‘Challenges and solutions for healthy working hours’
8-12 June 2015
Elsinore
Denmark

ABSTRACTS
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<td>Satellite Meeting</td>
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<td>Keynote I</td>
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<td>Richard G. Stevens:</td>
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<td>12:00-20:00</td>
<td>Chronotype</td>
<td>Interventions</td>
<td>Measurement and</td>
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<td>workplace fatigue</td>
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Welcome

Welcome to the 22nd International Symposium on Shiftwork and Working Time, Elsinore, Denmark.

All employees have working hours. The arrangement of working hours has strong impact on the structure of everyday lives. In some jobs, services are requested and provided for around the clock, e.g. health and elderly care, transportation and in the industry. It is therefore necessary to work outside ordinary working hours or in shifts. In some jobs, working hours are clearly distinguished from leisure time – in other jobs such as on-call work and boundary less work, the distinction is not so clear. The arrangement of working hours therefore challenges social lives, possibilities for restitution, and good health.

The scope of the 22nd International Symposium on Shiftwork and Working Time is to address these challenges and possible solutions for healthy working hours. This scope embraces the organization of optimal designs of working schedules considering biological mechanisms that compromise health and safety such as restitution and sleep as well as personal preferences for social life.

Building on the success of the 21st symposium held in Brazil in 2013, we have put great efforts into organizing a conference with high scientific standard bringing together a multidisciplinary cross section of researchers from different scientific areas specializing in all aspects of working time issues. According to the Ruthenfranz’s principles, the conference includes both early career researchers and more experienced researchers from countries around the world. Throughout the conference, we will provide plenty of breaks and meals thus enabling you to network and exchange ideas.

Thanks to your contributions in terms of keynote speaks, submitting and reviewing abstracts in addition to organizing thematic sessions and chairing oral sessions, we are confident that this conference has a good starting point for being a success.

On behalf of the organizing and scientific committees, we are honored and pleased to welcome you to the 22nd International Symposium on Shiftwork and Working Time, and hope that you will have some enjoyable and scientifically rewarding days here in Elsinore.

Anna Helene Garde
Chair of the Scientific Committee

Simone V. Møller
Chair of the Organizing Committee

Inger Schaumburg
Director General, NRCWE
Scientific Committee

- Anne Helene Garde, Chair (Denmark)
- Anette Harris (Norway)
- Ann Dyreborg Larsen (Denmark)
- Anna Arlinghaus (Germany)
- Arne Lowden (Sweden)
- Claudia Moreno (Brazil)
- Frida Marina Fischer (Brazil)
- Greg Roach (Australia)
- Göran Kecklund (Sweden)
- Hans van Dongen (USA)
- Henrik Kolstad (Denmark)
- Imelda Wong (Canada)
- Johnni Hansen (Denmark)
- Kirsten Nabe-Nielsen (Denmark)
- Masaya Takahashi (Japan)
- Mikko Härmä (Finland)
- Phil Tucker (United Kingdom)
- Sampsa Puttonen (Finland)
- Stephen Popkin (USA)
- Thomas Kantermann (Germany)
- Åse Marie Hansen (Denmark)

National Organizing Committee

- Simone Visbjerg Møller, Chair (NRCWE)
- Paul-Anker Lund, Senior Consultant (NRCWE)
- Andreas Tang, Head of Finance and Accounts (NRCWE)
- Ann Dyreborg (NRCWE)
- Anne Helene Garde (NRCWE)
- Henrik Kolstad (Aarhus University, Ramizzini Center)
- Johnni Hansen (Danish Cancer Society)
- Kirsten Jürgensen, Head of Services, (NRCWE)
- Kirsten Nabe-Nielsen (University of Copenhagen)
- Kirsten Rydahl, Communication Officer (NRCWE)
- Åse Marie Hansen (University of Copenhagen)
## PROGRAMME

### Monday, 8 June 2015

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>09:00-16:30</td>
<td>Satellite meeting DI Copenhagen. Shiftwork wellbeing and health research and implementation</td>
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<tr>
<td>12:00-20:00</td>
<td>Registration</td>
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<td>18:00-20:30</td>
<td>Get-together Buffet</td>
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### Tuesday, 9 June 2015

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<td>07:30-08:30</td>
<td>Registration</td>
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<td>08:30:9:15</td>
<td>Opening of the conference Room 1 (Conference room)</td>
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| 9:15 - 10:15| Keynote I: Shift work as a harbinger of the toll taken by light at night  
              Richard G. Stevens  
              Room 1 (Conference room) |
| 10:15 – 11:00| Coffee Break                                                          |
| 11:00 - 12:30| Oral Session 1A: Performance and safety  
              Room 1 (Conference room)  
              Session Chair: John Axelsson, Karolinska Institute, Sweden  
              Session Chair: Thomas Kantermann, University of Groningen, The Netherlands |
|             | Is performance on simple and complex tasks differentially affected by sleep dose, prior wake and circadian phase?  
              Anastasi Kosmadopoulos, Charli Sargent, Xuan Zhou, David Darwent, Drew Dawson, Gregory Daniel Roach |
|             | Work Hours as a Risk Factor for Motor Vehicle Crashes in Resident Physicians  
              Céline Vetter, Laura K. Barger, Christopher P. Landrigan, Charles A. Czeisler |
|             | Modeling physicians’ error risk in hospitals as a function of workload as well as shift length.  
              Johannes Gaertner, Anna Arlinghaus, Celine Vetter, Imelda Wong, Simon Folkard |
|             | Does alertness management reduce sleepiness in long-haul truck drivers?  
              Mikael Sallinen, Mia Pylkkönen, Hanna-Kaisa Hyvärinen, Sampsa Puttonen, Maria Sihvola |
|             | Work-related injury risk and severity of French Volunteer Firefighters are greatest at night  
              Marc Riedel, Alain Reiberg, Yvan Touitou, Michael Smolensky, René Clarisse, Nadine le Floc’h,  
              Guillaume Houberton, Michael Pierrat, Hugues Deregnacourt |
|             | Exploring the reasons why airline crew don’t use fatigue reporting systems  
              Alexandra Holmes, Sarah Booth |
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<tr>
<th>Time</th>
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<td>11:00-12:30</td>
<td><strong>Oral Session 1B: Well-being and social factors</strong></td>
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<td>Session Chair: Sampsa Puttonen, Finnish Institute of Occupational Health, Finland</td>
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<td>Session Chair: Kirsten Nabe-Nielsen, University of Copenhagen, Denmark</td>
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<td>The 4 Rs of working time and health: Regularity, rhythms, routine and ritual</td>
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<td>Ginny M Sargent, Jane Dixon, Cathy Banwell, Lyndall Strazdins, Julia McQuoid</td>
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<td>De-synchronized schedules and family time in the 24 hour economy</td>
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<td>Tomi Oinas, Mia Tammelin</td>
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<td>The impact of work schedule demands on nurses’ work related health, negative work–home interference and work ability: do work schedule resources help?</td>
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<td>Velibor Peters, Angelique de Rijk, Josephine Engels</td>
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<td>Educational level, work-life conflict and self-rated health among Brazilian civil servants of the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil)</td>
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<td>Cornelia van Diepen, Susanna Toivanen, Rosane Härter Griep, Joanna Miguez Nery Guimarães, Lidyane V Camelô, Estela M Aquino, Dóra Chor</td>
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<td>Shiftwork and the psychosocial work environment: A longitudinal exploration of moderation and mediation</td>
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<td>Mark Skowronski, Vishwanath Baba</td>
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<td>Dispositional factors and work-mastery among shift workers</td>
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<td>Vegard Foldal, Eva Langvik, Ingvild Saksvik-Lehouillier</td>
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<td>12:30-13:30</td>
<td><strong>Lunch</strong></td>
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<td>13:30-15:30</td>
<td><strong>Tematic Session I: Flexible working hours</strong></td>
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<td>Room 1 (Conference room)</td>
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<td>Session Chair: Göran Kecklund, Stockholm University, Sweden</td>
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<td>Session Chair: Michiel Kompier, Radboud University, The Netherlands</td>
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<td>‘How fast does the brain wake up from sleep and can we trust people working on-call?’</td>
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<td>John Axelsson</td>
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<td>Boundaryless work, psychological detachment and sleep: Does working anytime – anywhere equals employees’ ‘being ‘always on’?</td>
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<td>Christin Mellner, Göran Kecklund, Michiel Kompier, Amir Sariaslan, Gunnar Aronsson</td>
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<td>Work stress and objective sleep during night shifts: A study among rescue helicopter pilots</td>
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<td>Sabine Geurts</td>
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<td>An intervention study on self-scheduling among Dutch healthcare workers: Implications for experienced worktime control, satisfaction with schedules, and well-being</td>
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<td>Debby Beckers, Hylco Nijp, Michiel Kompier, Sabine Geurts</td>
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<td>15:30-16:00</td>
<td><strong>Coffee Break</strong></td>
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<td>15:30-17:30</td>
<td><strong>Early Career Researchers Session Program</strong></td>
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<td><strong>15:30-15:40: Welcome and presentation of the aim and content of the session</strong></td>
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<td><strong>15:40-16:00: Göran Kecklund</strong></td>
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<td>Göran Kecklund is associate professor in psychology at the Stress Research Institute, Stockholm University, Sweden. He is also associate editor for the journal “Scandinavian Journal of Work, Environment and Health”. He will share his experience – both as a researcher and as a journal editor – of what researchers early in their career can do to get their papers published in international journals, including some practical tips and insights into scientific publishing</td>
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16.00-16.40: Social activity
16.40-17.15: Mickey Gjerris
Mickey Gjerris is associate professor in bioethics at the University of Copenhagen and part of the group organising the mandatory courses for PhD students and supervisors at the faculties of HEALTH and SCIENCE on Responsible Conduct of Research. His talk will focus on issues related to scientific misconduct and questionable conduct of research, especially regarding authorship issues.
17.15-17.30: Summing up
19.30-: Dinner (tables reserved for ECR participants)

17:30-19:30 Poster session 1
1a: Circadian rhythms and chronobiology
1b: Health and diseases
1c: Safety and performance
1d: Methods

19:30 Dinner (Konventum)

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<th>Wednesday, 10 June 2015</th>
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<td>8:30-10:00</td>
<td>Oral Session 2A: Sleep</td>
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<td>Session Chair: Arne Lowden, Stockholm University, Sweden</td>
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<td>Session Chair: Philip Tucker, Swansea University, United Kingdom</td>
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<td>Number of consecutive night shifts and sleep</td>
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<td>Åse Marie Hansen, Marie Aarrebo Jensen, Kirsten Nabe-Nielsen, Jesper Kristiansen, Anne Helene Garde</td>
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<td>Differences in sleep time when adding a second job: Findings from the American Time Use Survey Helen Marucci-Wellman, David Lombardi, Joanna Willetts</td>
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<td>Quick returns and night work as predictors of sleep, recovery &amp; wellbeing Anna Dohlaren, Philip Tucker, Petter Gustavsson, Ann Rudman</td>
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<td>Fighting fires and fatigue: sleep during wildfire suppression Grace Vincent, Brad Aisbett, Sally Ferguson</td>
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<td>12-h shifts and age – effects on sleep, wakefulness and recovery from work Sampsa Puttonen, Kati Karhula, Mia Pylkkönen, Annina Ropponen, Tarja Hakola, Mikael Sallinen, Mikko Härnä</td>
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<td>Sleep-related differences in shiftwork and daytime work across two seasons Arne Lowden, Matilda Kämstam, Torbjörn Åkerstedt</td>
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<td>Session Chair: Masaya Takahashi, National Institute of Occupational Safety and Health, Japan</td>
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<td>Session Chair: Henrik Kolstad, Aarhus University Hospital, Denmark</td>
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<td></td>
<td>Shift work and cardiovascular disorders: a critical narrative review and meta-analysis. Giovanni Costa, Eleonora Burgazzi, Luca Neri</td>
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<td>Night shift work, chronotype and prostate cancer risk in the MCC-Spain case-control study Kyriaki Papantoniou, Gemma Castaño-Vinyals, Ana Espinosa, Nuria Aragonés, Beatriz Pérez-Gómez, Javier Burgos, Inés Gómez-Acebo, Javier Llorca, Rosana Peiró, Jose Juan Jimenez-Moleón, Francisco Arredondo, Adonina Tardón, Marina Pollan, Manolis Kogevinas</td>
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<td>Mismatch of sleep and work timing and risk of type 2 diabetes Céline Vetter, Elizabeth E. Devore, Cody A. Ramim, Frank E. Speizer, Walter C. Willett, Eva S. Schernhammer</td>
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<td>Night work and metabolic risk factors for diabetes among a non-diabetic population: baseline results from Brazilian Longitudinal Study of Adult Health (ELSA-Brasil) Aline Silva-Costa, Lucia Rotenberg, Rosane Griep</td>
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<td>Use of multistate models for examination of associations between shiftwork and short-term sickness absence Ann Dyreborg Larsen, Pernille U. Hjarsbech, Jacob Pedersen, Johnni Hansen, Åse Marie Hansen, Henrik Kolstad, Jens Peter Bonde, Reiner Rugulies, Anne Helene Garde</td>
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<td>Short term risk of breast cancer following night shift work in the public health sector: a register linkage study of pay roll data Helene Tilma Vistisen, Anne Helene Garde, Morten Frydenberg, Peer Christiansen, Åse Marie Hansen, Johnni Hansen, Jens Peter Bonde, Henrik Kolstad</td>
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<td>10:00-10:30</td>
<td><strong>Coffee break</strong></td>
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<td>10:30-12:30</td>
<td><strong>Tematic Session II: Mechanisms - new perspectives linking shift work and chronic disease</strong></td>
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<td>Session Chair: Sylvia Rabstein, Institute for Prevention and Occupational Medicine, Germany</td>
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<td>Session Chair: Kristan Aronson, Queen’s University, Canada</td>
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<td>Is shift work linked with vitamin D deficiency? Sylvia Rabstein, Sara Schramm, Beate Pesch, Lewin Eisele, Susanne Moebus, Raimund Erbel, Nico Dragano, Thomas Brüning, Thomas Behrens, Karl-Heinz Jöckel</td>
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<td>Association of night shift work with lifestyle factors Beata Peplorńska</td>
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<td>Shift work, cortisol, sleep disruption and metabolic syndrome Kristan Aronson, Pascale Lajoie, Eleanor Hung, Jill Korsiak, Saadul Islam, Andrew Day, Ian Janssen, Joan Tranmar</td>
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<td>Sleep, night shiftwork and breast cancer risk among women in Denmark Johnni Hansen</td>
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<td>12:30-13:30</td>
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### 13:30-15:30
**Tematic Session III: Shiftwork and pain**
Room 1 (Conference room)
Session Chair: Dagfinn Matre, National Institute of Occupational Health, Norway

- Hyperalgesia after experimental and work-related sleep restriction – experimental findings  
  *Kristian Bernhard Nilsen, Dagfinn Matre*

- Musculoskeletal pain and insomnia among workers of different occupations and work hours.  
  *Claudia Roberta de Castro Moreno, Suleima Vasconcelos, Arne Lowden, Elaine Marqueze*

- The comorbidity of headache and insomnia in the Nord-Trøndelag Health Survey  
  *Siv Steinsmo Ødegård, Trond Sand, Morten Engstrøm, Lars Jacob Stovner, John-Anker Zwart, Knut Hagen*

- Sleep quality and low back pain - implications for shiftworkers  
  *James Henry McAuley*

### 15:30-16:00
**Coffee break**

### 16:00-17:00
**Oral Session 3A: Epidemiological studies**
Room 1 (Conference room)
Session Chair: Johnni Hansen, Danish Cancer Society, Denmark
Session Chair: Annina Ropponen, Finnish Institute of Occupational Health, Finland

- How do different definitions of night shift affect the exposure assessment of night work?  
  *Anne Helene Garde, Johnni Hansen, Henrik Albert Kolstad, Åse Marie Hansen*

- A Conceptual Framework to Describe and Measure Shift Work in Epidemiological studies  
  *Daniella van de Langenberg, Jelle Vlaanderen, Wendy Rodenburg, Matti Rookus, Roel Vermeulen*

- Genetic susceptibility and night shift work in relation to breast, prostate and colorectal cancer in the MCC-Spain study  
  *Manolis Kogevinas, Ana Espinosa, Kyriaki Papantoniou, Gemma Castañó-Vinyals, Víctor Moreno, Inés Gómez-Acebo, Eva Ardanaz, Jone M. Altzibar, Beatriz Pérez-Gómez, Javier Llorca, Mariona Bustamante, Marina Pollán*

- An intervention study on the effects of Boundaryless Work on work hours, job characteristics, motivation, and well-being among office workers  
  *Hylco Nijp, Debby Beckers, Karina Van de Voorde, Sabine Geurts, Michiel Kompier*
| 16:00-17:00 | **Oral Session 3B: Health and disease II**  
Room 2  
Session Chair: Frida Marina Fischer, University of São Paulo, Brazil  
Session Chair: Simone Visbjerg Møller, National Research Centre for the Working Environment, Denmark  
Physical fitness and degree of attention on health among male shiftworkers  
*Mei-Chu Yen Jean, I-CHENG Lu, Shao-En Sharon Yen, Hsing-yen Hsieh*  
Associations between ergonomic shift schedule criteria with health and work functioning for regular (semi-)continuous shift systems  
*Hardy van de Ven, Sandra Brouwer, Wendy Koolhaas, Anneke Goudswaard, Michiel de Looze, Göran Kecklund, Josue Almansa Ortiz, Ute Bültmann, Jac van der Klink*  
Effects of shift schedule design on public transport drivers’ disability for service over the working life  
*Anna Arlinghaus, Martina Bockelmann, Jana Greubel, Friedhelm Nachreiner*  
Work schedule and self-reported hypertension – the potential beneficial role of on-shift naps among night workers  
*Lucia Rotenberg, Aline Silva-Costa, Paulo Roberto Vasconcellos-Silva, Rosane Härter Griep* |
| 17:30-19:30 | **Poster session 2**  
2a: Health and diseases  
2b: Sleep and fatigue  
2c: Social factors  
2d: New trends in shiftwork and working time research |
| 19:30 | **Dinner (Konventum)** |

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| **09:00-10:00** | **Keynote II: Sleeping with one ear open**  
*Sally Ferguson*  
Room 1 (Conference room) |
| **10:00-10:30** | **Coffee break** |
| **10:30-12:30** | **TS IV: Work hours, sleep and injury**  
Room 2  
Session Chair: Anna Arlinghaus, GAWO e.V., Germany  
Session Chair: Imelda Wong, Institute for Work and Health / University of British Columbia, Canada  
Flexible work hours and accident risk  
*Friedhelm Nachreiner, Anna Arlinghaus, Jana Greubel*  
Accident risk on rotating shift systems: the roles of metabolic dysfunction and cognitive impairment  
*Philip Tucker, Simon Folkard*  
Impact of work hours limitations on worker and patient safety in US Healthcare  
*David A. Lombardi, Simon Folkard*  
Shift work, fatigue and cognitive impairment: what are the next steps for future research?  
*Imelda Wong* |
| **12:30-13:30** | **Lunch** |
### 13:30-15:00 Oral Session 4A: Chronotype and diurnal rhythms
Room 1 (Conference room)

**Session Chair:** Claudia Roberta Moreno, University of São Paulo, Brazil  
**Session Chair:** Dorothee Fischer, Ludwig-Maximilian-University Munich, Germany

- Does chronotype impact health measured by Work Ability Index?  
  Mei Yong, Dorothee Fischer, Christina Germann, Céline Vetter, Stefan Lang, Christoph Oberlinner

- Association between melatonin onset, sleep timing, age and chronotype in rotating shiftworkers  
  Suleima Pedroza Vasconcelos, Debra Skene, Benita Middleton, Arne Lowden, Frida Marina Fischer, Elaine Cristina Marquez, Claudia Roberta Castro Moreno

- Individual time trends in cortisol response to shift work; A longitudinal study.  
  Heidi M. Lammers-van der Holst, Gerard A. Kerkhof

- Association between chronotype, food intake and physical activity in medical residents  
  Maria Carliana Mata, Daurea Abadia Souza, Luana Thomazetto Rossato, Catarina Mendes Silva, Sergio Tufik, Marco Tuilo Mello, Cibele Aparecida Crispim

- Night work and breast cancer in women  
  Torbjorn Akerstedt, Jurgita Narusyte, Pia Svedberg, Anders Knutsson, Göran Kecklund, Kristina Alexanderson

### 13:30-15:00 Oral Session 4B: Improving shiftwork: Interventions and solutions
Room 2

**Session Chair:** Henrik Kolstad, Aarhus University Hospital, Denmark  
**Session Chair:** Ann Dyreborg Larsen, National Research Centre for the Working Environment, Denmark

- Shift work intervention process  
  Sarike Verbiest, Hardy Van de Ven, Jac Van der Klink, Sandra Brouwer, Wendy Koolhaas, Ute Bültmann, Michiel De Looze

- Simplified participatory procedures for improving mental health of workers including joint change of working time arrangements and job content  
  Kazutaka Kogi, Toru Yoshikawa, Yuriko Takeuchi, Etsuko Yoshikawa

- Effects of a change in collective agreement –based rules of working hours for shift ergonomics among nurses – a controlled intervention study  
  Annina Ropponen, Päivi Vanottola, Aki Koskinen, Tarja Hakola, Sampsa Puttonen, Mikko Härnä

- Pharmacological interventions for sleepiness and sleep disturbances caused by shift work  
  Juha Liira, Jos H Verbeek, Giovanni Costa, Tim R Driscoll, Mikael Sallinen, Leena Isotalo, Jani H Ruotsalainen

- The effect of timing of exposure to monochromatic blue light on objective and subjective alertness and mood  
  Irena Iskra-Golec, Krystyna Golonka, Mirosław Wyczesany, Patrycja Siemiginowska, Joanna Watroba, Anna Wąsna, Ryszard Przewlocki, Małgorzata Dziewa, Sylwia Kozera, Szymon Kukulski

- Improving safety and operational flexibility in an Air Traffic Control system using Fatigue Risk Management  
  Adam Fletcher, Richard Yates, Kurt Oborne, Claire Marrison
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<td>16:30-17:00</td>
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<td>19:15-20:00</td>
<td>Transport to Restaurant Marienlyst (walk)</td>
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<td>20:00-23:00</td>
<td>Conference dinner at Restaurant Marienlyst</td>
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<td>Social program at Konventum</td>
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<td>10:30-12:15</td>
<td>Thematic Session V: Measurement and Prediction of Workplace Fatigue</td>
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<td>Session Chair: Hans P.A. Van Dongen, Washington State University, United States of America</td>
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<td>New technologies for fatigue measurement</td>
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<td>Subjective sleepiness as a measure of fatigue</td>
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<td>Thank you and welcome in 2017</td>
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**Friday, 12 June 2015**

09:00-10:00  **Keynote III: Promoting older workers’ job retention and health**
Mikko I. Härmä
Room 1 (Conference room)

10:00-10:30  **Coffee break**

10:30-12:15  **Thematic Session V: Measurement and Prediction of Workplace Fatigue**
Room 1 (Conference room)
Session Chair: Hans P.A. Van Dongen, Washington State University, United States of America
Session Chair: Torbjorn Åkerstedt, Karolinska institute, Sweden

New technologies for fatigue measurement
*Pia Marina Forsman*

Performance Assessment in Operational Settings
*Kimberly A Honn*

Model Predictions of Workplace Fatigue
*Hans P.A. Van Dongen*

Subjective sleepiness as a measure of fatigue
*Torbjorn Akerstedt*

12:15-13:15  **General Assembly**
Room 1 (Conference room)
Thank you and welcome in 2017

13:15  Lunch
Tuesday 9 June
Keynote I: Shift work as a harbinger of the toll taken by light at night
Richard G. Stevens

*Time:* Monday, 8/Jun/2015: 9:15 - 10:15

*Location:* Room 1 (Conference room)

*Session Chair:* Anne Helene Garde, NRCWE, Denmark
Shift work as a harbinger of the toll taken by light at night

Richard Stevens
Division of Epidemiology & Biostatistics, UConn Health, United States of America; bugs@uchc.edu

I have been working for a long time trying to help figure out why people get cancer. In the late 1970s, I began to study the confounding mystery of why breast cancer risk rises so dramatically as societies industrialize. In 1987, I proposed a radical new theory that use of electric lighting, resulting in lighted nights, might produce “circadian disruption” causing changes in the hormones relevant to breast cancer risk and account for a portion of the global burden of the disease. The first testable epidemiologic prediction of this theory was that shift working women would be at higher risk than day working women. Other predictions include:

1. blind women at lower risk,
2. short sleepers at higher risk, and
3. community nighttime light level would correlate with breast cancer incidence across societies.

Accumulating evidence has generally supported the theory, and it has received wide scientific and public attention.

My keynote speech will focus on the effects of ill-timed light exposure, particularly among non-day workers, on various aspects of physiology that could result in higher risk of many diseases in addition to cancer. I will discuss how shift workers may be a harbinger for much broader deleterious effects of light at night on health in society because almost no person in the modern world does not use electricity to light the night. Future research should continue to focus on three interrelated topics:

1. the basic biology of circadian rhythmicity, and the impact of light it,
2. epidemiological studies, particularly of night workers, of lighting and human health, and improvements in lighting technology that take advantage of the basic science and epidemiology to provide lighting that better accommodates circadian health while maintaining our ability to live and work at night if we choose.
Oral Session 1A: Performance and safety

Time: Tuesday, 09/Jun/2015: 11:00 - 12:30  
Location: Room 1 (Conference room)  
Session Chair: John Axelsson, Karolinska Institute, Sweden  
Session Chair: Thomas Kantermann, University of Groningen, The Netherlands
Is performance on simple and complex tasks differentially affected by sleep dose, prior wake and circadian phase?

Anastasi Kosmadopoulos1,2, Charli Sargent1, Xuan Zhou1, David Darwent1, Drew Dawson1, Gregory Daniel Roach1

1Appleton Institute for Behavioural Science, Central Queensland University, Australia; 2Bushfire Cooperative Research Centre, Australia; a.kosmadopoulos@cqu.edu.au

Introduction: It is well established that insufficient sleep, extended wakefulness, and the night-time circadian nadir contribute to performance deficits. However, it is not clear to what extent the influence of these factors is moderated by a task’s required mental effort. As simple measures of neurobehavioural function commonly used in applied research may have limited ecological validity in the workplace, the role of task complexity warrants further exploration. The aim of this study was to determine whether a simple sustained attention task and a more complex driving task are differentially affected by sleep dose, prior wake, and circadian phase.

Methods

Thirty-two male participants (M±SD; 22.8±2.9 years) completed a 13-day time-isolated forced desynchrony protocol. They were assigned to either a control condition or a sleep-restriction (SR) condition that differed only in sleep dose, the allocated duration of time in bed (TIB). The control condition provided 4.67h TIB per 14h and the sleep-restriction (SR) condition provided 2.33h TIB per 14h. Sustained attention and driving were assessed, respectively, with a psychomotor vigilance task (PVT) and a driving simulation task (DST) at 2.5-h intervals during wake times. Scores on each measure were standardised within individuals against their baseline average and standard deviation. Core body temperature was recorded to derive estimates of circadian phase.

Results

Mixed-models analyses of variance were conducted, with task, sleep dose, prior wake, and circadian phase included as fixed terms. Standardised performance, derived from the PVT and the DST, was entered as the dependent variable. Main effects of sleep dose [F(1,30)=52.5, p<.001], prior wake [F(2,1050)=7.3, p=.001], and circadian phase [F(5,1050)=97.1, p<.001], revealed that performance declined with sleep restriction and increasing prior wake, and was worse around the circadian nadir. Significant 2-way interactions of task x sleep dose [F(1,1050)=35.1, p<.001] and task x circadian phase [F(5,1050)=6.2, p<.001] were observed, such that the effects of sleep dose and circadian phase increased with task complexity. There was no interaction of task x prior wake [F(2,1050)=0.9, p=.39].

Conclusion

Understanding the factors that affect performance on tasks of varying complexity may elucidate circumstances in which further precautions may be required. The results of this study suggest that the negative influence of sleep restriction on performance is greater for more complex tasks, such as driving, than for simpler tasks. The results also suggest that complex tasks are more sensitive than simpler tasks to the time of day.

Support: This study received funding from the Australian Research Council.
Work Hours as a Risk Factor for Motor Vehicle Crashes in Resident Physicians
Céline Vetter¹, Laura K. Barger²,³, Christopher P. Landrigan²,³,⁴, Charles A. Czeisler²,³
¹Brigham and Women’s Hospital and Harvard Medical School, United States of America; ²Division of Sleep and Circadian Disorders, Departments of Medicine and Neurology, Brigham and Women’s Hospital, Boston, MA; ³Division of Sleep Medicine, Harvard Medical School, Boston, MA; ⁴Division of General Pediatrics, Department of Pediatrics, Children’s Hospital Boston, MA; n2cve@channing.harvard.edu

Background
Extended duration work shifts (>24 hours) have been a hallmark of medical education. However, we showed that each extended duration work shift in first-year postgraduate residents are in general associated with an 8.8 % (Confidence Interval [CI]=3.2%-14.4%) increased monthly risk of any motor vehicle crashes (MVC); this was accentuated for commutes home from the work place, with a 16% (CI=7.6%-24.4%) increased monthly risk of an MVC. Additionally, MVC risk was doubled (Odds Ratios [OR]=2.2, CI=1.5-3.2) and reported near-crash risk increased nearly six-fold (OR=5.9, CI=5.4-6.3) following an extended duration shift versus a non-extended duration shift (Barger, et al., 2005). Indeed, the effect of weekly work hours depends on length and type of shift, as well as resting opportunities (Folkard & Lombardi, 2006). Here, we further explore the role of work hours and other potential risk factors and its impact on motor vehicles crashes prevalence.

Methods
We conducted a nationwide, prospective cohort study over 5 academic years. Resident physicians completed monthly surveys providing detailed information on work hours, extended duration work shifts, motor vehicle crashes, near-miss crashes, the usage of wake-promoting and sleep-promoting sleep medications, caffeine and alcohol and amount of exercise. In addition, driving history data, specialty, and demographic data were collected.

Results
49,916 person-months of data were collected from 6,492 resident physicians. A total of 846 motor vehicle crashes and 10,236 near-miss crashes were reported. Approximately 40% of the MVCs occurred on the commute from work. Preliminary analysis revealed a dose-response relationship between weekly working hours and motor vehicle crashes, with up to a two-fold increase of an MVC in those residents working more than 100h/week as compared to the reference group (≤40h/week). Further analysis examining the effects of specialty, history of prior MVCs, caffeine and alcohol intake, as well as mediation use and demographic characteristics are ongoing.

Conclusions
Motor vehicle crashes and near-miss crashes pose a serious safety hazard, both for resident physicians and other motorists. Our preliminary results suggest an association between weekly work hours and the risk of MVC. Other potential risk factors may also bear significantly on safety, but have not been adequately explored; final analyses of these factors is currently being completed. Understanding the risk factors for motor vehicle crashes in this high-risk occupation has important implications for working time guidelines, and more specifically, for hospitals and residency programs.
Modeling physicians’ error risk in hospitals as a function of workload as well as shift length.

**Johannes Gaertner¹**, **Anna Arlinghaus²**, **Celine Vetter³**, **Imelda Wong⁴**, **Simon Folkard⁵**

¹XIMES GmbH & Vienna University of Technology, Austria; ²GAWO e.V., Germany; ³Channing Division of Network Medicine, Brigham and Women’s Hospital and Harvard Medical School, USA; ⁴UBC & Institute for Work and Health, Canada; ⁵Université Paris Descartes, France & Swansea University, UK; gaertner@ximes.com

**BACKGROUND**
Sharing resources between stationary and newly admitted patients in the emergency room is typical for Austrian hospitals. Workload in some emergency rooms is very high. With the existing long hours (24h+ for the persons working the nights) the risk of physicians’ errors is high. At the same time, continuity of patient care is a common concern for physicians. Shorter daily working hours would result in more handovers (i.e. transmission of patient information between shifts) which are known to increase risk. We aimed to determine the “best compromise” that would optimally balance different contributors to nighttime error risk.

**METHODS**
We developed a predictive model to estimate the probability of errors among hospital physicians between 16:00 and 8:00 hours. (i) We extracted base risk estimates from existing literature for important types of errors (e.g. medication). (ii) We chose probabilities of error-increase related to shift length from the literature (which again varies depending on circumstances, tasks, etc.). (iii) We included treatment workload scenarios (low, medium and high) based on secondary analysis regarding the number of ward patients treated within a shift, newly admitted emergency patients, and the handovers between physicians. High workload increases the potential for error and reduces the opportunity for rest as well as directly impacting on fatigue. We modeled error risk as a function of these factors and applied it to realistic shift lengths (3*8h, 12h+12h, 8h+16h and 24h).

**RESULTS**
The risk of errors differed strongly with the combination of workload and shift length. With a low workload, the relative risk of making errors was found to be lowest on 24h shifts for all reasonable scenarios (3*8h was often >50% higher, 8h+16h slightly worse than 24h). However, with a high workload, the relative risk was lowest on 8h+16h (for a broad range of different scenarios >20%), followed by 24h, 12h+12h, and 3*8h shifts.

**CONCLUSION**
Our results indicate that both the schedule and the patient workload have a significant impact on error rates and should be considered when regulating shift duration. The model needs to be validated against actual error rates (e.g. reoperation) and further refinement is necessary to take account of the physician’s task, the time available for rest, fatigue estimates and sleep duration both during and between shifts.
Does alertness management training reduce sleepiness in long-haul truck drivers?
Mikael Sallinen1,2, Mia Pylkkönen1,2, Hanna-Kaisa Hyvärinen1, Sampsa Puttonen1, Maria Sihvola3
1Finnish Institute of Occupational Health, Finland; 2University of Jyväskylä, Finland; 3mikael.sallinen@ttl.fi

Background
Driver sleepiness is a significant concern in transport. Especially long-haul truck drivers constitute a group of professional drivers that is regularly exposed to all primary sleepiness-inducing factors: reduced prior sleep, long prior wakefulness, night-time work, extended time on task, and task monotony. To find a feasible way of reducing on-the-job sleepiness in this particular group we investigated whether a short, group-based education on alertness management strategies improves drivers’ sleep between shifts, use of sleepiness countermeasures while on duty, and most importantly sleepiness behind the wheel.

Methods
Fifty-two truck drivers (mean age 37.6 years) were randomly assigned to an intervention (n=32) or control (n=20) condition. Data was collected during a 2-week period five months before and after a training day on alertness management strategies. The day included an interactive lecture (1.5 hours) and a workshop (2 hours) on sleepiness-inducing factors and alertness management strategies. In the end of the training day, each driver made a personal alertness management plan. We measured on-the-job sleepiness by the Karolinska Sleepiness Scale, use of sleepiness countermeasures by a diary, and sleep by a diary and actigraphs. The trips were divided into the following categories: first night shift, successive night shift, morning shift, and day/evening shift. A shift was defined as “sleepy” if at least one of the hourly given KSS ratings was ≥ 7.

Results
We found no intervention-related benefits for sleep prior to the shifts (sleep quantity and quality and frequency of napping), use of effective sleepiness countermeasures while on duty (caffeine consumption and taking a nap break) or the proportion of sleepy shifts in any of the four shift types. In all, the proportion of sleepy shifts was highest for the first night shifts (34.7%) and lowest for the morning shifts (7.8%).

Conclusions
The results propose that a feasible alertness management training is not a sufficient measure to reduce on-the-job sleepiness among long-haul truck drivers. To gain positive results it may be necessary to implement a multicomponent intervention that also includes amendments to the work itself, such as the development of shift schedules and the organizational policy on use of sleepiness countermeasures while on duty.
Work-related injury risk and severity of French Volunteer Firefighters are greatest at night

Marc RIEDEL1,2,3, Alain REINBERG, Yvan TOUITOU3, Michael SMOLENSKY4, René CLARISSE5, Nadine LE FLOC’H5, Guillaume HOUBERDON5, Michael PIERRAT5, Hugues DEREGNAUCOURT5
1Université François Rabelais de Tours, EA 2114, Psychologie des âges de la vie, France; 2Service Départemental d’Incendie et de Secours de Saône et Loire (SDIS 71), France; 3Chronobiology Unit - Fondation Adolphe de Rothschild, France; 4University of Texas at Austin, USA; 5Service Départemental d’Incendie et de Secours des Vosges (SDIS 88), France; marc.riedel@univ-tours.fr

Background
We aimed to determine if the risk of work related injuries (WRI) of French Volunteer Firefighters (VFF) and their severity are greater during the night than day. Studies on VFF are a major interest of the French civil security program since they constitute 78% of the total number of 244 900 French firefighters. VFF maintain a regular job, and volunteer during their free time such that some of them could be potentially exposed to both firefighter and regular job duty for up to 24h/24h, 7 days a week.

Methods
The Vosges Fire Department (SDIS 88) maintains a database of all interventions (fire, road accidents, medical emergencies...) as well as WRI of firefighters. WRI is defined here as a nonexercise, nonsport, and nonemotional/stress work-associated trauma, verified both by log book and medical record. We assessed the relative risk (RR) of WRIs per hour of the 24h span, with RR1=number of WRIs/h divided by the total number of interventions/h×1000 and RR2=the number of WRIs/h divided by the number of firefighters exposed/h×1000. The number of FF per dispatched emergency vehicle is thus taken into account (4.24±0.21 mean±SD). The severity of WRI according to clock-time of occurrence was gauged by the indices of mean number of days lost from work (DLFW), health costs (HC) in €, and compensatory damages (CD) in €. ANOVA, Cosinor, and power spectra analysis were used as statistical tools.

Results
From January 2008 to December 2013, records of the SDIS 88 revealed firefighters performed 146 479 interventions and occurrence of 252 WRI to VFF. The 24h pattern of both RR1 & RR2 was the same (ANOVA F1,46=4.4×10-9, p=.99), both characterized by a prominent nocturnal peak at 05:00h (RR1=3.75, RR2=8.36) and lesser early evening one at 19:00h (RR1=2.40, RR2=5.87). The diurnal trough occurred at 13:00h (RR1=0.93, RR2=2.15). Mean/h of DLFW, HC, and CD all exhibited a similar peak time: DLFW was longest and HC and CD highest for WRI occurring between 00:00 and 02:00h (DLFW=46.44, HC=536.9, and CD=698.22). DLFW was shortest and HC and CD lowest for WRI occurring 06:00/07:00 (DLFW=0, HC=11.40, and CD=0) but also reduced at 18:00h (DLFW= 0.33, HC=20.78, and CD=0).

