

SHIFTWORK INTERNATIONAL NEWSLETTER

The official newsletter of the *Scientific Committee on Shiftwork*
of the *International Commission on Occupational Health*
and the *Working Time Society*

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Editorial

Dear S.I.N. readers, it has been a very long time since the last edition and we must thank you for your enviable patience. We are now very pleased to deliver this issue, which is dedicated largely to the 19th Symposium in Venice. Along with recent news announcements, it contains the detailed Symposium program and the full collection of abstracts. It provides an opportunity for those who were unable to attend this delightful and scientifically stimulating meeting to still enjoy its intellectual content.

We are committed to continuing to develop S.I.N. to make it as interesting, widely accessible and useful as possible. As it is a tool to promote communication and capacity building, the editors recommended, and the Board agreed, that the electronic version of S.I.N. should now be free. As a searchable PDF file, it can be quickly searched to locate information of interest. It can also be easily e-mailed to subscribers or made available for download from the WTS website. The paper version is costly to produce and distribute, so national libraries and other subscribers who require hard copies will still have to purchase their subscriptions.

With regard to content, there is ongoing interest in developing new columns and enhancing established ones, such as the popular *Viewpoints*. We are currently seeking material for the next issue, which will appear before the Stockholm symposium in June next year. Please consider writing an opinion piece (the more controversial the better!) or providing suggestions for improvements to S.I.N. and the WTS, or ideas about how we can become a more relevant and accessible source of information for corporate and government decision-makers. There is an enormous pool of talent and expertise in our organization and we should ensure that it produces as much benefit as possible for shiftworkers and the wider workforce.

Philip Bohle, Executive Editor
Stephen Popkin, Associate Editor
Masaya Takahashi, Associate Editor

President's Report

Dear Members and Friends

This issue includes abstracts from the papers presented at the XIX International Symposium on Shiftwork and Working Time – “Health and well-being in the 24-h Society”, held at San Servolo Island, in the Venetian lagoon, 2-6 August, 2009.

The large number of participants, 170 from 29 countries all over the world, and their contributions, via 100 oral and 50 poster presentations plus many fruitful discussions, made the the Conference a great success, and confirmed the scope

(Continued on page 2)

President's Report (continued)

and relevance of the *Working Time Society* (WTS) and of the *ICOH Scientific Committee on Shift Work and Working Time*, for promoting workers' health and well-being.

The increasing number of young scientists and newcomers from developing countries, and the presence of scholars with different backgrounds (biology, medicine, psychology, sociology, management), testify to the growing interest and importance of this issue and its multifaceted aspects warranting more and more attention in a globalised world.

The Symposium succeeded in providing up-to-date information on many important topics concerning old and new risks associated with night and shift work, and new trends in working time organization, proposing practical interventions and feasible solutions for better adaptation of workers to irregular working hours.

In particular, interesting information and questions emerged in the five special sessions debating "hot" topics, such as Cancer Risk, Sleep and Sleepiness, Fatigue and Transportation, Tolerance-related Factors and Interventions for Shift Workers. Many important contributions also came from the oral and poster sessions, which addressed issues such as Chronobiology, Ageing, Sleepiness and Performance, Accidents Risk, Physical and Mental Health, Work Ability, Social Problems, and Working Time Organization.

Thirty-four selected papers have been published in highly reputed scientific journals: 19 papers in *Chronobiology International* (vol 37/5, pages 889-1158, 2010), 4 papers in *Industrial Health* (vol 48, pages 381-415, 2010), 11 papers in *Applied Ergonomics* (vol 42/2, pages 193-396, 2011). Four more papers will soon be published in *Ergonomia* (Poland). All information about the symposium, presentation slides and photos can be found at www.shiftwork2009.it.

As the Chair of the Organizing Committee, and on behalf of the Board of the WTS and ICOH Scientific Committee, I wish to thank once again all the participants for their major support and for ensuring continuity and improvement to our biennial conference. That will certainly be confirmed in the next XX International Symposium, to be held in Stockholm, in late June 2011, thanks to the strong commitment of our Swedish colleagues.

At the end of 2010 we will have to hold new elections for the renewal of the Officers (Chair and Secretary) of the ICOH SC on Shiftwork and Working Time and of the members of the Board of the Working Time Society (President, Secretary, six members). Appropriate information on candidatures and voting procedures will be sent in due time to the ICOH and WTS members in good standing, by the Election Committee, chaired by Stephen Popkin. I am now inviting those of you who are willing to contribute more actively to the life of our Committee and Society, to start proposing their candidature for these posts. I wish

just to remind you that, according to our Constitution & Rules, the President and Secretary of the WTS are also the Chair and Secretary of the ICOH SC, and they must be ICOH Members in good standing. For further general information please visit the ICOH (www.icohweb.org) and WTS (www.workingtime.org) websites.

Both ICOH SC and WTS are now in a crucial moment of consolidation and strengthening. On the one hand, the ICOH SC has to establish stronger contacts and collaboration with other ICOH Scientific Committees (i.e. Work Organization and Psychosocial Factors, Aging and Work, Occupational Health for Health Care Workers, Occupational Health in Nursing, Women Health and Work) for a more incisive and integrated activity in the prevention of occupational risk factors, through information, education, risk assessment and protective actions. In this connection, it is a great pleasure and honour for us to acknowledge the recent election of Prof. Kazutaka Kogi, who has served for many years as Chair of this Committee, as new President of the International Commission of Occupational Health (ICOH).

On the other hand, the WTS needs to consolidate its position and visibility in the world of the scientific associations dealing with workers' health and well-being, by structuring itself so to ensure more stable and efficient operational activity and links with other institutions and international agencies (i.e. ILO, WHO, IARC), as well as other scientific Societies (i.e. concerning sleep, stress, work organization, social life).

