Dear Working Time Society Members and Affiliates,

As you know, the nature by which we all communicate has changed substantially over the past decade. Formal newsletters and other publications have become increasingly supplanted by blogs, Facebook walls, free access journals and other social media tools and sites. The impact of these new ways of communicating has been profound. For example, no longer does one have to wait for a publication with a set periodicity to obtain its information, content and insight. Indeed these changes have sped up the time from development of the content to its “publication” or accessibility, which is great. Unfortunately it has also led to the proliferation of information portals, hot spots and other places one must continually monitor to keep up with this information flow. And of course, given that most of these sources are not subject to an editorial process, the consumer must be wary of its veracity.

The Board of the Working Time Society is currently holding a conversation about this and the future of its publications, including S.I.N., in light of these societal changes. As we continue to professionalize our organization we are reminded both of the great knowledge and talent that lies within WTS, and our and ICOH’s mandate to use and make accessible this talent and related information for the betterment of workers around the world. We do not want to be just another voice in the already loud chorus, so how we position ourselves and the services we can provide is of great significance. If you have ideas we encourage you to make them known either through the WTS listserv or directly contacting the WTS President and/or Board Members. WTS belongs to its members; your ideas are most welcomed!

S.I.N. Editorial Board

Dear colleagues

It was a pleasure to meet you again in Stockholm, in the beautiful surroundings near Haga Royal Park, while we were hosted at Radisson Blu Royal Park. We gathered from 32 countries to participate at the 20th International Symposium on Shiftwork and Working Time. This symposium was organized by the colleagues of Stress Research Institute, Stockholm University with the cooperation of the members of Working Time Society.
President’s Report (continued)

We enjoyed a pleasant weather from June 27th to July 1st 2011, the nights still alight with a blueish light sipping through the window to remind us the midsummer. In addition to the perfect climate, the symposium, though providing a relaxed atmosphere, achieved a high academic level, on par with all our past meetings. Thank you Torbjörn, Göran and your team for providing us with a wonderful symposium and experience!

This edition of the Shiftwork International Newsletter included the Book of Abstracts and Program of the Symposium that was printed and distributed to the participants of the symposium. This edition was prepared by Phil Bohle to be available on-line. The journal Chronobiology International 29(5), 2012, published selected papers of the symposium. Thank you, Phil, for this effort!

We also want to inform you of current activities of Working Time Society (WTS).

Since February 2011 the WTS Board has met regularly in virtual meetings, and discussed issues of interest. Many colleagues have to stay awake until dawn, while others wake up at early hours to attend these meetings. We have advanced in the discussion of major issues and made decisions through our extended board consisting of 14 members. In particular we want to mention the WTS strategic planning that is going on, which will influence the society in the coming years as well as the implementation of networking opportunities for "early career" WTS researchers. A German chapter of the Working Time Society has been formed and is active.

In addition, two important international events were held this past year with Frida’s participation as the official representative of the Working Time Society and the SubCommittee ICOH Shiftwork and Working Time: the 18th World Congress of the International Ergonomics Association Congress (IEA 2012) held last February in Recife, Brazil, and the 30th International Congress on Occupational Health (ICOH), held in Cancun, Mexico.

In the aforementioned events special sessions were held, (in the form of oral presentations, workshops, posters, and semi-plenary sessions) aimed to amplify themes on night and shiftwork/working times. These sessions attracted significant numbers of professionals working in the field of ergonomics and occupational health, from Latin America, as well as participants from other continents. There was a lot of interest in what we do as a profession and as a society.

Among the issues mentioned in my welcome address at the participants of the 20th International Symposium on Shiftwork and Working Time, I would like to reiterate the importance of the actions to be taken by Working Time Society in countries, which in spite of having a highly significant number of workers engaged in night and shiftwork, do not have solid directions to adopt sound regulations for healthy working time. The successive financial crisis across the globe, including in highly industrialized regions, has provoked a growing unemployment, and increased the deregulation of working conditions, including the length of daily/weekly working hours.

Lee, McCann and Messenger in their book “Working Time around the World” (ILO, 2009), comment on the decent work agenda of the International Labour Organization. Decent working time adjustments must meet 5 interconnected criteria, namely: to preserve the occupational health and safety, be family-friendly, promote gender equality, improve productivity and facilitate the choice and decision of the employee regarding the worktime duration. What this means is that we have to act beyond the limits of our research institutions, universities, and/or consulting firms in order to influence the public policies in countries to ensure that appropriate practices are established for the promotion of workers’ health.

As a final note, we would like to make public that the next symposium (21th International Symposium on Shift work and Working Time) will be held in Brazil, from November 4th to 8th 2013 (please see additional details at www.fsp.usp.br/shiftwork2013).

See you soon,
Frida Marina Fischer
Symposium Scientific Committee

John Axelsson (Chair, SE)
Björn Bjorvatn (NO)
Phil Bohle (AU)
Giovanni Costa (IT)
Anna Dahlgren (SE)
Sally Fergusson (AU)
Frida Marina Fischer (BR)
Adam Fletcher (AU)
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Anne-Helene Garde (DK)
Mikko Härmä (FI)
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Claudia Moreno (BR)
Greg Roach (AU)
Mikael Sallinen (FI)
Masaya Takahashi (JP)
Phil Tucker (UK)
Torbjörn Åkerstedt (SE)

National Organizing Committee

Göran Kecklund (Chair)
Torbjörn Åkerstedt (Co-chair)
John Axelsson
Anette Hedberg (Secretary)
Veronica Klevegren (Financial Officer)
Anders Knutsson
Sofia Lagergren (Information Officer)
Arne Lowden

SUBSCRIPTIONS TO S.I.N.


The printed S.I.N. can be subscribed to by sending an order form to Dr. Johannes Gaertner (Treasurer of the Working Time Society).

Please visit our website for more information under the section “Hardcopy issues of the Shiftwork International Newsletter.”

The cost for 2 years of S.I.N. is 20 €

General Terms:
• If a subscription is cancelled within 3 months, the money is refunded.
• Thereafter no refunds are given.
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Mikko Härmä (FI)
Kazutaka Kogi (JP)
Adam Fletcher (AU)
Irena Iskra-Golec (PL)
Natalia Bobko (UA)
Alexander Wedderburn (UK)

Honorary members in recognition of their distinguished contribution to the area:

Peter Colquhoun (1928 - 2005)
Simon Folkard (UK)
Juhani Ilmarinen (FI)
Peter Knauth (DE)
Kazutaka Kogi (JP)
Friedhelm Nachreiner (DE)
Don Tepas (US)
Alexander Wedderburn (UK)
Symposium Program

Monday 27 June, 2011

8.30-19.00 Registration

19.30-22.00 Welcome Buffet and Music

Tuesday 28 June, 2011

8.30-9.30 OPENING SESSION
Chairs: Kecklund G (SE) and Åkerstedt T (SE)

8.30-8.45 Opening I
Kecklund G (SE)

8.45-9.00 Opening II
Fischer F (BR)

9.00-9.30 Opening lecture
Practical ways to improve working time arrangements in occupational health practice
Kogi K (JP)

9.30-10.30 Keynote I
What do we know about recovery from schedules that involve sleep restriction
Dinges D (US)

10.30-11.00 Coffee break

11.00-12.30 ORAL SESSION I: Transport
Chairs: Sallinen M (FI) and Roach G (AU)

Comparing subjective and objective sleepiness between the two most common maritime watch systems: a bridge simulator study

Simulated driving under prior wake, circadian, sleep dose and sleep debt influences

Driving home after night shift – the effect of road treatments
Symposium Program (cont.)

Anund A, Ahlström C, Kecklund G, Åkerstedt T (SE)

The characteristics of sleepiness during real driving at night – a study of driving performance, physiology and subjective experience

Fatigued train drivers, but at what time?
Paech G M, Ferguson S A, Sargent C, Roach G (AU)

The impact of layover length on the sleep, psychomotor performance, and subjective fatigue level of long-haul airline pilots

11.00-12.30 ORAL SESSION II: Epidemiology - prospective studies

Nätti J, Anttila T, Oinas T, Hartikainen A (FI)

Retrospective cohort study of the risk of impaired glucose tolerance among shift workers: findings from the industry-based shift workers’ health study, Japan

Evaluation of breast cancer risk in relation to night shift work in a case-control study in a Spanish population

Inpatient care rehabilitation, differences in-between shift and day workers, in a pulp and paper industry during 1971-2006
Karlsson B, Knutsson A (SE)

Studying night work and disease in the million women study
Wang X, Travis R C, Beral V; on behalf of the Million Women Study Collaborators (UK)

12.30-13.30 Lunch

RESTAURANT
13.30-15.30 ORAL SESSION III: Fatigue modeling and risk management

Chairs: Folkard S (UK) and Rosekind M (US)

Introduction to fatigue modeling and applying sleep science to proposed rulemaking for commercial aviation: maximum duty periods and predicted fatigue (30 minutes)

van Dongen H (US)

Findings made when implementing direct fatigue model usage at a European flag carrier

Klemets T, Hellerström D (SE)

The validity of the risk index for the evaluation of shift systems – a study based on aggregated data

Greubel J, Nachreiner F (DE)

Work patterns of freight drivers and recovery from shift work

Robertson K, Spencer M, Hesketh S (UK)

Using the international standard for risk management (iso31000) to develop the next generation of fatigue risk management systems


Discussion (30 minutes)

Rosekind M (US)

13.30 – 15.30 ORAL SESSION IV: Shift work and health

Chairs: Lennernäs M (SE) and Knutsson A (SE)

The effect of the continuous long working hours on workers’ fatigue and sleepness

Okubo Y, Furusawa M, Kuroda R, Umekage T (JP)

Shift work, stress and CVD risk factors


Work hours and cortisol variation from non-working to working days

Marchand A, Durand P, Lupien S (CA)

Ischemic heart disease mortality of shift and day workers in a chemical company

Yong M, Messerer P, Nasterlack M, Lang S (DE)
Symposium Program (cont.)

QTc interval and cardiovascular changes by type of shiftwork organization
Meloni M, Setzu D, Del Rio A, Cocco P (IT)

Curvilinear relations between working time and psychic well-being
Tanskanen J, Anttila T, Nätti J, Oinas T (FI)

Do offshore rotations work onshore? Employee experiences from a large plant onshore
Holte K A, Merkus S, Kjestveit K, Hansen K (NO)

The association between 8 hour shift work and sick leave: a systematic literature review
Merkus S, van Drongelen A, Holte Kari A, Labriola M, Lund T, van der Beek A (NO, NL, DK)

15.30-16.00 Coffee break

16.00-18.00 ORAL SESSION V: Field studies of mechanisms
Chairs: Bjorvatn B (NO) and Wirtz A (US)

Age-friendly shift systems – do they exist?
Härmä M, Viitasalo K, Puttonen S (FI)

The effects of lifetime exposure to shift work on fitness for duty and health in the police force of a federal state of the Federal Republic of Germany
Wirtz A, Nachreiner F (US, DE)

Assessing shiftwork influences on heart disease risk through salivary biomarkers and subclinical heart disease indicators: a pilot study
Wong I S, Ostry A S, Demers P A, Davies H W (CA)

Genetic background of burnout and sensitivity to shift work
Sulkava S, Ollila H, Salomaa V, Perola M, Partonen T, Ahola K, Paunio T (FI)

Cortisol, reaction time test and health among offshore shift workers
Harris A, Waage S, Ursin H, Hansen Å M, Bjorvatn B, Eriksen H R (NO, DK)

Arterial stiffness in shift-workers: effect of shift-work
Sleep quality evaluation and symptoms related to the syndrome of obstructive sleep apnea in rotating shifts system workers in the mining of the high andes of Chile

Cantuarias J, Araya G (CL)

16.00-18.00 WORKSHOP I: Evaluating the Utilization and Impact of Shiftwork Research on Improving Public Safety and Worker Health

Chair: Popkin S (US)

Popkin S (US)
Coplen M (US)
Snow J Z (US)
Discussion: Dawson D (AU)

18.30-19.30 POSTER SESSION I

Drinks will be served before the poster session at the conference café

19.30 Dinner

20.30 Meeting for WTS-board members

Wednesday 29 June, 2011

8.30-9.00 Keynote II

Work and recovery: implications for working time arrangements

Sonnentag S (DE)

9.00-10.30 SPECIAL SESSION I: Flexible work hours and work-life conflict

Chairs: Bohle P (AU) and Garde A-H (DK)
### Symposium Program (cont.)

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<td><strong>Garde A-H (DK)</strong></td>
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<tr>
<td>9.30-10.00</td>
<td>Self-rostering solves problems for some and creates new ones for others</td>
<td><strong>Ingre M (SE)</strong></td>
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<td>10.00-10.30</td>
<td>Measuring and evaluating the effects of flexibility and variability of working hours</td>
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<td>10.30-11.00</td>
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<td>11.00-11.30</td>
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<td>11.00-11.30</td>
<td>If it makes you happy: hours control, work-life balance and workers’ mental health</td>
<td><strong>Golden L (US)</strong></td>
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<td>11.30-12.30</td>
<td><strong>ORAL SESSION VI: Social factors</strong></td>
<td><strong>Chairs: Hornberger S (DE) and Camerino D (IT)</strong></td>
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<td>11.30-12.30</td>
<td>Social networks, working time and sleep</td>
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<td>11.30-12.30</td>
<td>Influence of work ability index on shiftwork work and work/family conflict</td>
<td><strong>Camerino D, Sandri M, Conway P M (IT)</strong></td>
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<td>11.30-12.30</td>
<td>Trends of flexible working time in Finland</td>
<td><strong>Kandolin I, Härmä M (FI)</strong></td>
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<td>11.30-12.30</td>
<td>The impact of the interaction of work schedule control and hours irregularity on work-life conflict amongst older, full-time workers</td>
<td><strong>Mc Namara M, Bohle P, Quinlan M (AU)</strong></td>
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<td>11.00-12.30</td>
<td><strong>ORAL SESSION VII: Who works shift?</strong></td>
<td><strong>Chairs: Iskra-Golec I (PL) and Friedhelm Nachreiner (DE)</strong></td>
<td><strong>SEGELMAKAREN</strong></td>
</tr>
<tr>
<td>11.00-12.30</td>
<td>Trends of working time in Europe</td>
<td><strong>Oinas T, Anttila T, Hartikainen A, Nättili J (FI)</strong></td>
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The web of Penelope: an historical and cultural journey in women’s night work
Riva M A, Costa G, Cesana G (IT)

Selection into shift and night work
Axelsson J, Kecklund G, Gustavsson P, Rudman A (SE)

A longitudinal study of personality factors predicting fatigue, sleepiness, anxiety and depression among rotating shift working nurses

Characteristics of shift work drop-outs at Tata Steele in the Netherlands
van den ven H, Klein Hesselink J, Bültmann U, Goudswaard A, de Loose M, Brouwer S, van der Klink J (NL)

Overtime addiction – an organisational syndrom
Gärtner J, Boonstra-Hörwein K, Werner M (AT)

12.30-13.30 Lunch

13.30-15.30 SPECIAL SESSION II: Time conflicts and interventions amongst students
Chairs: Fischer F (BR) and Radosevic-Vidacek B (HR)

13.30-14.00 Paying off the sleep debt in adolescents attending school in shifts: are there similarities with shiftworkers?
Vidacek B (HR)

14.00-14.30 Sleep, media exposure and working hours among adolescents: cultural aspects
Tzischinsky O (IL)

14.30-15.00 Sleep and training effectiveness in adolescents and young adults in military training programs
Lewis Miller N (US)

15.00-15.30 Indoor exposure to bright light during evening hours increases alertness among college students
Teixeira L (BR)

13.30-15.30 TRAINEE SESSION
Chair: Axelsson J (SE)
Symposium Program (cont.)

13.30-14.00  Publication and hot topics in working time research  
Kecklund G (SE)

14.00-14.30  Research design and statistics in working time research  
Ingre M (SE)

14.30-15.00  How to make a career outside academia  
Fletcher A (AU)

14.30-15.00  How to make a career outside academia  
Fletcher A (AU)

15.00-15.30  How to make an academic career  
Wirtz A (US)

15.30-17.00  Break (including coffee)  
CONFERENCE  
CAFÉ

17.00-23.00  Gala dinner at the Vasa Museum (the bus leaves at 17.00h)

23.00  Disco (at the hotel)

Thursday 30 June, 2011

8.30-9.00  Keynote III  
REPSLAGAREN

Night work and cancer: an update of recent research  
Schernhammer E (US)

9.00-10.30  SPECIAL SESSION III: Night work and cancer  
REPSLAGAREN  
Chairs: Knutsson A (SE) and Costa G (IT)

9.00-9.30  Night work and breast cancer: possible mechanisms  
Stevens R (US)

9.30-10.00  Night work and breast cancer risk among Norwegian nurses  
Lie J-A (NO)

10.00-10.30  Night work and breast cancer estrogen receptor status  
Rabstein S (DE)
10.30-11.00  
*Coffee break*  

11.00-12.30  
**WORKSHOP II: Work hour implementations**  
*Chairs: Gärtner J (AT) and Di Milia L (AU)*  
- Koen S (US)
- Bohle P (AU)
- Dawson D (AU)
- Madsen J (DK)
- Takahashi M (JP)
- Kantermann T (UK)
- Hornberger S (DE)

11.00-12.30  
**ORAL SESSION VIII: Interventions**  
*Chairs: Fletcher A (AU) and Nabe-Nielsen K (DK)*  
- Three year evaluation after implementation of a new 5-shifts roster at Tata Steel in The Netherlands  
  *Klein Hesselink J, de Looze M, Kooij-de Bode H, Goudswaard A (NL)*
- Effects on sleep by melatonin treatment in adolescents with DSPS  
  *Nagai R, Lowden A, Åkerstedt T, Eckerberg B (SE)*
- Night-work and inflammatory markers  
  *Safaiyan A, Sadeghniat K, Aminian O, Sharifi F (IE)*
- Employee priorities when scheduling own shifts  
- Developing and coordinating cyclic individual rosters with the shift plan assistant 7.0  
  *Boonstra-Hörwein K, Gärtner J, Werner M, Wahl S (AT)*

12.30-13.30  
*Lunch*

13.30-15.30  
**SPECIAL SESSION IV: Light and individual differences in shift workers**  
*Chairs: Moreno C (BR) and Boivin D (CA)*

13.30-14.00  
We are all shift-workers  
*Ronneberg T (DE)*

14.00-14.30  
Sleep duration, genetics and metabolism  
*Allebrandt K (DE)*
Symposium Program (cont.)

14.30-15.00 Individual variability in the photic adjustment to a typical work schedules
Boivin D (CA)

15.00-15.30 Adapting to shiftwork in conditions of extreme daylength
Arendt J (UK)

15.30-16.00 Coffee break

16.00-18.00 ORAL SESSION IX: Sleep, sleepiness and life style
Chairs: Di Milia L (AU) and Lombardi D (US)

Subjective and objective measures of sleepiness during three different shift work schedules in offshore oil rig workers
Waage S, Harris A, Pallesen S, Saksvik I B, Moen B E, Bjorvatn B (NO)

Does impression management impact the relationship between morningness and self rated alertness?
Di Milia L, Muller H (AU)

Job stress and serum leptin concentration among lorry drivers
Moreno C, Marqueze E, Ulhoa M (BR)

Sleep duration, body mass and the risk of a work-related injury: Results from the US National Health Interview Survey (2004-2009)
Lombardi D A, Wirtz A, Willets J L, Folkard S (US, FR, UK)

Shift work disorder - operationalization, prevalence and related health outcome in nurses
Flo E, Pallesen S, Magerøy N, Moen B E, Grønli J, Nordhus I H, Bjorvatn B (NO)

Alcohol consumption in shiftworkers compared to dayworkers
Dorrian J, Skinner N, Pisaniello S (AU)

Performance protection: individual fatigue management strategies in coastal pilots
Ferguson SA, Weng O, Thomas M JW (AU)

16.00-18.00 ORAL SESSION X: Light at night
Chairs: Lowden A (SE) and Skene D (UK)
The complexities of studying light at night (30 minutes)

Skene DJ (UK)

Dynamic light in quickly rotating shiftwork, effects on alertness and sleep

Lowden A, Åkerstedt T (SE)

Light at night exposure and melatonin levels among Canadian rotating shift nurses

Grundy A, Tranmer J, Richardson H, Graham C H, Aronson K J (CA)

Rotating night shift work and 6-sulfatoxymelatonin in nurses and midwives


Discussion

Arendt J (UK)

19.00-20.00 POSTER SESSION II

POSTER AREA

Drinks will be served before the poster session at the conference café

20.00 Dinner

RESTAURANT

Friday 1 July, 2011

8.30-10.30 SPECIAL SESSION V: Shiftwork, metabolic and gastrointestinal diseases

Repslagaren

Chairs: Härmä M (Fi) and Tucker P (UK)

8.30-9.00 Shiftwork and the risk of ischemic heart disease

Kolstad H (DK)

9.00-9.30 Shiftwork and cardiovascular disease: pathways from circadian stress to morbidity

Puttonen S (Fi)

9.30-10.00 Gastrointestinal disorders among shift workers
Symposium Program (cont.)

Knutsson A (SE)

10.00-10.30 Shiftwork, metabolic dysfunction and impaired cognition
Tucker P (UK)

10.30-11.00 Coffee break

11.00-12.30 ORAL SESSION XI: Experimental studies on sleep/sleepiness
Chairs: Ferguson S (AU) and Axelsson J (SE)

Protein identification and changed protein levels after sleep deprivation
Bjørkum A A, Gurvin I, Nygård I, Aarhus Braseth T, Kristensen T R, Kluge B, Rosendahl K (NO)

The effects of a self-selected nap opportunity during simulated night shift work
Davy J, Goebel M (ZA)

Effects of cumulative sleep restriction and recovery sleep on self-perceptions of functional capacity

Mood and alertness differences in response to sleep deprivation and recovery sleep in experienced shift workers compared to matched non-shift workers
Wehrens S M T, Hampton S M, Kerkhofs M, Skene D J (UK, BE)

Measuring individual vulnerability to sleep loss – the CHICa scale
Oginska H, Fafrowicz M, Marek T, Mojsa-Kaja J (PL)

Putting the forbidden zone to bed: the influence of circadian phase on sleep probability when sleep is restricted

12.30-13.30 Business meeting (open for all WTS members)

13.30 Farewell lunch
PAPER TITLES

Tuesday 28 June, 2011

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Practical ways to improve working time arrangements in occupational health practice
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What do we know about recovery from schedules that involve sleep restriction
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Simulated driving under prior wake, circadian, sleep dose and sleep debt influences
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Driving home after night shift – the effect of road treatments
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The characteristics of sleepiness during real driving at night – a study of driving performance, physiology and subjective experience

Fatigued train drivers, but at what time?
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The impact of layover length on the sleep, psychomotor performance, and subjective fatigue level of long-haul airline pilots
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Retrospective cohort study of the risk of impaired glucose tolerance among shift workers: findings from the industry-based shift workers’ health study, Japan
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Evaluation of breast cancer risk in relation to night shift work in a case-control study in a Spanish population

Inpatient care rehabilitation, differences in-between shift and day workers, in a pulp and paper industry during 1971-2006
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Studying night work and disease in the million women study
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Introduction to fatigue modeling and applying sleep science to proposed rulemaking for commercial aviation: maximum duty periods and predicted fatigue (30 minutes)
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Findings made when implementing direct fatigue model usage at a European flag carrier
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The validity of the risk index for the evaluation of shift systems – a study based on aggregated data
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Work patterns of freight drivers and recovery from shift work
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Using the international standard for risk management (iso31000) to develop the next generation of fatigue risk management systems
Fletcher A, Johansson P, Baulk S, Mitchell P, Yates R (AU) .............................................................................. pg. 50

ORAL SESSION IV: Shift work and health

The effect of the continuous long working hours on workers’ fatigue and sleepness
Okubo Y, Furusawa M, Kuroda R, Umekage T (JP) ......................................................................................... pg. 52

Shift work, stress and CVD risk factors
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Work hours and cortisol variation from non-working to working days  
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Abstracts
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&
Keynote I
Practical ways to improve working time arrangements in occupational health practice

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Objective
Multifaceted work redesign is usually called for in improving working time arrangements. This is also the case in improving work systems with excessive work hours or irregular shifts. The diverse employment situations, often with increasingly complex risks and stress at work, need to be taken into account. It is useful to know practical types of joint change approaches dealing with job content and work schedules.

Methods
Recent experiences in participatory approaches for work redesign including the improvement of working time arrangements are reviewed. They include participatory programmes for improving small workplaces, stress prevention activities in various settings and workplace interventions in health care and nursing work. Views of health care workers about required improvements are also surveyed. Common types of improvements planned and achieved by these programmes are examined to know the effectiveness of the practical support measures used to facilitate them.

Results
The reviewed approaches usually address multiple areas of work redesign activities. The usefulness of addressing various ergonomics-related factors, work organization and psychosocial factors is confirmed also through the views of workers. Practical ways to improve working time arrangements include (i) aiming at good practices for improving work methods, physical environment as well as work organization and schedules, (ii) focusing on locally feasible improvements learned from these good practices, and (iii) utilizing action-oriented toolkits reflecting local needs. In most these programmes, attention is drawn to the stepwise progress commonly achieved by taking advantage of these features. Among the toolkits used, the use of action checklists and associated guides or checkpoints listing practical improvement options in multiple aspects has been particularly effective. This can help managers and workers look into available options in both working time and ergonomics-related aspects of work methods, including psychosocial factors. Providing feedback of step-by-step achievements through serial steps involving managers and workers is found important.

Conclusion
These recent experiences point to the effectiveness of participatory steps addressing the joint change of job content and work schedules. The use of interactive toolkits based on local good practices can lead to concrete results. It is recommended to spread participatory steps focusing on broad feasible improvements in this context.

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What do we know about recovery from schedules that involve sleep restriction?

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Time use studies in the USA suggest that compensated work time is the major reason people curtail their sleep duration on work days but extend their sleep duration on days off work. Therefore the duration of the recovery period between work days is central to the issue of cumulative fatigue from repeated works days. A related critical (but unstudied) issue is the length of the recovery period required between multi-day work periods. I consider this issue to be the question of the "recycle" rate of people across multi-day work periods. Unfortunately, recovery of neurobehavioral functions from chronic curtailment of sleep duration as a result of compensated work hours and commute time is not well understood, leaving open the question of how recovery is best achieved. Historically, governments have set limits on work hours in many professions, but paid less attention to time off work for recovery. When recovery time is considered in regulations, it is often allowed to be minimized in duration, based on the untested assumption that workers will utilize the majority of the off-work time for sleep. But this assumption is questionable when the time for recovery sleep is too brief, which is especially likely to be the case during consecutive nights of restricted sleep duration due to work times. It appears that people may not spend all or even a majority of the time sleeping during recovery periods—instead, they do a host of other essential activities. Moreover, much of what is assumed scientifically about recovery from sleep restriction has been based on total sleep deprivation experiments, where robust intensification NREM EEG slow wave activity is the normative recovery response. However both animal and human studies of recovery from chronic sleep restriction do not mimic the results from studies of recovery from acute total sleep loss. Experiments in healthy humans have confirmed that chronic reduction of sleep can result in waking neurobehavioral deficits that become progressively worse over days, and that the rate of accumulation of waking deficits is a function of the magnitude of the sleep restriction. Thus, chronic sleep restriction appears to induce slow changes (spanning days to weeks) in neural processes mediating alertness, attention and other aspects of cognitive functioning. How these slow (cumulative) changes are reversed via the dynamics of recovery sleep is unknown, but a recent experiment suggests extended recovery sleep duration is critical to this liquidation. If this is the case, time off work during and following consecutive days of chronic sleep restriction must receive more scrutiny for the extent to which it provides adequate recovery sleep duration and thereby reverses cumulative neurobehavioral effects in workers.

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ORAL SESSION I:

Transport
Comparing subjective and objective sleepiness between the two most common maritime watch systems: a bridge simulator study

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Objective
Fatigue at sea – where ships have to be operated on a 24/7 basis – is a safety issue needing thorough investigation. This study compares subjective and objective sleepiness in the two most common maritime watch systems: 4h on/8h off versus 6h on/6h off. In addition, the effects of a single free watch disturbance, simulating a condition of low demanding overtime, is compared between the two systems.

Method
49 bridge officers (aged 31 ± 9 years; 47 men; on average 9 years experience) participated; 30 in a 4h on/8h off system and the remaining 19 in a 6h on/6h off system on a comparable voyage in the North Sea and the English Channel. The free watch disturbance was counterbalanced and took place between day 2 and 3 or day 5 and 6. Participants rated their sleepiness every hour (Karolinska Sleepiness Scale, KSS) and carried out a 5-minute psychomotor vigilance test (PVT) at the start and the end of every watch. In addition, a work diary was filled in at the end of every watch.

Results
Average sleepiness ratings differed most profoundly between the shift systems during day shifts (F (4,317) = 20.13, p < 0.0001). But also during night shifts sleepiness was higher in the 6/6 system compared to the 4/8 (F (4, 308) = 3.11, p < 0.05). In both shift systems, average sleepiness was significantly higher after the free watch disturbance compared to the control condition in the other half of the week.

Average PVT reaction times did not differ between the shift systems during the night shifts, and was only moderately increased during the day shifts in the 6/6 system compared to the 4/8 (F (4, 318) = 2.79, p < 0.05). All watch teams in both systems showed an increased reaction time after the free watch disturbance, except the 4/8 team working 00:00-04:00. The average number of PVT lapses was higher in the 6/6 system, both during the day shifts (F (3, 318) = 4.18, p < 0.005) and during the night shifts (F (4, 309) = 4.07, p < 0.005). The free watch disturbance did not result in an increased number of lapses, except in the 4/8 team working 04:00-08:00.

In addition, many work diary components indicate much higher levels of sleepiness in the 6/6 system.

Conclusion
This study reveals that subjective and objective sleepiness are higher in a 6h on/6h off watch system compared to a 4h on/8h off. The differences are most profound during daytime. In addition, we showed that overtime work increases sleepiness in both watch systems.

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Simulated driving under prior wake, circadian, sleep dose and sleep debt influences

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Objectives
Driver fatigue is a causal factor in at least 7–10% of all fatal road accidents. Previous studies indicate that driving performance is affected by time of the day, prior wake, and sleep dose. However, in most studies these factors have been confounded. The aim of the current study was to examine the independent effect of each of these three factors on simulated driving performance.

Method
The driving performance of forty one male participants (22.6+/-3.5 years) was assessed using 3 speed and 3 lane position measures on a 10min simulated driving task. These driving measures were mean speed/lane position, speed/lane deviation and speed/lane violation (time spent above the speed limit and crash count). Participants were tested at 2.5 hour intervals after waking across 7 x 28 hour days under either a normal (1:2) restricted (1:3), or severely restricted (1:5) sleep wake ratio. Each driving session was assigned to a level of prior wake, circadian phase based on core body temperature and sleep dose.

Results
The results were analysed by a separate mixed model ANOVA for each driving measure. There was a significant main effect of sleep dose on all six measures, so that each measure depicted worst performance under sleep restriction. Circadian phase also significantly influenced all driving measures except for mean lane position, so that driving performance was worst near the circadian nadir. A significant effect of prior wake was observed for the measures of lane deviation, lane violations and speed violations, with driving performance worse with increased hours of prior wake. In addition to these factors, a significant day effect and a day/sleep dose interaction was observed for each measure. This main effect and interaction reflected worsening performance over the course of the experiment for the two sleep restriction conditions.

Conclusions
The main effects found support the trends suggested in previous literature. Performance at the circadian nadir corresponds to the prevalence of early morning accidents, while extending wakefulness beyond the habitual 16h and restricting sleep below the habitual 8h both decreases driving performance greatly. Of most interest was the identification of a day / sleep restriction interaction term. It is likely that this is the result of a building sleep debt over successive nights of sleep restriction, with a greater effect under more severe sleep restriction.

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Driving home after night shift - the effect of road treatments

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Objective
Work hours and sleep habits are important factors when it comes to occupational safety and it is known that night driving increases crash risk with 5 – 6 times. Night shift work is also associated with increased reported sleepiness and especially driving home after a night shift is a critical situation which at least doubles the risk of a crash. Sleepiness and fatigue have been estimated to account for 10 to 30 per cent of all crashes. Finding countermeasures against sleepy driving is therefore of great importance. The aim of this study was to describe the effects of sleep loss on behavioural and subjective indicators of sleepiness on roads with different road width and with different rumble strip placements. Particular attention was paid to a centre-of-lane rumble strip, and to possible erratic driving behaviour when hitting a rumble strip.

Method
In total 9 regular shift workers drove during the morning hours after a full night shift and after a full night sleep. The order was balanced. The experiment was conducted in a moving base driving simulator on rural roads with a road width of 6.5 and 9 meters. Two different rumble strips placements were compared, the conventional sides-of-lane positions and the alternative centre-of-lane position.

Results
Out of the 1636 rumble strip hits that occurred during the study, no indications of erratic driving behaviour associated with the jolt caused by making contact with the rumble strip could be found. Comparing the alert condition with the sleep deprived condition, both the standard deviation of lateral position (SDLP) and the Karolinska Sleepiness Scale (KSS) increased for sleepy drivers. For the two road widths, the drivers drove closer to the centre line on the 6.5-meter road. The KSS and the SDLP increased with time on task. There were less rumble strip hits in the alert condition compared to the sleepy condition. However, the individual differences in number of hits were large. The effect of centre-of-the-lane position did not differ from the sides-of-lane position, but the effect of time on task was stronger for the centre-of-lane position compared to sides-of-lane position.

Conclusion
Rumble strips placed in the centre of the lane demonstrate the same positive effects on sleepy driving as conventional.

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The characteristics of sleepiness during real driving at night
– a study of driving performance, physiology and subjective experience

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Objective
Driver sleepiness has been identified by the National Transportation Safety Board (US) as one of the most important factors contributing to road crashes. One potential source of driver sleepiness is shift-work. In fact, it has been shown that driving in the early morning after working a night shift results in decreased driving performance and increased subjectively reported sleepiness, compared to driving in the morning after a normal night of sleep. Most studies of sleepy driving have been carried out in driving simulators and the few studies of driver sleepiness carried out in actual motor vehicles on public roads have only considered a few indicators (measures) of sleepiness. The purpose of the present study has been to characterize driver sleepiness using several indicators during real driving on public roads.

Method
Nine females and nine males participated in the study. The participants drove an instrumented car in normal traffic along a 55 km long route on a nine meter wide rural highway in southern Sweden. The daytime driving sessions started at 09:00 or 11:00 and the nighttime driving sessions at 01:00 or 03:00 (balanced design). The car was equipped with a video-based lane tracker which recorded the position of the vehicle relative to the driving lane boundaries. The electroencephalography (EEG) and electrooculography (EOG) of the participants were recorded while driving. Subjective ratings of sleepiness, performed by the participants every five minutes while driving, were also collected.

Results
Subjective sleepiness and EEG-based indicators of sleepiness were found to increase significantly during nighttime driving. Pronounced effects were also found for blink duration and vehicle speed during nighttime driving: Blink duration increased, whereas vehicle speed decreased. Also, time on task showed significant effects for subjective sleepiness, blink duration, lane position and speed. Sleepiness was highest towards the end of the night drive. Night driving was also found to cause a leftward shift in lateral position towards the center of the road. Taken together, these findings provide new insights into the effects of sleepiness during night driving.

Conclusion
Driving a car on a public road during nighttime was found to be associated with high levels of subjective, electrophysiological, and behavioral signs of sleepiness.

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Fatigued train drivers, but at what time?

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Objectives
Shiftworkers commonly report feelings of fatigue and sleepiness during working times. The increased fatigue felt by shift-workers may be result of sleep loss and/or time of the day that work periods occur. The aim of the current study was to investigate the effect of shift starting time on subjective fatigue in a group of train drivers.

Methods
Thirty-eight train drivers (49.6±8.6 years) working a Fly-In, Fly-Out roster at a rural mine site in Australia participated in this study. Drivers worked for 14 consecutive days, consisting of seven dayshifts followed by seven nightshifts, with a 24-h changeover between day and nightshifts. Following nightshifts, drivers flew home for either seven or 14 days off before returning to the mine site. Shifts were 12h in duration with dayshifts beginning every hour between 01:00h and 12:00h and nightshifts beginning every hour between 13:00h and 00:00h. In this way shifts started across every hour of the 24-h day. Participants self-reported their level of fatigue at the start and end of each shift using the 7-point Samn-Perelli Fatigue Checklist. To assess for time of day effects on fatigue ratings, shift start times were binned into 6-h intervals (e.g. 2200-0400, 0400-1000 etc.). Separate linear mixed models were used to analyse time of day effects on pre- and post-shift fatigue ratings.

Results
For both pre- and post-shift fatigue levels a significant main effect of shift start time was found. At the start of shifts beginning between 22:00-04:00 higher feelings of fatigue were found than for shifts starting between 10:00-16:00 (p<0.05). Shifts starting between 04:00-10:00 were associated with lower fatigue at the end of the shift than those that started at 10:00-16:00 (p<0.05). Fatigue ratings at the start and end of shifts that beginning between 22:00-04:00 were the same. For all other start times, fatigue was rated higher at the end of the shift.

Conclusions
Whilst it is not unexpected that shifts starting during the night time are associated with a higher feeling of fatigue, at the end of the shift, the feeling of fatigue is still the same level. Over several consecutive shifts feelings of fatigue may increase, which may be indicative of increased performance impairments. The current study shows how fatigue experienced by train drivers changes significantly depending on what time of day shifts start.

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The impact of layover length on the sleep, psychomotor performance, and subjective fatigue level of long-haul airline pilots

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Objective
Long-haul airline pilots often experience elevated levels of fatigue due to extended work hours and circadian misalignment of sleep and wake periods. During international patterns of duty, pilots are typically given 1-3 days off between flights to recover and prepare (i.e. layover). Anecdotally, some pilots prefer long layovers because it maximises the time available for recovery and preparation, but others prefer short layovers because it minimises the amount of phase shifting from ‘home time’. The aim of this study was to examine the impact of layover length on the sleep, psychomotor performance, and subjective fatigue of long-haul pilots.

Method
Participants were 19 male pilots (10 Captains, 9 First Officers) working for an international airline. Data were collected during multiple-day international patterns of duty. The patterns involved (i) four days at home prior to the commencement of duty, (ii) an eastward flight of 14h across seven time zones, (ii) a layover of either 39h (i.e. short, n=9) or 62h (i.e. long, n=10), (iii) a return westward flight of 14h, and (iv) four days off at home. Sleep was recorded using a self-report sleep diary and a wrist activity monitor, psychomotor performance was assessed using the psychomotor vigilance task for a personal digital assistant (PalmPVT), and subjective fatigue was measured using the Samn-Perelli Fatigue Checklist.

Results
ANOVA were used to determine the effects of layover length (short, long) and phase of pattern (i.e. pre-pattern, layover, post-pattern) on the dependent variables (i.e. sleep/day, response speed, subjective fatigue level). Compared to the pre-pattern phase: (i) participants with a short layover obtained more sleep/day during the layover, and participants with a long layover obtained more sleep/day during the post-pattern phase, (ii) participants with a short layover had slower response speeds on the second layover day and during the post-pattern phase, and participants with a long layover had slower response speeds on the first layover day, and (iii) participants with a short layover were more fatigued during the layover and during the post-pattern phase, and participants with a long layover were more fatigued during the first layover day.

Conclusion
A short layover (i.e. 39h) during a long-haul flight pattern does not substantially disrupt pilots’ sleep, but it may result in elevated levels of fatigue during and after the pattern. If short layovers are used, pilots should have a minimum of four days off to recover prior to their next pattern of duty.

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ORAL SESSION II:
Epidemiology – prospective studies
Night work, gender and mortality: Prospective study among Finnish employees in 1984-2008

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Objective
There is a considerable amount of evidence showing that night work is associated with increased morbidity. However, only few studies have focused its relation to mortality. This study investigates the relationship between the type of working time arrangement (weekly night work/other working time arrangement) and mortality among men and women.

Methods
The data consisted of representative Working conditions survey on Finnish employees in 1984 (2286 men, 2216 women), which was merged with register-based follow-up data in Statistics Finland covering years 1985–2008. In the 1984 survey employees were asked if they worked during the night (23-06) and if so, how often. In this study we compare employees who worked weekly at night (140 men and 97 women) to other employees. The relative risk of death was examined by conducting Cox proportional hazards analyses for the night workers and other employees. The results were adjusted to background (age, level of education, family situation, and county), health (longstanding illness, pain symptoms, smoking status, and psychological symptoms) and work-related factors (physical and psychological demands, demands for learning at work, and perceived job insecurity).

Results
Female employees working weekly at night had a 2.26-fold higher risk of mortality than other female employees (95% CI 1.21–4.21) after adjusted for background, health- and work-related factors. Among men no significant association was observed.

Conclusions
The present study indicated that female night workers had higher risk of mortality than other female employees. Additional research on other potential factors and mechanisms behind the factors linking night work to mortality is needed.
Retrospective Cohort Study of the Risk of Impaired Glucose Tolerance among Shift Workers: Findings from the Industry-based Shift Workers’ Health Study, Japan

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Objectives
The authors investigated the effect of shift working on the risk of impaired glucose tolerance using a retrospective cohort study established based on a health care database system belonging to a manufacturing corporation in Japan.

Methods
Subjects for this study were 6,413 male employees (5,608 daytime workers and 512 three shift workers and 293 two shift workers; mean age 23.6 years) whose work schedules were consistent during the follow-up period (Population 1). Both of the shift systems consisted of four teams working continuous rotating shifts; counterclockwise for three shift system. Hemoglobin A1c ≥5.9% at annual health checkups, which was a former cut off criteria of Hemoglobin A1c by Japan Diabetes Society, was used to define cases. The Cox proportional hazards model was used to estimate the risk, with adjustments for age, smoking, alcohol drinking, and leisure time physical activity and body mass index (BMI). Additional analysis was performed among 2,319 workers whose body mass index was between 20.0 kg/m² and 25.0 kg/m² during the follow up period (Population 2). The subjects were further restricted to those whose BMI was between 20.0 kg/m² and 25.0 kg/m² and change in BMI was less than 2.0 kg/m² during the follow up period (Population 3).

Results
During the 23.2 years of follow up (63,601 person-years in total; mean follow-up period = 9.9 years), 1,209 incidences of impaired glucose tolerance were detected. Cox proportional-hazards model analysis revealed significantly increased risk among both three shift workers (relative risk (RR) =1.69, 95% Confidence interval (CI): 1.41, 2.03, p<0.001) and two shift workers (RR=2.48, 95%CI: 2.05, 3.00, p<0.001). Additional analysis revealed further elevated risk among both of shift workers; for three shift work RR=2.10 (1.43, 3.09) at population 2 and RR=3.29 (1.87, 5.79) at population 3, and two shift workers RR=2.91 (1.90, 4.44) at population 2 and RR=4.13 (2.23, 7.67) at population 3. This finding was due to decreased incident rates by the restrictions among day workers; and incidence rates among shift workers revealed almost no change by the restrictions regarding BMI.