Conclusions
The results evidence a prominent nocturnal peak and a diurnal trough in both WRI occurrence and severity. Such 24h patterns indicating times of greatest vulnerability must be taken into account in the design of accident prevention programs.
Exploring the reasons why airline crew don't use fatigue reporting systems
Alexandra Holmes, Sarah Booth
Clockwork Research, London, United Kingdom; sarah@clockworkresearch.com

Background
Fatigue Risk Management regulations in Europe and the United States require airlines to have a fatigue reporting system (FRS) in place. An effective FRS enables crew to report when they are unfit due to fatigue before or during a duty period, identify fatigue hazards, and report any concerns regarding fatigue. The objectives of an FRS are to allow both tactical and strategic fatigue risk management. This study aims to explore airline crews’ perceptions of existing FRSs.

Methods
At the end of 2014, crew from two short-medium haul airlines undertook online fatigue surveys. The surveys included questions relating to the airlines’ existing FRSs (both in place since 2011), and reasons why a crew member had not utilised the systems over the last 12 months.

Results
At the time of writing, 3030 crew had completed the surveys. The survey at Airline 2 was still in progress, so the results reported are preliminary.

At both airlines, similar proportions (60-68%) of crew indicated that in the last 12 months they had operated at least one flight duty period when, retrospectively, they should have reported unfit due to fatigue.

Crew were asked to identify the reasons they did not report unfit due to fatigue and the following same four reasons were most frequently cited by pilots and cabin crew from Airline 1: a) concern about a negative response from management (pilots 70%, CC 75%), b) concern regarding confidentiality (pilots 59%, CC 41%), c) not wanting to draw attention to themselves (pilots 51%, CC 43%) and d) concern relating to the company absence management process (FC 50%, CC 63%).

At Airline 2, the most commonly cited reasons for not reporting fatigue were, not wanting to inconvenience passengers (58%), fellow crew members (46%) or the airline (46%).

Conclusion
The survey results suggest that crew were still operating whilst fatigued and both FRSs have challenges to overcome. Airline 2 has resolved some of the significant issues that prevent fatigue reporting by putting in place a clear policy stating that crew can report fatigue confidentially, with ‘no questions asked’ and no consequences for pay. However, a culture of ‘getting the job done’ at Airline 2 means that crew are prioritising task completion over reporting. Details are provided on the guidance for implementing an effective FRS that has been informed by this study.
Oral Session 1B: Well-being and social factors

Time: Tuesday, 09/Jun/2015: 11:00am - 12:30pm
Location: Room 2
Session Chair: Sampsa Puttonen, Finnish Institute of Occupational Health, Finland
Session Chair: Kirsten Nabe-Nielsen, University of Copenhagen, Denmark
The 4 Rs of working time and health: Regularity, rhythms, routine and ritual

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Background
We argue that it is not possible to think about healthy working hours, or a healthy worker, without considering how the temporal demands of work impact on workers’ health practices. In this study we explore how health practices (by individuals or households), are supported or disrupted by work-time.

The conceptual starting point for this study is the practice sociology insight that practices are best understood as inter-related sets of routinised activities. Furthermore that a disruption in one set has repercussions across a range of inter-dependent sets.

Methods
In-depth interviews with full-time, part-time, casual, and self-employed workers (12 in total) investigate the ways in which participants describe how working time supports or undermines their expectations and capacity to carry out three essential health-related practices: preparation of healthy meals, keeping physically active and getting sufficient sleep. These data are examined using a combination of practice sociology and interdisciplinary scholarship on routines and rituals.

Results
For people working standard business hours, as well as those working shifts and at other ‘non-standard’ times, we find that work-time regularity, characterised by predictability of working hours, supports health practices. Work regularity produces rhythms which prompt health practices through the establishment of routines whereby people combine health practices with other daily activities. Routines reduce the effort required for planning and preparation and help people protect time for health practices in the context of other temporal demands.

The participants described how even long-established routines are disrupted by unpredictable work. The duration of time allocated to health practices is reduced or eliminated to absorb the duration of unpredictable work. Some health practices are more susceptible than others. Resilience to disruption is highest in ritualised health practices, where the practice itself has a meaning beyond the instrumental function, family meals are one example. Established healthy eating and sleep routines are disrupted on days of unpredicted work but are re-established the next day and maintained as long as disruptions are infrequent. However, physical activity practices are less easily re-established, resulting in long-term disruption of physical activity routines.

Conclusion
This research delivers a nuanced understanding of how contemporary work time is shaping health practices. Rhythms, supported by regular and predictable work hours, are important for the establishment and maintenance of health-related routines and rituals, even for people working ‘non-standard’ or unsociable hours. The importance of regular and predictable work on worker health may be addressed in labour market policy.
De-synchronized schedules and family time in the 24 hour economy

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Introduction
It is widely assumed that the 24/7-economy has radically changed the working time patterns and consequently the everyday life of families. These supposed changes are especially acute for dual-earner families. We are interested on how unsocial work hours affect the time parents spent with children among dual-earner families.

Methods
Study uses a sub-sample of heterosexual dual-earner couples from Finnish Time Use surveys (1999/2000 and 2009/2010). The couple data allows investigation of spouses working times simultaneously using detailed time use diaries. Unsocial working time is measured with work that takes place outside normal hours (between 8am and 4pm). We analyze the effect of unsocial hours to family time with two measures: time used caring for children (active) and time spent with children (passive). Analyses were restricted to dual-earner couples with dependent children and to weekdays when both spouses were at work (N=484).

The effect of spouses unsocial working time on their time spend with children was analysed with Actor-Partner Interdependence Model (APIM) using Structural Equation Models.

Results
The time spend in paid work was the most important determinant of active and passive childcare for both men and women. The longer work day, the less time was spend caring for children or with them. The timing of work hours (unsocial) had no effect on active childcare. However, working at evenings (between 4-12pm) increased slightly the time men spend with children. For women we found no similar association. In addition, the more men (women) worked during evening the more time women (men) spend with children.

Conclusions
Our results indicate that working at unsocial hours does not have negative effects on the amount of time parents spend in active childcare or time spend with children. Actually, unsocial work hours slightly increase the time spend with children. This might indicate the presence of so-called split-shift parenting where spouses arrange or choose their work schedules in order to decrease the need of non-parental childcare.
Educational level, work-life conflict and self-rated health among Brazilian civil servants of the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil)

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Background

The relationship between work-life conflict and self-rated health is widely researched. However, whether the association differs according to educational level has received less attention. The present study aims to investigate the association between work-family conflict and self-rated health, and to evaluate the possible influence of educational level in that association.

Methods

We used baseline data of Longitudinal Study of Adult Health (ELSA-Brasil), a cohort study of civil servants from six states in Brazil. Our analytical samples comprised 12,057 active workers (34-72 years of age, 48% men). Work-life conflict was measured by four indicators representing different aspects, i.e. work-to-family time-based, work-to-family strain-based, family-to-work and lack of leisure time. Self-rated health was evaluated by a single question: How do you perceive your health compared to others of your age? The respondents answered on a 5 point scale dichotomized into ‘good’ (good and very good) and ‘suboptimal’ (fair, poor and very poor). Logistic regression analyses were performed separated by gender, and the role of education level was assessed with interaction analyses.

Results

Women indicate to experience more frequent work-life conflict than men. The results show that more frequent work-life conflict leads to higher odds ratios of suboptimal self-rated health, with the exception of work-life conflict time based among men. Educational level plays a significant role in the association and higher educated have higher odds of rating their health as suboptimal with more frequent work-life conflict, except in the family-to-work indicator for women in which the lower educated were more affected (OR=1.62 and 1.20, respectively for lower and higher educated level).

Conclusions

There is an association between work-life conflict and self-rated health and it differs according to work-life conflict indicator. Stratifying by educational level and gender presents an important addition to research in the field of work-life conflict.
SHIFTWORK AND THE PSYCHOSOCIAL WORK ENVIRONMENT: A LONGITUDINAL EXPLORATION OF MODERATION AND MEDIATION

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Background

Prior research indicates that both shiftwork and work stress have harmful effects on various indicators of health and well-being. Although shiftworkers tend to work in positions with high levels of workplace stressors, the relationship between work stress and shiftwork may be more complex than one of mere confounding. Working shifts may increase one’s sensitivity to the stressful aspects of one’s work environment. Alternatively, shiftwork may create additional stressors and reduce coping resources. The current study uses longitudinal data to explore such possibilities in relation to three outcomes: psychological distress, chronic health conditions, and job dissatisfaction. Specifically, we test the hypotheses that 1) shiftwork moderates the effects of job demands, job control, social support, and/or mastery and 2) changes in job demands, job control, social support, and/or mastery mediate shiftwork’s effects.

Methods

This study used a multi-occupational sample of Canadian workers (N=2437) from the National Population Health Survey. Rotating day/night shiftworkers were compared to permanent day workers across three cycles of data collection (each cycle representing approximately 2 years).

Results

Shiftwork was associated with an increase in job dissatisfaction over time. However, there was no evidence of a relationship between shiftwork and changes in chronic health conditions or psychological distress. Consistent with the prior research, job demands increased distress and job dissatisfaction, while mastery was associated with less distress and job dissatisfaction. Overall, the effects were more consistent across two cycles than across three.

Tests of interactions did not generally support the hypothesis that shiftwork moderates the effects of stressors and coping resources. However, there was evidence that shiftwork reduces job control and social support over time and that these changes mediate the effects of shiftwork on job dissatisfaction. Exploratory analyses indicate that individuals with higher levels of job control and job dissatisfaction are more likely to leave shiftwork.

Conclusion

Shiftwork is responsible for greater job dissatisfaction over time and this relationship is mediated by real or perceived changes in one’s psychosocial work environment. These results support the existence of a “psychosocial pathway” between shiftwork and reduced well-being and suggest the need to carefully monitor shiftworkers’ perceptions of workplace stressors and coping resources.
Dispositional factors and work-mastery among shift workers

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Background
Shift work challenges the human adaptability to changes, both biologically and socially. While the body of research on shift work and work related outcomes are substantial, more research is needed on how individual dispositions are related to shift work and work related outcomes. Research propose that congruence between personality traits and the work environment is essential both for positive experiences for the individual and for the organization. Although personality factors has shown to predict health related outcome among shift workers, less is known about the relationship between dispositional factors and work mastery in this work group. The aim of the present study was to investigate how broad personality dimensions and dispositional resistance to change is associated with mastery of work among shift workers.

Method
Our study investigated how the Five-Factor Model and dispositional Resistance to Change relate to perceived mastery of work among shift-workers. Electronic questionnaires were completed by a total of 285 shift workers employed in rotating shifts with morning, evening, and night work and night shift schedules in a municipality in Norway. Personal dispositions were assessed using the Mini-International Personality Item Pool Scale and the Dispositional Resistance to Change Scale. Mastery of work was assessed using QPS Nordic Mastery Scale.

Results
Regression analyses showed that low scores on neuroticism and high scores on conscientiousness predicted better mastery of work. Extraversion, openness, agreeableness, and dispositional resistance to change were not related to the shift workers’ mastery of work.

Conclusion
The broad personality dimensions neuroticism and conscientiousness were significant predictors of perceived work mastery among shift workers in this sample, whereas the narrow trait dispositional resistance to change was not. The results of this study emphasis that personality traits are important for understanding not only health-related outcome among shift-workers but also work-related factors.
The impact of work schedule demands on nurses’ work related health, negative work–home interference and work ability: do work schedule resources help?

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Background
This study aimed to test among nurses working in residential elder care the relations of work schedule demands and work schedule resources with negative work–home interference and work ability and if these were mediated by emotional exhaustion and work engagement in line with the Job Demands-Resources model (Bakker & Demerouti, 2007) and the dual-process model of work-home interference (Bakker & Geurts, 2004).

Method
Questionnaires were distributed in 2009 to 975 Dutch nurses in residential elder care (response rate 51%). To test the hypothesis, the Preacher and Hayes bootstrapping Macro (Hayes, 2013) for testing mediation models (Process)(Hayes, 2013b) was used to test the indirect effect of work schedule demands and work schedule resources on work-home interference and work ability (x→m1→y).

Results
The bootstrap results showed a negative indirect effect of a more demanding type of work schedule on work-home interference and work ability through emotional exhaustion. The bootstrap results indicated an indirect effect of hours worked per week and overtime hours worked per week on work-home interference and a negative indirect effect on work ability through emotional exhaustion. The bootstrap results indicated an indirect effect of the work schedule resources: satisfaction with the work schedule, work schedule control and days off between shifts on work-home interference through emotional exhaustion. According to the bootstrap results, both satisfaction with the work schedule and work schedule control showed an indirect effect on work ability through emotional exhaustion and work engagement.

Conclusion
Satisfaction with the work schedule and work schedule control seem promising work schedule resources in withstanding the demands of a work schedule in terms of work-home interference and to increase positive outcomes in terms of work ability. It is also important to include the type of work schedule and the amount of hours worked into research when studying work-home interference and work ability of nurses. Furthermore, the Job Demands Resource model seems a valuable model to map and determine work schedule demands and work schedule resources of nurses.


Thematic Session I: Flexible working hours

*Time:* Tuesday, 09/Jun/2015: 13:30 - 15:30

*Location:* Room 2

*Session Chair:* Göran Kecklund, Stockholm University, Sweden

*Session Chair:* Michiel Kompier, Radboud University, Netherlands, The
’How fast does the brain wake up from sleep and can we trust people working on-call?’

John Axelsson

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Background
Sleep inertia poses a problem for occupations where the workers need to make safety-critical decisions directly upon awakening. Since there is a limited knowledge of how sleep quality prior to awakening affects sleep inertia and different cognitive functions, we woke people from different sleep stages and made them perform a cognitive test battery directly upon awakening.

Methods
Thirty-one healthy participants (mean age 25±4 SD yr, 10 women) went through the study protocol twice. The participants carried out a test battery (the Karolinska WakeApp) during baseline (2h prior bedtime), and directly upon awakening from slow wave sleep (SWS), NREM stage-2 sleep (N2), rapid eye movement sleep (REM), and 15 minutes before normal awakening. The test battery included tests for mathematical skill, short-term memory, working memory, semantic memory retrieval, and a probabilistic inference task – each test being 2min long and presented in a randomized order. Analyses for speed and correctness were made for all tests.

Results
Cognitive speed was slower for all tests after awakenings from sleep as compared to baseline (p’s <.05). With respect to mistakes, Mathematical skill (addition task) and retrieval of semantic memory (quiz questions) were significantly impaired after awakening from all sleep stages compared to baseline (p’s <.05), and SWS being characterized with most mistakes. Both short-term memory and working memory were poorer after awakenings from SWS and REM (p’s <.05), but not from N2. Performance on the probabilistic inference task showed no worsening of the amount of mistakes after awakenings from any sleep stage, but that people gathered more information (number of beads) before making decisions when awakened from all sleep stages as compared to baseline, (p’s < .05).

Conclusions
All cognitive processes deteriorated during sleep inertia as compared to wakefulness with the exception that people gathered more information before making decisions when being awakened from sleep. In all, worst performance occurred upon awakening from SWS and REM-sleep, but some cognitive functions were not found to be significantly worse when awoken from NREM stage-2 sleep or close to the normal waking time. The data will be presented in terms of how fast cognitive functions and amount of mistakes return to normal after awakening, something highly relevant for on-call workers.
Boundaryless work, psychological detachment and sleep: Does working anytime – anywhere equals employees’ being ‘always on’?

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Introduction
Profound changes are taking place within contemporary working life, where established boundaries between work and personal life are challenged by increased global competition, ever-faster changing markets, and rapid development of boundary transcending information- and communication technologies (ICT). This has led to more flexible forms of work organization, where employees are given increased time-spatial flexibility. This implies more individual freedom in organizing work in time and space, but it also puts increased demands on employees to manage the boundaries between work and personal life to be able to psychologically detach from work during leisure in order to unwind and get sufficient recovery. However, knowledge of the impact of boundaryless work for employees’ ability to psychologically detach, or ‘switch off’, from work during leisure and subsequent sleep is limited.

Methods
Drawing from a sample of Swedish, gainfully employed professionals (N=3,846) this study investigated the potential role of psychological detachment in the relationships between boundaryless work in time and space, weekly work hours and sleeping problems as well as sleep duration using SEM-analysis.

Results
Working boundaryless in time, i.e., anytime – all the time, affected both long weekly work hours and poor psychological detachment. In contrast, working boundaryless in space, i.e., working anywhere - everywhere, decreased the propensity for long weekly work hours and had no effect on psychological detachment. Poor psychological detachment acted as a mediator between boundaryless work in time as well as long weekly work hours and both sleeping problems and short sleep duration. This finding was further underscored by that long weekly work hours affected sleep only when not being able to mentally “switch off” from work during leisure. Finally, both poor psychological detachment and sleeping problems negatively affected sleep duration.

Conclusion
Not being able to switch off from work during leisure play a crucial role in the relationship between the time-related aspect of boundaryless work and sleep.
Work stress and objective sleep during night shifts: A study among rescue helicopter pilots

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In this longitudinal study we examined objective sleep during (a series of 3) night shifts and in-between (a series of 3) night shifts among the total population of rescue helicopter pilots in the Netherlands (n=23). We also examined how objective sleep was related to performance indicators (e.g., fatigue, energy levels and alertness) and to workload indicators (e.g. number of flight missions, hours on air, distressing shifts).

The results showed that pilots slept only 1-2 hours in-between night shifts. In contrast, during night shifts they spent relatively many hours on ‘recovering’ activities such as sleep (5-6 hours) and relaxing activities (1-2 hours). The number of flight missions and hours ‘on air’ during the night shifts were limited, and the shifts were not experienced as very demanding or distressing by the pilots. Although fatigue levels increased significantly during each night shift, absolute fatigue levels remained low and performance indicators generally showed that pilots were very well able to function adequately till the end of (a series of 3) night shifts. In conclusion, night shifts of these rescue helicopter pilots are not that demanding and distressing. When evaluated against criteria from effort-recovery theory and proper job design, these shifts generally reflect well-organized and acceptable working conditions.
An intervention study on self-scheduling among Dutch healthcare workers: Implications for experienced worktime control, satisfaction with schedules, and well-being

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Self-scheduling is a relatively new flexible worktime intervention, mostly applied in shiftwork settings: The employer defines the number of workers needed for specific time units and employees can then sign up for certain times, taking into account their personal preferences (Beckers et al., 2012). Ideally, self-scheduling results in preferred rosters, which may have favourable implications for work-home balance, stress, and recovery. However, when shift preferences of several employees overlap or when unpopular hours remain vacant, preferred rosters need to be adjusted. Other potentially unfavourable side-effects are that employees may choose rosters that are suboptimal from a recovery perspective and predictability of work hours is reduced (which may induce problems with combining work and family rather than resolving them; Geurts et al., 2014).

In recent years, pioneering researchers have studied the effects of self-scheduling (e.g., Albertsen, 2014, Garde et al. 2012, Hansen et al., 2015, Ingre et al, 2012, Nabe-Nielsen et al. 2011). So far, findings are mixed and two reviews of literature (Joyce et al., 2010, Nijp et al., 2012) cautiously concluded that the introduction of self-scheduling can have favourable effects, but more intervention research is urgently needed (Beckers et al., 2012).

As such, we conducted a small-scale intervention study within a Dutch healthcare organization that introduced self-scheduling. Self-scheduling covered the possibility to indicate preferences for starting time and length of shift down to 30-minutes intervals.

We applied a repeated measurements design, with respondents completing questionnaires on worktime control, schedule parameters, and indicators of well-being two months before the implementation of self-scheduling, and three-, six-, nine- and twelve months after the implementation (response rates varied between 65% on the first measurement to 41% on the last measurement; Nintervention group = 65-113 and Nreference group= 27-35; exact N depending on measurement moment). We aim to apply Repeated Measures MANOVAs and focus on group x time interactions on relevant proximal outcomes (i.e., schedule parameters) and more distal outcomes (indicators of well-being). Three research questions guide our study:

1) Does self-scheduling have an effect on schedule parameters (e.g., experienced level of worktime control, schedule satisfaction, satisfaction with scheduling procedure, prevalence of shift-swapping, predictability of schedules)?

2) Does self-scheduling have an effect on theoretically relevant indicators of well-being (e.g., work-home interference, stress, fatigue)?

3) Are changes in schedule parameters related to changes in indicators of well-being?

Analyses are currently ongoing and findings will be shared at the Symposium on Shiftwork and Working Time.
Poster session 1

Time: Tuesday, 09/Jun/2015: 17:30 - 19:30

1a: Circadian rhythms and chronobiology
1b: Health and diseases
1c: Safety and performance
1d: Methods
Individual vulnerability to chronic sleep deprivation - related to gender, chronotype and sleep need
Halszka Oginska¹, Ewa Beldzik¹², Aleksandra Domagalik¹², Magdalena Fafrowicz², Tadeusz Marek¹²
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Background
Chronic sleep deficit affects various social-professional groups, e.g. students suffering from social jet-lag, freelancers trying to meet deadlines, workers employed in not-biocompatible work schedules, mothers of young children. Based on common observation, some individuals can easily adapt to curtailed sleep, while other show impaired performance and lowered well-being. In this study we applied three criteria of vulnerability/resistance to sleep restriction: subjective assessments (self-reported physiological, affective and cognitive consequences of sleep loss – CHICa scale), performance (sustained visual attention task), and neural function (P300 amplitude).

Methods
Twenty four paid volunteers participated in the study (12 females; mean age 22.7 ± 1.6 years). All the subjects were healthy and drug-free, they reported regular sleep patterns and no sleep-related problems. Dense-array EEG data was recorded simultaneously with eye tracking; sleep timing and duration was controlled with actigraphy. Measurements were taken in two conditions: after a week of unrestricted sleep and after a week of daily sleep curtailment by 30% of individual sleep need, with a two-week gap in between. The saccadic task lasted 35 minutes and comprised 500 stimuli appearing in six possible localizations. A spatial cueing paradigm was used to induce leftwards and rightwards saccades to the targets – 60% of stimuli preceded with congruent directional cues, 15% with incongruent cues, 25% uncued. Individual factors taken into account included gender, chronotype (morning-evening orientation and subjective amplitude, described with Chronotype Questionnaire) and ‘somnotype’ (sleep need).

Results
Unrestricted sleep length amounted 8h 10 min (SD 37 min) vs. 5 h 41 min (SD 29 min) in chronic sleep deprivation. Average results of CHICa scale and amplitudes of evoked brain potentials (P3a and P3b) differed significantly (p<0.007) between unrestricted and restricted sleep conditions. Mean levels of performance (percentage of correct saccadic reactions) did not. Subjective assessments, performance and neural indices were not correlated. Only one out of 24 participants was resistant to chronic sleep deprivation according to all three criteria.

More severe subjective consequences of sleep loss tended to be associated with female gender and morning orientation (ANOVA: F=3.667, p=0.069; F=3.208, p=0.088, respectively). Lowered performance in sleep deprivation state and decreased amplitudes of P300 potentials were not related to gender or chronotype. Performance impairment in sleep restriction tended to be larger in declared long- than short-sleepers.

Conclusion
Vulnerability to chronic sleep restriction is a multifaceted phenomenon - the objective, subjective, and neural measures represent distinct aspects, diversely related to gender, chronotype and somnotype.
Light & mood relationship is stronger in females and in morning-oriented types  

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Background  
Regular ‘office hours’ of work result in dramatically diminished exposure to natural light in cold season of the year – the commuting in the dark. The lack of main circadian rhythm synchronizer (and the vitamin D booster) is known to affect mood and energy, leading to seasonal affective disorder in vulnerable individuals. This study aimed to observe mood fluctuations in relation to individual daylight exposure, gender and chronotype.

Methods  
One hundred and three young people (58 females; mean age 25.52, SD 3.87 years) took part in the study. Chronotype Questionnaire and Seasonal Pattern Assessment Questionnaire were used once; two mood scales – Positive and Negative Affect Schedule (PANAS) and UWIST Mood Adjective Checklist (UMACL) were administered twice: in January/February and in May/June. Participants self-reported the times of sleep and time spent outdoors in the two weeks preceding the survey in both seasons.

Results  
Direct natural light exposure, i.e. the time spent outdoors amounted 1 h 19 min (SD 1 h 4 min) in winter vs. 3 h 17 min (SD 2 h 38 min) in spring. This reflects the change from cold to warm season from 8.21% to 20.49% of individual waking time. Mean percentage of individual time awake during daylight hours (both outdoors and indoors) increased from 49.5% (SD 6.74) in winter to 73.5% (SD 6.6) in spring. It was accompanied by significant changes in all measured mood dimensions so that positive affectivity score, hedonic tone and energetic arousal were higher, while negative affectivity score and tense arousal were lower in spring (all the differences at p<0.005).

Subjective amplitude of circadian rhythm correlated with seasonality score and with all mood dimensions (positively with negative scales and negatively with positive scales), independently of the season of the year.

Time spent outdoors in the springtime was associated with higher hedonic tone (r=0.35; p<0.001) and lower negative affect (r=0.289; p=0.003); in winter the amount of time spent outside had no impact on mood. This phenomenon was more marked in females than in males and in morning-oriented than in evening-oriented individuals.

Conclusion  
Female gender and morning orientation intensify the positive effect of natural light exposure on mood.
Seasonal differences in scores on the Diurnal Type Scale

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The Torsvall & Åkerstedt Diurnal Type Scale (1980) is often used to estimate diurnal type characteristics in shiftwork research. The scale including seven items has been developed to suit shift work populations and is derived from the Horne & Ostberg scale (1976). A sample of workers in the mining industry situated above the Arctic Circle answered the Diurnal Type Scale. The sample included 495 day workers and 296 shift workers (total sample n=801). The first time of study occurred during winter and was repeated half a year later in summer. The seven items were summarized and a mean comparison made in-between seasons using repeated measures ANOVA. In a second step the answers on the last item (item 7 in scale) measuring self-estimated diurnal type in winter (morning type, somewhat morning type, somewhat evening type and evening type) was used to investigate what group showed largest seasonal change. In this study high diurnal scores represented eveningness.

The mean diurnal score reached 16.50 (SD±3.68) in winter and was significantly lowered towards morningness in summer, 16.01 (SD±4.01), p<0.001. Shiftworkers as expected showed higher eveningness scores (p<0.001). The interaction of season and work hour group (day work/shiftwork) was significant (p<0.035) indicating that shift workers stayed stable across season but day workers increased in eveningness scores. When comparing each single item, only two items indicated a seasonal difference. The first of these items (item 2 in scale) indicate preferred bedtime in connection to work hours free of choice (winter m=3.05±0.69; summer m=3.11±0.66; p<0.027). The second item (item 5 in scale) asked about when during the evening first signs of fatigue and needs of sleep occurred (winter m=2.00±0.93: summer m=2.13±1.02: p<0.001). No interactions across season for scores on item 2 or item 5 with self-estimated diurnal type (item 7) as grouping 2 were found.

In summary the diurnal type scale seems stable across extreme seasonal light changes for shiftwork populations but slightly less stable for day workers. Especially items associated with evening sleepiness indicate day workers getting more alert at summer evenings showing a diurnal phase delay towards eveningness.


Monochromatic blue light effect on performance on hemisphere-specific tasks

**Irena Iskra-Goleć, Krystyna Golonka, Patrycja Siemiginowska, Joanna Watroba, Anna Wazna, Małgorzata Dziewa, Sylwia Kozera, Szymon Kukulski**

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**Background**

There is an increasing evidence on acute alerting effect of monochromatic blue light (MBL) on alertness, performance, and mood. However, alerting MBL effects at different times of the 16-h day time waking has not been studied excessively yet. The aim of the study was to examine the effect of MBL on performance on hemisphere specific tasks during the 16-h daytime.

**Methods**

Fifteen students aged between 19 and 25 years (mean=22.3 years) were studied (first stage of experiment). A within-subject, counterbalanced repeated measures design was applied. The 16-h daytime period was divided into three sessions (07.00-12.20; 12.20-17.40; 17.40-23.00 h) with measurements at their beginnings and ends. Each participant took part in all sessions (one session per day) in both light conditions. The two light conditions comparable in luminance (6.96–7.53 Cd/m²) and different with regard to the wavelength were applied (white light, 6,5 lux; MBL (460 nm), irradiance 11.8 μW/cm²). Speed and accuracy of processing of laterally exposed stimuli were measured and recorded by purposely designed computer software. Words and pictures were displayed on a computer screen in a random order, either in the left or the right visual fields. The stimuli to be processed semantically were proceeded by a question concerning their meaning. The subjects were to press one of two buttons reacting to picture or word or to answer (‘yes’ or ‘no’) the question concerning stimuli meaning.

**Results**

Four factor analyses of variance with repeated measures (factors: light conditions (LC), time of day (TD), measurement (M), and visual field (VF)) were performed on the speed and accuracy of stimuli processing. Significant main effect of TD (F(1, 7)=3.08, p=.045) and interactive effect of TD and LC (F(1, 14)=4.259, p=.000) were found on the speed of processing. The stimuli were processed faster in the blue LC than in white LC in the morning and evening hours. Interactive effect of LC, M and VF was found on the accuracy of shallow processing of pictures (F(2, 28)=4.14, p=.000). In the second M it was an increase of accuracy of picture processing in the left VF in blue LC when compared to the first M and white LC.

**Conclusions**

Positive effect of monochromatic blue light on the speed of semantic processing of stimuli was more pronounced in the morning and evening hours than at noon and early afternoon. The effect of blue light on accuracy of information processing was more pronounced for right hemisphere specific tasks.
Circadian gene polymorphism and expression in rotating night shift nurses. A cross-sectional study.

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Background
The underlying mechanism of elevated breast cancer risk in long-term night-working women may involve genetic susceptibility and circadian genes expression alteration caused by exposure to light at night.

Methods
In a cross-sectional study 709 nurses and midwives (348 current rotating and 361 current day workers) genetic polymorphism of selected clock genes BMAL1 (rs2279287), CLOCK (rs1801260), PER1 (rs2735611), PER2 (rs2304672), PER3 (rs10462020), CRY1 (rs8192440), CRY2 (rs10838527, rs10838527) was analyzed. Transcript levels of BMAL1, CLOCK, CRY1, CRY2, PER1, PER2, PER3 in peripheral blood leukocytes were determined in 184 nurses and midwives, who currently work under either day shifts or rotating night shifts, matched by age, and calendar season of blood collection.

Results
There were no differences in BMAL1, CLOCK, CRY2, PER1, PER2, PER3 genotypes among nurses and midwives working rotating night shifts and day shifts. The frequency of women with rare CRY1 TT genotype was higher in the group of rotating night shifts workers than in day workers (17.0% vs. 13.9%, p=0.06). Moreover, CRY1 TT genotype was associated with the longer rotating shift-work duration, and more frequent night shift work. The highest expression of PER1 mRNA was observed among current night shift workers who had worked more than 15 years under rotating night shift work. PER1 gene expression was associated with the lifetime duration of rotating night shift work in women currently working under night shifts (p=0.04). PER1 and PER3 transcript levels in blood leukocytes were significantly down-regulated in the later vs. the early hours in the morning between 6.00-10.00 a.m. (β-coef.=-0.226, p=0.001 and β-coef.=-0.181, p<0.0001).

Conclusion
These results suggest that CRY1 (rs8192440) polymorphism may influence the adaptation to the rotating night shift work among nurses and midwives. Current rotating night shift work did not affect circadian gene expression in human circulating leukocytes. In analysis of peripheral clock in human studies, the hour of blood collection should be precisely specified.

This work was supported by PNRF/EOG-243-AI-1/07: Night shift work, melatonin metabolism and breast cancer risk factors in nurses and PNRF/EOG 89/2013 - CLOCKSHIFT: Breast cancer risk and epigenetic effects of the rotating night shift work and lifestyle (www.clockshift.pl).
Eveningness and languidity moderate the effect of blue enriched white light on affective state in women

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Background
There is a growing evidence from both laboratory and field studies on positive effect of blue light on mood. There is a question whether the effect of blue light may depend on individual characteristics associated with the body clock. The aim of this study was to find out the effect of blue enriched white light on affective state in morning and evening types and in circadian type. This is a part of a larger study on the effect of blue enriched light on mood and mood-related behaviour at work.

Methods
The participants were 56 female office workers (mean age=28.36 years, SD= 3.29 years) with the average work experience of 4.54 years (SD=2.79 years). They were exposed to white light (WL) and blue enriched white light (BEWL) conditions for three weeks in a counterbalanced order. In the BEWL conditions the light source were fluorescent tubes of colour temperature equal to 17000 K. In the WL condition the fluorescent tubes colour temperature was 4000 K. The average intensity of light in both conditions was 500 Lux. The variables under the study were measured once a day (at 11.00 a.m.), once a week for 6 weeks (3 weeks in each light condition). Affective state was measured by means of Affect Scale (Brief, 1998, Polish adaptation of Zalewska, 2002), morningness was measured by Morningnes/Eveningness Questionnaire (Horne & Ostberg, 1976), and flexibility and languidity were measured by means of Circadian Type Inventory (DiMilia, Smith Folkard, 2004).

Results
There was found a significant interactive effect of light conditions and chronotype F(1, 54)=7.011, p=0.011) on positive affective state. There was a lowering of positive affective state in the evening types in BEWL conditions when compared to WL conditions in two first weeks of exposure which disappeared in the third week. A significant interactive effect of light conditions and languidity on positive affective state (F(1, 54)=6.321, p=0.015) was found. The participants who scored lower in languidity had significantly higher results in positive affect scale in BEWL than in the WL conditions in the first and the second week of exposure.

Conclusions
Exposure to blue enriched white light resulted in increase of positive affective state in languid types in two first weeks of exposure. The negative effect of BEWL on affective state was found in evening type female office workers and tended to disappear with the passage of time of exposure.
Circadian pattern of food intake in female nurses working shifts and their relationship with nutritional status

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Background
Nursing professionals are involved in providing health services 24 hours for day which makes them a classic model of shift workers. Therefore, these work schedules has been associated with health problems including increase risk of developing metabolic and nutritional disorders such as obesity. The aim of this work was to assess the meal distribution across the day (energy and macronutrient intake) and its relationship to the nutritional status of nursing professionals.

Methods
The study included 221 female nursing professionals from a Brazilian university hospital. The participants were classified in three shifts: day shift (n=112), night shift (n=55), and day-night shift (n=54). The subjects underwent the following assessments: food intake assessment (3-day 24-hour recall) and anthropometric variables (weight, height, waist circumference and hip circumference).

Results
Night nurses consumed higher amounts of protein and fat compared to the day and day-night shifts (p<0.05). When the circadian distribution was evaluated separately for each shift, the time of day had a significant effect for most nutritional variables in the three groups. In general, energy, carbohydrate, protein and lipid intake among the three groups was lower at breakfast and snack, higher at lunch, and decreased at dinner (lunch > dinner; p<0.05). The eutrophic group had a higher intake of energy and all macronutrients at lunch, and this amount decreased from lunch to dinner (lunch > dinner, p <0.05). However, in individuals with excess weight, energy, carbohydrate and lipid consumption did not decrease from lunch to dinner (lunch = dinner; p> 0.05).

Conclusion
The distribution of meals throughout the day is associated with shift work and the nutritional status of individuals working as nurses. Special attention needs to be given to the circadian eating pattern as a positive tool in dietetic planning and as a possible strategy against overweight/obesity.
TRANSITION PERIOD IN THE AGE ADJUSTMENT OF BIOELECTRIC BRAIN ACTIVITY IN CONTROL ROOM SHIFTWORKERS TO THE ROUND-O-CLOCK SERVICE

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Objective
to reveal the age changes in the bioelectric brain activity in control room shiftworkers under round-o-clock service.

Methods
EEG was performed for engineer-electronics maintaining the air traffic control systems at three civil airports of Ukraine at the beginning and the end of the day (8:00 – 20:00) and night (20:00-8:00) shifts (altogether – 44 human-shifts). Data were analysed at p<0,05.

Results
In workers younger than 40 y.o. the significant correlation of age and topic bioelectric brain activity was pronounced at the beginning and the end of the night shifts: the positive one – regarding EEG beta-band magnitude, the negative one – regarding alpha-band. In workers 40 y.o.+ similar correlation was pronounced at the day shifts: the positive one – regarding beta-band magnitude, the negative one – regarding theta-band. At the night shifts in workers 40 y.o.+ the positive correlation between age and the over-shift changes in EEG magnitude was pronounced for beta-band, the negative one – for alpha-band. The summarized over-shift changes in beta-band magnitude also manifested the positive correlation with aging in workers younger than 40 y.o. at the night shifts. The sharp alteration in the age over-shift changes of beta-activity was found about 40 y.o. at the night shifts: it increased from -2% till +7% during 20-40 years period, from -7% till +7% - during 40-60 y.o.

Conclusions
The leading EEG band of age adjustment to the engineer-electronics work was found to be the beta-band. In workers younger than 40 y.o. its power passed to the strain phase of general adaptation syndrome by H. Selye at the night shifts while at the day shifts the non-strain age adaptation was revealed. In workers 40 y.o.+ the beta-band power manifested the strain phase of adaptation at the day shifts and passed to the exhaustion phase – at the night shifts. The compensatory decrease in EEG spectral power found in different bands at the two age periods due to literature data could manifest the qualitative changes in the age adaptation to the engineer-electronics work: under 40 y.o. it is realising mainly for the account of the increase in activation, beyond 40 y.o.– for the account of the decrease in cognitive control. At the night shifts the pronounced transition period in the age adjustment of EEG beta-activity was revealed about 40 years old. Beyond 40 y.o. the night work adaptation became the most physiologically costly.
‘Mid-sleep deviations’: quantifying and visualising circadian disruption of the sleep-wake cycle

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Background
Circadian disruption is argued to be a potential mechanism underlying the adverse health effects of shift work. A recent study demonstrated that mistimed sleep even disrupts the circadian regulation of the human transcriptome. Although the term ‘circadian disruption’ is commonly used, only few definitions and even fewer measures exist impeding the systematic investigation of its causes and consequences. We therefore propose a novel and simple method to quantify the extent of mistimed sleep, called ‘mid-sleep deviations’.

Methods
We analysed actimetry data over four weeks of 53 shift workers working in four different forwards rotating schedules (55% female, age 35 ± 10 years, body mass index 26 ± 5). Mid-points of sleep bouts were extracted daily and individual’s chronotype was determined via sleep-wake behaviour on free days after the evening shift.

Results
The method takes into account two crucial aspects of sleep: internal time (i.e., chronotype) and sleep history (i.e., prior sleep episode). By eliminating the time dimension, a distinctive geometry emerges that clearly identifies differences across individuals, shifts, and schedules. Creating density plots to visualise the geometry, we observed a higher variability of sleep timing the later the chronotype, independent of demographic variables, shift rotation, and sleep duration as confirmed by multiple regression models. Comparison with published measures of circadian disruption (i.e., inter-daily stability and ‘behavioural entrainment’) revealed good congruence; yet, our analyses suggest that the concept of ‘mid-sleep deviations’ provides unique information on disrupted sleep-wake cycles.

