

# Fatigue and its implications for aircrew: Thirty years experience of international operations

Presentation to ALPL Conference: Fatigue Risk Management

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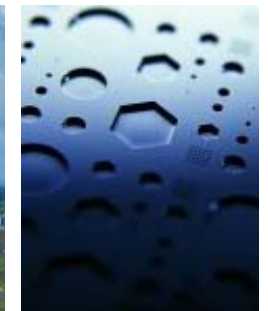
QinetiQ Proprietary

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# 01 Background



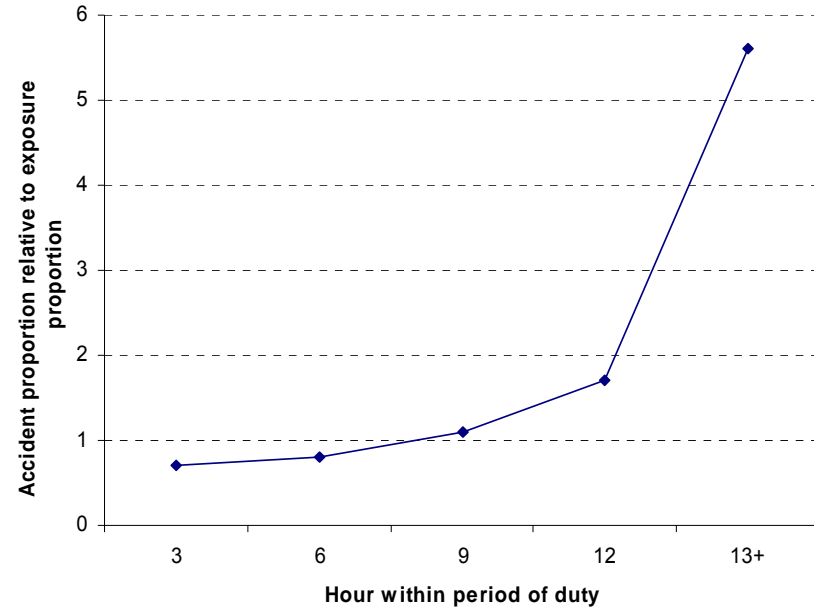
# Flight time limitations & fatigue

Regulations designed to:

- Minimise impact of fatigue on performance
- Protect against excessive levels of fatigue
- Prescriptive nature of FTL schemes means that some schedules:
  - Prohibited even though may be safe
  - Others that are fatiguing may be permitted

One identified risk factor for fatigue

- Length of duty period
  - As duration increases so risk of incidents and accidents increases



From JH Goode, 2003

## Other factors influencing fatigue in air operations

The way in which rosters are scheduled will also influence the development of fatigue

There are many issues to consider

- Time of day that the duty starts (e.g. early starts, night duties)
- Type of the operation
  - Long-haul: time zones, circadian rhythms/body clock
  - Short-haul: multiple sectors, mix of early starts, late finishes, long nights
- Breaks within and between individual duties
- Way in which individual trips are put together (cumulative factors)



Some of these issues will be addressed in following slides

## QinetiQ experience: Flight Time Limitation (FTL) issues

- Provided advice on duty rosters for over 30 years
  - Carried out in-flight studies to investigate:
    - basic physiology of individuals involved in air operations
    - how different factors influence crew alertness
- Provided advice on FTL issues to other regulatory authorities
  - E.g. Hong Kong CAD, CAA of Singapore, New Zealand CAA
- Advice to airlines on specific issues
  - E.g. crew complement, duration of layover, consecutive duties

## 02 Long-haul studies



## Assessing fatigue in long-haul operations

Collect data to establish impact of different COPs on crew alertness

Investigate the extent of the disruption to crews on different long-haul routes

Concerned principally with:

- sleep disturbance (e.g. on layover and on recovery)
- circadian adaptation
- the recuperation provided by in-flight rest

## Early studies

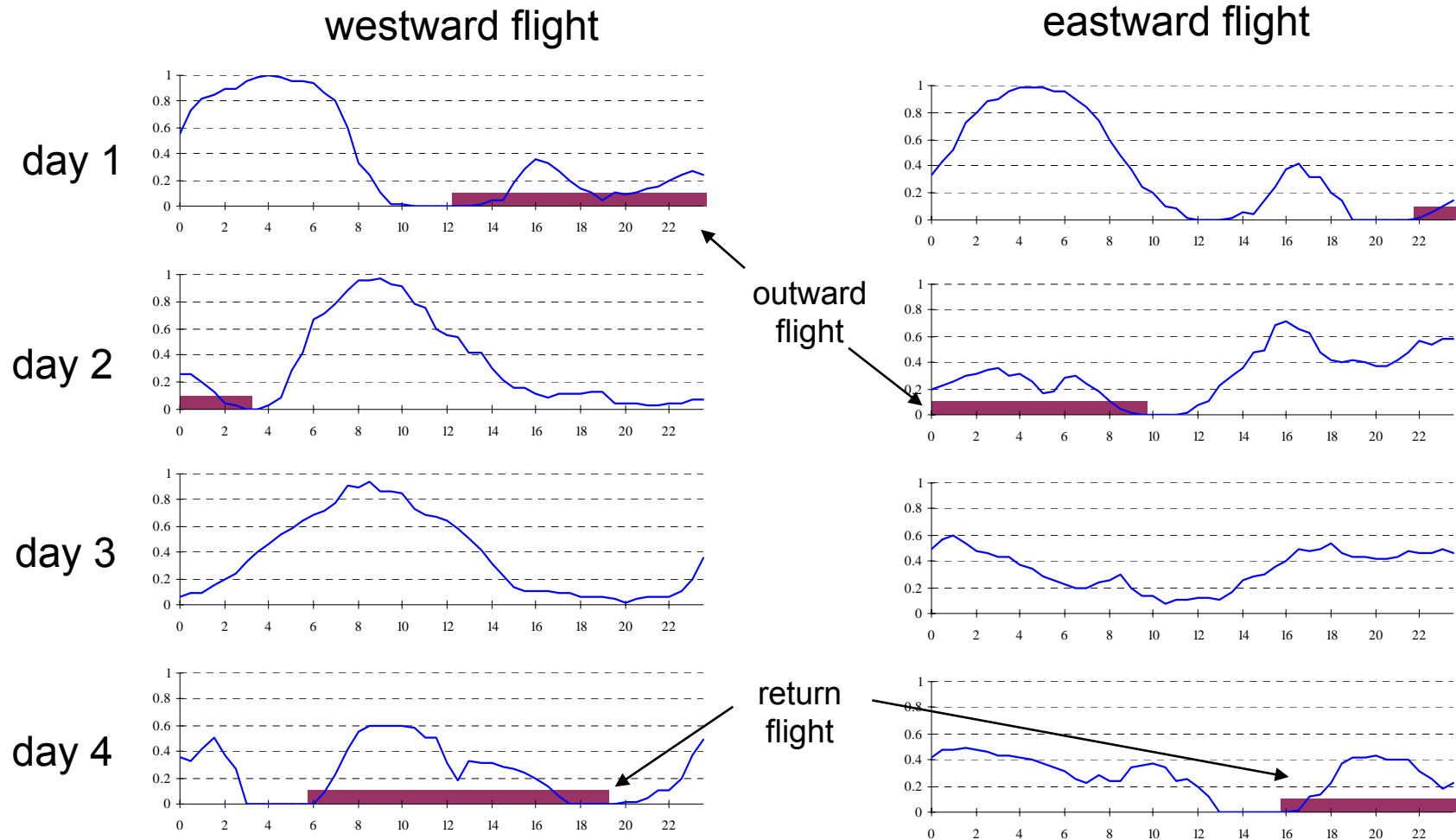
### Aircrew studies:

- LHR-SFO-LHR (part of an international collaborative study co-ordinated by NASA)
- the polar route (LHR-ANC-NRT-ANC-LHR)
- in-flight rest: LHR-JNB-LHR, LHR-NRT-LHR, LHR-SEL-LHR

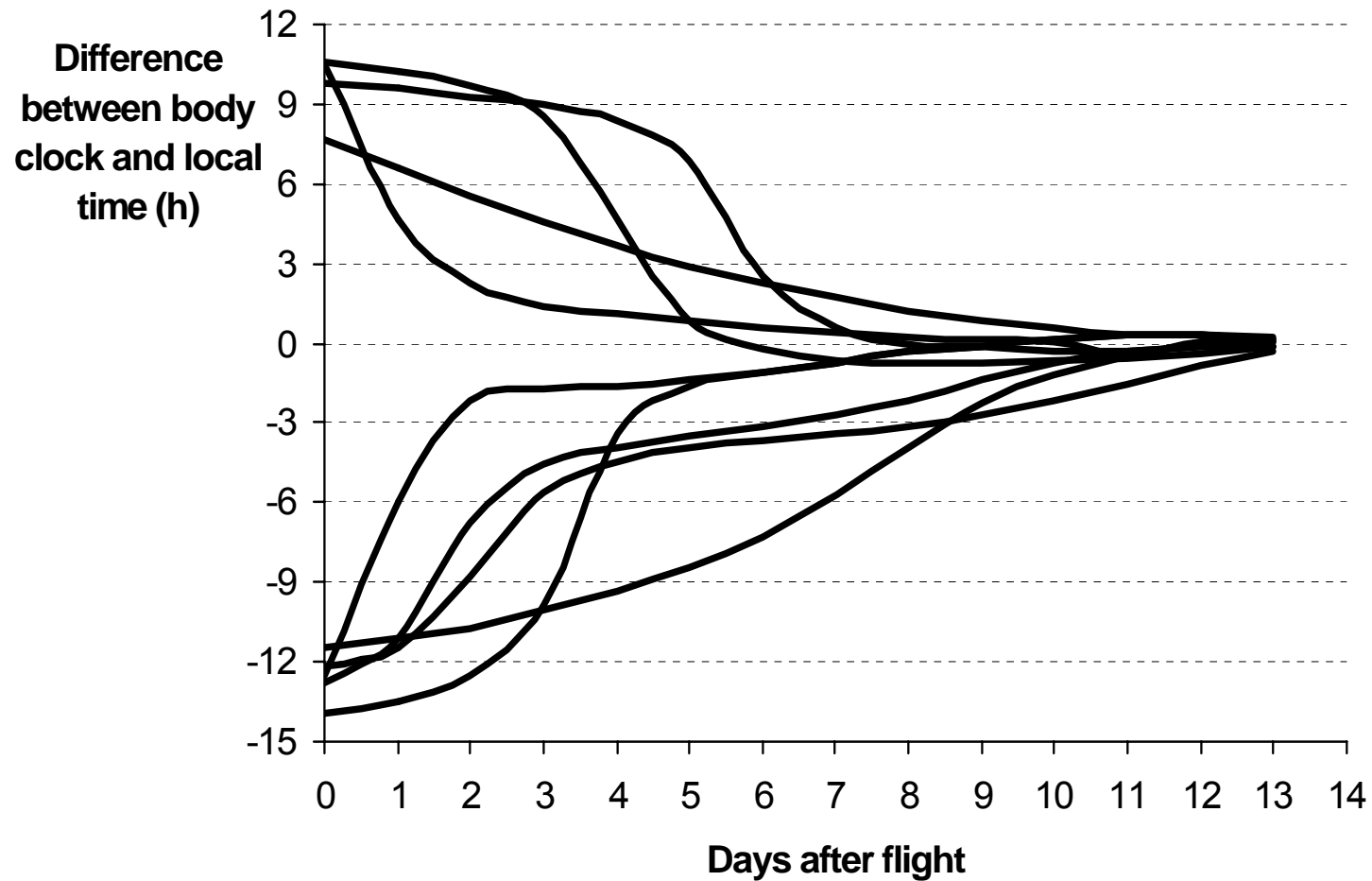
### Studies with volunteer subjects:

- 5-hour eastward and westward transition
- 7-hour eastward transition
- 10-hour eastward transition

# Sleep after westward and eastward flights



# Adaptation to a 10-hour eastward transition



## The Haj operation

Carried out every year by Britannia - involves the transportation of pilgrims between Indonesia and Jeddah

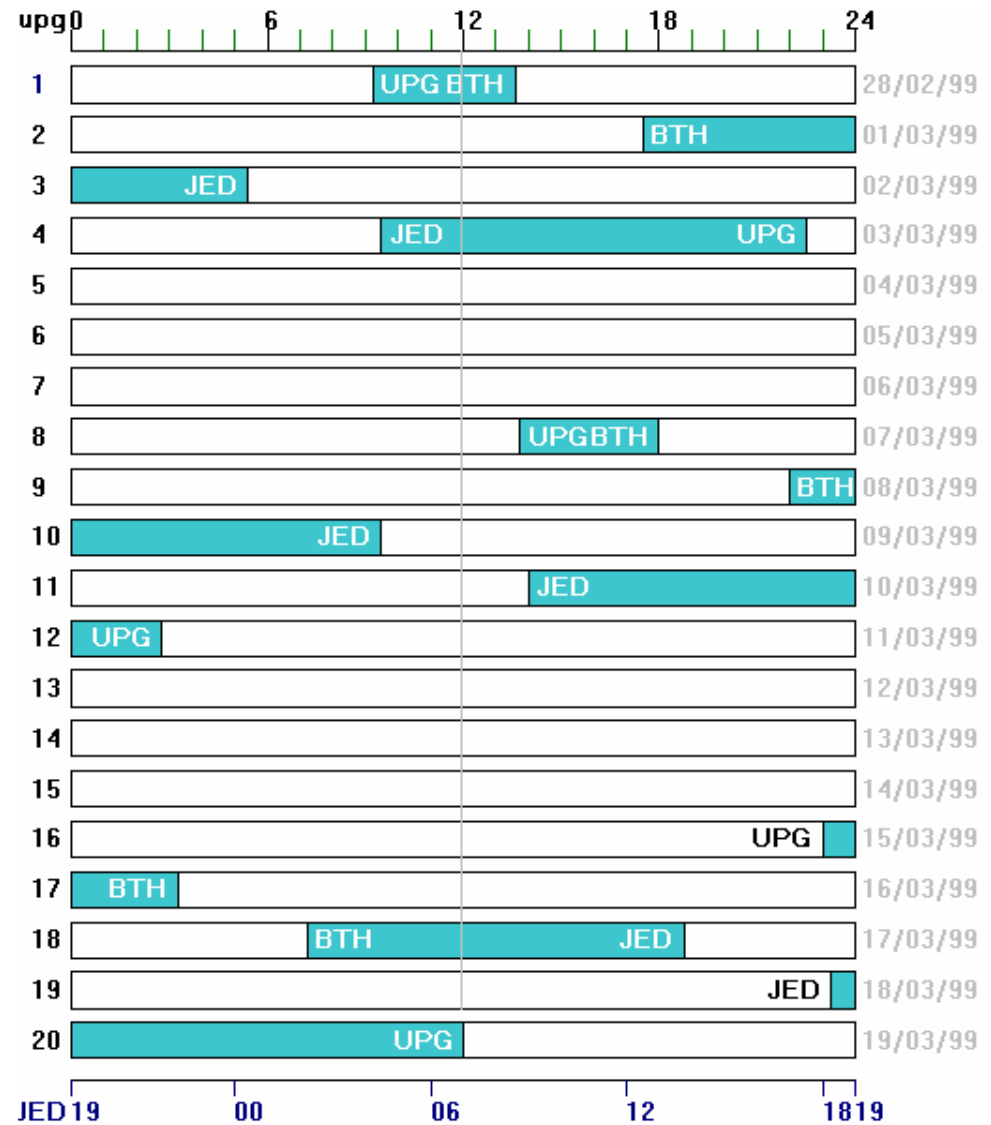
Phase I: the outward flights

Phase II: the return flights

Each phase lasts for about 4 weeks, with individual aircrew undertaking 3, 4 or 5 return flights

The operations are round-the-clock; flights depart at all times of day

# Example of a Haj duty schedule



# Fatigue monitoring of the Haj operation

Carried out for three consecutive years

Objectives:

- to monitor the variations granted by the CAA
- to determine the requirements for in-flight rest
- to obtain input for the model, particularly w.r.t. time of day

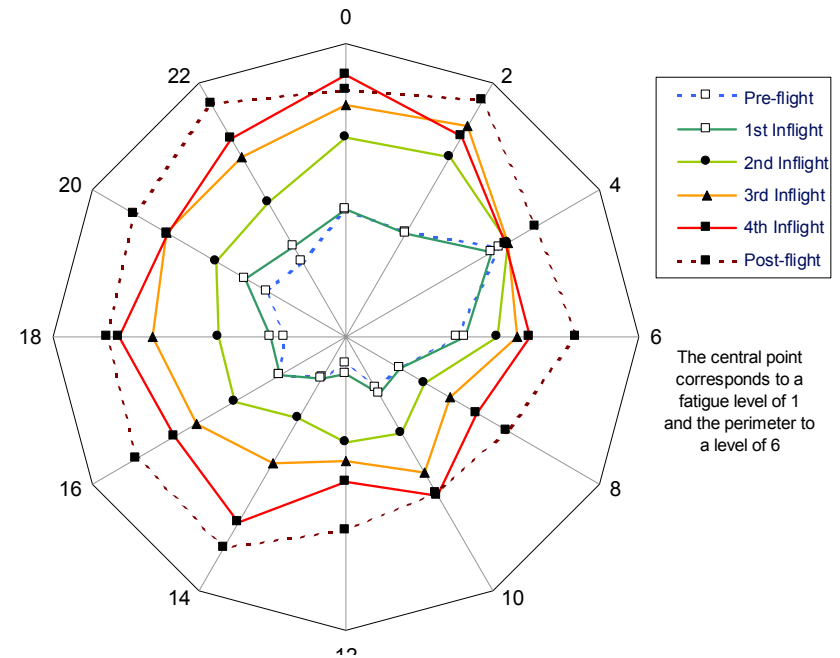
# Outcome of the Haj studies

A method of operating was introduced which was cost-effective and avoided excessive fatigue