Conclusion
Risk of impaired glucose tolerance among male shift workers was statistically demonstrated. Compared to three shift workers, two shift workers revealed relatively higher risk. The relative risk was more apparent among workers without obesity and whose BMI was stable during the follow up.

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Evaluation of breast cancer risk in relation to night shift work in a case-control study in a Spanish population

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Objectives
Recent epidemiologic and animal data indicate that night work may increase the risk for breast cancer. We evaluated breast cancer risk in female night shift workers in a population based case-control study in Spain, the MultiCase-Control study (MCC-Spain).

Methods
Incident breast cancer cases (n=795) and population controls (n=849) randomly selected from population rosters were enrolled in 7 regions of Spain. Lifetime occupational history including questions on shift work and information on reproductive, lifestyle and other factors were assessed by face-to-face interviews. We estimated the risk of different shift profiles using unconditional logistic regression models adjusting for a wide range of potential confounders.

Results
Among 1644 female subjects, 30 (14 controls and 16 cases) had ever worked in permanent night shift and 101 (49 controls and 52 cases) in rotating night shift for ≥ 1 year. Night shift workers were younger (median 50 years) than day workers (median 57 years) and more often premenopausal (51.9% versus vs 33.5%). Compared to subjects never worked on shift, night workers were more frequently obese (13.0% vs 12.6%), nulliparous (28.2% vs 20.2%) and more frequent users of oral contraceptives (51.9% vs 44.8%). Having ever worked in permanent night work was associated with an increased risk for breast cancer compared to permanent day workers after adjusting for confounders (Odds Ratio (OR) 1.36 (95% Confidence Interval (CI) 0.62-2.97). This increase was not statistically significant. The corresponding OR for rotating night shift workers was 1.17 (95%CI 0.71-1.92). Women who worked in permanent or rotating night shift for more than 10 years during lifetime, the median of the distribution among controls, had an OR of 1.43 (95%CI 0.79-2.57). Among these women, the risk was higher in postmenopausal women (OR=1.67, 95%CI 0.79-3.53) as compared to premenopausal women (OR=1.09, 95%CI 0.41-2.89).

Conclusions
A moderate increased risk for breast cancer was associated with having ever worked in night shift, but results were not statistically significant. Risk estimates tended to increase among workers with long-term exposure to night work and in postmenopausal women, but these estimates were based on small numbers due to the low prevalence of night shift in this population. The study is ongoing and, at the symposium, results will be presented for a much larger population sample.

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Inpatient care rehabilitation, differences in-between shift and day workers, in a pulp and paper industry during 1971-2006

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Objectives
In the scientific literature much more is known about short coming complaints and diseases, due to shiftwork, than diseases demanding inpatient rehabilitation at a hospital. Some common diseases have been shown, to be more frequent among shift workers than dayworkers, at least worsened by shiftwork. As shiftwork tends to be more common in the world, it’s of increasing interest to learn from the past what has been a great problem.

Methods
The study population is defined as employed people of workers in a pulp and paper industry between 1949-1998, in the North of Sweden (labelled the Modo cohort). The sample has been working either as shift workers (2337 individuals) for a various number of years, or as day workers (3052 individuals) during the observed period. The information is based on internal company register data. The outcome diagnosis are studied between 1971-2006, and these data are gathered from the Swedish National Patient Register. Three ICD versions (8-10) have been merged for diagnosis comparisons . Ordinary stable diagnosis as stroke, adiposities are compared between day- and shiftworkes. More severe psychiatric labeled diseases are studied, such as psychosis, depressions, anxiety, and compulsory disorders as well as ulcus ventriculi and ulcerous colitis are also compared. The statistics used is the direct standardized relative rate (SRR) method.

Results
One of the most striking outcomes in this material is that the relative risk to have an inpatient care rehabilitation for a shift worker (21 individuals) due to suicide attempt is 1.82 (CI 0.94-3.54), compared to a day worker (15 individuals).

Occurrence of labeled traffic accidents in the Patient Register is not increased (RR =0.84 (CI 0.62-1.16), shift 63 individuals and day 97 individuals).

Conclusions
Different diagnosis have been more or less common, in-between the day and shift-working populations in the same company and geographical area during the studied period of 35 years (1971-2006). This material give a hint of which diagnosis that could be of interest when to follow up, if there are differences for those being exposed for shiftwork or not!

References

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Objective
Shift work, including night work, has been proposed as a risk factor for a number of diseases. To assess the association between shift work and risk of cancer and ischemic heart disease, we are collecting data on night work and other related exposures in a large UK prospective study. Using data from a random sample of participants, we have compared various characteristics of women who have and have not worked at night.

Methods
1.3 million women aged 50-69 years old were recruited into the Million Women Study from 1996-2000 in England and Scotland. The 2009 follow-up questionnaire included questions on a number of factors including previous night work, chronotype, usual sleep duration, and sleep difficulties. Women also provided data on a range of other personal characteristics.

Results
Preliminary results show that 13% of participants have ever worked at night and these women differ from those who have never worked at night with respect to a number of major risk factors for breast cancer and ischemic heart disease, in that they are more likely to have a higher body mass index ($P=0.0004$), to smoke ($P=0.003$), and to come from lower socioeconomic groups ($P=0.03$).

Conclusions
Women who have worked at night have different characteristics than those who have not, which would put them at increased risk of breast cancer and ischemic heart disease.

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ORAL SESSION III:
Fatigue modeling and risk management
Applying sleep science to proposed rulemaking for commercial aviation: maximum duty periods and predicted fatigue

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Objectives
In 2009, the Federal Aviation Administration (FAA) in the U.S.A. chartered a Flight and Duty Time Limitations and Rest Requirements Aviation Rulemaking Committee (ARC) to develop new regulatory guidelines for flight and duty times in commercial aviation. In 2010, after considering the ARC’s recommendations, the FAA published its Flightcrew Member Flight and Rest Requirements Notice of Proposed Rulemaking (NPRM). The NPRM contains FAA-proposed maximum flight duty period (MFDP) limits, stratified by time of day for duty start and by number of flight segments per duty period. The FAA-proposed limits deviated in several cases from the ARC’s original recommendations. We used mathematical modeling of fatigue to predict whether these deviations are overly restrictive.

Methods
We extended a published mathematical model of fatigue (McCauley et al., 2009) to account for workload from multiple take-offs and landings, so as to make it suitable for predicting fatigue across the FAA’s proposed MFDPs stratified by time of day and number of flight segments. Representative flight schedules matching the FAA’s proposed MFDPs were constructed, and where divergent, the same was done with the ARC’s original recommended MFDPs. In these divergent cases, the mathematical model was applied to the two schedules, and maximum fatigue associated with them was compared.

Results
Out of 42 total cases where the FAA’s proposal deviated from the ARC’s recommendations, in 11 cases predicted maximum fatigue was no greater in the ARC’s proposed MFDPs than in the FAA’s more restrictive proposed MFDPs. These 11 cases involved morning duty start times (05:00-10:00), which meant that duty end times approached the wake maintenance zone in the early evening when circadian pressure for wakefulness would naturally mitigate fatigue.

Conclusion
Using predictive modeling based on sleep science, we provided plausible, quantitative evidence that some FAA-proposed limitations on MFDPs in multi-segment flight operations may be overly restrictive with respect to fatigue. This information was helpful as part of commercial aviation’s official commenting on the FAA’s NPRM, which was well received by the FAA as constructive feedback. The mathematical model on which our assessments were based will undergo validation in a high-fidelity flight simulator study to further support the findings.

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Findings made when implementing direct fatigue model usage at a european flag carrier
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Objective
A rule-only approach to manage crew fatigue in airline operation has proved difficult to implement without sacrificing crew efficiency unnecessarily. The objective in this work has been to pave and articulate a way for an operator to employ a more direct use of sleep and performance science that can be gradually introduced into real operation, fully in concert with regulatory requirement development and operational needs.

Method
The methodology employed in this work has been largely hypothesis-testing of a six-step approach applied carefully to an airline operator for gradually transitioning into a fatigue-model-supported operation. Tools used in this work are of a traditional nature for collecting data reflecting crew fatigue, but are based on new technology (iPhones) which significantly reduces costs and lead time. Analysis of solution scenarios was made using industry strength software for production of crew schedules and establishing a cost/benefit correlation. The model used, the Boeing Alertness Model, has been applied as a proxy for crew fatigue in these scenarios.

Results
The correlation of collected data to model output was found to be satisfactory in that the most problematic flights and situations were picked up by the model with good precision. The individual variation was found to be higher for less problematic situations. The usage of model output to guide the solutions throughout the scheduling process was found to be partly constrained by the flight schedule and connection limitations imposed on the solution space. The results were nonetheless found to be beneficiary where scheduling alternatives existed and long term benefits, applying anticipated future relaxations, were identified and quantified both for crew efficiency and for crew alertness levels.

Conclusion
The six-step approach, even though not fully completed in this work, was found to be a viable way of gradually transitioning into the use of very advanced fatigue risk management functionality. Work remains in verifying the last step where relaxations are activated and the effect and model correlation is reassessed regularly. We also concluded that the long term business and safety benefit potential is significant and should inspire other airlines to follow. However, unlocking the full potential will not be particularly easy as new and better aligned rules might need to replace or complement some of the old ones. Using alertness incentives only, without rules, will only guarantee a better average situation which could instill confusion at times among crew. This merits further investigation.

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The validity of the risk index for the evaluation of shift systems – a study based on aggregated data

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Objectives

The risk index (RI) is a tool designed to assess the relative accident risk associated with different shift schedules (1). Studies on the validity of the RI on the basis of individual data found only moderate associations between the RI and the risk of occupational accidents (2). As risk assessments are usually based on aggregated but not individual data, we studied the validity of the RI once again using aggregated data.

Methods

An existing data set (n=337) containing working hours over 4 weeks as well as a question on occupational accidents was used to calculate the RI maxima (RImax) and means (RImean). The participants were grouped according to different RI-values resulting either from different distribution parameters (e.g. percentiles) or the RI-values of proto-typical shift schedules.

Results

Apart from minor variations the results for the different models of aggregating the data are highly consistent. For nearly all models analyzed the accident rate increases exponentially with an increasing RI (group score). For example, a model based on cut off scores for four groups according to the RI for different shift schedules (day system/ long-backward rotating discontinuous shift system with 8hr shifts/ short-forward rotating continuous shift system with occasional 12hr shifts) leads to an 6.50 (RImax) or 5.12 (RImean) times higher accident rate for the highest compared to the lowest risk group. χ²-analyses yielded significant associations both for the RImax (χ²(3) = 10.46, p < .05) and the RImean (χ²(3) = 15.38, p < .01). The proportions of variance explained for the exponential model in this case are 91 % (RImax) and 64 % (RImean).

Conclusions

The results for the grouped data indicate a considerably higher validity of the RI than the analyses based on individual data. In general the association is rather independent of the method for aggregating the data. For further analyses a new data base is desirable, containing more cases as well as more precise information concerning the accidents.

References


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Work patterns of freight drivers and recovery from shift work

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Objectives
The aim of the study was to investigate patterns of work and factors influencing fatigue among freight train drivers.

Methods
A sleep and duty diary was sent to freight train drivers working for four companies. They were asked to provide details of their work pattern, fatigue and sleep covering 28 work days. Questions about sleep included the timing, quality and duration of sleep before a shift and factors that disturbed sleep and/or restricted sleep. The questions relating to duty included details of the timing of the shift. Participants were asked to rate how much they felt that they had recovered from the last duty or run of duties. They were also asked to rate their level of fatigue at the start and end of the shift using the Samn-Perelli Scale (seven-point scale).

Results
In total 101 diaries were included in the analyses, which provided data from 2626 duty periods. Overall, shifts were evenly distributed across all times of day. However, there was considerable variability in the pattern of work, with respect to the timing and duration of the shifts. Over half of consecutive shifts within the same sequence involved a change of more than an hour in the start time. Almost an equal number of shifts involved an advance in the start time, compared with a delay. Subjective fatigue at the start of the shift was most highly correlated with the assessment of recovery from the previous run of duties. At the end of the shift, three main factors contributed to fatigue:
1. the time of day at the end of the shift;
2. the length of the shift;
3. the extent of the recovery, at the start of a shift, from the previous run of duties.

The extent of the recovery at the start of a sequence of shifts depended both on the duration of the previous time off (p<0.001) and on the timing of the first shift (p<0.01), as well as the interaction of these two factors (p<0.05). Within a sequence of shifts, the extent of recovery depended on the nature and timing of the shifts themselves.

Conclusions
Improvements can be made to the schedule design so that the day-to-day variability in shift timing is reduced and to provide adequate recovery periods between shift sequences.

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Using the International Standard for Risk Management (ISO31000) to develop the next generation of Fatigue Risk Management Systems

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Objectives
An International Standard for Risk Management has been developed and published for the first time (as ISO 31000, by the International Organization for Standardization). While not a precise blueprint for managing risk in a specific context the Standard can be used as a unifying framework and pathway for improving any Fatigue Risk Management System (FRMS). The objective of this paper was to detail how the ISO31000 elements and interactions between the elements can be used to inform a new generation of Fatigue Risk Management Systems.

Methods
By aligning the components of existing (and planned) FRMS examples with the Risk Management Standard it was possible to identify the strengths and limitations of existing approaches. Specific example FRMS elements assessed included hours of work assessments using bio-mathematical models, semi-structured interview techniques, risk assessment workshops with operational personnel, as well as checklists and human reliability analysis approaches. Tools applicable for risk evaluation, such as root cause analysis, decision trees and cost/benefit analysis, could therefore be included in systems with greater awareness of their strengths and limitations. While technical system elements are fundamental to any robust and sustainable system, non-technical requirements, such as having a healthy incident reporting culture, are also considered crucial and were explored. The possible interaction of elements was also assessed.

Results
While acknowledging the unique requirements of specific operations and environments, the evaluation and development exercise has led to a method for assessing and building an FRMS to address the critical requirements of the International Risk Management Standard. Effective systems will address each of the required system elements, from risk identification through to risk treatment, as well as communication and consultation, and monitoring and review. Protective systems will include objective/quantitative and subjective/qualitative data, be proactive and reactive, fulfil strategic requirements while supporting appropriate tactical responses, etc.

Conclusions
The practical application of a Fatigue Risk Management framework in operational environments, with a focus on preventing unacceptable fatigue-related impairment, can be substantially improved using the International Standard for Risk Management.

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ORAL SESSION IV:
Shift work and health
The effect of the continuous long working hours on workers’ fatigue and sleepness

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Objectives
The prevention of the fatigue and health problems caused by the long working hours is one of the serious themes in occupational health activities. Actually, the long working hours among software programmers and engineers engaged in research and development are commonly observed. However the effects of the continuous long working hours on the physical and mental symptoms are still unclear. Thus we retrospectively investigated the relationships of the continuous long working hours and physical or sleep related symptoms.

Methods
The subjects were records of medical interviews for male engineers in electronic equipment manufacturing company from October 2004 to December 2009. Total number of workers was 1,845. The record of medical interview including the physical and sleep related symptoms, sleeping hours, burnout score and the result of interview. The monthly working hours was collected every month for each worker. The periods of the continuous long working hours were classified into 4 categories; 1-3 months, 4-6 months, 7-12 months and more than 13months. If the monthly extra working hours were less than 40 hours, we defined that the continuous long working hours was interrupted. We adopted the logistic regression model and general linear model in analyses. A p-value of <0.05 was considered to be statistically significant.

Results
The odds ratios of physical symptom and fatigue were significantly elevated with prolonging of the period of the long working hours. The odds ratios of onset insomnia, maintenance insomnia and termination insomnia were significantly elevated in the group of 4-6 month. The length of sleeping hours on weekday significantly shortened in the groups of 4-6 months, 7-12 months and more than 13months. And that on holiday was prolonged in the group of more than 13 months. The burnout score was significantly elevated in the groups of 4-6 months, 7-12 months and more than 13months.

Conclusion
The risks of sleep disturbance or insomnia was elevated in workers who were engaged in the long working hours for more than 3 months. However significant differences were not observed among the groups of 4-6 months, 7-12 months and more than 13months. It might be caused by healthy worker effect. On the other side, the risks of physical symptoms, burnout and fatigue were elevated with prolonging of the period of the long working hours. We consider that the results of this study might be available for the evaluation and the management of the long working hours.

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Objective
Shift-work is highly prevalent in industrialized societies especially night shift. The constant need to re-adapt to a different sleep-wake cycle causes stress and health problems. The psychosocial stress of work in Iran has not been focus of many scientific studies. The search for mechanisms through which work stress elicits harmful effects on health constitutes a major challenge in occupational research. This study was performed to determine health aspects of stressful work characteristics and its interaction with shift working on cardiovascular disease risk factors.

Method
A prospective cohort study has been run among 227 employees of Isfahan Polyacryl Company, Iran since 2009. This presentation covers phase I and phase II of the project which measured biological factors, and stress twice, at the baseline and at the first follow up (in 6 months apart). Background questionnaire consists of individual factors (age, marital status, number of children, and education level), and employment history. Work status defined in three categories according to two phases of the study (day-day, shift-shift, and those who changed day to shift or vice versa). Siegrist’s Effort-Reward Imbalance questionnaire was translated and standardized in Farsi to measure job stress; three composite scales assess efforts, rewards, and overcommitments. Stress score at each sub-scale treated as an interval variable. The higher the score, the higher the job stress. Medical examinations including assessments of height, weight, blood pressure and lipid profile through blood test were evaluated before completing the questionnaires. Generalised Linear Model was used as data analysis approach using SPSS16.

Result
Study population was totally male whom 83.7% of them were married. There was significant different mean change in low density protein (LDL) between two phases of study among different categories of shift workers (p=0.047). Mean level of LDL increased by 2.06 mg/dl in day-day workers; 0.73 mg/dl in workers with shift change; decreased by 2.09 mg/dl in shift-shift workers. Overcommitement had significant effect in LDL change over time (p=0.011) and the effect was different between different work status groups (interaction effect p=0.007)

Conclusion
Day workers exposed to stressful conditions more than shift workers, perhaps, because of the organisation. Stress management intervention is advisable to improve work place stressful conditions in this company.

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Work hours and cortisol variation from non-working to working days

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Objectives

The cortisol hormone, a biomarker of stress, has been associated with physical and mental health outcomes. The number of work hours per week was also associated with health outcomes, but the specific contribution of work hours in explaining the variation in cortisol concentration in individuals is still a matter of debate. This study aims at modelling the relationship between the number of work hours per week and cortisol variation by comparing non-working day to working day ones.

Methods

In an ongoing research project, saliva samples were collected on 132 workers employed in 13 workplaces in Canada. Consenting workers provided 5 saliva samples a day (awaking, 30 minutes after awaking, 2 pm, 4 pm, bedtime) repeated 3 times (Saturday, Tuesday, Thursday) over a week, to provide measures at work and non-work times and settings. Salivary cortisol concentrations were determined by radioimmunoassay. The limit of detection of the assay is 0.01dl, and all samples were assayed in duplicates. 28% of workers were females, mean age was 41.9 (SD=9.49; range 20-63) and average work hours per week was 40.05 (SD=6.52, ranged 8-68). Multilevel regression models were estimated with saliva samples at level-1, days at level-2 and workers at level-3.

Results

Controlling for gender and age, results show significant cortisol concentration variations between sample, day and worker levels. Cortisol increases from awakening to 30 minutes after awakening and then declines sharply. Cortisol increases linearly from non-working day to work days and work hours interact with days. As the number of work hours per week increases, so do the cortisol concentrations for each working day, but a greater number of work hours per week is related to a cortisol decline during a non-working day. Work hours are not interacting with morning, diurnal and bedtime cortisol concentrations. Gender and age had neither main effects nor interaction effects. Further analysis show no significant cortisol variations between workplaces.

Conclusion

Overall, these preliminary results suggest that work hours act as a stressor associated with variations in cortisol concentrations. Cortisol increases in work days and even more when the number of work hours increases. However, a non-working day promotes a decline in cortisol concentration for employees working longer work hours. Non-working days seem to contribute more to stress reduction in workers experiencing longer work hours. Cortisol concentrations may thus mediate the relationship between work hours and subsequent physical and mental health problems.

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Ischemic heart disease mortality of shift and day workers in a chemical company

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Objectives
Shiftwork is widely considered to be a health risk. In 2007, IARC has categorized shiftwork with chronodisruption as a probable human carcinogen. In a previous study we observed no elevated risk of total mortality in BASF shift workers followed up until the end of 2006. The present study aimed to investigate non-cancer mortality, especially ischemic heart disease (IHD) caused mortality, relative to shiftwork.

Methods
The cohort consisted of 14,038 male shift and 17,105 male day workers from manufacturing plants, who were employed for at least one year between 1995 and 2006. Vital status was followed from 2000 to 2009. Cause-specific mortality was obtained from death certificates. Total mortality as well as mortality specific to diagnoses from I20.0 to I25.9 according to ICD version 10 was compared between the two working time systems. To estimate the impact of shift work on the outcome of interest, Cox proportional hazard model was used to adjust for potential confounders such as age, smoking, alcohol consumption, occupational status and prevalence of diseases at baseline. The effect estimates were then given as hazard ratio (HR) with 95% confidence interval (CI).

Results
Between 2000 and 2009, a total of 1,062 deaths occurred in the cohort; 513 (3.6%) in shift and 549 (3.2%) in day workers, with an average age at death of 59 (SD = 9) and 57 (SD = 9) years, respectively. In 889 (84%) cases, the cause of death was available from death certificates. The missing causes were evenly distributed between the two working time systems. A total of 122 IHD caused deaths, 55 (0.39%) in the shift- and 67 (0.39%) in the day cohorts were found. After adjustment for age at entry and occupational status, no increased risk for total mortality (HR = 0.96; 95%CI: 0.84 -1.09) as well as for IHD caused mortality was apparent in shift workers (HR = 0.77; 95% CI: 0.52 - 1.14). The risk estimates were robust after further adjustment for more factors in all models and consistently tended to be in favour of shift workers.

Conclusion
The present analysis extends and confirms our previous finding of no excess risk of mortality associated with work in the shift system employed at BASF. More specifically, there is also no indication of an increased risk of IHD caused mortality.

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QTc interval and cardiovascular changes by type of shiftwork organization

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Objectives
Some authors have observed a significant increase in the average value of QTc in shift workers in respect to day workers. However those conclusions were based on very low average QTc values in day workers (338 msec) and normal QTc values in shift workers (396 msec). The aim of our work is to assess the prevalence of electrocardiographic changes, such as conduction disorders, alterations in the repolarization phase and QT interval prolongation which result from a difficult adaptation to shift work, as early warning of cardiovascular disorders.

Methods
We examined 60 subjects working fixed hours (from 08:00 to 14:00, plus two afternoons per week 15:00-18:00) and 65 shift workers, 32 of whom were soldiers on duty 24 hours a day followed by 96 hours rest (4 days), and 33 employees in a logistics and cargo handling company, working 8 hour shifts (3 x 8) on 21 shifts per week. All study subjects were males. For each subject, the following parameters were considered: age (years); height (m), weight (kg) and body mass index (BMI = weight in kg / height in meters squared); heart rate; QT interval corrected for frequency (msec); ECG morphology.

Results
The results show no significant differences in QTc in relation to the type of work shift or the presence of morphological abnormalities of ECG. However, the 8 hours continuous cycle shift workers, unlike the daily workers and the 24 hours shifts workers (followed by 4 days of rest), showed a QTc prolongation with increasing age. Borderline QTc values (>430 msec, < 450 msec) were detected in 7/60 daytime workers (prevalence rate = 0.12), 4/32 h24 shift workers (prevalence rate = 0.12), and 2/33 h8 shift workers (prevalence rate = 0.06); abnormal QTc values (> 450 msec) were detected in 1/60 daytime workers (prevalence rate = 0.02), 2/32 h24 shift workers (prevalence rate = 0.06), and 1/33 h8 shift workers (prevalence rate = 0.03).

Conclusions
Our results confirm the absence of significant changes in the QTc interval in relation to the type of work shift or the presence of ECG anomalies.

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Curve-linear relations between working time and psychic well-being

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Objectives
The aim of the paper is to examine curve-linear relations between working time and psychic well-being. Earlier studies show that long working week, unsocial working hours and high working time tempo have usually negative and working time autonomy positive effects on employees’ well-being. Empirical analyses are based on representative Finnish working conditions survey (2008, N=4305 employees). We separate four dimensions of working time: the number of hours worked (duration), when (timing) the hours are worked, work-time intensity (tempo), and the degree of time autonomy individuals have over their working hours (time autonomy). Psychic well-being is defined as work-related psychic symptoms.

Methods
Curvilinear relationships between working time dimensions and psychic symptoms were explored by constructing generalized additive models (GAMs). GAM estimates non-parametric smoothing splines which allow flexible relations between predictors and response. Statistic significance of curvilinearity and interactions between working time dimensions were tested using generalized likelihood ratio test and examining AIC and GCV –scores.

Results
Main effects of duration, tempo and time autonomy were found to be statistically significant predictors of psychic symptoms. Duration and tempo were in curvilinear relation to psychic symptoms whereas time autonomy had a weak negative linear relation to psychic symptoms. Duration and tempo increased psychic symptoms linearly only after a threshold value (duration: 40 hours a week, tempo: 3 in a scale 1-5). Besides of main effects some interesting interactions were found too. Those who had daytime job or shift work with night shifts, the tempo of work did not compound psychic symptoms until tempo exceeded an average level. Shift workers without night shifts had positive linear relation between tempo and psychic symptoms. Duration was not related to psychic symptoms except for shift workers with night shifts and not until working hours exceeded approximately 40 hours. After 40 work hours per week psychic symptoms increased linearly relating to duration. Time autonomy had significant effect on psychic symptoms only for daytime workers who had fewer psychic symptoms if time autonomy was above average level. Tempo and time autonomy had an interesting interaction effect. Employees with high work tempo and with high time autonomy had most psychic symptoms.

Conclusions
Exploring relationship between well-being and dimensions of working time using non-parametric smoothing splines revealed non-linear connections and threshold values which would have been unnoticed in classic linear regression analysis.

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Do offshore rotations work onshore? Employee experiences from a large plant onshore


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Objectives
Working 2 weeks offshore followed by a 4 week period of restoration at home is a common working schedule on the Norwegian Shelf. Variations of this schedule are spilling over to onshore installations within the petroleum industry, as well as to other sectors, such as the health care sector. Compared to offshore workers, these schedules could give onshore workers different recovery possibilities due to more interference with family life during the working period. The main objective is to explore the “need for recovery” in a group of workers at an onshore petroleum plant in Northern Norway after being introduced to a new offshore like schedule.

Methods
The study combines a qualitative questionnaire of all employees working this specific schedule (n=120, response rate = 79%) and qualitative interviews of employees (n= 10) and their partners (n=5). Recovery was assessed by the need for recovery scale. In the interviews, they were asked for factors related to organization of work, work-family balance and health issues, like sleep, adjustment from night work and recovery. The ability to interview the partner allowed for an “external perspective” on how they adapted and adjusted to this schedule. Logistic regression was performed for need for recovery and content analysis was performed for the interview data.

Results
Differences in need for recovery did not vary by the employees’ family situation (cohabitation, number of children, occupational status of the partner). There was, however, an increased risk for reporting high need for recovery among those who belonged to the local community around the plant (OR (95% CI) = 7.7 (2.2-26.5)) compared to those that had moved to the community after employment at the plant. The interviews revealed that employees with local ties may have higher demands for taking extra shifts in their long free period, compared to those commuting and those who had moved due to employment at the plant. The two latter groups were more absent from the local community during their free periods than those with local ties.

Conclusions
The analysis shows that recovery does not seem to be influenced by the family situation. Having local ties seem to be more important for need for recovery. The interviews indicated that workload related to taking extra shifts in the free-period, were not evenly distributed between the employees, laying higher demands on those with local ties the most.

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The association between 8 hour shift work and sick leave: a systematic literature review

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Objectives
Shift work is associated with negative health effects in the long run, amongst which are cardiovascular disease, type II diabetes (Hulst, 2003), gastro-intestinal problems (Knutsson & Boggild, 2010) and cancer (Pesch et al., 2010). The association between shift work and taking of sick leave is, however, not known. This systematic literature review was undertaken to investigate whether a relationship exists between 8 hour shift work and sick leave.

Methods
A systematic literature review was conducted on observational studies. Medline, CINAHL, PsychINFO, EMBASE, Web of Science, and NIOSHTIC-2 were searched from inception to 21st of April 2010 for peer reviewed articles. Two reviewers independently selected relevant articles. Inclusion criteria were 1) 8 hour shift work that included evening or night shifts, 2) sick leave due to illness, not due to accidents. Methodological quality was appraised and data extraction was performed independently by two reviewers. When summarising the results a levels of evidence synthesis was done.

Results
Nine articles met the inclusion criteria: one case-control study and eight cross-sectional studies. Methodological quality was assessed as high for one case-control study and three cross-sectional studies, and low for the remaining five cross-sectional studies. Two high quality studies focused on 2-shift workers, while three of the high quality studies focused on 3-shift workers.

Of the high quality studies, the case-control and one cross-sectional study found a crude increased risk for 2-shift workers to take sick leave, while the cross-sectional study also found an adjusted increased risk. When considering 3-shift schedules: the high quality case-control study found no crude association between working rotating shifts and sick leave. One cross-sectional high quality study found an age-adjusted lower percentage of sick leave spells for male 3-shift workers, but no association for percentage lost days. One high quality study found a crude and adjusted higher proportion of male 3-shift workers taking sick leave and higher accumulated number of sick leave days.

Conclusions
Based on the levels of evidence, it is concluded that there is some evidence for a crude increased risk for 2-shift workers to take sick leave, and some evidence for no crude association between working in 3-shifts and taking of sick leave. More high quality studies are needed to explore the adjusted associations.

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ORAL SESSION V:
Field studies of mechanisms
Age-friendly shift systems – do they exist?

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Objective
Based on the age-related changes in circadian rhythms, we have hypothesized that rapidly rotating shift systems would fit better to older workers. Based on an intervention study (1), a very rapidly forward rotating shift system (Respect) became popular among elderly shift workers in an aircraft technical maintenance unit. The aim of the current study was to study the interaction of age with shift systems of different shift characteristics in relation to perceived sleep-wakefulness, mood and inflammation biomarkers.

Methods
Based on an on-going cohort study of Finnair (participation rate 56%), a questionnaire and inflammation biomarkers (blood leucocytes and high sensitive CRP) were analysed among 895 male workers in two age groups (-44 or 45+) . The shift systems analysed were 1-shift work(day work, n=473), 2-shift work (n=176), backward rotating 3-shift work (n=45), rapidly forward rotating 3-shift work (Respect, n=69) and “flexible” 3-shift work” (n=102). All shift workers were working in the same technical maintenance unit.

Results
Based on chi-square tests, opinions on the positive or negative effects of the used shift systems on different aspects of perceived well-being depended strongly on shift system. Respect workers, and especially the older ones, reported less negative effects than the other 3-shift workers. Based on a 2-way analysis of variance, age had significant interactions with the used shift systems showing that higher age was related with more frequent insomnia, fatigue and blood leucocytes in all other shift systems except in Respect where older workers had fewer symptoms and lower leucosyte levels than younger workers. Sleep need increased according to age in all 3-shift systems but decreased in 1- and 2-shift systems. In general, the backward rotating group reported the highest amount of sleep complaints and blood inflammation markers but also the 2-shift workers reported a higher amount of sleep complaints than the day workers.

Conclusions
Shift work and age were both associated with sleep and mood but the age trends were dependent on shift rotation. The data thus does indicate that a rapidly forward rotating shift system is a more age-friendly one compared to two other 3-shift systems with different rotation.

References
The effects of lifetime exposure to shift work on fitness for duty and health in the police force of a federal state of the Federal Republic of Germany

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Objective
Ageing and demographic changes in Europe and other global economies have led to an ongoing discussion about delaying the legal retirement age in several countries. Despite possible ergonomic problems there has been no consideration of the health and safety consequences for the workforce of extending the lifetime working time while keeping the occupational stress, e.g. shift work or work in specific assignments, at the same or even an increasing level. The aim of the present study was therefore, to evaluate the effects of a delay in the retirement age, and thereby increases in lifetime shift work exposure, on fitness for duty in the police force of one federal state of Germany.

Method
Objective data of all police officers in that federal state were collected retrospectively over a 5-year period (2004-2008, n≈10,000 each year), providing factual information about the age, number of years in shift work, retirement age, and the medical diagnosis of “no more fit for duty” and/or “restricted fitness for duty” by a physician, based on a standard diagnostic procedure. Using survival analysis, the risk of restrictions in fitness for duty (dependent variable) depending on the number of years in shift work (independent variable) was estimated.

Results
The proportion of older police officers and of those with a restricted fitness for duty increased steadily over the study period. Results of the survival analysis indicated that working up to 10 years in shift work did not impact fitness for duty. However, between 10 and 20 years, the risk, i.e. the accumulated hazard rate, for fitness impairments increased as a linear function of the exposure to shift work. Beyond about the 21st year in shift work, a disproportionately high increase in the risk (e.g. an exponential function) was observed.

Conclusion
This is the first study investigating the effects of lifetime shift work on health/fitness for duty based on objective data. Although not all information about possible confounding variables could be collected due to privacy restrictions (e.g. type of job), the results indicate that the number of years of exposure to shift work has an impact on fitness for duty among police officers. These findings are in agreement with previous results of an internet based pilot study in three German federal states, and show that occupational stress factors, e.g. shift work or special assignments, should be taken into account when discussing a possible delay of the retirement age.
Assessing Shiftwork influences on heart disease risk through salivary biomarkers and subclinical heart disease indicators: a pilot study


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Background and Objectives
This pilot study is one of the first to examine the effects of shiftwork on both the Autonomic Nervous System (ANS) and the Hypothalamic-Pituitary-Adrenal (HPA) Axis through salivary biomarkers (i.e. cortisol and alpha-amylase) and subclinical heart disease indicators (i.e. heart rate variability and endothelial functioning). Biomarkers indicated intermediate changes in neuroendocrine activity; and subclinical heart disease measures provided information about chronic exposure to shiftwork on cardiovascular health. Alpha-amylase and HRV represented ANS activity, and cortisol and endothelial functioning represented HPA activity. In the process of conducting this study we also tested the feasibility of a rigorous biological sampling protocol using non-invasive measurements in a busy workplace setting.

Methods
Paramedics in southwestern British Columbia (n = 21) self-collected 5 salivary samples per day over 3 consecutive days (1 rest day followed by 2 work days). Samples were analyzed for both -amylase and cortisol diurnal profiles and daily production. Heart rate variability (HRV) was logged over full 12 hour shifts on both work days with Polar® RS 800 Heart Rate monitors. Endothelial functioning was measured using fingertip peripheral arterial tonometry. Job stress was ascertained with a paramedic-specific survey and re-categorized into Karasek’s Job Strain Model “demand” and “control” categories. Descriptive survey results and biological measurements of rotating shiftworkers were compared to daytime only workers.

Results
Paramedics working rotating shifts reported higher mean job strain scores (i.e. high job demand, low job control) than those working daytime only. On rest and working days, ANS activity among rotating shiftworkers showed flatter median \( \chi \)-amylase diurnal slopes, reduced median \( \chi \)-amylase production and reduced mean HRV. In addition, HPA responses showed flatter median cortisol diurnal slopes, elevated median cortisol production and reduced median endothelial functioning. Over 90% of all expected samples were collected and fell within expected normal ranges.

Conclusion
Despite non-statistically significant difference in results in this small pilot study, the consistency of the overall trend in survey results and biological measures suggest that exposure to shift work may lead to dysregulation in neuroendocrine activity; and over the long-term, lead to early signs of heart disease. Rotating shiftwork may be associated with increased psychosocial stress and disruption of normal circadian functions during work days and may carry over effects onto rest days. High compliance among paramedics to complete the intensive protocol suggests this study will be feasible in a larger population.

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Objective
Burnout is a work-related stress syndrome which reflects both stressful environment and individual sensitivity to stress. It consists of the key dimension of exhaustion and symptoms of cynicism and diminished professional self-esteem that are often accompanied with sleep problems. Due to irregular working hour-related circadian stress, sleep problems are also frequent among shift workers. However, there are large inter-individual differences in response to shift work. Previous twin studies of burnout and stress reactivity suggest that genetic factors contribute to the familiar clustering of burnout. In this study we explored for the first time the genetic background of occupational burnout with a particular focus on emotional exhaustion under circadian stress.

Method
We analyzed the Finnish Health 2000 study cohort with genome-wide information about 1254 workers of which 166 were shift workers. Individual differences in genome were assessed using single nucleotide polymorphisms (SNPs) genotyped with Illumina 610k BeadChip. Burnout was assessed using exhaustion score of the Maslach Burnout Inventory (MBI). Correlations between the genetic markers and MBI were calculated for all workers and separately for shift workers. In addition interaction for genetic variants and shift work was studied.

Results
We found several SNPs that associated suggestively with the burnout scale (P < 10x10^-6) in all workers. One of the markers reached the p-value level of 5x10^-7 both in all workers and shift workers. Genetic factors that associated with burnout in the group of shift workers were mostly different from those in the group of workers with regular working time.

Conclusion
This is the first study to identify genetic variants that affect the risk for burnout. Our results provide support on some common variants affecting burnout. Taking account shift work environment can be important when studying genes that modify stress reactivity. Eventually, this study will provide potential candidate genes for studying the inter-individual variability in coping with shift work stress.
Cortisol, Reaction time test and Health among Offshore Shift Workers

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Objective
The stress hormone cortisol shows a pronounced endogenous diurnal rhythm, which is affected by the sleep/wake cycle, meals and activity. Shift work and especially night work disrupts the sleep/wake cycle and causes a desynchronization of the natural biological rhythms. Therefore, different shift schedules may have different impact on performance at work and health. The purpose was to study if health, reaction time, and the cortisol rhythm were negatively affected when a group of shift workers changed their work schedule from ordinary night-day shift (fixed shift) to “swing shift”.

Methods
19 healthy workers on a Norwegian oil rig participated in the study. They worked two weeks offshore followed by 4 weeks off work. The ordinary schedule consisted of 12-hour day shift and 12-hour night shift every other work period (14 days or nights = fixed-shift). “Swing shift” involved one week of night shift, followed by one week of day shift during the work period. All participants worked ordinary day-night shift when baseline data were collected (questionnaires, saliva cortisol, and reaction time during work). After collection of baseline data the workers changed their work schedule to “swing shift”, for every working period, and 9 months later the same data were collected.

Results
“Swing shift” did not give any negative health effects or any negative changes in reaction time during the day they shifted from night work to day work. Personnel adapted to night shift within a week regardless of schedule, but recovery from night shift took longer time. During swing shift the cortisol rhythm went back towards a normal rhythm in the second week, but it was not returned completely to normal values when they returned home for the 4 weeks off period. However, the cortisol rhythms were readapted to normal values after one week at home. For personnel returning home directly from 14 consecutive night shifts, cortisol adaptation was not complete after one week at home.

Conclusion
We found no increase in health complaints from swing shift or reaction time in the shift from night to day work. Recovery from night shift takes longer time.

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Arterial stiffness in shift-workers: effect of shift-work rotation

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Objectives
Clockwise rotation is considered the shift direction of choice as it is assumed to cause less sleep and circadian disruption. A review of the shift-work literature, however, showed that sleep problems occurred mainly after counterclockwise rotation, and cardiovascular problems mainly after clockwise rotation. For the first time in a shift-work field study, we measured arterial stiffness, a recognised marker for chronic stress and cardiovascular risk, in clockwise and counterclockwise shift-workers versus day workers, to test for differential chronic effects in different shift rotations.

Method
Male steel workers (n=77, 32 fast clockwise (CW), 30 slow counterclockwise (CC), 15 day workers (DW); mean age 42 ± 7.6 yrs) with at least 5 years experience in their current work schedule participated. All completed questionnaires covering demographics, health, stimulant consumption, and the Munich Chronotype Questionnaire for shift-workers. Shift-workers also self-rated how shift-work affects their sleep, social and work life. In 63 workers (26 CW, 23 CC, 14 DW) we measured arterial stiffness using pulse wave velocity, in addition to blood pressure and heart rate on one morning shift.

Results
There were no differences in chronotype, age, BMI, WHR, blood pressure (BP), heart rate, smoking and coffee consumption between shift-workers (n=62) and day workers (n=15). But, by contrast to day workers, shift-workers reported more stomach upsets (+44.8%, p=0.02), digestion problems (+42.3%, p=0.02), and weight fluctuations (+38%, p=0.01, Mann-Whitney U-Test). The two shift-work groups (CW, CC) did not differ in the ratings of how shift-work affects their sleep, social and work life. Arterial stiffness was highest in fast clockwise workers compared to slow counterclockwise workers and day workers (main effect p=0.209, ANCOVA adjusted for age and average blood pressure as covariates).

Conclusions
Irrespective of shift rotation, shift-workers reported more health problems than day workers. Arterial stiffness differed across the three groups (CW, CC, DW) and was highest in clockwise rotators, indicating an elevated chronic cardiovascular risk in this group. Future studies are warranted to re-consider rotation specific health effects. Funded by the DFG (German Research Foundation) and the 6th Framework Project EUCLOCK (018471).

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Sleep Quality Evaluation and symptoms related to the syndrome of obstructive sleep apnea in rotating shifts system workers in the mining of the high Andes of Chile

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Introduction
The mining operation in the high Andes Mountains in Chile runs on the basis of 12 hrs a day by 7 days on and 7 days off work in day/night sequence. This study complements a nine-year research in a mining site in the north of Chile and it evaluates, at different geographical altitudes, the behavior of sleep quality and symptoms related to the syndrome of obstructive sleep apnea (OSA) which is characterized by snoring, pauses in breathing, obesity and excessive daytime sleepiness.

Goal
To determine the sleep quality and symptoms related to OSA at different geographical altitude in high mountain shift system workers.

Methodology
210 employees are evaluated during day shift at different geographical altitude level: 0, 1650-1850 and 2500-3300 meters above sea level (asl), anthropometric variables are determined (Age, Weight (kg), Height (h), Body Mass Index (BMI), Neck Circumference (NC)), and noninvasive oximetry measurements (oxygen saturation night (SpO2) and Apnea Index calculation(AI 17hr)). In addition, it is assessed subjectively the sleep quality and daytime sleepiness by the implementation of Epworth and Spiegel’s survey. Anthropometric variables are compared statistically (BMI, NC) and oxygenation parameters (Spo2, AI) at different altitude, being the 0 asl workers considered as the control group.