Hence, we wish to encourage and promote the more active participation of all members, particularly younger members, in the WTS and ICOH SC, to increase co-operation, collaboration and exchange of information among members, and to disseminate information and knowledge to all those who may be interested (organisations, unions, companies, consultants, workers, etc.): this will also help recruiting new members to WTS and ICOH SC.

This can be also achieved, on the one hand, by a redefining aims and composition of our sub-committees and, on the other, through a more extensive and participative use of our newsletter, website and network (SINET), which at present are not used as they should be in our intention, despite the great efforts by Johannes Gaertner for the website, Friedhelm Nachrenier for SINET, and Stephen Popkin, Philip Bohle and Masaya Takahashi for this newsletter (S.I.N.).

No doubt that all these initiatives will be successful provided that more and more young fellows are willing to join us with their enthusiasm and new ideas.

Giovanni Costa
Milano, 1 December 2010

Announcements

SJWEH Supplement for ICOH 2009 Shiftwork Sessions

The Scandinavian Journal of Work, Environment & Health published a thematic issue on shiftwork in 2010 (*"Shiftwork and Health"*, 36(2)). The issue was based on the ICOH shiftwork and health session in Cape Town in early 2009. It was edited by Mikko Härmä and Göran Kecklund and included reviews, original research and discussion papers.

Upcoming Meetings

2011 Conference on Fatigue Management in Transportation

The U.S. Department of Transportation hosted the fifth International Conference on Fatigue Management in Transportation Operations in Boston, Massachusetts USA on March 24-26, 2009. The focus of this meeting was *A Framework for Progress* and consisted of six tracks: (1) Defining and Measuring the Fatigue Problem, (2) Health and Pharmacological Issues, (3) Enacting and Implementing Sustainable Change, (4) Supporting Fatigue Management Technologies, (5) Fatigue and Performance Modelling, and (6) Evaluation of Fatigue Risk Management Systems.

The conference was designed to address the interests of researchers, practitioners, managers, labour organizations and operators involved in all modes of transportation from around the world. Keynote and special presentations were provided by senior decision makers and researchers from the U.S. National Transportation Safety Board, National Institute for Occupational Safety and Health, the Massachusetts State Senate and Liberty Mutual Research Institute for Safety. Three hundred participants from 13 countries attended this event. Conference abstracts are available at: <http://depts.washington.edu/uwconf/fmto/>. The next Conference on Fatigue Management in Transportation will be held in Fremantle Australia, March 21-24, 2011. Dr. Laurence Hartley will be hosting this meeting. To find out more, please go to: <http://www.fatigueconference2011.com.au>.

20th Symposium in Stockholm

At the 19th International meeting in Venice, it was decided to hold the next meeting in Stockholm. A short presentation of this event was given during the meeting. The organizing committee includes Goran Kecklund (chair), Torbjorn Akerstedt, John Axelsson, Anette Hedberg, Veronica Klevegren, Anders Knutsson, Sofia Lagergren, Arne Lowden and Louise Nordenskiöld. In addition, there is also

extensive collaboration with the other Scandinavian countries and Scientific Committee includes WTS members from many countries.

The meeting will be held between 28 June and 1 July 2011. The venue will be outside the city centre to promote an exciting scientific meeting plus a Scandinavian midsummer atmosphere. All related conference and venue information may be found at: <http://www.shiftwork2011.se>

In addition, on Monday June 27 there will be a satellite meeting entitled the "Sleepy brain", to summarize the state of the art in sleepiness research, emphasizing the relevance for working time research. All information about the satellite meeting can be found at: <http://www.sleepybrain.se>.

This symposium has a tradition of more than 30 years in providing up-to-date information on night and shiftwork, as well as new trends in working time organization. The Symposium is organized by members of the Working Time Society, and of the Scientific Committee on Shiftwork and Working Time of the International Commission on Occupational Health (ICOH). For more information please contact John Axelsson (John.Axelsson@ki.se).

We hope that the 20th International Symposium on Shiftwork and Working Time will attract many delegates throughout the world, including yourself!



Working Time Society Board Elections

This is a reminder that we are currently in an elections cycle; all leadership positions are open, and the President and Secretary positions must change due to term limits. The nomination process and form may be found at: http://www.workingtime.org/index.php?title=Voting_procedures. Any questions may be sent to: WTS_elections@juno.com. See page 5 for a sample nomination form. Elections will be held through an internet voting site.

2011 WTS Executive Board

President: Frida Fischer (BR)
Secretary: Stephen Popkin (USA)
Treasurer: Johannes Gärtner (A)

Elected Members: Drew Dawson (AUS)
Arne Lowden (S)
Claudia Moreno (BR)

Co-opted Members:
Torbjörn Åkerstedt (S)
Natalia Bobko (UA)
Philip Bohle (AUS)
Adam Fletcher (AUS)
Lee Di Milia (AUS)
Simon Folkard (UK)
Irena Iskra-Golec (P)
Ben Jansen (NL)
Peter Knauth (G)
Kazutaka Kogi (J)
Friedhelm Nachreiner (G)
Masaya Takahashi (J)
Don Tepas (USA)
Alexander Wedderburn (UK)

2011 ICOH Scientific Committee on Shiftwork and Working Time (Officers)

Chair: Frida Fischer (BR)
Secretary: Stephen Popkin (USA)

Dear S. I. N. Readers:

If you have not already done so, please go to the WTS web pages to participate in the various forums, obtain and contribute to this newsletter, and provide input to the new board on needs, direction and website improvements (<http://www.workingtime.org>) . We are looking for the best ways to utilize current technology to provide services and benefit to our members and stakeholder groups, which more and more include senior decision makers in industry and government. As we continue to professionalize our interdisciplinary area of science we need to find new opportunities to both support our research community and translate this information so it can be utilized by both practitioners and leaders, whether they be from management, labor or government organization. Please send your input to philip.bohle@sydney.edu.au. Your opinions and ideas will make the WTS stronger!

WTS Newsletter Committee

SUBSCRIPTIONS TO S.I.N.