Conclusion
The less stable sleep-wake behaviour in late chronotypes is argued to impact on development and prevention of diseases in shift workers and clinical patients, although its causes remain unclear. ‘Mid-sleep deviations’ as a measure for circadian disruption of the sleep-wake cycle will potentially help to elucidate the role of mistimed sleep-wake rhythms in health on an individual basis.
Impact of work and life style on nutritional status of rubber tappers and factory workers living on an extractive reserve in the Amazon.

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Background
The effect of lifestyle, on the nutritional status of the population, is well known, however exactly how job characteristics may influence nutritional status, leading to overweight and obesity is still unknown.

Objective: To evaluate the impact of work and life style on nutritional status of rubber tappers and factory workers living on an extractive reserve in the Amazon

Methods
Cross-sectional study with 340 rubber tappers and 148 day and shift workers of a factory, both groups living on an extractive reserve in the Amazon. Workers filled out questionnaires on demographic data (gender, age, marital status, and children), working conditions (type of job, work hours, and physical posture at work), health (morbidity, fatigue, sleep and sleepiness, musculoskeletal pain, and nutritional status) and life style (smoking, drinking, and physical activity). Logistic regression models were applied, considering overweight and obesity as outcome variables

Results
Most of the rubber tappers were male (91.5%) with a mean age of 42 years (SE=0.76). Factory workers had a mean age of 27.1 years (SE=0.5); 52% males and 48% females. Individuals who were overweight and obese accounted for 42.8% of the factory workers and 27.7% of the rubber tappers, with a statistically significant difference between groups (p<0.001). Independent variables were selected from the univariate model (p<0.20) which were: gender, age, marital status, type of job, shiftwork, smoking, presence of morbidity and musculoskeletal pain. Working in the factory and being male were found to be predictors for the development of overweight or obesity. Moreover, age between 31 to 40 years and older were also predictors for overweight and obesity. Smoking was revealed as a protection factor for overweight and obesity

Conclusion
The workers were submitted to different work conditions, even while inhabiting the same community. Factory workers performed a static activity on the assembly line, which may explain their higher risk of becoming overweight and obese. Rubber tappers had a work activity that involves dynamic physical activity, expressed in extractive activities. The establishment of a factory, on an extractive reserve in the Amazon, can be an interesting political strategy to maintain people living in the region, however, it can have a negative impact on the workers’ health.

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There is a substantial and diverse literature on the adverse scatological consequences of shiftwork. These effects range from minor problems such as diarrhoea, flatulence, foul-smelling faeces and inconsistent bowel habits (Brazil 2005) through to irritable bowel syndrome (Nojkov et al 2010). Further, following the seminal study of Sasaki (1984), the timing of bowel movements has commonly been used to measure chronobiological adjustment to rapid time-zone transitions (e.g. Airbus 2004). We are, however, unaware of any research attempting to assess chronobiological adjustment to shiftwork by means of the timing of the window of maximum propensity (WOMP) of bowel movements.

The present study will attempt to remedy this dire shortcoming in the shiftwork literature using a short, purpose built questionnaire, the “Shiftwork Chronobiological Adjustment Test” (SCAT). Volunteer shiftworkers will be asked to complete SCAT with respect to each of the shifts involved in their work schedule. We will determine whether the timing of main bowel movements (TMBM) may serve as a chronoscatological marker of circadian adjustment, thus avoiding the need for expensive and time consuming assays of, for example, urinary melatonin.

Volunteers who complete SCAT will also be asked whether they are prepared to keep a “Poop Log” (Kefsco 2015) for a complete cycle of their work schedule. This mobile app allows for the detailed recording of bowel movements - including the time, amount, texture and shape (the latter classified on the Bristol Stool Scale). Information from this diary should not only allow us to determine whether other bowel movement measures such as duration variability (BMDV) are important variables, but also whether more basic measures vary systematically with the shift.


Weight gain and body mass index following changes from day to night shift – a panel study on nursing professionals

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Background
Few studies analyze nutritional status following changes in work schedule. The objectives of this study were (i) to estimate overweight and obesity prevalence and incidence seven years after changing work schedule (ii) to analyze the association between changing from day to night work and changes in nutritional status (weight gain and body mass index) in nursing professionals.

Methods
The study was carried out with nursing professionals at a public hospital. Data collection derived from a panel study, which was based on two cross-sectional surveys, seven years apart. Our analytical samples comprised 372 current workers. A night worker was defined as one who worked at night at least once a week or 4 times a month in 12-h shifts. Workers were classified into three groups: (i) maintainers, i.e., those who didn’t change work schedule, (ii) day to nigh shift changers, and (iii) night to day shift changers. The participants were classified in weight gain (≤5Kg and >5Kg) and Body mass index was calculated as weight in kilograms divided by height in meters squared. Following current recommendations, overweight was defined as a BMI of 25.0 to 29.9 and obesity as a BMI of 30.0 or higher.

Results
The incidence of overweight and obesity were 19.8% and 17.4%, respectively. Those who have changed from day shift to night shift had 2.3 times greater chance to gain more than 5 kg and 2.2 times greater chance of increasing BMI category after seven years, compared to the reference categories (OR = 2.27; 95% CI: 1.17-4.39 and OR = 2.24; 95% CI: 1.16-4.34, respectively). The association remained significant for increasing BMI category and showed borderline significance in weight gain after adjusting for sex, race and age (OR = 2.14; 95% CI: 1.07 to 4.28, and OR = 2.00; 95% CI: 0.99 to 4.04 respectively).

Conclusion
Results showed a high incidence of overweight and obesity among nursing workers. Changing from day to night work seems to influence weight gain and increase in BMI category. Obesity prevention strategies should incorporate improvements in work environment, such as the provision of proper meals to night workers, in addition to educational programs on the health effects of night work.
Longitudinal associations between stressors including work schedules and the work ability in hospital workers
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Background
Work stressors well as work schedules exert impact on work ability; however, statistical conventional analyses might not control the effects of risk factors in repeated measurements. This study aimed to evaluate longitudinal associations between work stressors and work ability using mixed models.

Methods
A cohort of 1226 hospital workers was followed up from 2009 to 2012. The final sample comprised 498 (40.6%) volunteers, who were assessed at least at the onset and on the last year of follow-up. General linear mixed models were used to examine time-dependent variables associated with the Work Ability Index (WAI). Analyses included fixed effects of sociodemographic variables, lifestyle, occupational characteristics and work schedules, and interaction terms to estimate the effect of work stressors.

Results
Work stressors exhibited significant association with WAI at the intercept level and in the time interaction. The greater the control at work and the greater the social support, the higher the WAI scores, respectively: increase of 0.14 and 0.14 at the intercept, and 0.09 and 0.04 points/year per unit of increase in the WAI score along follow-up. WAI scores decreased parallel to increase in effort-reward imbalance, overcommitment and work-related activities that might cause pain/injury, respectively: reduction of 4.00, 0.22 and 0.01 at the intercept and 1.19, 0.10 and 0.01 points/year per unit of increase in the stressor scores. In addition to the time-interaction variables, increase of violence at the workplace, increased body mass index, female gender, sedentary lifestyle, and past history of work-related diseases at the intercept level were significantly associated with decreased WAI. The WAI of nursing assistants and unskilled helpers were higher compared to other job titles. Daytime work and morning shift work were associated with decreased WAI (p<0.010).

Conclusions
Work stressors are determinants of work ability having short and long-term effects, independent of other variables. The working hours (daytime and morning shifts) were also associated with impaired ability to work. This is likely to happen as the workload was higher during these working shifts. These results bear implications for work ability promotion, indicating that actions reducing physical and psychosocial work stressors should be continuous and might induce short and long-term benefits.
Heart rate variability during sleep after 2, 4 and 7 consecutive night shifts in male police officers
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Background
Night work is common in our increasingly 24/7 society. Night work has been associated with heart disease and when work at night is inevitable the question is whether there is an optimal way to organize it to reduce potential health problems. Heart rate variability (HRV) is an indicator of the balance between sympathetic and parasympathetic autonomic modulation of the heart rate. Autonomic imbalance results in reduced HRV, which is an independent risk factor for morbidity and mortality.

Aim
The aim of the study is to analyze how the number of consecutive night shifts affects the balance of sympathetic and parasympathetic activity in the ANS during recovery sleep in a crossover intervention study among male Danish police officers.

Method
The study is a part of the “In the Middle of the Night” project. Seventeen male police officers working in call centers in five different police district participated in the HRV measurements. The participants performed three interventions: ‘2+2’: two consecutive night shifts followed by two consecutive day oriented days (with either day work shifts or off work); ‘4+4’: four consecutive night shifts followed by four consecutive day oriented days; ‘7+7’: seven consecutive night shifts followed by seven consecutive day oriented days. The schedules were planned so there was a minimum of 7 days without night shifts before each intervention. On the last day with night shift and the last day in each intervention the participant underwent 24h HRV recordings. We analyzed HRV during primary sleep. Primary sleep was defined as the sleep during the night for the day oriented period and as the first sleep after work for the night shift period. Wake and sleep times were noted by the participants in sleep questionnaires and these times were used to determine time of sleep. The five 5-minute intervals with the lowest heart rate during each sleep period were chosen for spectral analysis of the heart interbeat interval time series. Periods with lowest heart rate reflects relatively dominant parasympathetic modulation of the heart rate. It is assumed to correspond to peak activity in restorative biological systems and hence the time of maximal physiological restitution during sleep.

Results and conclusion
Analyses are ongoing and results will be presented at the International Symposium on Shiftwork and Working Time.
ASSOCIATION BETWEEN USE OF MEDICATIONS AND NUTRITIONAL STATUS IN SHIFTS WORKERS
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A. Background
Shift work is frequently associated with metabolic and nutritional disorders, such as changes in eating behavior, obesity, insulin resistance, diabetes and metabolic syndrome. Studies also show that diseases such as cancer, depression, sleep and gastrointestinal disorders are more common in shift workers. Due to the high occurrence of health problems in this population, some studies have suggested that use of medication is higher among shift workers compared to day workers. However, this subject is scarce in the literature. Therefore, the aim of this study was to evaluate the association between use of medication and nutritional status of shift workers.

B. Methods
All employees working in shifts in a poultry processing company in Goiás State, Brazil, age between 18-60 years old, were invited to participate in the study. Of the 1828 shift workers, 1341 accepted to participate of the study. A questionnaire was used to evaluate age, sex, family income, education, work schedule, medical history, sleep pattern, physical activity, information regarding tobacco and use of medication. Anthropometric variables (height, weight and waist circumference) were obtained of all participants.

C. Results
Most of the employees worked in the early-morning shift (39.43%), were female (63.0%), sedentary (75.1%) and presented a high prevalence in use of medication (70.9%). The most used classes of medications were analgesics (37.4%), muscle relaxants (30.8%) and antacids (11.1%). Night workers presented a lower sleep time duration (6.96 hrs) and a greater median value of waist circumference (90 cm), when compared with early morning, day and evening workers (sleep duration: 7.07hrs; 7.50hrs and 7.02hrs for early morning, day and evening workers respectively; p = 0.000; WC: 86.0cm, 88.75cm, 87.0cm for early morning, day and evening workers respectively; p = 0.002). In linear regression analysis it was found, only between the evening shift workers, a positive association between BMI and number of medication classes (p = 0.05, R2 = 0.05).

D. Conclusion
According to the results, the prevalence of the consumption of medications between shift workers is high and may be associated with nutritional status. Thus, it is necessary to establish strategies aimed to prevent the unnecessary use of medications among these workers.
Long Working Hours and Subsequent Use of Psychotropic Medicine

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Background
Mental ill health is the most frequent cause of long-term sickness absence and disability retirement in Denmark. Some instances of mental ill health might be due to long working hours. A recent large cross-sectional study of a general working population in Norway found that not only “very much overtime”, but also “moderate overtime” (41-48 work hours/week) was significantly associated with increased levels of both anxiety and depression. These findings have not been sufficiently confirmed in longitudinal studies.

Objective
The aim of the project is to investigate the possibility of a prospective association between weekly working hours and use of psychotropic medicine in the general working population of Denmark. The null-hypothesis of the present project is that long working hours, to the extent that it is currently practiced in Denmark, neither adds to nor subtracts from the national burden of mental ill health.

Methods
People from the general working population of Denmark have been surveyed, at various occasions in the time period 1995-2010, and interviewed about their work environment. The present study link interview data from these surveys to national registers covering all inhabitants of Denmark. The participants are followed for the first occurrence of redeemed prescriptions for psychotropic medicine. Poisson regression is used to analyze incidence rates as a function of weekly working hours (32-40; 41-48; > 48 hours/week). The analyses are controlled for gender, age, sample, shift work, and socioeconomic status. According to our feasibility studies, the statistical power is sufficient and the exposure is stable enough to make the study worth the while.

Results
A study protocol presenting the design of the study is published, and Statistics Denmark has linked the data on deaths, migrations, socioeconomic status, and redeemed prescriptions for psychotropic medication. Results from the Poisson regression analyses will be presented at the conference together with results from auxiliary cross-sectional analysis regarding prescription bias and of sensitivity analyses of self-rated health, job-satisfaction and job insecurity.

Conclusions
The proposed project is free from hindsight bias, since all hypotheses and statistical models are completely defined, peer-reviewed, and published before exposure data were linked to the outcome data. The results of the project will indicate to what extent and in what direction the national burden of mental ill health in Denmark has been influenced by long working hours.
Making shift work associated health risks and potential solutions measurable: identification of non-circadian biomarkers

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Background

Shift work is a multidimensional exposure that disrupts both lifestyle and circadian rhythms, which are related to adverse health effects. One of the major difficulties in finding solutions for healthy working hours is to determine the effectiveness of the solutions on reducing health risks. This is related to the long latency before disease appears and to the heterogeneity of shift work exposure. Therefore, biomarkers that can indicate the severity of circadian disruption (due to shiftwork) as a proxy for adverse health effects are very valuable. We used animal studies mimicking shift work to discover new candidate biomarkers for circadian disruption associated with long-term adverse health effects. Importantly, we only identified biomarkers that are non-circadian. In contrast to traditional biomarkers, such as melatonin, cortisol etc. which are circadian markers and need to be measured “around the clock”, these newly identified markers can be more easily applied to large cohort studies, since they allow measurement at a single time-point. The newly identified markers are currently being validated in shiftworkers.

Methods

First, several prerequisites for a valuable biomarker were set: - non-circadian (to allow for measurements in large cohort settings at single time-points), non-invasive (measurable in blood), age-independent, dose-dependent (value relates to amount of shift work exposure). To model shiftwork, mice were exposed to several schedules of light shifts. Candidate biomarkers for circadian disruption were identified using a transcriptomics and data mining approach, followed by validation in blood samples of mice and shiftworkers.

Results

This study identified several candidate biomarkers which meet the prerequisites. In addition, we show that these markers can be detected in blood. At the moment, validation of the best candidate marker in shiftworkers is occurring. Interestingly, this marker is related to lipid metabolism, a component which might be linked to the health effects observed related to metabolic disorders.

Conclusions

Mimicking shift work in animal studies can be used to identify potential biomarkers for chronic health effects of shift work. Furthermore, if the newly identified biomarker is validated in shiftworkers, this marker can be used to determine the effectiveness of solutions for healthy working hours and to further disentangle the multidimensional exposure of shift work in relation to adverse health effects.
Occupational hygiene awareness programs – Challenge for offshore oil and gas industry.
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Employee awareness on health, safety, environment and quality (HSEQ) is a recurring issue for petroleum sector in addressing policies on quality, environment and occupational health and safety management systems. These issues should permeate upstream and downstream oil and gas sector to protect and promote employees health and safety. Awareness to offshore work force on adaptation to shift work and extended work periods beyond 8 hours a day, coping methods (diet, physical activity etc.), effects of shift work on health and performance are new challenges to OSH professionals. Awareness on health issues related to psychological concern is equally important to such as physical, chemical, biological and ergonomic stressors at workplace in oil and gas industry. Promotional framework for Occupational Safety and Health of International Labor Office (ILO) outlined imparting awareness and training without undermining business performance is one instrument to mitigate occupational hazards at workplace. The International Petroleum Industry Environment Conservation Association (IPIECA) and the International Association of Oil and Gas producers (OGP) are constantly working to increase awareness on occupational safety and health (OSH) issues to promote good work practices and guidance for oil and gas industry. The European Agency for Safety and Health at Work (EU-OSHA) has contributed for safer, healthier and better workplaces. The contribution of EU-OSHA is of good educational value through famous “Napo Films” with a prime objective of “Safety with a smile”. It is a fact that, awareness boosts the confidence so that all the co-workers are fully aware and trained in all HSEQ aspects, that leads to petroleum sector is the safest place to work. The role of OSH professionals (Industrial hygienist, Occupational health physician, Occupational health advisor, Occupational health nurse and allied professionals) is crucial in educating workforce to create healthy work environments that are conducive to more active life styles. Hear (H) the views of the employees, Survey (S) current training needs, and Enforce (E) awareness programs to target workforce to ensure HSE success in the business. The occupational hygienists can avail international resources available free of cost to impart awareness and training to job performers for sustainable growth of oil and gas industry. It should be continuous and on-going approach in optimizing the employee’s knowledge on OSH issues. Risk assessment, management, cooperation and coordination among OSH professionals play a key role in addressing and managing psychological health issues at offshore working environments.
The impact of long working hours, night work and shiftwork on risk of accidents at work
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Background
More than 40,000 accidents at work are reported in Denmark every year. A number of cross-sectional studies suggest that long working hours and shiftwork may increase the risk of accidents. However, evidence from prospective studies is lacking, and it is unknown whether young workers are specifically susceptible to a presumed effect of ‘work time scheduling’ on their accident risk.

Aim
The overall aim of the project is to investigate the prospective association of long working hours, night work and shiftwork with the risk of accidents at work. Furthermore, we investigate whether such an association is modified by age, gender and level of education.

Method
The study uses data from the Danish Labour Force Survey that has been conducted continuously since 1994 among a representative sample of the economically active population. The survey has a rotating panel design, and participants are interviewed four times over 1.5 years. Each interview includes questions about weekly working hours and work schedule. In 1999 and 2013 the interviews also included questions about accidents at work and work-related injuries during the preceding 12-month period. The study population for the present analyses consists of 11,893 employees who were interviewed about their working time in 1998 or 2012, and who were also interviewed in 1999 or 2013 about accidents at work.

Three exposure categories for the risk of accidents at work will be tested: 1) persons classified as having extended weekly working hours vs persons classified as having standard weekly working hours, 2) persons classified as having fixed night work vs persons classified as day worker, 3) persons classified as regularly working on shift vs persons classified as day worker.

Using logistic regression we are testing the prospective association of long working hours, night work and shiftwork with risk of accidents.

Results and perspective
Preliminary results will be presented at the conference as analyses are currently ongoing.
Human transport operator fatigue in Norway: literature and expert opinion
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Background
International studies show that fatigue can be detrimental to the health and safety of bus, lorry and taxi drivers, watch officers at sea, and train drivers. The main way in which operator fatigue is controlled is by proscriptive legislation based on hours-of-work. However, there are claims that more should be done to promote the systemic management of fatigue by transport organisations. Little has been done to review the problem of fatigue in Norwegian transport operators, so regulatory authorities do not know whether there is a need for organisational countermeasures, or who would benefit most from them. This study aimed to assemble knowledge on the prevalence, causes, outcomes and management of fatigue among professional operators in different organizations in different transport sectors (road, rail and sea) in Norway.

Method
To do this, we carried out a systematic literature review and interviewed 22 representative experts from the road, rail and sea sectors.

Results
An overview of studies of fatigue in operators of road, rail or marine transport forms shows that little has been done to map the prevalence and causes of fatigue in Norway, such that we cannot say which operators are most fatigued and why. While Nordic working models may provide favourable working conditions for operators relative to those in some other countries, results from the interviews suggest that framework conditions in some Norwegian transport branches may be developing such as to cause increased fatigue. Furthermore, there are conditions associated with working in transport in Norway that also increase fatigue ("lone operator" culture, infrastructure, seasonal variations). In most transport sectors, there is little evidence that fatigue is managed systematically.

Conclusion
Quantitative studies are required to better chart the problem of fatigue in transport operators in Norway. The results will inform not only about the need for organisational countermeasures, but the need for regulatory steps to improve framework conditions in certain transport branches.
Day-to-day variations in rest intervals between working days and recovery from fatigue: a 2-month single-case observational study

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Background
New work-time regulations have been discussed in Japan to prevent excessive fatigue among workers. One of the qualifications is to set “11 consecutive hour rest-intervals between working days (RIWDs)” that is defined by the EU’s working time directive. However, available findings regarding RIWDs in light of recovery from fatigue are very limited, especially regarding daytime workers. This pilot study aimed to illustrate the day-to-day variations in RIWDs, work hours, sleep, and fatigue, as well as to examine those associations with a 2-month, single-case observation.

Methods
A day-working male (age 37, researcher) who lived with his wife and infant (7 months) participated in this study. Over the 2 months, psychological signs of fatigue were repeatedly collected using a questionnaire for work-related fatigue feelings with a smartphone 5 times a day: at wake-up, start and end of working hours, returning home, and bedtime. This questionnaire consisted of 25 psychological signs of fatigue that were categorized into 5 factors of feeling: (i) drowsiness, (ii) instability, (iii) uneasiness, (iv) local pain or dullness, and (v) eyestrain. For each item, the respondent was requested to estimate the intensity of his feelings from “totally disagree (1)” to “agree strongly (5).” A 10-minute psychomotor vigilance task (PVT-192, AMI) was used to objectively evaluate fatigue at wake-up time and bedtime. Sleep was measured by actiwatch (AW64, Philips Respironics). The length of work hours and RIWDs were detected by means of digital records from his workplace.

Results
Psychological signs of fatigue showed not stable-increased change but variable changes during this study. “Drowsiness” was an underlying sign, while the signs of “instability” and “eyestrain” were found in peak levels of fatigue. Moreover, on the peak days, the participant took infant-care leave and then subsequent sick leave. Multilevel mixed-effects linear regression analyses showed that PVT reaction times were significantly more related to RIWDs ($\beta=-1.4, P=0.039$) than to work hours or sleep duration. Also, a marginal significant association of RIWDs with fatigue signs was found ($\beta=-1.2, P=0.051$).

Conclusion
The primary finding of this pilot study described the possible links that ensuring RIWDs could play a more crucial role in recovery from fatigue than other factors. We showed individual-level characteristics for long-term observations, which is the strength of this study. More samples with this design would be helpful to explore appropriate RIWDs along with each profile (work schedule, job, etc.) in terms of fatigue recovery.
Health, safety and bus drivers
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Background
A literature review shows that work-related health complaints are more prevalent for bus drivers than for those in most other occupations. These are typically stress-related psychological disorders and associated physical symptoms (especially elevated blood pressure), musculoskeletal problems, cardiovascular disease, stomach and related gastrointestinal problems, and chronic fatigue or burnout. The main causes are psychosocial stressors, but physical stressors, sleep pressure and work-home conflict can also play a major part in health outcomes. Given the convincing evidence on poor health outcomes in bus drivers, it is surprising that little has been done to (a) look at health-related effects of increasingly common split-shifts; and (b) draw links between long-term health on the one hand, and safety performance on the other.

Method
To begin exploring these issues, we analysed the results of an existing driver union survey of bus drivers in Norway (n = 1183).

Results
The data showed that one in three drivers report a work-related health problem, and the type of complaints reported were largely in line with those found for other bus driver samples. Notably, 81 per cent of health problems reported were musculoskeletal in nature, with or without associated stress problems. Greater shares of drivers working split shifts reported undesirable levels of work stressors, sleep pressure and poor health outcomes. Other data gave some limited support to a model describing that work stressors (psychosocial stressors, physical stressors, schedules and shift work) together influence a triad of dynamically interacting duty fitness factors – psychophysiological response, health status and sleep – which in turn influence the safety performance of bus drivers.

Conclusion
The results give cause for concern about the effects of split-shifts on health and sleep, and suggest there may be a need to account for health as a potential factor in safety performance.
Health and vocational outcomes among injured nonstandard shift workers

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Background and Objectives
An increased risk of work-related injuries and deleterious health effects has been associated with shift work. However, little is known about health and vocational outcomes following an injury among those working outside regular daytime schedules. It has been suggested that the increased fatigue and stress associated with nonstandard shifts may place additional demands on injured workers. This in turn, may lead to a longer or diminished recovery, making it more difficult to resume regular job duties and possibly jeopardizing future employment.

The overall objectives of this study are to examine (i) the interaction of work injury and nonstandard schedules on changes in self-reported health, shift schedule and employment status over a 2 year period; and (ii) whether outcomes may be more detrimental compared to regular daytime workers and uninjured nonstandard shift workers. We also examined the role that demographic factors, initial health status and occupational physical demands may have in the association with health and occupational outcomes.

Methods
Longitudinal data from the National Population Health Survey was used to examine health and vocational consequences over a 2 year follow-up. Retrospective matched cohort analyses were used to examine the main effects and interactions of shift schedule (day / nonstandard) and work injury (yes /no) with health decline, change in shift schedule and unemployment at the end of study follow-up. Each injured worker was matched to 4 uninjured workers by 5-year age group, province of residence and survey year. For significant interactions, further analyses were completed with combinations of shift and injury categories: uninjured day (reference), injured day, uninjured nonstandard and injured nonstandard shifts. Statistical models were adjusted for sex, education, initial health status and occupational strength requirements.

Results
After a 2 year period, a significant decline in self-reported health was found among injured nonstandard shift workers (p = 0.04), compared to regular daytime workers and uninjured nonstandard shift workers. No significant interactions between shift and injury were found with schedule change and unemployment at the end of study follow-up. Higher education and good initial health status were associated with better self-reported health, remaining in same shift schedule and sustained employment.

Conclusion
Results suggest that although injured nonstandard shift workers are as likely to remain employed as other groups, they may be vulnerable in terms of diminished health. Additional research is needed to examine whether job accommodations and occupational health and safety measures address this group’s needs adequately.
Sleep pattern is associated with dietary intake among Brazilian university students

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A. Background
University students in modern society experience a form of circadian misalignment, especially due to the large number of commitments related to university, family and social relations. Social jetlag represents the discrepancy between circadian and social clocks, which is measured as the difference in hours in midpoint of sleep between work and free days. The degree of misalignment is dependent on the individual’s chronotype, and the late chronotype is typically associated with a greater degree of misalignment between social rhythms and the circadian clock. The objective of this cross-sectional study was to examine the relationship between chronotype, sleep pattern and dietary intake of among Brazilian university students

B. Methods
The chronotype was derived from mid-sleep time on free days weekend (MSF) nights with further correction for calculated sleep debt, which is calculated as the difference between sleep duration on weekends minus the weekly average sleep duration. Social jetlag was calculated based on the absolute difference between mid-sleep time on weekdays and weekends. Perceived sleep debt was calculated using the difference between students’ preferred weekday sleep duration and their self reported actual weekday sleep duration. Food intake was assessed by a validated food frequency questionnaire (FFQ).

C. Results
A total of 204 students (92 men and 112 women) participated and 91% presented social jetlag (> 30 min). Circadian parameters revealed that average MSF was 5:40 A.M (+ 1:48). Regarding dietary parameters, 12.2% revealed skipping breakfast. These students had also higher means of MSF (6.19 versus 5.28, p=0.02) compared to those who reported some breakfast. It was found positive correlations between chronotype (MSF) and time of completion of the breakfast (r=0.24, p=0.003) and lunch (r=0.19, p=0.01). Multiple regression analyses, adjusting for age and BMI, found the following results: perceived sleep debt was positively associated with intake of beverages (coffee, soft drinks and alcoholic beverages) (coefficient=0.15; p=0.02) and dairy (coefficient =0.17; p=0.01); chronotype (MSF) was positively associated with and intake of meet (coefficient=0.20; p=0.004); and social jetlag was negatively associated with intake of beans (coefficient=-0.17; p=0.01).

D. Conclusion
The chronotype seems to influence the meals completion time and is associated with the type and amount of food consumed. In addition, a pattern of disturbed sleep seems can influence the food choices of college students.
It’s not whether you win or lose, but when you play the game: The impact of night-time competition on sleep in professional athletes.

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Background
In recent years, there has been a gradual shift in the scheduling of professional sports fixtures from games played during the day to games played at night. Anecdotally, professional athletes often report poorer sleep following night games compared to day games, but this has yet to be objectively examined. The aim of this study was to assess the impact of night-time competition on sleep in a group of professional athletes.

Methods
Data were collected with 22 members of a professional Australian Rules Football team during a regular season. The 2-week data collection period encompassed a day game (16:30-18:30h) and a night game (19:10-21:10) that were scheduled eight days apart. Sleep was assessed following each game using wrist activity monitors in conjunction with self-report diaries. The day after each game, players were required to attend a recovery session at 09:00h. Separate repeated-measures ANOVAs were conducted for each of the dependent sleep variables with one within-subjects factor (i.e., game type – day or night).

Results
After the day game, players initiated sleep at 23:35h (±00:55), terminated sleep at 08:00h (±00:53) and obtained 7.4h (±1.1) of sleep with a sleep efficiency of 87.0% (±5.2). After the night game, players initiated sleep at 01:55h (±00:50), terminated sleep at 08:05h (±00:29) and obtained 5.3h (±0.6) of sleep with a sleep efficiency of 86.6% (±3.6). Analyses revealed that after night games, sleep onset time was significantly later (p=.0001), time in bed was significantly shorter (p=.0001), and the amount of sleep obtained was significantly less (p=.0001) than after day games. There was no difference in sleep offset or sleep efficiency between night games and day games.

Conclusion
In this study, sleep duration following a night game was reduced by more than 2h compared to after a day game. The primary cause of this difference appears to be due to a later sleep onset time following night games. It may seem reasonable to encourage athletes to initiate sleep earlier following night games, but given that players are required to eat, shower, attend post-game meetings and press conferences, it may be difficult in practice to achieve this. Alternatively, in the case of the present cohort of professional athletes, delaying the start of recovery sessions the following day by 2h should enable them to obtain more sleep than they currently do.
Introduction
Increasing demands are arising for professional qualification, both to get a job as to keep it. This often requires workers to perform concomitant activities, such as work and study. Several studies showed impact on health of those working and studying simultaneously. The main implications are: sleep restriction, recurrent complaints of health problems, excessive fatigue, diurnal sleepiness and significant perceived stress. The present study aims to investigate new contexts on the use of time at the 24-hour society among working students, as well as the impact on health and lifestyles.

Method:
Data collection took place from August 2013 to July 2014 in an educational institution that provides undergraduate courses during early morning hours (from 5:30am to 8:00am), in São Paulo, SP, Brazil. Participants were 29 adults, age 20-48 years; 11 are men. All participants agreed to participate and signed a consent form. They filled up a comprehensive socioeconomic questionnaire; sleep dairies, KSS sleepiness scale and food intake recorded during 7 consecutive days. Rest and waking times were monitored with a wrist actigraphy monitors. Additionally, in-depth interviews about their daily routine were performed.

Results and discussion:
Time optimization and better financial opportunities were the main factors reported by participants for choosing to study early morning hours and work day and evening times. Preliminary results showed impact on health and lifestyle of participants. Sleep restriction, excessive day sleepiness, overweight and obesity were identified. High caffeine consumption and others stimulants were mentioned as a strategy to keep the participants awake during the work hours. The present labor market demands a qualified work force. Henceforth workers looked for an opportunity to study during early morning hours in order to conciliate to their working hours. According to the study participants, their professional qualifications help to improve their income and eventually work conditions at the expenses of their health and quality of life.

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The impact of different types of shiftwork schedules on sleep/wake patterns.

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Background
Sleep loss on work days is one of the main difficulties associated with shiftwork. The aim of this study was to compare the amount, and timing, of sleep obtained on work days and rest days by shiftworkers working morning, afternoon, night, and mixed shifts.

Methods
253 locomotive engineers (249 male, 4 female) from 14 Australian rail depots volunteered to participate in the study. The participants were aged 39.7±6.8 years (mean±SD) and had been doing shiftwork for 19.8±7.7 years. Participants recorded the start/end times of all sleeps and shifts in a self-report diary for 14 consecutive days while they worked their normal roster patterns. For analyses, participants were assigned to one of four groups: (i) morning – greater than 50% of work hours between 0500h–1300h; (ii) afternoon – greater than 50% of work hours between 1300h–2100h; (iii) night – greater than 50% of work hours between 2100h–0500h, (iv) mixed – did not reach the 50% threshold for any of the other three categories. For each type, data from the diaries were used to calculate sleep probability distributions as a function of time of day for work days and rest days.

Results
Morning. On work days, participants obtained 6.6±0.8 hours of sleep and sleep probability peaked at 83% at midnight. On rest days, participants obtained 8.3±1.2 hours of sleep and sleep probability peaked at 92% at 0300h.

Afternoon. On work days, participants obtained 7.4±1.0 hours of sleep and sleep probability peaked at 86% at 0300h. On rest days, participants obtained 8.1±1.1 hours of sleep and sleep probability peaked at 93% at 0300h.

Night. On work days, participants obtained 7.3±0.8 hours of sleep and sleep probability peaked at 61% at 0600h. On rest days, participants obtained 8.9±1.1 hours of sleep and sleep probability peaked at 91% at 0500h.

Mixed. On work days, participants obtained 7.1±0.9 hours of sleep and sleep probability peaked at 68% at 0300h. On rest days, participants obtained 8.4±0.9 hours of sleep and sleep probability peaked at 89% at 0300h.

Conclusion
All types of schedules restrict the amount of sleep obtained by shiftworkers, such that they lose 0.7 to 1.7 hours of sleep on work days compared to rest days. Given that sleep loss is a seemingly intractable problem associated with shiftwork, safety systems should have the capacity to identify when individuals have had insufficient sleep so that appropriate risk minimisation and/or mitigation strategies can be applied.
Interaction of shift work and aging on sleep: a longitudinal study among factory workers

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Background
According to the advancement of aging society, the population of aged shift workers is expected to increase. Sleep problems are common among shift workers. Also sleep changes with age. Therefore, the effects of shift work on sleep might be more apparent among aged shift workers. The aim of this study to investigate the interaction of shift work and aging on sleep by a longitudinal study

Methods
We carried out sleep questionnaire surveys among factory workers, in 2004 and 2014. The subjects targeted were 4,670 under the age of 50 at baseline. Among them, 3,630 (2,006 men and 1,174 women) participated in both surveys. The prevalence of sleep problems at baseline were compared in groups of working schedules. Also, the change of sleep quality in 10 years were compared among the groups of working schedules in 2004 and 2010. These analysis were carried out by age groups.

Results
At baseline, the sleep problems were more prevalent among shift workers in almost all age groups in male subjects. Regarding female subjects, the significant relationship between sleep quality and work schedules was not shown because of the lack of sufficient number of the shift workers. Changing from fixed day work to shift work during 10 years worsened sleep quality among the subjects aged 40-49 in both sexes. Among subjects aged 30-39 and 40-49 years in both sexes, transferring from day work to shift work had relation to causing a longer time to fall asleep.

Conclusion
Our study suggested that elderly workers would have difficulties in adjustment for sleep more frequently than younger ages when they transfer from day work to shift work.
Sleep Disorders in Shift Workers and Unemployed: Circadian Mismatch vs Psychosocial Condition
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This study aimed to estimate the differential impact of sleep-wake shifts vs psychosocial conditions on the prevalence of sleep disorders in shift workers, compared with both day workers and unemployed. The latter group was chosen because of its adverse socioeconomic status and associated psychosocial condition, and because it was assumed to occupy an intermediary position in terms of sleep-wake stability. A representative national sample filled out 45 questions including a clinically validated sleep disorders questionnaire (HSDQ). The final database consisted of 1604 participants: 971 day workers, 212 rotating shift workers and 421 unemployed. The results revealed that both shift work and unemployment were associated with a relatively higher prevalence (and severity) of a general sleep disorder (39.0% and 47.0%, vs 24.6% for day work, p < .05), as well as shift work disorder symptoms (10.4% vs 16.6% vs 6.1% for day work; all p < .05). Overall, shift work disorder symptoms suggest a widespread disruption of sleep and wake functioning, as manifested in insufficient sleep, impaired sleep quality, high comorbidity of specific sleep disorders, and daytime fatigue and dysfunctioning. The results of a discriminant analysis suggest a different etiology for sleep disordered shift workers vs unemployed. Whereas the latter were characterized by symptoms of insomnia and daytime dysfunctioning in association with their socioeconomic/psychosocial condition (‘psychosocial insomnia’), sleep disordered shift workers showed symptoms of shifted sleep insomnia as well as psychosocial insomnia. This result suggests that shift work disorder in shift workers is amenable for regular insomnia therapy.
The effect of an educational program on sleep-wake patterns of adolescents attending full-time school
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Background
Young populations have a peculiar sleep-wake cycle (SWC), characterized by longer, delayed bed and awakening sleeping times. These features are induced by physiological changes taking place during adolescence years until adulthood. The current literature shows an increasing use of social media affecting duration of sleep among adolescents and young adults. Toppling it individuals are usually unaware of chronobiology principles that could help to minimize their sleep debts.

This study aimed to evaluate SWC patterns of young students before and after an intervention on their sleep habits, in order to suggest actions that may improve their sleep duration and sleep quality.

Methods
Thirty-seven students, mean age 15.1±0.6 years; 22 women, participated in this study. They attended a vocational high school, Mon-Fri, 08:00-17:00h, in Rio de Janeiro, Brazil. An intervention was planned to improve sleep duration and sleep quality among adolescents and young adults (four hours per week for two weeks). The data collection took place during March to October in 2014 (5 consecutive school days, Monday to Friday), in three steps: 1) before an educational intervention about sleep habits, right after this intervention and three months after the second data collection. Students wore actigraphs during the collecting weeks and registered their activities (and respective duration) performed during the data collection. The sleep variables (sleep duration, latency, efficiency, sleep fragmentation index – SFI, and brief wake rate (BWR) were assessed for normality, mean comparisons and correlations.

Results
The subjects have an irregular sleep pattern, resembling polyphasic sleep behavior. The total sleep duration decreased over the year (DUR1=7:35h±3:23h; DUR2=7:16h±3:28h; DUR3=6:52h±3:00h;), SFI increased (SFI1=4,27±5,97; SFI2=4,52±5,75; SFI3=4,78±6,29) and BWR decreased without statistical significance (BWR1=0,41±0,25; BWR2=0,40±0,243; BWR3=0,36±0,23) over the three steps of the data collection. The mean comparisons of the sleep duration showed a reduction of 42 minutes on third step over the first (S.E.= 14,69min; p<0,01). Correlation analysis showed a negative relation between SFI and sleep % (r = -0,75; p<0,01).

Conclusions
Fragmented sleep period and slight reduction in sleep duration lead to a poor sleep quality. Information on chronobiology and sleep education were not enough to change adolescents’ behavior in order to prevent a potential harm of the sleep debt to their health and development. We suggest that guidelines to parents, students and school teachers be regularly discussed to increase awareness of the effects of school and other activities on SWS changes of adolescents.