Results
The anthropometric variables obtained at different heights are: 0 asl (BMI 27.1±3.7, NC 40.4±8.8), 1650/1850 asl (BMI 27.6±3.9, NC 38.7±3.6), 2500/3300 asl (BMI 27.8±2.7, NC 39.8±2.2). The nocturnal SpO2 average and AI behavior are: 0 asl (SpO2 95.6± 1.3, AI 5.9±8.7),1650/1850 asl (SpO2 93±1.6, AI 8.3±8.1), 2500/3300 asl (SpO2 91.7±1.7, AI 9.4±6.8). Comparing BMI, NC and AI, it is observed that groups with BMI> 25 and NC> 38 cm have a higher incidence of apnea, regardless of the geographic altitude where they work. (p <0.01)

Conclusions
These results indicate that approximately 13% of each group that was evaluated shows an AI (1/hr)> 10, indicating obesity and neck diameter as an aggravating factor in the quality of sleep and OSA (IA 1/hr ), which increases its severity by geographical altitude. We therefore generate two intervention strategies, the first aimed at controlling OSA (IA 1/hr) by experts evaluation to determine the origin (central or obstructive) and the second one, intended to control the workers nutritionally through an educational programme which is considered to be a key element so as to keep healthy habits.
POSTER SESSION I
Self-reported morbidity among health care night workers

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Objective

Recently, the number of companies and institutions working 24 hours has increased. In order to accommodate this demand large changes in work organization have occurred. Consequently, the risk of work-related illness has also increased. In this context, the aim of this study was to estimate the prevalence of self-reported morbidity. In addition, we analyzed associated factors with health care workers, according to the work shift.

Method

This study had a cross-sectional design with 272 health care workers from an emergency hospital. They were distributed among three types of shifts: 27.6% were day workers, 26.1% night workers and 46.3% worked both day and night (day or night work plus extra-time). They were interviewed in order to answer the following questionnaires: sociodemographics, work conditions, life style, fatigue (1) and Work Ability Index (WAI) (2). The association between the variables and morbidity was tested using Pearson’s Chi-square test ($\chi^2$) or Fisher’s Exact Test. Subsequent analysis was performed using multiple logistic regression with all independent variables with $p<0.20$, in decreasing order of statistical significance (stepwise forward technique) with the Odds Ratio being estimated with a confidence interval of 95%. The consistency of the models was verified by the Hosmer-Lemeshow Goodness-of-Fit Test.

Results

Mean age was 41.7±9.3 years and 82% were females. The number of hours per week was on average 63.6±13.3 hours. 69.5% were sedentary, 16% were smokers and 15.4% consumed alcohol, at least, once a week. The prevalence of self-reported morbidities was 85.7%. Out of those, 39.7% reported from 3 to 5 morbidities and 14% from 6 to 12 morbidities. The more prevalent diseases were: musculoskeletal diseases (37.1%); digestive tract diseases (28.7%) and mental disorders (28.3%). The final model showed that morbidity is associated with excessive workload ($p=0.01$); fatigue ($p=0.05$); night work ($p=0.01$). The morbidity’s odds ratio was 6 times higher for night workers than day workers, adjusted by age and gender.

Conclusion

Night work has a pronounced impact on morbidity out of many variables related to work conditions.

References


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Long working hours, gender and the risk of occupational injury in the U.S. working population

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Objective
Long working hours and short or disturbed sleep can lead to an accumulation in fatigue that may lead to increased injury risk for workers. The aim of the present study was to investigate the effect of the number of weekly working hours on the risk of a work-related injury, and to compare this risk across gender in a large and representative sample of the U.S. population.

Method
The U.S. National Health Interview Survey (NHIS) is a clustered, stratified cross-sectional sample representative of the U.S. population, collected every year. Pooled data of workers from the years 2004-2009 were analyzed (N = 213,506) using weighted multiple logistic regression modelling to estimate the risk of a self-reported occupational injury requiring medical attention across weekly working hours, controlling for age, sex, race/ethnicity, education, type of pay, industry, occupation, body mass index, self-reported usual nightly sleep duration, and measures of psychological distress. Injury risk was then estimated separately for men and women, to examine any differences in the impact of weekly working hours on injury risk. Other health-related variables, e.g. heart conditions, psychological distress, and the level of leisure-time physical activity, were also explored for modifying effects.

Results
The total 2004-2009 NHIS sample had a mean age of 40.7 years, and 47% of respondents were women. Overall, 0.7% of the workers reported an injury in the last 3 months, while working an average 40.2 hours per week. Among all workers, the unadjusted annualized injury rates/100 workers across weekly work hours were 1.92 (≤20 h), 2.81 (21–30 h), 2.42 (31–40 h), 3.35 (41–50 h), 3.48 (51–60 h), and 4.20 (>60 h). After controlling for all potential confounders, an increasing trend in risk with increasing hours/week was observed (OR: 1.01, 95% CI: 0.99-1.02). A significant effect of weekly working hours on injury risk could be found in women (OR: 1.01, 95 % CI: 1.00-1.03), however for men, although there was a slight increase, the effect was not significant (OR: 1.00, 95 % CI: 0.99-1.01). The level of psychological distress was significantly positively associated with injury risk in both sexes, whereas the inclusion of other health-related variables did not modify the estimated risk for weekly working hours.

Conclusion
The results indicate that injury risk is increased by about 1 % per additional hour worked/week. Long working hours increased injury risk in women slightly more than in men.

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Shift work and occupational accidents

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Introduction
Shift work has become an integral part of labor. Good evidence shows that night shift causes disruption of circadian rhythm which leads to mal-adaptation symptoms.

Objective
The aim of this study is to find the relation between type of occupation and accident rates, evaluate work related accidents among rotating shift workers and try to detect risk factors, among workers, leading to accidents.

Materials & Methods
Two hundred workers were selected; 100 were working on rotating shift system and another 100 on day shift (considered as control group). All these workers had experienced occupational accidents during the period 2008-2009.

Results & Discussion
The most common cause of accidents was striking against objects. There was a statistically significant difference between accidents and environmental conditions. Upper and lower limbs were the most commonly affected parts of the body by accidents, fractures and fissures constituted the common type of injuries. Most of the injuries occurred in the morning shift among the rotator group with the peak time between 9-11 a.m., but the severity of the injury increased during the night shift. There was a statistically significant difference between shift work and sleep disturbance among workers.

Conclusion
We recommend proper selection of workers for shift work, proper shift design, regular medical examinations and general measures of accident prevention especially house keeping.

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Long Working Hours among Women Workers in Manufacturing Industries

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Objective
The Philippines has established many export zones as a response to the Structural Adjustment Programs of the World Bank in order to stabilize its economy. The study aimed at looking into the problems caused by long working hours on health and safety of women workers in diverse manufacturing industries.

Methods
This was conducted in an export zone involving 31 industries and an interview with 613 women workers.

Results
The results showed that most of the respondents worked overtime (75.8%) compared to only 24.2% who did not. In fact, 33.9% and 33.2% of the workers in the garments and electronics said that they were required to do overtime work in order to finish their work, while about 27% for each industry said that they did it to receive additional pay for the overtime work. The workers aid in the interview that overtime is a prerogative of management. For hazard exposures, workers in the electronics industry reported the following hazard exposures: high temperature at 31%, intoxicating odor at 25.8%, cold temperature at 20.6%, noise at 19.7%, prolonged standing at 18.8% and then radiation at 18%. On the other hand, the workers in the garment industry reported the following hazards: high temperature at 28.4%, dust at 18%, intoxicating odors at 17.5% and then noise at 13.6%. The electronics industry was characterized by both cold and heat exposures because of the various processes done for the manufacture of electronics. Those that are very sensitive to heat are done in maintained cold temperatures. The work processes in both electronics and garment industries emit these hazardous elements and present adverse work conditions. The very nature of the technology and the process necessities the emission of these hazards. Results also showed that the illnesses occurred after the work shift (57.4% for garments and 58% for electronics), when work was perceived to be too much and when the workplace was too warm or hot.

Conclusion
The showed that working overtime was associated with occupational health issues among the women workers in manufacturing industries.

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Working Time and Occupational Health Issues of Workers and Supervisors in Export Processing Zones which Support Global Markets

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Objectives
This is an investigation of the working time schedule and occupational health issues of workers and supervisors in manufacturing industries in the Philippines that export their manufactures to other countries. These industries are owned by multinational companies.

Methods
Sample consisted of 23 establishments, 613 workers, and 47 supervisors for the survey, and 10 focus group discussions (FGDs) for workers, and 5 FGDs for supervisors. Workers and supervisors alike reported long working hours and job dissatisfaction.

Results
Survey showed that the most prevalent issues among workers were the need to upgrade skills (77.6%), pressure in intensified working time (60.4%), fast paced work (60.4%), repetitive work (63%), and that work entailed both physically tiring tasks (59.6%). Logistic regression showed that large industries were more exposed to hazardous environment and work time pressure compared to the medium industries. Workers tended to have low physical health when they were subjected to close monitoring, work time pressure, and lack of job autonomy. Focus group discussions showed that workers and supervisors were confronted with stress, overtime work, extended working time, night shift work, fast-paced work, the need to upgrade skills due to accommodation of information technology into the work production, and fatigue.

Conclusion
This study was able to show the nature of working time schedule in manufacturing work that support global markets.

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Day-to-day prediction of the day-to-day variation in subjective sleepiness – a 42 day longitudinal diary study

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Objectives
Most studies of the causes of sleepiness have either been laboratory studies with manipulations of sleep or circadian phase or field studies of shift workers or studies of treatment effects in sleep apnea patients. One interesting question is what the relation between sleep and sleepiness looks like in daily life with its, presumably, modest variations of sleepiness and sleep between days. Is there any perceivable variability between days and if it is, is it linked to prior sleep? This question would require a study of daily measures of sleep, sleepiness and other variables over a longer period of time. The present study addresses this problem.

Methods
50 participants kept a diary on sleep, sleepiness (ratings 8 times per day), days off, stress, and others. Sleep was also recorded with actigraphs. The data was analyzed using mixed model regression, using mean daily sleepiness (Karolinska Sleepiness Scale – KSS) as criterion. Predictors represented sleep, health symptoms and stress during the preceding night (and the night before that).

Results
The results show that the main predictor was prior sleep (Coefficient: -.166, SE: .012) and illness the preceding day (C= -.46±.046). Minor effects were seen for prior sleep quality, time of awakening, total sleep time (TST) two nights back. The coefficients refer to the 1-9 KSS, meaning that TST reduces KSS to the value of 0.166 KSS units per hour of sleep. Moving from 8h sleep to 5 hours would increase KSS 0.5 units. The constant was 7.85±0.33. The effect days off was significant in the univariate analysis but was accounted for by TST.

Conclusions
It was concluded that TST is the major determinant of next day levels of sleepiness, together with illness. Since the variation of TST across time was modest, the results probably underestimate the effects of larger reductions of sleep duration.

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Is night work the main problem with shift work and irregular work hours - a national representative sample of shift work problems

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Objectives
Night work dominates the view of shift work problems, but there are other characteristics that may be important. The problem areas of shift work is probably not a topic that should be investigated in a particular company since work load, environmental influences and local culture may affect the results and make generalizations difficult. The purpose of the present study was to obtain a national representative impression of the problems in shift work.

Methods
A series of questions was developed with a specific focus on easy responding and short duration. The questions were of the type: “do you have night work (at least 4h between 2400h and 0600h) at least once a month”. The response was yes/no, and a “no” was followed up with: “Is this a big problem?” – yes/no (see results for other questions). In addition, questions on sleep problems, fatigue, health, and risk were included. A sample of 8000 individuals in the regular labor market survey interviews was asked if they had work hours outside of day work. Those who responded “yes” were asked if they would respond to a short questionnaire on work hours. The response rate was approximately 70%.

Results
The results showed that the following work hour characteristics constituted a big problem among those exposed to them (% problem/%exposed): Short forward planning of work hours (36/21), Split duty (29/17), <11h off between shifts (26/34), ≥10h shifts (18/51), Day/night alternation (16/45), >10h overtime/week (16/12), Variable starting times (15/29), Night shifts (12/32), On Call (11/18), Morning work (10/31), Evening work (9/80), Period planning (7/47), Day work (2/84). Women had a much higher problem prevalence for split duty, <11h off, >10h overtime, and on call. White-collar workers had a higher prevalence for the same work hour characteristics than blue collar workers. In addition, 33% of the sample thought their work hours disturbed sleep, 46% thought they caused fatigue, 28% a health risk, and 17% an accident risk. Logistic regression analyses showed a close relationship between work hour problems and the health indicators.

Conclusions
It was concluded that short forward planning, split duty, and short time off between shifts were the main factors constituting work hour problems. Night work or morning work appears to be of less widespread importance. This needs to be considered in future research on shift work.

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Effect of work intensification and work extensification on women’s health in the globalised labour market

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Objectives
This study examined the association between labour intensification due to work intensification and work extensification and ill health in women in certain manufacturing work in the Philippines. Work intensification is defined as more workload for each worker, and work extensification as less deadtime or work rest and more overtime.

Methods
The sample was 23 establishments and 630 respondents. Workplace environment monitoring showed exposure to hazards such as noise, chemicals, poor ventilation, and poor illumination.

Results
The most prevalent illnesses and health problems were headache and coughs and colds. Results of focus group discussions showed adverse work conditions, hazard exposures among women workers, fast pace of work, close supervision, prevalent occupational illnesses, and management style that do not comply with the national work standards. The results indicate that the health issues of women workers depend on many factors, such as management and supervisory style, job autonomy, nature of task, and hazard exposures.

Conclusion
This study resulted in three major analytic observations on the engagement of women workers in the new global labour market, the role of information technologies (IT) in women’s work, and occupational illnesses caused by work intensification and work extensification.

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Work schedules and cortisol in saliva

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Objectives
Shift work has may cause cardiovascular disease and other health outcomes, hypothetically mediated through the stresses related to shift work and the accompanying changes in cortisol secretion. The aim of this study was to examine how salivary cortisol varied with different work schedules.

Methods
We examined cross-sectionally civil servants employed in a Danish county and municipality (hospitals, schools, day care nurseries etc.). 4489 (45%) answered a questionnaire including a question on their most common work schedule with response categories ‘day’, ‘evening’, ‘night’, and ‘changing work schedules during the week’. Saliva samples were collected in cotton tubes 30 minutes after awakening, and at 20:00 h. Sampling details and circumstances on the sampling day were also reported, including information on the time they started and ended work on that day. This work schedule was transformed to categories of ‘no work’, ‘day shift’, ‘evening shift’, and ‘night shift’. 4411 persons returned saliva samples. Concentration of cortisol in the morning and evening were analysed as dependent variables in multiple regression analyses with the common work schedule, the sampling day work schedule, exact sampling times (hh:mm), awakening time (hh:mm) and other potential confounders as covariates.

Results
There was no difference in cortisol concentration in saliva between day time workers (n=2717) and workers with changing work schedules during the week (n=1329). The unadjusted morning mean cortisol was lower among workers working evenings (n=99) and nights (n=39) than among day workers and changing schedule workers. The evening cortisol was higher for night schedule workers than for other work schedules. These differences became smaller after adjustment for awakening time and the work schedule on the day of saliva sampling, and disappeared after further adjustment for exact sampling times.

Conclusions
Working evening, night or changing time schedules was not associated with any significant changes in salivary cortisol after adjustment for exact sampling times. These results do not support that potential adverse health effects of other work schedules than fixed day work are mediated by a stress-related increase or decrease in cortisol secretion.

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Flexibility and variability in working hours for fatigue recovery, sleep quality, and near misses

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Objective
Working hours have become more flexible and variable over the last two decades. Limited information, however, is available about how the flexibility and variability of working hours are associated with worker’s health and safety. The purpose of this study is to examine these associations in terms of fatigue recovery, sleep quality, and the frequency of near misses at work.

Methods
A total of 1,372 employees (41.4±9.3 years, Male:1226/Female:146) working in the manufacturing industry returned a questionnaire (response rate = 68.7%), which assessed worktime flexibility (1), worktime variability (2), fatigue recovery, sleep quality (Pittsburgh Sleep Quality Index, 3), and the frequency of near misses in the past six months(yes/no). Flexibility was evaluated on the following three aspects: control over working times, over daily working hours, and over days off. Participants were divided into high and low groups according to the median of the flexibility and variability scores. Group differences were analyzed using analysis of covariance and multiple logistic regression analysis. Covariates included age, sex, work schedules, and overtime worked in the past month.

Results
Fatigue recovery was significantly greater in the high flexibility group than in the low flexibility group on all aspects. More recovery was found in the low variability group than in the high variability group. Significantly better quality of sleep was obtained in the group with increased flexibility for working times only. Sleep quality was significantly better in the low variability group than in the high variability group. The frequency of near misses was significantly less in the group with increased flexibility for working times only. No significant difference was found for the frequency of near misses by the level of worktime variability.

Conclusions
Workers who perceived their working times as more flexible showed more recovery from fatigue, better sleep quality, and lower frequency of near misses than their counterparts with reduced flexibility. Similar associations were observed for decreased variability, except near misses. Our findings suggest that providing more flexibility and less variability of working hours may contribute to the improvement of health and safety at work.

References

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Implication of overweight on the effect of shift work on serum total cholesterol level

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Objectives
The aim of this study was to clarify the influence of shift work on serum total cholesterol (T-Cho) levels according to body mass index (BMI) at entry in Japanese male workers.

Method
A 14-year prospective cohort study was conducted in day workers (n=4079) and alternating shift workers (n=2807) who received annual health check-ups between 1991 and 2005 in a Japanese steel company. The association between job schedule and increases in T-Cho was investigated using multivariate pooled logistic regression analyses with age, BMI, lifestyle (Smoking habit, Drinking habit, Habitual exercise), and the results of blood chemistries (creatinine, glycosylated hemoglobin A1c, aspartic aminotransferase, $\chi$-glutamyl transpeptidase, uric acid) serving as covariates in those who were not overweight (BMI < 25kg/m2, n=5,082) and overweight (BMI ≥ 25kg/m2, n=1,804) at entry, respectively. The endpoints in the study were either a 20%, 25%, 30%, 35%, 40% or 45% increase in T-Cho during the period of observation compared to T-Cho at entry.

Results
In subjects who were not overweight at entry, alternating shift work was associated significantly with five serum T-Cho endpoints (≥20%, odds ratio[OR] 1.15 (95% confidence interval[CI] 1.05, 1.26) ≥25%, OR 1.17 (95% CI 1.05, 1.31), ≥35%, OR 1.24 (95% CI 1.05, 1.46), ≥40%, OR 1.30 (95% CI 1.06, 1.61), ≥45%, OR 1.31 (95% CI 1.01, 1.71)). However, alternating shift work was not associated with any of the six T-Cho endpoints in subjects who were overweight at entry.

Conclusions
In the present study, shift work was shown to be a potential risk factor for increased T-Cho in non-overweight Japanese male workers. However, we did not obtain a consistent association between shift work and an increase in T-Cho levels in overweight subjects. The results suggest that the effect of shift work on lipid regulation may be influenced by BMI.

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Cognitive performance in shift-workers and internal time

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Objective
The circadian clock generates a biological, internal time that is the basis for all daily rhythms in physiology, behaviour and performance. To date, field research investigating the consequences of shift-work on human performance has predominantly focussed on external, local time (e.g., regarding shift schedules) but has rarely considered internal time. Here, we investigate cognitive performance of shift-workers based on internal rather than on external time.

Methods
We assessed cognitive performance, i.e. psychomotor vigilance, in two field studies with a total sample of 44 young, rotating shift-workers (every two hours for each shift over a course of four weeks). Daily sleep-logs were filled out across the 4-week study period as well as an initial assessment of chronotype by the MCTQ (Munich ChronoType Questionnaire). The sleep-deficit-corrected mid-sleep on free days after evening shifts (MSFEsc) was used as a marker for internal time (chronotype), validated by sleep logs and actimetry.

Results
A significant shift-specific modulation of psychomotor vigilance speed was observed, whereby both external and internal time both contributed additively. Homeostatic sleep pressure and chronotype-modulated sleep duration also influenced performance. These results were confirmed by a second field study.

Conclusions
Cognitive performance is strongly influenced by individual phase of entrainment (chronotype). This is apparent both in the laboratory and in real-life settings. The effects of shift-work on cognitive performance can only be understood in the light of internal time.

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Factors affecting the sleeping behaviour of Australian Rail industry employees

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Objectives
The irregular work and sleep hours associated with shift work are major contributing factors to fatigue in the Rail industry. Current fatigue management systems assume that employees use rest opportunities to obtain recovery sleep. This is not always the case. However, the factors that may influence the likelihood that an individual obtains adequate sleep are not well understood. This lack of understanding represents a major limitation in the current state of fatigue management in the Australian rail industry. To address this shortcoming, the present study investigated the contribution of demographic variables to sleep behaviour in rail safety workers.

Methods
The sleep and work behaviour of 26 Rail Safety Workers (25M; 43y+13y; 20-67y) from seven freight depots in Western Australia were monitored for two weeks using sleep diaries, work diaries and actigraphy. Demographic data were also collected.

Results
Preliminary analyses revealed that participants had significantly greater TST in the 24h preceding afternoon (7.54h) and night (8.35h) shifts, compared to morning (7.12h) shifts and days off (6.9h), (p < .05). Naps (TST <180mins) were taken before 42% of night shifts, 12% of afternoon shifts and 4% of morning shifts. Results indicated that having three or more children was associated with significantly reduced sleep time (7h) compared to having two or less children (7.71h) or no children (7.73h), (p < .05). There was a significant interaction between age and number of children (p < .05). Participants under 40y obtained less sleep the more children they had. Having no children or two or less children was associated with consistent total sleep time for participants aged 41-55y; however having three or more children was associated with reduced sleep time. Participants over 55 years had reduced sleep regardless of whether they had children.

Conclusions
Results indicate that recovery opportunities provided to rail safety workers may be of differing value to the worker depending upon both their age and the number of children they have. There is also evidence of napping in this population, indicating either learned compensatory behaviours for coping with fatigue or attempts to offset accumulated sleep debt. Understanding the factors which may contribute to sleep time in Rail Safety Workers may help identify employees who are at higher risk of disturbed or inadequate sleep and thus more likely to be impaired by fatigue. In turn, this information could be used to more effectively manage fatigue-related risk at work and to target education programs regarding coping with fatigue.

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Aircrafts manufacturing: managing variability in the structural assembly work

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Objectives
Variability is present in all work activities. This is due to inter and intra individual differences as well as the difference between prescribed tasks by the work organization management and real work situation. The aim of this study was to examine how variability is handled by workers at aircraft structural assembly cells, considering the work characteristics in different shifts.

Method
It was performed in situ observations of work tasks for recognition and description of the work activities and the work-load imposed on workers. We conducted 25 hours of ergonomic work assessments during all shifts. There were three fixed shifts, from Monday to Friday: mornings (05:51-15:36h), afternoon-evenings (15:36-01:34h) and nights (20:41-06:30). Documents were examined to help understanding the performed tasks. They were: production orders, operation guides, spreadsheets and flowcharts used by management to control progress of the assembly processes. Dialogues were carried out with workers, production monitors and supervisors. They occurred both at the initiative of researchers and workers, as the formers seek to understand workers’ actions, and the latter spontaneously demonstrated assembly tasks. The observations took place in all stages of structural assembly cells using the Ergonomic Work Analysis (1).

Results
The work on aircraft assembly showed high physical and cognitive demands. As the assembly parts were on templates, they should be completed in accordance with deadlines established by the production planning, and usually no later than two and half days, independently of their complexity and worked shifts. In order to reach this goal, the number of assigned operators per cell was variable. Workers acted as regulating agents of their own work activity to overcome the difficulties imposed by the anomalies observed during the production process. In spite of that, the work activities at the aircraft structural assembly cells showed situations of conflict between the prescribed tasks and the real work. These subjected the workers to physical and mental overload, regardless of work shift.

Conclusions
The variability of work activity is common phenomena in the aircrafts structural assembly process. The tasks schedules disregarded differences concerning the worked shifts. In spite of that, as workers were able to regulate their work pace, they overcome difficulties faced at work.

Reference

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Ways to improve working time conditions in IT-service companies

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Objective
Employees, especially in the IT sectors, are increasingly facing more complex work loads combined with excessive demands and time pressure at work. Every second IT employee complains about work interruptions and time pressure leading to loss of control, fatigue and occupational stress (Gerlmaier/Latniak 2011, p.71f). This abstract outlines a practical preventive working time concept in a middle-sized IT company in Germany, which was developed through the project “DIWA-IT” (demographic change and prevention in the IT economy), financed by the Ministry of Education & Research, Germany, and co-financed by the EU. The working time concept, including issues of stress and health management, was developed in participative workshops with the employees. The check-up analysis provided important information and was conducive to creating innovative working time concepts.

Method
The participating company is an IT service/consultant company mainly for the energy sector with 80 employees and three agencies in Germany. DIWA-IT workshops were administered to 19 employees from one agency who volunteered during regular working hours. In the first workshops they received basic information about working time, occupational stress and health management and the importance of these key factors in connection with effective resource management. Then they completed the questionnaire for the check-up analysis. All participants were assured that their responses would remain confidential. The sample comprised 15 men and 4 women; all are employed full-time.

Results
The check-up analysis revealed that although the participants have a great deal of latitude, they also feel a great deal of time pressure. Very often the employees leave work late (r = 0.47; p = 0.04). Employees who find inflexible working time unpleasant prefer trust-based working time (r = 0.7; p = 0.0009).

In addition, there is a clear connection between satisfaction at work and strains on family and social relationships. Satisfaction decreases when the work-life balance is seen as bad (r = -0.82, p <0.0001) and when working conditions for elderly employees are perceived as negative (r = -0.60, p = 0.0095).

Conclusion
In organizational psychology, scope of action at work is desired (Ulich 2005), but in this case it didn’t prevent participants from working overtime and suffering from time pressure. Effective and sustainable concepts should focus on customized mechanisms and participative designs with goal-oriented agreements.
Sleep disturbance in nursing personnel working shifts

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Objectives
The aim of the present study was to examine the effects of sleep disturbance between shifts on nursing personnel working in an irregular shift system.

Methods
A cross-sectional survey was carried out in order to study the factors that are associated with sleep problems. The instrument used for data collection was the Standard Shiftwork Index, which was completed by 365 nurses and nursing assistants working either rotating shift system including night shifts or permanently morning shifts.

Results
Female nurses and nurses with elevated levels of chronic fatigue were found with greater problems on sleep disturbance between all shifts (early, late, night). Sleep disturbance between most shifts was greater in participants with more than 18 years of working experience and those having three or more family members to look after. Greater sleep disturbance between early shifts was found in participants with greater score on morningness scale and those working rotating shifts including nights. No differences were observed in family status, professional training, or circadian characteristics (languidity, flexibility).

Conclusion
Our results suggest that female nurses, the rotating shift system, having more than three family members to look after, more than 18 years of professional experience are the factors most responsible for sleep disturbance between shifts in nursing personnel. Therefore, reorganisation of shift work to suit individual preferences would be a solution to the problem.

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Working time in Korea: The results of 2010 Nationwide Working Conditions Survey

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Objective
Working hours have received much legislative concerns throughout the world and is now the subject of a growing body of research activity (1). Although Korea introduced 40 legislative weekly working hour 5 years ago, Korea is still considered to be one of countries with long working among OECD countries. This report aimed to provide an overview of the status of working time in Korea.

Method
KOSHA carried out the second survey on working conditions in 2010 in Korea. For the survey, a total 10,019 workers were interviewed in face-to-face interviews, which were conducted in their own homes. A representative sample of the economically active population aged more than 15 year, i.e. persons who were either employees or self-employed workers at the time of interview, was used. The basic sample design is a multi-stage random sampling, called ‘random walk’. We used the Enumeration Districts in the 2005 Population and Housing Census for sampling. The questionnaire included 14 items on working time.

Results
(Standard working hours) Approximately 70 % of all workers work the same number of hours every day and over 76.6% work the same number of days every week. Over 69 % have fixed starting and finishing times. (Long working hours) 54% of all workers work more than 45 hours per week. The self-employed work average 54.4 hours per week, compared to over 45.0% of employee. (Shift work): Over 7 % of all workers are shift workers. (Work-life balance) Over 54% of workers report that they are satisfied with how their working time arrangements fit in with their non-work responsibilities. (Commuting time) Employees spend average 54.7 minutes per day in commuting.

Conclusion
Korean workers tend to work regularly and longer than average workers in EU countries (2).

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How chronobiology can impact shiftwork


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Melatonin is a nocturnally secreted indoleamine, which is a chemical group that inter alia can scavenge oxygen radicals to prevent DNA damage and eventually cancer development. The Light-at-Night (LAN) hypothesis relies on the potential of light to suppress nocturnal melatonin production which consequently interferes with this cascade. LAN is theoretically interesting, but there are few studies looking at actual melatonin changes and light exposure levels in real life settings, and which take other potential factors into account. LAN might rather be a predictor of a lifestyle conducive to cancerogenesis - but without itself being part of the equation.

We can only improve shiftwork schedules and individual adaptation to it by identifying a person’s chronotype and predictors that permit estimation of the impact of shiftwork on sleep, health, and wellbeing. Candidates for such predictors are the individual amount of social jetlag accumulated in different shift schedules, the individual light exposure, and the average duration and quality of sleep. The detrimental effects of shiftwork are an enormous challenge for circadian research and occupational sciences and can only be solved if we apply new multi-centre approaches. The potential outcome of this research is a triple win situation: healthier employees, more productivity, and reduced health costs for the whole community!

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Performance simulations of current and proposed medical intern schedules highlights the need for reform

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Objective
The U.S. Accreditation Council for Graduate Medical Education requires residency training programs to limit first year resident-physicians (interns) to 16-hour shifts beginning July 2011. Using a mathematical model of circadian rhythms and performance [Jewett et al. J Biol. Rhythms 1999], we quantitatively compared predicted performance of schedules designed in response to these guidelines and of schedules currently in use.

Methods
Five schedules of ~1 month duration, were simulated using the mathematical model: (1 and 2) The newly designed schedule included two daytime interns (A,B), with six “cross-cover” night float interns (XC). Interns A and B worked 5 days “on” (7:00 to 17:30) followed by two days “off”. Two potential schedules for XC interns were: five contiguous 17:00-07:00 (14-hr) “on” plus 2 days off or two blocks of 3 on-1 off-2 on-1 off at the same hours. (3) Every-third night “on” (Q3); (3) Every fourth night “on” (Q4) and (5) Rapid Cycle Rotation (RCR) of one short day shift, one 15-hour day shift (07:00-22:00), and one 16-hour night shift (21:00-13:00) [Landrigan et al. New Engl J Med 2004]. The lowest (25th), median (50th) and highest (75th) quartiles of predicted performance for each work shift and across days were computed. For model simulations, the metric used was the percentage of maximum performance output by the model. A value of ~50% (out of 100% maximum) corresponds to more than 24 hours of wakefulness, which has been associated with increased medical errors and occupational injuries [Barger et al., New Engl J Med 2005].

Results
Over the entire month, the predicted performance quartiles during the work-shifts schedules varied. We focused on the lowest quartile because it is the most sensitive metric in terms of evaluating poor performance on a work shift, and the times of expected errors and accidents. For both XC schedules (1 and 2) the lowest quartiles of performance never strayed below 80%. In the Q3 & Q4 simulations, the lowest percentile never exceeded 60%. The RCR schedule had better performance levels than Q3 & Q4 in the lowest percentile, but they never exceeded 70%.

Conclusions
Our results suggest that implementation of either of the new schedules would improve performance over any Q3, Q4 or RCR schedule. Mathematical modeling is potentially an effective tool for evaluating residency schedules. Using the mathematical model, we can provide quantitative evidence to be used in schedule reform.

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Light at night penetrating the skull and reaching the pineal organ in newborn and adult possibly results in pathologic effects by suppressing melatonin secretion

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Objectives
Diurnal biological periods are adjusted to the light cycles of the environment by retinal and pineal nonvisual photoreceptors (1,2). Night illumination inhibiting pineal melatonin secretion may result in pathological effects like breast and colorectal cancer (3,4). The skull of vertebrates and human has transparent windows above the pineal organs. Pineal photoreceptors are more differentiated postnatally and regressed in adults (1,5). In our present work, we measured the intensity and wavelength of light penetrating the skull to the pineal organ in various ages.

Methods
The transparency of human skull and head hair (light intensity and wavelengths) was measured under different illuminations in various ages of humans and compared to that of other vertebrates. Light conducting effect of cerebrospinal fluid, sinusoids and veins to the pineal organ was also investigated.

Results
In frogs and reptiles the windows of the skull above the pineal organs have low filtering effect. The skull has several transparent areas in mammals and human. Sinusoids, veins and cerebrospinal fluid may conduct light to the pineal organ. The transparency of the skull is the highest in newborn animals as well as in humans. The head hair and its color also influences the transparency of the skull.

Conclusions
Our results suggest that pathological effects of night illumination may be caused by light penetrating the human skull and reaching the pineal organ. The high transparency of the skull in newborns indicates the higher risk of night illumination in younger ages. Besides of wearing light filtering goggles at night work to reduce retinal nonvisual effect, we suggest to wear shadowing cap also, according to the density and color of the head hair.

References

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Investigating the On-call system of work in UK Railway Infrastructure Provider - Network Rail

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Objectives
The rail industry in the United Kingdom is one of those, among many others, in which on-call work is performed on a regular basis by a great number of both frontline and managerial staff. These are duties that are usually performed when unexpected situations occur and therefore demand high quality immediate actions. Interestingly, in spite of being such a commonly used system it has received remarkably little research attention. The current research work aims to understand the on-call system of work in the UK railway infrastructure provider - Network Rail (NR), how it is planned, managed, and how this affects those who work under this system, namely regarding well-being, fatigue, and performance.

Method
A causal model has been outlined based both on the available literature and data collected in the early steps of the research in which on-call work was identified as a disruptive factor in NR. The outlined model predicts a set of relationships between the arrangements of on-call work, the actual on-call work and consequences on fatigue, well-being, and performance. The existence of mediator and moderator variables is expected and has been included in the model. Interviews are in progress in two areas of the country to explore the planning, management, and requirements of on-call work. The results found in the different areas will be presented at the symposium and will provide the basis on which to build further work across the organisation.

Results
The conducted interviews are firstly expected to help clarify the concept of on-call work in the rail industry and how it is managed in different parts of the country. It is predicted that on-call work will play a mediating role between on-call planning and managing and sleep depravation and sleep disruption, which in turn affect the development of Shift-Work Sleep Disorder (SWSD) in rail industry workers.

Conclusion
The outlined model presents a clear causal relationship between on-call work and sleep related conditions affecting fatigue, well-being, and performance. Research into the idiosyncrasies of these relationships in NR will expand the knowledge of the on-call system of work and will provide the basis to more in depth research work to clarify the impact of the on-call system of work.

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Enhancing nurses’ knowledge and attitudes about shift work risk and risk-reduction

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Objectives
Evidence of harm associated with shift work is extensive and growing. Many shift workers remain unaware of these occupational risks, which may be partially mitigated through behavioural modification. Behaviour modification is challenging to instigate and may be aided by appreciation of its importance. This project evaluated the use of a web-based multimedia educational module to inform nurses about the hazards of shift work. Secondly, the study examined whether there was a change in the nurses’ perception of shift work risks. Lastly, the study sought to determine whether the information presented would influence nurses’ intention to change behaviour to reduce risk.

Methods
A multimedia online educational module was created by the researcher. The program was self directed and required less than one hour to complete. A single group convenience sample of 39 hospital based registered nurses participated in a brief assessment of knowledge before and after completion of the program. Participants were also asked to rate their perception of shift work risk in three categories; risk of injury or serious illness for themselves, and risk of an error in patient care. Likelihood of behavior change associated with risk reduction was assessed pre and post intervention.

Results
A paired-samples t-test was conducted to compare pre and post intervention knowledge of shift work risks. There was a significant difference in the scores pre-intervention and post intervention with t(38) = 4.61 (p<0.0001). Additional paired samples t-tests were conducted to compare pre and post intervention perception of risk. These analyses indicated that the nurses’ perception of risk differed significantly after completing the educational module. A final set of paired samples t-tests compared pre and post intervention scores on the nurses’ likelihood of behavioural change, with a significant difference demonstrated post intervention.

Conclusion
Paired samples t-test analysis demonstrated significant increase in participants’ knowledge of shift work hazard post intervention. Perception of risk and likelihood of behaviour change were significantly increased from pre to post intervention. The findings of this study indicate that completion of a short online educational presentation allowed nurses to increase knowledge of hazards associated with shift work. Moreover, nurses demonstrated enhanced awareness of risk and increased likelihood of behavioural change.

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Does shift work lead to changes in health behaviours?

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Objective
Shift work is suggested to affect the risk of cardiovascular diseases through negative health behaviours such as increased smoking and sedentarism. To investigate this hypothesis, the aim of this study was to analyse how exposure to shift work affected health behaviours among social and health care workers in the eldercare and health care sectors in Denmark.

Method
We used baseline (2004), 1st (2005) and 2nd (2006) follow-up data from a prospective cohort study among 2073 female social and health care helpers and assistants who were enrolled in the study a few weeks before graduation. We estimated whether exposure to shift work in 2005 was associated with positive or negative changes in the participants’ health-related behaviours from 2004 to 2006. The outcomes were smoking status and leisure-time physical activity. We analyzed whether day workers and shift workers (divided into fixed evening work, fixed night work, 2-shifts without night work, and 2- or 3-shifts with night work) differed with respect to the odds of stopping/starting to smoke and the odds of becoming physically active/inactive. We adjusted for physical and psychosocial work characteristics.

Results
The adjusted analyses showed that among ex-smokers at baseline, fixed night workers were more likely to take up smoking again during follow-up than day workers (OR=7.10; 95% CI: 1.65-30.55). At the same time, among smokers at baseline, night workers were less likely to stop smoking (OR=0.11; 95% CI: 0.02-0.83). In addition, among initially inactive participants, night workers had lower odds of becoming physically active (OR=0.08; 95% CI: 0.01-0.73).

Conclusion
This prospective study demonstrated that, compared with day workers, fixed night workers in the eldercare and health care sectors were more likely to take up smoking again, and were less inclined to improve their cardiovascular risk profile by stopping to smoke or by becoming physically active within the first two years after graduation.

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Sleep and health effects of one-year change in worktime control

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Objective
Worktime control gains considerable attention, since its increase can produce better outcomes of employee health and well-being (1,2). Given limitations in previous research with a cross-sectional design, a prospective investigation is critically needed to determine the role of worktime control. The present study examined how 1-year change in worktime control was associated with sleep, fatigue, and depression in daytime workers.

Method
A total of 2,796 workers from a market research panel who participated in our baseline study (Nov/2007) were asked to complete a follow-up questionnaire 1 year later (Feb/2009). From 2,612 responders (response rate = 93%), 2,497 daytime employees (1,614 men) were selected (42+/-11 yrs). We measured worktime control (3,4), sleep, fatigue, recovery, and depression. Scores for worktime control and its subscales (daily working hours and days off) in both years were divided into low and high levels according to median in baseline. The 1-year change was then classified into four groups: low to low (LL; n = 1,014), low to high (LH; n = 319), high to low (HL; n = 315), and high to high (HH; n = 735). Analysis of covariance tested group differences at follow-up, with the corresponding score, age, gender, occupation, and weekly work hours in baseline as covariates.

Results
The LH group showed longer sleep duration, fewer symptoms of insomnia (p<0.05), lower fatigue (p<0.05), and lower levels of incomplete recovery (p<0.05) and depression than the LL group. In contrast, the HL group reported shorter duration of sleep (p<0.05), greater fatigue, more incomplete recovery, and higher depression than either the LH or HH group. These patterns of results were found much clearly for control over days off, rather than control over daily working hours.

Conclusions
Participants who increased worktime control at 1-year follow-up (13%) yielded favourable changes in sleep and health measures. The other 13% who decreased worktime control, however, presented the opposite. The results highlight the likelihood of health improvement following a short-term increase in employees’ control over working time. Our data also suggest the relative advantage of control over days off.

References

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Boundaryless work: The effects of spatial and temporal flexibility at work on perceived job demands, overtime hours, recovery, motivation and work-home balance

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Objectives
Nowadays, more and more companies provide their employees with flexibility in determining their work time and work location. In the Netherlands, a campaign on the ‘new way of work’ (i.e., boundaryless work) was recently started to invite companies to implement regulations of increased temporal and spatial flexibility. The objective of this study is to examine the effects of increased temporal and spatial flexibility on perceived job demands, overtime hours, recovery, motivation and work-home balance. Moreover, we assess whether and why employees choose to actually use possibilities of flexible work hours and location.

Method
Data are collected within a Dutch company that has implemented boundaryless work within certain divisions, i.e.: employees at these divisions are free to work where and when they prefer. Employees at a second division are not yet provided with these possibilities (i.e., employees do not have boundaryless work). A questionnaire is distributed among all employees (N = 1000) at both divisions to assess health, perceived job demands, motivation, need for recovery, work-home balance and the amount of worktime control and spatial flexibility employees experience. Comparisons on these variables will be made between both groups, and the role of gender, age, employee’s type of function and personality, as well as other work characteristics, will be controlled for. Additionally, reasons for actual usage of flexibility are measured as variables of interest among employees with boundaryless work.

Results and conclusion
Data collection is currently in progress. Research questions to be addressed include whether temporal and spatial flexibility at work impacts employee’s health, recovery, motivation and perceptions of job demands and work-life balance. We also examine whether this impact is comparable over different age- and gender groups, and whether effects depend on employee’s function type and/or personality. Moreover, attention will be paid to potential negative aspects of flexible working, like the loss of social contacts or hindered cooperation at work. Data collection will soon be completed, and at the time of the symposium on shiftwork and working time we will have insight into the findings of our study.
Airline crew management processes for staffing flights in a cost efficient manner for large airline operators is a very complex task. The number of possible ways to staff the flights is huge, even when constrained by labor agreements and flight and duty time limitations. Operators need to solve the initial problem in only a few hours for thousands of crew, striving to reach the best balance between efficiency, minimization of real costs, robustness, and quality of life aspects for crew. Now they are also faced with addressing fatigue in much more detail, perhaps even showing “equivalent level of safety” to a regulator. It will not be an easy task.

We will report on the experiences from controlling fatigue in the optimization process, when creating crew schedules by using scientific fatigue models. We will further illustrate, by examples, a number of challenging properties needing to be managed by a mathematical model throughout this process, spanning over flight schedule design, pairing creation - to construction of individual crew schedules.

Once crew schedules are created, fatigue will also need to be anticipated and mitigated by crew themselves. We will show how handheld devices may play a role in this aspect – not only for mitigation advice, but also for data collection and consolidation needed in order to improve the fatigue models themselves. Closing the full circle, we will then illustrate how models may be improved by automating a tuning process based on parameter optimization using the above data, and finally how these models may be benchmarked towards each other, driving model improvement even further.

Finally, we will also propose a path forward for managing actual fatigue risk, rather than just fatigue, by placing fatigue into an operational context by moving up to dynamic risk management, taking mission difficulty into account. Here we will show how fatigue risk, similar to managing fatigue only, may be managed and minimized throughout this process.
Sleep habits and fatigue among young student workers: the effect of job characteristics

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Objectives
To describe sleep habits and explore the relationship between job characteristics and fatigue among students with school-year employment.

Method
Ninety-four subjects (40 males) aged 19-21 years old (8 high school, 52 college, and 34 university) were recruited from an ongoing prospective cohort study of health risk behaviors in adolescents. A first interview was conducted at the beginning of school year to gather data on school and job schedules, job characteristics, and associated hazard exposure. In addition, subjects’ sleep was monitored with an actigraph (Actiwatch-L, Respironics) for two consecutive weeks. At the end of the two weeks, subjects completed the morningness-eveningness questionnaire (MEQ), the Pittsburgh Sleep Quality Index (PSQI), and the Chalder Fatigue Scale (CFS). A second interview was conducted 3-4 months later to collect data on possible changes regarding school or employment. Subjects then also completed the Occupational Fatigue Exhaustion Recovery (OFER-15) scale and the Karasek’s Job Content Questionnaire. A multiple linear regression analysis was performed to identify factors associated with chronic work-related fatigue.