The *electronic* version of S.I.N. may be downloaded freely at our website: <http://www.workingtime.org/index.php?title=Newsletter>.

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

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

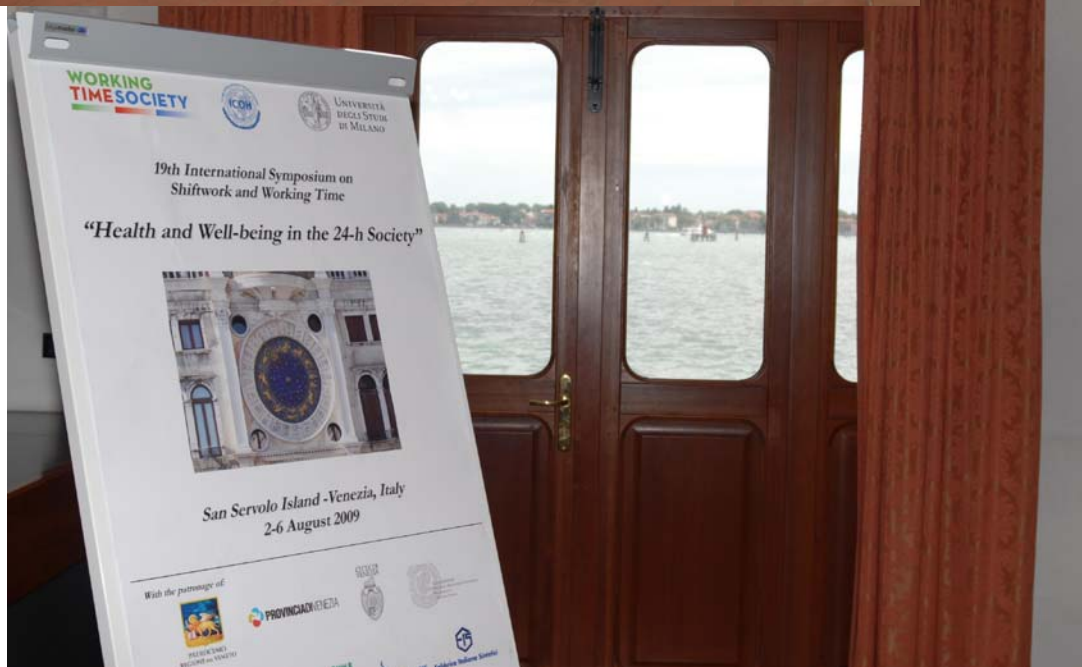
The cost for 2 years of S.I.N. is 20 €

General Terms:

- If a subscription is cancelled within 3 months, the cost is refunded.
- Thereafter no refunds are given.

XIXth International Symposium on Shiftwork and Working Time

Some photos for those who could not attend ...





The organisers ...

National Organizing Committee

Giovanni Costa (Chair)
Donatella Camerino
Paolo Campanini
Paul Maurice Conway
Daniela Fano
Giuseppe Paolo Fichera
Silvia Punzi

International Scientific Committee

Torbjörn Akerstedt (Sweden)
John Axelsson (Sweden)
Pier Alberto Bertazzi (Italy)
Philip Bohle (Australia)
Antonio Colombi (Italy)
Giovanni Costa (Italy)
Lee Di Milia (Australia)
Frida Marina Fischer (Brazil)
Adam Fletcher (Australia)
Simon Folkard (UK)
Johannes Gaertner (Austria)
Mikko Härmä (Finland)
Sonia Hornberger (Germany)
Sergio Iavicoli (Italy)
Ben Jansen (The Netherlands)
Peter Knauth (Germany)
Anders Knutsson (Sweden)
Kazutaka Kogi (Japan)
Claudia Moreno (Brazil)
Friedhelm Nachreiner (Germany)
Anne Pisarski (Australia)
Stephen Popkin (USA)
Shantha Rajaratnam (Australia)

SYMPOSIUM PROGRAM AND PRESENTATION OVERVIEW

SUNDAY - 2 August, 2009

15.00-19.00 **Registration**

19.00-22.00 **Welcome Buffet and Music**

CLOISTER

MONDAY - 3 August, 2009

08.30-09.00 **Opening**

Keynote: Joint change strategy for improving work schedules and job content
Kogi K (J)

09.00-10.30 **SPECIAL SESSION 1: Does Tolerant Shift Worker Exist?**

AUDITORIUM

Chair: Härmä M (FIN)

Introduction: how can so many shift workers stay healthy?
Härmä M (FIN)

Identifying individual differences in sleep and performance among shift workers
Dawson D (AUS)

Long-term effects of shift work on sleep quality as a function of age: results from the VISAT longitudinal study
Marquié JC, Ansiau D, Tucker P, Folkard S (F, UK)

Individual differences in susceptibility to shift work
Axelsson J (S)

Individual coping in different shift systems by appropriate timing of sleep and naps
Sallinen M (FIN)

10.30-11.00 **Coffee break**

11.00-13.00 **SPECIAL SESSION 2: Sleepiness and Working Hours**

AUDITORIUM

Chair: Åkerstedt T (S)

Geophysical, social, and sleep-dependent determinants of sleep timing and duration following transmeridian travel
Darwent D, Sletten T, Dawson D, Roach GD (AUS)

Predicting fatigue: sleep quantity versus sleep quality in miners
Paech G, Jay S, Lamond N, Dorrian J, Roach GD, Ferguson S (AUS)

Inter-individual differences in performance over the development of homeostatic sleep pressure
Zhou X, Sargent C, Darwent D, Ferguson S, Paech G, Matthews R, and Roach GD (AUS)

Early morning work - prevalence and sleep/wake problems
Åkerstedt T, Kecklund G (S)

Can short sleeps be predicted by work hours of Australian doctors?
Ferguson S, Dorrian J, Jay S, Weissenfeld A, Thomas M (AUS)

Daily sleep, weekly working hours, and risk of work-related injury: US national health interview survey (2004-2007)
Lombardi D, Folkard S, Willets J, Smith G (USA, UK)

13.00-14.00 **Lunch**

14.00-16.00 **ORAL SESSION 1: Sleep and Sleepiness**

AUDITORIUM

Chair: Dawson D (AUS)

SYMPOSIUM PROGRAM AND PRESENTATION OVERVIEW (CONT.)