Crew rotation was implemented on all augmented flights

Bunks were installed on all the critical flights

Unique dataset that allowed the impact of flights of a similar duration to be assessed at two-hourly intervals throughout the 24-hour period



# 03

## Short-haul studies

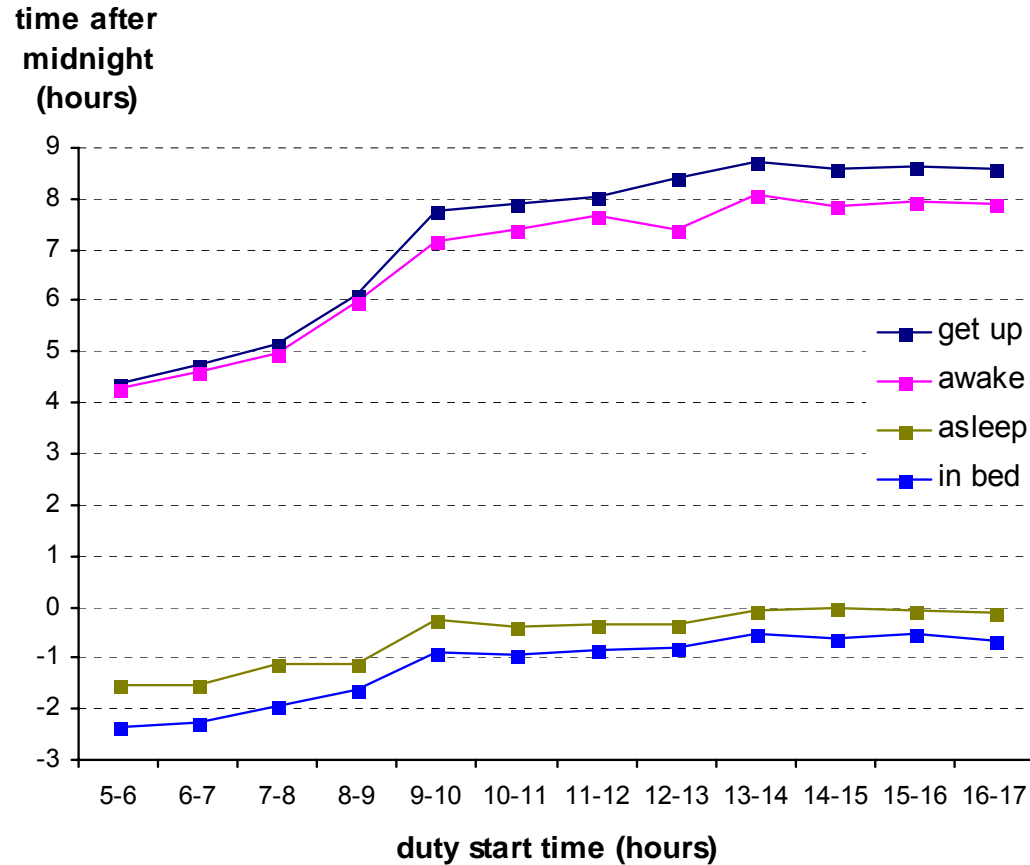


# Short-haul operations

Main issues addressed:

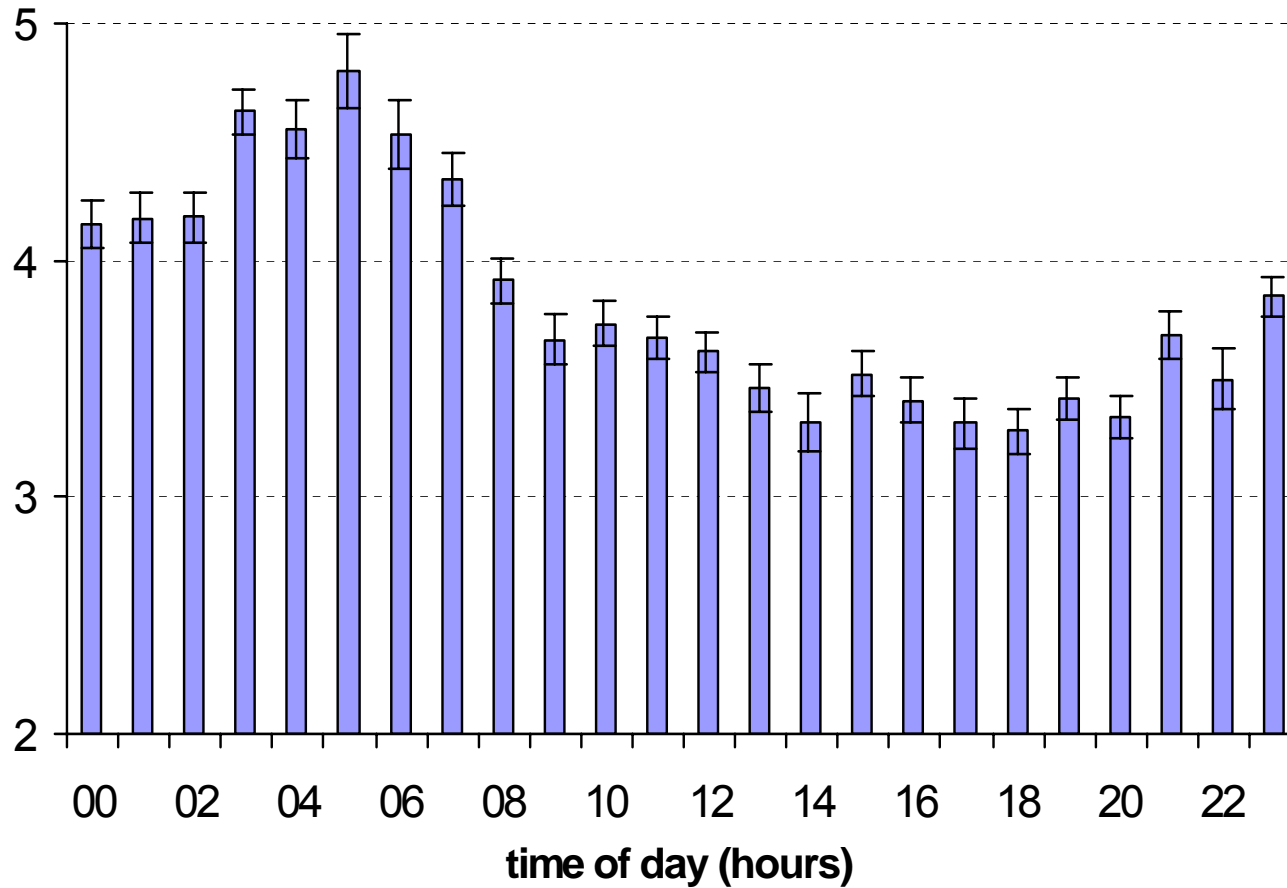
- multiple sectors
- early starts
- late finishes
- overnight duty
- consecutive duties