Results
Subjects averaged a 46-hour workweek (school, paid work, homework). Excessive fatigue (CFS score ≥4) was present in about 41% of girls and 18% of boys. Sleep problems (PSQI score >5) were present in about 46% of subjects. Subjects fell asleep (24h07 vs. 01h28, p<.001) and woke up (7h49 vs. 9h06, p<.001) earlier on school days than on weekends. Average sleep duration was 6.5 h. Results from the regression analysis revealed that low social support (b=-1.6, p<.001), higher number of organizational constraints on job (b=2.9, p<.001), a more delayed circadian phase preference (b=-.6, p<.001), higher psychological demand of work (b=1.0, p<.01), and greater number of jobs since age 15 (b=10.5, p<.01) were associated with increased chronic work-related fatigue levels.

Conclusions
Young student workers suffer from significant sleep problems and fatigue, two factors acknowledged to predict work injury in adult workers. Job characteristics constitute a potentially modifiable risk factor that may diminish the level of chronic work-related fatigue in this population.

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**Daily rhythm of salivary IL-1beta, cortisol and melatonin in day and night-workers**

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**Objectives**

Shiftwork-induced sleep deprivation and circadian disruption probably leads to an increase in the production of inflammatory cytokines (1, 2) and dysregulation of innate immune system, including cytokines production (3), respectively. This ongoing project aims evaluating changes in salivary level of cortisol, IL-1 beta and melatonin according to a work schedule of five fixed days or night shifts followed by two days off.

**Methods**

Sleep parameters were estimated by actimetry and activity protocols for five male healthy workers, three-night and two-day workers. Saliva was collected at waking and bedtime the last workday and in the following two days-off. Analyses were performed by ELISA (eBioscience, San Diego, USA; IBL, Hamburg, Germany).

**Results**

Neither sleep duration nor sleep efficiency showed any association with levels of IL-1beta. IL-1beta levels were higher at waking than at bedtime during working days for all workers, but only one day and one night-worker maintained this pattern during days off. Their cortisol and melatonin daily rhythms were maintained during days-off. However, for the cited night worker, melatonin levels were shifted to daytime. A second one presented a clear alteration in IL-1beta, cortisol and melatonin rhythms at waking and bedtime on the days-off.

**Conclusion**

Our preliminary results suggest that the variation pattern of salivary IL-1beta can be disturbed by night work. We found no association of this variation with sleep. It seems that disruption in melatonin and cortisol rhythms is reflected in the salivary IL-1beta levels at waking and bedtime. Conversely, these levels seem to be maintained when the rhythms are present, in spite of the melatonin level shift to daytime, as observed for one night worker.

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Circadian adaptation to a week of night shifts in police officers on patrol

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Objectives
Only a very small minority of permanent night workers (<3%) show complete circadian adaptation to their work schedules. There is evidence to suggest that substantial circadian adaptation can be achieved in night workers when an extended series of consecutive nights are scheduled. The aim of the present study was to assess the resetting of the circadian rhythm of urinary 6-sulfatoxymelatonin (UaMT6s) excretion in police officers working 7 consecutive night shifts as part of a rotating schedule.

Methods
Eight police officers (age ± SD; 28.9 ± 4.2) were studied before, after (in laboratory) and during (ambulatory) a series of 7 consecutive nights as part of a rotating schedule. Participants were asked to keep their usual daytime sleep schedule during the ambulatory week of night work. Urine samples were collected at wake time and bed time throughout the week of work and also during laboratory visits preceding and following this week. The rate of UaMT6s excretion (ng/h) during diurnal sleep episodes was measured. A one-way ANOVA was used to analyze the progression of UaMt6s excreted during diurnal sleep episodes at home. A paired T-test was used to compare the amount of UaMt6s excreted during diurnal sleep between the two laboratory visits.

Results
There was a significant effect of time on the excretion of UaMT6s during diurnal sleep at home (F(5,35)=5.9, p=0.0005). More specifically, the amount of UaMT6s excreted during sleep increased across the week of night shift work. Post hoc test revealed that this rate was significantly higher during the 6th diurnal sleep episode compared to the 1st (p=0.0324), 2nd (p=0.0460) and 3rd (p=0.0284) ones. This excretion rate was also higher during the 5th diurnal sleep episode compared to the 1st (p=0.0420) and 3rd (p=0.0399) ones. Even though the excretion of UaMT6s during sleep increased throughout the week of night work, it remained significantly reduced during the second compared to the first laboratory visit (T(7)=3.27, p=0.0137).

Conclusion
Police officers working on a rotating schedule showed a partial adaptation of their endogenous circadian rhythm of UaMT6s. A work schedule comprised of consolidated bouts of nights can favor significant circadian resetting. However, our results indicate that substantial disturbances of melatonin excretion still persists. This situation might contribute to the increased risk of several medical conditions, including cancer, associated with shift work.

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The associations of objective and subjective work schedule characteristics with negative and positive consequences; a survey in the Netherlands.

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Objective
It is known that shiftwork contributes to health problems, decreases well-being and increases poorer health habits. Nevertheless, many nurses prefer and voluntarily do shiftwork.

Studies have shown that ‘objective’ work schedule characteristics such as the type of work schedule and working part-time are related to negative consequences. Subjective work schedule characteristics, i.e. employees’ perception on their work schedule like satisfaction with work schedule, possibly act as a resource and allow the employees to withstand the demands of the work schedule. Research on this matter is limited. The aim of this study is therefore to examine which work schedule characteristics are associated with positive and negative consequences, such as burnout, work motivation and health.

To examine the impact of work schedule characteristics on negative and positive consequences, we used the job demands resources theory (1). Corresponding to the JD-R, job demands are the main predictors of negative job strain. Job resources are the most important predictors of work engagement and buffer the negative effects of job demands.

Method
Questionnaires were distributed to 975 nurses who worked shifts in 2009. 481 returned the questionnaire. Average age 42 years (SD 11.9), all women. It contained items on work schedule demands: the type of work schedule, average working and overtime hours; work schedule resources: satisfaction with irregular working hours (SIW) and work time control (WTC); health outcomes burnout, work engagement and health complaints. Multiple hierarchical regression analyses with interaction terms were conducted.

Results
SIW, a ‘job resource’ was positively associated with work engagement and negatively with burnout and health complaints (p ≤.001 for all outcomes). Employees with high SIW(+1SD) experienced less negative consequences of work schedule demands than employees with low SIW(-1SD). WTC was (positively) associated with engagement. Work schedule demands were positively associated with burnout and work engagement, not with health.

Conclusion
SIW, WTC and work schedule demands were directly associated with positive and negative consequences according to the JD-R model. SIW buffered the negative effect of work schedule demands on burnout and health complaints in accordance with the JD-R model.

Reference

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Development of a Web-Based Approach to Improving the Sleep Health of Railroaders

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Objective
The United States National Transportation Safety Board has set education and research of operator fatigue as a high priority in the transportation industry. In this country, railroad workers, particularly freight locomotive engineers and conductors, work sedentary jobs with long and unpredictable schedules that often include night and on-call work. Consequently, this population frequently experiences both acute and chronic sleep deprivation. Recent evidence also suggests a risk for sleep disorders such as sleep apnea, putting this population at an elevated risk of accidents. Effective interventions are greatly needed to improve railroaders’ sleep health. As one approach, the Federal Railroad Administration is sponsoring the development of a tailored, interactive, multi-media website devoted to sleep health education for railroaders.

Method
The primary goal of the website is knowledge translation: helping railroaders and their families understand the science of sleep and make connections between healthy sleep, on-the-job safety and overall personal health. In order to achieve this goal, user testing was conducted during website planning and development stages as part of an ongoing, independent, formative project evaluation. We also brought together a panel of labor and industry stakeholders who provided their insight and comments on aspects of website planning, development, and future implementation.

Results
Outcomes of user testing and focus group discussions amongst stakeholder panel members indicate that the website’s success will be driven by a site that is: 1) personalized and engaging for railroaders; 2) contains practical and usable strategies, countermeasures, and how-tos; 3) prioritizes quality of life and family as central themes; and 4) ties sleep health to “fatigue,” a term that continues to resonate with the industry and its workers.

Conclusion
The ultimate success of this website depends not only on the credibility of its sleep health content, but also that the material is engaging and accessible to railroaders, ultimately resulting in behavior changes that improve sleep. The strategies used to engage stakeholders, increase the likelihood of website use, and accomplish knowledge translation of sleep health strategies to a high-risk audience will be presented as the project team continues to build momentum toward the release of the website in Fall 2011.

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12-hour shift schedule in the energy industry – a five-year follow-up

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Objectives
The purpose of this study was to investigate the effects of changing to a 12-hour shift schedule from an 8-hour shift schedule, and to follow the permanency of these effects on the sleep, vigilance, and work ability of process operators in two Finnish nuclear power plants.

Methods
The original 8-hour shift system consisted of 7 working days with 2–3 mornings (07.00–15.00), 2–3 evenings (15.00–23.00), and 2–3 night shifts (23.00–07.00 am) in a row, and 2–9 days off in between. The 12-hour shift system had 2 day shifts (07.00–19.00), and 2 night shifts (19.00–07.00) in a row, and 6 days off in between.

The 8-hour shift basic survey was carried out in spring 2005, the 12-hour shift follow-ups were 0.5, 1.5, 3.5, and 5.5 years later (in 2005, 2006, 2008, and 2010, respectively).

A total of 68–58 operators participated in the surveys. Of the 64 respondents in the basic survey, 56, 53, 44, and 35 subjects who participated in the follow-up questionnaires. The mean age of respondents was 43.7, 43.9, 44.6, 44.7, and 44.4 years (range 25–60 years).

The study was a modification of both the Standard Shiftwork Index (Barton et al. 1995) and the Work Ability Index (Tuomi et al. 1998) questionnaires.

Results
The impact of the 8-hour shift schedule on sleep and vigilance was clear compared with the 12-hour shift schedule (58% of subjects perceived disturbance in the basic survey and 11% in the 5.5 years follow-up). Sleep was estimated to be longer (average 7.6 vs. 8.1 hours), and sleep debt shorter (average 19 min vs. 9 min) in 12-hour system. Work ability compared to life-time best was also slightly better (average 8.72 vs. 8.97, scale 0–10) in the 12-hour system.

Conclusion
The follow-up study revealed no evidence against the 12-hour schedule in the sleep, vigilance, and perceived work ability of operators. The positive results also remained through to the five-year follow-up. These results are likely to be due to the improved regularity of the 12-hour shift system.

The turnover rate of operators was moderate due to retirement and moving to other duties. This led to a smaller number of subjects, who were also relatively younger. This weakened the generalization of the results. Therefore, when utilizing a 12-hour shift system, special attention should be paid to both older workers’ well-being and to those who may have sleep disorders.
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Self-rostering – which working hours do the employees choose? (The PRIO-project)

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Objective
With self-rostering employees may select working hours which fit their personal needs and preferences. Observational studies indicate that control over working hours is associated with well-being. However, this is not always reproduced in intervention studies. A reason could be that the employees do not change their working hours or they choose working hours which do not favour health. The aim of the present study was to explore if and how introduction of self-rostering lead to changes in the actual working hours.

Methods
The study was a prospective, quasi-experimental intervention study with a 12 months follow-up. Workplaces planning to introduce self-rostering were invited to participate. Three interventions were implemented in order to facilitate self-rostering: 1) A comprehensive intervention encompassing IT-system and organizational changes 2) An IT-system with the same possibilities for self-rostering as (1), but with few demands to organizational changes 3) A less comprehensive IT-system with restricted degrees of self-rostering (not reported here), and 4) A reference group.

A total of 1068 participants (response rate: 79%) were included at baseline and 1074 at follow-up (response rate: 73%). Data on actual working hours were collected for a 4-weeks period at baseline and follow-up from the salaries office. Preliminary analyses were performed on 537 participants. Assessed working hour characteristics were midpoint of shift (= shift end-shift start), working-hour-variability (= sd(midpoint-of-shift) + sd(shiftlength)), no. of sequences with 3-or-more-days-off and no. of shifts-of-9-hours-or-more. The p-value for the interaction term between group and time is reported.

Results
Working-hour-variability increased from 3.32 (sd = 0.19) to 4.46 (sd = 0.21) among participants in intervention group 1) after introduction of self-rostering (p = 0.003). Corresponding changes were not observed in group 2) and the reference group. Effect estimates for other working hour variables were not significant.

Conclusion
The variability in working hours increased in the intervention group encompassing IT-system and organizational changes, whereas these preliminary analyses indicate that the schedules were not changed with respect to midpoint of shift, the number of periods with more than 3 days off and number of long shifts. This indicates that employees did not tend to use their influence to work compressed workweeks.

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Shift work and heavy drinking

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Objective
Sleep disturbance is one of the most important health problems among shift workers. Drinking alcohol to overcome sleep disturbance is a popular coping behavior for Japanese. However, little is known the effects of sleep problems among shift workers on heavy drinking or alcoholism. Accordingly, we investigated the relationship between shift work and heavy drinking habit among industrial workers by a cross sectional study.

Method
A total of 922 male Japanese employees in manufacturing light metal factory aged 35-54 years (mean age 45.0, SD 6.0) were enrolled in the study. A self-administered questionnaire survey was done in 2009 that included questions on sleep, alcohol consumption and work conditions. Heavy drinking was defined daily alcohol consumption of ≥60g/day. This is based on upper 10 percentile of distribution of alcohol consumption among subjects. The rates of heavy drinkers was compared between subjects engaging night work and others. The interaction of night work and presence of sleep disturbance was evaluated by categorization of subjects into four groups, A(n=420):night work(-) and poor sleep(-), B (n=207): night work (-) and poor sleep(+), C(n=181): night work(+) and poor sleep (-), D(n=109): night work (+)and poor sleep(+).

Results
The rates of heavy drinkers were not different between the workers engaging night work and others. The rates of poor sleep quality were not different between two groups. The rate of heavy drinkers was the highest in D group, 17.4%, and followed by A group, 9.8%, B group, 9.7%, and C group, 7.7%. Compared to A group, the odds ratio (95% confidence interval) for heavy drinking in the other three groups were 0.99 (0.56-1.73) for B group, 0.83 (0.44-1.57) for C group and 1.98 (1.09-3.58) for D group with adjustment for age.

Conclusion
Our data suggested that night workers with poor sleep inclined to get heavy drinking habit. Assessment and improvement of sleep quality are important to prevent heavy drinking for shift workers.

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Adaptation and readaptation to different shift work schedules measured with sleep diary and actigraphy

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Objectives
The aim of this study was to examine sleep during adaptation and readaptation to different shift work schedules in the offshore oil industry.

Methods
The sleep of 19 offshore workers was assessed daily for one week before, during the work period and for one week after three different work schedules: 1) day work (14 consecutive days of work from 7 am to 7 pm), 2) night work (14 consecutive nights of work from 7 pm to 7 am) and 3) swing shift work (first seven nights of night work then seven days of day work). The workers’ sleep was assessed for 84 days all together. Three sets of separate 3-way repeated ANOVAs were performed on actigraphy and sleep diary estimates of sleep assessing: (1) Adaptation to offshore shift work, (2) sleep across the two offshore work weeks, and (3) readaptation after the work period.

Results
Regarding adaptation, sleep efficiency was higher when working day than night and swing shift the first week of work. Subjective sleep quality was better during swing than regular day/night shifts the first week of work. Total sleep time was longer during day and night shift than swing shift across the two work weeks. Sleep efficiency, based on sleep diaries, was higher during day than night and swing shift during the two work weeks. There were no significant differences between the shifts in readaptation in terms of sleep.

Conclusion
Adaptation to swing shift was more difficult than adaptation to regular day and night shifts in terms of sleep. Readaptation to day work after one week of night work affected sleep negatively. There were no differences between the shift schedules the week after the work period.

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Occupational Burnout and Stress in the Context of the Attitude Towards Shiftwork and Work Satisfaction amongst Nurses

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Objectives
The aim of this study is to analyze the relationships between occupational burnout and stress in the context of the attitude towards shiftwork and work satisfaction.

Methods
The research was carried out in Southern Poland and involved 250 nurses aged between 22 and 54 (average age 34 years) with an average of 12 years work experience. Most of the nurses i.e. 178 work in hospital wards; 157 of them in a day-night shiftwork system and the remaining 72 work in medical centers on a daytime basis. The sample group consisted of 170 and 80 nurses with secondary and tertiary level education respectively.

The following research methods were used:
- Burnout Inventory (MBI – Maslach Ch.);
- Effort – Reward Imbalance (Siegrista and co-authors) - Polish version (Pajćk A.);
- Attitude Towards Shiftwork Scale (ATSS) - Polish version (Iskra-Golec I.);
- Manual for Minnesota Satisfaction Questionnaire (Weiss D.J. et al.).

Results
Out of three occupational stress-related factors such as ‘rewards’, ‘efforts’ and ‘balance between rewards and efforts’ included in the regression model, the only significant predictor of emotional exhaustion are the efforts invested in work. It enables prediction to the highest degree (up to 31%) the results of emotional exhaustion in the group of both low work satisfaction and a negative attitude towards shiftwork. In the remaining groups the percentage of explained variance of the variables is hovering at about 20%. For the sense of depersonalization the key predictor turned out to be the rewards and the balance between rewards and efforts, excluding the group with low work satisfaction and a negative attitude towards shiftwork. Those variables can explain variations in results between 15% to 23% for depersonalization. The analysis did not show significant relationships with assumed predictors within the third dimension of occupational burnout i.e. the sense of self-achievements.

Conclusion
As the majority of nurses work in a day-night shiftwork system, the research indicates that more attention needs to be paid to efforts invested in work as well as rewards and the balance between rewards and efforts in the group of low work satisfaction and of a negative attitude towards the shiftwork system. For these are the fundamental predictors of occupational burnout in emotional exhaustion and depersonalization.

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Subjective sleepiness, individual differences and daytime work

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Objectives
The aim of the present study was to describe the variation in sleepiness across a workweek in a large sample of daytime workers. A secondary aim was to evaluate individual differences of severe daytime sleepiness and explore the determinants of sleepiness.

Methods
The sample included 526 daytime workers (79% females, mean age =44 years, sd=10) that answered a questionnaire and filled in a sleep/wake diary during one week. The diary included questions on sleep, stress, health and sleepiness (Karolinska Sleepiness Scale, KSS, 1 very alert-9 very sleepy, rated at 6 times/day between 07h and 22h).

Results
Mean sleepiness showed a significant variation across the week (p<0.001); lowest sleepiness was observed on Saturday (mean: 3.9) and highest sleepiness was observed on Thursday (mean: 4.5). The time-of-day peak in sleepiness (mean: 6.2) was found in the evening (22h) whereas lowest sleepiness (mean: 3.5) was found at 10h. There were clear individual differences in the prevalence of severe sleepiness. 6% of the sample never rated KSS 7 or higher, whereas 4% of the participants rated severe sleepiness during more than 50% of the ratings. The determinants of severe sleepiness were young age, being a female, having high education and difficulties awakening. The group that had the highest prevalence of severe sleepiness reported longer weekly working hours, longer travel time to work, higher daily stress levels and poorer self-rated health.

Conclusion
Subjective sleepiness was low during daytime work although there was a minor group of individuals (≈13%) that reported excessive daytime sleepiness at the same level as night workers and individuals suffering of chronic stress (with a burnout diagnosis). Excessive sleepiness was associated with sex, age, socioeconomic status, and sleep complaints, which removed the effects of working times, health, work demands and family situation.

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Physiological sleepiness during a 7 day simulated sea voyage using the 6 h on/6 h off watch system

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Objective
Fatigue at sea has been raised as an important issue by the International Maritime Organization (IMO). Sleepiness due to disturbed sleep is considered to be one of the major reason behind fatigue. Sleepiness has been discussed as a major component behind ship accidents, collision risk, economic cost, poor performance, etc.

90% of world trade use of maritime transports. More than 1.2 million seafarers operate ships. Hence, the special sea-watch systems used to allow around-the-clock operations are of great importance regarding sleepiness and performance. The use of only two officers with alternating watches on the bridge (the “6 h on/6 h off”) system is becoming more frequent since it is considered economically favourably. This may lead to serious threats to sufficient wakefulness on the bridge.

The present study investigate objective sleepiness among deck officers and engineers working continuous 7 day simulated voyages with normal navigational challenges using the traditional two-watch (6 h on/6 h off) system.

Methods
Twenty-eight officers, divided into two groups, were working on the 7 day simulated sea voyages. Group 1 worked at 12h/18h and at 24h/06h, group 2 at 18h/24 and 06h/12h. Sleepiness of all subjects were measured using the KDT (including a manual scoring of EEG and EOG measures for signs of sleepiness). Group 1 was measured in the beginning of the seven days on day 2 and day 3 (at 17h and at 5h), and at the end of the seven day on day 6 and day 7, whereas Group 2 was measured in the beginning of the seven days on day 2 and day 3 (at 23h and at 11h) and at the end of the seven day on day 6 and day 7.

Results
Results show a significant increase of sleepiness across the seven days between the first morning KDT recording (5h or 11h) and the last morning of KDT recording (F=6,05, p<.05), but there was no significant increase of sleepiness between the first evening recordings and the last.

Group 2 showed a significant higher sleepiness level during the morning compared to the evening shift (F=8,54, p<.01).

Conclusions
The 6 h on/6 h off system lasting for seven days seems to have a cumulative negative effect on sleepiness levels, disregarding type of schedule, although it is clearly evident only in the morning. The results may suggest a higher vulnerability to sleepiness in the morning in 6 h on/6 h off systems, but further studies should be promoted to confirm the findings in real life settings.

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Indicators and predictors of driver sleepiness – a real road experiment

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Objectives
The aim of the study was to identify indicators and predictors of driver sleepiness in a real road setting.

Method
43 healthy drivers (21 females) with a mean age of 44 years (range 30-59) conducted three consecutive 90 min driving sessions on a real rural road: one in daytime, one in the evening and one at night. Three drivers took turns to drive on each experimental day. The drivers were not allowed to sleep or to drink any caffeine containing beverages during the experiment. Electroencephalography (EEG), electrooculography (EOG), blink duration (camera based) and driving parameters were continuously registered and the drivers reported their sleepiness level on the Karolinska Sleepiness Scale (KSS) every five minutes during the driving sessions. Background information was collected from questionnaires. The EEG and EOG were scored according to the Karolinska Drowsiness Score (KDS). Six road segments of four km were selected for analysis. A repeated measures analysis of variance (ANOVA) was conducted to compare the effect of session and segment on KSS, KDS, blink duration, lateral position, standard deviation of lateral position (SDLP) and speed.

Two logistic regression analyses (forward conditional stepwise regression) were done in order to find factors that could predict 1) that the driver would reach KSS>=8, and 2) that the driver would reach KDS>=30. Independent variables were driving session, arrival (i.e. order of the three drivers), light condition, age, sex, Epworth Sleepiness Scale (ESS) score, mileage, time in bed, time awake, “had enough sleep”, and KSS before start of driving session.

Results
There was a significant effect of session on KSS, blink duration and lateral position at the p<0.05 level. For segment, there was a significant effect on KSS, blink duration, lateral position, SDLP and speed. Preliminary results show that session and KSS before start of driving session were significant predictors of reaching a KSS level of >=8, with 85% correct classifications on a training set and 73% correct classifications on a validation set. Arrival and “had enough sleep” were significant predictors of reaching a KDS level of >=30, with 79% and 76% correct classifications on the training set and the validation set, respectively.

Conclusions
In conclusion, it was possible to identify significant indicators and predictors of driver sleepiness in a real road setting.

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**Sleep duration, genetics and metabolism**

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**Objectives**
Extremes of sleep duration and chronotype have been associated to adverse health outcomes that characterise the metabolic syndrome. Body homeostasis and circadian rhythm are though to interact to regulate these phenotypes, but little is known about the molecular mechanism behind it. We thus investigated the association of the genome-wide variability of independent populations with their sleep duration habits.

**Methods**
We conducted genome-wide association studies (GWAS) in 7 European populations. To investigate functional relevance, we produced a Drosophila knockdown for a homologue of the gene found to be associated with sleep duration.

**Results**
We identified a variant in the ABCC9 gene that explains ≈ 5 % of the variation in sleep duration. We found supportive evidence in a subgroup of an independent de novo replication cohort, which we selected based on gene-environment (time of year) and chronotype interactions. RNAi knockdown experiments of the conserved ABCC9 homologue in Drosophila neurons reduced flies night sleep duration by 3h.

**Conclusions**
ABCC9 regulates sleep duration in humans and Drosophila. Nevertheless, different chronotypes may adjust differently to environmental clues, and thereby influence sleep duration. Therefore, scanning only for main effects on sleep duration, one might miss important genetic variants specific to subgroups of the population. ABCC9 is involved with energy homeostasis, and the susceptibility to overweight and cardiovascular disease, which correlate with sleep duration. The relation of these genes to metabolism and disease indicates a common mechanism for the regulation of these phenotypes and sleep duration.

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Wednesday 29 June, 2011
Keynote II
Work and recovery: implications for working time arrangements

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This presentation addresses the question of how employees can recover and unwind from job stress. The presentation summarizes findings from empirical research and discusses consequences for the design of working time arrangements. Specifically, the empirical studies showed that engaging in sport and exercise activities during leisure time is beneficial for recovery. Psychological detachment from work during leisure time (“switching off”) is highly important for staying in a good mood and for protecting one’s well-being over time, particularly in the face of high work demands. Employees who feel well recovered when they come back to work are more engaged and more proactive throughout the working day. Moreover, work situation factors affect recovery activities and experiences: After a long day at work, employees are less able to mentally detach from work during leisure time; moreover, after having faced hassles at work, employees find it more difficult to engage in sport and exercise activities after work.

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SPECIAL SESSION I:
Flexible work hours and work-life conflict
Self-rostering, sleep and need for recovery – an intervention study (The PRIO-project)

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Objective
Influence on own working schedule has been associated with better health and well being. A potential mechanism is that self-rostering provides a better fit between working hours and personal needs and preferences. The aim of the present study was to explore if introduction of self-rostering at the workplace was followed by improved sleep and less need for recovery among employees.

Methods
The present study was a prospective, quasi-experimental intervention study with a 12 months follow-up. Workplaces planning to introduce self-rostering were recruited through public advertising, meetings and by personal contacts. The intervention comprised implementation of different kinds of self-rostering: The employees were able to make wishes about days and times of the day they wanted to work and days where they did not want to work to on a running basis via an IT-software. The preferences of the employees were matched with the required resources. At some workplaces, employees were invited to solve discrepancies between preferences and need for resources by voluntarily altering their preferences. A total of 1065 participants (response rate: 79%) were included at baseline and 1074 at follow-up (response rate: 73%). Analyses were performed on 1057 participants, who responded to the questionnaire at baseline and/or follow-up. Sleep quality (single item), disturbed sleep index (DSI, 5 items) and awakening index (AWI, 3 items) were derived from the Karolinska Sleep Diary. The range was 1-5 with higher values representing better sleep. Need for recovery (NFR) was assessed by a scale with 9 items (range: 0-100), with higher values representing more need for recovery. Statistical models tested the interaction between group and time. They were adjusted for gender and age.

Results
DSI increased among participants in the intervention group from 2.61 to 2.70 after introduction of self-rostering (p=0.015). NFR decreased from 51.7 to 47.4 (p=0.007) in the intervention group. Corresponding changes were not observed in the reference group. Effect estimates for sleep quality (p=0.112) and AWI (p=0.184) were not significant.

Conclusion
Sleep was less disturbed and the need for recovery decreased after introduction of self-rostering. Although the effects sizes were small, introducing self-rostering may improve the fit between working hours, personal needs, and preferences in relation to sleep.
“Self-rostering” solves problems for some and creates new ones for others

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Objectives
“Self-rostering” is a flexible scheduling system where the employer’s staffing need’s at different times of the day, and days of the week, are planned for fixed periods of time. The employees are then required to sign up on free shifts in the schedule according to their preference. On the surface, this looks like a perfect system where staffing requirements and employee working preferences/needs could meet to make a win-win situation. However, these systems have constraints that reduce the freedom of choices, introduce new administration for the employees and typically have a lead-time of only a few weeks. The present study aimed to investigate the impact of these factors in two groups working with “self-rostering”.

Methods
A questionnaire was completed by 145 healthcare workers (mean age 57, 132 women) and 105 call-center operators (mean age 44, 73 women). Response rate was 69%. Actual work-hours for the past six months were also collected and analyzed.

Results
72% of the subjects indicated that they were satisfied or very satisfied with their work hours and 62% indicated a high or very high degree of control over their work hours. Dividing the group into morning types and evening types showed that evening-type persons tended to work more hours at night (20-06h) compared to morning types (p<.05) suggesting some individual influence over the shifts. However, data also suggest a high proportion of subjects (39%) that, if been able to choose, would have preferred to work with traditional fixed schedules instead of the present flexible “self-rostering” system.

The Preference For Fixed Schedules (PFFS) was submitted to correlation analyses to examine possible explanations. The result suggest that PFFS may be explained by: less perceived control over work hours (r=-.42), having to work when needed to have a day off (r=.25), presence of “mandatory” shifts (r=.16). With respect to control, PFFS correlated with control over scheduling (r=.29) and free days/vacation (r=.23) but not with flextime (r=.03) and the length of shifts (r=.07). They wanted more regularity to plan ahead (r=.69) and tended to want two months of lead-time (r=.55). There was also a correlation with work-family conflicts (r=.18). Data further indicated a correlation between PFFS and workplace conflicts because of work hours, but this was isolated to one of the sites (r=.35) and not the other (r=.03).

Conclusion
“Self-rostering” is popular and seems to work well for the majority of employees. However, a large minority is unsatisfied and seems to get worse work-hours with this system compared to traditional fixed schedules. They seem to not be able to utilize the system for their own needs. There is a lack of lead-time in particular in leisure time/vacation. Also, conflicts about work hours seem to be an important factor and might be explained by the specific implementation of the system.

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Measuring and Evaluating the Effects of Flexibility and Variability of Working Hours

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Objectives
Costa et al. (2006) distinguished between irregular working hours controlled by the employer (variable hours) and those controlled by the worker (flexible hours) and demonstrated that they have differential effects on health and well-being. Previous investigations of variability and flexibility have generally used simple, subjective measures of irregularity. This paper presents a novel application of a more objective measure of irregularity, based on the mean absolute deviations (MADs) of shift starting and finishing times and daily working hours. It also uses the interaction of irregularity and individual control over hours to test the effects of variability (high irregularity, low control) and flexibility (high irregularity, high control) on dissatisfaction with working hours, work-life conflict, and health.

Method
A survey was administered to 187 telephone operators from 10 call centres in Sydney, Australia. Eight who did not respond to 10% or more of the survey items were excluded, reducing the sample to 179. 124 (69.3%) were female and one did not report gender. The survey included self-report measures of work schedule control, working hours dissatisfaction, work-life conflict, psychological well-being (GHQ-12) and fatigue, plus a 2-week, retrospective log of working hours.

Results
MADs are shown to provide a more objective measure of irregularity with benefits over standard deviations including meaningful units and easier interpretation, robustness to error and non-normality, and lower sensitivity to differences in numbers of observations between cases. Structural equation modelling, using partial least squares, demonstrates significant effects of both hours irregularity and the interaction of hours irregularity and hours control on hours dissatisfaction and, in turn, work-life conflict and health (psychological well-being and fatigue). The negative coefficient for the interaction indicated that the greater the schedule control, the smaller the effect of irregularity.

Conclusions
This study demonstrates the interactive effect of hours irregularity and schedule control on hours dissatisfaction, work-life conflict and health. MADs are also shown to have significant benefits as measures irregularity over standard deviations or more subjective measures.

Reference
If It Makes You Happy: Hours Control, Work-Life Balance and Workers’ Mental Health

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Objectives
Low control over working hours is likely to be associated with greater work-life conflict, work stress, fatigue and unhappiness. This may hold even when controlling for the duration of work hours and other job characteristics. The aim of this study is to investigate the differences in the four outcomes above, comparing workers who lack versus those who possess a degree of control over the timing of their daily work schedule and overtime work.

Method
Data from the 2006 US General Social Survey (GSS) (n=4500) and two of its modules are applied—the Quality of Worklife (QWL) module and the 2005-06 International Social Survey Program (ISSP) Work Orientations (WO) III module. The QWL has 1760 employed respondents and the ISSP has 957. Ordinary least squares and multinomial logistic regressions are conducted to estimate the effects of five separate types of worker control over work time and schedules, available in the two modules.

Results
When controlling for number of hours worked, negative effects of low levels of control have serious adverse consequences for work-life balance. They are also present, for fatigue and stress indicators, which are more sensitive to the duration of hours. Employee-centered flexibility, particularly the ability to take some time off during a workday, is associated with greater happiness.

Conclusions
The duration of work hours may matter for well being less than the degree and type of control over work hours. However, key distinctions exist between hourly paid and salaried workers, by gender and by type of flexibility for workers.

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ORAL SESSION VI:
Social factors
Social networks, working time and sleep

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Objectives
Variable work schedules may interfere with social interactions. Social networks are important for providing social support and for alleviating burdens, thus relieving stress and reducing the risk for disturbed sleep and ill-health. The objective of this study is to study the relationship between change in working time schedule, social networks and disturbed sleep.

Methods
The Work Lipids and Fibrinogen Norrland (WOLF) study, a dynamic cohort study aiming at investigating the effects of work organization and psychosocial variables on health at three follow-ups, T1 (1996-1998), T2 (2000-2003), and T3 (2009), was used. Out of the 4,715 participants participating at T1, 56 % (n=2,662) participated in all three waves. The participants’ social networks, both at and outside work, were assessed by using the Availability of Social Integration Scale, AVSI (1). Change in AVSI was measured by combining AVSI at T1 and T2. The Karolinska Sleep Questionnaire, KSQ (2) was used to assess sleep quality at T3. Change in working time was assessed by combining questions on working time between T1 and T2. Data was analyzed using logistic regression, controlling for confounding variables.

Results
A small social network (fewer than 5 persons) at work at T2 increased the risk for disturbed sleep at T3 (OR 1.46; 1.07-1.99). Reporting a reduction in social network size increased the risk for disturbed sleep (OR 1.58; 1.04-2.40), however, the result was explained by change in demands. Moreover, reporting an increase in network size decreased the risk for disturbed sleep at T3 (OR 0.57; 0.37-0.89). The results were only found in participants who reported to work day time at both T1 and T2. No significant results were found for those who changed schedule from shift to day, day to shift or for those who remained shift workers. Social networks outside work showed no relationship with disturbed sleep in working time change.

Conclusions
Having a larger social network seems more important for day time workers than for shift workers in the relationship with sleep. Potentially there is more time and room for social interaction during day time works, making day time workers more vulnerable to change in social networks.

References

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Influence of work ability index on shiftwork work and work/family conflict

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Objectives
Since family role is crucial to women’s self-concept and social identity, negative spillover or interference from work to family/private life is expected to be more frequent among female workers. In fact, higher levels of work/family conflict (WFC) were found to be more strongly, albeit slightly, associated with physical and mental problems in women than in men.

In the literature, shiftwork is commonly used as a predictor variable, WFC as a moderating or mediating variable and health as an outcome, but some authors demonstrated a reverse or reciprocal causation mechanism. Accordingly, poor health may enhance WFC and decrease tolerance to shiftwork. A previous study showed that Work Ability Index (WAI), which is an integrated and multidimensional score of health and well-being at work, is significantly associated, independently of work-related stress, with shiftwork, WFC and family/work conflict (FWC); different strengths of such association were observed between male and female Italian nurses. Thus, the objective of this paper was to confirm the existence of these associations through different European countries and also to test the reversed causation hypothesis.

Method
The present analysis was based on a previous longitudinal study on European nurses (Nurses Early Exit Study, n=16,597 female nurses from seven countries). The associations between WAI, background variables, predictors and the moderating variables were tested in all seven countries by means of Random Forest Analysis and estimation of GLM penalized models.

Results
Our results confirm a significant relationship between WAI, shiftwork and WFC in all countries, though association strengths were varied (coeff. -0.12 / -0.15). Compared to other countries, among Italian nurses the coefficient of WAI with FWC and other parental care duties results higher: respectively -0.13 (range among the other countries -0.02 / -0.10) and -0.15 (range among the other countries -0.02 / -0.08). Moreover, in the total population lower WAI was associated, one year later, with higher WFC (-0.01 p<.001) and shiftwork with nights (-0.07 p <.001).

Conclusions
Among women, WAI scores are found to be often lower than in the male population. This study confirms the association of WAI with WFC and FWC especially in Italy, a country where raised retirement age has been established without any increase in family social support policies or other benefits, career justice or other specific preventive measures. Finally, confirmation of the reverse causation hypothesis implies the need of an increased attention to female workers’ health in the light of reducing WFC.

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Trends of flexible working time in Finland

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Objectives
In constantly changing working environment, work organizations are required to be more flexible than before. The purpose of company controlled flexibility is to respond to fluctuations in demand and services. In practice, this usually is done by overtime work and various shift systems. Individually flexible working time takes into consideration employee’s wishes. The aim of this study was to study long term trends of working time flexibility in Finland.

Methods
The data ‘Work and Health Survey’ gathered by the Finnish Institute of Occupational Health consists of a representative sample of employees (2000 n=1767, 2003 n=2037, 2006 n=1917, 2009 n=2048). Company controlled flexibility e.g. flexibility required by tasks or superiors is often achieved by overtime work compensated by money or time off regularly every month. Individual flexibility is present if employees have many or some possibilities to regulate the length of working time. The trends of flexible working time were studied according to socio economic status, gender and age.

Results
Overtime work compensated by money or time off has systematically decreased in the 2000s. In 2000 44% of employees did overtime work, but in 2009 only 26% worked overtime (p<.001). The decreasing trend was most evident among blue collar workers. In 2000 blue collar workers (49%) more often did overtime work than lower white collars (42%) and upper white collars (38%), but in 2009 blue collar workers (21%) did somewhat less overtime work than white collar employees (29%). The gender differences decreased respectively. Also the age differences decreased, the decrease was most frequent among youngest e.g. the 24-34 year olds who most often did overtime work (52% -> 33%) and least frequent among the 55-64 year olds who did overtime work least frequently (30% -> 19%).

Individual flexibility was equally prevalent during the 2000s, 58% of employees were able to influence their working time somewhat or much in 2000 and 2009. This kind of flexibility has somewhat increased among the most individually flexible upper white collar employees (75% -> 83%). Among lower white collar employees it has somewhat decreased (60% ->52%) and there was no change to be seen among the blue collar workers (42% in 2009). No changes were evident among gender and age groups.

Conclusions
Working time flexibility has not increased in Finland during the 2000s. Company controlled flexibility has decreased, especially among blue collar workers, but there were no major changes regarding individual flexibility.

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The impact of the interaction of work schedule control and hours irregularity on work-life conflict amongst older, full-time workers

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Objectives
There is extensive evidence that poor work schedules have negative impacts on work-life conflict and, in turn, on domestic, social and health outcomes. Negative effects of irregular and unpredictable hours, and a lack of schedule control, on work-life conflict have been demonstrated in population and industry-based data. A trend toward longer full-time working hours in many developed countries has exacerbated these effects. It is envisaged that as weekly working hours increase, work-schedule control becomes more critical. This study investigates the effect of the interaction between work schedule control and hours irregularity on work-life conflict amongst older, full-time workers.

Method
Survey data were obtained, using computer aided telephone interviewing, from a nationally representative sample of 1541 Australians aged 45 to 64. This study is based on a sub-sample of 448 respondents who reported working 38 or more hours per week (mean = 46). The mean age of these respondents was 54 and 34 per cent were female.

Results
Hierarchical linear regression modelling was used to predict work-life conflict with variables entered in blocks in the following order: demographic characteristics (age, gender), employment status, average weekly working hours, the interaction of hours irregularity and schedule control, hours irregularity and schedule control. In the final regression model ($R^2 = 0.15$), age, gender, employment status, hours irregularity and schedule control were not significant predictors. However, average weekly working hours ($=0.12$, $p<.05$) and the interaction of hours irregularity and schedule control ($\chi=0.29$, $p<.05$) were significant predictors. As hours increased and as greater irregularity was combined with less control, work-life conflict increased. Structural equation modelling using partial least squares, revealed the structural relationships between the relevant variables.

Conclusions
These findings highlight the effects of the interaction of hours irregularity and schedule control on work-life conflict in a sample of older workers. The increased importance of schedule control as hours irregularity increases is demonstrated.

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ORAL SESSION VII:
Who works shift?
Trends of working time in Europe

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Objectives
The flexibilization of working times and work places has become an increasing focus for analysis on quality of work and life. This study approaches the flexibilization as transition from industrial towards post-industrial time regime. The post-industrial working time regime is usually characterized by deregulation of collective norms, diversification of the length and pattern of working time, the blurring of the limits of working time. We assume that flexible forms of work vary. In this study we examine, how and to what extent working times vary across European countries.

Methods
Analyses are based on European Working Conditions Surveys (EWCS) from 1995-2010. We use EWCS Survey Mapping Tool to derive country level estimates of various dimensions of working time (1). In analyses we separate four dimensions of working time: the number of hours worked (duration), when the hours are worked (timing), working time intensity (tempo), and the degree of time autonomy individuals have over their working hours (autonomy). We compare trends in dimensions of working time in countries that represent different institutional and cultural characteristics. The countries involved in the study were: Finland, Sweden, United Kingdom, Germany, France, Italy and Poland. Trends are investigated at the county level for men and women separately. Data is analyzed by means of descriptive graphics.

Results
According to results there are common European trends in working time. The proportion of employees working long weeks (over 40h/week) has decreased in almost every county in the 1995-2010 period. Similarly, the share of employees working unsocial hours (at night i.e. 10pm - 5am) has decreased in all counties excluding Germany. The level of employees working time autonomy increased in almost every country in 1995-2005 period, but by 2010 it has stagnated or decreased. However, there are clear differences between countries in trends of working time intensity. Working time intensity increased notably in 1995-2005 in Finland, Sweden and Germany but has decreased by 2010. In Poland and UK the working time intensity has decreased throughout the observation period.

Conclusion
Our findings indicate that there are clear European level trends in various dimensions of working time. This finding supports views of growing similarity i.e. convergence between European countries. However, trends in working time intensity point to somewhat divergent patterns in Europe. In addition, our results do not support the hypothesis of transition to post-industrial working time regime characterized by deregulation of collective norms.

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The web of Penelope: an historical and cultural journey in women’s night work

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Objectives
Much is known about the effect of night-work on women’s reproductive function. More recently IARC highlighted “limited evidence in humans for the carcinogenicity of shift-work that involves night-work”, referring to female breast cancer in particular. Actually, unhealthy consequences of night-shift for women have been known since past times and restrictions on women’s night-work have been enacted by several countries during the 20th century. Lately national legislations have been reformed in a gender-neutral manner, abolishing gender disparities in night-work. This would appear to have reduced women’s protection. We thus set out to investigate the historical evolution and social and cultural values concerning women’s night-work and its protection.