The effect on sleep of leaving or entering shift work

Åkerstedt T, Kecklund G, Nordin M (S)

Working memory capacity is decreased in sleep deprived internal medicine residents

Gohar A, Adams A, Gertner E, Sackett-Lundeen L, Heitz R, Engle R, Haus E, Bijwadia J (USA)

Work time control, shift work and disturbed sleep

Kecklund G, Åkerstedt T, Oxenstierna G, Westerlund H, Theorell T (S)

The prevalence of short sleep duration by industry and occupation in the national health interview survey

Luckhaupt S, Tak SV, Calvert G (USA)

Sleep length, sleepiness and reaction time of working college students, males and females, during working days and free days

Nagai R, Fischer FM, Moreno CR, Teixeira LR, Conceição AB, Mussi M, Luz AA, Lowden A (BR, S)

Mood regulation and individual differences during sleep loss

Paterson J, Dorrian J, Tremaine R, Jay S, Lamond N, Ferguson S, Murphy P, Campbell S, Dawson D (AUS)

Persistent deleterious effects of night work on sleep

Rotenberg L, Griep RH, Diniz TB, Silva-Costa A (BR)

14.00-16.00 ORAL SESSION 2: Chronobiology

SALA TEATRO

Chair: Rajaratnam SMW (AUS)

Contribution of core body temperature, length of prior wake and sleep stages to cognitive throughput

Darwent D, Sargent C, Paech G, Matthews R, Zhou X, Ferguson S, Roach GD (AUS)

A preliminary analysis of the time awareness scale

Di Milia L, Folkard S (AUS, UK)

Determinants of melatonin among rotating shift nurses

Grundy A, Sanchez M, Richardson H, Tranmer J, Graham C, Aronson KJ (CDN)

Chronic responses of glucose metabolism in shift workers

Guarita-Padilha HG, Crispim CA, Zimberg IZ, Dattilo M, Tufik S, de Mello MT (BR)

Daytime intermittent bright light effect on the ultradian rhythms of hemispheric information processing speed

Iskra-Golec I, Smith L (PL, UK)

The influence of the internal body clock and prior wake on low order cognitive performance

Matthews R, Ferguson S, Darwent D, Zhou X, Gemma P, Sargent C, Roach GD (AUS)

Principal component structuring of inter-individual variation in waking EEG spectra provides a possibility to quantify sleep debt and sleep pressure

Putilov A, Donskaya OG, Verevkin EG (RUS)

The influence of circadian phase and prior wake on neuromuscular function

Sargent C, Darwent D, Zhou X, Paech G, Matthews R, Ferguson S, Roach GD (AUS)

16.00-16.30 Coffee break

16.30-18.00 ORAL SESSION 3: Sleep, Sleepiness and Safety

AUDITORIUM

Chair: Moreno CR (BR)

Stop the bus, driver! About the importance of br(e)aking before traffic lights turn red

Amelsberg S, Tempel J, Schramm J (D)

Transportation professionals - from drivers to control room operators: common features about working time and its effects

Carvalho J, Simoes A (P)

Comparative analysis of lapses of attention and errors in professional train drivers, performing more or less than 12 daily work hours

Fernandes Junior SA, Maculano EA, Barreto AT, Paim LS, Bittencourt RL, Tufik S, de Mello MT (BR).

Train driving and sleepiness: the influence of age and alerting devices
D'Onofrio P, Sartori S, Åkerstedt T, Costa G (I, S)

Sleep quality effects on commercial aviation pilots' mood states
Noce F, Kouyoumdjian C, Licati P, Santos C, Miranda I, Terry P, Tufik S, de Mello MT (BR)
(Note: Abstract withdrawn by author from this publication.)

Sleep perception, age, apnea-hypoapnea index and sleep efficiency in professional train drivers
Paim LS, Faria PA, Bittencourt RL, Garbuio AS, Tufik S, de Mello MT (BR)

16.30-18.00 ONE-SLIDE POSTER PRESENTATION I
Sleep, Sleepiness and Performance, Chronobiology, Ageing, Social Aspects
Chair: Di Milia L (AUS)

SALA TEATRO

Sleep, Sleepiness and Performance

- (1) Subjective somnolence perception and sleep in shift workers
Barreto AT, de Arrujo FJS, Paim LS, Bittencourt LR, Tufik S, de Mello MT (BR)
- (2) Recovery brief naps and prefrontal cognitive performance in partially sleep deprived subjects
D'Onofrio P, Costanzo A, Åkerstedt T, Ficca G (I, S)
- (3) Sleepiness, stress and compensatory behaviours in nurses and midwives
Dorrian J, Paterson J, Pincombe J, Grech C, Dawson D (AUS)
- (4) Chronic sleep deficit and performance of a sustained attention task: an EOG study
Fafrowicz M, Oginska H, Marek T, Golonka K, Mojsa-Kaja J, Tucholska K (PL)
- (5) Performance on a simple reaction time task: is it about sleep or work for miners?
Ferguson S, Paech G, Dorrian J, Roach GD, Jay S (AUS)
- (6) Sleep and alertness of nurses in two-shift work
Hakola T, Paukkonen M, Pohjonen T (FIN)
- (7) How do the length and timing of nighttime napping have an impact on sleep inertia?
Kubo T, Takahashi M, Takeyama H, Matsumoto S, Ebara T, Murata K, Tachi N, Itani T (J)
- (8) The influence of shift work in military air traffic controllers' decision making
Noce F, Kouyoumdjian C, Santos C, Waterhouse J, Tufik S, de Mello MT (BR, UK)
- (9) The effects of homeostatic and circadian influences on sleep quality and quantity in humans living on a 28h day
Paech G, Sargent C, Darwent D, Zhou X, Matthews R, Ferguson S, Roach GD (AUS)
- (10) How sleep loss and perception of workload influences self-reported mood in Australian midwives
Paterson J, Dorrian J, Pincombe J, Grech C, Dawson D (AUS)