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Is food intake associated with fragmentation, stability and/or sleep duration?

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Background
Numerous studies point out changes in food composition for both night and shift workers. At the same time, it is common for these individuals to experience sleep disturbances. Understanding the relationship between food intake and sleep disturbances seems to be essential to the health of workers.

Objectives: The aim of this study was to evaluate the differences between truck drivers working irregular hours (including night work) and daytime drivers with respect to sleep duration and nonparametric variables of rest-activity rhythm. A second objective was to investigate the association between the type of food ingested by these drivers and fragmentation, stability and duration of sleep.

Methods
Alongitudinal study, which involved 44 truck drivers, 23 daytime drivers and 21 drivers working irregular hours, was conducted. The mean age of the drivers was 40.8 years (SE=1.53). To evaluate the activity/rest cycle, the drivers used actigraphs for 10 days and responded to the 24-hour recall for two work days and one day off. Linear regression analyzes were applied, having as dependent variables, the average intake of calories, carbohydrates, proteins and fats. Independent variables were total sleep duration and nonparametric variables at: intradaily variability (IVM), interdaily stability (ISM), sum of least active five-hour period (L5m) and sum of most active ten-hour period (M10m).

Results
As expected, no differences were found between shifts in relation to intradaily variability. However, there was increased activity during sleep (irregular: mean=27778, SE=2058; day: mean=8735, SE=1580; p<0.001), lower activity during wakefulness (irregular: mean=111144, SE=3905; day: mean=132077, SE=3795; p<0.001) and lower interdaily stability (irregular: mean=0.26, SE=0.04; day: mean=0.62, SE=0.27; p<0.001) among drivers working irregular hours compared with daytime drivers. Fat intake showed statistically significant correlation with the duration of sleep on work days (p=0.05). When analyzing the groups separately, the correlation remained only for irregular shift workers (p<0.01).

Conclusion
Apparently there is a relationship between ingested food content and duration of sleep in drivers working irregular hours. This is possibly explained by the conflict between biological rhythms and environmental synchronizers (light/dark cycle and work hours). Although this conflict appears to also affect sleep fragmentation and stability, these sleep variables were not correlated to food intake. However, the sample size may be a limiting factor in the analysis and further studies are needed to verify the relationship between sleep patterns and eating habits.

SUPPORT: CAPES.
Sleep efficiency, sleep length and sleepiness in miners during winter in Kiruna, Northern Sweden
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Introduction
One of the effects of rotating shift system, among others is sleepiness and the alteration in the quality of sleep.

Aim
The aim of this study was to analyze day and night sleep and sleepiness of shiftworkers during winter working in a mine of Kiruna, Northern Sweden. The instrument used for data collection was wrist actigraphy and a selfocumented diary.

Methods
Mixed linear models were used in order to find if there were any significant association between shift type, sleepiness ratings (KSS), and actigraph variables (Mean Activity, Total Activity, Sleep Efficiency, Wake After Sleep Onset (WASO), number of awakenings and Total Sleep Time. The sample consisted of 20 participants with recorded sleep across 17 days including a week of night work (52.6% of recordings) and following days off.

Results
Regression analysis results indicated that Mean Activity was not associated with KSS, shift type (3 permanent night workers/15 shift workers/2 day workers), sleep type (119 day sleeps /132 night sleeps) or the existence of nap. Total Activity was greater in night sleep recordings than during day sleep. Sleep Efficiency and WASO were greater in cases of existence of a nap during the day. The number of awakenings was greater in night sleep as compared with day sleep. Additionally, total sleep duration was longer in case of night sleep recordings and shorter in cases that a nap during the day was present. Furthermore, total sleep duration was associated with lower KSS values (β=-14.13, SE=4.79, p=0.003). KSS was lowered in connection to night sleep and elevated in cases that a nap during the day was present.

Conclusion
Short sleep periods seem to positively affect sleep efficiency as in the case of multiple consecutive day sleeps compared to night sleeps but long sleep periods more strongly fights sleepiness during wake time. Also the occurrence of napping decreases sleep length, increases sleep efficiency but is associated with day time sleepiness.
Poster session 1D: Methods

Time: Tuesday, 09/Jun/2015: 17:30-19:30

AN APPROACH FOR HOLISTIC FATIGUE RISK MONITORING

Tomas Klemets, David Karlsson
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Monitoring and controlling the overall fatigue risk for an entire airline operation is not a straightforward task and existing guidance from authorities is sparse. The guidance available is often rule-driven and, as shown in many publications, rules often lack the needed precision and may even increase overall fatigue risk.

For example, a limitation of duty time during night operation will lead to an increased number of night duties, which of course will lead to a higher ratio of consecutive night duties. This, in turn, will build sleep debt in crew and hence negatively impact the operation by increasing overall risk.

At the same time, reactive measures like fatigue reports are blunt instruments for gauging the operation as they are susceptible to noise and variation in the operation, affecting the willingness of crew to invest work for issuing them in the first place. Fatigue reporting frequency may increase after fatigue management training, after the latest safety bulletin is issued where crew are reminded to write them and during salary negotiations etc. which makes reports poor gauges of overall built-in fatigue risk.

This presentation will propose an approach using predictive fatigue models to complement and expand on traditional risk monitoring and risk control in an FRMS. The approach provides an objective, scientifically based metric for the latent overall fatigue risk in the operation, as well as tracking the development over time. With such an approach, negative and positive trends in the operation can be spotted and addressed early on, guiding the organization to address fatigue risk in the most efficient way.
Do workplace interventions reach shift workers?

Kirsten Nabe-Nielsen¹, Marie Birk Jørgensen², Anne Helene Garde², Thomas Clausen²
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Background
One potential mechanism linking shift work with adverse health outcomes is that shift workers are exposed to more physical and psychological stressors in the working environment than day workers. Some of the differences in exposures when comparing shift workers and day workers relate to the special tasks that are taken care of during the evening and night—for example in the police or eldercare. However, also modifiable workplace structures may contribute to the preservation and reproduction of a poorer working environment for employees working evening and night shifts. For example, shift workers often constitute the minority at a workplace, personnel meetings often take place during the day, and leaders are seldom present during evening and nights.

Thus, we hypothesize that workplace initiatives aimed at improving the working environment less frequently reach shift workers. The specific aim of the study was therefore to investigate whether workplace initiatives such as the implementation of stress-reducing activities, varied between shift workers and day workers.

Methods
We used questionnaire data from 5361 female care workers in the Danish eldercare sector. The self-reported working hours was divided into “day work” (reference), “evening work”, “night work”, “variable working hours without night work”, and “variable working hours with night work”. We also asked: “Has one or several activities been implemented to reduce work stress during the preceding 12 months?” followed by “Improved methods of management”, “Work pace has been reduced and there are fewer tight time schedules”, and “There is more flexibility in the working hours and/or the work tasks” (response options: yes/no).

Results
Overall, we found that shift workers, were less likely to experience that workplace interventions aimed at stress reduction were available to them. For example, night workers less frequently experienced improved management (OR=0.5; 95% CI:0.3-0.6), lower work pace (OR=0.6; 95% CI:0.3-0.9), and more flexibility (OR=0.5; 95% CI:0.3-0.7).

Conclusion
Our study support the hypothesis that shift workers, especially those who are working fixed night shifts, are difficult to reach when it comes to workplace interventions. Therefore, we suggest that future studies focus on how to reach this group and meet their needs when designing and implementing workplace interventions.
A Smart Phone-based Task Analysis

Werner Schafhauser¹, Johannes Gärtner¹, Gerhard Mostbeck², Marina Sailler-Katramados², Günter Wukovits²

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BACKGROUND: In hospitals and health care organizations, there is some uncertainty regarding staffing levels:

* Is there enough staff to accommodate workload in the current way of planning?
* Which tasks are performed and what are the time requirements for each task?
* Are there too few or too many times to rest within shifts for the personnel?

Traditional methods, such as self-reported surveys or diaries, used to record work tasks performed by medical staff may not be the most accurate for several reasons. Medical staff may work under high stress levels, often completing several tasks at the same time, making it difficult to record all activities accurately. Moreover, it is quite common that medical staff change their work station during their shifts making it difficult to administer traditional survey methods without incurring substantial costs.

METHOD: XIMES has developed a smart phone-based task analysis tool for conducting work sampling studies in hospitals and health care organizations. Our approach is easy to use and requires only minimal interference with regular working duties of participants. The smart phone is programmed to prompt participants randomly every 30 minutes with an audible beep to gather information about their current duties from a pre-defined task list. Answers can easily be recorded within seconds with just one finger click. For longer resting periods sampling can be interrupted. Errors can be corrected by participants after the end of their shift by logging onto their records at a predetermined website.

We have pilot tested this mobile work sampling instrument at two tertiary referral hospitals. Nine different physicians were recorded each day for two months. The lengthy observation period provided representative samples of working time and resting activities.

RESULTS: The convenient handling was commonly appreciated and our approach had a high response rate (> 95% over two months). We were able to record more than 10,000 data points, thereby obtaining a reliable perspective of work activity across weekdays, weekends and during night shifts. Our data showed that physicians usually rested for four hours or more during night shifts. However, the variability in idle periods was high between days and individuals. A detailed breakdown of non-patient times (e.g., waiting, walking) facilitated discussion of process design.

CONCLUSION: The smart phone-based task analysis facilitates accurate collection of detailed information with minimal financial and administrative efforts. Results obtained in our pilot study helped to inform development of work/rest scheduling among hospital physicians.
A FATIGUE RISK MANAGEMENT SYSTEM VISUALIZED

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ICAO defines a Fatigue Risk Management System as: A data-driven means of continuously monitoring and managing fatigue-related safety risks, based upon scientific principles and knowledge as well as operational experience that aims to ensure relevant personnel are performing at adequate levels of alertness. Despite this definition and provided guidance material, many airline operators find it hard to fully embrace and visualize how an FRMS will function once operational and the tools, metrics, processes and components within. Many operators have been found to have more questions unanswered after reading the documents than they had before. There is a need, at least in the aviation industry, of simplifying and visualizing a FRMS to stakeholders for enabling faster adoption.

This poster attempts to clarify and visualize an entire FRMS for an airline operator in just one page. It explains the role of ICAO, the regulators, the science community and how they interact with the airline internal functions. The poster also illustrates the role of the crew management processes, crew themselves, top management and the Fatigue Safety Action Group (FSAG). This poster, already in use by some airline safety departments and regulators, assist enhancing the understanding of an FRMS and simplifies implementation by explaining the how fatigue reporting, rules as well as bio-mathematical modeling assists in controlling and reducing crew fatigue risk in a systematic way. It also illustrates the data driven and scientifically based work of the FSAG and the expected output of this group for driving flight safety in an efficient manner.
EFFICIENT FATIGUE DATA COLLECTION WITH MOBILE DEVICES

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Traditional fatigue data collections within aviation include distribution to participating crew of so-called acti-watches, but also devices for reaction-time tests as well as extensive paper material with instructions and forms for collecting sleep diaries and duty patterns by pen and paper. These collection methods not only suffer from intense logistics during the study, but also from increased risk of introduced bias and poor data quality due to user input error and lack of cross-validation between data sources. These shortcomings consistently require scientists to correct and clean collected data, which leads to data loss and imprecise adjustments. Due to the huge amount of manual work invested, it is not uncommon that a dataset ends up costing around 100-300 USD per duty day collected.

This presentation will report on the experiences of applying mobile technology (primarily iPhone and iPad) to overcome the problems of traditional fatigue data collection. We will discuss considerations made in the application design, and the strengths and weaknesses of the approach found during 15 fatigue data collections from airline crew worldwide. Results to date have been very encouraging with a collection methodology that is fully scalable and, since crew often are already in possession of the devices, even provides opportunity for allowing airlines to collect at minimal cost. We will also briefly discuss the ongoing trend towards wearable technology and what role this might play in reducing crew workload for collecting data.
Development of a job-exposure matrix specific on night work in France

Jean-Baptiste Pelletan¹,², Delphine Dezewski-Serra¹, Pascal Guenel¹,³, Marie Houot¹, Mounia El Yamani¹, Corinne Pilorget¹,²
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Background
Shiftwork that involves circadian disruption has been classified as probably carcinogenic to humans (IARC Group 2A). Due to growing concern about health consequences of night shift work, we are developing a job-exposure matrix to assess retrospectively the proportion of exposed workers and the frequency of worked night by job, calendar period and gender.

Methods
This matrix should lead to an exhaustive and retrospective assessment of evening and/or night work for each job in France since 1950.
The steps of this work consist in: 1) assessing the exposed jobs by an expert; 2) using data from a national job-survey that since 1984 has asked periodically to a representative sample of workers their potential involvement in evening and night work; 3) comparing the expert assessments with data coming from the job survey and completing them if necessary.

Results
The first results of this matrix will be available on the early 2015. It will concern the exposed jobs to night work in the rail transport industry using different job classifications (national PC S 2003 for occupations / national NAF 2008, European NACE 2008 and international ISIC 2008 for industries). The estimated probabilities and frequencies of exposure and the trends of these indices, according to the gender and to the exposure periods, will be presented.

Conclusions
It will provide an exposure assessment tool to evening and night work for all previous and current jobs in France.
Validation of shiftwork exposure

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Background
The quality of information about the "true" shift work exposure is currently debated. How well do the participants in focus, when asked, remember the true exposure? On the other hand, how reliable are the register data we can base our assumptions on with regards to shift work exposure?

Methods
In the WOLF cohort from 2009 questionnaire, shift work estimation is based on responses to the question: "How many years of your working life have you been working shift work? In register obtained from a pulp and paper factory, computerized data and earlier manual data for the same person were combined to define the exposure time.

Four hundred and twenty persons provided a shift work estimation on the questionnaire.

Three hundred and twenty-eight individuals fulfilled the criteria of having a combination of both self estimated and register data. Three hundred and eight were men and twenty individuals were women. A subtraction valuable of self estimated shift years minus official register data of shift years was primarily analyzed.

Results
Comparison between the level of self-estimated shift work years and the register data showed that the mean difference was -0.83 years and the median difference was -0.67 years among the 328 included. The SD was 6.40. The spread of shift work exposure among the individuals was between 0.5 to 48 years. It was noted that those at the extreme of over or under estimation consisted of difficult to define job categories.

Ninety-two individuals were excluded from the main analysis due to incomplete register data. Due to those, a discrepancy of up to 10 years may exist between the register and self-reporting.

Conclusions
According to these results, when asked if and for how long they have been working shift, workers tend to underestimate. That could perhaps contradict some expected assumptions?

The 92 excluded individuals were mainly characterised as those with job misclassification in the register, or perhaps have performed shift work in other locations? Answers from individuals, about shift work exposure, that could be reliable?

What are the difficulties in comparing self-estimates with register data? Are there specific issues of job classification in the pulp and paper industry which should be taken into consideration when producing job exposure matrices in the future?
Wednesday 10 June
OS 2A: Sleep

*Time:* Wednesday, 10/Jun/2015: 8:30 - 10:00
*Location:* Room 1 (Conference room)
*Session Chair:* Arne Lowden, Stockholm University, Sweden
*Session Chair:* Philip Tucker, Swansea University, United Kingdom
Number of consecutive night shifts and sleep
Åse Marie Hansen, Marie Aarrebo Jensen, Kirsten Nabe-Nielsen, Jesper Kristiansen, Anne Helene Garde
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Background
Shift and night work have an impact on health in the short and long run. It is debated how to best organize night work in order to reduce potential harm to sleep and health. The purpose of the present study was to investigate how the number of consecutive night shifts affected sleep in a real life setting.

Methods
The study is a part of the “In the Middle if the Night” project. 73 policemen from five districts performed three interventions: ‘2+2’: two consecutive night shift followed by two consecutive day oriented work shifts or off work; ‘4+4’: four consecutive night shift followed by four consecutive day oriented work shifts or off work; ‘7+7’: seven consecutive night shift followed by seven consecutive day oriented work shifts or off work. The schedules were planned so there was a minimum of 7 days without night shifts before each intervention. All participants scored their sleep problems (poor sleep = higher score), using six items from the Karolinska Sleepiness Diary on all days during the three interventions. Scores were compared with the sleep score for the last day oriented day in 7+7.

Results
It was easier to fall asleep on days with night work than days with day-orientation (day work or off work) in all three interventions, particular in the first 2-4 days after starting night work. However, sleep after night work was characterized by being less restful and by waking up too early without being able to fall asleep again. There were no indications that reports of restful sleep and sleep without early awakenings improved within 7 days consecutive days with night work. Sleep was rated more disturbed on the first 2-3 days of both night shifts and day shifts in 7+7 intervention, indicating that a change in shift, either from day-orientation (day work or off work) to night shift or in the other direction, had a negative effect on disturbed sleep.

Conclusion
We found that different aspects of sleep responded differently to of the number of consecutive days in a field setting. Some sleep characteristics were worse on all days with night work indicating that there was not a total adaptation even after 7 days, while other sleep characteristics improved after the 2-4 days after a change in shift. Also, it was easier to fall asleep on days with night work, but sleep was less restorative and participants woke up too early.
Differences in sleep time when adding a second job: Findings from the American Time Use Survey

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Background. Approximately 10% of the employed population in the U.S. work in multiple jobs (ATUS, 2013) and work schedules are varied (Presser and Gornick 2005). Workers in multiple jobs in a one week period (MJH) have a higher risk of injury than single job holders (SJH), controlling for work hours (Wellman et al., 2014). Demanding work schedules, long work hours and shift work impact sleep duration and quality and increase the risk of injury (Folkard et al., 2004, 2005, 2006a, 2006b, Lombardi et al., 2010, Tucker et al., 2006, Williamson 2011, Dembe et al. 2005). The United States American Time Use Survey (ATUS) provides nationally representative estimates of how people in the U.S. spend their time. In this study we analyzed ATUS data to determine whether there are significant differences in sleep duration and sleep onset between MJH and SJH.

Methods. ATUS data was pooled over a nine year period (2003–2011). Respondents completed a structured interview and a separate diary component providing self-reported start and end times of each activity they participated in during the previous 24-hour period (4am to 4am). Those working on the diary day are classified as either SJH or MJH depending on whether they were employed in one or more jobs in the week prior to interview. They are further classified based on: 1) whether they worked their primary, other or both jobs on the diary day or 2) a work shift start time of 0500-1059, 1100-1459, or 1500-0459. ANCOVA models were used to compare sleep duration between single and multiple job holders and whether this was modified by work shift start times, gender, age and other covariates.

Results. There were significant differences with respect to duration of sleep time between MJH (7.56hrs, +/- 0.035) and SJH (7.82hrs, +/- 0.012). MJH working both jobs on the diary day had the least sleep time (7.01hrs, +/- 0.053) of any work group. Proportionally more MJHs worked the night shifts, 15.8%, +/- 0.66 MJHs with start time 1500:0459 vs 13.7%, +/- 0.23 SJHs, and had significantly less sleep time, 7.74hrs, +/- 0.12 vs 8.05hrs, +/- 0.04.

Discussion. We found significant differences in sleep time for MJH and SJH that may contribute to injury risk due to inadequate rest. We will present the results of an ANCOVA model determining differences in sleep time between each work group, controlling for other factors related to sleep time (e.g. age, gender, day of week, usual weekly work hours, and occupation).
Quick returns and night work as predictors of sleep, recovery & wellbeing

Anna Dahlgren¹, Phillip Tucker², Petter Gustavsson³, Ann Rudman³

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Background
Quick returns (short intervals between the end of one shift and the start of the next) restrict opportunities for sleeping and other non-work activities between shifts. Consequently, they are associated with shorter sleeps and increased fatigue on the subsequent shift. Recent evidence suggests that shift workers regard quick returns as being more problematic than night work (1). The aim of the current study is to compare quick returns and night work in terms of their impact on sleep, unwinding, recovery, exhaustion, satisfaction work hours and work-family interference. We also examine mediators of the relationship between quick returns and exhaustion.

Method
Data from the 2006 cohort of Swedish nursing students within the national Longitudinal Analysis of Nursing Education (LANE) study (2) were analysed (N=1459). Respondents completed a questionnaire in their last semester prior to graduation (response rate 69.2%) and then annually for the three years after graduation. The analyses examined associations between measures taken at the last measurement occasion, while adjusting for age, gender, type of employment, morningness (all measured at the last measurement occasion); self-reported health, sleep quality, living with children and previous experience of night work (all measured prior to graduation).

Results
Frequency of quick returns was a significant predictor of sleep problems, short sleeps, unwinding, exhaustion, satisfaction with work hours and work-to-family interference. In each case, higher frequency predicted more negative outcomes. It did not predict recovery after rest days. Frequency of night work did not predict any of the outcomes. Problems unwinding, difficulty falling asleep and work-family interference were all partial mediators of the association between frequency of quick returns and exhaustion, while frequency of short sleeps was not.

Conclusion
While it could be expected that quick returns might have a greater impact than night work on social factors, it is rather more surprising that this extends to impacts on sleep and health. However, the current observation of relatively benign effects of night work on sleep is consistent with other survey findings. Unexpectedly, short sleeps did not mediate the relationship between quick returns and exhaustion – possibly because the definition used (sleeps <5 hours) was insufficiently sensitive.

Insufficient recovery opportunity between shifts is an important determinant of sleep, recovery and wellbeing.
Fighting fires and fatigue: sleep during wildfire suppression
Grace Vincent¹,², Brad Aisbett¹,², Sally Ferguson²,³

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Background
Australia’s firefighting personnel are usually rostered to work a 12-h day or night shift, but can regularly work shifts of up to 15 h for 3-5 consecutive days. Consequently, rest between shifts is reduced, resulting in truncated sleep opportunities. In addition, firefighters regularly sleep in temporary accommodation near the fireground during such deployments. However, the existing evidence surrounding lack of sleep and the operational factors that contribute to inadequate sleep during fire suppression remain largely anecdotal. Therefore, the primary aim of this study was to determine firefighters’ sleep quantity and quality throughout multi-day wildfire suppression, and secondly to assess how sleep location and shift length may impact these variables.

Methods
Forty-one volunteer firefighters were recruited across Australia’s state fire agencies. Sleep was measured objectively using wrist actigraphy for a period of four weeks. The variables were examined in two conditions: 1) fire days, and 2) non-fire days. Activity monitors were set to sample in 1-min epochs, with a sensitivity of <40 counts per epoch to distinguish between sleep and wake states. Time in bed (hours), total sleep time (hours), latency (minutes), fragmentation index (%) and efficiency (%) were evaluated. Participants subjectively reported shift length, sleep location, as well perceptions of sleep quality.

Results
Time in bed was greater during non-fire days (7.85 ± 0.73 h) than fire days (6.78 ± 0.92 h). Total sleep time was less during fire days (6.05 ± 1.07 h) than non-fire days (6.89 ± 0.82 h). When assessed by location, sleep quantity was less in a tent (5.21 ± 0.96 h) or vehicle (4.50 ± 1.75 h) when compared to home (6.17 ± 1.70 h) or motel (6.22 ± 1.42 h) locations. Sleep quantity was less when shifts were greater than 14 hours (5.65 ± 1.66 h) compared to all other shift lengths less than 14 hours (6.45 ± 1.31 h). There was no difference in actigraphy measured sleep efficiency, sleep latency, fragmentation index or perceptual reports of sleep quality between non-fire and fire days.

Conclusion
This is the first empirical investigation providing objective evidence that firefighters' sleep is compromised during wildfire suppression. When sleeping in tent or vehicle locations or when shift lengths exceeded 14 hours in duration, sleep loss was exacerbated. Therefore, sleep location and shift length should be targeted when designing appropriate controls to manage fatigue-related risk to ensure firefighter health and safety during these events.
12-h shifts and age – effects on sleep, wakefulness and recovery from work

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Background
Despite reports that long work shifts may result in increased sleepiness and fatigue and consequently risk of accidents, longer 12-h shifts have gained popularity and they are spreading also in the industrial sector in Finland. Long shifts can be especially demanding for older workers but research how older workers tolerate 12-h shifts is limited. We studied how working 12-h shifts affect sleep, fatigue and recovery in different age-groups of workers.

Methods
Altogether 600 employees of paper, pulp and chemical industry (91% males) participated in the cross-sectional study. Participants filled-in questions on need for recovery from work (NFR-questionnaire), sleep quantity, sleep need, sleep loss and night and morning shift-specific insomnia and fatigue symptoms. Forty five percent worked a 12-hour shift system (DDNN------) and 55% worked either a fast rotating 8-hour shift system (MMEENN----, n=162) or a slowly rotating 8-hour shift system (MMMM-EEEE-NNNN------, n=170). Age was divided into 5 categories (18-25, 26-35, 36-45, 46-55, and 56-65 years). We compared 12-h shift workers and 8-h shift workers with sex as a covariate in the analyses.

Results
Age group was associated with NFR (p=.006) and NFR was higher in older age groups, but not in the oldest age group. Sleep was longest in the youngest age group (8:11) and shortest in the 46-55 age group (7:28). The oldest age-group reported more difficulties in initiating sleep after a night shift than the youngest age group. The effect of age group on NFR and fatigue during morning shift differed between the 8-h and 12-h systems (p’s <.005). In the 12-h system NFR increased with age and so it did in the 8-h system until the 46-55 age group after which the level of NRF dropped in the oldest age group. Similarly, fatigue during morning shift showed slight increase with older age in the 12-h shift, while in the 8-h group a decrease of fatigue was observed in the oldest age group.

Conclusion
When comparing the 8- and 12-hour shifts, we did not find much evidence for a poorer tolerance to the fast forward rotating 12-h shifts among the older workers. Although older age predicted decreased recovery from work in the 12-h shift system, the level of NRF was not remarkably different from that observed in the 8-h system.
Sleep-related differences in shiftwork and daytime work across two seasons

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The Torsvall & Åkerstedt Diurnal Type Scale (1980) is often used to estimate diurnal type characteristics in shiftwork research. The scale including seven items has been developed to suit shift work population and is derived from the Horne & Östberg scale (1976). A sample of workers in the mining industry situated above the Arctic Circle answered the Diurnal Type Scale. The sample included 495 day workers and 296 shift workers (total sample n=801). The first phase of study occurred during winter and the second phase the following summer. The seven items were summarized and a mean comparison was made in-between seasons using repeated measures ANOVA. In a second step the answers on the last item (item 7 – “morning type”, “somewhat morning type”, “somewhat evening type” and “evening type”) measuring self-estimated diurnal type in winter was used to investigate what group showed largest seasonal change. In this study high diurnal scores represents eveningness.

The mean diurnal score reached 16.50 (SD±3.68) in winter and significantly lowered mean score towards morningness in summer, 16.01 (SD±4.01), p<0.001. Shiftworkers as expected showed higher eveningness scores (p<0.001). The interaction of season and work hour group (day work/shiftwork) was significant (p<0.035) indicating that shift workers stayed stable across season but day workers increased in eveningness scores. When comparing each single item, only two items indicated a seasonal difference. The first of these items indicates preferred bedtime in connection to work hours free of choice (winter mean=3.05±0.69; summer mean=3.11±0.66; p<0.027). The other item asked about when during the evening first signs of fatigue and needs of sleep occurred (winter mean=2.13±1.02; p<0.001). No interactions across season for scores on these items with self-estimated diurnal type (item 7, four response alternatives) as grouping were found.

In summary the diurnal type scale seems stable across extreme seasonal light changes for shiftwork populations but slightly less stable for day workers. Although diurnal preference is not supposed to vary across time, differences between seasons with extreme light changes may lead to more reported alertness during summer showing a diurnal preference delay towards eveningness.


Oral Session 2B: Health and disease I

*Time:* Wednesday, 10/Jun/2015: 8:30 - 10:00

*Location:* Room 2

*Session Chair:* Masaya Takahashi, National Institute of Occupational Safety and Health, Japan

*Session Chair:* Henrik Kolstad, Aarhus University Hospital, Denmark
Many epidemiological studies carried out in the last two decades have shown that shift and night work may be associated to severe long-term effects on health, including cardiovascular disorders. Fifteen years ago a systematic review by Bøggild and Knutsson (SJWEH 1999) evidenced a strong association between shift work and CVD, shift workers having on average 40% excess risk for ischemic heart disease as compared to day workers. Perturbed sleep/wake cycle and related circadian disruption with disturbed cardiac autonomic control, chronic sleep deprivation, work/family conflicts, and lifestyle changes (i.e. smoking, obesity, dyslipidemia) have been suggested as the main stress and risk factors in shift workers.

Ten years later another systematic review on ischemic heart disease (Frost et al, SJWEH 2009) concluded for a limited epidemiologic evidence for a causal relation due the heterogeneity of the studies, while a more recent review of the English-language literature published during the last decade (Esquirol et al, Arch Card Dis 2011) on cardiovascular risk factors, documented an impact of shift work on body mass index, blood pressure, carbohydrate and lipid metabolism.

Other recent studies have also pointed out the importance of elevated markers of inflammation and mechanisms of thrombogenesis (i.e. homocysteine, fibrinogen) in shift workers, as well as changes in autonomic cardiac control (i.e. increased heart rate variability and cardiac arrhythmias).

We have reviewed the English language literature of the past 20 years. We included 18 articles in the narrative review out of 192 records selected in the preliminary analysis. We conclude that it is very difficult, at present, to establish a clear causal relation between shift work and CVD. The association is plausible and probable, but selection, information and confounding biases affect most studies and may weaken or mask such association. They are related to inaccurate definition and quantification of exposure (duration, frequency, rotation), misclassifications of cases and controls, type of study (cross-sectional, historical and prospective cohorts), groups and work sectors examined, diagnostic tools and criteria, methods of reporting (self-reported, objective measurements), confounders and/or modifiers considered/adjusted (e.g. race, socio-economic status, diet, physical activity, job-related stress, smoking, alcohol), and the “healthy worker effect” (aging, recruitment, screening due to periodical medical surveillance). These factors are of particular importance also at forensic level in the assessment of a causal or concausal association between shift work and cardiovascular disorders.
Background
Night shift work has been classified as a probable human carcinogen based on experimental data and limited epidemiological studies on breast cancer. Evidence on other common cancers, such as prostate cancer, is scarce. Chronotype is an individual characteristic that may relate to night work adaptation and thus may modify the night shift work-cancer association.

Methods
We evaluated night shift work with relation to prostate cancer, taking into account chronotype and disease severity in a population based case-control study in Spain. We included 1095 prostate cancer cases and 1388 randomly selected population controls. We collected detailed information on shift schedules using lifetime occupational history. Socio-demographic and lifestyle factors were assessed by face-to-face interviews and chronotype through the Munich Chronotype Questionnaire. We used unconditional logistic regression analysis adjusting for potential confounders.

Results
Subjects who had worked at least for one year in night shift work had a slightly higher prostate cancer risk (Odds Ratio (OR) 1.14; 95%CI 0.94, 1.37) compared to never night workers; this risk increased with longer duration of exposure (≥28 years: OR 1.37; 95% CI 1.05, 1.81; p-trend=0.047). Risks were more pronounced for high risk tumors (D’Amico classification, Relative Risk Ratio (RRR) 1.40; 95%CI 1.05, 1.86), particularly among subjects with longer duration of exposure (≥28 years: RRR 1.63; 95%CI 1.08, 2.45; p-trend=0.027). Overall risk was higher among subjects with an evening chronotype (OR 1.79; 1.16, 2.76, p-trend=0.017).

Conclusion
In this large population based study we found an association between night shift work and prostate cancer particularly for tumors with worse prognosis. Both morning and evening chronotypes had an increased prostate cancer risk after night work, compared to subjects with neither chronotype.
Mismatch of sleep and work timing and risk of type 2 diabetes

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Background
Whether type 2 diabetes (T2D) risk among rotating night shift workers depends on chronotype (or preferred sleep timing, ‘larks’ versus ‘owls’) could be informative for occupational health guidelines and shift scheduling. Here, we examined whether women with late chronotypes have a higher risk of T2D, and whether shift work modulates this association.

Methods
We analyzed a sample of 64,615 participants of the Nurses’ Health Study 2 (NHS2), a cohort comprising women nurses who were aged 25-42 years at the 1989 recruitment from 14 US states. The NHS2 ascertained chronotype by a single question on diurnal preference in 2009. Rotating night shift work exposure was assessed regularly beginning in 1989. Newly developed T2D self-reported between 2005 and 2011 (N=1,452) was our main outcome measure. All participants were free of chronic disease at baseline (i.e. cancer, myocardial infarction, or stroke). We estimated confounder-adjusted odds ratios (ORs) and 95% confidence intervals (CIs) using logistic regression models.

Results
35% of all women classified themselves as early chronotypes, 54% as intermediate, and 11% as late chronotypes. Compared to intermediate chronotypes, the age-adjusted risk of T2D was significantly lower among women with early chronotypes (OR=0.74, 95%CI=0.66-0.83) and significantly higher among late chronotypes (OR=1.39, 95%CI=1.20-1.61). Multi-variable (MV) adjustment, especially with body mass index, attenuated these estimates (early chronotypes: MVOR=0.87, 95%CI=0.77-0.98; late chronotypes: MVOR=1.04, 95%CI=0.89-1.21). Among women who had never worked rotating night shifts, T2D risk was reduced for early chronotypes (MVOR=0.81, 95%CI=0.63-1.04), and significantly increased for later ones (MVOR=1.51, 95%CI=1.13-2.02). For women working 1-10yrs of rotating night shifts, risk estimates remained reduced in early chronotypes (MVOR=0.84, 95%CI=0.72-0.98), while the association with T2D was attenuated in late chronotypes (MVOR=0.93, 95%CI=0.76-1.13). Among women with >10yrs shift work exposure, neither early nor late chronotypes had an increased risk of T2D, as compared to intermediate ones (early chronotypes: MVOR=1.15, 95%CI=0.81-1.63; late chronotypes: MVOR=0.87, 95%CI=0.56-1.34). The interaction between chronotype and exposure to rotating night shift work was significant (likelihood ratio test of cross-product term, P=0.0004). Analyses restricting to incident T2D cases revealed similar patterns.

Conclusions and Relevance
Chronotype was associated with T2D risk and exposure to rotating night shift work significantly modified this effect, with lowest risks for early chronotypes working daytime schedules, and late types working schedules including night shifts. These data – if replicated – suggest that workers could benefit from individualized shift schedules aimed at minimizing interference with chronotype-dependent sleep timing.
Night work and metabolic risk factors for diabetes among a non-diabetic population: baseline results from Brazilian Longitudinal Study of Adult Health (ELSA-Brasil)

Aline Silva-Costa¹, Lucia Rotenberg², Rosane Griep²,³

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Background
Non-diabetic individuals but with high levels of triglycerides and LDL cholesterol, and low levels of HDL cholesterol, obese, especially with abdominal obesity, are at greater chance of developing diabetes. The aim of this study was to test the association between night work and metabolic risk factors for diabetes among a non-diabetic population of men and women from the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil).

Methods
ELSA-Brasil, a prospective cohort study, comprises 15,105 civil servants, aged 35 to 74 years at baseline (2008-2010), who were sampled from universities of six capital cities of Brazil. A 12-hour fasting blood sample was drawn for the measurement of serum cholesterol, triacylglycerol, and glucose. For the current analysis, we excluded participants classified as having diabetes, retired workers and participants classified as day workers with previous experience in night work. Workers (N=8,853) were classified as exclusively day workers and current night workers. Generalized linear models, a gamma regression model with an identity link function, were performed to test the association between night work and metabolic risk factors for diabetes.

Results
The present study consisted of 3,918 men and 4,935 women, 305 (7.8%) and 379 (7.7%) were male and female night workers, respectively. Among men, the exposure to night work increased in average 0.542 kg/m² in BMI (p = 0.032) and 1.66 cm in waist circumference (p = 0.014). In relation to triglycerides, a borderline association was found (β = 12.836, p = 0.072). For women, fasting plasma glucose was the only variable significantly associated with night work after adjustments (β = 2.278, p < 0.001). No significant association between night work and LDL-C, HDL-C, total cholesterol levels or waist-rip ratio was found for both men and women.

Conclusions
These findings contribute to discussions related to the link between night work and diabetes, as well as others cardiometabolic diseases. A higher number of variables were significantly associated with night work among men compared to women. Nevertheless, data specifically related to fasting glucose point to the greater chance of developing diabetes among female night workers, confirming our previous results on a gender-specific association between night work and diabetes.

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Use of multistate models for examination of associations between shiftwork and short-term sickness absence

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Aim
The aim of this study is to test the use of multistate models when examining the impact of shift work on short-term sickness absence among Danish employees doing person-related work. We hypothesize that the risk of sickness absence is higher among employees with work patterns that include displaced shifts, which can be disruptive for circadian rhythms. Potential mechanisms behind the hypothesis are that fatigue and decreased immune response can increase susceptibility for disease and thus sickness absence.

Methods
We drew a random sample of 1,000 employees from the Danish Working Hour Database (DWHD). Of these we included employees doing person-related work, yielding an analytic sample of 540 unique persons with 834,752 work-time observations (shifts).

We calculated a displacement statistic for each registered shift and divided shifts into “non-displaced shifts” or “displaced shifts”. Furthermore, each shift was linked to a continuous average of shifts worked in the past 28 days and categorized in three work patterns of: 1) no displaced shifts, 2) low degree of displaced shifts and, 3) moderate/high degree of displaced shifts. Short-term sickness absence was measured as 2-7 days of sickness absence. As covariates we included sex, age, and occupational group.

A multistate model was used to analyse transitions between three states: work, sickness absence and other states, e.g., holiday, sick children and maternity leave. Hazard ratios (HR) for sickness absence were calculated by the Cox Proportional Hazards Model.

Results
Preliminary results show an increased risk of sickness absence for work patterns of low degree of displaced shifts (HR=1.14; 95% CI: 0.99-1.31) and of moderate/high degree of displaced shifts (HR=1.26; 95% CI: 1.07-1.49) compared to the reference group of no displaced shifts. Adjustment for sex and age did not alter results; however, after adjustment for occupational group estimates were attenuated.

Conclusion
The use of a multistate model seems appropriate for this type of study. The methods and analysis will therefore be included in a confirmatory study based on a larger sample of the DWHD study population, where we are also able to include register-based covariates such as socio-economic status.
Short term risk of breast cancer following night shift work in the public health sector: a register linkage study of pay roll data
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Background: Suppression of melatonin at night may act as a promoter of oncogenesis and the aim was to examine if recent night shift work is a short term risk factor for breast cancer.

Methods: We conducted a cohort study of 154,751 women employed in the Danish public healthcare sector with a high prevalence of night shift work and day-by-day night shift information from pay roll registers 2007 to 2012. Incident breast cancers were identified in national registries 2008 to 2012. From study entry, the number of night shifts was quantified for five consecutively increasing exposure periods: from the last year to the last five years.