# Sleep prior to different report times

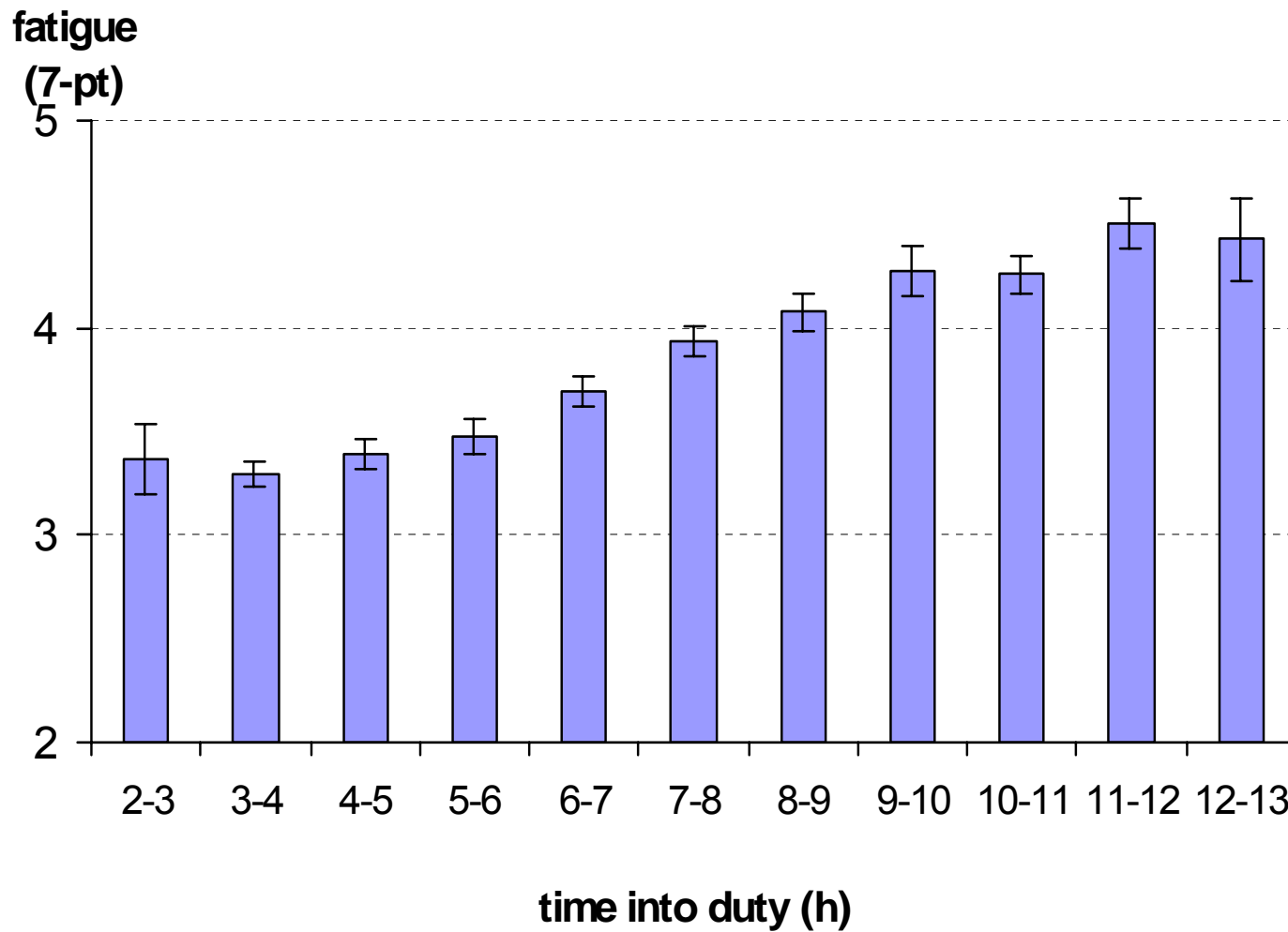


# The effect of time of day

fatigue  
(7-pt)