Methods
An analysis of women’s night work over times was conducted through historical and literary sources. In particular, social and cultural values regarding women’s work at night were described. Finally, the ratification and recent denunciation of ILO conventions prohibiting women’s night-work were also investigated.

Results
The night and the woman were strongly related in past times. In Egyptian, Greek, Roman and Norse mythologies nocturnal divinities were often goodness or female entities. In Western civilization the most ancient description of a non-military night-work is related to a woman, Penelope, in the Odyssey. Actually, in ancient times only religious women and birth-attendants could work at night. Indeed, until the industrialization night-work was considered as inappropriate and unseemly for women, since it was related to witchcraft and prostitution. During the Industrial Revolution, the increased need for workforce led to the recruitment of women in night-shift. At the beginning of the 20th century, trade unions and international movements let the acknowledgement of unhealthy effects of night-shift and its ban for women through ILO Conventions. Lately some countries have abolished these restrictions due to gender disparities. In particular, in 1991 the European Court of Justice strongly criticised the ban on women’s night work as being at odds with the 1976 EU Directive on the principle of equal treatment for men and women as regards working conditions.

Conclusion
In past times night-work was culturally considered as inappropriate for women, so international movements promoted a strong protective legislation towards women. The correct principles of equal treatment for genders have limited these restrictions, but general legislation on shift-work should be able to protect also women. Actually, the detrimental effects of women’s night-work could become a problem in newly industrialized countries, where there are no general protective laws on shift-work.

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Selection into shift and night work

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Objective

Selection factors may be an important mediator of the relationship between shift and night work and impaired health. The aim was to investigate if factors already during higher education (e.g. demographical and health behavioral factors) are more prevalent amongst individuals working shift-work or permanent night work one year after graduation.

Methods

Three national cohorts of nursing students (n=1155, 1702, and 1459) filled out a questionnaire before graduating and after one year in work life. The sampling frame constituted the total population of last semester nursing students from all 26 universities in Sweden (in the autumns of 2002, 2004 and 2006, respectively). At baseline, the response rate varied between 68 and 73%. At follow up, one year post-graduation the response rate was 92% for the 2002 and 2004 cohorts, and 78% for the 2006 cohort. Data from the baseline questionnaires was used to predict future work schedules of 3-shift (including night, 26%), and permanent night (5%). Other work schedules were: day shift (Mon-Fri, 8%), 2-shift (morning/evening, 54%), other schedules (6%). All p’s are <.05.

Results

The typical 3-shift worker was a single, healthy male nurse. More specifically, socio-demographic predictors for working 3-shift one year post graduation were being male, living alone, having no children, regular alcohol consumption, being a non-smoker, having ideal BMI, and high self-rated health. With respect to choosing permanent night work one year post graduation, the characteristic nurse had more often children, smoked, had high BMI and lower self-rated health as measured at the time of graduation.

Conclusions

We found that selection into shift- and night work was mainly related to demographical variables and to some degree to life-style and health factors. While selection into 3-shift work was related to a wide range of ‘positive’ health factors, the opposite was true for those starting to work permanent night work, largely supporting and extending on recent work (1). Thus, selection into 3 shift-work seem to largely relate to factors that also promote health while the opposite seem true for selection into permanent night work.

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A longitudinal study of personality factors predicting fatigue, sleepiness, anxiety and depression among rotating shift working nurses

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Objectives
The aim of this study was to investigate the relationship between personality factors and shift work tolerance (fatigue, sleepiness, anxiety and depression) over one year among rotating shift working nurses. To our knowledge, no other longitudinal study investigating this topic has been performed the last decade.

Methods
A cohort of 707 Norwegian nurses working in a rotating three shift schedule participated in the study. The cohort was established by age stratified selection among members of the Norwegian Nurses Association in 2008 and examined by questionnaires in 2008/2009 (T1) and 2009/2010 (T2). Questionnaires included established measures of shift work tolerance and personality. At T1 instruments measuring shift work tolerance (fatigue, sleepiness, anxiety and depression) and personality (morningness, flexibility, languidity and hardiness) were included in the questionnaire. At T2 only the measures of shift work tolerance were included.

Results
Morningness was not related to any indicators of shift work tolerance at T2 when controlling for shift work tolerance at T1. Flexibility was negatively related to anxiety at T2 when controlling for anxiety at T1. Languidity was positively related to sleepiness at T2 when controlling for sleepiness at T1. Hardiness was negatively related to fatigue, anxiety and depression at T2 when controlling for the scores on these constructs at T1.

Conclusion
It seems like personality factors may predict some measures of shift work tolerance over a period of one year. More studies, with longer follow up periods are needed to further investigate the relation between personality traits and shift work tolerance.

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Characteristics of shift work drop-outs at Tata Steele in the Netherlands

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Objective
Irregular working hours are burdening to workers, due to the disturbance of biological and social circadian rhythms. The majority of workers develops health and social problems. When health problems become structural, workers often prefer a day time schedule. These problems increase with the age of the workers. At the intersection of shift work and ageing, a dilemma appears. In many organizations older workers begin to constitute a large percentage of the workforce. The traditional strategy to transit older workers from shift work to day work is no longer feasible. This study aims to identify the characteristics of shift work drop-outs in order to develop preventive measures for a sustainable and healthy work life of older workers with irregular night and shift work in the future.

Method
Demographics, sickness absence and health check data from 2005 – 2009 were derived from the company’s registers of Tata Steele, the Netherlands. Data are obtained from 11,000 employees in shift work (45%) and regular day work (55%). Comparisons were made between shift workers placed in a day work group, because of health problems (shift work drop-outs), shift workers who did not make the transition to day work and workers with a regular day schedule. ANOVA analyses were performed between the different groups on age, fatigue, musculoskeletal complaints, influenza symptoms, work stress, complaints about work, and absenteeism.

Results
Shift work drop-outs are significantly older (mean age 48.0; SD 9.8) then shift work stayers and regular day workers. Compared to shift workers who did not make the transition to day work, shift work drop-outs scored higher on work stress. Furthermore, shift work drop-outs reported significantly higher scores on fatigue, musculoskeletal complaints, influenza symptoms, complaints about work and absenteeism compared to regular day workers.

Conclusion
Shift work drop-outs seem to have different characteristics, compared to shift workers who did not make the transition to the work day group and regular day workers. Further stratified analyses will be performed to compare characteristics and reasons of sickness absence of older and younger workers. During the data collection a new shift work roster has been implemented at Tata Steele the Netherlands. The effects of the roster change will be presented in another presentation.

This study is part of the Shift Your Work project, aiming to design and implement new night and shift work rosters to reduce specific shift work problems of older workers in different organizations in the Netherlands.

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Overtime addiction – an organisational syndrom

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Objectives
Employees sometimes oppose rosters that are preferable from an ergonomic point of view. Such resistance to change can be substantial and kept up for a long time in spite of pressure for organisational change as well as high risks for the employees and their customers due to extremely long work hours and insufficient rest periods. The main reason for this behaviour was discussed in (1) overtime being the main opportunity to earn additional money. However, it is not only a question of the absolute amount of money as such, since defenders of overtime can be found in rather different professional groups including well paid occupational groups like physicians, highly trained technical specialists, etc.

The objective of this paper is to better understand the mechanisms that lead to such behaviour and make it an organisational force so strong and insusceptible to change that it can be seen as an addiction.

Method
We compared and analysed 10 cases where we as consultants were confronted with very strong opposition to ergonomic improvements. In these cases overtime was at or beyond legal limits. We analysed the network of actors, their behaviour and the benefits they draw from such a situation.

Results
First, the hope for additional money or the fear for loss of money seems to fire overtime addiction. It is not the absolute amount but the potential change. Second, besides employees it is often the middle management that opposes change, i.e. reduction of overtime. Partly because middle managers earn overtime payment themselves but mainly they benefit from overtime in additional ways: Awarding/withdrawing overtime is a strong management tool. Allowing more overtime spares them to criticise employees for doing the wrong work or working inefficient. Together with employees they benefit from a culture of little transparency and avoidance of organisational change.

Conclusions
Varying pay (or even a potential of variation) may cause overtime addiction with severe negative consequences for the employees (risks for their own health and others) but also for the organisation, as it hinders organisational development and transparency and potentially corrupts middle management. Stabilization of pay seems to be a key question to get rid of overtime addiction.

References
SPECIAL SESSION II:
Time conflicts and interventions amongst students
Paying-off the sleep debt in adolescents attending school in shifts: are there similarities with shiftworkers?

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Objectives
Studies show that early morning starts to the school day restrict the sleep of adolescents during a school week, and that sleep is extended the following weekend. The organisation of school time in Croatia does not limit opportunities for extended sleep to the weekend. The majority of Croatian adolescents attend school one week in the morning and the following week in the afternoon; extended sleep is possible during the week of the afternoon shift. The question is whether additional opportunities for extended sleep affect sleep in the week with a morning schedule. This study compared the sleep of a group of adolescents attending continuously on the morning schedule, with a group attending for one week on the morning schedule followed by a week on the afternoon schedule.

Methods
Two groups of secondary school students aged 16 years participated. One group (N1=76, 27 girls) attended school between 8.00 and 13.00. The other (N2=97, 55 girls) attended between 8.00 and 13.00 in one week, and between 14.00 and 19.00 in the following week. The school week consisted of 5 days with free weekends. Sleep data were collected using sleep-wake diaries. The characteristics of the main sleep in the two groups were compared by ANOVA. Differences between the groups in daytime sleepiness and napping were tested by Chi-square tests. Individual differences in sleep extension at the weekend were examined by correlation analyses. The relationship between napping and sleep duration was examined by ANOVA.

Results
The duration of the main sleep on school nights of a morning schedule (M1 =6.74, SD1=0.97; M2 =6.82, SD2=0.67) was significantly shorter than on weekend nights (M1 =8.81, SD1=1.60; M2 =9.01, SD2=1.34), but did not differ between the two groups. Adolescents from the two systems did not differ in daytime sleepiness or in naps taken on school and weekend days. In both groups, a shorter main sleep on school nights was associated with more frequent napping during the school week and longer sleep extension at the weekend.

Conclusion
Adolescents who attend school in two weekly rotating shifts do not change their main sleep or napping during a week on the morning schedule, because opportunities for additional sleep are anticipated in the following week while on the afternoon schedule. Both extension of sleep at the weekend and napping on school days are used to compensate for reduced main sleep, indicating some similarities with shift workers paying-off the sleep debt.

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Sleep, media exposure and working hours among adolescents: Cultural aspects

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Developmental changes in adolescent sleep patterns are determined by biological sleep/wake systems and by environmental lifestyle factors. Puberty is associated with a delay in the circadian timing system and a slower accumulation of homeostatic sleep pressure. Environmental factors include early school start times, homework, social and extracurricular activities, employment, less parental influence, and increased ‘screen time,’ including television viewing and computer and internet use.

Sleep patterns are known to vary considerably between cultures. This presentation will focus on the relationship of sleep-wake patterns, leisure time patterns (e.g., media exposure and sports), and working hours with sleep-related behaviors and mood problems in Israeli adolescents of Arab and Jewish cultures. A cross-sectional survey was conducted with 6th to 10th graders using the School Sleep Habits Questionnaire (Wolfson & Carskadon, 1998) and leisure time pattern questionnaires. Cultural and age differences in sleep patterns, leisure time patterns, and sleep-related behaviors were examined.

Israeli adolescents are found to have the shortest sleep duration and are among those with the latest bedtimes. In addition, Israeli adolescents are ranked as the highest television viewers and computer users. Arab adolescents go to bed earlier and take longer to fall asleep on both weekdays and weekends as compared to their Jewish counterparts. Although no differences are found in total sleep time, Arab adolescents also wake up earlier on weekdays and are generally sleepier than Jewish adolescents.

Potential lifestyle factors may be associated with the current findings. These factors include electronic media exposure, caffeine consumption, employment, and extracurricular activities, such as sports. As these factors are potential confounders in the relationship between sleep, culture and biology, their assessment is warranted. The results will enhance our understanding of the cultural contribution to the developmental biological process of adolescent sleep.

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Sleep and training effectiveness in adolescents and young adults in military training programs

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Sleep is a vital commodity, required for human survival and adequate sleep is important for performance in any environment. Over the past several decades, we have learned that adolescents and young adults need more sleep than their adult counterparts, requiring an estimated 8.5 to 9.25 hours of sleep per night. In addition, the timing of their sleep patterns is shifted so that it is both delayed and extended: that is, adolescents and young adults have a natural propensity for later bedtimes and even later awakenings.

These differences in the sleep patterns of this age group have important implications for scheduling their learning activities. Research has shown that sleep is crucial for individuals who are learning new skills and information. Studies of memory and academic performance have clearly demonstrated that the ability of individuals to learn and retain information is dependent on adequate sleep.

We present results from studies of learning and performance in three military trainee populations: a four-year longitudinal study of sleep in cadets at the United States Military Academy in West Point, NY; a study of US Navy recruits for whom the timing of sleep has been shifted and lengthened; and a third population of Army recruits in basic training whose major sleep period has been shifted to be more aligned with the naturally occurring sleep patterns of this age group.

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Indoor exposure to bright light during evening hours increases alertness among college students

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Introduction
Several studies have shown that exposure to bright light prevents sleepiness during night work. This effect might also apply to reducing sleepiness among night school students. In this context, we used bright light to reduce sleepiness among college students.

Aim
To evaluate the effects of exposure to bright light on sleepiness during evening hours among college students.

Methodology
Twenty-seven healthy college students, all males, with ages ranging from 21 to 24 years, working during the day and studying in the evening, participated in this study. During three weeks, the students filled out daily activities logs (including sleep duration), wore actigraphs, and recorded levels of sleepiness three times in the evening (19:00h; 20:30h; and 22:00) using the Karolinska Sleepiness Scale. In a crossover design, on the second and third weeks, the students were exposed to a white bright light pulse for 20 minutes (8,000 lux) at either 19:00h or 21:00h. Salivary melatonin samples were collected before and after light exposure. Wilcoxon, Friedman, and Tukey tests were performed to evaluate the effects of bright light exposure on sleepiness. The onset of melatonin secretion (20:00h and 21:30h) was defined as salivary melatonin concentrations greater than 4pg/ml.

Results
After bright light exposure, sleepiness levels were reduced at 20:30h and 22:00h (R = 0.33, p< 0.01). ANOVA showed statistical differences between time (F = 4.84, p = 0.04) and between day and time of bright light exposure (F = 4.24, p = 0.05). The results showed effects of melatonin onset at 20:00 and 21:30 and sleepiness levels (F = 7.67, p = 0.02) and perception of sleepiness and intervention time (F = 6.52, p = 0.01). The melatonin onset around 20:00h, combined with the exposure to bright light at 19:00h was not sufficient to reduce sleepiness among students. However, when they were exposed at 21:00h, the melatonin levels were maintained throughout the evening hours. Students with melatonin onset around 21:30h showed the effects of bright light exposure at either 19:00h or 21:00h, as they were able to maintain alertness levels throughout the evening hours.

Conclusion
Controlled exposure to bright light during evening hours increased alertness among college students. The effects of bright light on sleepiness varied according to the time of melatonin onset. Support: CNPq (501766/2007-3; 500782/2008-3; 472153/2006-4; 307919/2006-4); CAPES, FAPESP (07/04648-4; 06/59053-2), PIBIC-CNpq.

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Keynote III
Night work and cancer: an update of recent research

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Background
The invention of the incandescent light bulb allowed people to extend typical daytime behavior well into the night. Millions of people are now up at night, working night shifts or simply staying up late. Yet this revolutionary change may pose new and unexpected challenges to human health.

The biological clock in the suprachiasmatic nucleus (SCN) in the hypothalamus controls numerous functions that follow regular, daily patterns (or ‘circadian’ rhythms). Light entrains the biological clock, as the SCN receives environmental dark/light information directly from the retina. Melatonin is a hormone and marker of circadian rhythmicity produced almost exclusively at night, when it is dark. Melatonin, cancer-protective properties, is intimately linked to the circadian system and its secretion is suppressed by light exposure at night. Human twin studies of abnormal circadian phenotypes showing that much of morning and evening preference is heritable, led to the identification and characterization of clock genes responsible for circadian behavior.

Results
Our group has demonstrated that circadian disruption by means of light exposure at night, as in rotating night workers, increased not only breast, but also colorectal and endometrial cancer risk in two independent prospective cohorts, the Nurses’ Health Study cohorts. We have done fundamental work in developing and validating melatonin as a biomarker of circadian disruption. In support of the above mentioned underlying mechanisms of the association between night work and cancer risk, we showed that this biomarker was indeed associated with breast cancer risk, thus corroborating the initial findings from the observational studies of night workers. We explored, which dietary and lifestyle factors, besides night work, influence melatonin production. More recently, we have conducted a randomized controlled trial to study the effects of exogenous melatonin on hormones in postmenopausal women, and completed an extensive data collection to explore which factors, besides light, affect the circadian system in night workers. These include genetic markers as well as chronotype, activity, and timing of meal intake during night work.

Conclusion
Observational studies have consistently associated rotating shift work with increases in cancer risk, prompting the WHO in December 2007 to classify night shift work a probable carcinogen. Our work continues to contribute to the body of evidence exploring the effects of circadian disruption on health overall, and cancer risk in particular.

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SPECIAL SESSION III:
Night work and cancer
Night work and breast cancer: possible mechanisms

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A limited but growing body of literature has recently linked altered lighting, particularly light-at-night (LAN), to breast cancer risk. The LAN theory has resulted in a series of predictions that have been tested, and so far generally support the theory: shift working women would be at higher risk, blind women would be at lower risk, long sleep duration (as a surrogate for hours of dark) would lower risk, and community nighttime light level would co-distribute with breast cancer incidence among societies. Originally, the proposed mechanism was by a light-induced suppression of melatonin at night. Later LAN was proposed to also contribute to circadian disruption which might mean alterations in clock gene expression and function; this might be a result of melatonin suppression and/or be independent of it. The strongest experimental evidence for a possible mechanism for LAN increasing breast cancer risk is from a rodent model by Blask and colleagues which targets a melatonin inhibition of existing tumor growth. This mechanism would be at the end of the pathogenic chain of carcinogenic events from ‘initiation’ of normal cells, to ‘promotion’ of intermediate lesions, to ‘progression’ of fully transformed cells to a clinical detectable cancer. At the other end of this chain, melatonin inhibition might also contribute to altered growth and differentiation of normal mammary tissue, thus influencing cancer risk at the very earliest stages (even perhaps by maternal exposure to LAN during pregnancy and subsequent risk in female offspring).

Very recently, we have investigated epigenetic mechanisms by which LAN might increase breast cancer risk. We found, as predicted, CLOCK gene promoter hypomethylation (Cancer Res. 2010;70:1459-68), and CRY gene promoter hypermethylation (Cancer Prev Res. 2010;3:539-48) in breast cancer cases compared to controls. To determine whether this mechanism might account in part for the shift work association with breast cancer risk, we conducted a study in nurses. Archived blood DNA samples of 117 female subjects from a prospective cohort conducted in Denmark were included in the study. PCR-based method was used for methylation detection of gene promoter, while genome-wide methylation analysis was performed on the Illumina Infinium Methylation Chip. Long term shift work resulted in the same promoter hypomethylation in CLOCK and hypermethylation of CRY2 in PBLs as was previously observed in breast cancer cases. Genome-wide methylation analysis discovered widespread methylation alterations in shift workers, including changes of many methylation and cancer relevant transcripts. Ingenuity pathway analysis further revealed several cancer-related pathways.

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Night work and breast cancer risk among Norwegian nurses

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Objective
The objective of the study was to examine the relationship of shift work and breast cancer risk by different exposure metrics of night shift work.

Shift work, implying exposure to light at night, and the subsequent reduction in the synthesis of the hormone melatonin, has been suggested as a contributing cause of breast cancer. Epidemiological studies in this field have been hampered by limited exposure information; and more details characterizing shift systems have been requested. In this study work history, in addition to previously used indicators of night work, also includes information on number of consecutive night shifts for each job held.

Methods
The design is a nested case-control study among Norwegian nurses who graduated before 1985. Cases of breast cancer were identified by linking data from the Cancer Registry of Norway to the Norwegian Board of Health’s registry of nurses. A total of 699 (74%) of the live cases (diagnosed 1990-2007) and 895 (65%) of the frequency-matched controls, cancer-free at the time of sampling, were interviewed about known and suspected risk factors, including a detailed occupational history.

Odds ratios (OR) for risk of breast cancer, in relation to new and previously used exposure metrics, were estimated by multivariate unconditional logistic regression models, adjusting for age, period of diagnosis, parity, breast cancer in mother or sister, and alcohol consumption.

Results
No increase of risk was found after long duration of work by nurses working ≥ 3 night shifts per month. Small, non-significantly increased risks were observed for exposure to ≥ 30 years in hospitals or other institutions (OR= 1.1), ≥ 12 years in schedules including night work (OR=1.3), ≥ 1007 night shifts during lifetime (OR= 1.2), and lifetime average number of night shifts per month ≥ 4 (OR=1.2). Non-significantly increased risks of breast cancer were observed in nurses who worked ≥ 5 years with ≥ 4 and ≥ 5 consecutive night shifts (OR = 1.4, 1.6). Significantly increased risks were seen in nurses who worked ≥ 5 years with ≥ 6 consecutive night shifts (OR=1.8, 95% confidence interval 1.1, 2.8).

Conclusion
The results suggest that breast cancer risk may be related to number of consecutive night shifts.

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Night work and breast cancer estrogen receptor status

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Objectives
Night work might increase the risk for breast cancer and mechanisms of tumorigenesis are extensively discussed. Exposure to light at night is supposed to deplete melatonin by misalignment of circadian rhythms. By this, levels of hormones such as estrogens might be affected. To assess the direct and indirect effects on tumorigenesis we explored associations of shift work and breast cancer in relation to the estrogen receptor status (ER).

Methods
GENICA (Gene-ENvironment Interaction and breast Cancer) is a population-based breast cancer case-control study in Germany which documented shift-work information in 857 breast cancer cases and 892 controls. Risks of employment status and night-shift characteristics were estimated with conditional logistic regression models, adjusted for potential confounders. Estrogen receptor status was assessed by immunohistological staining.

Results
In 857 breast cancer patients the ER-status was assessed for 827 cases whereof 653 showed positive and 174 negative receptor status. Additionally, 892 controls were recruited. Among all women, 53 cases and 56 controls worked in night shifts for at least one year. In total, ever shift work and ever night work were not associated with an elevated breast cancer risk for receptor positive or negative cancer when compared to women employed in day work only. However, never employed women showed an elevated risk for estrogen receptor positive breast cancer vs. employed women (OR 1.72, 95% CI 1.02-2.92). Night work for ≥20 years was associated with an OR of 4.73 for receptor negative breast cancer (95% CI 1.22-18.36; based on four cases and five controls only; compared to women employed, but never in shift work).

Conclusions
It is not well understood how shift work affect carcinogenesis and could favour receptor positive or negative breast cancer. Animal and in-vitro testings have provided a large number of putative biological mechanisms, but epidemiological studies even failed to address whether specific shift schedules cause continuous reductions in melatonin concentrations leading to raised estrogen levels which favor the development of breast cancer. In our case-control study, long term night shift work significantly increased the risk for ER-negative only but not for ER-positive breast cancers. However, the low prevalence of night work and potential confounders limit the validity of the results.
ORAL SESSION VIII:
Interventions
Objective
Tata Steel in the Netherlands implemented a new 5-shifts roster in 2006. Before implementation, the company applied a backward rotating NNN--EEE--MMM-- roster, with two days off after each sequence of duties. Because of expected health risks in this roster, the medical department proposed a new fast forward rotating MMEE-NN--- roster that was implemented as an experiment. In our presentation we present the evaluation of the new roster three years after implementation.

Method
The effects of the roster are evaluated by means of data derived from the company's registers: occupational accidents, sickness absence and health check data. Data cover one year before and three years after implementation of the new roster, and involve 11,000 employees in the 5-shifts system (43%), in other 2- and 3-shifts systems (2%), in daytime production jobs (14%) and daytime office jobs (41%). Comparisons are made between the 5-shifts group and: (1) the daytime production group and (2) all other employees.

Results
The new roster revealed positive effects in the first year after implementation. Health status and sickness absence improved, in particular for the employees of 50 years and older (1). In the second year after implementation the volume of the effects diminished, but relationships with musculoskeletal complaints, work stress, and 8-28 days absenteeism were still present. Age-related effects were not significant any more. In the third year after implementation, only the effects on work stress and absenteeism were significant. There was a raise in health complaints probably due to the economic recession that was felt most directly in the 5-shifts group.

Conclusion
Positive effects are found, but diminish over years. The explanation of results is limited by the small number of variables available in the registers. Data may contain selection effects because shift workers with health problems are placed in the day work group. The influence of selection effects will be discussed in another presentation. Particular attention will be given to age-related effects.

This study is part of the Shift Your Work project, aiming to design and implement new night and shift work rosters to reduce specific shift work problems of older workers in different organizations in the Netherlands.

References
Effects on sleep by melatonin treatment in adolescents with DSPS

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Objective
Assessing the effects of melatonin intake on sleep length, sleep onset and offset among adolescents, screened for having a delayed sleep phase syndrome (DSPS).

Methods
Students from eighth grade in primary school classes to second year of high school filled out a questionnaire on sleep (range 14-19 years). Twenty-three students with delayed sleep phase syndrome (DSPS) symptoms were selected. Inclusion criteria were inability to fall asleep before midnight several nights a week and long delayed sleeping times on weekends. Students, divided into two groups, were followed in a 5-week crossover design, starting with a baseline week, melatonin/placebo intake week (1 mg of melatonin at 18:00h), wash out week, placebo/melatonin and finishing with a melatonin/melatonin intake week. During the experiment students were followed with sleep diaries and provided saliva samples for melatonin analyses. Samples were taken at individually set times in the morning and in the evening at the end of each experimental week. ANOVA for repeated measures and post-hoc testing was calculated using the factor week (5 weeks) against sleep variables and squared-root melatonin, using Huynh-Feldt corrections. Sleep analyses were performed separately for schooldays (SD) and weekends (WD).

Results
Sleep was significantly affected by condition. Post-hoc tests showed that on schooldays sleep length was increased by 0.5 hour in the melatonin condition compared to placebo (p=0.030). On the weekends the difference increased to 1 hour (p=0.019).

Similar results were found for sleep onset. Post-hoc tests showed that on schooldays sleep onset was advanced by 45 minutes in the melatonin condition compared to placebo (p=0.000). On the weekend the difference was 1.15 hour (p=0.003). No significant condition effect on sleep offset was found.

Morning melatonin levels (mean/se=4.47/0.51 pg/ml) were not reduced in the first week of melatonin intake compared to placebo (mean/se=5.07/0.73 pg/ml). However, a significant reduction on melatonin levels was observed in the second week of melatonin intake (mean/se=2.89/0.55 pg/ml; p=0.006).

Evening melatonin levels were increased in the first week of melatonin intake (mean/se=5.00/0.46 pg/ml) compared to placebo (mean/se=3.95/0.60 pg/ml; p=0.052).

Conclusion
Melatonin treatment seemed to decrease DSPS symptoms, increased sleep length and advanced sleep onset on both schooldays and weekends.

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Night-work and inflammatory markers

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Objectives
Various adverse health effects associated with shift work have been documented in the medical literature. These include increased risk of cardiovascular disorders, inflammatory disorders, cerebrovascular disorders, and mortality. Sleep deprivation has been shown to be associated with an elevation in inflammatory makers such as Interleukin 6 (IL-6), Tumor necrosis factor-alpha (TNF-α) and C-reactive protein (CRP). It is hypothesized that the increased risk of many disorders associated with shift work may be due to inflammatory processes resulting from sleep deprivation. The purpose of the present study was to investigate the relationship between night work and inflammatory markers.

Materials & methods
Fifty workers were selected according to specified inclusion and exclusion criteria and randomly assigned to one of two groups in a cross over study. The 25 workers in group one were scheduled to work the following consecutive shifts: 3 days shifts, 1 day off and 3 night shifts. The 25 workers in group two were scheduled to work the following consecutive shifts: 3 night shifts, 1 day off and 3 day shifts.

Blood samples were obtained between 7 and 8 AM after the periods of day-work and night-work and tested for inflammatory markers.

Results
There was a statistically significant increase in IL-6, CRP, White blood cells (WBC), neutrophils, lymphocytes and platelets following night work compared to day work. TNF-α was increased but it was not statistically significant, and also the change in monocytes count was not significant.

Conclusion
This study demonstrated an increase in inflammatory markers following night work, as reported in several pervious studies on sleep deprivation. No significant changes in monocyte count can be justified by the results of a study showed the elevation in blood levels of inflammatory markers is due to increase in gene expression, not in monocytes count.

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Employee priorities when scheduling own shifts

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Objectives
Self-scheduling is hypothesized to improve health. Nevertheless, the results from previous intervention studies have not unequivocally supported this theory. One hypothesis is that employees do not prioritize their health and restitution when they are scheduling their own shifts. Therefore, the first aim of this paper was to investigate quantitatively how employees prioritize when they schedule their own shifts and to which extent priorities depend on having a partner/children, educational level, and age. The second aim of this paper was to investigate qualitatively the employees’ opportunities for considering their private needs when scheduling their own shifts.

Method
We used follow-up questionnaire data from an intervention study aiming at investigating the effect of introducing self-scheduling. The 440 participants in the intervention group, who responded to the follow-up questionnaire, were asked to what degree they considered different aspects of their family/private life, economy, job content, health, or sleep when they were scheduling their own shifts. In addition, we conducted interviews with a total of 41 participants from eight workplaces. In these interviews we investigated the employees’ use of their flexibility together with the perceived opportunities and constraints related to this use.

Results
Our preliminary analyses demonstrated that when doing self-scheduling the participants were primarily taking the following aspects into consideration: family life (88.6%), time for restitution between shifts (86.5%), having consecutive time off (80.6%), leisure time activities (74.5%), sleeping rhythm (67.7%), the regularity of their everyday life (66.1%), and health (65.5%). Having a partner or children, gender, educational level, and age influenced how the employees where scheduling their own shifts. The qualitative data showed that the employees did not always have the opportunity to schedule their shifts according to their own needs.

Conclusion
This study demonstrated that family life and the scheduling of leisure time were most often taken into consideration when the employees were scheduling their own shifts, but a majority of the employees also considered their health and opportunities for sleep and restitution. Nevertheless, under some circumstances, employees also had to schedule their own shifts according to the workplace’s staff demands.

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Developing and Coordinating Cyclic Individual Rosters with the Shift Plan Assistant 7.0

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Objectives
Two essential approaches improve the fit between shift schedules and private time: a) with a stable cyclic roster employees can adjust (mid-long-term) family and recreational activities to their working times and b) by self-scheduling in accordance with individual preferences their working times to (short-term) family and recreational activities. In (1) the first is “characterized” as a system prevailing in “paper mills” and the second as “a market like approach”. Both approaches have their benefits, so we wanted to explore possibilities to combine them.

Since individual preferences are often quite constant over time (e.g. preference for morning/evening shifts, swimming every Tuesday evening), more win-win situations might be established by a (moderated) process of developing several coordinated rosters. Reusing these e.g. for a year justifies more planning effort and still renders them more efficient than developing rosters in monthly/bi-weekly rhythms. Ideally the benefits of both planning approaches can be combined to a large extent.

In this study we: 1) demonstrate potential benefits of using coordinated individualized cyclic rosters and 2) show how their development and coordination are facilitated by the View Manager in the Shift Plan Assistant© 7.0.

Method
We will discuss two cases, where computer aided shift scheduling helped to develop coordinated individualized cyclic rosters that established win-win situations for different “interest groups”. The use of special features of the Software Shift Plan Assistant© 7.0 for deconstructing a scheduling problem into smaller problems and composing the partial solutions into a whole thus comparing the different rosters within the same frame work and checking whether a maximum of individual requirements can be met, will be demonstrated.

Results
In the first example from the health sector we developed individualized rosters that share a common distribution of weekend duties. The second example from the transportation sector exemplifies the usefulness of the Shift Plan Assistant© 7.0 for developing several interdependent rosters for different age groups.

Conclusions
The methods developed contribute to better working times because they help to converse identified complementing requirements of different (groups of) employees (e.g. reducing night shifts in general for older employees in exchange for more Saturday shifts) into coordinated individualized cyclic rosters.

References

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SPECIAL SESSION IV:
Light and individual differences in shift workers
We are all shift-workers

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The circadian clock is a fundamental biological programme that controls, organises and modulates every aspect of life, from cellular metabolism to complex behaviour. Although significantly influenced by social time, circadian clocks are predominantly synchronised to the 24-hour day by light and darkness ("zeitgeber"), so that the clock of individuals within a time zone delays from east to west in parallel to dawn and dusk. This means people are falling asleep and waking up later towards the west within a given time zone despite having to go to work/school at the same times (notably, the prevalence of depression shares similar clines within time zones).

The internal, circadian time shows large inter-individual differences ("chronotype"), manifested as the time (phase) at which the clock settles itself into the daily light-dark cycle. Chronotypes show a normal distribution in the population, and the differences between the extreme "owls" and "larks" (documented by their habitual sleep times on work-free days) can be up to twelve hours. The genetic differences in chronotype are exacerbated by weak zeitgebers (e.g., by predominantly working indoors). Individuals in industrialised societies are exposed to zeitgeber strengths that are up to 1000-fold weaker than in rural populations. As a consequence, the entrainment of the circadian clock is drastically changed in relationship to local, social time.

Not only long-term shift-workers suffer from circadian rhythm and sleep disruption, a condition referred to as "social jetlag". Approximately 60% of the Central European population have traditional work times that impose a more or less permanent early shift, and many people work in shift schedules to keep up with the 24h economy. These economic drivers, in combination with weak zeitgebers and individual chronotype, generate increasing levels of social jetlag. The consequences compromise sleep (both duration and quality), result in learning and memory deficits, challenge to the immune system, lead to a higher risk for the metabolic syndrome, diabetes and obesity, increase nicotine and alcohol consumption, and decreases in performance.

New approaches in work-time management have to develop more individualised schedules to minimize social jetlag and allow individuals to sleep within their specific circadian windows.

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Sleep duration, genetics and metabolism

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Objectives
Extremes of sleep duration and chronotype have been associated to adverse health outcomes that characterise the metabolic syndrome. Body homeostasis and circadian rhythm are though to interact to regulate these phenotypes, but little is known about the molecular mechanism behind it. We thus investigated the association of the genome-wide variability of independent populations with their sleep duration habits.

Methods
We conducted genome-wide association studies (GWAS) in 7 European populations. To investigate functional relevance, we produced a Drosophila knockdown for a homologue of the gene found to be associated with sleep duration.

Results
We identified a variant in the ABCC9 gene that explains ≈ 5 % of the variation in sleep duration. We found supportive evidence in a subgroup of an independent de novo replication cohort, which we selected based on gene-environment (time of year) and chronotype interactions. RNAi knockdown experiments of the conserved ABCC9 homologue in Drosophila neurons reduced flies night sleep duration by 3h.

Conclusions
ABCC9 regulates sleep duration in humans and Drosophila. Nevertheless, different chronotypes may adjust differently to environmental clues, and thereby influence sleep duration. Therefore, scanning only for main effects on sleep duration, one might miss important genetic variants specific to subgroups of the population. ABCC9 is involved with energy homeostasis, and the susceptibility to overweight and cardiovascular disease, which correlate with sleep duration. The relation of these genes to metabolism and disease indicates a common mechanism for the regulation of these phenotypes and sleep duration.

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Individual variability in the photic adjustment to atypical work schedules

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Objectives
Individuals vary greatly in their physiological capacity to tolerate work on atypical shifts. We hypothesized that light exposure is a major contributor to the resetting of central and peripheral circadian clocks and impact the degree of sleep-wake disturbances. The results of two field and one laboratory studies are presented to address this issue and illustrate the inter-individual variability in circadian resetting.

Methods
Experiment 1: 15 night nurses (mean age ± SD: 41.8 ±7.9 years; 9 controls and 10 intervention) worked ~12 non-consecutive 8-h night shifts as part of a permanent schedule. The intervention consisted of bright white light exposure and morning neutral grey density goggles. Diurnal sleep was measured at home by Nightcap or polysomnography. Circadian phase was assessed at the start and end of study by constant routines.

Experiment 2: 15 police officers on patrol (~30.1 ±5.2 years; 9 controls and 8 intervention) worked 7 consecutive 8-h shifts as part of a rotating schedule. The intervention consisted of bright white light, orange-tinted goggles at sunrise, and a regular sleep schedule. Diurnal sleep was measured at home by wrist actigraphy. Circadian phase was assessed at the start and end of study by constant postures.

Experiment 3: 5 healthy young men (24.9 ± 4.8 years) participated to a simulated shift work experiment during which they underwent 3 serial 24-h blood sampling procedures and were exposed to an 8-h bright light session for 8 nights. Plasma melatonin and cortisol were assayed 1x/h and PBMCs collected 1x/2h for the measurement of circadian clock gene expression.

Results
Following night shifts, treatment nurses had longer diurnal sleep duration (Mann-Whitney, p=0.05) and greater circadian phase delay (t-test, p=0.04) than control nurses. Sleep duration and circadian phase shifts were comparable between the two groups of police officers, although psychomotor vigilance was more stable in the treatment group. At the end of study, the rhythmicity of PER1 and PER2 expression in PBMCs was in a conventional relationship with the shifted sleep/wake schedule. Inter-individual variability was observed in the resetting of clock genes in PBMCs.

Conclusion
Daily light exposure and individual factors associated with atypical work schedules affect the temporal alignment between markers of the central circadian pacemaker, peripheral oscillators, and the sleep-wake schedule.
Adapting to shift work in conditions of extreme daylength

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Most shift workers in temperate regions do not adapt the circadian system to night work, as assessed by the rhythm of 6'-sulphatoxymelatonin (aMT6s) in urine. In contrast night work on an Antarctic base (Halley, 75oS, 2000-0800h) is characterised by apparently complete adaptation in the majority of individuals within a week. Readapting back to dayshift can take weeks, with large variations between individuals. When delays occur to readapt this could be described as a period of free-running following night shift. A similar situation occurs on North Sea oil installations, specifically when working 1800-0600h. Average shifts of approximately 12 h in the timing of the aMT6s rhythm have been found on different installations, but with great individual variability. Different shift schedules have different circadian characteristics, even a one hour difference in schedule timing, 1800-0600h to 1900-0700h, can modify the response and seasonal variations have been reported. These responses are probably due to lack of natural daylight in the Polar winter, to short winter photoperiods in high North Sea latitudes, and to social isolation in both cases. This situation has enabled us to characterise some postprandial responses in adapted and unadapted workers thereby identifying risk factors for heart disease in shift workers. We have tried to facilitate readaptation to day shift by timed light treatment in a restricted number of subjects. A skeleton light treatment after a week of night work hastened return to day shift circadian status and sleep was improved by a block of light treatment during mornings after night work, with variable circadian responses, in Antarctica. A single light pulse theoretically timed to phase advance the circadian system after two weeks of night work in the North Sea also improved sleep, without significant circadian effects. Timing light treatment was difficult even with prior assessment of individual adaptation to the same schedule. We have investigated the reasons for individual differences in response to the same conditions. Diurnal preference influences the rate of delay to night shift in Antarctica and initial phase at the start of night shift in the North Sea was associated with the direction of readaptation to day shift. Current investigations include possible relationships of a variable-number tandem-repeat polymorphism in PER3 to adaptive responses since these variants are associated with diurnal preference (PER3 5/5: morningness, PER3 4/5: intermediate, PER3 4/4: eveningness). For references see Arendt J., Occ Med 2010;60:10–20; Thorne et al., Sleep Biol Rhythms 2010;8:212-221.

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ORAL SESSION IX:
Sleep, sleepiness and lifestyle
Subjective and objective measures of sleepiness during three different shift work schedules in offshore oil rig workers

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Objective
Shift work is associated with negative health, and night shift in particular is associated with sleepiness and reduced performance. The aim of this study was to examine sleepiness in relation to three different shift work schedules from the offshore oil industry.

Method
19 oil rig workers were measured with both subjective (the Karolinska Sleepiness Scale and the Accumulated Time with Sleepiness) and objective measures (reaction time tests) of sleepiness during three different shift work schedules in a within subject design. Subjects worked two weeks offshore followed by four weeks off work. The following work schedules were compared: two weeks of 12 h day work (day shift), two weeks of 12 h night work (night shift) and two weeks of swing shift work (one week of night work followed by one week of day work). The three schedules were compared using 2-way and 3-way ANOVAs.

Results
Workers reported increased levels of sleepiness during the first days of night and swing shifts, and also increased levels of sleepiness in the middle of the work period during swing shift. After returning home following the two week work period, the workers reported significantly more subjective sleepiness after the night shift than after day or swing shifts. Objective measures of sleepiness during the two work weeks showed no significant differences between the three shift schedules. There was a significant difference concerning objective sleepiness across work days, with a significantly shorter reaction time measured on the last day of a work period compared to the beginning as well as in the middle of the work period.

Conclusion
Subjective sleepiness was increased during the first days of night and swing shifts compared to during day shifts, and also in the middle of the work period during swing shift. However, objective reaction time tests showed no differences between the shift schedules. Subjective sleepiness was increased at home following night shifts as compared to after day and swing shifts, suggesting that swing shift workers adapted their circadian rhythm during their second work week offshore.

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Does impression management impact the relationship between morningness and self rated alertness?

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Objectives
New measures of morningness require extensive assessment to ensure they are reliable and valid before being widely used. The ‘morning affect’ scale (1) is a four-item measure based on the Composite Scale of Morningness. The first objective of this study is to replicate and validate this scale in a working sample and secondly, to examine whether the relationship between morningness and self rated alertness is influenced by impression management (2).

Methods
Participants working at a nickel processing plant completed a survey that collected demographic data, responses to the composite scale of morningness, the impression management (IM) scale and the Karolinska Sleepiness Scale at 2-hourly intervals. Structural equation modelling (SEM) was used to confirm the factor structure and multivariate general linear modelling examined group differences (morningness and impression management) in alertness.

Results
One-hundred and ninety one participants (102 males, 89 females) completed the survey. Mean age was 36.28 years and participants worked a mean 40.91 hours/week. 137 participants worked day shift only and the balance worked shift work. The SEM results indicated the ‘morning affect’ factor fitted the data $\chi^2(7, n=191)=12.68, p>.05)$. A significant effect was found for morningness as expected ($p>.04$) and for IM ($p>.001$) with those scoring high on this scale reporting significantly more alertness during the morning period. The interaction between morningness and IM management was not significant. Both morning and evening types that scored high on IM reported greater alertness across the day.

Conclusion
The factor structure was replicated in a working sample. As expected morning types were more alert during the early hours while evening types were more alert at night. Participants scoring high on IM also rated themselves more alert at all time points. The failure to find an interaction effect between morningness and IM suggests that self reported alertness ratings can be used as indicators of construct validity. Nonetheless, future studies should employ objective markers of adjustment to determine construct validity for the morning affect factor.