Chronobiology

- (11) Study of sleep-wake cycle - sleep and chronotype of night university students in a higher level technology course
Andreoli CPP, de Martino FMM (BR)
- (12) Diurnal patterns of activity of orienting and executive control neuronal networks in subjects performing monotonous vs. demanding driving task – an fMRI study
Marek T, Fafrowicz M, Golonka K, Mojsa-Kaja J, Oginska H, Tucholska K, Orzechowski T, Urbanik A (PL)
- (13) Chronotype, sleep loss, and diurnal salivary cortisol pattern in simulated driving task
Oginska H, Fafrowicz M, Golonka K, Marek T, Mojsa-Kaja J, Tucholska K (PL)
- (14) Genetic polymorphism of circadian genes in nurses - pilot study
Reszka E, Peplonska B, Gromadzinska J, Wasowicz W, Bukowska A, Marjanska J, Kjuus H, Lie JA (PL, N)
- (15) Is performance on the psychomotor vigilance task for a personal digital assistant affected by feedback or inter-stimulus interval?

SYMPOSIUM PROGRAM AND PRESENTATION OVERVIEW (CONT.)

Roach GD, Dawson D, Lamond N (AUS)

(16) Lost in transit: measuring core body temperature using ingestible temperature capsules
Sargent C, Darwent D, Zhou X, Paech G, Matthews R, Ferguson S, Roach GD (AUS)

(17) Relation on circadian profile on driving performance
Vivoli R, Bergomi M., Bussetti P, Vivoli G (I)

(18) Inter-individual differences in performance across circadian cycle
Zhou X, Roach G, Darwent D, Ferguson S, Paech G, Matthews R, Sargent C (AUS)

Ageing

(19) Blood circulation in electricity distribution network controllers depending on age, experience and tiredness of the rotating shifts
Bobko N (UA)

(20) Young workers and their working time
Grzech-Sukalo H, Haenecke K (D)

(21) Subjective age and assessment of work and non-work stress, work ability and burnout
Iskra-Golec I (PL)

Social

(22) Procedures for waking up spouses
Gaertner J, Folkard S, di Milia L, Miksch S (A, UK, AUS)

(23) Recovery from work among nurses: is there an interaction between sleep/rest on the night-shift and domestic work?
Silva Costa A, Rotenberg L, Griep RH, Fischer FM (BR)

(24) A diversity-focused approach to work-family conflict and burnout among Hispanic-American male workers
Ward L, Worley J, Hellman C (USA)

19.00 **Dinner**

21.00 **WTS and ICOH SC Board Meeting**

TUESDAY - 4 August, 2009

08.30-10.30 **SPECIAL SESSION 3: Cancer and Shiftwork**

AUDITORIUM

Chair: Costa G (I)

Keynote: Circadian disruption and carcinogenesis
Haus E (USA)

The IARC Monograph, Vol 98: Shiftwork that involves circadian disruption
Straif K, Baan R, Grosse Y, Secretan B, El Ghisassi F, Bouvard V, Benbrahim-Talla L, Coglian V (F)

Melatonin and breast cancer risk: a systematic review and meta-analysis
Travis R, Roddam A, Key T (UK)

Is there an association between shift work and cancer?
Knutsson A, Karlsson B (S)

Shift-work and breast cancer risk among Danish employees
Hansen J (DK)

Need for a better assessment of exposure for assessing cancer risk in shiftworkers
Costa G (I)

10.30-11.00 **Coffee break**

11.00-13.00 **ORAL SESSION 4: Mental and Physical Health**

AUDITORIUM

Chair: Takahashi M (J)

Performance, work load and shift work tolerance at different ages in a large production company

De Looze M, Groenesteijn L, Blok M (NL)

Depressed mood in the working population: association with work schedules and working hours

Driesen K, Jansen N, Kant I, Mohren D, Van Amelsvoort L (NL)

The contributions of work hours and work schedule on psychological distress, depression and burnout

Marchand A, Durand P, Perreault AM (CDN)

Cardiovascular prevention on the workplace: effectiveness of two-stage intervention

Kontsevaya A, Kalinina A, Pozdnyakov Y, Belonosova S (RUS)

Retrospective cohort study of the risk of obesity among shift workers: findings from the Japan shift workers health study

Kubo Ta, Otomo H, Shirane K, Nakamura T, Oyama I (J)

Changes in Body Mass Index in shift and daytime workers over time, preliminary results from the 10 years follow up of the Maastricht Cohort Study

van Amelvoort L, Jansen N, Mohren D, Janssen N, Kant I (NL)

A retrospective cohort study of shift work and longitudinal changes in systolic and diastolic blood pressure and body mass index in an Iranian cohort of workers

Yadegarfar G, Gholami M, Sanati K, Sanati J (IR)

11.00-13.00 **ORAL SESSION 5: Intervention and Organization (I)**

SALA TEATRO

Chair: Gaertner J (A)

New approaches in predicting and optimizing workforce requirements

Boonstra-Hörwein K, Punzengruber D, Gärtner J (A)

Health care staff's opinions about an individually controlled and flexible working time arrangement

Bringsén Å, Andersson I, Ejertsson G (S)

Assessing the risk for different kinds of impairment as a function of the design of flexible work schedules

Dittmar O, Schomann C, Nachreiner F (D)

Visual analytics for workforce requirements

Gärtner J, Aigner W, Bertone A, Klausner R, Lammarsch T, Mayr E, Miksch S, Risku H, Smuc M (A)