Results: Overall 1,050 breast cancer cases were observed during follow-up. Risk of breast cancer was lower among women who worked night shifts during the last year compared with those who did not after adjustment for age, age at birth of first child, number of children, family history of breast cancer or ovarian cancer, oral contraception, hormone replacement therapy, other sex hormones, medications related to alcoholism, family educational level, mammography screening attendance (rate ratio (RR) 0.82, 95% confidence interval (CI) 0.71 to 0.96). No difference in breast cancer risk was observed between night shift work and other shift schedules when the last two to five years of exposure were considered. Working night shifts during the last five years showed an adjusted RR of 1.00 (95% CI 0.74 to 1.37). Comparable results were observed if we restricted analyses to women first employed in 2007 or later (inception population).

Conclusion: These findings do not show a short term effect of night shift work on breast cancer risk and do not support a promoter effect. These results are reassuring for the many women working night shifts, but only in the short run. It is still unclear if night shift work has long term effects on breast cancer risk.
Thematic Session II: Mechanisms - new perspectives linking shift work and chronic disease

Time: Wednesday, 10/Jun/2015: 10:30 - 12:30
Location: Room 1 (Conference room)
Session Chair: Sylvia Rabstein, Institute for Prevention and Occupational Medicine, Germany
Session Chair: Kristan Aronson, Queen's University, Canada
Is shift work linked with vitamin D deficiency?

Sylvia Rabstein¹, Sara Schramm², Beate Pesch¹, Lewin Eisele², Susanne Moebus², Raimund Erbel³, Nico Dragano⁴, Thomas Brüning¹, Thomas Behrens¹, Karl-Heinz Jöckel²

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Objectives
Various health outcomes, for example cancer or cardiovascular diseases have been associated with vitamin D deficiency. Vitamin D in humans is produced in the skin under ultraviolet B radiation or can be obtained through dietary intake. Shift work, especially long-term night work, has been hypothesized to increase the risk for chronic diseases. Among potential mechanisms linking shift work and disease, altered vitamin D levels due to reduced daylight exposure in shift workers may play a role. Here, we investigated the influence of current shift work on vitamin D concentrations in a cohort of elderly subjects from the general population.

Methods
The Heinz Nixdorf Recall (HNR) study is a population-based prospective cohort in the Ruhr area in Germany. Baseline interviews were conducted between 2000 and 2003. Baseline serum vitamin D concentrations were determined as 25-hydroxy-vitamin-D. Current employment in shift work at baseline was calculated from detailed shift work biographies in the 10-year follow-up between 2010 and 2014 for economically active participants. Associations between vitamin D and shift work were analysed with logistic models adjusted for age, month of blood collection, smoking status, body-mass index and stratified by sex using a threshold of 20 ng/ml.

Results
Preliminary results in 895 men (70 currently in shift work, 40 including night shifts) and 687 women (39 currently in shift work, 15 including night shifts) show a prevalence of vitamin D deficiency in 49.8% of men and 48.3% of women. Among night shift workers, 23 men (58%) and 10 women (66.7%) had a vitamin D deficiency. We did not find a significant influence of current shift work on vitamin D deficiency (OR 1.12 95%CI 0.66-1.89 for men, OR 1.04, 95%CI 0.52-2.08 for women), but higher risk estimates for current night work (OR 1.41, 95%CI 0.71-2.79 in men, OR 1.75, 95%CI 0.55-5.54 in women). Restricting the analyses to “dark” months (October till March) revealed higher estimates for female night-shift workers (OR 2.10, 96%CI 0.40-11.1 in women, OR 1.09 95%CI 0.42-2.84 in men). However, results were based on small numbers.

Conclusions
Non-significantly elevated risks for vitamin D deficiency were found with even higher estimates especially for female night workers in the dark season. Investigations of associations between vitamin D and shift work should imply a detailed analysis of sunlight exposure, chronotype, and characteristics of shift-work exposure.
**Association of night shift work with lifestyle factors**

**Beata Pepłońska**  
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**Background**  
Night shift work has been linked to some chronic diseases like cardiovascular and metabolic diseases and cancer. Modifiable factors such as smoking, physical activity, alcohol consumption and obesity contribute to the etiology of these diseases. Unhealthy lifestyle changes have been suggested to play a role in the development of potential health effects of shift work, and the evidence for the association between night shift work and lifestyle factors has been mounting.

**Methods**  
Physical activity, smoking, alcohol drinking and BMI were analyzed in two populations (each included current rotating night shift workers and day workers): 725 nurses and midwives (women), aged 40-60; and 605 blue collar workers (both women and men), aged 35-60. Information was collected through a questionnaire. The distribution of the lifestyle factors and body mass index (BMI) was compared between rotating night shift and day workers. Linear or regression analyses were run to assess their associations with night shift work.

**Results**  
Among nurses and midwives, current night shift work status was associated with higher total and work-related physical activity (PA), but lower recreational PA, with increased OR for recreational “inactivity” (OR=1.57, 95%CI:1.11-2.20). Current smoking was more common among night shift nurses and midwives than women working during the days only (34.7% vs. 26.2%, respectively), with higher prevalence of heavy smokers, i.e. persons smoking ≥15 cigarettes per day (16.1% vs. 9.2%). Current night shift work and its duration were consistently associated with obesity (BMI≥30kg/m²).

In the study of industry workers, the prevalence of current smoking among women was higher compared to former or never night shift workers (40.6% vs. 33.3% and 17.9%, respectively). The OR for alcohol drinking was reduced by approximately 50% (OR = 0.45, 95%CI:0.21–0.97) among the current female night shift workers compared to the day workers.

Current night shift work was associated with recreational inactivity (OR = 2.43, 95% CI: 1.13–5.22) among males. In addition, in this group we observed a statistically significant positive relationship between night shift work duration and BMI (p = 0.029).

**Conclusions**  
Both studies confirm the previous evidence highlighting poor lifestyle among night shift workers, with increased smoking, lower exercising and increased body weight. These findings provide important public health implications for the prevention of chronic diseases among night shift workers.
Shift work, cortisol, sleep disruption and metabolic syndrome
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Background
While basic science and laboratory studies have identified potential psychophysiological pathways linking work at night to adverse health impacts, few studies have elucidated and confirmed these pathways in various working populations, such as adult women. Moreover, few have addressed the complexity of the hypothesized relationships using multiple variables and biomarkers.

Objectives
Investigating potential pathways linking shift work and cardiovascular diseases (CVD), this study aims to identify relationships between shift work and the metabolic syndrome, a cluster of CVD risk factors, sleep disruption, and cortisol.

Methods
Women working in an acute care teaching hospital in Kingston, Ontario, Canada were asked to volunteer: the 330 participants included about half who worked a shift schedule including nights, and half who worked days only, although among the latter group many had worked night shifts in the past. Metabolic syndrome was determined based on anthropometric, clinical and serum measures. Participants completed a detailed questionnaire including information on chronotype and sleep quality (Pittsburgh Sleep Quality Index (PSQI)). Sleep duration and efficiency was determined from actigraph data obtained in an 8-day collection period. Cortisol production was determined from an analysis of spot urinary creatinine-adjusted cortisol levels collected over 48 hours that included night work for shift workers.

Results
Shift work is strongly associated with the metabolic syndrome (OR = 2.29, 95% CI: 1.12-4.70), and with poor sleep as indicated by the PSQI global score (OR=2.10, 95% CI: 1.20-3.65), poor sleep latency (OR=2.18, 95% CI: 1.23-3.87) and poor sleep efficiency (OR=2.11, 95% CI: 1.16-3.84). However, the relationship between shift work and the metabolic syndrome is not mediated by sleep latency or efficiency.

Results for cortisol will be presented.

Conclusions
Women working a rapid forward rotating shift pattern have a higher risk of the metabolic syndrome and poorer sleep quality, according to self-reported indicators of the validated PSQI, compared to women currently working during the day only.
Sleep, night shiftwork and breast cancer risk among women in Denmark

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Background
Various studies have relatively consistently shown that night shiftwork decreases sleep quantity and quality. The decreased daily length of sleep has been suggested as an independent cause of breast cancer due to lower production of melatonin and immune suppression, which both experimentally reduce cancer risk. However, only relatively few and partly conflicting epidemiologic studies exist. The aim of the present study is to elucidate associations between daily sleeping hours and breast cancer risk in day and night shift-workers and by different diurnal preference.

Methods
In total of 1157 women diagnosed with primary breast cancer (2000-2004), and 2658 randomly selected age matched controls participated in two independent nationwide case-control studies in Denmark. Information on hours of daily sleep the year before and 10 years before diagnosis/index date, the entire work history, including night shiftwork and potential risk factors for breast cancer (e.g. reproduction, BMI, alcohol, HRT, heredity and diurnal preference) was obtained by telephone interviews.

Results
Women who had ever had at least five years of night work reported significantly shorter sleep than day workers only, even decades after quitting night work. A U-shaped risk profile, adjusted for night work, was observed for breast cancer by hours of sleep 10 years prior to index date: Both women reporting less than 6 hours sleep and over 9 hours sleep were significantly associated with increased breast cancer compared to average length of sleep (7 hours). The results were only slightly affected by confounders and were roughly similar across study groups. However, some variation in risk was seen in people with morning, evening and mixed diurnal preference.

Conclusion
This study shows in line with previous studies that night shift workers sleep less than day works. Both short and long time sleepers show increased breast cancer risk after adjustment for night shift work, suggesting involvement of other mechanisms than melatonin, including inaccurate sleep assessment. Diurnal preference may be an effect modifier.
Thematic Session III: Shiftwork and pain

*Time:* Wednesday, 10/Jun/2015: 13:30 - 15:30
*Location:* Room1 (Conference room)
*Session Chair:* Dagfinn Matre, National institute of occupational health, Norway
HYPERALGESIA AFTER EXPERIMENTAL AND WORK-RELATED SLEEP RESTRICTION – experimental findings

Kristian Bernhard Nilsen1,2,3, Dagfinn Matre1
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Background
Sleep restriction is reported to increase the sensitivity to experimental pain. Whether sleep restriction due to night work has the same effect on pain sensitivity is not known. The aim of this study was to determine if night work leads to increased pain sensitivity, and to compare the effects with changes in pain sensitivity after experimental sleep restriction.

Methods
In study I, twenty-two healthy volunteers (14 females) and in study II 24 nurses (17 females) received experimental pain stimuli in the laboratory twice; after 2 nights with habitual sleep (study I and II) and after 2 nights of experimental 50% sleep restriction (study I) or after 2 nights of work with ad libitum compensatory day time sleep (study II). The order of sleep conditions was randomized. Sleepiness was measured by the Karolinska sleepiness scale (KSS) and the psychomotor vigilance test. Painful stimulation with heat, pressure and brief high-density electrical pulses were given. Pain-elicited cortical responses and event related desynchronization were measured. Endogenous pain inhibition was measured with a conditioned pain modulation paradigm. The effect of sleep restriction or night work on pain responses and pain modulation was analyzed using linear mixed models (LMM).

Results
Sleepiness and pain sensitivity ratings did not differ between study I and II after habitual sleep. Sleepiness increased both after experimental sleep restriction and after night work. The increase in sleepiness did not differ between study I and II. Both sensitivity to heat pain and pressure pain increased after experimental sleep restriction, but only heat pain sensitivity increased after night work. Our measure of endogenous pain inhibition increased after sleep restriction, as well as the magnitude of the cortical responses. The habituation of the cortical responses did not change after sleep restriction.

Conclusion
Both experimental- and night work-induced sleep restriction leads to increased subjective sleepiness and higher pain ratings of experimental heat pain, although not after work-induced sleep restriction for all pain stimulation modalities. The increased pain sensitivity is not explained by reduced endogenous pain inhibition. The increased cortical responses to painful electrical stimulation after sleep restriction is possibly related to changed processing within the somatosensory cortex.
Musculoskeletal pain and insomnia among workers of different occupations and work hours.
Claudia Roberta de Castro Moreno1,2, Suleima Vasconcelos1, Arne Lowden2, Elaine Marqueze3
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Background
Insomnia symptoms have been associated to increased chance of developing chronic pain. However, several studies demonstrate a bidirectional relationship between insomnia and pain and the present study aimed to evaluate the role of work hours and type of occupation possibly being mediators in this relationship within two studies.

Methods
The first study included 1592 workers (airline pilots, rural workers, production line workers, product quality control workers, and maintenance workers). Insomnia symptoms were measured using a validated index including seven questions from the Karolinska Sleepiness Questionnaire-KSQ (Nordin et al., 2013). The Nordic Musculoskeletal Questionnaire (Kuorinka et al., 1987) accessed musculoskeletal pain symptoms. In the second study, 1273 workers, 453 white collars and 220 blue collars, insomnia was estimated by six questions from KSQ, and musculoskeletal symptoms was self-reported.

Results
Prevalence of insomnia was 57.3%, musculoskeletal symptoms 72.3% and both outcomes 46.7%. Multiple regression analyses revealed that rural work and night work were the strongest predictors whereas airline pilot work was found to be a protective factor for both outcomes together (insomnia and musculoskeletal symptoms). In addition, musculoskeletal symptoms, respiratory, emotional and skin diseases as well as sedentary habits were predictors for insomnia. The predictors for musculoskeletal symptoms were digestive and metabolic diseases, having children less than 12 yrs., and drinking more than twice a week. Results from the second study showed prevalence for insomnia of 47.4% and 74.4% for musculoskeletal symptoms whereas both together were 38.7%. Multiple regression analysis showed that musculoskeletal symptoms, depression, gastrointestinal and allergies problems, and failure on stop drinking at least once were predictors for insomnia. Interestingly, night work was found to be a protective factor against insomnia in this study. On the other hand, the predictors for musculoskeletal symptoms were insomnia, depression, gastrointestinal and respiratory problems whereas working at night was not. When we looked at outcomes together, the predictors were depression, allergies and gastrointestinal diseases, and failure on stop drinking at least once past year.

Conclusion
Prevalence was high on outcome variables. Results were consistent with previous studies showing the reciprocal path of insomnia and pain. It seems work hours and type of occupation might play a role in the establishment of the direction of the relationship between sleep and pain.

References:
Nordin et al. Sleep and Biol Rhythms 2013.

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The comorbidity of headache and insomnia in the Nord-Trøndelag Health Survey

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Background
Headache and insomnia are common disorders in the general population. They are both associated with serious consequences for the affected individuals, such as increased morbidity, reduced quality of life and reduced working ability. Further, these conditions are costly for the society at large. Previous studies, mostly using a cross-section design, indicate that there is a relationship between headache and insomnia. Most of these studies have lacked diagnostic precision in the classification of headache, and few studies have measured sleep disturbances with validated instruments.

Method
The adult population of Nord-Trøndelag County of Norway has three times, with 11 years intervals, been invited to take part in a large epidemiological survey called the Nord-Trøndelag Health study (HUNT). These surveys give opportunity to study the relationship between headache and insomnia at a given time and over several years. We investigated the cross-sectional relationship between sleep disturbances and headache (diagnosed by neurologists) in a sub-population of HUNT 3. Furthermore, based on data from subjects that took part in both HUNT 2 and HUNT 3, we carried out two prospective studies evaluating whether 1) insomnia might be associated with increased risk of headache and 2) headache and chronic musculoskeletal complaints might be associated with increased risk of insomnia.

Results
In the first study we found a strong statistical association between headache and sleep disturbances. This association was somewhat stronger for migraine than tension-type headache, and most pronounced for chronic daily headache. In the second study we found that insomnia at baseline gave increased risk of headache at follow-up. This association was especially true for subjects with severe insomnia at baseline. The third study illustrated that headache and chronic musculoskeletal complaints gave increased risk of insomnia. We found at dose-response relationship between location and frequency of pain and risk of insomnia.

Conclusion
The results of this thesis indicate that there is a bidirectional causal relationship between insomnia and headache, and it seems as these two disorders reciprocally influence and exacerbate each other. These findings should motivate for treatment studies clarifying whether treatment of one disorder reduce the prevalence of the other disease and vice versa.
Sleep quality and low back pain - implications for shiftworkers

James Henry McAuley

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Low back pain is a common condition with serious consequences. Annual prevalence estimates are 40% and it is the leading cause of disability worldwide. Low back pain is associated with psychological distress and sleep disturbance, commonly reported by shiftworkers who are also at increased risk of low back pain.

The relationship between sleep quality and low back pain is poorly understood. For example the directionality of this relationship is unclear; it is not known whether poor sleep quality leads to more severe low back pain or whether low back pain leads to increased sleep disturbance. A clearer understanding of these relationships is likely to provide novel targets for interventions to improve shiftworker’s lives.

We investigated these relationships in a series of studies. First we investigated whether poor sleep quality was associated with more severe low back pain. We then investigated whether these relationships were bidirectional.

The first study used data from a randomised controlled trial. Each week for four weeks participants rated sleep quality over the past week and pain intensity over the last 24 hours. We modeled this relationship, controlling for symptoms of depression and low back pain prognostic factors.

1246 patients were included. We found a strong effect where for every 1-point (0-3) decrease in sleep quality, pain intensity increased by 2.08 units (95% CI: 1.9 to 2.1) on a 0-10 scale.

In the second study we recruited patients attending primary care. For 7 days and nights participants completed a sleep diary on waking to assess their previous nights sleep and their pain intensity and again prior to going to bed to assess their day-time pain intensity. We modeled the relationship between day-time pain intensity and sleep.

80 participants were included. We found that a night of poor sleep quality was followed by a day with higher pain intensity. Further, a day with higher pain intensity was associated with a decrease in the subsequent night’s sleep quality.

Conclusions
These findings demonstrate that sleep quality plays a critical role in the development and maintenance of low back pain. Furthermore there is a bidirectional relationship where poor sleep quality is associated with increased pain that is in turn associated with poor sleep quality. Future research is needed to determine whether improving sleep quality in patients with LBP leads to reductions in pain intensity. These findings are particularly relevant for shiftworkers who are at high risk of low back pain.
Oral Session 3A: Epidemiological studies

_Time:_ Wednesday, 10/Jun/2015: 16:00 - 17:00
_Location:_ Room 1 (Conference room)
_Session Chair:_ Johnni Hansen, Danish Cancer Society, Denmark
_Session Chair:_ Annina Ropponen, Finnish Institute of Occupational Health, Finland
How do different definitions of night shift affect the exposure assessment of night work?

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Background
Night shift is defined differently in most epidemiologic studies. Some studies describe an entire period within the “night”, whereas others specify a shorter period e.g. at least 3 hours of work between 24:00 and 05:00 as suggested as a standard by Stevens et al. (2011). Start and ending times have also been used. Such differences in exposure assessment may consequently influence the proportion of exposed and non-exposed study subjects and thereby affect the risk estimate in epidemiological studies. The aim of the present study was to show how different definitions of night work affect the proportion of shifts classified as night shifts in the Danish health care sector.

Methods
We counted the number of night shifts based on pay-roll data from the Danish Working Hour Database (DWHD) from 2007-2013 using seven different frequently used definitions of night shifts: 1) at least 3 hours of work between 24:00 and 05:00 (reference), 2) the entire period between 24:00-5:00, 3) the entire period between 24:00-06:00, 4) ≥ 3 hours between 23:00–06:00, 5) ≥ 1 hour between 01:00-04:00 hours, 6) beginning work after 19.00 and leaving work before 09:00 (graveyard shift), and 7) starting work after 22:00 hours (and before 6:00).

Results
More than 98% of the total night shifts were classified as night shifts by both the reference definition and definitions based on definitions including a specified period during the night (definitions 2-5). The corresponding overlap with definition 6, based on a starting and ending time of the shift was 82.6%. The reference definition and the definition specifying only a starting time for the night shift (def. 7) captured 68.4% of the same shifts.

Conclusion
Different definitions of night shift period affect the proportion of classified night shifts. The problem is minor when night shifts are based on definitions including a specified short period of night time (e.g. definitions 2-5), whereas studies based on other definitions (e.g. 7 and 8) may be less comparable.

Reference
A Conceptual Framework to Describe and Measure Shift Work in Epidemiological studies

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Background
Shift work is a multidimensional exposure and disrupts both lifestyle and circadian rhythms. Identifying which dimensions contribute most to shift work induced adverse health effects is important both from an etiological and a public health perspective. We developed a conceptual framework that describes the multidimensionality of exposure to shift work in order to optimally utilize future epidemiological studies through implementation of improved exposure metrics. Furthermore, this framework can be used to develop risk analyses through the use of Directed Acyclic Graphs. Finally, we also identified measurement methods that can optimally assess each of the identified exposure dimensions.

Methods
We conducted a literature review of epidemiological and animal studies to identify exposure dimensions and associated biological pathways. We structured the exposure dimensions and biological pathways to provide a clear overview of overlap and interactions. Measurement methods were primarily identified from existing epidemiological studies or studies focused on exposure assessment.

Results
The conceptual framework describes the wide range of (biological, social and behavioral) aspects and includes the following shift-work dimensions: disturbed social pattern, behavioral changes including diet and physical activity, disturbed sleep, nutrition at night, light at night, and sun exposure. We have identified a suite of tools which are capable of measuring these dimensions including traditional epidemiological methods (e.g. questionnaires), objective exposure measurement devices (e.g. actimetry and light sensors), and biological markers (circadian disruption).

Conclusions
Accurately measuring shift-work aspects in future research, using our conceptual framework, will result in innovative new research directions and might lead to promising clues for interventions. We used the conceptual framework to design a molecular epidemiology study among nurses which aims to identify the most relevant exposure dimensions of night-shift work using detailed questionnaires and objective monitors. In addition we aim to identify biomarkers for both acute and chronic circadian disruption associated to these specific night-shift work dimensions. Linking accurate measurements of specific night-shift work dimensions with biomarkers reflecting circadian disruption might provide insights into which dimensions are most harmful to human health.
Genetic susceptibility and night shift work in relation to breast, prostate and colorectal cancer in the MCC-Spain study

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Background
Epidemiological studies on shift work have shown an association between night shift work and breast cancer while less evidence is available for prostate and colorectal cancer. There is some evidence on genetic susceptibility and gene-environment interactions with genes in circadian pathways in relation to breast cancer. We explored in a joint analysis the role of circadian gene polymorphisms and night shift work in relation to risk of breast, prostate and colorectal cancer in a population-based study in Spain (MCC-Spain study).

Methods
We conducted face-to-face interviews with 2453 cases (869 colorectal, 872 breast, 712 prostate) and 2048 population controls in 5 areas of Spain. We assessed exposure to ever night shift work through lifetime occupational histories, sociodemographic and lifestyle information. We evaluated 248 SNPs from 22 genes involved in circadian rhythm regulation and melatonin metabolism using the Infinium HumanExome BeadChip supplemented with custom SNPs. We analyzed marginal shift work effects using unconditional logistic regression analysis adjusting for potential confounders. We examined gene-environment (GxE) interactions testing simultaneously the main effect and the GxE interaction (2 degrees of freedom test). We also performed a gene-based test using VEGAS (versatile gene-based association study).

Results
Twenty % of controls and 24% of cases had ever worked in permanent or rotating night shift for ≥1 year. Having ever worked for more than a year as a night shift worker was associated with an approximate 20% increased cancer risk (OR=1.18, 95%CI 1.02-1.37). Increased risks with night shift were also observed for each of the tumors independently. We observed nominal (p-value<0.05) main effects on cancer risk for 34 SNPs in circadian genes including CLOCK, CRY1, ARNTL, PER2, TPH2, TPH1, NPAS2, NR1D1, CYP2C19, NQO2. Nominally significant GxE interactions with ever night shift work, were found for 21 SNPs mostly in the above mentioned genes. In the gene-based analysis low p-values for main effects were found for PER2 (p=0.012), CRY1 (p=0.027) and TPH2 (p=0.018). However individual SNP/gene associations with cancer risk did not remain statistically significant after correction for multiple testing (Benjamini-Hochberg).

Conclusions
In this large population-based study we found an increase in breast, prostate and colorectal cancer risk in shift workers. We also found an indication of associations with several genes in circadian pathways and interaction of these genes with night shift work and cancer risk. Genotyping will become available for an additional 3000 subjects and updated results will be reported at the conference.
An intervention study on the effects of Boundaryless Work on work hours, job characteristics, motivation, and well-being among office workers

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A) Background

Due to technological innovations work in the 21st century can be organized more flexibly. This has resulted in an increasing prevalence of ‘Boundaryless Work’ conditions. One core characteristic of these work conditions is the so-called time- and place independent working.

The benefits such flexible work conditions could bear for employees are oftentimes accentuated. Employees’ increased control over their working times and the location of their work could help to improve the balance between work- and private live, and to reduce stress and fatigue as caused by work, while increased autonomy may lead to higher job satisfaction and performance. Contrastingly, however, increased flexibility may also result in loss of structure, high autonomy could increase stress, and the permeability of boundaries between work and nonwork domains could make work-home interference more likely to occur. Intervention studies that statistically assess the benefits and drawbacks of Boundaryless Work conditions are scarce but highly needed to test these conflicting possibilities.

The aim of our intervention study was therefore to assess the impact of Boundaryless Work on employees’ work characteristics, work hours, employees’ control over working time and location, and their relation with employees’ work-nonwork balance, well-being and job-related outcomes.

B) Method

We conducted a large-scale intervention study (total n ≈ 3,000) within a large, Dutch financial company that implemented Boundaryless Work. A pre-measure was applied (1-2 months before implementation), followed by two post-measures (respectively 4 and 10 months after implementation). A control group was adopted to control for the effects of time.

Online questionnaires were used to measure employees’ work characteristics (e.g., work demands, social support), work hours and location (e.g., total hours, overtime hours, working hours spent at home), control over working times and location, and various outcomes related to work-nonwork balance, health (e.g., fatigue, stress) and job-related outcomes (e.g., job satisfaction, performance).

Data collection is completed, and analyses are currently in progress.

C) Results

We will present findings on the impact of Boundaryless Work implementation on 1) employees’ working hours and work location, on 2) employees’ well-being and job related outcomes, and examine 3) the role of other job characteristics in determining these effects.

D) Conclusion

Implications of these findings will be discussed and recommendations for practice and future research will be provided.
Oral Session 3B: Health and disease II

*Time:* Wednesday, 10/Jun/2015: 16:00 - 17:00

*Location:* Room 2

*Session Chair:* Frida Marina Fischer, University of São Paulo, Brazil

*Session Chair:* Simone Visbjerg Møller, National Research Centre for the Working Environment, Denmark
PHYSICAL FITNESS AND DEGREE OF ATTENTION ON HEALTH AMONG MALE SHIFTWORKERS

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BACKGROUND
To explore the impact of rotating shift work on physical fitness among male employees of steel manufacturing group factories in southern Taiwan.

METHODS
In accordance with the project of 2010 National Fitness Test, 815 male employees of steel manufacturing group factories in southern Taiwan completed physical fitness test (body mass index, sit-and-reach, 3 minutes step test, 1 minute sit-ups) and filled out a questionnaire of need assessment developed by focus group interview in a previous study for health promotion activities. The results of physical fitness test were further categorized into five grades according to the national norm provided by Administration of Sport, Ministry of Education of Taiwan. Information of shift work, degree of attention to health, age, monthly average income, education, marital status, and smoking were collected with informed consent. After excluding subjects with missing data, total of 520 subjects were included in the analytic database of this study. The possible correlated factors of each dimension of physical fitness were explored by logistic regression for categorical variables and student test for numerical variables. All analyses were performed using SPSS software version 18.

RESULTS
There were significant difference in education level and monthly average income between the 201 subjects undertaking rotating shiftwork and the 319 subjects who did not work in night time during the fitness test project. With regards to degree of attention to health, chi-square test analysis showed that there were no difference between subjects with or without rotating shiftwork, but age, marital status, and monthly average income will make significant difference. After controlling factors of degree of attention to health, educational level, and smoking, the subjects undertaking rotating shift had an odd ratio of 2.3 in being overweight and an odd ratio of 1.8 in poor performance at 3 minutes step test comparing to subjects who did not work in night time.

CONCLUSIONS
This study showed that subjects undertaking rotating shiftwork were at higher risk of being overweight and under performance in 3 minutes step test, which were indicators of disadvantaged cardiovascular health. More effort and resources in health promotion should be allocated to employees undertaking rotating shiftwork in company health management policy.
Associations between ergonomic shift schedule criteria with health and work functioning for regular (semi-)continuous shift systems

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Background
Ergonomic shift schedule recommendations, like limiting the number of consecutive work days and shifts, have been formulated to mitigate the adverse effects of shift work on health and work functioning. So far these recommendations have not been examined among a large number of regular shift schedules that varies with respect to the scheduling recommendations to investigate their separate and joined contribution, while using the same outcome measures. The aim of this study is to examine associations between ergonomic shift schedule criteria, separately and combined, for shift-specific and generic health and work functioning measures. It is hypothesized that shift schedules meeting the ergonomic criteria, are associated with better health and work functioning.

Methods
In this cross-sectional study survey data were collected of 491 shift workers of 18 different companies working in 9 different regular (semi-)continuous shift schedules. Based on existing recommendations (1), eight shift schedule criteria were formulated. Sleep quality (Karolinska Sleep Questionnaire) and need for recovery (Dutch Questionnaire on Perception and Judgment of Work) were included as shift-specific measures and assessed per shift. General health (Short Form 12), fatigue (Checklist Individual Strength) and work functioning (Work Role Functioning Questionnaire) were included as generic outcome measures and assessed overall. The ergonomic criteria were analyzed separately and combined using multilevel linear regression models adjusted for age and gender.

Results
Analyzing the ergonomic shift schedule criteria separately resulted in ten associations with shift-specific sleep quality and need for recovery and ten associations with generic health and work functioning. Combining the criteria in one model, seven associations were found with shift-specific measures and none with generic outcome measures. No associations were found for night shifts, nor for the ergonomic criterion ‘direction of rotation’.

Conclusion
The hypothesis was largely not confirmed. A weak but positive relation was found for ergonomic shift schedule criteria with shift-specific and generic health and work functioning measures. Although some associations were found when analyzing the criteria separately, only a few associations remained significant when combining the ergonomic criteria in one model. The healthy worker effect, schedules that already met the ergonomic criteria, limited variation between included schedules and the cross-sectional design might explain the results. Longitudinal research is needed to verify the results over time.

References
Effects of shift schedule design on public transport drivers’ disability for service over the working life
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The public transport sector in Germany and other countries shows high levels of sickness absence and work-related health problems of drivers. However, little is known about the current prevalence and reasons of permanent and temporary disability for service (PDS, TDS) in public transport drivers in Germany.

Therefore, the aims of this study were to (1) investigate which work hour and workplace characteristics are related to an increased risk of PDS/TDS, and (2) examine the health risks of different shift schedules and workplace characteristics over the course of the working life in public transport drivers.

The study design included an online survey of n=1,419 active and retired drivers in Germany (88% male, 13% retired drivers, mean age 48 years) conducted in 2013. It included questions on work history (retrospective), personal and workplace characteristics, occurrence of medically diagnosed PDS and TDS (including the year of the diagnosis), and usual work hours (e.g., direction and speed of shift rotation, number of work hours, split shifts, and work hour control).

The prevalence of PDS and TDS was calculated. The risk of PDS or TDS over the course of the working life was estimated using survival analyses, comparing sub-populations with different shift schedule characteristics.

The prevalence was 5% for PDS and 29% for TDS. While PDS was mostly related to poor ergonomic workplace design (e.g., no ergonomic seats), lack of control over working hours, high number of work hours, and frequent split shifts, TDS was clearly affected by the direction and speed of shift schedule rotation. Compared to drivers with forward rotated systems, those with other rotation directions showed earlier diagnoses of TDS in their career, and had a higher risk of developing TDS (Hazard Ratios (HR): backward 2.20 [95% CI: 1.05-4.60], mixture of forward and backward 2.41 [1.12-5.14], no clear rotation pattern 2.29 [1.09-4.80], permanent shifts 3.23 [1.57-6.67]). Regarding rotation speed, highest risks were found for permanent shifts and a mixture of fast and slow rotation, followed by fast rotation. Against expectations, slow rotation showed the lowest risk of TDS.

The results of this study, thus, confirm ergonomic recommendations for forward rotated shift systems, and argue against irregular and permanent shift schedules in this population. Processes underlying permanent and temporary disability for service might differ and should be further investigated. Prevention measures, especially participatory, ergonomic shift scheduling and workplace design may help to increase work ability over the working life.
Work schedule and self-reported hypertension – the potential beneficial role of on-shift naps among night workers
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Background
There are controversial results on the association between shift work and hypertension or blood pressure increases, which could partly be ascribed to sleep restriction. The reduction in diastolic blood pressure is among the potential beneficial effects of napping during night shifts (Hirosi, 2005). The present investigation deals with self-reported information on napping and hypertension at real life settings, aiming at (i) comparing the prevalence of hypertension among work schedules, (ii) testing the association between on-shift nap and hypertension, and (iii) analyzing sleep features of nappers and non-nappers in order to clarify the association between napping and hypertension.

Methods
This cross sectional study was performed at the 18 largest public hospitals in Rio de Janeiro, Brazil in 2010-2011 (N=2,588 female registered nurses). They mostly worked twelve-hour fixed day (7:00 to 19:00hr) or night shifts (19:00 to 7:00hr), with one or two days off. Nurses were informally allowed to nap for up to three consecutive hours during working nights. Data collection was based on a self-filled questionnaire concerning sociodemographic, work- and sleep-related variables (napping, sleep duration, insufficient sleep, unsatisfactory sleep, sleepiness, and insomnia). Information on hypertension was based on self-reported physician diagnosis of hypertension. Results Mean age was 39.9 (SD= 10) years. Most workers (64.3%) had more than one job in nursing; mean weekly work hours was 54.8 hr. Higher prevalence of hypertension was observed for both current and former night workers, compared with day workers with no experience on night shifts (OR=1.69 and OR=1.39, respectively), after adjustment for age, physical activity, smoking, alcohol consumption, sleep duration, weekly work hours, BMI, and race/ethnicity. Among night workers, on-shift naps reduced the odds of reporting hypertension (OR=0.79; 95% CI 0.63-1.00), compared to non-nappers. Nappers (n=721) and non-nappers (n=759) did not differ as to sleep features, except for insomnia (prevalence of 27% and 43%, respectively; p<0.001). An interaction was observed between napping behavior and insomnia (p=0.037), thus analyses were stratified according to insomnia complaints. A significant association between napping and the prevalence of hypertension was restricted to workers with insomnia (OR=0.58), whereas odds for nappers without insomnia corresponded to 0.85.

Conclusion
On-shift nap may be a protection factor for hypertension, particularly among insomniacs. Further clarification of this topic can benefit from the simultaneous automatic monitoring of blood pressure and sleep. Aspects related to melatonin secretion, blood pressure control and dipping pattern are likely to be involved in the relation between on-shift nap and blood pressure.
Poster session 2

*Time:* Wednesday, 10/Jun/2015: 17:30 - 19:30

2a: Health and diseases
2b: Sleep and fatigue
2c: Social factors
2d: New trends in shiftwork and working time research
A prospective study of the association between shiftwork and prescription drug use
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Background
Evidence of the association between shiftwork and impaired health / wellbeing has previously been obtained from both self-report measures of health and objective measures such as medical diagnoses. However, there is a lack of evidence regarding the links between type of work schedule and prescription drug use. In the current study, national drug prescription data was linked to survey data obtained from a large population of public sector employees, in order to examine the links between shiftwork involving night duties and eight chronic medical conditions.

Methods
We analysed data from the Finnish Public Sector Survey (FPSS) of local government employees in 10 towns and 21 public hospitals in Finland (N = 53,275). We compared shift workers (participants who reported working shifts including nights) with a sample of day workers (participants who only ever reported doing day work). Day workers were selected on the basis that their occupation should match that of at least one of the night workers. Separate analyses were conducted for drugs related to each of eight categories of disease, namely alimentary tract; type-2 diabetes; hypertension; high cholesterol (statins); musculo-skeletal pain; metabolic disorders; sleep problems (hypnotics and sedatives); and a combined category of anxiety or depression. The analyses were based on identifying the first incidence of use for each participant i.e. analysis of ‘any incident use’. Every analysis included adjustments for the following covariates: Model 1 - age, sex, education, marital status, size of apartment (a correlate of income); Model 2, Model 1 + BMI, physical activity (met days), smoking status, self-rated health and geographical region. Participants were excluded if they had any recorded purchase of the drug in question prior to follow-up. Cox proportional hazard regression models were used to compute hazard ratios with 95% CIs.

Results
In Model 1, shiftworkers were more likely to use medications for hypertension, metabolic disorder, and hypnotics and sedatives. They were less likely to use medication for pain, and anxiety / depression. In Model 2, shiftworkers were more likely to use hypnotics and sedatives, but less likely to use medication for pain, and for anxiety / depression.

Conclusions
The results provide only limited evidence of greater prescription drug use among those who work shifts that include nights. However, the greater use of hypnotics and sedatives by shiftworkers is a relatively unique finding, in so far as it suggests an association between night work and clinically significant levels of sleep disturbance.
Night work and risk of breast cancer defined by receptor status: results of the CECILE study
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Objectives
In 2007, the International Agency for Research on Cancer (IARC) classified “shift work that involves circadian disruption” as probably carcinogenic to humans. Since then, several studies on night work and breast cancer risk have been published, but only few have reported data according to the hormonal receptor status. We explored this association in the CECILE study by tumor subtypes defined by Estrogen (ER), Progesterone (PR) and Human Epidermal growth factor (HER2) receptor status.

Methods
Lifetime history of night work was obtained in a population-based case-control study on breast cancer including 1232 cases and 1317 controls. ER/PR status and HER2 status were obtained in 1133 and 894 cases, respectively. Associations between night work and breast were studied after stratification by receptor status using multivariate unconditional logistic regression models.

Results
Ever working at night was associated with an OR for breast cancer of 1.27 [0.99–1.64], and 1.35 [1.01–1.80] in women who worked during overnight shifts. These ORs were slightly higher for ER+/PR+ breast cancer but differed only slightly with ORs for ER-/PR- cases. ORs for HER2+ breast cancer cases increased to 1.83 [1.08-3.12] in women who worked at night and 2.29 [1.28-4.10] in women who worked on overnight shifts. The risk of HER2+ tumor increased with the number of nights per week, but not with the number of years of night work. For breast carcinomas that were positive for HER2, ER and PR, the OR was 3.24 [1.66-6.31] in women who ever worked at night, and 4.46 [2.19-9.08] in women who worked on overnight shifts.

Conclusion
Our results suggest that night work is more strongly associated with breast cancer subtypes that are positive for ER, PR and HER2. The influence of HER2+ tumor on the ORs was particularly noticeable in our data and deserves confirmation in other studies.
Mental health problem in Korean shift workers: Data from the Korea National Health and Nutrition Examination Survey (KNHANES IV - V), 2007-2012

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Background
Shift work may impact on workers’ health. Under the body of evidence of adverse health effects, Korean society introduced a regular medical examination by law from 2014 to find and prevent health effects. However, still mental health problems did not get much attention. In the modern society, the importance of mental health is increasing. Therefore, I would like to explore mental health effects in shift workers in Korea.