Job stress and serum leptin concentration among lorry drivers

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Objective
Leptin is a hormone involved in energy balance, which can be influenced by many factors such as food intake, meal timing and obesity. Moreover, like cortisol, it has been suggested that leptin is involved in the regulation of the stress response. This cross-sectional study aimed to analyze the relationship between leptin and job stress among day shift and irregular shift working lorry drivers.

Method
In a cross-sectional study, the participants were 57 male drivers (39.8±6.6yrs), 31 of whom worked irregular shifts and 26 who worked the day shift. The drivers completed questionnaires about sociodemographics, lifestyle, and job content, including Karasek’s job stress scale. They provided a fasting blood sample for leptin analyses, which was collected once at 7:00 h. BMI was derived from height and weight measurements made on each participant. Sleep data were collected by actigraphy.

Results
Job control was found to be negatively correlated with leptin (p=0.02) only for the day workers. Irregular shift workers had significantly less job demand and job control compared to day workers (p<0.05). Social support was similar between the two groups of workers. The average sleep duration for the day and irregular shift workers was 400±89 min and 415±77 min, respectively. There were no significant differences between the groups in the actigraphic sleep parameters (ttest, p>0.05). Crude levels of leptin were significantly higher (p=0.04) among irregular shiftworkers (3179±2413 pg/mL for day workers and 5205.4±4181 pg/mL for irregular shiftworkers). An interaction between type of shift and categories of job stress scale was observed to predict leptin levels (p=0.04 by ANCOVA, adjusted by age, number of meals and sleep duration). Post hoc comparisons showed significantly higher levels of leptin among irregular shiftworkers than day workers who have low strain. A second model considering BMI and categories of job stress scale as factors (adjusted by age, type of shift, and number of meals) showed a significant effect of BMI on leptin concentration (p<0.00).

Conclusion
Although the results of this study do not allow us to corroborate a link between stress response and leptin levels, an impact from the categories of the job strain model on levels of leptin was found. Moreover, the higher levels of leptin among the shiftworkers compared to day worker might indicate a circadian misalignment. In any case, these results indicate that BMI has more influence on leptin levels than stress-related factors. Support: CNPq

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Objective
Fatigue has been linked to adverse safety outcomes and poor quality or decreased sleep has been associated with obesity (higher body mass index (BMI)). Using the US National Health Interview Survey (NHIS), we examined the risk of a work-related injury as a function of total daily sleep time across categories of weekly work hours and BMI.

Methods
The NHIS is an in-person household survey using a multistage, stratified, clustered sample design representing the US civilian population. During the survey period 2004-2009, 83,472 adults, reported their total work hours during the prior week, usual daily sleep hours, and height and weight (for BMI), and whether they had a work-related injury in the past 12 months. Weighted annualized work-related injury rates were estimated across a priori defined categories of daily sleep, stratified by BMI categories: healthy weight (BMI: <24.99), overweight (BMI: 25-29.99), and obese (BMI: >30). To account for the complex sampling design, weighted multiple logistic regression was used to estimate the risk of a work-related injury as a function of usual daily hours of sleep controlling for body mass, weekly work hours, age, sex, race/ethnicity, education, pay type, and occupation.

Results
There were an estimated 129,723,086 workers annually at risk with an overall injury rate of 2.71/100 workers. Comparing obese to healthy workers across categories of daily sleep duration, the estimated annualized injury rates (per 100 workers) were: 6.41 vs. 4.75 (<6 hours sleep), 4.76 vs. 3.35 (6-6.9 hours), 2.79 vs. 1.60 (7-7.9 hours), 3.50 vs. 2.04 (8-8.9 hours), and 3.02 vs. 3.65 (9+ hours). In the weighted logistic regression model, significant increases in risk per decrease in sleep hour category were observed after controlling for categories of weekly work hours (p < 0.04) and BMI (p < 0.005) and the aforementioned covariates. Using 7-7.9 hours of sleep as the referent period, the adjusted injury risk (odds-ratio) for a worker sleeping a total of <6 hours per day was OR = 1.92 (95% CI: 1.39-2.65), and for 6-6.9 hours was OR=1.54 (95% CI: 1.21 – 1.95). No other sleep hour categories were significantly different than the referent.

Conclusion
These results from a large representative sample of US workers suggest an increase in injury risk for decreasing total daily sleep hours adjusting for body mass, weekly working hours, gender, age, ethnicity, education, pay type, industry, and occupation.
Shift work disorder - operationalization, prevalence and related health outcome in nurses

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Objectives
Shift work disorder (SWD) is defined by the International Classification of Sleep Disorders (ICSD-2) as sleepiness or insomnia, attributable to a work schedule (WS) overlapping with the usual time for sleep, where the symptoms have been present for at least one month. We explored three different SWD operationalizations, the SWD prevalences and associations to variables concerning work, health, and personality.

Methods
In this cross-sectional questionnaire study, 1998 nurses (response rate = 38.1%, counting 90.2% females) reported age, gender, information on WS, commuting time, weekly work hours, presence of children in the household, number of nights worked the last 12 months, number of shifts separated by less than 11 hours off duty, sleep medication use, and completed the Bergen Insomnia Scale (BIS), the Epworth Sleepiness Scale (ESS), the Global Sleep Assessment Questionnaire (GSAQ), the Diurnal Scale, the Revised Circadian Type Inventory (languidity and flexibility), the Dispositional Resilience (Hardiness) Scale—R, Fatigue Questionnaire, the Hospital Anxiety and Depression Scale and alcohol consumption (AUDIT-C). Based on the ICSD-2, we investigated three different SWD operationalizations; i) adopting three previously used symptom based questions (1); ii) additionally controlling for other sleep disorders (using GSAQ); or iii) additionally having clinical levels of insomnia or sleepiness as inclusion criteria (in this study assessed by BIS and ESS).

Crude and adjusted logistic regression analyses were performed with each SWD operationalization as the dependent variable.

Results
SWD prevalence rates for the whole sample varied between 31.7-37.5% depending on the operationalization and between 4.8-44.3% depending on WS. Positive relationships were found between SWD and night work, age, number of shifts separated by less than 11 hours off duty, number of nights worked the last 12 months, languidity, insomnia and anxiety. Flexibility and being female were negatively related to SWD. Similar results for prevalence and regression analyses across different operationalizations suggest that the three symptom questions alone adequately assessed symptoms.

Conclusion
A three-item symptom-based questionnaire appeared adequate for SWD assessment in epidemiological studies. The prevalence of SWD in nurses was high, and SWD was associated with work schedule, health, and personality.

Alcohol Consumption in Shiftworkers Compared to Dayworkers

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Objectives
The detrimental effects of excessive alcohol consumption are well documented. There is evidence that shiftworkers consume more alcohol than dayworkers, using alcohol as a sleep aid to compensate for sleep difficulties associated with shiftwork schedules. This study investigated drinking patterns in people working outside a typical Monday-Friday daytime work schedule, compared to dayworkers.

Method
This study included the 2006 and 2007 waves of the Household Income and Labour Dynamics Survey of Australia, which has a sample representative of the Australian population. A subset of workers who were not in full-time study and worked a single job were selected, excluding participants who did not drink alcohol (1262 male, 1007 female, mean age=41.6y SD=11.3y). Using the 2001 Australian Government alcohol guidelines, which were in effect during data collection, alcohol consumption for risk of short-term harm (7+ standard drinks for men and 5+ for women) was investigated. The number of people who drank alcohol nearly every day or every day was also examined.

Results
Nearly 11% of participants reported consuming alcohol at levels risky for short-term harm. Having a child less than 17 years (OR=0.53, 95%CI=0.32-0.88), higher job demands (OR=0.74, 95%CI=0.61-0.89), working more hours than preferred (OR=0.58, 95%CI=0.36-0.95) being female (OR=0.47, 95%CI=0.27-0.81), and being older (OR=0.89, 95%CI=0.87-0.92) were associated with a reduction, and being a shiftworker (OR=2.05, 95%CI=1.18-3.57) with an increase in the odds of drinking alcohol at short-term risky levels.

Nine and a half percent reported consuming alcohol at short-term risky levels at least weekly. Having a child less than 17 years (OR=0.39, 95%CI=0.21-0.72), higher job demands (OR=0.70, 95%CI=0.55-0.88), being female (OR=0.29, 95%CI=0.16-0.54), and being older (OR=0.91, 95%CI=0.88-0.94) were associated with a reduction, and increased work-family strains (7-point scale, OR=1.33, 95%CI=1.11-1.60) and being a shiftworker (OR=2.26, 95%CI=1.64-4.39) were associated with an increase in the odds of consuming alcohol at such risky levels at least weekly.

Nearly 18% reported consuming alcohol in any amount near daily or daily. Working more hours than preferred (OR=1.64, 95%CI=1.10-2.44) and being older (OR=1.09, 95%CI=1.07-1.12) were associated with an increase, and being female (OR=0.22, 95%CI=0.14-0.37), and being a shiftworker (OR=0.35, 95%CI=0.20-0.61) were associated with a decrease in the odds of consuming alcohol daily or near daily.

Conclusions
Results suggest that shiftworkers may be more likely to consume alcohol at levels considered to be risky for health in the short-term. In contrast, they appear less likely to drink alcohol daily. This is suggestive of a ‘binge drinking’ pattern of behaviour.

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Performance Protection: Individual fatigue management strategies in coastal pilots

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Objectives
Coastal marine pilotage operations in Australia currently require pilots to be on board for the length of the passage. Trips vary greatly in length from eight hours and in some cases trips can extend beyond thirty-six hours. The fatigue-related risk associated with such extended work hours has implications for pilot performance and therefore the safety of the ship, the crew and the delicate marine environment in which the ships travel. However, despite the long work hours, for the most part pilotages occur without incident. This apparent paradox suggests that there are likely to be specific strategies utilised to protect performance and maintain safety even whilst fatigued. The current study investigated the strategies that pilots employ while on board to manage their individual fatigue-related risks.

Methods
Seventeen coastal marine pilots participated in individual or small group interviews either in person or over the phone. The aim was not to test pre-defined hypothesis but to conduct an exploratory qualitative data collection process. The interview data underwent thematic analysis to define key themes in performance protection.

Results
The evaluation of the interview data revealed eight key themes describing strategies used to manage fatigue risks. The themes were: napping, rest/break, caffeine, mental engagement, physical stimulation, team strategies, maintaining a dynamic and accurate mental model, and the use of technological performance aids.

Conclusions
The strategies described by the pilots may be an effective additional layer of defence against fatigue-related risk inherent in the working time arrangements. Potential applications of this research focus on formalising these strategies in procedure design, pilot training, and regulation of minimum equipment specifications.

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ORAL SESSION X:

Light at night
The complexities of studying light at night

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The reported association between night work and cancer has focussed attention on the effects of “light at night” as a possible, though unproven, link between the two. In highly controlled laboratory studies, light at night has been shown to suppress the nocturnal production of melatonin as well as increase core body temperature, heart rate, alertness and performance. These acute effects of light depend on light intensity, duration and wavelength as well as the clock and circadian time that the light is delivered. Appropriately timed, light also has the ability to delay or advance the timing of the circadian clock according to the light phase response curve.

The acute and phase shifting effects of light can be utilised to offer some benefits to working at night. Simulated shift-work studies and field studies of shift workers have demonstrated increased night-time alertness and performance administering light at night. Appropriate timing of the light (in the early part of the night shift) and avoidance of light (in the late part of the night shift and during the morning commute home) have aided circadian adaptation to the night shift providing better daytime sleep.

A person’s response to a light stimulus, however, is highly individual depending on inter alia age, chronotype, diurnal preference, clock gene polymorphisms and previous photic history (season; sleep/wake cycle; outdoor light exposure). Predicting the effect of light at night on a worker is thus not trivial and requires detailed knowledge of the work environment (lighting levels); the work schedule (night breaks; days off; rotating shifts; permanent night work) and the individual (chronotype; age; photic history). Recent developments in measurement tools, e.g. portable light sensors to measure the work environment (Hobos) and individual light exposure (lux levels (e.g. Actiwatch); spectral composition (e.g. LightWatcher)); saliva melatonin kits; The Munich ChronoType Questionnaire for shift work (MCTQshift), will assist in collecting the necessary data to address the question of the beneficial and adverse effects of light at night and its relationship, if any, to night work and cancer.

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Dynamic light in quickly rotating shiftwork, effects on alertness and sleep

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Objectives
To improve alertness, sleep and adaptation to rotating shiftwork, a new dynamic light regiment adjusted to current work hours was tested.

Methods
The illumination level in a control room at a nuclear power station was about 200lux at straight horizontal gaze. In a small part of the control room above the positions of the reactor operators new lightning equipment was installed. The new lights were in major part shielded from other operators also working in the same room. The new lights were designed to give three different light exposures; 1. White strong light, 1050lux at 90o horizontal gaze, 6000K. 2. Weak yellow light, 650lux, 3000K. 3. Yellow moderate light, 700lux, 4000K. The fitting consisted of five Savio™ armatures including Philips lightning (AktiViva Natural, 54W, 16mm and TL5, 827, 54W, 16mm). In a cross-over design the old and new light exposures were given in connection to a sequence of three night shifts, two free days and two morning shifts (NNN++MM) and with 7 weeks in-between sessions. The operators consisted of two groups, 7 reactor operators from seven work teams were at one time exposed to the new equipment and 16 other operators were used as controls. The study was conducted during winter months with no opportunities to receive day light exposure during work, after night work or before morning work. Operators were given actigraphs and filled in a sleep/wake diary. The exposure group had a mean age of 50,2 ranging from 42-57 yrs, the control group had a mean age of 46 yrs ranging from 30-62 yrs. ANOVAs were calculated in connection to night work, free days and morning work using the factors group (exposed reactor operators/non-exposed other operators) and light (new/old exposure).

Results
Results from the wake/sleep diary showed that the new light treatment increased alertness in connection to the second night shift night (interaction group x light x time, p<0.01). Time of waking was delayed in the light condition after the third night shift (group x light, p<0.05) but amount of wake time during sleep increased after the second night shift (p<0.05), also showing a tendency to affect sleep efficiency (p<0.10)

Conclusion
In conclusion it seems that appropriate dynamic light in windowless rooms during the dark Nordic season may promote alertness, sleep and better adaptation to quickly rotating shiftwork.

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Light at night exposure and melatonin levels among Canadian rotating shift nurses

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Objectives
Shift work has been identified as a risk factor for several cancer sites in recent years. While the exact biologic mechanism for this relationship is still unknown, the main hypothesis involves melatonin, a hormone that follows a circadian rhythm, with peak levels observed at night. The purpose of this research was to examine the influence of light at night exposure on melatonin levels among rotating shift nurses.

Methods
123 nurses at Kingston General Hospital working a rotating shift schedule (two 12-hour days, two 12-hour nights, 5 days off) were recruited. Nurses participated four times over a one-year period, on a day and night shift in both the summer and winter seasons. Over a 48-hour study period nurses wore light data logger and provided two urine and four saliva samples. Mean light intensity from 12AM – 5AM was assessed from light data loggers during a 24-hour period of melatonin assessment that covered either the first day shift or the second night shift of the rotation pattern. Since saliva measurements showed a pattern of melatonin that generally did not differ according to day/night shift, peak melatonin levels were assessed from morning urine samples in both shift groups and a variable describing the change in melatonin levels over this period was calculated.

Results
Mean light exposure was significantly higher (p < 0.0001) when nurses were working at night, although peak melatonin levels (p = 0.65) and the daily change in melatonin levels (p = 0.80) were similar across day/night shift groups. Multivariate analysis did not demonstrate an association between light exposure and melatonin levels in the full study population; however, when nurses were working their night shift, a statistically significant inverse relationship between light and change in melatonin was observed (p = 0.04), and an inverse relationship with peak melatonin levels was suggested (p = 0.07).

Conclusions
While no difference in melatonin production was seen between day and night shifts, a small inverse relationship between light exposure and melatonin production among nurses on the night shift was observed. These results demonstrate that light exposure does not appear to be strongly related to reduced melatonin production among nurses on this rapidly rotating shift schedule. Future research that considers more extreme shift patterns or brighter lighting conditions could further clarify the relationship between light exposure and melatonin production in observational settings.

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Rotating night shift work and 6-sulfatoxymelatonin in nurses and midwives

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Objectives
Synthesis of melatonin, a pineal gland hormone, follows circadian rhythm with high melatonin levels during the night and low during the day. Although, experimental studies have shown decrease in melatonin synthesis after light exposure, only few observational studies have been performed in human population, and their results are inconsistent. The aim of our study was to investigate the association between night shift work in nurses and midwifes, exposure to light at night and 6-sulfatoxymelatonin (MT6s).

Methods
The cross-sectional study included 356 nurses and midwifes currently working on rotating night-shifts and 369 women working during the days only. Details on the night shift work, frequency of the night shifts, napping and light exposure during the night shift as well as data on potential confounders were collected through a personal interview. MT6s levels were determined in the morning urine samples (ELISA assay, adjusted for creatinine). Associations between rotating night shift work characteristics and MT6s were tested in multiple linear regression models with log transformed MT6s as dependent variable. The potential confounders were retained in the models if they changed the estimate by more than 10%.

Results
No differences in the morning MT6s levels were found between current rotating night shift nurses and daily nurses (geometric mean (GM): 40.1 ng/mg creatinine, 95%CI: 36.9-43.1 vs 40.1 ng/mg, 95%CI: 36.9-43.2 respectively). Women working 8 or more night shifts per month had lower MT6s than those working less than 8 night shifts per month (GMs: 35.8 ng/mg: 27.3-44.3 vs 41.1 ng/mg: 37.6-44.5 respectively), this difference was seen in premenopausal women (32.9 ng/mg : 22.6-43.2 vs 43.3 ng/mg: 39.0-47.7), but not in post-menopausal and was statistically insignificant. Women reporting exposure to operational lamp or full light allowing reading at the current job, both pre- and postmenopausal, had MT6s lower than those who worked under dim light conditions, although the differences were statistically insignificant (39.5: 29.1-49.9 and 39.8: 35.0-44.7 vs 43.0: 37.6-48.4).

Conclusion
Preliminary findings of our study suggests that frequent rotating night shifts (≥8 per month) and exposure to bright light at night might disrupt melatonin synthesis, although definite conclusions are limited by statistical insignificance of the results.

The project is supported by a grant from Norway through the Polish - Norwegian Research Fund

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POSTER SESSION II
Night Work Among Nurses: Effects on BMI, Smoking, Alcohol, Caffeine and Exercise

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Objective
To study the relationship between night work and especially the number of nights worked during the last year (NNLY), and the following dependent variables: Body mass index (BMI), smoking (pack years smoked), alcohol consumption, caffeine consumption and high-intensity exercise.

Methods
The data used in this cross-sectional study were collected in a survey answered by 2059 Norwegian nurses (90.6% women). Response rate was 38.1%. Mean age was 33.1 years (range 21-63 years). Hierarchical multiple regression with three steps was used for analyses. Demographic factors (sex and age) were entered in step 1. Hours worked/week and children living at home (yes/no) were entered in step 2. Number of nights worked during the last year (NNLY) and duration of current night work (More than five years or five years and less) were entered in step 3. Dependent variables were BMI, number of caffeine containing drinks/day, alcohol consumption (AUDIT-C: a 3 question screening test for potential alcohol misuse), pack-years smoked among current smokers (one pack year equals 20 cigarettes daily in one year), and time of high-intensity exercise (more or less than three hours total workout per week). Separate analyses were done for each of the dependent variables. Chi-Squared test for Independence was used for evaluating high-intensity exercise.

Results
Using BMI as dependent variable in the hierarchical regression we found that step 1 (age and sex) explained 4.5% of the variance. Step 2 did not explain significant parts of the variance. After step 3 the model explained 4.9% of the variance $F(6, 1668)=14.18, p<.05$. Step 3 explained .3% of total variance in BMI, $F(2, 1668)=2.63, p=.073$. Evaluating each of the independent variables separately, NNLY was statistically significant and positively related to BMI (Beta =.055, p<.05). NNLY did not make a significant contribution in explaining the variance of any of the other dependent variables (smoking, alcohol, caffeine, exercise).

Conclusion
Our study showed a significant positive association between number of nights and BMI, suggesting that there may be a cumulative effect of night work on weight gain. We found no significant associations between number of nights worked and smoking, alcohol consumption, caffeine consumption and exercise. Caution must be taken due to methodological issues, i.e. data based on subjective reports.

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Psychosocial determinants of a positive side of work-family interface in shift working nurses

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Objectives
Majority of research concentrates on antecedents and outcomes of a negative side of work family interface. There is a shortage of research on a positive side of work/family interface especially in populations working non standard hours. The aim of this study was to find out which of job-, family-, and satisfaction-related factors can predict work to family and family to work enrichment in working shifts nurses.

Methods
The participants were 200 married and having children nurses aged between 22 and 52 years (average age 32.4 years) working at hospitals and medical centers of southern Poland. They worked 12 h day and night, quickly rotating shift system. Positive side of work-family interface which was a dependent variable was measured by Work-family Enrichment Scale (Carlson et al., 2006). Predictors were work stress factors measured by Effort Reward Imbalance Questionnaire (Siergist et al., 2004), family communication measured by Marital Communication Questionnaire (Plopa, 2008), and job and life satisfaction which were measured by Minnesota Satisfaction Questionnaire (Weiss et al., 1967) and Satisfaction With Life Scale (Diener et al., 1985). Multiple regression analyses (stepwise method) have been performed on the data.

Results
Around 40% of the variability (adjusted $R^2$=39.6%) in work/family enrichment have been predicted by job satisfaction (beta=0.49), satisfaction with life (0.35) and work rewards (job security) (0.28). The significant predictors of family/ work enrichment (emotions) have been supportive style of marital communication (beta=0.48), psychosocial work rewards (0.25), and respectful style of marital communication (0.24) accounting for over 30% of variance explained (adjusted $R^2$=31.9%).

Conclusions
Work to family enrichment has been found to be predicted to a substantial degree by satisfaction-related (job and life satisfaction) and work-related (job security) variables. Whereas family to work enrichment has been found to be predicted to some degree by family related variables (supportive and respectful family communication style) and work related variable (psychosocial work rewards).

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Blue-enriched light effect on daily course of alertness, mood and light perception – a field study

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Objectives
Laboratory studies provide evidence on blue light alerting and circadian effects on humans. There is a shortage of studies on the effect of blue light in real work situations. The aim of this study was to find out the effect of blue enriched white light (BEL) on the daily course of alertness, mood and light perception in real work settings.

Methods
The participants were 30 office female workers (mean age=26.8 years, SD=3.5 years) employed at the sales accounting passage of a big airlines office. The participants were divided into two groups and exposed to two light conditions (LC) in a counterbalanced order. There were BEL conditions and white light (WL) conditions lasting 3 weeks each. The variables under the study were measured three times a day (MT: 07:15 h, 12:15 h, and 14:15 h) on two days (Tuesday and Thursday) of each week. Alertness and mood were measured by means of Activation-Deactivation Adjective List (Thayer, 1978) and Mood Adjective Check List UMACL (Matthews et al., 1990). Lighting conditions were assessed by application of Light Perception Sheet (Knez, 1995).

Results
The opposite daily course of Energetic Arousal (EA) has been found in the BEL when compared to the WL conditions (LC x MT: F(2, 58)= 10.587, p=.001). In the BEL conditions EA was high at the beginning of the work day and decreased in the course of work day. The opposite was true for EA in the WL conditions. The tension increased sharper during working day in BEL that in WL conditions (LC x MT: F(2, 58)=4.155, p=.026).

BEL was assessed as more bright (LC x MT: F(2, 58)= 3.990, p=.036) and glaring (LC x MT: F(2, 58)= 4.287, p=.030) and less dark (LC x MT: f(2, 58)= 7.668, P=.002) than WL at the beginning and at the end of work day. At midday assessment of that three characteristics of both light conditions did not differ significantly. BEL was assessed as less soft (F(2, 58)=7.049, p=.006) and warm (F(2, 58)=6.597, p=.003) than WL at all MT.

Conclusions
More pronounced effect of BEL on alertness have been found at the beginning of work day and on tension at the end of work day when compared to the other times of the working day. At the beginning and the end of work day the workers seemed to be more sensitive to brightness of light while throughout the whole work day they seemed to be similarly sensitive to the color temperature of light.

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Fatigue risk: The influence of napping, depression and alcohol consumption outside of work

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Objectives
To examine the role of individual factors (i.e. depression; alcohol consumption outside of work; and napping) in adding to or reducing the fatigue risk of shift workers

Method
Three individual shift worker self-report surveys were conducted in two Australian open-cut mining (N= 164 and N= 244) and one underground (N= 173) mining operations. Depression was assessed using the Centre for Epidemiological Studies Depression Scale (Radloff, 1977) - a 20-item self-report checklist. Alcohol consumption was assessed using self-report responses about consumption relative to the shift being worked. Napping was assessed using 4-point Likert scale responses to survey items about the use of naps as a fatigue self-management tool.

Results
The results indicate that (a) depression is a significant issue and linked to fatigue risk; (b) excessive alcohol consumption is linked to increased fatigue risk; and (c), napping is symptomatic of poor and inadequate sleep and poor coping rather than an effective or sustainable fatigue management strategy.

Conclusions
The results are discussed in the context of the need for a frame of reference that includes life-style factors in addition to roster design and shift length when considering both the predictors of fatigue risk and the most effective strategies for managing fatigue risk with shift workers.

References

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**Prospective Cohort Study of Preexisting Sleep Disorders and Subjective Adaptation to Shift Work**

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**Objectives**
Previous reports suggest that there are individual differences in ability to adapt rotating shift work however, factors which affect the ability are still unclear. The aim of current study is to evaluate the relationship between pre-existing sleep disorders and subjective maladaptation to shift work among female workers who were being assigned to three-shift work for the first time.

**Methods**
This study was designed as a prospective cohort study. The subjects were 38 middle-aged female workers (age range: 44 to 59 years) who were working at a chemical plant. The shift system in place was that of four teams each working three shifts, consisting of three workdays and one rest day per shift. This pattern was repeated in a continuous counterclockwise circulation system. The women completed a self-administered questionnaire before starting three-shift work. By this baseline questionnaire Sleep initiation disorders, Sleep maintenance disorders and Sense of insufficient sleep were surveyed. Levels of adaptation to shift work were assessed by the question ‘Have you become used to the life rhythms of three shift work’?. The available responses were: ‘Very agree’, ‘Considerably agree’, ‘Rather agree’, ‘Slightly agree’, and ‘Not agree at all’ and 31% of the subjects gave one of the last two answers, which were defined as subjective maladaptation to shift work.

**Results**
Relative risk for subjective mal-adaptation to shift work were Sleep initiation disorders (RR=8.0, 95%CI: 1.5, 41.6, p=0.01), Sleep maintenance disorders (RR=1.4, 95%CI: 0.3, 6.3, p=0.71) and Sense of insufficient sleep (RR=2.9, 95%CI: 0.5, 16.2, p=0.28) respectively.

**Conclusion**
Sleep initiation disorders were significantly associated with elevated risk of subjective maladaptation to shift work. No significant relationships have been observed for the other two types of sleep disorders.

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Scheduled versus Actual Work/Rest Hours - Detecting Problem Zones by Explorative Data Analysis

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Objectives
Many studies focus on the impacts of work hours and rest times on health, risk, family life etc. Corresponding recommendations often found their way into legal requirements. However, even if schedules are developed according to ergonomic and legal requirements, actual working times do not always comply. Overtime and short-term changes often lead to long work hours and/or short rest periods.

Different Software packages enable checks of legal/ergonomic requirements and balances for (groups of) employees; e. g. (1) presents a tool for evaluating even highly irregular rosters. These approaches detect problems and partly quantify them, but hardly help in identifying “problem zones”, i. e. repeating patterns of unsafe actual working hours for large numbers of persons.

This study focuses on: 1) facilitating the evaluation of shift rosters, actual work/rest hours as well as possible gaps, legal violations or problematic ergonomic features for many employees over long periods of time; 2) testing assumed causal relationships with organizational features, etc. to have a starting point for improvements.

Method
Using methods from Explorative Data Analysis (EDA) we evaluate a vast number of work and rest hours over long periods of time and many employees. By combining this data with different attributes (e. g. department, day of the week/year, workload) we can extract valuable information about the dispersion of problem zones, patterns of deviation from the original schedule etc. This enables the improvement of the work force scheduling in a repeated process of evaluation and improvement.

Results
We will discuss two cases from the transportation sector to exemplify the usefulness of this approach. In the first example we analyse overtime over different groups and over a year. In the second example it can be shown that the number of ergonomically very unfavourable shift changes (night – 24 h off – morning shift) highly correlates with using a specific shift roster. Furthermore, even within the persons sharing the same roster, some individually problematic patterns and high variance can be seen.

Conclusions
The methods developed contribute to better working times because they facilitate the identification of problem zones, help to test theories of possible causes and thereby identify starting points for change.

References

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Sleepiness in Nurses Working 16-hour Night Shifts

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Objectives
In recent years, the system of working shifts for nurses in Japanese hospitals has rapidly changed from a conventional three-shift system to two-shift system. This change has been accompanied with a marked increase in the number of 16-hour night shift, which consist of the evening and night shift worked in succession. This study investigated the sleepiness in nurses working such a long night shift.

Methods
The present study was carried out in November and December 2010 in cooperation with medical workers’ unions. Three nurses worked the night shift per ward (42 beds) at which a 16-hour night shift had been introduced. Data were collected from a total of 145 nurses working in 10 wards of 9 hospitals for 5 days from Sunday to Friday. The number of actual cases was 148, since three nurses worked the night shift twice during the period. Workloads was determined from actograms and from subjectively assessed busyness recorded to an accuracy of 10 minutes time budget study. Sleepiness was evaluated by the time budget study also.

Results
The mean age ± standard deviation of the nurses was 33.6 ± 8.9 years. The actual on-duty hours per night shift included elective overtime was 18.8 ± 0.7 hours. On average, nurses started the shift at 15:28 ± 30 and finished at 10:19 ± 44. Three nurses took a nap at different times during night shift, starting around 22:00, 2:00, and 4:00. Actograms and busyness ratings followed a bimodal course during night shift, with two peaks at 18:00 and at 7:00. The highest sleepiness was at 5:20 (28.1%), followed by 9:10, 3:10, and 0:30. The time points of 5:20, 3:10, and 0:30 corresponded to the mean ending times for the three nap opportunities. The sleepiness during the busiest time period (5:50-8:10) occupied 12.4 %. This rate was higher than during the evening shift (2.6%).

Conclusions
In the 16-hour night shift, the nurses have highest sleepiness during the early morning hours, even evaluated as the busiest period based on higher actogram values, and also at the end of the night shift. We conclude that a 16-hour night shift may have certain benefits in maintaining circadian rhythm for daytime work, since the night shift occurs only once in 5 days and nurses can take a nap during the night shift (Minors et al,1981), however, it also resulted in frequent sleepiness during such a long night shift.

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**Psychosocial factors and gender are associated with working times among nursing professionals**

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**Objectives**
In recent decades, there has been a global trend to increased working times. This paper aims (i) to identify determinant factors and mediators associated with professional and total working hours (professional + domestic); (ii) evaluate the role of working hours associated with availability for leisure and rest, and health outcomes, based on an explanatory model describing the relations between the factors associated with working hours and health impacts (1).

**Methods**
A study was conducted in an University hospital during 2004-2005, among 696 nursing professionals (registered nurses and nursing aids). Females were the majority of the studied population (87.8%). Working times were fixed days and/or night shifts. Data collection included a questionnaire on sociodemographics, working and living conditions as well as information on: Job Strain (to evaluate demand-control and social support), effort-reward, over commitment (ERI), Work Ability Index, and the Medical Outcomes Study- Short Form-36. All four instruments were adapted to Brazilian Portuguese. Pearson $\chi^2$ and multivariate logistic regression analyses were performed to evaluate the associations between the variables.

**Results**
Income responsibility and night work (determinant factors) and effort-reward imbalance (moderator factor) were significantly associated with professional and total work hours. When working time was evaluated as exposure variable, it was significantly associated with insufficient time for leisure and not enough time for rest.

Working time was not associated with reduced work ability. Males showed longer professional working times than females, but no significant differences were observed regarding total working time.

**Conclusions**
Financial responsibilities, night work and effort-reward imbalance deserve being throughout evaluated in future nursing studies, as these professionals accumulate activities that can interfere on rest and leisure times. The overload interfering on leisure and resting times can also have negative consequences for males.

**Reference**

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Effects of chronic partial sleep restriction on error processing in saccadic task – an fMRI study

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Objectives
The aim of the study was to trace the consequences of chronic partial sleep restriction on the brain activity during error processing. Simultaneous eye movement and fMRI registrations enable to study behavioural and neural aspects of this phenomenon during a sustained attention task.

Method
The participants were 14 right-handed and right eyed female paid volunteers (age 24.1 ± 1.9). The fMRI scanning was performed in two conditions: chronic sleep deficit (SD, after 7 days of 3-hour-a-day reduced sleep) and rested wakefulness (RW). Imaging was performed on a 1.5 T GE Signa scanner. During scanning subjects were performing saccadic task consisting of 2392 targets (3:1 ratio of congruent to incongruent) presented on saccadometer panel. The experimental task was to direct one’s attention and gaze from fixation point only to targets preceded by cue. Participants were trained to ensure familiarity with the task. Reactions were classified according to subjects’ performance to following types: correct responses (HT), errors (ER) including omissions and incorrect reactions and false alarm responses. For each type of reaction and for both conditions maps of activation were created and averaged across subjects with corresponding t test (p<0.001).

Results
In all maps activation were present in presupplementary motor area (pre-SMA) and supplementary motor area (SMA) regions believed to be responsible for preparing and control movements and bilateral frontal eye fields (FEF) which are involved in eye movements due to top-down attention mechanism, i.e. voluntary saccades. The maps also showed activation of superior parietal (SP) cortex – region involved in visuospatial processing and attention shifts. The contrast maps of ER vs. HT were obtained (p<0.001) and resulted with activations in anterior cingulated cortex (part of medial-frontal cortex, MFC), dorsolateral prefrontal cortex (DLPFC) and pre-SMA only for deficit condition (rested wakefulness condition did not reach significant level). For further comparison of SD and RW conditions differences for those maps were calculated. Significant difference (p<0.005) sustained only for parietal regions: inferior parietal (IP), precuneus and superior frontal (SF).

Conclusions
ER evoked MFC activation which is related to precessing of conflict and “high level” errors (failures to achieve a goal). Higher activation of pre-SMA for ER trials reflects stimulus conflict detection. MFC functions seem not to be affected by chronic sleep deficit whereas IP showed increased activation for SD condition what indicates processing of “low level” errors (discrepancy between planned and realised action).

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Subjective estimations vs. objective measures of saccadic performance in rested wakefulness and chronic sleep restriction

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Objectives
The aim of the study was to investigate relations between objective indicators and subjective estimations of saccadic task performance in rested wakefulness and chronic sleep restriction.

Method
Thirteen healthy right eyed female paid volunteers (age 24.2 ± 2.0) participated in the study in two conditions: rested wakefulness (RW) and 7-days chronic sleep deficit (SD, 21 h of total sleep debt). The participants performing saccadic task consisting of 2392 targets (3:1 ratio of congruent to incongruent) presented on saccadometer panel were instructed to direct their attention and gaze from fixation point only to targets preceded by cue. Right eye movements were recorded using infrared oculography. Reactions were classified according to subjects’ performance as correct responses (HIT) and three types of errors: directional and spatial errors (ERR), omissions (OM) and commissions/false alarms (COM). Just after finishing the task participants were asked to evaluate their performance, i.e. speed and accuracy on visual analogue scales. Subjective performance index (SPI) based on those scales was used in further analysis. Generalized linear model was applied to test the significance of the differences. Additionally, regression analysis was used to test whether the number of ERR, OM and COM predicts the SPI.

Results
SD condition in comparison to RW resulted with decreased number of HIT (p = 0.002). The number of OM was greater in SD condition (p = 0.004), while the number of ERR did not differ. SPI was significantly lower in sleep deprived subjects (p < 0.0001). Regression model assumed that SPI can be predicted from each type of error. It turned out to be significant for both but different between conditions (RW: R2cor = 0.71, p = 0.002; SD: R2cor = 0.77, p = 0.001). For RW condition the biggest contribution had number of OM whereas for SD condition OM and ERR.

Conclusions
According to regression model number of omissions committed predicts subjective performance evaluation in both conditions due to significance of this independent variable. However, in SD condition it is the ERR ratio that explains mostly the subjective index (absolute ERR coefficient higher than OM coefficient). This result was rather unexpected considering that amount of ERR did not differ between sleep condition and OM number was higher in SD. It seems that sleep-deprived subjects are not that aware of omissions, what can be caused by microsleeps, and that error monitoring system is more sensitive to directional and spatial errors.

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Combining work and home spheres to access recovery among nursing workers

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Objectives
The need for recovery from work (NFR) is a workload-related concept that is dependent on off-work life (1). In this study we aimed to analyze the combined effect of professional and domestic work features as to the NFR among nursing workers.

Methods
A cross-sectional study was carried out at three hospitals (2005–2006) with nursing teams. They completed a questionnaire with data on professional work hours, domestic work hours, work schedule (day/night work), effort-reward imbalance (ERI) as well as the NFR. Three variables were combined with domestic work hours and were tested in relation to the association with high NFR: ERI, work schedule and professional work hours (high ERI, night work and long professional work hours as risk factors). For each combination, the workers were divided into four exposure categories: those not exposed to any risk factor (reference group), those exposed only to one risk factor, those exposed only to the other risk factor, and those simultaneously exposed to both risk factors. Logistic regression analyses were performed to estimate association (adjusted odds ratios and respective CI 95%). Only female workers who reported to have worked their habitual hours both at hospitals and at home (N=1122) were analyzed.

Results
An improved risk estimation of high NFR by combining high ERI and domestic work was observed (OR=3.50 and OR=5.60 for short and long domestic work hours, respectively). The same result held true for the combination of night work and domestic work hours (OR=1.30 and OR=3.50 for short and long domestic work hours). However, this increase was not observed for the combination of professional and domestic work hours; high level of housework corresponded to high NFR regardless of professional work hours.

Conclusion
In the studied group, household demands were relevant as to the NFR, confirming that the study of the need for recovery should not be restricted to job factors. The availability of time for recovery associated to stressful and temporal aspects of the job may explain the results. The analyses of the recovery process can benefit from addressing both the professional and the domestic spheres, particularly among women.


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Hospital cleaning workers and work ability: the role of work activities and psychosocial factors

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Objectives
A significant amount of literature was published about health care workers and work ability index (WAI). However, not much is known about WAI and hospital cleaning workers. Their work activities are characterized by important physical demands associated with the development of lesions and health symptoms, and eventually reduced work ability.

The aim of this study is to evaluate associated factors related to work ability among hospital cleaners professionals.

Methods
A cross-sectional study was carried out in a hospital in São Paulo, Brazil, in 2009. Participants were 94 cleaning workers (87.9% of the total number of workers). A self-administered questionnaire included socio-demographic data, life styles, functional and working features, the Brazilian versions of the short Job Stress Scale (JSS), Effort-Reward Imbalance (ERI), Work-related activities that may contribute to job-related pain and/or injury (WRAPI) and the Work Ability Index (WAI). Descriptive and multivariate analyses were performed.

Results
The majority of workers were females (63.8%), under 40 years old (61.7%), and had six or more years working as cleaning workers (60.6%). WAI mean was 42.5 points (score from 7.0 to 49.0). Participants referred high demands (64.9%), low control (28.7%), low social support (4.3%), effort-reward imbalance (2.1%). The WRAPI means was 70.8 points (score from 0.0 to 150.0). Working hours were during day time (administrative personnel), and three fixed 8-h shifts, 42 hours per week. The final multivariate model showed variables negatively associated with WAI: females (p<0.001), effort score (p=0.026) and history of work-related disease (p=0.001). The model was adjusted by age. Separate analyses of effort and reward dimensions offered a better explanation of the associated variables and WAI than if they would be jointly considered.

Conclusions
The work activities of hospital cleaning workers may explain the observed associations. Shift work was not associated with reduced WAI. This suggests that physical demands overlap issues of work organization in this working group. Men showed higher WAI than women. This finding may be explained by distinct gender roles exercised by workers: women usually have higher demands on household work than men.

A number of features should be taken into account when planning and implementing measures to maintain the work ability among shiftworkers, particularly among those who predominantly perform physical activities.

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Bergen Shift Work Sleep Questionnaire: a new and comprehensive measurement of shift work related sleep disturbances

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Objectives
Although studies have shown varying sleep problems related to different work schedules (WS), there has so far not been developed any reliable questionnaire assessing sleep and WS associations. Hence, the questionnaire “Bergen Shift Work Sleep Questionnaire” (BSWSQ) was constructed to meet these demands. In this study, we assess the factorial structure of the BSWSQ, and its test-retest, convergent- and discriminant validity.

Method
We studied 784 nurses (response rate 76.7%, 91.7% females) working three shift rotations (day, evening and night work). BSWSQ measures insomnia symptoms (a) >30 min sleep onset latency; b) >30 min wake after sleep onset; c) >30 min early morning awakenings; d) non-restorative sleep; e) being tired/sleepy at work, during spare time on work days and when not working/on vacation. Symptoms reflect an average of the past three months. Symptoms are rated separately for day/evening/night shifts and time-off/vacation. The response alternatives are “never”, “rarely”, “sometimes”, “often”, “always” or “N/A” (scored as 0, 1, 2, 3, 4, missing, respectively). Each WS can be summarized with range 0 to 24 and time-off/vacation 0 to 20. The BSWSQ model fit (factor loadings between the WS and insomnia symptoms) were tested using structural equation modelling. Three months test-retest correlation analyses for the BSWSQ was conducted (subsample n=234). We investigated the convergent and discriminant validity by administering the Epworth sleepiness scale (ESS), the Fatigue scale (mental/physical) and the Hospital anxiety depression scale (HADS).

Results
BSWSQ demonstrated adequate model fit (Minimum Discrepancy/ Degrees of Freedom = 4.41, Comparative Fit Index = .91, Root Mean Square Error of Approximation = .07; 90%CI = .07 -.08) and sound test-retest validity (all p< .001; r =.64, .64, .64, and .67 for day, evening and night time off respectively). We found satisfactory convergent and discriminant validity (all p<.001) with large (above .70) correlation coefficients between WS and moderate to small between shifts and time off (above .3 and .13 between night and time off) within BSWSQ, and small (Below .3) coefficients between BSWSQ and the other scales. This indicates that the questionnaire discriminates symptoms from other constructs such as sleepiness. Ranging from 0-24 WS had mean sum scores for day 9.3/24, evening 9.8/24 and night work 12.7/24, while time-off had 5.6/20.

Conclusions
BSWSQ demonstrated good psychometric properties, enabling the systematic study of discrete insomnia symptoms in different WS. Different WS showed varying symptom load and distribution. Night work showed the highest total symptom load.

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The effects of quitting shiftwork on perceived well-being

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Objective
To examine the combined effects of age and shiftwork on longitudinal trends in five indices of well-being.