Minimizing split shifts in highly flexible working time models

Gärtner J, Punzengruber D, Birmily E, Gottschall B (A)

Well-functioning working times in knowledge-intensive work

Kandolin I, Järvenpää P, Sallinen M, Härmä M, Kuosma E (FIN)

The role of experience in night work: lessons learned from two ergonomic studies

Pueyo V, Toupin C, Volkoff S (F)

13.00-14.00 **Lunch**

14.00-16.00 **ORAL SESSION 6: Health and Work Ability**

AUDITORIUM

Chair: Nachreiner F (D)

Implications of job design for worker well-being in international context: cross-nation patterns of work ability, work demands, and work strain of healthcare professionals

Barnes-Farrell J, McGonagle A, Walsh B, Walker C, DiMilia L, Fischer FM, Hobbs B, Iskra-Golec I, Kaliterna L, Smith L, Tepas D (USA, AUS, BR, PL, HR, UK)

The validity of the fatigue and risk index (FRI) for predicting impairments to health under different shift schedules in the context of risk

SYMPOSIUM PROGRAM AND PRESENTATION OVERVIEW (CONT.)

assessments

Greubel J, Nachreiner F, Dittmar O, Wirtz A, Schomann C (D)

Intolerance to shift work and health in hospital workers

Magnavita N, De Nardis I, Leso V, Magrini A, Piccoli B, Bergamaschi A (I)

Lifetime working time - effects on health and fitness for duty: results from a pilot study

Nachreiner F, Dittmar O, Wirtz A, Schomann C (D)

Napping opportunity and work ability, subjective health and job satisfaction in shiftworking nurses participating in the NEXT study

Pokorski J, Pokorska J, Hasselhorn HM, Nitecka E (PL, D)

Is health, measured by Work Ability Index, affected by 12-hour rotating shift schedules?

Yong M, Nasterlack M, Pluto RP, Elmerich K, Karl D, Knauth P (D)

Fatigue and associated factors among college students

Teixeira LR, Nagai R, Moreno CR, Lowden A, da Luz AA, de Paula LR, Turte SL, Conceição AB, Mussi MH, Soares NS, Fonseca MB, Steluti J, Fischer FM (BR, S)

14.00-16.00 Oral Session 7: Intervention and Organization (2)

SALA TEATRO

Chair: Bohle P (AUS)

Managing fatigue at nuclear power reactor sites: a systems approach

Koen SL (USA)

Improving nursing work using electronic medical records in an acute care unit

Yoshikawa T, Matsumoto S, Kogi K, Mizuno Y, Takahashi E, Takezawa C, Sakai K (J)

Nursing, sleep and readaptation after night work by use of light boxes

Lowden A, Petersen H, Åkerstedt T (S)

Interventions for sleepiness and sleep disturbances caused by shift work: a Cochrane systematic review protocol

Ruotsalainen J, Liira J, Sallinen M, Driscoll T, Rogers N, Costa G, Verbeek J (FIN, AUS, I)

Implementing a new shift schedule in a large steel plant: critical success factors of the change process

de Leede J, Hekman C (NL)

Influence on own working hours and sleep - an intervention study

Garde AH, Nabe-Nielsen K (DK)

16.00-16.30 Coffee break

16.30-18.00 ORAL SESSION 8: Cancer risk and Accidents

AUDITORIUM

Chair: Knutsson A (S)

Possible epigenetic effects on blood DNA in shift workers

Costa G, Bollati V, Sartori S, Tarantini L, Motta V, Rota F, Baccarelli A (I)

Do miners have lower risks of prostate cancer?

Girschik J, Glass D, Ambrosini G, Fritsch L (AUS)

Risk of prostate cancer among rotating-shift workers: findings from the Japan Shift Workers Health Study

Kubo Ta, Otomo H, Shirane K, Nakamura T, Matsumoto T, Oyama I (J)

Humans are diurnal: what shiftworkers are? Analysis of individual contribution for accidents in a general hospital

Magrini A, D'Alessio P, Dattolo R, Superti C, Bergamaschi A (I)

Working hours and biomarkers of inflammation

Puttonen S., Tiittasala K., Harma M (FIN)

Shiftwork trends and risk for worker injury in Canada

Wong ISY, McLeod CB, Demers PA (CDN)

Health, Cancer, Intervention, Organization*Chair: Fletcher A (BR)***Health**

- (25) Long hours, shift, and overtime: their associations with occupational injury and illness among nurses in the Philippines
de Castro AB, Fujishiro K, Rue T, Gee G (USA)
- (26) Referred health of current, former and never-night workers: a study on female nurses
Griep RH, Rotenberg L (BR)
- (27) Work load among female construction workers during night time in construction industry of Uttarakhand, India
Karki I, Promila S, Pratibha J (IN)
- (28) Association between working hours and complaints of musculoskeletal pain in the spine among truck drivers
Lemos L, Marqueze E, Nery ML, Moreno CR (BR)
- (29) Seniority at night work and weight increase among nursing professionals
Marqueze E, Lemos L, Nery ML, Soares N, Moreno CR (BR)
- (30) Long-working hours, night work and occupational stress in an Italian off-shore company
Montagnani R, Bontadi D, Boscolo A, Marullo A, Pinaffo G, Conway PM (I)
- (31) Effects of high-carbohydrate and high-protein diet on night security guard's sleepiness
Nehme P, Ulhoa M, Codarin MA, Mulatlet E, Moreno CR (BR)
- (32) Sleep deficit, age and health in shiftworking nurses participating in the NEXT study
Pokorski J, Oginska H, Widerszal-Bazyl M, Marek T, Hasselhorn HM (PL)
- (33) Problems of shiftworkers in health centres of India: causes and prevention
Promila S, Suketa S (IN)
- (34) Correlation between night shift work and components of health and sleep in employees of the hotel sector and the bakery trade
Seibt R, Ulbricht S, Seibt A, Hunger B (D)
- (35) Effects of shift work on the health in employees of the catering trade
Seibt R, Ulbricht S, Seibt A, Hunger B (D)