Methods
In this study, data from the Korea National Health and Nutrition Examination Survey (KHNAES) 4th-5th (2007-2012) was analyzed. KHNAES survey was designed by complex sampling design. To reveal mental health effects, self-rated stress, depressed mood, and suicidal ideation. In the final analysis, 7,431 full-time workers (age; 20-65 years) were included. The study population was divided day worker group and shift worker group. To consider the gender difference, mental health effects in shift workers were analyzed after gender stratification.

Results
In the final analysis, 4,543 (61.1%) male workers and 2,888 (38.9%) female workers were included. The number of day workers was 4,543 (61.1%) and that of shift workers was 1,069 (14.4%). In male workers, the proportion of high stress group was significantly high in day workers (29.2% vs 24.8%, p=0.0466). The proportion of depressed mood is higher in shift workers (6.3% vs 7.6%), and that of suicidal ideation was higher in shift workers (5.4% vs 7.3%, p=0.0824). In female workers, the proportion of high stress group was high in shift workers (36.4% vs 37.5%). The proportion of depressed mood is higher in day workers (12.9% vs 12.0%), and that of suicidal ideation was higher in shift workers (14.5% vs 17.4%). Furthermore, the proportion of mental health effects was significantly higher in female workers. After controlling related factors, the odds ratio (OR) of self-rated stress, depressed mood and suicidal ideation in shift workers were 1.08 (95% confidence interval (CI), 0.83-1.42), 0.97 (95% CI, 0.65-1.47), and 1.23 (95% CI, 0.87-1.75), respectively.

Conclusions
This study did not reveal that shift work may have strong impact on mental health effects. However, the proportion of depressed mood and suicidal ideation were higher in male shift workers and that of self-rated stress was higher in female shift workers. Moreover, mental health effects of shift work may have a bigger burden to female shift workers. Further studies are needed to investigate the background mechanism in female shift workers.
Night shift work and prostate cancer risk: preliminary results from the EPICAP study

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Background
In 2007, the International Agency for Research on Cancer (IARC) classified “shift work leading to a disruption of circadian rhythm” as probably carcinogenic to humans based on sufficient evidence from experimental animal models but limited evidence from epidemiological studies in humans. Despite a large literature for breast cancer, very few studies examined the role of night shift work in prostate cancer with contradictory results. In this context, we investigated the role of night shift work in the occurrence of prostate cancer based on data of the EPICAP study.

Methods
EPICAP is a population-based case-control study conducted in the département of Hérault in France. Eligible cases are all cases of prostate cancer newly diagnosed in 2012-2013 in men less than 75 years old and residing in the département of Hérault at the time of diagnosis. Controls are men of the same age as the cases and living in the département of Hérault, recruited in the general population. The data collection will end at the end of December 2014. Up to now, 812 cases and 867 controls have been included. The cases and controls have been face-to-face interviewed by research clinical nurses using a standardized questionnaire. The questions focus primarily on usual socio-demographic characteristics, personal and family medical history, lifestyle, leisure activities and lifetime occupational history including detailed information on work schedules (night or rotating shift work) for each job held for more than 6 months.

Preliminary analyses were conducted using unconditional logistic regression adjusted for age, familial history of prostate cancer and potential confounders such as tobacco, alcohol and bmi.

Results
Forty five percent of the cases and fifty percent of the controls had ever worked at night or with changing work schedules (OR=0.83 [0.68-1.02]). Night work defined as at least 3 nights per months during at least one year was not associated with prostate cancer (OR=0.94 [0.74-1.19]), without increased risk with increased duration of night work. In contrast, we observed a moderate increased risk in men with aggressive prostate cancer (Gleason ≥ 7) (OR=1.26 [0.85-1.85] increasing with increased duration of night work (OR=1.48 [0.91-2.41] for more than 15 years of night work corresponding to the median of night work duration in controls).

Conclusion
These preliminary results are to deepen. Analyses about night work indicators (number of hours per night, number of nights or number of consecutive nights) and rotating shift work indicators are still in progress.
BREAST CANCER RISK AND EPIGENETIC EFFECTS OF ROTATING NIGHT SHIFT WORK AND LIFESTYLE –
AIMS AND METHODS
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Background
Despite increasing evidence that suggests a link between night shift work and breast cancer risk, the mechanisms underlying this association remain to be elucidated. It has been suggested that working at night may contribute to epigenetic changes in the circadian rhythm genes. The main aims of the study are to investigate the association between night shift work and breast cancer risk and to study epigenetic changes (levels of 5-methylcytosine in the promoter regions of genes) related to night shift work.

Methods
The study hypotheses will be tested based on data and DNA samples from two populations: 705 healthy women aged 40-60 selected from the Local Registry of the Chamber of Nurses and Midwives in Lodz (participants of a Polish cross-sectional study on nurses and midwives working at the moment of recruitment) and 563 women with breast cancer and 619 controls from a case-control study nested in the Norwegian nurses cohort aged 35-74. The project is organized into five thematic workpackages (WP). WP1 and WP2 will aim at determination of global methylation and promoter methylation status for core circadian genes, melatonin receptor genes, estrogen and progesterone receptor genes and cell cycle regulatory genes. In the Norwegian study, methylation levels in DNA from breast cancer cases and controls will be compared. In both the Norwegian and Polish study, the effects of night shift work on epigenetic changes will be analyzed. Workpackages WP3-WP5 will address associations between lifestyle factors (diet, alcohol consumption, smoking physical activity), steroid hormones, sleep deprivation and methylation of circadian rhythm genes and cell cycle regulatory genes in Polish nurses and midwives.

Results
DNA was isolated from 705 blood samples (in the Polish part of the study) and 1182 saliva samples (in the Norwegian part). Epigenetic analyses of the methylation status of the promoter in the core circadian genes (PER1, PER2, PER3, BMAL1, CLOCK, CRY1, CRY2, NPAS2), cell cycle regulatory genes (TP53, CDKN1A, CDKN2A, RB1, BRCA1, BRCA2), melatonin receptors genes (MTNR1A, MTNR1B), and sex-hormone receptor genes (ER-a, ER-b, PR) are in progress.

Conclusion
This exploratory study will investigate a novel mechanism by which night shift work may influence breast cancer. The topic is of high importance given that as many as ca. 20% of employees work on night shifts and breast cancer is the most common cancer among women.
The Assessment of Work Endurance in European countries

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ABSTRACT (for oral or poster presentation)

Background
An important part of the disability benefit assessment by insurance physicians (IP’s) in the Netherlands is the evaluation of work endurance (WE) i.e. the number of hours per day or per week a disabled person is able to work in otherwise suitable work. However, there’s a discussion on the definition of limited WE and methods to assess it lack a scientific basis. As a result, inter-rater reliability between Dutch IP’s assessing WE is low.

In 2013 a research project was started in the Netherlands aiming to better define and operationalize the concept of WE, to identify methods potentially suitable to assess (impaired) WE, and to develop and validate a method to assess WE. The present study is a first step in this project. It aims to explore whether the assessment of WE is part of the assessment of work disability in other European countries and if so, how impaired WE is measured. Exploring and discussing similarities and differences in the assessment of (normal and impaired) WE in an international context, may help to better define and operationalize the concept and to develop valid methods to assess it.

Methods
Representatives from member countries of the European Union of Medicine in Assurance and Social Security (EUMASS) completed a questionnaire, starting with the question whether the disability assessment includes the evaluation of WE. The questionnaire contained open-ended follow up questions on the definition, operationalization and the assessment of WE in the practice of professionals, i.e. IP’s assessing work disability benefit claims, and on the content of available guidelines. Selected representatives from countries which assess WE will be contacted by email for in-depth interviewing on the assessment of WE.

Results
24 Representatives from 16 member countries completed the questionnaire. In 13 out of 16 member states WE is assessed. In almost all countries WE is assessed by a clinical test, in 5 countries self-report questionnaires are used. Physical and mental disorders are most frequently reported as accepted causes for restricted WE.

Conclusion
In 13 member countries WE is part of assessment of work disability Physical and mental disorders are accepted causes. Methods of WE assessment differ per country.
Interaction between job stress and shift-working on CVD risk factors: A longitudinal Study on Employees of Polyacryl Iran Corporation Company

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Objective
Shift-work is highly prevalent in industrialized societies especially night shift. Job stress is one of established CVDs risk factors which affected heart diseases through two direct and indirect mechanisms. The psychosocial stress of work in Iran and its interaction with shiftwork has not been focused on many scientific studies. This study was conducted to investigate health aspects of stressful work characteristics and its interaction with shift working on cardiovascular disease risk factors.

Method
This is a prospective cohort study which carried out on 227 (13.6% of 1,665 employees) from 2010 to 2012 employees of Polyacryl Iran Corporation Company. A self-administered questionnaire was used to measure background and shift working variables and the Farsi version of Siegrist's ERI questionnaire to measure job stress. Medical examination including assessments of height, weight, blood pressure and lipid profile were collected at pre-employment, baseline and 3 times in a 6-months interval at the time of completing the questionnaires. A two-level linear regression model was applied to CVD risk factors as outcome variables to assess the effect of job stress, shiftwork and their interaction adjusted for confounding factors using STATA 13.

Result
Shift working including night shift was dominant by 78%. Mean scores of effort, reward, and overcommitment were 10.7 (SD=3.6), 41.4 (SD=9.2), 14.1 (SD=2.6) at baseline. Adjusted results for smoking, pre-employment height, weight, glucose, triglyceride, cholesterol, SBP and DBP showed age appeared to be a significant predictor of longitudinal change in all outcome variables: BMI, SBP, DBP, LDL, total cholesterol, and triglycerides but not HDL, shiftwork only predictor of DBP (β=2.7 mmHg, p=0.011, 95% CI: 0.6 - 4.7); reward only predictor of longitudinal changes in BMI (β=-.01, p=0.012, 95% CI: -0.02, -0.002); effort predictors of LDL (β=-3.7, p=0.026, 95% CI: -6.9, -0.44) and HDL (β=0.3, p=0.004, 95% CI:0.10, 0.51), and overcommitment a predictor of HDL (β=-0.45, p=0.003, 95% CI:-0.75,-0.15). There was no any interaction effect between shift work and job stress.

Conclusion
This study provided strong evidence that age is a longitudinal predictor of CVD risk factors; shiftwork was only a predictor of DBP. There was no any interaction effect between shift work and job stress.
Work-time for health

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Background
The World Health Organisation as well as national agencies are encouraging workplaces to provide health promoting activities for their workers. Some state and territory governments in Australia received funds from the Australian National Preventive Health Agency to support small and medium sized workplaces to implement healthy promoting activities with small financial incentives and access to a facilitation service. However, workplace uptake and worker participation has been lower than anticipated.

Methods
We conducted case studies in small and medium sized businesses in the region of Canberra, Australia. Managers and workers in a variety of positions were asked about their perception of the role of workplaces in maintaining or improving the health of workers, what they thought their workplace was doing that was health promoting, and what they would like their workplaces to do. Qualitative analysis of 40 in-depth interviews investigates their perceptions and experiences of workplace health promotion.

Results
The time and monetary costs of health promotion were an integral consideration both for managers and staff, however, they differed in the ways these costs were considered. In terms of offering health promoting activities, small business managers in particular were more concerned about additional time costs of: providing services, affecting business viability and interrupting core business. Time costs arose from organising and synchronising staff for activities, especially for casual or part-time staff, but these time costs were not included in any staff job description. Overall managers differed in their views on whether staff should participate in health activities in paid work or personal time and their willingness to pay for a health promotion activities. Time was also central to workers’ decisions to participate in workplace health promotion. They were concerned about: time taken from main work duties, difficulties with scheduling participation, and whether they were expected to use their paid or personal time.

A conceptual model illustrating the tensions between the financial and temporal considerations of managers and workers regarding workplace health promotion will be presented.

Conclusion
Health promotion at work poses multiple challenges to managers and workers, with the time costs being more difficult to resolve than financial costs. Activities which are offered in paid work-time, are most acceptable to workers, hence have the highest participation, but are costly to business. Along with providing financial incentives, supporting workplaces with practical help and information resources would minimise the time it takes to plan and maintain health promoting activities.
Night shift duration and two types of workload among nursing home care workers: effects on disabling back pain, insomnia, and psychological distress

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Background
Principal determinants of healthy shift schedules relate to both duration of work and workload, particularly on the night shift. The assessment of workload is usually made by self-report, but the objective assessment is also called for. We tested interactive influences of night shift duration and workload (measured subjectively and possible objectively) upon health of nursing home care workers.

Methods
A total of 2,380 care workers (mean age 36 ± 12 years; 66% of women) working at elderly care facilities participated in this questionnaire study (response rate = 72%). We measured anonymously shift schedule characteristics, workload, disabling back pain, insomnia, psychological distress (K6 ≥ 5), and other relevant variables. Night shift duration was divided into three levels: ≤ 9 hours, 9.1-15.9 hours, and ≥16 hours. Two types of workload on the night shift were assessed here: (1) Perceived workload by Standard Shiftwork Index and (2) Number of residents per care worker on a night shift as a potential objective measure. Each workload measure was categorized into two (low and high) levels by median [(1) 28, (2) 20]. We created 6 groups according to both night shift duration (3 levels) and workload (2 levels each). Multivariate logistic regression analysis was used to examine how night shift duration and workload were associated with three dependent measures while controlling for age, gender, and weekly work hours.

Results
(1) Perceived workload: Disabling back pain was significantly more reported as night shift duration got longer when perceived workload was high (adjusted odds ratio, aOR: ≤ 9 hours & low workload = 1.0 [reference], ≤ 9 hours & high workload = 1.1, 9.1-15.9 hours & high workload = 1.7, ≥16 hours & high workload = 1.9). Insomnia was found to be generally higher with high workload independent of night shift duration, and significantly higher aOR was observed for the ≥16 hours & high workload group. Psychological distress was significantly greater with high workload despite the duration of night shift. (2) Number of residents per care worker: Influences of night shift duration and this workload were less clear up to 16 hours.

Conclusion
These data suggest that compared to the number of residents per care worker, the perceived workload may help to determine the influences of the duration of night shift on care workers’ health. The number of residents per care worker could inform explicitly the maximum limit of the night shift duration.
Cumulative exposure to shift work and sickness absence: associations in a five-year historic cohort

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Background
Although shift work in relation to sickness absence has been studied before, its association remains unclear. This study aims to investigate the associations between cumulative exposure to different types of shift schedules and cumulative exposure to night shifts on the one hand, and the number of sickness absence episodes and long-term sickness absence on the other, among ground staff employees of a large international airline company.

Methods
This study is part of the MORE study, a five-year historic cohort. The study population consisted of 7,562 ground staff employees. For each employee, work schedules and sickness absence days during 2005 to 2009 were obtained from company records. For the exposure to different shift schedule types, and exposure to night shifts during 2005 to 2008, the association with long-term sickness absence (>7 consecutive sickness absence days) and the number of sickness absence episodes during 2009, was calculated using logistic and Poisson regression analyses. Socio-demographic variables, work-related variables, job classification variables, and previous sickness absence days were regarded as confounders.

Results
After adjusting for previous sickness absence and job classification variables, only the group of employees that switched into working in a three shift schedule, showed a significantly increased risk for long-term sickness absence (OR=1.31, 95%CI 1.02-1.69). Night shift exposure was not significantly associated with long-term sickness absence. Compared to day work, exposure to shift work was negatively associated with more sickness absence episodes. Employees who were exposed to more than 46 night shifts also showed a lower risk for more sickness absence episodes, compared to employees who were not exposed to night shifts. Subgroup analyses showed that single employees and employees without children had an increased risk for long-term sickness absence when exposed to a two-shift schedule, and when they changed between shift schedule types during the exposure period.

Conclusion
Shift work was only associated with future long-term sickness absence when employees started working in a schedule that included nights shifts. Problems adapting to the new shift schedule may have led to sleep problems, fatigue and subsequent sickness absence. Future research should explore the influence of household composition, and take into account both previous sickness absence and psychosocial and physical work factors to obtain a good estimation of the association between shift work and sickness absence.
Process Evaluation of a tailored mHealth intervention aiming to reduce fatigue in airline pilots

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Background
MORE Energy is a mHealth intervention, which aims to reduce fatigue and improve health in airline pilots. The primary objective of this process evaluation was to assess the reach, dose delivered, compliance, fidelity, barriers and facilitators, and satisfaction of the intervention. The second objective was to investigate associations of adherence to the intervention with compliance and with participant satisfaction. Thirdly, we investigated differences between the subgroups within the target population.

Methods
The MORE Energy intervention is a smartphone app, supported by a website. It consists of advice on optimal light exposure, sleep, nutrition, and physical activity, tailored to flight and personal characteristics. The reach of the intervention was determined by comparing the intervention group participants and the airline pilots who did not participate. The dose delivered was defined as the total number of participants that was sent an instruction email. Objective compliance was measured through the control management system of the application. To determine the fidelity, an extensive log was kept throughout the intervention period. Subjective compliance, satisfaction, barriers and facilitators, and adherence were assessed using online questionnaires. Next, associations between the extent to which the participants applied the advice in daily life (adherence), compliance, and satisfaction were analysed. Finally, outcomes of participants of different age groups and haul types were compared.

Results
Reach was 22% and dose delivered was 99%. Of the intervention group participants, 81% consulted any advice, while 17% did this during more than four weeks. Fidelity was 67%. The participants rated the intervention with a 6.4 (sd 1.6). Adherence was not associated with compliance, but was associated with satisfaction (p≤0.001). Pilots of 35 to 45 year old were significantly more interested in advice regarding physical activity than their colleagues, and shorthaul pilots were more interested in advice regarding nutrition compared to longhaul pilots.

Conclusion
The MORE Energy intervention was well received, resulting in a high reach and dose delivered. The compliance and satisfaction scores indicate that engagement and functionality should be enhanced, and the content and applicability of the advices should be improved to appeal all subgroups.
Systematic review of the relationship between quick returns and health-related outcomes

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Objective
The aim of this study was to systematically review literature published investigating the relationship between quick returns (i.e., 11.0 hours or less between two consecutive shifts) and outcome measures ranging from health, sleep, functional ability and accidents.

Methods
Systematic searches were carried out in the databases Web of Science, Pubmed and PsycINFO. A total of 22 studies published in 21 articles were included in this review.

Results
Quick returns were associated with, or the cause of, shortened sleep duration, more disturbed sleep, and in most cases increased reports of sleepiness and fatigue. Three types of quick returns were differentiated in this review (from evening to morning/day, night to evening, morning/day to night shifts) where sleep duration and sleepiness appeared to be differently affected depending on which shifts the quick returns occurred between. There are conflicting and negative findings concerning the relationships between quick returns and physical and mental health-related outcomes, and between quick returns and the balance between work and private life.

Conclusions
There were clear indications of detrimental effects of quick returns on proximate problems (e.g., sleep, sleepiness and fatigue), although the association with more chronic outcome measures (physical and mental health and work-life balance) remained inconclusive.
Recovery from work relates to quality of shift workers’ nutrition
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Background
Shift work results in sleep loss, decreased alertness and fatigue in many workers. Shift workers’ proper recovery from irregular working hours can prevent sleep disorders and maintain healthy lifestyle. In the present study, our aim was to determine how the ability to recover from work associated with food intake in shift working employees in an airline.

Methods
Study participants were shift working men (n=416) and women (n=372). Mean age was 46.5. Working times were as follows (in men and women, respectively): 2-shift work 30% and 9%, 3-shift work 54% and 28%, night work 2% and 0%, flight work with crossing time zones 10% and 55%, flight work without crossing time zones 4% and 8%. Of all participants, 11.5% worked part-time. Participants completed comprehensive questionnaire including questions in lifestyle, work, sleep, and nutrition. Ability to recover from shift work was assessed by the 11-item Need for recovery (NFR) questionnaire with rated 4-point scale from 1 (never) to 4 (always). High scores reflected poorer recovery from work. Food intake during the past month was estimated using a validated 16-item food intake questionnaire. Participants were divided into groups based on their consumption of selected foods: vegetables, fruits, confectionaries, sweets (daily vs. less than daily users) and fast food (weekly vs. less than weekly users). Variance analysis was used to compare the need for recovery score between the food intake groups separately for men and women. Analyses were adjusted for potential confounders (age, education, working time).

Results
Men, who consumed vegetables daily, had lower NFR points than men who did not consume vegetables daily (20.1 vs. 21.2 p=0.02). Daily sweets consumption associated with higher NFR points in men (21.7 vs. 20.2, p=0.008) compared with participants who did not consume sweets daily. In women, weekly consumption of fast food was associated with higher NFR points (23.6 vs. 21.7, p=0.005). Results remained statistically significant after adjustments for education, age, and working time.

Conclusion
Our results showed that shift workers who reported that they recover well from work during their free time tended to choose healthier food items compared with those who reported poorer recovery. Especially consumption of sweets was increased when recovery from shift work was poor. Taken together our results suggest that decreased recovery from work can have a negative impact on the quality of shift workers’ nutrition.
The association between melatonin and sleep quality among female hospital workers
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Background
Current epidemiological research suggests that shiftwork may be a risk factor for cancer, cardiovascular disease, diabetes, and the metabolic syndrome. The etiological mechanisms for these associations are complex and largely unknown, but a potential pathway may be through the effect of nighttime light exposure on melatonin suppression and sleep disturbance. Melatonin rhythms tend to exhibit a close association with sleep cycles, with peak melatonin observed at night during usual sleeping hours, implying an important link between melatonin production and sleep. There is evidence indicating that shiftworkers suffer from sleep disturbance; however, a causal association between shiftwork and melatonin suppression has been less conclusive. The primary objective of this study is to assess the association between melatonin production and sleep disturbances among female shiftworking nurses compared to other female hospital workers to explore a potential pathway in which shiftwork is a risk factor for cancer, cardiovascular disease, diabetes and the metabolic syndrome. The secondary objective is to assess the validity of self-reported sleep quality through comparisons to objective accelerometer readings.

Methods
An observational study was conducted among female nurses (n=330) who have been regularly employed for at least ten years at Kingston General Hospital. Over an 8-day study period, participants wore accelerometers during waking and sleeping hours and completed the Pittsburgh Sleep Quality Index. Participants also provided 48-hour urine samples in which 6-sulfatoxymelatonin concentrations were measured. Detailed information about current and previous shiftwork patterns, including length of employment, duration of shifts, and part-time/full-time status was determined through interview.

Results
Analysis is underway and results will be presented.

Conclusions
A greater understanding of the association between melatonin suppression and poor sleep quality as a potential pathway in which shiftwork is a risk factor for cancer, cardiovascular disease, diabetes and the metabolic syndrome will lead to improvements in primary prevention measures and healthy workplace policies
12-hour shift schedule in the energy industry – a nine-year follow-up
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Background
The purpose of this study was to investigate the effects of a 12-hour shift schedule, and to follow the stability of these effects on the sleep, vigilance, and work ability of process operators in two Finnish nuclear power plants.

Methods
The 12-hour shift system had two day shifts (07.00–19.00), and two night shifts (19.00–07.00) in a row, and 6 days off. The basic survey was carried out in 2005 after a half year trial period. The follow-ups were 1, 3, 5, 7 and 9 years later (in 2006, 2008, 2009, 2012, and 2014, respectively).

A total of 57–83 (72–89 %) operators participated in the surveys. The turnover rate of operators was moderate due to retirement and moving to other duties. The mean age of respondents was 42.5 years (range 25–60 years), shift work experience was 17 years (range 2 months–40 years), and average experience of 12-hour schedule was 3 years (range 2 months–9 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
Mean sleep length was 7.6–7.9 (+ 1.0) hours, mean sleep need 7.9–8.1 (+ 1.0) hours, and mean sleep debt 0.2–0.4 (+ 0.9) hours per day during the follow-ups. The perceived impact of the 12-hour shift schedule on sleep and vigilance was moderate, only 12% of the subjects perceived disturbance being due to their working times. Work ability compared to the life-time best varied between 8.9–9.2 (+ 0.9) on a scale 0–10 during the follow-ups. Only 4% of the subjects estimated their work ability to be poor (score 0–7).

Conclusion
This study revealed no evidence of compromised sleep, vigilance, and self-perceived work ability during a 9 year period with 12-hour shifts among process operators. The positive results remained through the follow-up. These results are likely to be at least partly explained by the regularity of the shift system. However, when utilising a 12-hour shift system, special attention should be paid to both older workers’ well-being and to those who may have sleep disorders.
Conditioned pain modulation is not decreased after partial sleep restriction

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Background
Sleep problems is a common health problem in shift-work and have been identified as a risk factor for several chronic pain conditions. Reduced sleep has been related to increased pain perception and it has been hypothesized that reduced pain inhibition may explain this. The aim of this study was to investigate if sleep restriction affects heat pain perception and conditioned pain modulation.

Method
In a paired cross-over design with two conditions (2 nights habitual sleep vs. 2 nights 50 % sleep restriction) the conditioned pain modulation was tested in 22 healthy individuals (14 female, 8 males). The test stimulus (TS) was 2-min contact heat stimulation (47°C ± 1.3) to the volar forearm. TS were delivered before and during a 7° C cold pressor test (conditioning stimulus, CS) to the contralateral hand.

Results
TS alone was perceived as more painful after sleep restriction compared to after habitual sleep (p < 0.001). A stronger inhibitory conditioned pain modulation was found after sleep restriction vs. after habitual sleep (p < 0.001).

Conclusion
The results indicate that sleep restriction leads to increased heat pain perception and at the same time enhanced inhibitory conditioned pain modulation. Thus, it is not likely that the increased heat pain perception after sleep restriction is caused by reduced pain inhibition.
Sleep and performance in teenagers as a model for shift-work research

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Adolescence is characterized by a significant delay in sleep timing: the circadian clock entrains later in teenagers and young adults, leading to later sleep. This phenomenon collides with early starting school times. The mismatch between internal (circadian) and external (social) times in adolescents is comparable to shift-workers with a late chronotype working the morning shift.

Chronic sleep deficiency, as incurred by teenagers attending school, can lead to deficits in cognitive performance. We measured this in teenagers by evaluating academic performance on exams with reference to chronotype (circadian phase of entrainment) and sleep duration. We correlated chronotype with scores on exams. In total, 4,734 grades were collected from 741 Dutch high school students (377 female; mean age 14.1 ± 1.7 SD; range 11-18 years) who had completed the Munich ChronoType Questionnaire (MCTQ). The MCTQ quantifies chronotype as the mid-point of sleep on work-free days (MSF), corrected for sleep debt on workdays (MSFsc). Lowest grades were obtained by late chronotypes (MSFsc > 5.31 h; F4,520.6=3.864; p=0.0042) or by students with short sleep duration on schooldays (SDw < 7.03 h; F4,546.6=4.615; p=0.0011). The chronotype-effect on exam performance varied with time of day of an exam (F2,3551=4.171; p=0.0155): compared to late types, early types obtained significantly higher grades between 8:15-9:45 and 10:00-12:15. In the early afternoon (12:45-15:00) the group difference was absent.

Our findings show that typical school schedules confound performance evaluations in adolescents. As a first remedy, we suggest a shift of school exams to the early afternoon to secure equal exam conditions for all chronotypes. More studies are needed – e.g. testing re-entrainment protocols – to elucidate the features that help young adolescents to synchronize their late circadian clocks to early school schedules, and that might be expanded to also help adjust circadian timing in shift-workers.

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**Athens Insomnia Scale and PolySomnoGraphy: a pilot study in RNs working rotating shift system**

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**Background**
RN nurses who are routinely work rotating shifts are exposed to sleepiness which can lead to acute insomnia.

**Aim of the study** was to describe sleep characteristics in RNs working rotating shift system, and to compare night sleep, (between afternoon-morning shift) versus day sleep (after night shift). Also, to examine if RNs suffer from acute insomnia.

**Methods**
10 female RNs, between 26-37 years old (mean age= 29.8±2.2), working in an ICU department rotating shift system participated in the study. The participants underwent traditional PSG after night shift (day sleep) and between afternoon-morning shift (night sleep). Also, completed the Athens Insomnia Scale (AIS) after a week (7 days) of working rotating shifts. The participants worked three shift system with no particular sequence of rotation and were free from any medical history. The night sleep between afternoon- morning shift was of the same duration (00.30 lights off-6.30 lights on) for all the participants. The RNs after the end of the afternoon shift underwent Polysomnography and in the morning had the obligation to go to work. The participants were allowed to sleep as much as they wanted after the night shift.

**Results**
Day sleep was characterised by more Sleep Efficiency, more SWS, less REM, less REM latency compared to night sleep. Also, RNs had no evidence of acute insomnia (AIS=4.4±1.4) (Table1).

**Conclusion**
Although according to bibliography, night sleep is more effective, in our study is proven the opposite. According to our results, day sleep is more efficient, is characterized by more SWS sleep, despite the fact of less duration. One explanation would be that night sleep was ‘compressed’, as RNs had to wake up in particular time. Another explanation would be that the effect of sleeping in a sleep laboratory can result in an inaccurate representation of the participant’s sleep, exaggerating sleep difficulties-the classic “first night effect”. Finally, RNs had no signs of acute insomnia, as Athens Insomnia Scale (AIS) was scored <6.
Sleep restriction increases salivary IL-6 production

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Background

Sleep restriction leads to elevation and peaking of IL-6 serum levels the following day and total sleep loss over several days increase daytime serum levels of IL-6 and its receptor. Morning working shifts can contribute to sleep restriction of about 2-4 hours of night sleep. The aim of this study was to investigate the effects of sleep restriction associated to morning shifts on production of salivary IL-6.

Methods

Twenty-one workers of permanent morning shifts (shift hours: 7:00 to 17:00) from a sanitary metals industry accepted our invitation to participate in this study. Work schedule comprised 5 workdays (Monday-Friday) followed by two days off (Saturday-Sunday). Night workers wore actigraphs (Motion Logger, Ambulatory Monitoring) and filled activity protocols for ten consecutive days. Workers collected saliva samples for ELISA analysis of IL-6 three times during three workdays: in the middle of the day shift, at approximately 14:00, and at bed and wake times, approximately at 6:00 and 22:25, respectively. Shift workers were then classified to the “non-sleep restricted” (N = 12) or “sleep restricted” (N = 9) groups according to the number of hours of time in bed on average: “non-sleep restricted” workers spent more than 6 hours in bed, whereas “sleep restricted” workers spent 6 or less hours in bed. Salivary IL-6 concentrations were compared between the groups by Mann-Whitney exact tests for the three sampled times.

Results.

“Sleep restricted” workers presented significantly higher concentrations of salivary IL-6 in the three sampled times after comparison with the “non-sleep restricted” workers. Conclusions. As previously demonstrated by several authors, we confirmed that sleep restriction after morning shifts is associated with increasing levels of IL-6. Moreover, this effect was demonstrated for IL-6 in saliva, which can be used instead of blood in future studies. Support. CAPES (grant number 8755/11-6), FUNDACENTRO, FAPESP (grant number 2011-10503/4) and the Finnish Institute of Occupational Health.
Fatigue among Icelandic Flight attendants
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Purpose
To examine fatigue among flight attendants, analyse the possible relationship between sleep, work environment, mental health, physical condition.

Method
A descriptive cross-sectional survey was utilized. The participants were permanently employed flight attendants with Icelandair (N=400). The main variable was fatigue during morning, evening and night flights.

Results
The majority of participants experienced fatigue during morning flights (80.6%). Twenty three percent experienced fatigue during evening flights and 52.7% during night flights. About 73% cabin crew members experienced fatigue or exhaustion at one point or another during their shifts.

Participants who reported feeling fatigued during morning, evening and night flights were significantly more likely to value their sleep, both at home and during lay-overs, as worse or less effective. They also felt that this particular lack of high-quality sleep affected their performance at work, contrary to other participants. Those who reported feeling fatigued during morning and evening flights were also significantly more likely to have difficulty falling asleep at home and during lay-overs. Slightly more flight attendants with a university degrees experienced fatigue during morning flights than others.

Conclusion
Fatigue is common among flight attendants. It is important that cabin crew unions and employers pay attention to cabin crew schedules in order to reduce fatigue among its people.
Estimated natural light exposure, sleep and depression among day workers and shiftworkers at Arctic and Equatorial latitudes
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Background
Light is the most important time cue for maintaining the 24h period of circadian rhythms in humans. In case of northern latitudes, for instance, lack of natural light during winter exerts a strong influence on sleep problems and depressive illness. This study aimed to investigate the relationship between individual natural light exposure, sleep need and depression at two latitudes, one extreme with a few hours of light per day during winter, and other with equal hours of light and darkness throughout the year.

Methods
This cross-sectional study included a sample of Brazilian workers (Equatorial, n=488 workers) and a Swedish sample (Arctic, n=1,273). The study included two outcomes, insufficient sleep and depression. At both sites, clinical depression was reported. In the Equatorial sample a question regarding depression from the Work Ability Index (WAI) was used, and participants indicated if the diseases are diagnosed by a physician. In the Arctic sample, depressive symptoms were measured using a 6-item scale corresponding to the Hamilton Depression Subscale (HAM-D6). Background variables included age, sex, smoking, civil status, educational level, electricity at home, and groups of workers according to light exposure.

Results
Equatorial and Arctic groups had similar mean age (37.5 ± 14.1 vs. 38.3 ± 11.9 yrs, p>0.05). All participants from the Arctic sample worked indoors and obtained an average amount of natural light exposure ranging from 15.7-16.4 h/4-week cycle. These levels were comparable to the Equatorial 2-shifts and 3-shifts workers (13.6 h/4-week cycle and 17.0 h/4-week cycle, respectively, p<0.05). By contrast, the Equatorial early morning, Equatorial late morning and Equatorial day workers were, on average, exposed to more light at work days & days-off (88.3 h/4-week cycle, 88.1 h/4-week cycle and 47.6 h/4-week cycle, respectively) than other groups (p<0.01). Short light exposure was a predictor for insufficient sleep. We also found an association of extreme latitude with depression. A linear regression analysis demonstrated that a reduction of one hour of light exposure on work days at the northern latitude gave an increase of 0.09 points on the depression scale (p<0.01).

Conclusion
Lack of exposure to natural light appears to increase the perception of obtaining insufficient sleep. Arctic workers were more prone to develop depression than Equatorial workers.

Acknowledgments
Parasomnias among shift working nurses

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Background
Shift work is associated with sleep problems and impaired health. In work schedules that include night work, difficulties initiating and maintaining sleep, reduced sleep duration and excessive sleepiness during work are among the most frequently reported problems. Parasomnias are undesirable physical events or experiences that occur during entry into sleep, during sleep or arousals from sleep. Such events are manifestations of central nervous system activation, and are divided into two major groups, non-rapid eye movement (NREM) sleep-related parasomnias and REM sleep-related parasomnias. The association between shift work and parasomnias is uncertain.

Methods
Data were collected from an on-going longitudinal cohort study “SUrvey of Shift work, Sleep and Health (SUSH)” that was initiated in 2008/2009, with annually follow-ups. Data were collected by questionnaires, posted along with a prepaid envelope for return. Initially, a sample of 5400 nurses was randomly selected from the Norwegian Nurses Organization’s membership roll which includes most of the nurses in Norway. This study presents findings from the fourth data collection (wave 4) that took place in 2012, including 2198 nurses. The nurses reported (no/yes) whether they had experienced different parasomnias (confusional arousal, sleepwalking, sleep terror, sleep related eating, sleep related violence, sexsomnia, nightmare, dream enactment) during the last three months (less than once a month; 1-3 times a month; weekly or more often).

Results
The prevalence of the different parasomnias ranged from 0.3% (injured somebody else during sleep) to 42.4% (nightmare) among day workers only, from 0.0% (sleep related eating; injured yourself during sleep) to 46.8% (nightmare) among night workers only, from 0.7% (sleep related eating; injured somebody else during sleep) to 54.7% (nightmare) among two shift workers and from 6.6% (injured yourself during sleep) to 53.7% (nightmare) among three shift workers. In all work schedules nightmare was the most common parasomnia. Nurses working a two shift schedule (including day and evening) and three shift schedule (including day, evening and night) showed higher prevalence for nearly all parasomnias compared to nurses working day only and night only schedules, but statistical significance was seen only for confusional arousal and nightmares. There were no apparent differences between day only and night only schedules.

Conclusions
In summary, nurses working rotational shift work schedules reported more confusional arousal and nightmares compared to nurses working daytime only. Most likely this findings can be attributed to circadian rhythm misalignment and sleep deprivation caused by shift work.
The profile and motivations of the fatigued driver: a cross-sectional study of the Australian population

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Background
Fatigue is implicated in 20-30% of all road deaths. Targeted public health campaigns and educational interventions have proven successful for other driving risks such as speeding and inattention. In the case of fatigue, however, little is known about the profile of the ‘fatigued driver’, nor their motivations. Indeed, there is evidence that people drive despite perceiving themselves to be impaired by sleepiness.

Methods
The aim of the present study is to understand the profile of individuals who report fatigued driving and to determine why individuals take the risk to drive when fatigued. Using data currently being collected from the CQUniversity Population Research Laboratory’s National Social Survey, this project will investigate fatigued driving behaviour in a cross-sectional sample of 1,500 Australians. Demographic data such as age, gender, income, education level, employment status, health status and years of driving experience are being collected. Participants are asked to indicate how often they have driven when they thought they might have been too tired to drive safely, the main reason for choosing to drive in these instances, how often they are aware of having fallen asleep while driving and finally, how many hours of sleep they think are necessary to drive safely.

Results
Logistic regression will be used to predict a) whether someone will report having engaged in fatigued driving, b) the frequency that they will report having engaged in fatigued driving and c) the frequency that they report having fallen asleep while driving, based on predictor variables (e.g. age, gender, income, education level, employment status, health status and years of driving experience). Qualitative analysis will be used to investigate free-text responses given regarding reasons for fatigued driving. A general inductive data analysis approach will be used. This involves data immersion, coding, categorisation and theme generation and allows key themes to be identified in the data. Descriptive analysis will be used to investigate how many hours of sleep individuals think are necessary in order to drive safely.

Conclusion
These results will provide insight into the demographic profile of drivers who report fatigued driving, the frequency and severity of fatigued driving and the reasons why fatigued driving occurs. Importantly, this project will also address how much sleep individuals think is needed to be safe to drive. This information will be used as pilot data in the development of effective, targeted public health campaigns to address fatigued driving behaviour.
Sleep and satisfaction in different fast forward rotating shift systems: industrial employees prefer 12-hour shift
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Background
The use of 12-hour shifts has become more popular in Finnish industry. Earlier studies suggest that 12-hour shift systems may increase fatigue and risk of occupational injuries. On the other hand, 12-hour shift systems associate with longer continuous free time and reduced commuting time. We studied the cross-sectional associations of 8- and 12-hour shifts with general health, sleep difficulties, sleep duration, work-life balance, and industrial employees’ shift system preferences.