Method
Analyses were based on data from VISAT, a prospective study involving measurement of subjective well-being at three time points over 10 years. The sample comprised 680 male and female employees, who were 32 or 42 years old at the first measurement occasion (T1, 1996), and who were seen again five (T2) and ten (T3) years later. Participants were categorised in terms of whether they worked either shifts or regular day work on each of the three measurement occasions (T1-T2-T3), as follows: shift-shift-shift; shift-shift-day; shift-day-day; day-day-day [former shiftworker, prior to T1]; and day-day-day [never a shiftworker].

Results
Higher scores reflect negative outcomes.

Chronic Fatigue: Working shifts was associated with higher scores. There was an interaction between Measurement Occasion and Work Schedule reflecting decreased scores following cessation of shiftwork.

Emotional Reactivity: There was an interaction between Measurement Occasion and Work Schedule, reflecting decreased scores following cessation of shiftwork. However, those who quit shiftwork before T2 showed a rebound in scores at T3.

Social Isolation: There was an interaction between Measurement Occasion, Work Schedule and Age Cohort. Within the older cohort (42 at T1), those who quit shiftwork before T2 (i.e. between the ages of 42 and 47) showed a reduction in scores that was sustained at T3. Those who quit shiftwork after T2 (i.e. between the ages of 47 and 52) showed no reduction after quitting.

Perceived Stress: Those who had never worked shifts scored lowest, while those who had quit shiftwork scored highest. Those working shifts on all three measurement occasions had relatively low scores, compared to those who had quit shiftwork. There was little indication that quitting shiftwork decreased stress.

Perceived Health: Scores were higher among the older cohort but there was an interaction between Age Cohort and Work Schedule. The largest differences between cohorts were among those who had quit shiftwork before T2; the smallest differences were among those who had never worked shifts and those who worked shifts on all three measurement occasions.

Conclusion
Quitting shiftwork and transferring to day work was associated with only limited improvements in well-being, with the clearest beneficial effects seen in chronic fatigue. Those who remained in shiftwork until late middle age (i.e. 52) showed relatively little impairment of well-being, suggesting either a selection effect (the healthy worker effect) or relatively benign working conditions.

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Heart rate variability and endothelial function in response to sleep deprivation in experienced shift workers and non-shift workers

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Objectives
Endothelial dysfunction and alterations in heart rate variability (HRV) as well as shift work and sleep deprivation have been associated with increased risk of cardiovascular disease. The aim of the study was to compare the response of experienced shift workers to total sleep deprivation (TSD) and recovery sleep with matched non-shift workers in identical laboratory settings with strict control of body posture, physical activity, meals, circadian phase and ambient lighting.

Method
Eleven shift workers (shift work≥5 years) and 14 non-shift workers were matched for age (35.7±7.2 (mean±SD) and 32.5±6.2 years, respectively) and BMI (28.7±3.8 and 26.6±3.4 kg/m², respectively). HRV parameters in the time and frequency domain were derived from 5 min analysis bins within the electrocardiograms 0.25, 4.25, 11.5, 12.5 and 13.5 h after habitual wake up time and endothelial function was assessed by flow-mediated dilatation (FMD) with high-resolution ultrasound recordings 0.75 and 10.75 h after habitual wake up time, following adaptation sleep, baseline sleep, TSD and recovery sleep (posture and food controlled throughout). A mixed-model regression analysis was conducted to determine main effects (‘group’, ‘day’ and ‘time’) and interactions between these main effects. Circadian phase was assessed before baseline sleep by salivary dim light melatonin onset.

Results
There was no difference in circadian phase between shift workers (melatonin onset time 21.1±0.5 h) and non-shift workers (21.2±0.7 h). Significantly higher low frequency/high frequency (LF/HF) ratio reflecting higher sympathetic activity as well as significantly lower variability and longer NN intervals in the time domain were observed in shift workers compared to non-shift workers. A trend for a lower %FMD in shift workers was also detected (P=0.07).

Conclusions
Despite similar demographics, circadian phase, posture and food intake at the time of the assessments, differences in endothelial function and HRV parameters pointing to an increased cardiovascular risk were observed in shift workers compared to non-shift workers.

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Interactive effects of shift work and physical activity on cardiovascular risk factors

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Objectives
Occupational and environmental factors influence the risks of obesity and cardiovascular diseases, such as hypertension. Cross-sectional studies indicate that shiftworkers have higher BMI and blood pressure than their dayworking peers (1). However, these studies have tended to employ rather simple scales for measuring lifestyle-related covariates such as physical activity. Therefore, we aimed to examine the impact of shift work and also leisure-time physical activity (LTPA), measured using an internationally-validated inventory, on cardiovascular risk factors.

Methods
A cross-sectional study was undertaken on 57 male lorry drivers (age: 39.8yrs, SD=6.6), of whom 31 worked irregular shifts and 26 worked solely on the day shift. Participants completed the long version of the International Physical Activity Questionnaire (IPAQ) alongside measurements of body mass index (BMI) and waist-hip ratio (WHR). The mean of three measurements of resting blood pressure and heart rate were recorded, which also allowed calculation of mean arterial pressure (MAP) and rate-pressure product (RPP). Participants also provided a fasting blood sample for analysis of lipid-related factors. Measures of work demand, control at work and social support were obtained from Karasek’s questionnaire. Data were analysed using a factorial model which was covariate-controlled for age, smoking, work demand, control at work and social support.

Results
An interaction between type of shift and LTPA was observed to predict SBP, DBP, total cholesterol levels, waist circumference, WHR and BMI (p<0.05). Post hoc comparisons showed significantly higher levels these variables among moderately active shift-workers than moderately active day-workers. The type of shift was a predictor for a higher level of total cholesterol and LDL-cholesterol in the shift-workers compared to day-workers.

Conclusions
The results of this study showed an involvement of LTPA in protecting the cardiovascular risk factors; however this effect is dependent of the type of shift. The results might indicate a chronic desynchronization of the circadian system among shift-workers that can favour the development cardiovascular diseases.

References

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Commuting in mine shiftworkers

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Objectives
In Queensland, many mine workers live on site during their roster cycle. For most, the commute distance to return home is long. A challenge facing industry and workers is how best to manage the effects of fatigue during the commute, and reduce the prevalence of drowsy driving accidents.

Methods
A questionnaire was distributed to 17 coal mines in Central Queensland, with n=917 employees responding. Employees were asked about their roster length, accommodation during their roster cycle, length of commute and whether they rested before commencing this commute at the end of their roster cycle. Regression analyses were employed to investigate the effects of duration and means of commute on the decision to rest before starting their commute.

Results
Employees worked between 8-13.5h shifts, with most working 12-12.5h, and 78% working both day and night shifts. During their roster cycle, most employees resided in a house (64%), 21% in a studio style unit and 10% in a room. 67% commuted between 1-3h, 19% between 3-5h, and 12% more than 5h. 81% of employees reported driving alone in a car, while 12% reported car pooling. Approximately half (46%) do not rest following their last shift, although 33% reported resting between 1-4h before starting home. The logistic regression model with commute duration and means of commute as predictors of the decision to rest was significant. Those workers commuting with others (car pooling) were less likely to rest before commuting by a factor of 0.36 relative to those travelling alone (Wald=16.24, p<0.05). Commute duration also contributed to the decision to rest; with each additional hour of commute time increasing the likelihood ratio by 1.23 (Wald = 9.03, p < .05).

Conclusions
The data demonstrate that many shiftworkers in the Queensland mining industry engage in long drives following the end of their roster cycles, with little or no rest breaks between finishing work and driving. These findings highlight the potential fatigue-related risks due to inadequate sleep facing workers who are required to drive long distances home. Additionally, the data suggest that voluntary rest breaks prior to driving are not an effective fatigue management strategy.

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The influence of travel time on the alertness of rail maintenance staff

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Objectives
The influence of travel time on levels of alertness was investigated as one element of a study undertaken with rail maintenance staff. The overall aim of the study was to investigate patterns of work and factors influencing fatigue among rail maintenance staff.

Methods
Data relating to travel time were collected using structured focus groups, a questionnaire of shift work and general health, and a sleep and duty diary. Staff from three companies took part in focus groups and the questionnaires and diaries were sent to staff working for 16 companies. The questionnaire provided general information about travel time and other issues influencing journey times. The diary was used to record daily information for a total of 28 work days.

Results
All data sources highlighted the influence that travel time had on alertness. Concerns were raised during focus groups and in both the questionnaires and diaries about the amount of time spent travelling and the risk of falling asleep at the wheel. Generally, travelling time did not contribute towards hours of work.

Data from the questionnaire indicated that 60% of respondents commuted for two hours or more each day, of these 30% for three or more hours and 15% for four or more hours. As the amount of travelling time increased there was an increased tendency for individuals to fall asleep when they did not want to. Those individuals with the longest travel times found it harder to concentrate during the night shift (p<0.05) and were more likely to find their breaks during the night shift inadequate (p<0.01).

The diary data showed that long travel times were a significant factor influencing levels of alertness at the start of a shift (p<0.001). The sharpest increase in fatigue occurred after individuals had been travelling for 1.5 hours. Long travel times were also associated with an increase in mental tiredness (p<0.001), with poor quality sleep (p<0.01) and a greater requirement for more sleep (p<0.01). However, the effect on both the sleep requirement and the duration of sleep was stronger between two daytime shifts than between two night shifts (p<0.01 and p<0.001, respectively).

Conclusions
Long periods spent travelling reduced levels of alertness at the start of a shift and were also associated with poor quality sleep. When travel time at the start of a shift is anticipated to exceed 1.5 hours, alternative arrangements warrant consideration.

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Control of food intake in shift workers: levels of ghrelin, leptin and appetite rates

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Objectives
To evaluate the circadian levels of leptin, non-acylated and acylated ghrelin and appetite ratings in male groups working on different shift schedules.

Method
Circadian levels of non-acylated and acylated ghrelin, leptin and appetite rates were measured in 3 groups: those on fixed night shifts (n=9), on fixed early morning shifts (n=6), and on fixed day shifts (n=7). Appetite was evaluated by a validated questionnaire. Blood samples were collected every 4 hours over the course of 24 hours, totalling 6 samples.

Results
Leptin concentrations after sleep were higher in those working on early morning and night shifts than in those on day shifts, whereas concentrations after sleep and 24-h averages of total and acylated ghrelin were significantly lowest in the early morning group. No significant circadian variation was found for any of these three hormones in any of the groups. In general, appetite was lowest in those working the early morning shifts.

Conclusions
Shift workers on the early morning shift have different rates of appetite and circulating level of leptin and non-acylated and acylated ghrelin from those on other shifts. Further studies are required so that the detailed needs of these individuals can be better understood.

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Adipokines levels in shift workers

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Objectives
To investigate the concentrations of adiponectin, tumor necrosis factor- (TNF-χ) and interleukin-6 (IL-6) in male groups working in different shifts.

Method
Circadian levels of the peptides were measured in 3 groups: fixed night shifts (n=9), fixed early morning shifts (n=6), and fixed day shifts (n=7). Blood samples were collected every 4 hours over the course of 24 hours, totalling 6 samples. Analysis of variance (ANOVA) was used for group comparisons.

Results
Twenty-four-hour mean levels of adiponectin, TNF-χ and IL-6 period were not significantly different between groups. Early morning group had higher levels of TNF-χ and lower levels of adiponectin at 04:00 h, when compared to day shift group (p < 0.05). Adiponectin and TNF-χ, but not IL-6, showed a significant main effect of shift (p=0.016 and 0.0001, respectively).

Conclusions
Although no significant differences were found between the mean concentration of the adipokines evaluated, shift had shown to have a significant effect on concentrations of TNF-χ and adiponectin. These results indicate that more attention should be given to these workers, given the important role of peptides analyzed in the occurrence of cardiovascular diseases and obesity.

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Strategies used by train drivers to cope with irregular working hours

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Objectives
Hours of work of train drivers, very irregular, are well known to induce sleep deprivation and increase the risk of fatigue during the work shifts (1, 2). The aim of this study is to evaluate strategies focused on the task or the sleep/wake cycle develops by drivers in order to cope with such specific working hours and maintain performance at work.

Methods
An extensive research provides data from a survey by questionnaire among 1311 drivers to investigate the impacts of hours of work on fatigue, health and social life. Observation data on a sample of 25 train drivers on 42 trips were analyzed. Sleep/wake rhythm was assessed by actigraphy and sleep log.

Results
Results from the field data collection show the large amount of sleep deprivation associated with some duty hours (night and morning). Furthermore, to counteract sleep loss, train drivers develop strategies at work (anticipation and reactivation) and nap strategies. Napping has a beneficial effect of reducing the sleep debt. Preventive napping was only used by 17% of the drivers; however this strategy is more commonly used in other profession, for example, by airline pilots. Furthermore, a significant correlation between nap and age of train drivers was observed.

Conclusion
From a health and safety point of view, these results suggest the need to develop education programmes to help train drivers to better manage sleep and alertness; with an emphasis on the benefits of taking a nap before night train operation. In addition, this study highlights the role played by experience in coping with fatigue caused by irregular hours of work.

References

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Sleep duration, nutritional status and food intake habits in night security guards
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Objectives
The chronic sleep deprivation observed in night workers can lead to changes in their food intake, with consequences for their nutritional status. The aim of this study was to analyze sleep duration and verify its relation with nutritional status and food intake habits in night security guards.

Method
Participants were 15 male night security guards, mean age 30.8 years (SD=5.5 years). This study was carried out in three consecutive weeks. In the first week (Condition 1 - Baseline) there were no changes in food composition. In the second workweek (Condition 2), the amount of carbohydrates was increased by 30% above the baseline intake and in the third week (Condition 3) the protein intake was increased by 40% above the baseline. The participants filled out a 24-hours dietary recall for three days each week. Moreover, throughout the whole period they filled in a sleep log and wore an actigraph to estimate sleeping and waking times.

Results
Out of fifteen participants, only four were eutrophic, five were overweight and six obese. The mean Body Mass Index (BMI) was 28.7 kg/m² (SD= 4.0 kg/m²). Regarding the meals taken at home we found a correlation between higher energy intake and age bellow 40 years (p=0.04). Moreover, a correlation between the higher energy intake and BMI above 25 kg/m² (r=0.29, p<0.03) was found. A repeated measures ANOVA with BMI as a grouping factor showed an interaction effect between condition and body mass index (p=0.03). The mean sleep duration for the obese group on the Condition 1- Baseline was significantly lower (p=0.02) compared to the Condition 2 - Carbohydrate (213.1 min and 345.3 min, respectively). In the overweight group, the mean sleep duration in the condition 3 - Protein was significantly higher (p=0.04) compared to condition 2- Carbohydrate (442.6 min and 261.4 min, respectively.

Conclusion
The effect of night meal content on sleep duration seems to be mediated by BMI. The carbohydrate enriched meal increased sleep duration for obese participants, but this effect was not observed in eutrophic or overweight participants.

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Long term psychosocial stress and sleep among shift-working nurses

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Objective
Psychosocial stress and irregular working hours are a substantial problem in modern societies. Both of these health risk factors are common among health-care professionals. The aim of this study was to explore the effect of long term job stress and shift schedule features on sleep quality, work load, and recovery of female health care professionals.

Methods
Subjects were 99 female shift workers (mainly nurses, midwives, and nursing assistants) with an average age of 47.30 years (range 31-60). They were recruited from The Finnish public sector cohort study. The subjects were from wards that belonged to the highest or lowest quartile on job strain according to the Karasek’s model and they evaluated their own job strain at least as high or low as their ward on average. The study included three phases: baseline surveys via Internet, laboratory testing at the Finnish Institute of Occupational Health and three weeks field measurements. Laboratory tests included cognitive tests and a psychosocial stress test. Field measurements consisted of sleep diary and actigraphy combined to more intensive measurements during one day with a morning shift, a night shift and a day-off from work. The data collection was completed in January 2011 and first results of sleep are reported here.

Results
Preliminary analyses adjusted for age showed that high and low job strain groups did not differ with respect to self-reported habitual sleep length. However, difficulties in initiating sleep (p=.006) and getting back to sleep after waking up in the night (p=.044) in relation to evening shifts were more common in the group of high job strain. The analysis of actigraphy data is under preparation.

Conclusion
Long term job strain appears not to affect self-rated sleep length but may affect sleep quality especially in connection with evening shifts.

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Early 2-shift work and sleep difficulties

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Objective
Insomnia symptoms are common among shift workers. Relatively little is known about the sleep of a growing employee group of early 2-shift workers. The aim of our study was to assess how early starting morning shifts affect self-rated sleep length and quality.

Methods
The participants (n=1098; 670 men and 413 women) were derived from an on-going cohort study of a Finnish airline company. Full-time working participants reported their usual sleep length frequency of insomnia symptoms (difficulties in initiating sleep, awakenings during sleep, and daytime sleepiness and fatigue) during the last three months. Perceived effect of current working schedule on sleep and fatigue was also assessed. We compared day workers (n=828) with 2-shift workers dichotomised as early 2-shift shift (n=53) (shift starting before 6.00 am) vs. late 2-shift workers (n=217). Analyses were adjusted for age, sex, and additionally for obesity, perceived pains, smoking, physical activity, and education.

Results
Compared to day workers, daytime fatigue (p=0.009) and sleepiness (p=0.039) were more frequent in early 2-shift. In addition, difficulties in initiating sleep (p=0.031) were more common in early 2-shift workers, while self reported sleep length was similar in day workers and early 2-shift workers. A more direct question asking how much current shift schedule influences sleep and fatigue showed a stronger association for early 2-shift, a finding that lends support to the presumption that differences in sleep are due to work-related factors rather than other non-work factors. Further adjustments separately for obesity, pain, smoking, physical activity, and education did not remarkably influence the results. Only the association between difficulties in initiating of sleep was no longer significant when physical activity was adjusted and additional adjustment for education attenuated the difference of day time sleepiness to null (p-values > 0.05). No differences between day shift and later starting 2-shifts for sleep were found.

Conclusions
Our results suggest that sleep quality of 2-shift workers is highly dependent on starting time of shifts. Early starting shifts appear to result in poorer quality of sleep and may weaken day time alertness.

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Nap opportunities during night shift: a solution for improving quality of work?

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Objectives
This study falls within the framework of a general discussion concerning night shift risk management in which a night time napping strategy plays an important role in improving working conditions. The benefits of napping during night shifts are well known in terms of reducing sleepiness and fatigue, in particular at the end of the shift, thus improving mood state as well as performance in a care task simulation (1). Our intention was to use an ergonomics-based approach to demonstrate the beneficial effects of nocturnal napping on work activity and quality of work, i.e. areas which have not been extensively explored in earlier studies.

Method
The study was carried out in a hospital intensive cardiology care unit with a capacity of 20 patients and with two fixed night work teams consisting of 5 nurses and 3 nursing assistants alternating night shifts (8:45 p.m. to 6:45 a.m.). The opportunity to take a nap during the shift consisted of an informal rest episode taken in a lying position and approved by management. Data were collected over 20 night shifts for the 8 nurses and nursing assistants. The duration and timing of the naps taken by the nursing staff were identified by means of a sleep diary. Sleepiness ratings [Karolinska sleepiness scale (KSS)] were obtained at 7 points during the shift. Systematic observations of the work performed during the shift made it possible to gather information relating to work requirements (busy versus calm nights). The quality of the work was self-evaluated by each of the 8 operators who completed a questionnaire at the end of each night shift period.

Results
The results show that night work teams most often take a nap when the demands of the work permit this (calm nights). They also confirm that naps can reduce the level of sleepiness in health workers who are active late at night. Moreover, naps have certain beneficial effects on the quality of work.

Conclusion
Naps during night shifts can be seen as a tool for regulating work activity which enables operators to be less sleepy and more effective during their night work.

References

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Weekly school time is associated with socio demographic, lifestyle and sleep-wake variables among working college students


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Objective
The aim of this study is to assess the associated factors with weekly school time.

Methods
This is a cross-sectional study carried out in a public college, in São Paulo, Brazil. All working students aged 21-26 years attending a college institution in the evening (19:30 -22:30h) were invited to participate in this study. Inclusion criteria were: 6 or more daily working hours and attending daily evening classes, 2 hours or more, from Monday to Friday. Eighty-two students agreed to participate. They answered a comprehensive questionnaire about socio-demographic, lifestyle, working conditions and health symptoms. In the second step, all participants wore an actigraph for 7 consecutive days to obtain information about sleep length, sleep efficiency, sleep latency, nocturnal awakenings and naps. During the same week, they also filled out a daily activity protocol to obtain information about time spent on the following activities: college attendance, commuting time, work, extracurricular activities, and leisure time. The statistical analysis consisted in descriptive statistics (frequency distributions, means and standard deviation), Shapiro-Wilk test to detect its normality, and a multivariate linear regression analysis. A stepwise forward selection was performed. In all analysis was considered =5%.

Results
The linear regression analysis showed an association between time spent in college and being a female (increased 141.09 minutes on time spent in school), reported drinking habits (decreased 188.31 minutes on time spent in school), higher weekly working time (for each minute of work time spent in school decreased 0.29 minutes), shorter sleep length during work days (for each minute of sleep during work days time spent in college decreased 1.45 minutes) and high levels of sleepiness on Saturday (increased time spent in school 185.24 minutes). The model was adjusted by sleep onset and age.

Conclusions
Socio-demographic, life-style, sleep length during work days, higher sleepiness on Saturdays and higher working times significantly affect time spent in College and may have negative effects on academic performance.

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Effects of music and open window as countermeasures to driver sleepiness during day and night driving on real roads

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Objectives
Sleepiness is a major risk factor for car accidents, sleep intrusions have been shown in occupational drivers particularly during night work. Therefore, finding effective countermeasures is a key issue. Listening to music and cold air were no sufficient countermeasures in a driving simulator. However, these countermeasures are still more popular than intake of caffeine or napping. This raises the question if the lack of effectivity previously was due to the simulator environment. Thus, we investigated the effect of these countermeasures during real road driving.

Methods
Driving on a highway (ca. 90min) during day and night, 16 healthy participants (8 female, mean age+SD: 43.13+8.93 years) received the countermeasures open window and music in intermittent intervals. 8 subjects (4 female, mean age +SD: 38.75+10.55years) served as control group. Subjective sleepiness was assessed every 5th minute using the Karolinska Sleepiness Scale ((KSS) 1=very alert, 9=very sleepy)). EEG was recorded continuously. KSS and Standard Deviation of Lateral Position (SDLAT) were analyzed by means of multilevel mixed-effects linear regression, Karolinska Drowsiness Score (KDS) as indicator of physiological sleepiness was analyzed with repeated measurements ANOVA.

Results
The results showed, that subjective sleepiness and SDLAT were slightly reduced only during the intervals of actual countermeasure application (-0.16 KSS steps; -0.8 in SDLAT), while night driving (+1.5 KSS steps, +1.4 in SDLAT) and driving duration had a strong impact. A relatively large residual error in the SDLAT model indicated that also other factors such as road conditions might influence this parameter. KDS was only affected by condition and time.

Conclusion
In essence, applying the in-car countermeasures music and open window showed only minor and transient effects in counteracting the pronounced effects of night driving and driving duration on real roads. They are unlikely to be of any practical significance.

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**Sensitivity and specificity of the Psychomotor Vigilance Test in the detection of awake time in rotating shift workers**


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**Objectives**
To verify the sensitivity and specificity to detect the awake time ≥ 19 hours in rotating shift workers using cutoff scores for several variables of Psychomotor Vigilance Test (PVT).

**Methods**
This study was approved by the Ethics Committee Research at Universidade Federal de São Paulo (REC 0268/09). The test variables of PVT were obtained through a laboratory protocol of acute sleep deprivation with young non-shift workers. Fourteen men aging between 18 and 31 years old (23.2 ± 4.3) were evaluated every 2 hours with PVT in a protocol of sleep deprivation of 36 hours. The accuracy of several variables obtained in testing for the awake time ≥ 19 hours were evaluated using a receiver operating characteristic curve. The awake time ≥ 19h was compared with the reduction of performance similar to a drunk individual (1). Subsequently, the cutoff scores obtained were compared with PVTs from a sample of 202 men, aging from 23 to 60 years old (34.1 ± 8.6), workers of rotating shift on a scale characterized by 4 days of 6 hours working with 24 hours rest of a Brazilian company of transportation. They were evaluated in 4 occasions: before and after a night of sleep control (baseline) and before and after a day of work. They were questioned immediately before each test how long they have been awake. For the statistical analysis, all tests of PVT were considered as independent measurements. Alpha level was set at 5% and statistical significance marked with *.

**Results**
In the laboratory the most association with time awake was χ (measurement - baseline) of lapses (r = 0.65 *) while the best area under curve (AUC) was based on a linear model and χ lapses and χ errors (0.908 *). The lowest AUC was 0.714 * (errors). The highest sensitivity (S) was 84% (median reaction time - MTR) at specificity (Sp) 70%. In the shift workers, 10 tests revealed awake time of ≥ 19h and when applied the cut scores, the values of Sp and S were much worse. The S ranged of 70% (MTR with Sp 53.8%) to 0% in several variables.

**Conclusion**
Although published studies demonstrate an association between lapses and awake time, in the present study wasn’t possible to demonstrate the PVT as a reliable tool for tracing the awake time ≥ 19h in rotating shift workers.

**References**
Evening-type individuals are more tolerant to rotating shift work? – A comparative analyses through objective and subjective criteria

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Objectives
To compare between different chronotypes sleep and wakefulness pattern, body mass index, and subjective variables such as quality of life and fatigue before and after a workday night in Train drivers to maneuver in a Brazilian cargo transportation company.

Methods
This research was approved by the Research Ethics Comitee at Universidade Federal de São Paulo (REC 0547/08). A total of 128 male Train drivers to maneuver rotating shift workers (work schedule: 4 days of work for 6 hours and 24 hours off), between 23 and 60 years (34,4±9,0), participated in the study. Workers were evaluated by anthropometric measurements, subjective questionnaire of sleep and quality of life SF-36. Psychomotor Vigilance Test (PVT) was assessed immediately before and after night shift work. Pattern of activity and rest during 10 days was measured by actigraphy and chronotype was determined by the version of Morningness-Eveningness Questionnaire of Horne and Ostberg (1). Individuals who studied between shifts (n=8), had naps before shifts (n=28) or both conditions (n=1) were excluded. For data analysis ANOVA and ANCOVA one-way with post hoc LSD when appropriated and Pearson Chi-Square tests were used. Statistical tests with P ≤ 0.05 were accepted as significant.

Results
48.4% of the shift workers were intermediate-type, 45.1% morning-type and 6.6% evening-type. Evening-type presented significantly more irregular sleep hygiene (p=0.03), higher wake time before night shift work (p=0.05) and higher wake time when compared to morning-type (p=0.01). It was also found in evening-type a statistical tendency to have a worse overall score of quality of life compared to the morning-type (p=0.11). There was no significant difference between groups regarding the change in PVT performance even when covariating for time awake before the exam, percentage of gain or loss of weight in the last six months of work, body mass index and fatigue before and after the beginning of the shift.

Conclusion
Evening-type workers tended to present the worst parameters related to sleep hygiene and quality of life and also did not show higher rates of fatigue before and after the shift as well as performance on tests of sustained vigilance. Thus, the results suggest that evening-type individuals do not necessarily tolerate better rotating shift work scheme when compared to morning-type.

References

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Objective
To characterize the socio-demographic and health profile of Brazilian train drivers.

Methods
This study was approved by the Research Ethics Comitee at Universidade Federal de São Paulo (REC 0547/08). The sample consisted of 140 train drivers in a Brazilian load transportation company, with rotating schedule work (6 working days: 6 x 24). All subjects were submitted to a polysomnography (PSG) and clinical assessment and diagnosis of sleep disorders was performed by a doctor specializing in sleep. The Chronotype was determined by the Horne and Östberg (HO) questionnaire and the Short-Form Health Survey (SF-36) were used for subjective assessment of diurnal preference and quality of life, respectively. The results were demonstred in percentages and mean±SE.

Results
The mean age of the overall sample was 34.05 ± 8.41 years, 65% are married, 35.7% Caucasian, 79.3% had completed high school. The average shift work time in the company is 8.2 ± 5.5 years and the average journey time from home to the company is 46.24 ± 24.10 minutes. Considering the lifestyle 75.7% are sedentary, 47.9% drink alcohol, 9.4% smoke. In relation to anthropometric parameters 51.4% of drivers are overweight, 15.7% are obese and 40% showed waist circumference ≥92 cm. Analyzing the chronotype, 53.2% were classified as intermediate-type, 41% morning-type and 5.8% evening-type. Among sleep disorders, 5% had insomnia and 58.6% had obstructive sleep apnea syndrome (OSAS). Of these, 56% were diagnosed as mild OSAS, 27% moderate and 17% severe. The SF-36 scores, train drivers had lower values in mental health and vitality dimensions. The PSG data were: total sleep time: 342.28 ± 59.67min; sleep efficiency: 84.84 ± 11.11%; sleep latency: 17.31 ± 19.73 min, stage 1: 6.2 ± 6.5%, stage 2: 44.7 ± 7.7%, stage 3: 27.39 ± 7.31%; REM: 21.53 ± 6.8%, number of awakenings:14.42 ± 6.63, so these values showed no discrepancy in the general population.

Conclusion
There was an increased prevalence of OSA in this population, as well as a worsening of socio-demographic and general health status, which can lead to excessive sleepiness and accidents.
Napping during night shifts under a gender perspective

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Objective
To investigate the relation between household demands and napping during night shifts, since deprivation of sleep amongst women tends to be accentuated with domestic activities, being on the other hand, attenuated by napping during night shifts.

Methods
Two cross-sectional studies were accomplished in different hospitals, in which the nursing staff was allowed night napping. Both studies were based on questionnaire data related to sleep, professional tasks and household demands; in Study 2, workers also used actigraphs for up to 10 consecutive days. In both cases, household demands were evaluated (i) by the number of hours dedicated to housework per week and (ii) by the domestic overload, in which the activities performed and the number of potential receivers was considered. In Study 1 (N=247), the group was divided according to the length of napping at work (up to two hours and from two to three hours). In the second study (N=49), the median was used as a cut-off. Mann-Whitney and Chi-square tests were used in the analysis, with SPSS, version 18 software.

Results
Significant associations between the length of napping and household demands were observed in Study 2 only, in which longer napping was associated both to longer housework hours, as to greater domestic overload. In Study 2, workers were significantly older, with a shorter professional work hours, worked more night shifts per fortnight, dedicated more time to housework, and had a greater domestic overload as compared to workers in Study 1.

Conclusions
The association between the length of napping during night shifts and household demands seems to manifest itself only after certain levels of sleep deprivation, which tended to be greater in Study 2. Concerning specifically female workers, the results stress the possible contribution of napping during night work in the diminishing of sleep deprivation, which is influenced by housework.

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Obstructive Sleep Apnea Syndrome in Brazilian train drivers: Risk factors for disease severity

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Objective
The objective is the health issues that attract attention when analyzing train drivers who have a high prevalence of risk factors considered for Syndrome of Obstructive Sleep Apnea (OSAS). In this study, we sought determine factors that are associated with increased risk of OSAS in train drivers in a Brazilian Company.

Methods
This study was approved by the Research Ethics Comitee of UNIFESP - Universidade Federal de São Paulo (REC 0547/08). The population tested was composed by a sample of train drivers who work in rotating schedule (6 working days: 6 x 24). The OSAS was diagnosed according the American Academy of Sleep Medicine (1). The predictive factors tested were: Berlin Questionnaire (identified for the risk of OSAS), The Pittsburgh Sleep Quality Index and Epworth Sleepiness Scale (level of daytime sleepiness), smoke habits, shift work time (SWT) and anthropometric measurements. The sample was divided into two groups and considered a risk group of individuals with Apnea Hipopnea Index (AHI) ≥15 (moderate and severe OSAS); individuals without apnea and individuals with AHI ≥ 5 and < 15 (NOSAS and mild OSAS). We used an analysis odds ratio (OR) [95% confidence interval].

Results
We studied 176 Brazilians train drivers in the age of 33.36 ±8.2 years, with body mass index (BMI) of 26.67±3,71 kg/ m2, neck circumference (nc) of 37.81± 4.54 cm and shift work time (SWT) of 9,59 ± 6,43 years. The risk (moderate and severe OSAS) was present in 40,6% of the total sample. Age ≥ 31.5 years [OR (95% CI), 5.29 (2.12-13.20)], obesity 3.12(1.14-8.52), nc ≥ 40 cm 3.40(1.29-8.94) and SWT ≥ 9.5 years 2.37 (1.01-5.58) were significant, independent predictors of OSAS.

Conclusion
We concluded that age increased, BMI, neck circumference, as well SWT are risk factors associated with moderate and severe OSAS in train drivers.

References
Post-lunch dip effect on targeted eye movement task performance in rested wakefulness and chronic sleep restriction

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Objectives
The temporary drop in performance observed in midafternoon hours seems to be the effect of bi-circadian sleep propensity rhythm. The study focused on the extent of this phenomenon in the visual attention domain, in rested and sleep-deprived subjects.

Method
Thirteen healthy right eyed female paid volunteers (age 24.2 ± 2.0) participated in the study of targeted eye movements in two conditions: rested wakefulness (RW) and 7-days chronic sleep deficit (SD, 21 h of total sleep debt) in counterbalanced order. The targeted task consisted of two unpredictable conditions: one with a cue congruent to a target and the other with incongruent cue. It was performed three times during the day: at about 10.00, 14:00, and 18:00 h. There were 598 stimuli for each session, presented on saccadometer panel. The participants were instructed to direct their gaze and attention from fixation point only to targets preceded by cue. Right eye movements were recorded using infrared oculography. Reactions were classified according to subjects’ performance as correct responses (HIT), directional and spatial errors (ERR), omissions (OM), and commissions/false alarms (COM). Before each session participants were asked to estimate their state on Karolinska Sleepiness Scale (KSS) and after the session they evaluated their performance, i.e. speed and accuracy (ESA – estimated speed and accuracy) on visual analogue scales. Generalized linear model with double repeated measurements (sleep condition; time-of-day) was used to test the significance of the differences for each type of reactions and scales.

Results
There was significant effect in HIT for sleep condition (p=0.02) and time-of-day (p = 0.01). Post-hoc test showed that midafternoon session differentiated mostly (64% vs. 74%, p = 0.01). Significant effect for time-of-day condition was also observed for OM (p=0.05) and ESA (p=0.03): an increase between first and second session and plateau before the third. KSS differed significantly between SD and RW and constantly increased during the day. ERR and COM did not differ.

Conclusions
In both sleep conditions, time-of-day main effect for number of HIT and OM, as well as ESA, demonstrated strong post-lunch dip phenomenon. This study contributes with two additional conclusions. Firstly: post-lunch dip phenomenon is magnified by sleep restriction according to post-hoc test on HIT number. Secondly: this phenomenon is only partially explained by sleepiness as the gradually increasing KSS score, in evening session, is in opposition to performance level. Lack of the effect for ERR and COM might be due to some compensatory mechanism.

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Agreement between self-reported data and actigraphic measurement of sleep duration during night shifts among nursing workers

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Objectives
Questionnaire data are often used in sleep research, particularly when dealing with big samples. The present study aims to analyze the agreement between questionnaire data and actigraphic measures of sleep duration during night shifts among nursing workers.

Methods
A cross-sectional study was carried out in 2009 at a public hospital in São Paulo, Brazil, in which the nursing staff is allowed night napping for up to three hours, when work demands are not too high. They worked 12-h shift (1900 to 0700) each other night. Forty five female night workers who did not report sleep complaints (mean age: 40; dp: 10.2 years old; 73% nurse assistants) participated of the study. They were asked whether they usually sleep during the night shifts and for how long; they also wore an actigraph in the non-dominant wrist, during up to ten consecutive days. Only workers who reported to usually sleep during the night shifts were analyzed. The median of actigraph sleep duration was calculated considering all working nights for each participant. Bland-Altman technique (1) was used to assess the agreement between sleep duration during working nights as evaluated by the questionnaire and by actigraph.

Results
Among the 45 participants, 29 had their sleep durations registered in both instruments; a good agreement was observed between them, according to Bland and Altman procedure. Sleep duration was systematically overestimated by the questionnaire in about 7.5 minutes, in relation to actigraphic measures. Moreover, only one participant, out of the 29, has fallen outside the limits of agreement, as proposed by Bland and Altman.

Conclusions
In the studied sample, results suggest that self-reported data on sleep duration can be reliably used in researches on this subject.


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Shift work and health: The relation between shift work, work factors and mental health in the Norwegian petroleum industry
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Objectives
Aim of the study is to test the relations between shift work and a broad range of work factors and their combined effects on workers mental health. Shift work and night work especially, may lead to ill health (Waage, Pallesen & Bjorvatn, 2007). Studies show a relation between low control over decisions, low social support, high psychological demands and mental health (e.g. Stansfield & Candy, 2006). Depending on working days or nights the nature of the work tasks one performs may be different, hence the effects of work factors on mental health may be different.

Method
The sample is a part of the first wave data collection of a prospective, longitudinal study on shift work, work factors sleep and health in the Norwegian on- and offshore industry. The data are cross sectional collected using a web-based questionnaire. Three hundred and thirty six completed questionnaires from 828 invited onshore employees of a Norwegian oil and gas company (2010), were received, yielding a response rate of 40.5 %. Work factors were measured using QPSNordic, and mental health was measured on a five point scale using HADS.

Results
A Multivariate ANOVA showed an effect of shift schedule on work factors, where workers working nights showed less positive challenges at work, less control over work intensity and decisions, less quantitative demands, and less empowering leadership compared to day workers. However, night workers showed more decisional demands, more role clarity and support from co-workers, compared to day workers. To test the effects of shift schedule, and work factors on mental health, two multiple regressions were conducted, one with anxiety as dependent variable and one with depression as dependent variable. With the effect of neuroticism ruled out, the results showed a significant positive effect of decisional demands (=.14, p < .05), and a negative effect of support from co-workers (=.25, p<.01) on anxiety. No significant results were found for shift schedule, positive challenges, learning and quantitative demands, control, role conflict and role clarity, support from superior or leadership (R squared =.43). However, for depression positive significant results were found for quantitative demands (=.16, p<.01) and role conflict (=.13, p<.05). (R squared =.45).

Conclusion
The results indicate that day and night workers experience their work environment differently. High work demands, role conflict and little support from co-workers are related to poorer mental health in workers.

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Staying alert in a dark room by participant activation and interaction

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Objectives
Staying alert is important in many work situations. This is especially difficult in situations with little light and high monotony. At the same time, interventions have to be designed in such a way as to not interfere with the main task. Our objective was to develop and test an intervention technique to maintain alertness.

Method
We developed a method that should activate users by asking them to monitor environmental activities and to solve a simple spatially structured identification and memory problem. While the problem itself is simple, it requires people to process situational information in many dimensions (e.g. identifying the repetitive behavior of others or monitoring technology). Furthermore it requires fast reactions under certain, pre-specified, conditions and even includes a competitive element in order to maximize potential psycho-social activation.

To test this newly developed method we initially performed a multidimensional factor analysis to minimize the interaction between the dimensions of activation and to improve the method. In a second step we identified scientific conferences as an excellent environment in which to test this method since participants have to sit quietly in a dark room and falling asleep is considered to inappropriate behavior unless one is from Scotland. Attendees have to at least give the impression of staying alert and, especially in the case of the chair-person, to interact by attempting to ask meaningful questions.

A detailed description of the method, the materials used, and a brief training manual can be found at (1).

Results
The applied method appeared to succeed in keeping participants awake. Sleepiness on the Karolinska Institute’s Sleepiness Scale was reduced from 7.8 (SEM ± 0.32) to 3.1 (SEM ± 0.23) while Slow Eye Movements (SEM) were substantially reduced. Structural Equation Modelling (SEM) provided a highly significant fit in which the method directly reduced both KISS and SEM, but it also identified several side effects, e.g. participants could not recall the main message of any of the presentations. The activation effect diminished slowly with repeated application suggesting the need for multiple parallel versions of the materials used.

Conclusion The method successfully maintained wakefulness but the side-effects warrant further investigation.

References
(1) http://www.workingtime.org/StayingAlert

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Vacation planning: minimizing conflicts and preventing postponement

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Objectives
In most countries employees are entitled to a certain amount of vacation time per year. However, often substantial amounts of vacation are not taken – for different reasons (e.g. social and individual preferences, coincidence of holiday season and high workload, insufficient planning, fear of missing important developments). This might lead to undesired health issues resulting from insufficient recreation. Companies additionally have to make provisions for any unused vacation time.

The objectives of this study were: 1) to facilitate the (negotiation) process of timing vacation days (often with the management and/or the co-workers) and 2) designing a set of commonly agreed rules for a test case that exceeds the legal constraints ensuring that the legal entitlement to vacation can and is fully met without losing a certain amount of flexibility for both employees and the company.

Method
A subsidiary of a medium-sized company producing standardized furniture elements was selected for the test phase. In multiple negotiation rounds with management, production planning, and employee representation a multi-stage model (capacity planning, agreement on the timing of consuming vacation from previous years, reserve planning, external reserves, main (summer) vacation planning, additional vacation planning,) with planning rules was established. The rule set consists of priority rules (e.g. parents during school holidays, farmers during hey harvest), the (most important) rule of planning the full time of vacancies at the beginning of the year, and flexibility rules (vacation can only be moved to other available time slots and NOT deleted, replacement priorities for flexibility wishes by the employees or by the management).

Results
After the initial planning process and the higher necessity for information operative/daily planning became easier and is now regarded as a fair process.

The number of vacation day savings could be reduced on average by 4 within one year for employees exceeding the threshold and the system helps maintain the reason for vacation (i.e. recreation) with positive health aspects to be expected in the medium run. The crucial point to success is the acceptance and inclusion of the management.

Conclusions
More and careful planning with an extended rule set can lead to a higher rate of satisfaction for the employees. It reduces the ongoing planning work and discussions and nevertheless ensures flexibility for all participants. Transferring the facilitation model to other organizations and participatory design of specific rules is ongoing work.

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The impact of night and shiftwork on the health of nurses in Khartoum state Sudan

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Objectives
1- To obtain basic data about shiftwork organization within the health services in Sudan.
2- To assess the work environment of nurses in selected hospitals.
3- To evaluate the impact of night and shiftwork with respect to the following: a - Sleep disturbance and fatigue. b - Health and well-being. c - Interference with social life. d - Interference with domestic life. e - Maternity problems: 1) Menstruation, 2) Pregnancy, 3) Delivery.
4- To recommend ergonomically designed shift schedules based on identified problems.
5- To raise the awareness of young nurses about the risks of frequent nigh shift.

Methodology
This cross-sectional study was conducted in four teaching hospitals: Khartoum Teaching Hospital, Khartoum North, Omdurman and El Ribat, in addition to two private hospitals: Alfaisal and Fedail Clinics. A total of 310 nurses filled the Standard Shiftwork Index (SSI) questionnaire. The nurses’ work environment was assessed for heat, noise and light levels. Environmental measurements were done using instrument availed by the Occupational Health Department.