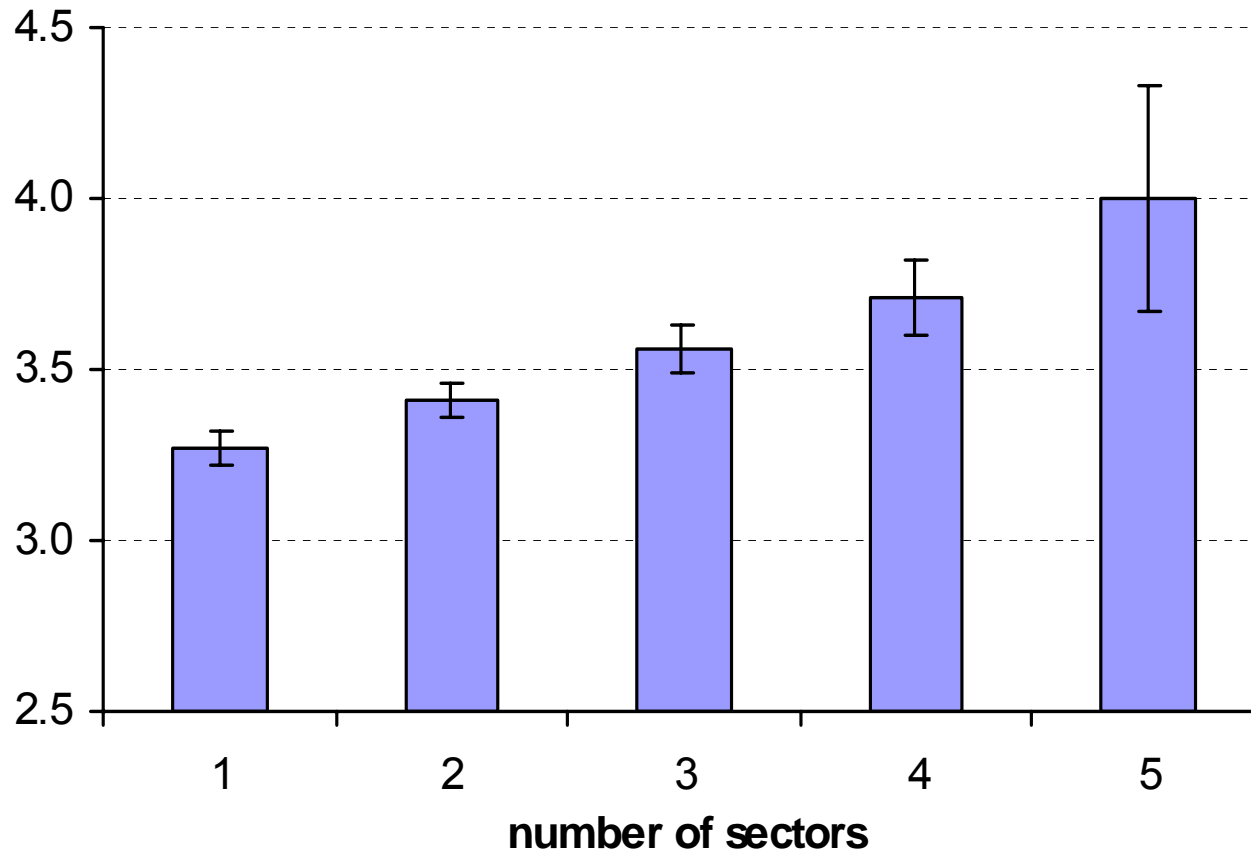


# The effect of time on duty



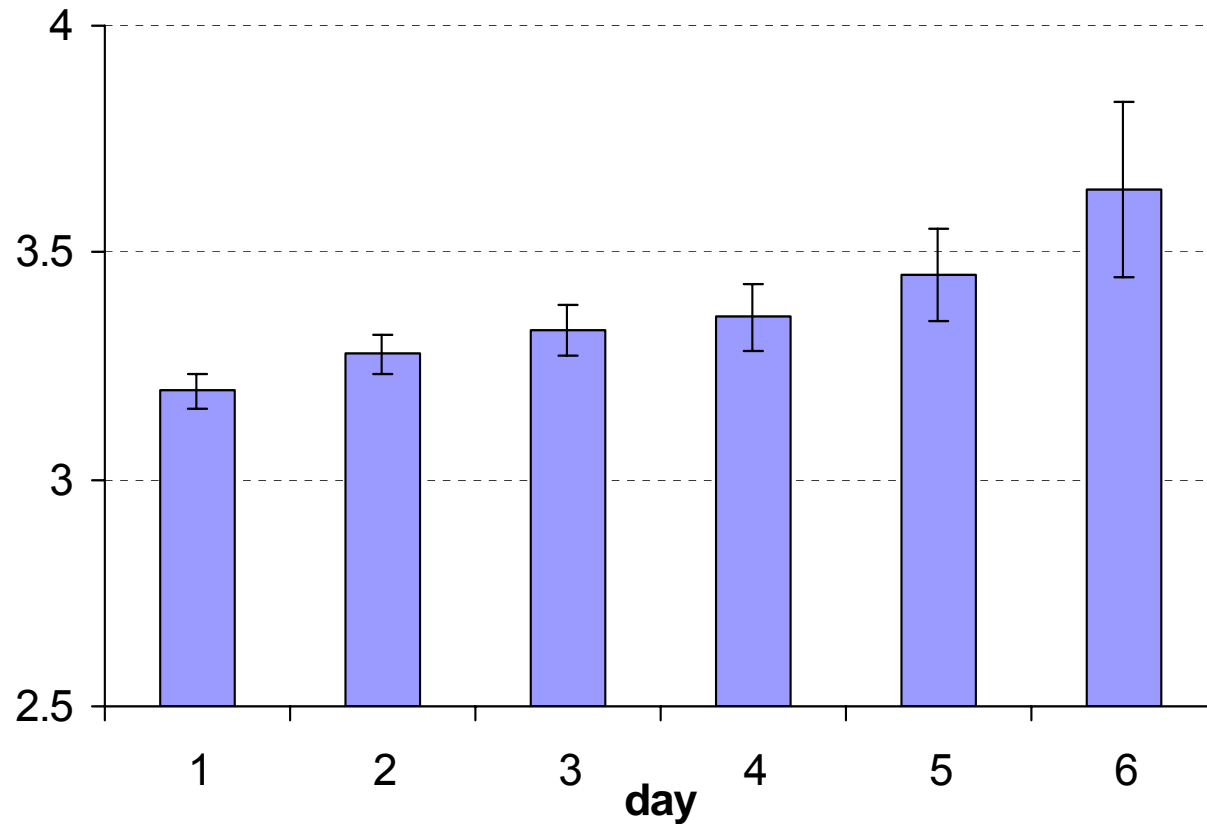
# The effect of multiple sectors

fatigue  
(7-pt)