Cancer

- (36) Measuring chronodisruption retrospectively
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- (37) Night shift work, melatonin metabolism and breast cancer risk factors – ongoing cross-sectional study in nurses in Lodz, Poland
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Intervention

- (38) The challenge of change: digging deeper into the mining sector.
Ferguson S, Shaw A, Blewett V, Stiller L, Aickin C, Cox S (AUS)
- (39) Shifting the human sleep-wake cycle using monochromatic blue light: a shift work simulation study
Heinze C, Schirmer S, Golz M (D)
- (40) The effectiveness of exercise and naps as countermeasures to night shift and post shift sleepiness
Hobbs B, Kerk C, Kellogg S, Hobbs D (USA)
- (41) Influence on own working hours and risk factors for cardiovascular disease - an intervention study
Nabe-Nielsen K, Garde AH, Diderichsen F (DK)
- (42) Fatigue recovery, daytime sleepiness, and depressive symptoms in a working population: the role of worktime control
Takahashi M, Iwasaki K, Sasaki T, Kubo T, Mori I, Otsuka Y (J)

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Organization

- (43) Shiftworking and the employee organisation relationship
Chowne J (UK)
- (44) Shiftworking and the temporal personality
Chowne J (UK)
- (45) Environmental and organizational conditions affecting napping/rest during nurses' night work: a qualitative approach.
de Araújo MM, Silva-Costa AS, Rotenberg L, Moreno CR, Fischer FM (BR)
- (46) Assessment of relationships between macroergonomic conditions and employees work and hours satisfaction
Habibi E, Amini N, Porabdian S, Rismanchian M (IR)
- (47) Risk assessment and safety measures for working time: an excel-tool
Haenecke K, Grzech-Sukalo H (D)
- (48) The importance of individual preferences when evaluating the associations between work schedule characteristics and intention to leave the workplace
Nabe-Nielsen K, Kecklund G, Ingre M, Skotte J, Diderichsen F, Garde AH (DK, S)
- (49) Break optimization in shifts
Schafhauser W, Beer A, Musliu N, Slany W, Gaertner J, Boonstra-Hörwein K (A)
- (50) Design and implementation of an internet based tool for the design and evaluation of shift systems
Schomann C, Dittmar O, Nachreiner F (D)
- (51) Workload, lifestyle and health: monitoring the heat of employees with irregular working hours
van Drongelen A, Boot C, Bruinvels D, Hlobil H, van der Beek A, Smid T (NL)

19.00 **Visit to S. Marco's Mosaics**

21.00 **Dinner**

WEDNESDAY - 5 August, 2009

8.30-13.30 **SPECIAL SESSION 4:**

AUDITORIUM

Interventions towards shift workers: what is really effective?

Chair: Axelsson J (S)

Bright light treatment for shiftwork
Bjorvatn B (N)

Pharmacological interventions for shiftwork: melatonin and its agonists
Rajaratnam SMW (AUS)

The European Working Time Directive and junior doctors: safe implementation of a 48-hour work week
Lockley SW (USA)

Napping in operational settings
Axelsson J (S)

Shiftwork and diet
Tucker P (UK)

10.30-11.00 **Coffee break**

11.00-13.00 **ORAL SESSION 9: Working Time Organization**

AUDITORIUM

Chair: Knauth P (D)

Changing working time and well-being
Anttila T, Nätti J, Oinas T (FIN)

Flexible work in call centres: effects on working hours, work-life conflict, and health
Bohle P, Willaby H, Quinlan M (AUS)

Experience in the evaluation and intervention of a work shift system at a high altitude mine site, 2000-2007: model for the protection of the health of workers
Cantuarias J (RCH)

Shiftwork, hours of work, and modifiable health risk factors
Colombi A, Bushnell T, Tak SW, Caruso C (USA)

Less quick returns means more well-being
Hakola T, Paukkonen M, Pohjonen T (FIN)

Evaluation of the new 5-shifts roster at Corus steel in the Netherlands
Klein Hesselink J, de Leede J, Goudswaard A (NL)

The impact of working time arrangements on fatigue among junior doctors
Tucker P, Osborne M, Dahlgren A, Davies G, Ebdon P, Folkard S, Hutchings H, Rapport F, Åkerstedt T (UK, F, S)

13.00-14.00 Lunch

14.00-15.30 ORAL SESSION 10: Age and Ageing
Chair: Rotenberg L (BR)

AUDITORIUM

A strategy towards age-related working time arrangements
Hornberger S (D)

Working time of the ageing workforce. Lessons learned from the KRONOS research project
Knauth P, Karl D, Elmerich K (D)

Adolescent shiftworkers: different shifts, different risks
Loudoun R, Townsend K (AUS)

Adaptation of working schedule to the customers
Molan M, Molan G (SLO)

16.00 Cruise and Dinner in the Lagoon

THURSDAY - 6 August, 2009

08.30-10.30 SPECIAL SESSION 5: Fatigue and Transportation
Chair: Folkard S (UK)

AUDITORIUM

Can postural control performance be an indicator of a truck driver's sleep deprivation?
Albuquerque A, Louzada F, Rodacki A, Lemos L, Marqueze E, Lorenzi-Filho G, Moreno CR (BR)

Work hours, workload, sleep and fatigue in Australian Rail Industry employees
Dorrian J, Baulk Stuart D, Dawson D (AUS)

Truck driving and sleepiness: a quasi-experimental study
Kecklund G, Anund A, Kronberg P, Åkerstedt T (S)

The use of in-flight napping as a fatigue counter-measure by long-haul aviation pilots
Roach GD, Darwent D, Dawson D (AUS)

SYMPOSIUM PROGRAM AND PRESENTATION OVERVIEW (CONT.)