Results
The results of light measurements showed that all values do not reach the minimum limit value of the international standards (IES and WBG). Heat Stress Index (HSI) values in the selected hospitals are affected by ventilation systems. Heat measurements taken in the Nurseries in all hospitals, were found to be very high indicating severe heat stress. All noise measurements were found to be ranging between 45 and 74dB (A) while the standard according to the World Bank Group for hospitals is 30 to 40 dB (A). Results of questionnaire analysis showed that more than half (56.8 %) of study participants work morning shifts (M) only, 28 % work afternoon night (AN) shift (16 hrs) and 10.8 % work both shifts (M+AN). About 40 % of the participants work in night shifts. However, results showed that 20% are night active individuals according to the questionnaire. About 76 % of the participants are in the age group (18-30yrs). The mood and performance of this age group is more prone to the adverse effect of insufficient sleep. Some nurses spend in transportation up to three hours for one way only. For a nurse working 16 hours when adding time for transportation only two hours left in the day for all other activities. The results strongly support what has been found in previous studies that shift work especially night work and long working hours have pronounced effects on the sleep quality and quantity. Shift work caused health disturbance which can be explained by the use of many drugs for prolonged periods. These medications include antacids, laxatives, vitamins and pain killers. The percentage of participants having regular menstruation dropped to almost half after shiftwork. Shiftwork had badly affected 50% of the participant in their performance, and over 80% in their sleep, social life and domestic life.

Conclusion
This study clearly indicates that nursing managers, administrators, and policymakers should guarantee sufficient sleep for the nurses in order not to put their health and their patients’ health at risk.

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Objectives
The sustainable development approach is spreading around the world and it will have impact on present and on the future, with the goals to obtain development in a fair work process, with environmental preservation, low carbon consumption activities and equality between gender and diversity. The aim of this study is to outline the profile related to socio-demographic, life style, self-report compared health and work characteristics in non-standard working hours workers.

Methods
A cross-sectional study was conducted among 455 workers, with less than 30 years old, that work in micro and small enterprises, and beginning the work around 5 a.m., in a large city in Sao Paulo State - Brazil. Work Ability Index, questions from Occupational Stress Questionnaire and general questionnaire was applied. Statistical analyses were performed in SAS 9.2®.

Results
The majority was men (86.4%), with age ranging from 15-29 years, average age of 23 (SD 3.7) years, was single (64%); had completed at least high school (48.4%), and 23.5% was studying; 17.4% smoking (about 16 cigarettes per day); 50.3% referred alcohol intake; 65% did physical activity (play soccer) and 98% had leisure time activity. In relation to work mixed demand (physical and mental) was prevalent (40.7%), followed by physical demands (37.4%). Almost half of the sample had started the first job under the age of 15 years (48.3%). 69.8% had legal contract and 10.8% was owner or relatives; 27% related overtime; 13.6% had a second job; 8.3% referred work accident during the last year; 39.4% cannot decide about work tasks, and 1/3 lost between 1-5 days of work during the last year. Sleep problems are referred by 13%. Work ability average was 42.8 (SD 3.9) points; current work ability 8.6 (SD 1.4) and 14.3% considered not been active and alert. 42.4% considered to have better health when compared with person of the same age.

Conclusion
It is important to spread workplace health promotion culture with special attention to small enterprises with the participation of managers, workers, health centres, trade unions and researchers.

References

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Fatigue and work ability among pre-hospital mobile emergence service workers

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Objectives
The assistance provided by the Pre hospital Emergency Care Mobile Unit can be defined as that performed outside the hospital, aiming to provide the user with better response to your request. To this end, the service has many professionals working in order to face different situations and require certain skills, which may result in changes in the health of work-ers. This study aimed to evaluate the fatigue, work ability and working conditions among Pre-hospital Emergency Care Mobile Unit (SAMU) workers in Campinas, São Paulo.

Methods
A cross-sectional study was developed and four questionnaires were used for data collection: demographic data, lifestyle and health issues and work; work ability index (WAI), incivility and violence at work, fatigue and sleepiness. The response rate was 86.6% and the sample consisted of 197 workers - registered nurses, physicians, technicians and nursing assistants, ambulance drivers and administrative staff. Statistical analyses were performed in SAS 8.02®.

Results
The results showed the prevalence of males (61.4%), mean age 39.1 years (SD = 8.3), residing in the city of Campinas (80.7%), married (63.5%) with children (76.7%) and high school (40.1%). Predominated in the professional category of drivers (30.5%), followed by physicians (18.3%) and nursing assistants (16.75%) and performance on the day shift (54.3%). They noted the high percentage of having another job (42.1%), doing overtime (48%) and working 70 hours or more per week (25.3%). Most practiced physical activity (56.5%) and leisure (96.5%) and had plans for the future (94.4%). The average score of the WAI was 41.8 (SD 5.4) points, 41.1 among nursing professionals, 41.5 among physicians, 42.9 among drivers; 42.5 between the telephone operators and 40.3 among workers in the administrative sector. Epworth scale average was 7.2 (4.2) points. Fatigue score ranged from 35-111 points and the average was 66.1 (16.1). Several variables were associated with loss of work ability, these include: marital status, children, physical activity, accidents, incivility at work, fatigue, sleepiness, stress, satisfaction with life and work.

Conclusion
It is necessary to use multidimensional approach to the implementation of programs aimed at maintaining and promoting physical and mental health in general and, specific to each professional category. Another relevant aspect is the education of the user population about the correct use of the service. This project received partial grant from CNPq.

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Association between circadian typology and both fatigue and depressive tendencies: Self-administered questionnaire for Japanese chemical factory workers

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Objectives
The association between circadian typology and depressive tendencies has been evaluated by previous studies, but fatigue has not yet. Therefore, in this study, we surveyed the association between circadian typology and both fatigue and depressive tendencies.

Methods
A self-administered questionnaire survey was conducted in 1748 workers who employed by an Japanese chemical factory. Valid responses are 1517 (1379 male persons, 138 females, mean age 41.5 years). Index of circadian typology was Morningness-Eveningness Questionnaire (MEQ), Self-rating Depression Scale (SDS) as a depression scale. Fatigue was quantitatively assessed using the Cumulative Fatigue Symptoms Index (CFSI) developed by Kosugo* et al. The scale comprises 8 subcategories: Decrease in vitality(NF1), General fatigue(NF2-1), Physical disorders(NF2-2), Irritability(NF3), Unwillingness to work(NF4), Feelings of anxiety(NF5-1), Depressive feelings(NF5-2), Chronic fatigue(NF6). We used on-duty hours for index of working time that includes scheduled working hours, overtime work hours and commuting hours per one month. We divided on-duty hours into 3 groups; less than 200 hours on-duty hours a month, less than 250 hours, and more. Overall differences among the groups were evaluated by 2-way ANOVA for 2 independent factors of a 5 point MEQ scale and groups of on-duty hours.

Results
The frequency distribution of MEQ scale and 3 groups of on duty hours were followings. There were no Definitely Evening type subject, 50 Moderately Evening type (mean age 30.2 years), 896 Neither type (39.1 years), 524 Moderately Morning type (45.9 years), 47 Definitely Morning type (49.5 years). 715 workers in less than 200 hours on-duty hours a month (39.1 years), 609 workers in less than 250 hours (42.8 years), and 193 workers in more than 250 hours (45.0 years). After controlling for on-duty hours and gender factors, MEQ scale was more likely to be involved in SDS score and CFSI 8 subcategories except General fatigue(NF2-1) in order of Morningness, Neither end Eveningness types. In female, neither SDS nor CFSI had associated with MEQ scale.

Conclusion
We indicated a probable association between circadian typology and both fatigue and depressive tendencies. This suggested that we need to consider circadian typology when we evaluate fatigue and depressive tendencies. In female, neither SDS nor CFSI had associated with MEQ scale due to the lack of sample number.

References

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Understanding motivators of food choice in shiftworkers and day workers

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Objectives
Shiftworkers are more overweight when compared to day workers. Poor food choice may contribute to the high obesity rates found in this population. Previous research suggests shiftworkers make unhealthy food choices and consume more snacks than day workers. Motivators of food choice provide insight into unhealthy eating behaviour and in turn may assist in the planning of health promotion strategies. The aim of this study was to determine if shiftworkers and day workers differ in their motivators of food choice.

Method
Thirty individuals (15 males and 15 females) participated in a questionnaire based study. Eighteen were shiftworkers (mean ± SD, 42.5 ± 15.3 yr) and 12 were day workers (46.1 ± 16.8 yr) employed in the printing and medical industries. Motivation underlying food choice was assessed with a 36-item food choice questionnaire. The food choice questionnaire assesses nine factors which may motivate food choice including: health, convenience, mood, familiarity, price, natural content, weight control, sensory appeal and ethical concern.

Results
The shiftworkers in this study were more overweight when compared to day workers. Based on body mass index cut-offs shiftworkers in this study were categorised as overweight (27.2 ± 9.2 kg/m2), whereas day workers were categorised as normal weight (22.8 ± 12.4 kg/m2). Shiftworkers (mean familiarity = 2.4 ± 0.8) also had significantly (F (1, 28) = 5.50, p= <0.05) higher scores for familiarity as a motivator for food choice when compared to day workers (mean familiarity = 1.7 ± 0.5). The two groups did not differ significantly on any other factors.

Conclusions
Preliminary findings indicate that shiftworkers in this sample did not differ from day workers on many motivators of food choice. However, they were more likely to choose foods they were familiar with (such as foods they usually eat and foods they ate as a child). Data collection will continue to include a larger sample and further analysis will investigate the dietary habits of participants using a comprehensive food-frequency questionnaire. Future studies should also examine if motivation for food choice differs depending on shift type.

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Subjective and objective sleepiness in a simulated “4 hours on/8 hours off” maritime watch system

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Objective
Since ships are operated around the clock, seafarer fatigue poses a potential hazard on safety at sea. Severe sleepiness has been documented as a direct or contributing factor in many maritime accidents. This study investigates subjective and objective sleepiness in a simulated 4h on/8h off watch system as well as the effects of a single free watch disturbance, simulating a condition of low demanding overwork.

Method
30 bridge officers (aged 30 ± 6 years; 29 men) with on average 7 years experience at sea participated in five parallel bridge simulators during two separate experimental weeks. The three watch teams started respectively with the 00:00-04:00, the 04:00-08:00, and the 08:00-12:00 watch on an identical voyage in the North Sea and the English Channel. The free watch disturbance was counterbalanced and took place between day 2 and 3 or day 5 and 6. Participants rated their sleepiness every hour (Karolinska Sleepiness Scale, KSS) and carried out a 5-minute psychomotor vigilance test (PVT) at the start and the end of every watch. In addition, a work diary was filled in at the end of every watch.

Results
Average sleepiness ratings were significantly different between the different watches (F (5, 382) = 11.27, p < 0.0001), being highest during the 04:00-08:00 watch and lowest during the 16:00-20:00 watch. In all watch teams, average sleepiness was significantly higher after the free watch disturbance compared to the control condition in the other half of the week.

Average PVT reaction times differed between the different watches (F (5, 384) = 3.45, p < 0.01), being highest during the 04:00-08:00 watch and lowest during the 12:00-16:00 watch. The free watch disturbance resulted in increased reaction times only in the watch teams working 04:00-08:00 and 08:00-12:00.

Average number of PVT lapses differed between the watches (F (5, 384) = 3.86, p < 0.01), being highest during the 04:00-08:00 watch and lowest during the 12:00-16:00 watch. The free watch disturbance increased the number of lapses only in the team working 04:00-08:00.

In addition, many work diary components indicated highest levels of sleepiness during the 04:00-08:00 watch.

Conclusion
This study reveals that – within a 4h on/8h off shift system - both subjective and objective sleepiness peak during the 04:00-08:00 watch, coinciding with a time frame in which relatively many maritime accidents occur. In addition, we showed that overtime work strongly increases sleepiness.

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Fatigue and sleepiness in seafarers working in a 6-on 6-off shift system – results from one week of simulated navigation work

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Objective
Globalisation of the shipping industry has put shipping companies under economic pressure. In striving for efficiency, the 6-on 6-off shift system has become popular. This system has been criticised for generating high levels of fatigue and increased accident risks. The aim of the present study was to examine how fatigue and sleepiness varied within this shift system and to examine the effect of disruption of one free-watch by working overtime.

Method
Nineteen seafarers participated in a simulator study for seven days (mean age 34±12, 18 men). They were randomly assigned to work on the 00-06/12-18 watch team (WT1, n=9) or the 06-12/18-00 watch team (WT2, n=10). Participants spent their watches in a navigation simulator, all piloting a comparable voyage in the English Channel and North Sea. Participants rated their sleepiness (Karolinska Sleepiness Scale – KSS, 1-9 very sleepy) every hour. After the watch they rated fatigue symptoms (1-5 to a great extent) and workload (1-5 very low). Before and after each watch a 5 minutes Psychomotor Vigilance Test (PVT) was performed. A whole free-watch was disturbed in either the beginning (day 2) or end (day 5) of the week (counterbalanced between and within watch teams) by simulating administrative overtime work. The watch after the disturbed free-watch was compared with a similar watch without previous disruption.

Results
Sleepiness ratings varied between the different watches (F(3,243)=3.9, p<0.05). Post hoc analysis showed that sleepiness was higher during the 06-12 watch as compared to the 18-00 watch (p<0.05). Symptoms of fatigue such as heavy eyelids (F(3,237)=6.2, p<0.05) and irresistible sleepiness (F(3,237)=4.6, p<0.05) differed between watches. Those in the 06-12 watch demonstrated greater fatigue symptoms compared to the 12-18 watch.

In both watch teams, the interruption of one free-watch significantly increased sleepiness (WT1 t(8)=6.1, p<0.05; WT2 t(9)=6.2, p<0.05) and PVT reaction times (WT1 t(8)=2.4, p<0.05; WT2 t(9)=2.6, p<0.05), for the following watch. Moreover, both watch teams showed an increase in fatigue symptoms such as heavy eyelids and irresistible sleepiness (p<0.05).

Workload did not differ between watches (F=0.3, p>0.05) or after the disturbed free-watch (WT1 t(8)=0.0, p<0.05; WT2 t (8)=1.5, p<0.05).

Conclusion
Fatigue and sleepiness levels differed between the watches in the 6-6 shift system with highest levels in the 06-12 watch. This suggests that factors other than circadian rhythms are influencing the results. Moreover, disruption of a single free-watch was associated with a marked increase in sleepiness and fatigue symptoms for both watch teams.

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Observations in the association of the workers’ health effect and the working time through the working conditions survey (2006 to 2010) in Korea

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Objectives
Psychosocial factors such as work-related stressor have been included as hazard factors (working time schedule - shift work, long working hours) in the workplace, and the health promotion activities have became an important component of worker’s health management before symptoms and signs of work-related disorders manifest. We set out to make a clue how the working time and it’s scheduling contribute to the workers’ health and also what is the difference of impact of working time between EU and Korea.

Methods
The Second Working Conditions Survey (WCS) in Korea was conducted in 2010 next to the First WCS in 2006. The survey was focused on psychosocial factors of workers’ health in the workplace. The survey was based on the framework of European Foundation’s WCS. The 2010 Second WCS was using the same questionnaire as the fifth survey of the European Foundation’s WCS in order to compare Korea and EU. The questionnaire was translated with the back translation technique and carried out in the form of the household survey nationwide. So, 10,043 interviews had been carried out in 2006 and 10,019 interviews were collected in 2010.

Results
Workers in 2010 work shorter hours than workers in 2006 in the decrease of an average of 50.1 hour per week to 47.7 hour per week. Otherwise, 7.2% of workers in 2006 were shift workers compared to 8.1% of workers in 2010. As the results, the magnitude of work-related symptoms and signs in the previous 12 months was detailed. the highest prevalence rate is that of musculoskeletal symptoms was increased from 18.1% in 2006 to 36.0% in 2010.

Conclusions
We would explain that what the change is correlated between the workers’ health effect, and the working time and it’s schedule by the period and compared to data of EU.

References

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Self-rostering and psychosocial working environment
– an intervention study (the prio project)

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Objectives
Self-rostering, also called prioritized working hours or self-elected working hours, is a concept where an IT-software is used to improve shift-workers influence on the planning one’s own working hours. It is largely unknown to what degree self-rostering affects the psychosocial working environment. The aim of the present study was to shed light on positive as well as negative consequences of self-rostering for the psychosocial working environment among shift workers.

Methods
The present study is a prospective, quasi-experimental intervention study with a 12 months follow-up. Workplaces planning to introduce self-rostering were recruited through public advertising, meetings and by personal contacts. A total of 1068 participants were eligible for inclusion at baseline and so far 1074 at follow-up. In total 763 women and 77 men returned the questionnaire at baseline (response rate = 79%) and 712 women and 72 men participated at follow-up (response rate = 73%). They were allocated to either an intervention or a reference group. Intervention: Three different kinds of self-rostering were implemented: 1) A comprehensive intervention encompassing IT-system and organizational changes; 2) An IT system with same possibilities for self-rostering as (1), but without demands of organizational changes; 3) A less comprehensive IT-system with restricted degrees of self-rostering; and 4) a reference group without an intervention. The psychosocial working environment was measured as emotional demands, influence, job satisfaction, justice, possibilities of development, predictability, quantitative demands, leadership, role clarity, reward, support colleagues, support supervisors, work pace, social community, mutual trust, person related negative behaviour and work related negative behaviour.

Results
A linear regression model showed that at follow-up the total intervention group perceived more social support from colleagues compared to baseline. A post hoc analysis revealed differences between interventions. All analyses are adjusted for gender.

Conclusion
The results showed only few overall consequences of self-rostering on the psychosocial work environment. However, the effect was highly dependent on the specific intervention implemented, with the most positive results in the group implementing a comprehensive IT system without demands of organizational changes. Further, analyses of the specific process following the different implementations processes are needed.

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Who chose to work overtime?

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Objective
Studies of overtime work and health show contradictory results. Selection factors may be a potentially important mediating factor of the association between overtime work and health. The aim of this study was to investigate frequency of nurses working overtime one year after graduation, and the predictors of frequently working overtime in relation to 1) sociodemographic background, 2) health behavior and indicators, 3) and attitudes to working hours.

Methods
Three national cohorts of nursing students (n=1155, 1702, and 1459) filled out a questionnaire before graduating and one year into work life. The total population of nursing students from all 26 universities in Sweden at their last semester in higher education (in the autumns of 2002, 2004 and 2006, respectively) constituted the sampling frame. At baseline, the response rate varied between 68 and 73%. At follow up, one year post-graduation the response rate was 92% for the 2002 and 2004 cohorts, and 78% for the 2006 cohort. Data from the baseline questionnaires was used to predict future ‘overtime’.

Results
Frequency for working overtime ‘several times per week’ was 27%, and another 33% reported overtime ‘about once per week’. Impaired health during the graduate year (i.e. bad sleep quality and low self-rated health) and being a non-smoker predicted frequent overtime work one year post graduation. Those working overtime several times per week were more dissatisfied with working hours and more often had two-shift work schedules in hospital wards.

Conclusions
Both risk (poor sleep and health) and protective factors (not smoking) were prospectively related to overtime one year later. The findings support the assumption that selection may play a role in the relationship between overtime and health.

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Working hours and work tempo: independence, combination, interaction?

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Objective
Working hours depends both from the requirements imposed by external demand and manufacturing processes. How do these requirements combine as a function of current trends in manufacturing processes? Within these trends, how do these requirements affect operator activity, in terms of work tempo, working hours, and life outside the workplace?

Methods
These questions have been treated on the basis of informations collected through interviews made with employees working in different companies of the food industry sector and the retail shopping sector.

Results
Actually, in food industry, the economic constraints of making cost-effective the machines have a direct impact on the working schedules: shiftwork, maintenance on nightshift. On its side, the rhythm of the machines applies by conditioning the possibilities of answer to the external demand variations: overtime hours if the equipments do not allow a temporary increase of the staff. But it appears that above all, it is the choices made by the companies in terms of staff that mostly determine the load and the rhythm of work; the machine cadences itselfs are the expression of the choices made on the employees workload as much as the expression of the constraints inherent to technology.

In the retail shopping sector, the schedules are mainly commanded by the shops opening hours and the fluctuation of the customer’s flow. Besides, technical factors intervene. They are characteristic to each function and linked to the important time of preparation needed before the shops opening and the cleaning after closing time. These schedules are also determined by the decisions taken in human resources management and adopted to respond to the customers rush: massive use of part time work, overtime hours decided in a rush, working schedules alternating from one week to another, splitted shifts when the rush is the lowest. The working rhythm of these employees is clearly conditioned by the pressure of the external demand. But this pressure is reinforced by the practice of internal flexibility which consists in assigning the employees to jobs which are not their usual job during the numerous periods of work increase.

Conclusion
In this sector, the human resources policy (method of absenteeism compensation, keeping of the staff at its lowest level) plays a major role on the rhythm of the work execution and is as much decisive as the technical constraints.

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The misbalance in psychophysiological maintenance of human-operator performance under shift work

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Objective

to reveal the differences in psychophysiological maintenance of human-operator performance at the standard and non-standard working hours at the within-system, between-system and over-system levels.

Method

Cognitive performance (CP) was tested in control room shiftworkers at a NPP under 8-h shifts (1270 human-observations); blood pressure (BP), heart rate and CP were tested in both control room shiftworkers at a HPP under 8-h shifts (375 human-observations) and electricity distribution network controllers under 12-h shifts (1224 human-observations). A 5-anchor scale was used to estimate the perceived levels of fatigue, stress and work tension experienced by each controller.

Results

(1) The disturbances in normal selfregulation in cognitive microcycle “work-rest” at night shifts as well as in bloodcirculation (BC) beyond 8-h duty at the 12-h day shifts, at night shifts and at the 2nd consecutive 12-h shifts were found.
(2) The misbalance in the dynamics of correlations between CP and BC were found at the evening and night 8-h shifts.
Age-experience misbalance in BC regulation from sympathetic and parasympathetic parts of vegetative nervous system at the evening and night shifts was revealed. (3) There were found: the increase in the non-stability of CP as a reply to the work tension increase against fatigue accumulated (at the 2nd 12-h shifts), paradoxical reaction in BP to the work load increase at the 2nd 12-h shifts, the decrease in reactivity and central coordination in haemodynamic parameters changes as a reply to the work load increase at the night (compared to the day) 12-h shifts, more pronounced age-experience deterioration in CP and BC at the evening, night and 12-h shifts. In this, under night shifts the heart part of BC could be overloading along with age-experience increase in its sympathetic activation that is associated in literature with coronary pathology development. At the 8-h evening and 12-h shifts the vascular part of BC could be overloading along with age-experience increase in parasympathetic influences that is associated with CP deterioration and increase in physiological price of its maintenance.

Conclusion

The revealed regulation misbalance at the within-, between- and over-system levels reflects the mechanism of the weakness in psychophysiological maintenance of human-operator performance under non-standard working hours. This could increase the risk of both the safety problems and cardiovascular pathology development.

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Shift workers 30% more likely to be overweight/obese

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Objectives
The present study is part of the Nurses and Midwives’ e-cohort Study (NMeS), which is a longitudinal population-based study funded by the Australian Research Council and a range of industry partners. NMeS is an international study, recruiting participants from Australia, New Zealand and the United Kingdom. There have been 10120 total registrants to date. NMeS also employed a novel electronic data collection method.

Shift work could interrupt people’s daily routines; therefore, it may lead to poorer lifestyle factors that increased one’s risk of being overweight or obese. The aim of this study was to examine the association between shift work and overweight/obesity among female nurses and midwives from the NMeS.

Methods
The study purpose was achieved by analyzing both cross-sectional data from the baseline survey and longitudinal data of a 3-year’s follow up period. Measures: Exposure variables: shift work; Outcome variables: overweight (BMI 25.0-29.9), obesity (BMI > 30.0); Confounding variables: modifiable lifestyle factors (including diet quality, physical activity level, alcohol consumption, and smoking status), general mental health, menopausal status, hours of sleep and work pattern.

Results
Among the 2494 participants (1259 day and 1235 shift workers), 31.8% were overweight and 26.9% were obese. More shift workers reported to have less than 5 hours of sleep comparing to day workers. After adjusting the selected founders, shift workers were 1.15 times more likely to be overweight/obese than day workers (p = 0.013, 95% CI 1.03 – 1.28; p = 0.02, 95% CI 1.02 – 1.30, respectively). Among the shift workers, rotating shift work was found to be associated with both overweight and obesity; and night only shift was only associated with obesity, not overweight (p = 0.007, 95% CI 1.004 – 1.03; p = 0.02, 95% CI 1.004 – 1.04; p = 0.031, 95% CI 1.002 – 1.04, respectively).

In the longitudinal analysis, the participants who maintained their shift work status and those who changed from day work to shift work were found to have an increase in their BMI over 3 years (p < 0.001); however, the participants who maintained day work and those who changed from shift work to day work were found to have an decrease in their BMI over 3 years (p < 0.001).

Conclusion
Both cross-sectional and longitudinal studies demonstrated that shift work was associated with higher risk of being overweight and obese.

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Friday 1 July, 2011
SPECIAL SESSION V:
Shiftwork, metabolic and gastrointestinal diseases
Shift work and the risk of ischemic heart disease

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Objective
The objective of this review was to evaluate the epidemiologic evidence for a causal relation between shift work and ischemic heart disease

Method
We conducted a systematic search until May 20, 2011 for studies analysing possible causal associations between shift work and ischemic heart disease. The quality of the included papers was evaluated with respect to design, exposure and outcome information, selection and information bias, confounding, exposure response assessment and possible causal factors related to shift work. In case overall relative risk estimates or confidence intervals were not reported these were computed from the published results.

Results
We identified 13 studies that reported shift work and relative risk of ischemic heart disease incidence or mortality. All but one study relied on a prospective design or non-self-reported exposure information. Eight studies analysed mortality and five incidence. The overall relative risk estimates varied between 0.68 and 1.98 with an average relative risk about 1.30. Associations were generally stronger for studies analysing incidence compared with mortality as well as studies with limited confounder control compared with extensive control for smoking, body mass index and other competing or mediating risk factors. Associations were weaker for studies relying on information about shift work obtained from company records compared with self-reported or aggregated measures. Four studies reported duration of night shift work and indicated no exposure response effect. In a majority of studies we could not reasonably rule out negative or positive bias due to the quality of outcome or exposure information, or confounder control (1).

Conclusion
There is limited epidemiological evidence for a causal relation between shift work and ischemic heart disease.


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Shift work and cardiovascular diseases: pathways from circadian stress to morbidity

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Shift workers have an increased risk of cardiovascular diseases (CVD) compared with day workers. However, the evidence for a causal relationship between shift work and CVD is not conclusive. In order to interpret the epidemiological data correctly, it is necessary to understand the mechanisms mediating the effects of shift work on disease. This paper discusses our current knowledge regarding pathways from shift work to CVD, defined as a group of disorders of the heart and blood vessels.

The review was based on a model where the circadian stress due to working in shifts can influence three different major pathways: a psychosocial, behavioural, and physiological one. There is evidence that psychosocial mechanisms are related to increased difficulties in controlling working hours, decreased work–life balance, and poor recovery following work among shift workers. Influential behavioural pathways appear to be related to weight gain and smoking. In addition, the results suggest that plausible physiological and biological mechanisms are activation of the autonomic nervous system, inflammatory processes, changed lipid and glucose metabolism, and related changes in the risk for atherosclerosis, metabolic syndrome, and type II diabetes. Taken together, the reviewed data provided some evidence for all three major pathways from shift work to CVD, but compelling evidence on any specific mechanism is still missing.

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Gastrointestinal disorders among shift workers

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Objectives
Gastrointestinal (GI) diseases include diseases of the esophagus, the stomach, and intestines. Gastrointestinal symptoms are amongst the most frequent symptoms in the general population. In the literature it has been generally agreed that gastrointestinal symptoms are more prevalent among shift workers than day workers. This critical review is an attempt to update the reader of the published literature.

Methods
We carried out a systematic review of the literature on association between shift work and gastrointestinal symptoms and diseases (1). We used Medline to search for articles from 1966 through 2009. Next, we manually searched articles in reference lists of each article and in previous reviews.

Results
Twenty studies met the inclusion criteria. Six studies reported only gastrointestinal symptoms without a specific diagnosis. Four of those showed significant association between shift work and gastrointestinal symptoms. We found 25 epidemiological studies on peptic ulcer disease in shift workers but only six articles met our inclusion criteria. Five of those reported increased risk of peptic ulcer in shift workers. Two of 3 studies showed association between shift work and functional gastrointestinal disease. We found two studies that reported chronic inflammatory bowel disease in relation to shift work. The results were inconsistent. One study reported increased risk of colorectal cancer in night working nurses.

Conclusions
Our general judgement is that shift workers appear to have increased risk of GI symptoms and peptic ulcer disease. However, control for potential confounders, e.g. smoking, age, socio-economic status and other risk factors are often lacking, or insufficient. More research is needed where modern diagnostic methods are used. Many GI diseases have not been targeted in research on shift workers.

References

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Shiftwork, metabolic dysfunction and impaired cognition

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Objective
Previous research has identified associations between non-standard work schedules (e.g. shiftwork) and the development of metabolic syndrome, and also between non-standard work schedules and impaired cognitive performance. The current study is the first to explore the relationship between shiftwork, metabolic syndrome and cognitive performance within a single sample.

Method
Analyses were based on data from VISAT, a prospective study involving the measurement of physiological, subjective and cognitive performance outcomes at three time points over 10 years, from 3237 participants at baseline. The sample comprised employed and retired wage earners, male and female, who were 32, 42, 52 and 62 years old at the time of the first measurement (T1, 1996), and who were seen again five (T2) and ten (T3) years later.

Results
At T1, participants who were working, or had previously worked, non-standard schedules (i.e. schedules that involved either: rotating shifts; not being able to go to bed before midnight; having to get up before 5 a.m.; or not being able to sleep during the night) were more likely to exhibit symptoms of metabolic syndrome, after controlling for age, sex, socioprofessional status, smoking, alcohol intake and perceived stress (aOR 1.81; 95% CI 1.05 – 3.12).

Participants exhibiting symptoms of metabolic syndrome at T1 showed a significant decline in cognitive performance between T1 and T3, while those without the syndrome showed no change. This interaction between metabolic syndrome status and measurement occasion was significant (p < .01) after taking into account effects on cognitive performance of age, gender, socio-professional status, sleep disruption, alcohol consumption, tobacco consumption, perceived stress and type of work schedule.

A partial replication of the second analysis (substituting type of work schedule with length of exposure to rotating shiftwork) identified an interaction between metabolic syndrome status and length of exposure (p < .05). Among participants who were free of the syndrome at T1, those with 0 – 10 years exposure at T1 had higher cognitive performance scores than those with ≥10 years exposure. Participants exhibiting symptoms of metabolic syndrome tended towards lower cognitive performance (non-significant), but there was no effect of length of exposure in this group.

Conclusion
Glucose is the main metabolic food for the brain and is therefore necessary for mental performance. Impaired glucose metabolism associated with metabolic syndrome may be responsible for reduced cognitive functioning. However the effects of metabolic syndrome on cognitive performance did not appear to be exacerbated by prolonged exposure to shiftwork.

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ORAL SESSION XI:
Experimental studies on sleep/sleepiness
Protein Identification and Changed Protein Levels after Sleep Deprivation

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Objective
Sleep deprivation (SD) might lead to cell stress. Cellular stress might be reflected in changed protein profiles and amount and type of specific proteins in blood serum. These possible changes might hint to SD-affected cellular structures,- mechanisms and -important signalling pathways. We searched for such changes.

Methods
Humans (n=6-8) was subjected to 3 or 6 hours of SD and blood were sampled before, during and after a SD-night (16 corresponding time points during 48 h). Seldi-ToF-MS (Ciphergen), Maldi-ToF-MS (AutoFlex, Bruker Daltonics) and an Hsp70 ELISA-kit (EKS-700 Stressgen biotechnologies) were used to detect changes in human blood serum proteome and identify changed protein fragments.

Protein profile changes (in the m/z spectrum) after SD were searched for by principal component analysis (PCA, Sirius 7.0-PRS), support vector machine- and decision three-models analyzing the mass spectrometry data.

Results
A protein of 71 kDa was decreased in the blood (serum) 0h, 3h and 9h after 3h SD. Similarly Hsp-70 with molecular weight around 70 kDa was also reduced 0h, 3h and 9h after 3h SD by the Stressgen-kit measurement.

The protein profile from the Seldi-ToF-MS (2.5 - 100 kDa, n=3) measurements also showed changed expression for several proteins. Proteins highly expressed during the control night seem to be reduced after SD and not getting back to basal level the day after SD and vice versa for lower expressed proteins.

The protein profile from the Maldi-ToF-MS (0.4 - 15 kDa, n=7) also showed changed expression for several proteins.

Several proteins (2.5 - 100 kDa) where differentially expressed after 3 and 6 hours of SD, specifically Hsp-70 was reduced after 3 hours of SD. One of several changed proteins were identified as Inter-alpha-trypsin-inhibitor-family heavychain-related protein and verified by Q-ToF-MS of the synthesised protein (by Beijing SBS Genetech Co, Ltd, www.sbsbio.com) and are now being explored together with the change in Hsp-70 with the curated database MetaCore by GeneGo (www.genego.com).

The decrease of many proteins as Hsp-70 in the blood during SD is in line with what has been observed in obstructive sleep apnoeas.

Conclusion
SD might lead to cell stress. This seems to be reflected in changed protein profile in human serum. To be able to ID changed proteins and their interactions might shed light on the cellular mechanisms, possible affected extracellular matrix and or cellular pathways of interest to identify underlying sleep and/or being disturbed after SD.

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The effects of a self-selected nap opportunity during simulated night shift work

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Objectives
Napping has been identified as one option to manage fatigue during shift work. Scheduled naps provide breaks at set points in time, making them relatively easy to apply in an organised environment. However their inclusion does not consider individual fatigue patterns during the night. This study assessed the impact of a self-selected 1-hour nap opportunity on various physiological, perceptual and performance-related variables during a 3-day simulated night shift phase. This was compared to a no nap condition consisting of three set breaks which amounted to an equal amount of total rest time.

Methods
The laboratory study consisted of two conditions: a standard night regime and the napping condition (taken between 00h00 and 04h00). 24 subjects were spread evenly across both conditions according to chronotype and sex, forming two independent sample groups, both of which were then randomly and evenly allocated across three, separate 3-day shift cycles. Subjects were required to perform a beading task over the three consecutive 8-hour night shifts while being exposed to a 19-variable test battery that included physiological, performance, neurophysiological and subjective measures such as heart rate measures, response time and subjective sleepiness.

Results
The nap, relative to the standard regime, resulted in higher heart rate frequency responses, faster low precision response times, higher beading outputs and reductions in subjective sleepiness over the 3-night shifts. Simple reaction time and memory also improved following the nap, but only during the third night shift. All the heart rate and temperature measures displayed the effects of circadian down regulation, which in turn was reflected in response and reaction time measures, beading output and subjective sleepiness. Neither the conditions nor the circadian fluctuations had an effect on critical flicker fusion frequency and target deviations responses during a Fitts test. The nap also resulted in an increase in saccade latency, where as the control resulted in decreased saccade latency responses. Finally, the nap did not significantly reduce recovery sleep, relative to the no nap condition.

Conclusion
The inclusion of the self selected nap resulted in improvements in some physiological, performance and subjective measures. It may thus be applied as an individual-specific method of counteracting some of the effects of night work, and should be considered in fatigue management when appropriate.

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Effects of cumulative sleep restriction and recovery sleep on self-perceptions of functional capacity

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Objectives
Alertness and a wide range of task performance are known to deteriorate while being sleep restricted and usually recover in 2 days of normal sleep (1,2). Much less is known about individuals’ perceptions of their own functional capacity in this kind of condition. To further elucidate this issue, we examined individuals’ experiences of their own functional capacity during successive days of sleep restriction and recovery sleep.

Methods
A total of 20 healthy men (19-29 yr) participated in a laboratory study. 13 of them attended a sleep restriction (SR) condition including a baseline day (8 h in bed per night), five SR days (4 h in bed), and two recovery days (8 h in bed). Seven controls slept 7-8 h each night. Each participant had two 50 min multitask sessions daily. After a training phase task difficulty was set individually. During each task session, the participants rated their experiences of sleepiness, efficiency, effortfulness, stressfulness, task difficulty, and task pace by 9-point scales. Self-ratings of multitasking performance were measured by a visual analog scale.

Results
The subjective measures responded to the SR differently: “sleepiness” was clearly increased and “efficiency” and “performance self-ratings” were decreased by the SR, whereas “stressfulness”, “effortfulness”, “task difficulty” and “task pace” showed no SR-induced changes. Most of the SR-related changes were rather small compared to impairments in multitasking performance itself. In contrast to multitasking performance, all subjective measures showed a complete recovery already on the first recovery day.

Conclusions
Many of the changes in self-perceptions of functional capacity do not parallel with changes in actual task performance under cumulative sleep restriction. This discrepancy between subjective and performance measures may make a sleep-deprived individual overestimate his or her actual capacity to perform properly.

References

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Mood and alertness differences in response to sleep deprivation and recovery sleep in experienced shift workers compared to matched non-shift workers

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Objectives
Previous research has shown clearly that during sleep deprivation sleepiness increases and wellbeing is affected. Few studies, however, have assessed how experienced shift workers respond to sleep deprivation in a laboratory setting compared to non-shift workers. The aim of the study was to investigate the effects of one night of total sleep deprivation (TSD) and recovery sleep on vigilance, alertness and mood in shift workers and non-shift workers under identical laboratory conditions.

Method
Eleven experienced shift workers (shift work≥5 years) and 14 non-shift workers were matched for age (35.7±7.2 (mean±SD) and 32.5±6.2 years, respectively). Subjective alertness and mood were recorded by Karolinska Sleepiness Scale (KSS) and 9-digit alertness and mood rating scales at 0.25, 4.25, 5.25, 7, 8, 9, 11.5, 12.5 and 13.5 h after habitual wake up time following adaptation sleep, baseline sleep, the TSD night and recovery sleep. Vigilant attention was assessed by psychomotor vigilance test (PVT) following the mood and alertness ratings. Mood, alertness and vigilance were also assessed every hour during the sleep deprivation night between habitual bed and wake up time.

Results
Shift workers felt significantly more alert, more cheerful, more elated and calmer than non-shift workers throughout the laboratory study. However, out of the 6 analysed PVT parameters the only group differences observed were a significant day*group interaction for median reaction time (RT) with faster median RTs after TSD and recovery sleep and significantly slower 10% fastest RTs (FRT) during the entire study in shift workers. As expected, both groups showed a decrease in subjective alertness and PVT performance during and following the TSD night.

Conclusions
Although shift workers felt better and were more alert than non-shift workers throughout the sleep deprivation and recovery protocol, this was not accompanied by improved PVT performance. This mismatch between subjective sleepiness ratings and objective performance in shift workers may have health and safety consequences in their work environment.

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Measuring individual vulnerability to sleep loss – the CHICa scale

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Objectives
People differ in their sleep needs and in their vulnerability to sleep deprivation. This project aimed to construct a psychometrically satisfying scale to measure the severity of sleep loss consequences. It may be helpful in studying inter- and intra-individual differences, effects of stimulant use and of other countermeasures taken to relieve sleep deficit.

Method
The scale comprised a pool of items reflecting lowered mood and well-being associated with sleep deprivation, based on literature review. Additionally, 30 students of psychology course were asked to describe their cognitive and affective symptoms following the night with curtailed sleep. In result, the list of over 120 items was prepared and 69 items were included into the final experimental set. One hundred and two young women (age 22.5 ± 1.9), university students, fulfilled the scale several times during one week in June and on the ‘control day’ in September; 478 forms in total were collected. It was supposed that preparing to summer exams would affect students’ sleep.

The second part of the study based on sleep-logs of 12 female volunteers (age 24.1 ± 2.0) subjected to one week, 3-hours-a-day sleep restriction. They were filling-in the final version of CHICa every day.

Results
Self-reported length of sleep during summer examination session averaged 7h 17min (SD=102 min). Related to the declared sleep need (mean 8h 40min, SD=63 min), it resulted with the average “sleep index” of 0.850 (SD=0.213). Factor Analysis of the scale yielded to 4 components that explained 67% of total variance. Factor loadings and item-total correlations analysis allowed for selecting the final set of 26 symptoms: 4 items pointed to disturbed thermoregulation (C for cold), 5 reflected disturbed appetite (H for hunger), 8 related to negative affect (I for irritability), and 9 regarded cognitive problems (Ca for cognitive attenuation). Crobach’s alphas of those sub-scales were between 0.92 and 0.95. Comparison of “full rest” and “sleep deficit” weeks revealed significant (p<.001) differences in all the subscales. During the week with sleep restriction, cognitive problems showed the most steep increase (p<.001), then affective symptoms (p=.003), appetite (p=.020) and thermoregulation (p=.024).

Conclusions
The results supported the posited 4-factor structure of the scale. The CHICa scale showed satisfactory psychometric properties in young female sample. Lack of energy and feeling sluggish, decreased accuracy at work, and problems with concentration seem to be the most characteristic subjective manifestations of the chronic sleep deficit state.

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Putting the forbidden zone to bed: the influence of circadian phase on sleep probability when sleep is restricted

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Objectives
Previous forced desynchrony studies have highlighted the close relation between the endogenous circadian rhythm of core body temperature and sleep regulation. Data from these studies indicates that a ‘forbidden zone’ for sleep exists on the rising limb of the endogenous core body temperature rhythm. In these studies, the length of the experimental day was either ultra-short (90 minutes), short (20h) or long (28h), but the ratio of wake to sleep was held constant (1:2). The aim of this study was to examine the presence of the forbidden zone for sleep using a 28-h forced desynchrony protocol in which the ratio of wake to sleep was reduced (1:4).

Methods
Twenty-seven healthy males lived in a time-isolation sleep laboratory for 12 consecutive days. Participants completed either a control (n=13) or sleep restriction (n=14) condition. In both conditions, the protocol consisted of 3x24-h days of adaptation followed by 7x28-h days of forced desynchrony. On forced desynchrony days, participants in the control condition had 9.3h in bed and 18.7h of wake and participants in the sleep restriction condition had 4.7h in bed and 23.3h of wake. Core body temperature was continuously recorded with rectal thermistors and was used to determine circadian phase. Sleep was recorded using standard polysomnography.

Results
Each 30-second epoch of the sleep recordings was scored as either sleep or wake and was assigned a circadian phase based on the core body temperature data. Circadian phase data was divided into 72 bins using a width of five degrees (~20 minutes). In both conditions, sleep probability was determined by calculating the percentage of participants asleep for each circadian phase bin. For the control condition, there was a clear peak and trough in sleep probability – the highest probability (97.4%) occurred at 320 degrees and the lowest probability (64.8%) occurred at 245 degrees. In contrast, sleep probability remained relatively high across all circadian phases for the sleep restriction condition with an average of 96.4%, a minimum of 91.4% and a maximum of 99.1%.

Conclusion
Under normal sleep conditions, the influence of circadian phase on sleep probability is pronounced, such that a forbidden zone for sleep exists. When sleep is restricted, this influence is greatly diminished. In particular, sleep probability remains relatively high across all circadian phases, including those that coincide with the forbidden zone for sleep. In future studies, we will examine whether this observation persists under less severe sleep restriction (i.e. 1:3).

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www.shiftwork2011.se
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