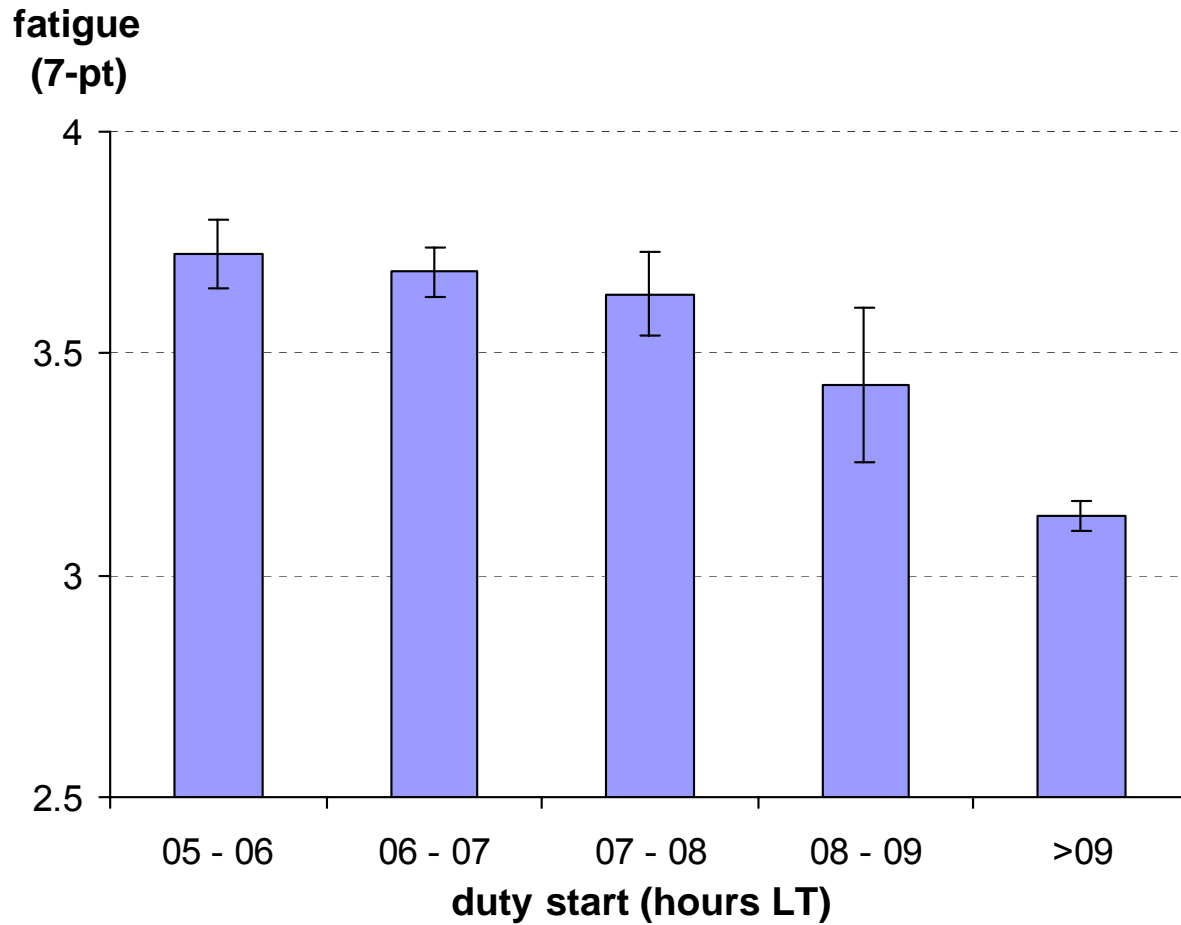


# The effect of consecutive duties

fatigue  
(7-pt)