Methods
A total of 600 employees (91% males) from 9 factories in paper and pulp, and chemical industry located in 8 Finnish towns filled in an online questionnaire (response rate 59%). Using the Pearson’s $\chi^2$-test and variance analysis with age, gender, shift work experience and self-rated stress as covariates, shift-specific sleep difficulties, sleep duration (h:mm), and the effect of current shift system on sleep, general health and work-life balance were compared between 3 shift systems: a fast forward rotating 12-hour shift system (12fast, n=268, 45%, DDNN------), a fast forward rotating 8-hour shift system (8fast, n=162, 27%, MMEENN----) and a slow forward rotating 8-hour shift system (8slow, n=170, 28%, MMMM-EEEE-NNNN----).

Results
In the 12fast group, 98% of the participants were satisfied with their shift system compared to 75% and 54% in the 8fast and 8slow groups, respectively (p<0.01). Very few (8%) reported general negative effects on sleep and alertness in the 12fast group, compared to 53% in the 8fast and 66% in the 8slow groups (p<0.01). In the 12fast group 8%, in the 8fast group 27%, and 41% in the 8slow group (p<0.01) reported at least one regular sleep difficulty. Self-reported average sleep duration (12fast 7:50, 8fast 7:24, 8slow 7:15, p<0.01) and sleep duration in connection with morning shifts (12fast 7:05, 8fast 5:53, 8slow 5:51, p<0.01) also favored the 12fast group. The 8slow group reported longer sleep durations after night shifts compared to the 8fast and 12fast groups (5:57 vs. 5:37 and 5:34, respectively, p<0.01). Shift system was reported having negative effects on general health (12fast 4%, 8fast 31%, 8slow 41%, p<0.01) and work-life balance (12fast 8%, 8fast 53%, 8slow 63%, p<0.01) more often in the 8-hour groups.

Conclusion
Employees in the 12-hour rapidly forward rotating shift system were markedly more satisfied with their current shift system, perceived increased work-life balance, and had better sleep quality than employees in the 8-hour rapidly and slowly rotating shift systems.
CURVILINEAR RELATIONSHIP BETWEEN WORKING TIME AND WELL-BEING
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The aim of the paper is to examine curvilinear relations between working time and well-being. Earlier studies show that long working week, unsocial working hours and high working time tempo have usually negative effects and working time autonomy positive effects on employees’ well-being. Usually these effects have been studied separately. In this study working time is separated to four dimensions: 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). Well-being is defined through psychosomatic symptoms and work-life interaction.

In this study a representative Finnish working conditions surveys from years 2003, 2008 and 2013 (total sample N=13372) were applied to estimate connections between working time and well-being. Curvilinear relationships between working time dimensions and well-being were explored by constructing generalized additive models (GAMs), where connections between study variables are estimated as nonparametric smooth functions.

Duration, tempo and time autonomy were found to be statistically significant predictors of psychosomatic symptoms and work-life interaction, when unsocial working hours did not have a significant effect on well-being. Duration had a U-shaped relationship with well-being and there were fewest symptoms at about 40 hours per week and work had minimum conflict with other aspects of life at about 25 hours per week. Working tempo had a curvilinear exponential relationship with psychosomatic symptoms. Only after a threshold value (3 in a scale 1-5) tempo was connected to symptoms. Tempo had a positive linear connection with work-life interaction. Autonomy had an expected negative effect on psychosomatic symptoms but the relation was positive with work-life interaction.

Exploring relationship between well-being and dimensions of working time using nonparametric smoothing splines revealed curvilinear connections and threshold values which would have been unnoticed in classic linear regression analysis. Duration, tempo and autonomy of work time predict well-being, although in different extent. The working tempo was the most influential predictor of both psychosomatic and work-life interaction.
Patterns of Sleep and Work-Life Balance of Machine and System Operators – a comparison between two work schedules

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Aim
It has long been proven that shift work is connected to particular strains which can lead to sleep disturbances, health issues and which can have an impact on the workers’ social life. One appropriate measure to reduce shift related strains could be the design of shift schedules based on valid scientific knowledge from the Work Science research. The aim of the present work is to perform a comparative analysis on the sleeping patterns and work-life balance (WLB) of machine and system operators (MSO) with a 12-hour shift (12-h-SH; morning and night shift) and those with an 8-hour shift (8-h-SH; morning, afternoon and night shift), and to examine relations to the different shift patterns.

Methods
The sample consisted of 38 MSO with a 12-h-SH (average age: 41±10) and 42 MSO with an 8-h-SH (average age: 45±10) from two companies operating in chemical and food processing industries. The 12-h-SH comprised a morning shift (6.00 – 18.00) and a night shift (18.00 – 6.00), the 8-h-SH comprised a morning shift (6.00 Uhr – 14.00), afternoon shift (14.00 – 22.00) and a night shift (22.00 – 6.00). Sleep related factors such as sleep quantity and quality, sleeping problems, disturbances and daytime sleepiness were collected using a shift worker questionnaire (Seibt & Ulbricht 2011), a sleeping quality questionnaire (PSQI; Buysse et al. 1989) and a sleepiness questionnaire (ESS; Johns 1991). The shift worker questionnaire was also applicable for the Work-Life-Balance factors. The data analysis is carried out with control of the covariables such as age, length of shift work service, family status.

Results
Differences between the two shift patterns were small. However, the survey revealed, that the MSO of the 8-h-SH had significantly more difficulties to remain asleep (p=.025) than those with a 12-h-SH. Conversely, for the workers with a 12-h-SH a significantly shorter sleep duration was observed (p=.009). No significant shift related effects for sleeping disturbances, quality and daytime sleepiness were shown. Though, there seems to be a relation between the difficulty to remain asleep and the length of the shift work service. Relations between the sleeping variables and the shift system are very small or not existent at all (τ=.06-.28). For the MSO with a 8-h shift, the analysis has revealed a worse WLB (satisfaction with time available for friends and relatives, p=.032; participation in organisations and unions, p=.005; the impairment of the private life by the work, p=.024; work as a hindrance to spend time with friends, p<.001; no energy to enjoy leisure time, p=.013). In the 12-h-SH group, the distribution of the rest days turned out to be very influential for the workers’ satisfaction. The study revealed small relations between the WLB and the shift system (variance explanation: 5-15%).

Conclusion
Regarding the sleeping patterns, there are no clear indications confirming superiority of the 12-h-SH over the 8-h-SH. The WLB was rated more positively for the 12-h-SH (more spare time on rest days raised the satisfaction with the social and family situation and enhanced the quality of the recovery period). Impaired work-life balance seems to have bad impact on health aspects. In general, the results underline the need for further research. The WLB should be accounted for to a greater extent when designing shift schedules, whereby the attention should be directed towards a balanced relation between work and leisure time.
“The Shift Work Challenge” — Certification examination as a risk communication tool among night workers, shift workers and their profits’ recipients —

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Background
As is commonly known, major accidents and disasters involving occupational transportation, medical organizations, or large-scale processing industries tend to occur during the late-night and early-morning hours. Major accidents can also have significant effects on the social lives of citizens who have nothing to do with night and shift works. According to statistics, as a mere 20% of residents in industrialized countries work at night, the remaining 80% may find it difficult to imagine the safety risks faced by night and shift workers. To address these failures in risk communication, the authors designed a certification examination to test knowledge of the risks associated with night and shift work. Inspired by the Ice Bucket Challenge, they gave the exam a playful name: “The Shift Work Challenge”.

Methods
This report compares rates of correct answers given by workers from two occupations in response to 20 multiple-choice practice questions (each with four choices). Seventy-one valid answer sheets (85.5%) were collected from train drivers and 76 (76%) from occupational health nurses.

Results
By job type, the average rate of correct answers was 43.5% for train drivers and 52.5% for occupational health nurses. For two questions, the percentage of correct answers given by train drivers was 70% or better; for two other questions, this figure was 20% or worse. For six questions, the percentage of correct answers given by occupational health nurses was 70% or better; for two other questions, this figure was 20% or worse. Those with night and shift work experience gave correct answers at a rate of 46.3%. Other hand, among those without experience was 30.4%. Same tendencies were found between those with and those without night shift experience in rates of correct response to questions associated with either high or low rates of correct answers.

Conclusion
While rates of correct answers generally tended to be higher among those with night and shift work experience than those without, occupational health nurses still gave a higher rate of correct answers than train drivers, although nurses reported less experience with night and shift work than train drivers. Based on this finding, the authors speculated that rates of correct answers may be driven by extent of interest in night and shift work, rather than actual their experience. On this basis, the authors conclude that “the Shift Work Challenge” may serve as an effective tool for risk communication.
Lifestyle choices and the health of construction workers performing long and unsocial work hours in Australia: Do line managers have a role to play?

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Introduction
Stressful work environments and associated work/life interference are inversely related to general well-being, psychological strain, psychiatric disorders and substance abuse. Very little is known, however, about the impact of stressful work environments on the dietary habits of workers. This is particularly important for shiftworkers and those working long hours as research shows they are more likely to develop gastrointestinal disorders. The focus of this study is work environments in project based construction work. Our interest is the intersection between an industry in which long hours are worked, wellbeing that is dietary related, and the role of line managers.

Methods
Participants were drawn from 5 Brisbane urban construction projects. Most workers performed long work hours (50-60 hours/week) with work starting between 5 and 6am but the majority (> 90%) rose between 3 and 4am owing to the required long commute. Survey data on nutritional intake and health indicators were gathered from (n=186) trade workers, interview data were collected from 15 site managers (n=21) and focus group data collected from 18 focus groups with trade workers.

Results
Survey data showed that lifestyle factors associated with food and drinking habits were poor onsite. Risk scores using validated tools indicated that 53% of participants were at moderate or high risk of developing Type Two Diabetes in the next 5 years, fruit and vegetable consumption was well below Australian guidelines and 43% of workers replaced breakfast with energy or soft drink. Interview data on the role of managers in creating a positive food environment was unanimous with all managers and workers holding the view that the line managers do not and should not have any influence over the eating habits of construction workers on their site. However indirect interview evidence suggests that line manager decisions can (and do) influence the eating habits of workers performing long and atypical work hours. Three broad themes are used to address these influences: work pressure/time pressure; environmental influence; and behavioural influence.

Conclusion
Together findings indicate dietary habits are of concern for construction workers performing long and unsocial work hours and line managers have a ‘hidden influence’ over the consumption choices of workers at their site. This influence does not impinge on personal choice, however, line managers make decisions that could be changed and with these changes a positive impact on employee consumption is likely to follow.
Asking the night workers: problems, coping strategies and research priorities

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Background
Various coping mechanisms have been studied by researchers to minimize the negative effects of night work on health and social life. However, night workers are rarely consulted about their own coping strategies and their own needs for future research.

Methods
In this pilot study, a questionnaire was distributed to Canadian sleep technologists asking for the problems they experience with night work, the coping strategies they use and their suggestions for future research. Among responders, 36 were working nights, of which the majority had more than 5 y of experience with night work.

Results
The top four problems reported by the workers were: sleep disturbances (76%), mood-related problems (55%), social difficulties (45%) and appetite/digestion problems (41%). Other difficulties pointed out by workers were weight gain and limited daylight exposure during winter. Among coping strategies, 19% used hypnotics or melatonin, 8% used alcohol at bedtime, and more than half used various ways to control the environment in order to help daytime sleep. To increase vigilance during night shifts, 56% consumed caffeine while 53% had a nap before their shift. When asked about controlling light exposure during night shifts, most did not want to change the light intensity while 29% decreased and 14% increased light intensity. Furthermore, 34% were using dark glasses when going home after work. Other adaptation strategies proposed by night workers were: protect sleep time, exercise regularly, eat before going to bed, and, during the night shift, keep busy, drink plenty of water, snack frequently and avoid high carbs and sugary foods. Suggestions for research priorities were mostly directed on weight gain avoidance. Other questions they would like researchers to address included: how to switch from night to day schedule, usefulness of over-the-counter medications (melatonin, vitamin D), best time to exercise when working nights, and effects of night work on pregnancy, mood, hormone imbalance, chronic diseases and life expectancy.

Conclusion
Some of the coping strategies reported by the night workers are consistent with recognized main recommendations (e.g., protect sleep, have a nap before night shift), but others do not meet consensus (e.g., light exposure at night). Notably, one main concern of the night workers was weight gain and other nutritional aspects, an area of research that received limited attention from night work researchers. Involving night workers in the identification of research priorities may help finding adaptation strategies more relevant to their daily life and more readily applicable.
What is the preferred number of consecutive night shifts? Results from the "In the Middle of the Night" project

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Background

Attention has been directed to the question of how to organise working hours to minimise adverse health outcomes related to shift work. For example, it has been recommended to minimise the number of consecutive night shifts to prevent circadian disruption of physiological systems. However, when working several consecutive night shifts the employee has the chance of adapting to night work which seems to occur after the 4th night shift with observed improvements in number of errors, reaction time, and concentration. Importantly, however, the superiority of a given number of consecutive night shifts depends on the outcome under study. Furthermore, the individual employee's tolerance to shift work may also determine the optimal number of consecutive night shifts. The employee's tolerance to shift work may be reflected in his or her preferences for or against certain working hours and/or shift systems.

We designed an intervention study to investigate the effect of working 2, 4, and 7 consecutive night shifts on different outcomes. The aim of this abstract was to analyse how many consecutive night shifts the participants preferred and the characteristics of employees preferring shorter or longer spells of night work.

Methods

In this crossover intervention study among 73 male police officers the participants filled in a baseline questionnaire and a follow-up questionnaire. All participants were exposed to three interventions: 2 night shifts followed by 2 restitution days ("the 2+2 system"), 4 night shifts followed by 4 restitution days ("the 4+4 system"), and 7 night shifts followed by 7 restitution days ("the 7+7 system"). Restitution days were either day work or days off.

Results

At baseline, the participants preferred, on average, 4 consecutive night shifts. At follow-up, the "4+4 system" was the most popular intervention condition (n=36). However, a minority preferred either the short sequence of night shifts (the "2+2 system"; n=16) or the long sequence of night shifts (the 7+7 system; n=8). Preferring longer spells of night shifts was associated with experiencing that night work was less demanding, finding it relatively easy to sleep at different times of the day, and being more evening type than morning type.

Conclusion

Most participating police officers preferred 4 consecutive night shifts, although some participants had strong preference for fewer or more consecutive shifts. Employees' preferences reflected considerations with respect to health, sleep, and how demanding night work is. We therefore suggest that such preferences are taken into account when designing shift schedules.
CHANGING WORKING TIMES IN FINLAND 1977–2013
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Changes in working time are usually described as flexibilisation, fragmentation and shift from industrial towards post-industrial working time regime. The extent and consequences of the post-industrial working time regime vary - besides gender - across socioeconomic groups. The aim of this paper is to examine changes in working times between men and women and between different socioeconomic groups in Finland.

Empirical analyses are based on representative Finnish Working Conditions Surveys (1977, 1984, 1990, 1997, 2003, 2008 and 2013). Sample size has been 3000-4500 employees. We examine changes in 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). We separate four comparison groups: male manual, female manual, male non-manual, female non-manual workers.

According to the results, changes in working times vary with socioeconomic status and gender. Differences between comparison groups have increased in duration and timing of working time during the period 1977–2008. After 2008 the differences have slightly decreased. We found a convergent trend in perceived time pressure. Time autonomy has increased in all groups, but especially among non-manual workers.
Flexible employment and a convenience culinary culture; implications for employee health and well-being
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Background
Flexible employment is a ‘modern award objective’ lying at the heart of Australia’s Fair Work Act 2009 and claims to address problems of work-personal life balance. Relevant sections allow parents, carers, people with disabilities and older workers to request part-time work, changes to start and finish times, shift arrangements and home-based work. Employee uptake of these flexible work provisions is modest, yet many Australians report that their employment arrangements interfere with basic health behaviours. This study addresses the subtly shifting risks to health and well-being arising from new flexible employment regimes alongside the evolution of a national culinary culture oriented to meet the needs of time-pressed citizens.

The last three decades in Australia have seen a more intense mobilization of the labouring capacity of adults in family households. Moreover intensified patterns of work lead people to believe time is scarce. Consequently, the consumption of fast and commercially prepared foods increases, employees (typically working in sedentary occupations) struggle to schedule the recommended times for physical activity, and eat more often at work desks and in cars.

At present, it is unclear whether unhealthy eating practices result from inadequate labour market flexibility provisions, inability to take up the ‘right to request’ flexible work, or from broader features of contemporary culinary culture.

Methods
A reanalysis of Australia’s Time Use Surveys – 1974 to 2006 - was undertaken with a focus on household work time patterns and food practices time (shopping, preparing food, and the when, where and with whom of eating food). Some surveys collected self-rated health. The nationally representative time diaries provide information about healthy and unhealthy food practices, using an evidence-based typology linking food practices and diet-related risks. The resulting analysis was interpreted within a social history examination of key trends in Australia’s culinary culture and labour market policies, acknowledging time lags in employee adoption of trends.

Results & Conclusion
The research provides new insights into the temporal strains, and potential health impacts, of particular forms of working arrangements. For example, long hours of work may not undermine healthy food practices as much as insecure work. It also reveals that the nutritional health of the whole population is at risk due to a culinary culture that is constructed around convenience in many guises.

In confronting the challenge of a fair, productive and healthy workforce, we conclude that it is essential that the ‘cultural economic’ mechanisms that generate health status are understood.
Measuring the association of shift length and nurse outcomes: findings from a cross-sectional study of 12 European countries

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Background
In some countries hospital nursing is moving from a 3 shift working pattern with typical shifts of 8 hours to a 2 shift pattern with shifts of 12 hours. These changes appear to be popular with some nurses because the extended shift length means that they work on fewer days per week. Nevertheless, there is concern that these extended shifts may adversely affect nurses’ well-being.

Objectives
To examine the association between working long shifts and burnout, job dissatisfaction, satisfaction with work schedule flexibility, intention to leave current job.

Methods
Cross-sectional survey of 31,627 registered nurses in 2,170 general medical/surgical units within 487 hospitals across 12 European countries.

Results
We controlled for shift type (day/night), overtime working, nurse staffing levels (ratio of patients per nurse on the last shift they worked) hospital size (< 250, 250 to 500 beds, >500 beds), high technology hospitals (those that performed major organ transplant surgery, open heart surgery, or both), teaching status (hospitals that provide training to undergraduate medical students) and whether the nurses worked full time or part time. The results of our binary generalized mixed models show that nurses working shifts of ≥12 hours were more likely to report high levels of burnout (OR = 1.83; 95% CI = 1.30-2.58), to report being dissatisfied with work schedule flexibility (OR =1.20; 95% CI = 1.29-1.48) and to report intention to leave their job (OR= 1.31; 95% CI = 1.14-1.51), when compared to nurses working shifts of 8 hours or less. The odds of nurses reporting job dissatisfaction were greater among nurses working all shifts of longer than 8 hours, and nurses who had worked ≥ 12 hours had the highest odds of job dissatisfaction (OR = 1.42; 95% CI = 1.22 – 1.65).

Conclusion
Despite the apparent popularity of the compressed working week that results from working long shifts, European registered nurses working 12 hours or appeared to have lower levels of well-being at work, evidenced by burnout and lower job satisfaction. Furthermore, they were more likely to express an intention to leave their job than those working shorter shifts. Despite their apparent popularity with nurses, policies aimed at increasing the length of shifts may have negative consequences for the nursing workforce.
Call Me Maybe - The Relationship of On-Call Work with Fatigue, Work-Home Interference and Perceived Performance Difficulties
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Background
On-call work is a flexible work arrangement and refers to work done on a ‘as needed basis’, meaning that employees must be available at certain times to be called into work if required by the employer. Previous research has shown that on-call work can have negative effects on employees’ well-being and performance, but most of these studies have been conducted among medical staff with on-site on-call duties. The aim of the present study was to gain more insight into the consequences of another type of on-call work: on-call duties during which employees do not have to remain at work, but can be called to work in case of an emergency. More specifically, the present study examined the relationship between different aspects of on-call duties on the one hand, and fatigue, strain- and time-based work-home interference and perceived on-call performance difficulties on the other hand. A distinction was made between on-call exposure (on-call hours a month, active on-call hours a months, number of calls per duty) and employees’ experience of being on-call (i.e., experience of on-call stress due to unpredictability, restrictions during on-call duties, on-call work demands, and satisfaction with compensation for on-call duties).

Methods
Cross-sectional survey data were collected among a large heterogeneous sample of Dutch employees (N = 5437). Of the 1798 employees who completed the questionnaire, 203 (11.3%) reported to have jobs including on-call duties. The final sample consisted of 157 employees (23-69 years, 71% male). Data were analyzed by means of hierarchical regression analyses (controlling for age, job demands, autonomy and social support).

Results
On-call work exposure itself was not related to fatigue, work-home interference and perceived on-call performance difficulties (all p’s > .50). However, the experience of being on-call explained a medium proportion of the variation in fatigue and strain-based work-home interference, and a medium to large proportion of the variation in time-based work-home interference and perceived on-call performance difficulties over and above the control variables.

Conclusions
On-call duties officially count as rest time, during which employees should be able to recover from work. However, the present study suggests that this may not always be the case. Employees’ experience of being on-call, especially the experience of stress due to the unpredictability, is related to fatigue, strain-based and time-based work-home interference, and perceived on-call performance difficulties, regardless of the amount of exposure to on-call work.
The influences of split shifts on sleep and fatigue

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Background
A representative study of Swedish shift workers showed that 19% had split shifts, i.e. two shorter shifts of 4-5 hours, with a long break (usually 2-5 hours) between the working periods. There are hardly any studies of split shifts and the aim with this paper was to examine whether split shifts are related to disturbed sleep and increased fatigue.

Method
The study group was bus drivers in local transport. 231 drivers (26% females, age range: 24-67 years) filled in a questionnaire and 60 drivers (18 females, age range: 24-64 years) participated in a two-week diary study, which also included actigraphy. 23 of the drivers in the diary study worked at least one split shift during the two-week data collection.

Results
64% of the participants in the questionnaire study reported that they had to work split shifts and 36% regarded this as a big problem. The group that reported big problems with split shifts showed more sleep/wake complaints, such as insomnia (46% versus 18% for those that worked split shifts but did not regarded it as a problem, p<0.001) and involuntarily falling asleep at work (29% versus 12% for the non-problem group, p<0.01). The actigraphy study showed that split shifts were associated with early wake-up times (mean: 05:16) and short sleep duration (05h 52 minutes). The mean length of the split shifts were 12h (SD=1:13h), including a break of 4h and 12 min (SD=1:08h). The subjective ratings of the diary did not show elevated fatigue or impaired sleep quality for the split shifts, when the analysis was adjusted for the early start time. A nap was taken during 47% of the breaks of the split shifts. Nine drivers in the diary study reported that split shifts were a big problem for them. A comparison with 14 drivers, who did not perceive split shifts as a big problem, showed that the problem group took less naps during the break (28% versus 67%) and reported higher levels of fatigue and sleepiness during the split shifts.

Conclusions
Split shifts were common, regarded as on the drivers’ biggest working hour problems, were longer than the other shifts and started early in the morning, and were associated with short sleep. Napping during the long break seems to be a key factor for the tolerance of split shifts, and the drivers who perceived split shifts as a big problem reported less napping and higher work-related fatigue.
Work time control, sleep & accident risk

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Background
Flexible working time arrangements are becoming increasingly common as organizations seek to satisfy employees’ desires to combine work and private life, while maintaining high productivity and optimum staffing levels. Work time control (WTC) reduces the risk of sleep disturbance among employees (Salo et al, 2014). The current study considers whether the beneficial impact of WTC on sleep leads to lower accident risk.

Method
We analyzed data from the Swedish Longitudinal Occupational Survey of Health, which is a nationally representative cohort survey. Since the start in 2006, follow-ups have been conducted every second year. All occupations are represented, and the number of men and women is approximately equal. The survey questionnaires include established measures of WTC (Ala-Mursula et al, 2002), sleep disturbance (Åkerstedt et al, 2002, 2008), short sleeps, job characteristics and individual differences. We used logistic regression to examine WTC in 2012 as a predictor of accidents occurring in the subsequent 2 years (as reported in 2014). We also examined sleep disturbance and sleep duration in 2012 as potential mediators of the association between WTC and accident risk. All analyses adjusted for age, sex, education, occupational category, weekly work hours, shiftwork status and perceived accident risk associated with the job. Analyses were restricted to participants working at both times (N=4715).

Results
Having WTC was associated with lower accident risk in the subsequent 2 years (adjusted OR = 0.80, 95% CI = 0.73 – 0.89). Similar findings were observed when examining two subscales of WTC separately, namely Control Of Working Time (comprising items ‘influence over start and finish times’ and ‘influence over length of shift’; adjusted OR = 0.88, 95%CI = 0.81 – 0.95) and Control Over Free-Time (comprising items ‘influence over taking rest breaks’, ‘influence over taking paid leave’ and ‘influence over running private errands in work time’; adjusted OR = 0.79, 95%CI = 0.72 – 0.88). Sleep disturbance in 2012 was identified as mediator of the association between WTC and accident risk (effect = -.016, Bootstrap 95%CI = -.034 — -.002), but frequency of short sleeps (< 6 hours) was not (effect = -.006, Bootstrap 95%CI = -.016 – +.001).

Conclusion
WTC may enable individuals to manage their fatigue by allowing them to match their work schedules to their circadian preferences, and to the demands of their lives outside work. The reduced risk associated with enhanced WTC may benefit both workers and the public they serve.
Choice between Income Increase and Reduced Working Time – First experiences in Austria

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Background
Austria has a long tradition of collective bargaining agreements for all employees of Industry Sectors. The Electronics Industry (FEEI Fachverband der Elektro- und Elektronikindustrie) agreement concluded in May 2013 provided – besides the usual pay increases – a new option. Companies and their employees were allowed to choose an additional amount of paid time-off (at least 56 hours for full-time employees in this year and the years thereafter) instead of the otherwise mandatory increase of 3% of income[1]. Even though the agreement was seen as an interesting innovation by many experts the practical use of it in 2013 was minor – hardly anybody used the option. Interesting enough, in 2014 not only the same industry again agreed on the same principle in May 2014, but was also followed by a number of other industries (Steel and Metal Producing companies and Car Suppliers) and the overall response was increasing.

In this study the main motivation and arguments both for employers and employees will be analyzed and the first practical experiences will be presented.

Method
The Employers Federation FEEI will interview employer representatives in companies that make use of the option. Following that a questionnaire will be used to follow up on the employee side including employee representatives (works council).

Results
A mix of qualitative statements from the interviews and statistical data from the questionnaires will be combined to present the further findings.

Conclusion
Preliminary results indicate that the reduction of income is less attractive for employees than a reduced annual working time (2). The study will provide information regarding

- Main drivers for employers why to provide the option in their company
- Main arguments for employees why to choose the option individually
- Demographic analysis of the group of participating employees regarding gender, age, years of service and income level (grade)

Individualized rosters in collective shiftwork systems: some Dutch evidence
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Background
In the Netherlands more than 1,1 million employees work during nights. Most of them work in shiftwork systems (17% of the total working population). They do have less control over working times compared to other workers (9% versus 25%; NEA, 2013). Older workers (45+ years) are a growing portion of shiftworkers. In the manufacturing and process industry we still observe the dominance of collective shift systems. Key characteristics of most shiftworking systems are (1) they are based on a flat demand and (2) they are collective with shifts allocated to fixed teams. These facts combined (older workers with flat collective shifts with little control) could be negative to health and safety. At the same time, we witness the trend toward more individualized employment systems, driven by the need for healthier shiftwork systems in order to keep employees productive and healthy until retirement. In addition, flat demands (and thus flat rosters) are no longer logical given increasing sales fluctuations. We want to address in this paper the possibility to incorporate individual rosters in collective shiftworking systems, to accommodate both employer and employee wishes.

Methods
We developed a classification for different variants of individual rostering, based on two dimensions (degree of autonomy and degree of collectivism). Furthermore, we collected data from six case studies within the Dutch manufacturing and process industry. These cases illustrate the possible variants of individual rostering within collective shiftwork. The data came from interviews with managers, staff, union representatives and employees. We also used company documents.

Results
The classification based on the two dimensions of autonomy and collectivism resulted into five variants of individual rostering: (a) flexible group rosters, (b) wish rosters, (c) shift picking, (d) matching, (e) self-rostering and (f) individual arrangements. The last variant is mostly developed for ageing workers who cannot otherwise survive the shiftwork regime. Our case study data suggest some typical effects for employers (higher productivity, lower absenteeism, better match capacity-demand and better labor market position) and for employees (better work-life balance, better fit with own chronobiology and better employability). Our case studies also provide typical change process issues, such as the collective culture, leadership and reward. Furthermore, the role of unions and works councils are discussed.

Conclusions
In collective shiftwork schemes there is a need for more individual working time arrangements. Our case studies reveal that different variants are possible, however, they also reveal that it is a difficult process.
Employer- and employee-oriented working time flexibility and subsequent long-term sickness absence

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Background
Working time flexibility can be divided into employer-oriented flexibility serving employers’ needs and employee-oriented arrangements serving employees’ needs. Employer-oriented flexibility aims to respond to fluctuations in demand and services, while employee-oriented flexibility aims to respond to personal preferences and family requirements. Earlier studies indicate that employer- and employee-oriented working time flexibility may have different outcomes for the workers. The aim of this study is to investigate the separate and combined associations of employer- and employee-oriented working time flexibility on long-term sickness absence during a three-year follow-up period.

Methods
The data is taken from the Finnish Quality of Work Life Survey 2003 (n=3114), a representative sample of Finnish 15 to 64 year-old employees, combined with a register-based follow-up from Statistics Finland, covering the years 2002 to 2008. In the 2003 survey employees were asked about their working time arrangements. Employer-oriented working time flexibility was measured with three items by asking respondents e.g. how often they had to be flexible in working hours dictated by their tasks or their superior (Cronbach’s alpha 0.74). Employee-oriented working time flexibility was measured with four items by asking respondents e.g. to what extent they could use flexible working hours sufficiently for their own needs (Cronbach’s alpha 0.75). The participants were classified into quartiles to indicate lower and higher levels of employer- and employee-oriented working time flexibility. The register data included information on long-term (more than 10 days) sickness absence. A negative binomial (NB) model was used in the analysis of long-term sickness absence days between 2004 and 2008. The results were adjusted for several background and work-related factors and controlled for baseline absenteeism in 2002.

Results
Employer-oriented working time flexibility increased long-term sickness absence, while employee-oriented working time flexibility decreased long-term sickness absence. Employee-oriented working time flexibility did not moderate the effects of the employer-oriented working time flexibility, i.e. employee-oriented working time flexibility decreased sickness absence equally in the groups of low and high level of employer-oriented working time flexibility.

Conclusions
The result showing that employee-oriented working time flexibility decreased long-term sickness absence indicates that employee-friendly working time may play an important role in the health of employees. Consequently, establishments which use employee-oriented working time flexibility as a human resource instrument may benefit from reduced absenteeism.
Individual and organizational consequences of employee-determined flexibility - A comparative study of employee-determined flexible and fixed shift schedules within police patrols

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Background and Methods
Police authorities within one of the member states of the FRG apply three different kinds of shift schedules. The 4SGS uses four shift-groups which work a specified fixed shift roster with three shifts. The 5SGS consists of five shift-groups which also work a specified roster but whose members need to work approx. two additional shifts in other groups to achieve the agreed 40 h/w, and which can be chosen by the employee (as an element of employee-determined flexibility). The third, a flexible system (FS), has no specified shift sequences. Officers create their individual schedules (observing some administrative constraints), but shifts are basically free to choose. Shifts, shift lengths and shift changeovers are the same for all systems.

To test the hypothesis that the FS has advantages with respect to social aspects but disadvantages with regard to organizational criteria and vice versa for a fixed, e.g. the 4SGS, resulting from a qualitative, interview based pilot study with police chiefs, an online questionnaire was distributed to all police officers from four districts within this Federal State working under those systems. Data were analyzed using multivariate analyses, controlling for possible confounders.

Results
N=927 (4SGS=650, 5SGS=51, FS=266) officers returned the questionnaire. The results show that purely employee-determined flexibility (FS) leads to a better compatibility of shiftwork with social life and thus less work-life conflict. At the same time it is associated with a loss of work-related social structures, less job satisfaction and drawbacks concerning work-climate, leadership, information transfer as well as reciprocal trust and support. Almost reverted results have been found for the 4SGS. The 5SGS, a system with a widely employer determined roster and some employee determined flexibility, provided almost as good results as the FS concerning social life, but did not share its significant structural and organizational disadvantages.

Conclusions
Although employee-determined flexibility provides some clear advantages for the individual, pure employee-determined flexibility is also accompanied by a broad variety of dysfunctional, especially organizational effects. The conclusion is thus to support such kinds of flexible systems with some synchronizing elements which allow to develop some social structure and to allow for effective leadership. On the other hand, fixed shift systems should allow for at least some flexibility on the side of the employee in order to alleviate possible (shift) work-life conflicts.
Women, shift workers, and public sector workers report lower levels of work time control in a nationally representative Swedish sample

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Background
Although research on flexible work time arrangements is on the rise, basic differences in the levels of work time control (e.g., control over start and ending times of a work day) between labour sectors, other work-related factors or demographic variables have been neglected. The present study aimed to investigate this matter and additionally analysed the factorial structure of an established measure of work time control.

Methods
The study was based on data from the 2014 data collection (n = 38657, response rate 52%) of the Swedish Longitudinal Occupational Survey of Health (SLOSH) which is a follow-up of an approximately representative sample of the Swedish working population. Work time control was measured multidimensionally using an established 6-item index. An exploratory and confirmatory factor analysis was performed to assess the factorial structure of the work time control measure. Differences in the levels of work time control were investigated for demographic and work-related factors with Mann-Whitney U and Kruskal-Wallis H tests. Because of the large sample size (valid n = 14974) focus for interpretation of effects was put on effect sizes instead of significances.

Results
Best model fit was found using 5 items of the work time control measure and a two-factor structure (RMSEA = .06; 95% CI .04 to .09; CFI = .99). The two components were ‘control of working time’ and ‘control of time off’. Women were found to perceive lower autonomy than men (Cohen’s d = .30/.47). Self-employed individuals reported higher control than employed ones (d = .23/.21), likewise the private sector reported higher control than the public sector (d = .36/.54). Effects of contractual working time (e.g., shift work including nights compared to daytime work, d = .41/.30) and actual working hours per week (e.g., 30 to 39 compared to 40 to 49 hours, d = .29/.24) on the perceived work time control levels were found. Working overtime at least once a week resulted in higher reported work time control than working less overtime hours (d = .43/.24).

Conclusion
The results point towards important confounding variables when researching work time control. Differences in perceived working time autonomy suggest that some groups (e.g., women, shift workers, the public sector, part-timers) seem to be in greater need of interventions to increase perceived work time control than others.
Thursday 11 June
Keynote II: Sleeping with one ear open

*Time:* Thursday, 11/Jun/2015: 9:00am - 10:00am  
*Location:* Room 1 (Conference room)  
*Session Chair:* Anne Helene Garde, NRCWE, Denmark
Sleeping with one ear open: how does on-call work impact sleep, waking function and home life?

**Sally Ferguson**
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Shiftwork and night work are associated with disruptions to sleep, adverse outcomes for health and well-being and unique challenges to home life. A large variety of working time arrangements are used around the globe and there is an increasing emphasis on the use of ‘flexible’ working hours. This paper briefly discusses the impacts of flexible hours on sleep, waking function and home life. The main focus however, is on a particular working time arrangement known as on-call, sometimes called standby.

On-call work arrangements are used by many industries to provide cover for emergencies or urgent situations. Industries from mining to medicine, reporters to railway engineers, emergency services to electricity companies, all employ workers who are on-call to respond to a variety of events. On-call work is most commonly scheduled out of ‘normal hours’ and therefore impacts on sleep and home life. While the disruptions to sleep when a worker is called are obvious, less clear is the impact on sleep if a worker is on-call but not called. We are working on a series of studies looking at the factors that impact sleep even in the absence of a call-out. Results from field studies suggest that factors such as anxiety about missing the alarm, anxiety about the circumstances an individual might face upon being called and uncertainty in relation to the likelihood they will be called may impact sleep.
Thematic Session IV: Work hours, sleep and injury

*Time:* Thursday, 11/Jun/2015: 10:30 - 12:30
*Location:* Room 1 (Conference room)
*Session Chair:* Anna Arlinghaus, GAWO e.V., Germany
*Session Chair:* Imelda Wong, Institute for Work and Health / University of British Columbia, Canada
Flexible work hours and accident risk
Friedhelm Nachreiner, Anna Arlinghaus, Jana Greubel
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Background and Methods
Flexible and thus variable work hours can lead to a desynchronization with biological and social rhythms, which, as demonstrated in shift work research, can impair safety, health and social participation. Recent research has shown that “unusual” working hours are also associated with an increased accident risk, even when controlling for shift work. Variability of flexible work hours which may lead to unusual hours might thus increase the occupational accident risk. Most of the available evidence has been gained with categorical or such analysis methods which do not provide for the distribution of rare events (both for accidents, time lost due to accidents and the degree of flexibility), thus possibly underestimating existing relationships.

Data from the 5th European working conditions survey (n=35,187, 34 countries) has been used for multivariate analyses using Poisson regression of factor analytically determined variability of hours and work load indices on the occurrence of accidents and the duration of lost time due to accidents, controlling for possible confounders, e.g. a priori risk of a job, sex, age, shift work, hours per week, etc..

Results
Subjective reported work load is a definite risk factor for the occurrence of an accident (ORs for different kinds of work load varying between .85 and 1.8), but even when controlling for these factors variability of working hours yields ORs of ≈ 1.15, using normal log regression. Using Poisson regression to estimate the effects of variability (main effects as well as interactive effects with the autonomy in controlling work hours) on the duration of lost time accidents yielded an OR of 1.8 for variability, representing the most substantial risk factor besides physical work load.

Conclusions
Flexibility of work hours, when associated with variability of work hours, must definitely be considered one of the important risk factors for occupational accidents. Variability thus should be controlled and reduced to an acceptable level, even when it results from employee controlled flexibility.
Accident risk on rotating shift systems: the roles of metabolic dysfunction and cognitive impairment

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Background
Safety on shift systems is a topic of major concern for two main reasons. First, a number of “headline” incidents such as Bhopal, Three Mile Island, Chernobyl, the Rhine chemical spillage and the Exxon Valdez, all occurred at night and have drawn attention to both the risk and cost of impaired safety on shift systems. Secondly, both the frequency and severity of occupational injuries is higher at night. At the same time, it is widely acknowledged that shiftwork also poses substantial risk to workers’ health. Some of the health problems associated with shiftwork (e.g. cardio-vascular heart disease) seem to be linked to shiftworkers’ heightened susceptibility to metabolic syndrome, compared to day workers. Metabolic syndrome is also associated with chronic impairment of cognition, although no published research has attempted to demonstrate such a link within the shift working population. Nevertheless, with emerging evidence that prolonged exposure to shiftwork leads to chronic cognitive impairment, the question arises as to whether metabolic syndrome mediates that relationship too. There is a substantial body of evidence linking obesity (one of the components of metabolic syndrome) to increased accident risk, a relationship that is not mediated by changes in sleep duration. Finally, the evidence for a link between cognitive impairment and accident risk, although limited in scope, provides reasonably good support for what is an intuitively plausible association. Thus, not only might metabolic syndrome underlie the greater prevalence of health problems experienced by shiftworkers, but it may also contribute to impairments in their cognition, with potential implications for both their job performance and risk of errors leading to accidents. It is our contention that the pathway from shiftwork to increased accident risk, via metabolic dysfunction and chronic cognitive impairment, may help account for an anomaly in the evidence concerning shiftwork and accident risk.

