving licences may be issued to applicants or drivers with moderate or severe obstructive sleep apnoea syndrome who show adequate control of their condition and compliance with appropriate treatment and improvement of sleepiness, if any, confirmed by authorised medical opinion
- 11.5.** Applicants or drivers with moderate or severe obstructive sleep apnoea syndrome under treatment shall be subject to a periodic medical review, at intervals not exceeding three years for drivers of group 1 and one year for drivers of group 2, with a view to establish the level of compliance with, the maintain of good vigilance, and the need for continuing, the treatment

# Addition to Annex III – EU Directive, June 2014

## Mandatory Implementation by Member States - Dec 2015

- 11.2. Define the population:- Sleepy patients with moderate/severe OSAS defined by standard criteria
- 11.3. Sleepy patients suspected of moderate/severe OSAS may be precluded from driving, pending investigation
- 11.4. Allow patients with adequately treated OSAS to resume/continue driving
- 11.5. OSAS patients on treatment require periodic medical follow-up, with stricter requirements for Group 2 drivers.

# Summary

- Sleepiness represents a major factor that limits work performance and contributes to accidents, particularly while driving.
- Highly desirable that sensible measures be taken to limit driving risk of sleepiness
  - Hence the need to specify OSAS in Driving Regulations
- Encourage people with symptoms of OSAS to seek medical attention with view to diagnosis and effective therapy: Information and Education
  - Don't drive OSAS sufferers "underground"
- CPAP therapy returns OSAS patients to same level of accident risk as general population
  - Thus, public safety will be best served by regulations that favour the patient who is compliant with therapy.

# EU/EC Links to Documents

- Addition to Annex III:
  - [http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L\\_.2014.194.01.0010.01.ENG](http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.194.01.0010.01.ENG)
- Working Group report:
  - [http://ec.europa.eu/transport/road\\_safety/topics/behaviour/fitness\\_to\\_drive/index\\_en.htm](http://ec.europa.eu/transport/road_safety/topics/behaviour/fitness_to_drive/index_en.htm)
- My e-mail:        walter.mcnicholas@ucd.ie