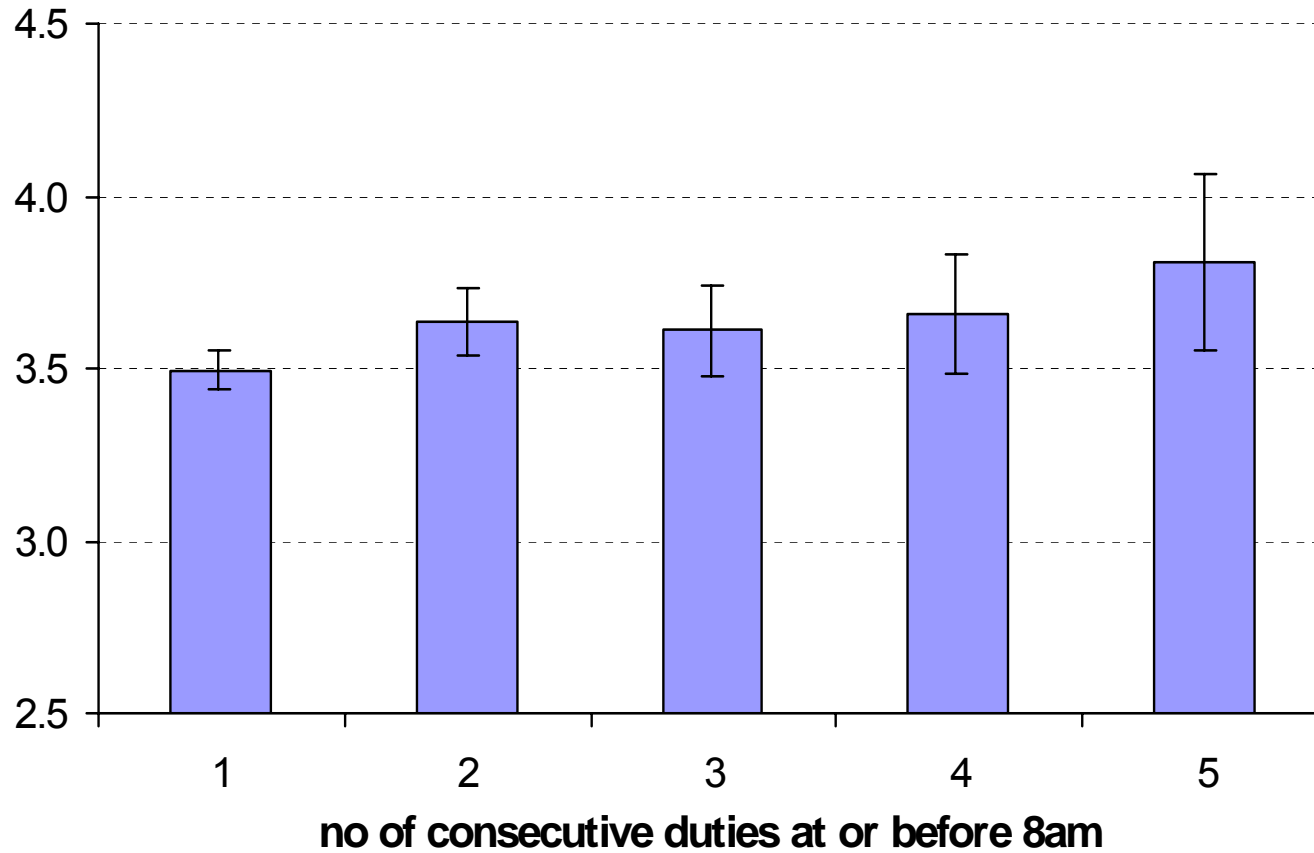


# The effect of early starts



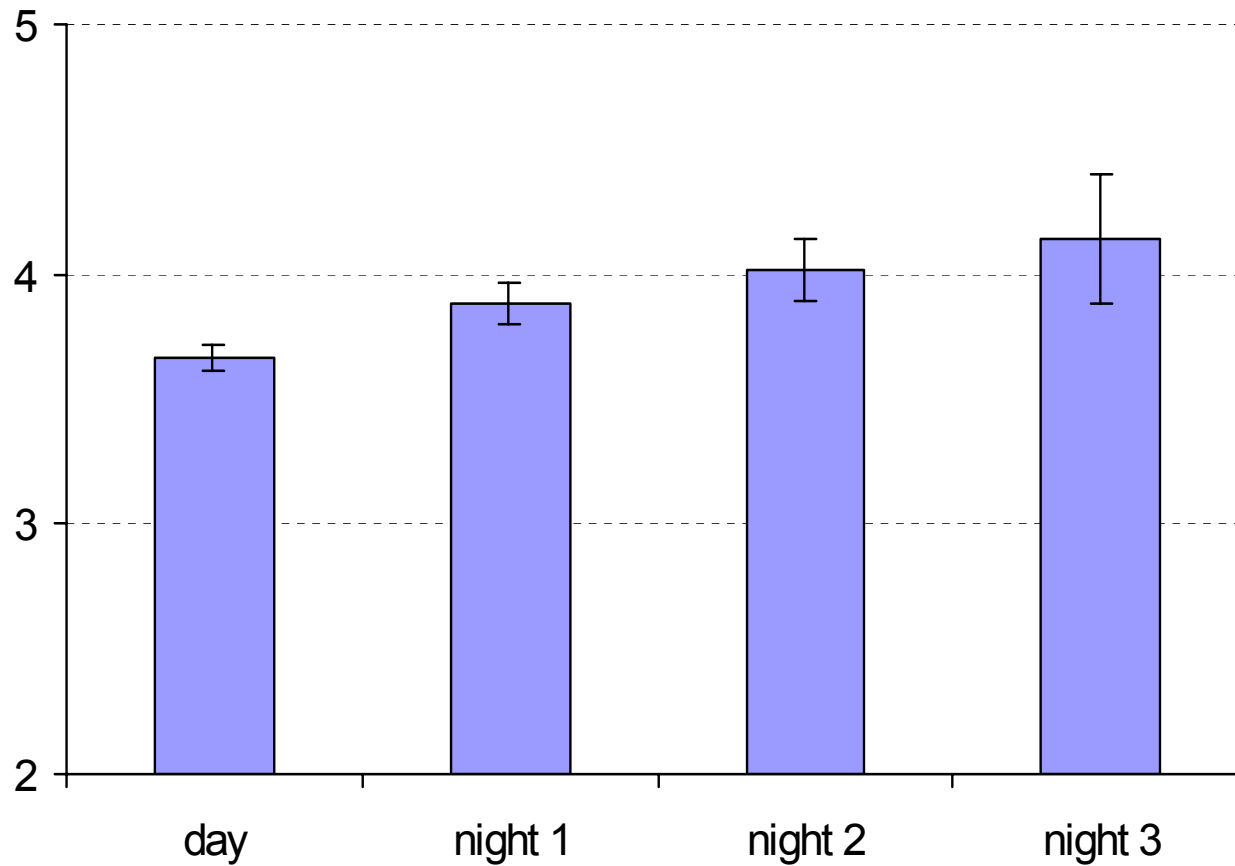
# The effect of consecutive early starts

fatigue  
(7-pt)



# The effect of consecutive late finishes

fatigue  
(7-pt)



# Conclusions

- Many factors influence the development of fatigue in aircrew
  - Alone or in combination
- Data collected during in-flight and other studies has been used to provide advice on scheduling issues and led to the development of a software program
  - System for Aircrew Fatigue Evaluation (SAFE), which can be used to evaluate the fatigue implications of duty schedules

## Acknowledgements

This work was funded by the Safety Regulation Group of the UK Civil Aviation Authority and the Singaporean Civil Aviation Authority.

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