Method & Results
Drawing upon previously published data, and comparing it with predictions generated using the UK Health and Safety Executive’s ‘Risk Index’ (RI), we have identified notable discrepancies between the levels of risk associated with shiftwork in empirical studies and the levels of risk that are predicted by the RI.

Conclusion
We contend that the above discrepancies arise because the RI overlooks the chronic effects of shiftwork on cognition. These discrepancies highlight the shortcomings of attempts to predict the adverse consequences of shiftwork through the use of mathematical modelling of fatigue and/or risk.
Impact of work hours limitations on worker and patient safety in US Healthcare

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Objective
Healthcare facilities depend on the ability of their personnel to meet patient needs 24/7, relying often on long and demanding work schedules to meet these needs. Healthcare workers are subject to stressful working conditions and, with an aging population, an increasing numbers of patients to care for with inadequate staffing that relies on highly incentivized long working hours (Royal College of Physicians, 2006, Rogers, 2004). Long work hours, demanding work schedules and short sleep durations are associated with adverse outcomes on worker safety (injuries and “accidents”) and well-being (Caruso et al., 2006), in addition to an increased risk of serious medical errors (Landrigan et al., 2007). For example, an increase in both errors and near-errors due to reductions in cognitive performance mediated by sleep deficits was demonstrated in 502 critical care nurses, where error risk doubled for those working 12.5 or more consecutive hours and >40 hours per week (Lockley et al., 2004, Rogers et al., 2004). Work schedule is also significantly associated with patient mortality when staffing levels and hospital characteristics are controlled for; in particular pneumonia deaths (OR = 1.42) and acute myocardial infarction (OR = 1.33) were significantly more likely in hospitals where nurses reported schedules with long work hours (Trinkoff et al., 2011).

Work hour limitations have been implemented in the US healthcare environment to help ensure acceptable levels of health and safety risks to providers and patients. In 2003, the ACGME passed duty hour requirements (work hour limitations) for all US resident training programs, and were revised in 2001 which in summary limits work week to 80 hours (averaged over 4 weeks), continuous time on duty to 24 hours (+6 hours all tasks), 10 hours off between shifts for adequate rest, and requires 24 consecutive hours off out of every 7 days. In 2004, IOM recommendations were also made for nursing staff, prohibiting them from providing patient care in excess of 12 hours in any given 24-hour period and in excess of 60 hours per 7-day period.

This presentation describes the impact of work hour limitations on US healthcare worker safety risks and patient safety, together with challenges in their implementation based on a review of published literature. It ends by discussing proposed alternative approaches to managing fatigue among healthcare workers, such as a “Risk-Index” to evaluate the components of the work schedule to help ensure maximum worker safety (Folkard and Lombardi, 2004; 2006).
Shift work, fatigue and cognitive impairment: what are the next steps for future research?

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Nonstandard schedules can require workers to be awake during typical (night) sleeping hours, and sleep during regular waking (day) hours. The misalignment of wake/sleep and light/dark cycles can lead to disruption of normal circadian rhythms and the homeostatic drive for sleep. While recovery from short term sleep disturbances is possible, adverse effects of partial sleep may be cumulative, leading to chronic fatigue and the higher risk for workplace accidents.

Increased risk of accidents and decrements in cognitive performance (eg, decreased attention, slower decision-making abilities) among shift workers is often attributed to sleep-related fatigue. However, fatigue is considered to be complex, multidimensional construct which can also result from psychological and physical sources, such as stress or physical discomfort. Fatigue is sometimes considered to be an initial acute stress response to an activity and with adequate rest, effects can be diminished. Without sufficient recovery, fatigue can act as a stressor by activating neuroendocrine systems. Over time, chronic neuroendocrine activity can lead to a systemic inflammatory response, affecting regions in the brain (ie, prefrontal cortex and hippocampus) and ultimately memory and cognitive performance (eg. memory, concentration and motor skills).

Reviews of studies on the association of shift work with fatigue and performance have found that most assume that performance deficits and injury risk remains constant throughout a shift. However, job tasks, staffing numbers, workload and environmental exposures may differ between night and day shifts. This may contribute to fatigue and cognitive performance differences among shift workers. As such, other sources of fatigue, in addition to sleep-deprivation should be considered when examining the effects of shift work on cognitive performance and accident risks.

This short presentation will conclude the thematic session on “Work hours, sleep and injury”. The aim is to provide a brief review of existing literature to generate discussions on future research directions. Industry members, policy makers, practitioners, scientific researchers and all other interested conference attendees are invited to raise questions and participate in the discussion.
Travel weariness and workplace accidents

Olav Titus Muurlink¹, Georgina Murray², David Peetz²

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Introduction
Distance to work has not been widely studied as a variable impacting on aspects of workplace performance (Koslowsky et al 1995). Waterhouse’s term ‘travel weariness’ (2004) has been applied to work performance chiefly in a sporting context and with long distance air travel. This study focuses instead on long distance road and air travel as a component of the working day of miners, and the relationship between the total of commuting and work time as a predictor of accidents rather than motor-vehicle injuries as a function of commuting distance (e.g. Trimpop et al 2000) or motor accidents resulting from working hours (e.g. Barger et al., 2005). Lukes (2008) used commuting distance as a proxy for fatigue and found commuting distance had no measurable impact, while Smiley (1955) focused on accident-prone workers, and found no relationship between travel time and accidents.

Methods
The Australian Coal and Energy survey is a longitudinal study (wave 1 cohort of 2752 members, wave 2 ‘survivors’ of 950) of the Construction, Forestry, Mining and Energy Union’s (CFMEU) mining division members. Participants were given a bank of scales, including key components of the SSI, the Epworth sleepiness Scale (Johns, 1991), and scales of workplace and non-workplace accidents in the previous 12 months.

Results and conclusions
Results indicate that more than twice as many of the miners who characterised themselves as “drive-in-drive-out” miners were in the high range of the Epworth Sleepiness Scale compared with a reference group of Australian adults, and showed higher Epworth scores than ‘fly-in-fly-out’ miners. Controlling for key demographics and accident proneness, weariness was significantly predicted by a total of work hours and travel time, and significantly predicted workplace accidents.


OS 4A: Chronotype and diurnal rhythms

_Time:_ Thursday, 11/Jun/2015: 13:30 - 15:00
_Location:_ Room 1 (Conference room)
_Session Chair:_ Claudia Roberta Moreno, University of São Paulo, Brazil
_Session Chair:_ Dorothee Fischer, Ludwig-Maximilian-University Munich, Germany
Does chronotype impact health measured by Work Ability Index?

**Mei Yong**, Dorothee Fischer, Christina Germann, Céline Vetter, Stefan Lang, Christoph Oberlinder

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**Background**

The individual phase of entrainment (chronotype) of the circadian system regulates physiology and behavior so that peaks and troughs occur earlier or later within the 24h day. A misalignment between the individual biological time, which can be assessed by chronotype, and social time, as determined by work schedules, results in a so-called social jetlag. Both chronotype and social jetlag may potentially influence health. The present study investigates the impact of chronotype, sleep duration, and social jetlag on self-estimated health, measured by Work Ability Index (WAI), within an industrial setting.

**Methods**

Between 2011 and 2013, 2474 employees participated in a health check offered by an occupational health promotion program and filled out the Munich ChronoType Questionnaire, adapted to the 3x12h shift schedule, and the Work Ability Index (WAI). We computed sleep duration on work and free days, chronotype (based on mid-sleep timing on work days and corrected for sleep debt accumulated during the work week) and social jetlag (difference between mid-sleep on work and free days). The WAI summarizes 7 dimensions with respect to one’s own health, ability to cope with job demand, and mental resource which yields a sum score ranging from 7 to 49. We used linear regression models to examine the impact of chronotype, sleep duration, and social jetlag on the WAI sum score after adjusting for potential confounders such as age, gender, smoking behavior, and job level.

**Results**

The median WAI of the present study population was 42 (inter-quartile range: 39-44). Participants reported an average daily sleep duration of 7.35h (SD: 1.2), had an average chronotype of 3:08 am (SD: 1h). Average social jetlag corresponded to 1.96h (SD: 2.05). Increasing social jetlag was associated with a decreasing WAI sum score, and longer sleep duration was positively associated with WAI. Chronotype was not significantly associated with WAI. All associations remained significant after multi-variable adjustment.

**Conclusion**

In line with a growing body of literature, our results show that circadian misalignment, but not chronotype per se, may be critical for health outcomes. Our results suggest that adequate sleep duration and work schedules minimizing the mismatch between work and circadian time could have positive repercussions on health.
Association between melatonin onset, sleep timing, age and chronotype in rotating shiftworkers
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Background
In order to elucidate the pathophysiological mechanisms by which night work has a negative impact on health, the conflict between the natural light-dark cycle to which workers are exposed and their work schedule needs to be further investigated.

Objective
To determine the relationship between sleep patterns, chronotype and melatonin secretion among shiftworkers and living in an environment with a natural 12:12h light-dark cycle. Method: The study was performed with 20 shiftworkers residing on an Amazonian reserve and working in the following rotating shifts: Evening (15:00-23:00h), Morning (06:00-15:00h) and Night (22:00-06:00h). The workers answered questions about their diurnal preference (Diurnal Preference Scale); chronotype (Munich Chronotype Questionnaire for Shiftworkers); sleep characteristics (Karolinska Sleep Questionnaire); and on sociodemographic data, lifestyle, and work organization. In addition, the workers filled out diaries, wore actimeters and answered the Karolinska Sleepiness Scale throughout the 21-day work cycle. Saliva collection to estimate dim light melatonin onset–DMLO was carried out on the fifth night of work and on the first day off

Results
Workers were divided into two groups according to DLMO: Late Group (DLMO≥22:00) and Early Group (DLMO<22:00h). Workers from the Late Group were younger (mean=21.5 years; SE=0.48) compared to the Early Group (mean=30.3 years; SE=2.91) (p>0.01), and also exhibited a greater tendency for evenningness (mean=03:54 hours; SE=0.39) compared to the Early Group (mean=05:44 hours; SE=0.34) (p<0.001). For the evening shift, workers from the Late Group slept later during the work week (mean=00:45; SE=0.18) and also on their days off (mean=01:09; SE=0.40) compared to the Early Group on work week (mean=00:07; SE=0.07) and days off (mean=23:28; SE=0.28) (F=8.20; p<0.01). For the morning shift, the Late Group showed mean sleep onset of 22:46h (SE=0.15) on work days, whereas the Early Group had a mean of 22:07h (SE=0.15); mean sleep onset on the days off was 00:27h (SE=0.58) and 22:34h (SE=0.24) in the Late and Early Groups, respectively (F=6.9; p<0.05). For the evening shift, an effect of the late onset of melatonin on mean waking times was identified (F=4.63; p<0.05), showing that workers from the Late Group woke later compared to the Early Group.

Conclusion
Our findings showed that the group of workers reacted differently to exposure to the same shift schedule, where a late melatonin onset after night shifts was found only in the younger workers with a tendency for evenningness.

Support: FAPESP-UniS (2011/50169-6); UGPN-Research Collaboration Fund (Call-2012); CNPq (471085/2010-3); FUNTAC (752618171/11); CAPES/STINT (004/2012); FAPESP (2011/19563-0; 2014/01514-0).
Individual time trends in cortisol response to shift work; A longitudinal study.
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Background
Cortisol awakening response (CAR) is a reliable biological marker for the adrenocortical activity. Therefore, CAR is a strong indicator for individual differences in shift work tolerance. The objective of this longitudinal study was to investigate individual trends over time in the cortisol response to rotational shift work.

Methods
46 novice police officers were examined four times within their first years of rotating shift work. At baseline (prior to commencing shift work) and during 3 follow-up sessions after 4, 12 and 18 months of rotational shift-work. Each time, cortisol saliva samples were collected immediately upon awakening and 30 and 60 minutes thereafter. To estimate the CAR, the Area under the curve (AUC) was calculated. In addition to CAR, subjective fatigue was assessed with the checklist individual strength (CIS). To explore trends over time, repeated measures Anova with trend analysis was performed.

Results
For the averaged group trend (N=25, complete records), the CAR increased significantly between 4 and 12 months and remained elevated at 18 months of shift work. Polynomial contrasts in repeated measures Anova detected both a significant linear and cubic trend over time. The inspection of individual time trends revealed two subgroups. Over the first three time points a similar trend was shown for all subjects. After 12 months, the first subgroup (N=9, 4 females) showed an upward trend in time; the CAR increased even more at 18 months. The second subgroup (N=16, 5 females) showed a more cubic trend; the CAR declined at 18 months. Remarkably, participants reported no differences in subjective fatigue over time.

Conclusion
Police officers showed an elevated stress response within the first 1.5 years of working rotating shifts, with detectable individual differences in time trends. For some shift workers the stress response kept rising, whereas for others first signs of a stabilization appeared. Early signs of elevated stress responses might help to prevent further associated health problems, through proper countermeasures adjusted to the individual shift worker.
Association between chronotype, food intake and physical activity in medical residents

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A. Background
Chronotype, an attribute that reflects individual preferences in the timing of sleep and other behaviors, is a continuum from morningness to eveningness. Evening types tend to have unhealthy lifestyle and suffer from psychological problems more frequently than morning types. In terms of nutritional status, evening types has been associated with higher values of body mass index (BMI) when compared with morning types. In this study, we examined the relationship between chronotype, sleep, food intake and physical activity.

B. Methods
The study included 72 resident physicians (52 women and 20 men) who underwent the following assessments: anthropometric variables (height, weight, body mass index and waist circumference) and sleepiness (Epworth Sleepiness Scale - ESS). Assessments included the Horne and Ostberg Morningness-Eveningness questionnaire and, based on their scores, chronotype was also analyzed as a continuous variable. Food intake was determined through a self administered food diary that was kept over the course of 3 non-successive days and included a day shift, a night shift and a day off. Physical activity was assessed using the Baecke questionnaire (BQ), from which three indexes are calculated: the work index (refers to physical activity at work); the sport index (refers to sports participation during leisure time); and the leisure-time index (refers to physical activity during leisure time, excluding sport activities).

C. Results
Analysis of chronotype categorized 26 participants as morning types, 36 as intermediate types and 10 as evening types. In the linear regression, after adjustment for age, sex, BMI, hours of additional work per week and ESS, chronotype score remained negatively associated with cholesterol (coefficient =-0.24; p=0.04), and sweets intake (coefficient=-0.27, p=0.03); however, it was also identified a negative association with vegetables (coefficient=-0.26; p=0.04), and a positive association with oils intake (coefficient=0.27, p=0.03). Regarding the physical activity level, following the same statistical adjustments chronotype score remained positivity associated with leisure-time index (coefficient=0.26, p=0.03) and BQ total score (coefficient=0.27, p=0.03).

D. Conclusion
Progression towards morningness was associated with higher level of physical activity during leisure time and total physical activity. In addition, inadequate food intake were identified with both lower (i.e. eveningness) and higher (i.e. morningness) chronotype score. The findings emphasize the importance of separating between different dimensions of chronotype when examining its relationships with feeding behavior.
Night work and breast cancer in women
Torbjorn Åkerstedt1,2, Jurgita Narusyte1, Pia Svedberg1, Anders Knutsson3, Göran Kecklund1, Kristina Anderson1
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Earlier research on night work and breast cancer has given varied results although the overall impression suggests a link. Few of the studies have been cohort studies with data analyzed in relation to years of exposure. The present study used a register with 13000 women (from the Swedish Twin Registry), starting in 1998 with information on night work and a follow-up in the Swedish cancer registry up to 2012. All diagnoses of cancer in Swedish health care are found in the register and may be linked to the Twin Registry using each individuals social security number. Individuals 40-60 years of age at baseline were included. The analysis (Cox regression) controlled for a number of background factors. The results for the group with longest exposure to night work (>20 years) showed a Hazard Ratio (HR) = 1.77 with a 95% Confidence interval (Ci) =1.03-3.04 in the group followed to 60 years of age. For the full group the result was HR=1.68 (Ci=0.98-2.88). Groups with 1-5, 6-10, 11-20 years of exposure showed non-significant (and low) HRs.It was concluded that the present data, together with previous work suggests links between long-term exposure to night work with the occurrence of breast cancer in women.
Oral Session 4B: Improving shiftwork: Interventions and solutions

*Time:* Thursday, 11/Jun/2015: 13:30pm - 15:00pm

*Location:* Room 2

*Session Chair:* Henrik Kolstad, Aarhus University Hospital, Denmark

*Session Chair:* Ann Dyreborg Larsen, National Research Centre for the Working Environment, Denmark
Shift work intervention process
Sarike Verbiest\textsuperscript{1}, Hardy Van de Ven\textsuperscript{2}, Jac Van der Klink\textsuperscript{2}, Sandra Brouwer\textsuperscript{2}, Wendy Koolhaas\textsuperscript{2}, Ute Bültmann\textsuperscript{2}, Michiel De Looze\textsuperscript{1}
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Background
Nearly 20\% of the labour force worldwide works in shifts that include work hours outside 07:00 and 18:00. Shift work is generally organized following a specific time schedule. Organizations may consider a schedule adjustment based on different reasons: increased need for flexibility, cost reduction, growth or decline in production demands, and, an aging work population. The adjustment of shift work schedules is a complex process in organizations. Different stakeholders with different stakes are involved in the schedule adjustment. A process that does not take into account the interests of all stakeholders involved, may lead to resistance and will most probably fail. The process towards a new work schedule is as important as the new work schedule itself.

Research question
In the present study, work schedule intervention processes in six different Dutch production companies were analysed. The research question is: ‘What are facilitating and impeding factors for the implementation of a work schedule adjustment in companies?’ Four sub questions address employee participation, management vision and support, the role of trade unions and the role of headquarters.

Method
The process was analysed using a qualitative research technique, the framework approach. Interviews were conducted with different stakeholders in the companies. The framework approach was useful in identifying the facilitating factors in the process towards intervention accomplishment. By using change management theory and expert insights as input for the interview questions, a broad view was derived on the research topic.

Findings
The study shows that involvement of different stakeholders in the work schedule intervention process in a timely matter, is important to facilitate the intervention process. Employee participation and management vision and support are no guarantee for the implementation of an intended intervention. If central organisational policies need to be adjusted, the involvement of trade unions and headquarters are an impeding factor. The intervention process may fail, due to failed negotiations. Finally, the case companies showed that in work schedule interventions, production reasons are dominant over sustainable employability reasons.
Simplified participatory procedures for improving mental health of workers including joint change of working time arrangements and job content

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Background
Advances are seen internationally in improving working time arrangements and job content in a combined manner. Awareness is growing that both these aspects need to be addressed in improving mental health of workers. Recent experiences in participatory approaches for improving mental health demonstrate the merits of applying simplified procedures for facilitating the improvement actions.

Methods
The participatory procedures of implementing immediate actions for improving mental health of workers in selected workplace programmes are examined by comparing the group work process. The programmes studied include participatory mental health activities for local government employees, health/nursing care facilities and small enterprises. The common features of the participatory procedures facilitating the improvement process are discussed.

Results
The reviewed programmes comprise serial group-work steps for implementing multifaceted improvements at the workplace. A clear emphasis is placed commonly on a broad range of workplace improvements that contribute to reducing stress at work and improving mental health of workers. A common emphasis is placed on improving teamwork, work schedules, work methods, physical environment, communication and welfare conditions. To facilitate the planning of improvements, all these programmes focus on local good practices and facilitate the planning process by means of simplified, easy-to-follow procedures for group work of workers. These procedures thus consist of serial steps of (a) learning local good practices and potential improvements, (b) group work on existing good practices and proposing immediate improvements, (c) agreeing on immediate improvement plans, and (d) implementation and reporting of improvements within a deadline of a few months. These steps are usually realized by utilizing a mental health action checklist adapted to the local situation and by organizing a brief group work session for proposing immediate improvements. The group work results generally led to many concrete improvements. Actions in working time include limiting overtime hours, planning of paid leaves, securing resting periods and rearranging tasks. These actions are usually conducted in combination with other actions such as teamwork arrangements, ergonomic methods and mutual communication. Main contributing factors for multifaceted improvements are the simple group work procedures and the use of a checklist for proposing feasible actions.

Conclusion
The simplified participatory procedures utilizing action tools are found to facilitate the implementation of multifaceted improvements including working time arrangements with visible impacts on mental health of workers. It is suggested to undertake easy-to-follow procedures with a view to multi-area actions including teamwork, working time and productive work.
Effects of a change in collective agreement–based rules of working hours for shift ergonomics among nurses – a controlled intervention study

Annina Ropponen, Päivi Vanttola, Aki Koskinen, Tarja Hakola, Sampsa Puttonen, Mikko Härmä
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Background
Legal regulations and collective agreements influence working hours and the possibilities for ergonomic shift scheduling. In Finland, the working hours in the municipal health and social sector are mostly irregular and arranged in the periods of two or three weeks. Trade organizations initiated a trial period in the beginning of 2013 to test a modification of the collective agreement at the health and social sector. The main changes included the fixation of total working hours for the two or three week period and limiting possibilities for time compensation of overtime or shift work and lost time due to absences. This study evaluated the effects of the new regulations on shift ergonomics using pay-roll data on working hours.

Methods
The final sample consisted of 493 nurses of hospitals, elderly care, and a laboratory unit who were voluntary to participate the trial, and 2303 age-, sex-, and occupation-matched controls from a large hospital district. All these had at least one working day in both the years 2012 and 2013. The working hour data were collected from employers’ electronic working hour records and analyzed by calculating the annual prevalence for 29 different shift ergonomics factors. Repeated measures mixed model was applied to estimate the effects of group, time and the interaction between group and time for shift ergonomics factors in 2012 (prior the trial) and 2013 (during the trial).

Results
The changes in shift ergonomics between the two years were mostly small and affected both the trial and the control group. Based on significant interactions between time and group, some evidence of trial effect were detected: in the trial group the proportion of having short recovery periods (< 28 h) after the last night decreased from 5% to 3%. The proportion (%) of long (> 48h) working weeks decreased from 19% to 17% and the mean number of leave days/period decreased from 5.8 to 5.3 days. In addition, very small but statistically significant increases were detected in shift characteristics describing shift intensity (for example in the number of consecutive working days).

Conclusion
The modification of the collective agreement had only minor effects on shift ergonomics. The slight improvements in shift characteristics may have been influenced not only by the change in regulations, but also by concurrent emphasis and instructions to follow good shift ergonomics. The introduced limited possibilities to use time compensation for overtime may have negative influence on shift ergonomics.
Pharmacological interventions for sleepiness and sleep disturbances caused by shift work
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Background
Shift work is associated with reduced sleep duration and impaired quality in daytime sleep between shifts, and reduced alertness during night shifts. Shift workers frequently use pharmacological substances for better sleep and alertness. The effectiveness of drugs in shift work was evaluated in a Cochrane Review.

Methods
Eligible studies on pharmacological interventions were sought by searching the data bases for RCT or cross-over RCT studies made in shift work employees with or without shift work disorder. Primary outcomes were alertness and sleepiness at work and sleep length and sleep quality while off work.

A total of 15 trials (1240 participants) were included. Nine trials used melatonin and one hypnotic drug (zopiclone) to improve sleep after night shift. Two trials used armodafinil, one modafinil and one caffeine with naps to reduce sleepiness during night shift.

Results
Melatonin (1 to 10 mg) after the night shift was associated with significant increase in sleep length in daytime (mean increase 24 minutes, low quality evidence) and increased night-time sleep when compared to placebo. There was no dose-response association. There was no association between melatonin and sleep latency. The hypnotic medication, zopiclone, was not associated with longer daytime sleep length compared to placebo and there were no sleep data in another study on lormetazepam.

Armodafinil before the night shift significantly reduced sleepiness during the night shift (-1.0 point on the Karolinska Sleepiness Scale (KSS) moderate quality evidence) compared to placebo. Modafinil was also associated with a reduction in sleepiness (-0.9 points in KSS, moderate quality evidence) and increase in alertness in patients with shift work sleep disorder. Adverse effects reported by trial participants were headache (modafinil 34%, Placebo 23%) and nausea (11% and 3% respectively). Post-marketing surveys reported rare severe skin reactions such as Stevens-Johnson syndrome. Based on one trial, caffeine plus pre-shift naps taken before the night shift were associated with decreased sleepiness (-0.6 point in KSS, low quality evidence) when compared to placebo.

Conclusion
Use of pharmacological substances to reduce consequences of shift work brings only limited and temporary relief. Alertness increasing drugs have also risk of frequent mild side effects and may have risk for rare serious side effects.
The effect of timing of exposure to monochromatic blue light on objective and subjective alertness and mood

Irena Iskra-Golec, Krystyna Golonka, Mirosław Wyczesany, Patrycja Siemiginowska, Joanna Watroba, Anna Wazna, Ryszard Przewlocki, Małgorzata Dziewa, Sylwia Kozera, Szymon Kukulski

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Background

There is a growing evidence on non circadian effect of monochromatic blue light on human physiology and behavior. However, its effect at different times of the day is not well documented yet. The aim of the study was to examine the effect of monochromatic blue light on objective and subjective indices of alertness and mood at different times of day.

Methods

Fifteen students aged between 19 and 25 years (mean=22.3 years) were studied (first stage of the experiment). A within-subject, counterbalanced repeated measures design was applied. The 16-h daytime period was divided into three sessions (07.00-12.20; 12.20-17.40; 17.40-23.00 h) with measurement times at their beginnings and ends. Each participant took part in each session (one session per day) in both light conditions. The two light conditions comparable in luminance (0.696-0.762 cd/m²) and different with regard to the wavelength were applied (control conditions with white light of 6.5 lux intensity; experimental conditions with monochromatic blue light (460 nm) of irradiance 11.8 μW/cm²). Alertness in the central nervous system was measured by EEG spectral power parameters. Sleepiness, subjective alertness, and mood were assessed by means of KSS (Akerstedt & Gillberg, 1990), Thayer list (Thayer, 1970), and UMACL questionnaire (Matthews et al., 1990) respectively.

Results

Three factor analyses of variance with repeated measures were applied (factors: light conditions (LC), session (S), and measurement time (MT)). Main effect of LC was found in alpha power (F(1, 7)=9.162, p=.019) which in MBL conditions decreased when compared to WL conditions. Interaction of LC, S, and MT was found in theta power (F(2, 14)=3.817, p=0.48) which decreased in the last session in MBL conditions when compared to its relatively stable level in the other sessions. Interactive effect of LC and MT was found for hedonic tone (F(1, 14)=5.056, p=.02) which decreased in WL and increased in MBL conditions from the first to the second MT. Interactive effect of LC, S and MT (F(2, 28)=13.00, p=.05) was found for tension. Tension increased during the first session and then remained stable in WL conditions while in MBL conditions increased during the second session and then decreased.

Conclusion

Objective measures showed an increase of alertness in MBL when compared to WL conditions especially during evening hours. Subjective measures showed the effect of MBL on mood like increase of hedonic tone and tension. The effect of MBL on tension seems to be more pronounced in the early afternoon hours.
Improving safety and operational flexibility in an Air Traffic Control system using Fatigue Risk Management

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The consequences of fatigue in Air Traffic Control systems are potentially catastrophic. In everyday operations, smaller consequences occur with negative safety, operational efficiency, compliance and reputation outcomes. Airservices is the air navigation service provider for 11% of the world’s surface, including all of Australia. Integrated Safety Support worked with Airservices Australia to enhance their Fatigue Risk Management System (FRMS) and validate its effectiveness. The project involved union, operational, management and scientific stakeholders.

The project involved the development of essential rules and resources including:

1. Scientifically-based rules for strategic scheduling of hours of work,
2. Flexible principles based on the hours of work rules to maintain operational efficiency,
3. An electronic process to support the use of additional risk controls when flexibility was required,
4. A method for accepting certain shift swaps between employees,
5. Training and communication programs aimed at raising awareness, compliance and personal accountability,
6. Advanced tools for reporting and investigation of possible fatigue-related safety incidents, and
7. A monitoring, reporting and continuous improvement system to allow the FRMS to improve based on data and lessons learned.

More than one year after the completion of the FRMS project, in August 2014, there was a major review of the data that had been generated from the most recent 12-month period as compared with the 12 months earlier. The Air Traffic Controllers had worked 1,799,933 hours, up 1.98% from the previous year. The compliance of work periods with the organisational target of less than 80 points using the FAID Fatigue Management software program was improved to 99.1% from 99.0%. The proportion of risk assessments accurately completed, including those not yet signed off for implementation, increased from 87.6% to 91.9%. Other results will also be discussed.

Operational flexibility was most frequently required for:
(a) Reducing the minimum break between shifts to <11h,
(b) Increasing the maximum number of consecutive shifts to >7,
(c) Using backwards rotation beyond prescribed limits and
(d) Reducing the length of the two ‘weekend equivalents’ per 28 days to less than 59 hours per break.

The most common risk controls used were:
(a) Controlled naps of >45mins duration,
(b) Sharing workload by rotating or sharing positions,
(c) Increasing the number and/or duration of breaks and
(d) Ensuring rest and meal breaks were taken.

This project demonstrates that it is possible to successfully achieve simultaneous improvements in safety, risk and compliance metrics while maintaining operational flexibility and productivity.
Friday 12 June
Keynote III: Promoting older workers' job retention and health

Time: Friday, 12/Jun/2015: 9:00 - 10:00
Location: Room 1 (Conference room)
Session Chair: Anne Helene Garde, NRCWE, Denmark
Promoting older workers’ job retention and health by working hour patterns

Mikko Härmä
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Changing physical, medical, social and personal needs and growing individual differences during ageing create individual needs for the modifications of working hour patterns. Older workers have more often insomnia, are more often morning types, and may have higher needs for recovery. Adaptation to night work is highly individual, and older shift workers often represent a strictly selective population with different work characteristics and working hours compared to younger workers. In rotating night shift work, ageing is related to shorter sleep during the day after the night shifts and possibly lower cognitive performance during consecutive night shifts. Since ageing is normally related to longer shift work exposure, older shift workers have a higher risk for chronic diseases normally associated with shift work. There is also considerable evidence that certain aspects of working hours, especially poor work-time control, are related to disability pensions and earlier retirement.

The job retention and wellbeing of older workers can be supported by specific working hour patterns as either "push" or "pull" factors in relation to older workers’ job retention and health. Shift work can be an additional risk factor for exit from work while some other features, like work-time control and part-time work, could offer opportunities for more sustainable work. Although evidence is still insufficient, we can hypothesize that improvement in working hours can extend individual working careers and increase the work ability of older workers by means of prevention of health problems, decrease of work load and improvement of work-life balance.

The prevention of health problems is possible by shortening long working hours and by favoring the use of forward rotating shift systems. Shorter working hours, part-time work, and partial sick-leave arrangements can help ageing workers with disabilities. The improvement of work-life balance by supporting individual possibilities to control working hours is one of the most promising ways to support work ability and to make working life a more attractive option for the growing number of ageing workers. Considering the increase of individual differences due to ageing, the promotion of health and work ability of the more heterogeneous older work force should be based on individual solutions.
Thematic Session V: Measurement and Prediction of Workplace Fatigue

Time: Friday, 12/Jun/2015: 10:30 - 12:45
Session Chair: Hans P.A. Van Dongen, Washington State University, United States of America
Session Chair: Torbjorn Åkerstedt, Karolinska Institute, Sweden
New technologies for fatigue measurement
Pia Marina Forsman
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There has been considerable progress in the development of technologies that detect objective signs and symptoms of fatigue. Further progress requires dealing with several significant challenges. Over the 24-hour day, fatigue develops non-linearly and exhibits transient fluctuations. Moreover, fatigue affects performance in different individuals in different ways. Useful fatigue detection technologies must be sensitive, specific, and have user acceptance.

Fitness-for-duty tests assess whether a person is sufficiently alert to commence work and/or finish a shift. These tests are usually brief and portable, but it is unclear if they can predict onset of fatigue during a shift. Moreover, fatigue mitigations (e.g., caffeine and social interaction) can transiently make the test-taker appear less fatigued. Effective fatigue risk management would require that individuals re-test periodically during a work shift, which may be hard to implement in practice. Online monitoring of psychophysiological correlates of fatigue addresses this issue and provides a potentially sensitive way to detect the onset of fatigue in real time. Unfortunately, these tests may not predict task-specific performance impairment and may require wearing a monitor that evaluates the user rather than his/her ability to perform tasks. Such monitors may affect user acceptance negatively.

Online monitoring of embedded performance metrics drawn from the work environment or from the equipment being operated may provide a task-specific and non-invasive solution. An example is monitoring driving performance from car-based signals. Current car-based lane departure warning systems video-monitor lane markers and alarm the driver about unintentional departures. Such systems miss even 70% of lane departures because of data loss (e.g., due to light conditions). Lane position can also be derived from the steering wheel signal, which is more robust than video-based approaches. Moreover, a fatigued driver tends to make less corrective steering movements but more over-corrective movements. This results in larger steering variability, which can be detected before outright lane departures occur. We are developing techniques for estimating fatigue from the steering wheel angle and for detecting steering movements that predict upcoming over-corrective steering movements, in order to give drivers time to implement preventive countermeasures.

A way forward for monitoring and predicting fatigue in operational settings may involve combining several different techniques, including monitoring of psychophysiological variables and embedded performance metrics, enhanced with mathematical/statistical forecasting methodology.
Performance Assessment in Operational Settings

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Objectively assessing performance impairment due to fatigue or other stressors in operational settings involves unique obstacles. For instance, in aviation and road transportation, duty shifts may vary by day and change in real time during operations, making it difficult to take performance measurements that accurately reflect duty requirements and task load. Nonetheless, carefully selected performance assays can provide reliable assessments in operational settings. Understanding the unique aspects of an industry and creating detailed study protocols and measurement procedures are essential to meaningful data collection. Here we illustrate some approaches to performance assessment in operational settings.

Truck driver duty hours vary by day and by individual. In a within- and between-subjects, naturalistic, field study examining driving times, sleep schedules, and performance impairment, professional truck drivers were studied over two full duty cycles and the intervening break. Sustained vigilance performance was measured repeatedly using a 3-minute psychomotor vigilance test (PVT) administered before, during and after each duty day. Results showed that drivers with two or more biological nights in their break between duty cycles obtained more sleep during the break and had less performance impairment during duty cycles than drivers with only one biological night.

Commercial aviation faces variable weather and air traffic conditions and potential flight delays. In a within-subjects study of regional airline pilots to compare performance between a single-segment and a multi-segment duty period of equal duration, these factors were standardized, without losing operational realism, with a high-fidelity, moving-base flight simulator. A researcher in the simulator ensured collection of repeated, high-quality performance measurements on a 10-minute PVT, and a flight simulator operator rated pilots’ flight performance. Results showed that there was a small but significant build-up of performance impairment across the multi-segment duty period that was not observed in the single-segment duty period, but ratings of flight performance were the same.

Police officers work in complex, high-risk operational settings. In a within-subjects, hybrid-design study combining the real-world duties of officers with laboratory-based testing of performance, active-duty officers were tested twice: at the end of the last of five consecutive night shifts, and at the same time of morning after three days off duty. Performance was measured using a high-fidelity driving simulator and 10-minute PVT administrations. Results showed that fatigue caused by real-world night shift duties, as compared to baseline after three days off, caused police officers to experience PVT performance impairment and greater lane deviations during simulated driving.
Model Predictions of Workplace Fatigue
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Mathematical models of sleep and fatigue are increasingly important in fatigue risk management systems in aviation and other transportation modes and in many 24/7 industries. Sleep and wakefulness are regulated by a homeostatic process exerting pressure for sleep as a function of current hours awake and past sleep and wakefulness, and a circadian process exerting pressure for wakefulness as a function of time of day. Under conditions of sleep loss, shift work or transmeridian travel, these two processes are misaligned, resulting in fatigue and performance impairment. Mathematical models of sleep and fatigue track the homeostatic and circadian processes and predict fatigue levels.

While predicted fatigue does not, by itself, predict the exact degree to which performance on a particular task will be degraded, the general trends of performance impairment can be predicted and fruitfully applied in operational settings. Risk of errors and accidents increases as a function of both predicted fatigue level and duration of exposure. Fatigue model-predicted risk may be evaluated in the context of other (non-fatigue-related) factors contributing to error/accident risk by means of a performance risk model approach.

Recent developments introducing distribution-based fatigue modeling have enabled the development of a performance risk model framework that is probability-based. Such a framework allows for statistically valid comparisons of relative risk levels associated with different work schedules and for cost/benefit analyses of fatigue countermeasures. This provides a fatigue risk management tool that helps to direct risk mitigation resources to where they are most needed and will be most effective.
Subjective sleepiness as a measure of fatigue

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The main consequence of insufficient sleep is sleepiness. While measures, such as sleep latency, continuous EEG/EOG recording and performance tests are useful indicators of sleepiness in the laboratory and clinic, they are not easily implemented in large, real life, field studies. Subjective ratings of sleepiness, which are easily applied and unobtrusive, are an alternative, but whether they sensitively, reliably and validly measure sleepiness remains uncertain. This presentation brings together research relevant to these issues. It is focused on the Karolinska Sleepiness Scale (KSS) which is a 9 point Likert type of scale. The literature shows that the diurnal pattern is U-shaped, with high KSS values in the morning and late evening, and with a great stability across years. KSS values sensitively increase during acute total and repeated partial sleep deprivation and night work, including night driving. The effect sizes range between 1.5 and 3. Also morning work (shifts) are associated with intermediate levels of sleepiness. The temporal pattern of sleepiness is markedly similar across different studies of shift work, including flights across time zones. The relation to driving performance or EEG/EOG indicators of sleepiness is strongly curvilinear and consistent across individuals. The highest values are particularly associated with impaired driving performance and sleep intrusions in the EEG. KSS values are also increased in conditions such as sleep apnea, depression and burnout. Importantly, physical activity, social interaction and strong lighting will reduce KSS values by 1-2 units. Time on task in a monotonous context will increase KSS assessed sleepiness by 1-2 units. Thus, context is important. In summary, subjective ratings of sleepiness as described here are as sensitive and valid as indicator of sleepiness as objective measures, and particularly suited for field studies.
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