Attentional lapses rate comparison between professional train drivers with and without sleep apnea syndrome
Teixeira CW, Esteves AM, Koyama RG, de Martino FJS, Bittencourt LR, Barreto AT, Tufik S, de Mello MT (BR)

10.30-11.00 **Coffee break**

11.00-12.30 **ORAL SESSION II: Social Problems**

AUDITORIUM

Chair: Fischer FM (BR)

Shiftwork, work/family conflicts and effectiveness of prevention
Camerino D, Sandri M, Sartori S, Campanini P, Conway PM, Costa G (I)

Staying safe in the jungles of Borneo: five studies of fatigue and cultural issues in remote mining projects
Fletcher A (AUS)

Work-family conflict as a predictor of changes in work schedules and working hours
Jansen N, Mohren D, Van Amelsvoort L, Kant I (NL)

Effects of flexible employment and insecurity on work-life conflict and health amongst hotel workers
Mc Namara M, Bohle P, Quinlan M (AUS)

Working and living conditions associated with quality of life of nursing professionals
Silva AA, Souza JM, Borges FN, Landsbergis P, Fischer FM (BR, USA)

The effects of extended working hours on health and social well-being - a comparative analysis of four independent samples
Wirtz A, Nachreiner F (D)

12.30-13.30 **GENERAL Assembly and Closing**

Chair: Costa G (I), Hornberger (D)

AUDITORIUM

13.30 **Farewell Lunch**

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Early morning work - prevalence and sleep/wake problems

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Aim: Night work is associated with increased sleep impairment and increased fatigue. Less is known about morning work (starting before 7am) and even less about early morning work (starting before 5.30am). The impression from the few previous studies is that sleep loss and fatigue may be considerable. One might think that early morning work is very rare, but no data exist. The present study aimed to describe the prevalence of (early) morning work in Sweden and as well as associated health problems.

Methods: Phone interview with a representative sample (N=1500) of the adult Swedish population.

Results: The response rate was 70%. 32.7% always worked mornings (starting 0300-0730). 52.9% had morning work always or sometimes. 7.5% always worked very early morning hours (starting 0300-0530), while 14.8% did it always or sometimes. As a comparison, 1.7% had permanent night work (starting 2100-0259h), while 5.3% had night work always or sometimes.

Early morning work showed more negative responses to sleep/wake related questions than day work. Rather high or very high levels of fatigue during work was reported by 15% vs 9% ($p<.05$). For difficulties awakening the values were 25% vs 19% ($p<.05$), for difficulties falling asleep the values were 15% vs 8% ($p<.05$) and for sleep duration the values were 5.2h vs 7.2h ($p<.05$).

Conclusion: It was concluded that the proportion of the population that is affected by very early morning work is relatively high and higher than the proportion with night work. In addition very early morning work was associated with complaints of impaired sleep and fatigue.

Keywords: morning, work, fatigue, prevalence, sleep, survey

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The effect on sleep of leaving or entering shift work

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Aim: Disturbed sleep is a common observation in shift work such the night shift is associated with sleep complaints. Most studies, however, have been of the cross sectional kind. Here the purpose was to examine the effects on sleep of exiting or entering shift work.

Methods: We used the WOLF database, which contains 5000 individuals and two points of measurement (T1 and T2) with 5 years in-between. The Karolinska Sleep Questionnaire (KSQ) was administered on both occasions. Four questions on difficulties falling asleep, premature awakening, repeated awakenings and restless sleep were combined to an index. Poor sleep was considered to be present if at least one of the problems was reported at least three days per week. The change in sleep between time points was scored as an improvement when a subject changed from poor to good sleep, and as impaired when the change was reversed.

Results: 112 individuals entered shift work, 145 left it, and 913 remained in shift work at both points of measurement. All analyses were adjusted for gender, age, heavy work, work demands. Improved sleep was not significantly predicted by Exit from shift work (OR=1.17, Ci=0.59-2.32), but Consistent shift work (shift work at both time points) predicted a decreased probability of improved sleep (OR=0.68, Ci=0.48-0.97). Impaired sleep was not predicted by any of the changes in shift work, or by consistent shift work. Chronically poor sleep (Poor at both points in time) was predicted by consistent shift work (OR=1.59, Ci=1.24-2.04).

Conclusion: Entering shift work does not cause sleep to be perceived as poor, nor does leaving shift work cause sleep to be perceived as good. Possibly, the time period covered may have been too short for clear effects. Moreover, consistent shift work seems to be associated with poor sleep. This indicates a process of accumulation.

Keywords: sleep, shift work, prospective

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Can postural control performance be an indicator of a truck driver's sleep deprivation?

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Introduction: Long-haul drivers work irregular schedules due to load delivery demands. In general, driving and sleeping occur at irregular times and, consequently, partial sleep deprivation may emerge and result in sleepiness at the wheel. Many methods have been tested to measure sleepiness while driving in order to avoid accidents; however, there is a need to find a way to estimate sleepiness before driving. Recently, postural control performance has been suggested as an indicator of sleepiness in laboratory studies. Nevertheless, to our knowledge no previous studies have been conducted measuring postural stability with truck drivers chronically exposed to sleep deprivation.

Aim: The aim of this study was to investigate whether postural stability in the anteroposterior and mediolateral planes differs in truck drivers before and after a night's work.

Methods: Eight male truck drivers working at night (NG), mean age=34.8 yo; SD=4.4 yo, volunteered to participate in this study. The drivers' postural stability was assessed immediately before and after an approximately 450 km journey. Two identical force platforms were used to record a number of postural variables (AMTI, OR6-7) at departure and arrival sites, and included: amplitude, frequency and speed of anteroposterior and mediolateral movements of the centre of pressure. The control group was made up of nine day truck drivers who were measured before and after a day's work (DG; mean age=38.4 yo; SD=6.3 yo). Drivers were evaluated in two conditions: eyes open and eyes closed during 60s in a comfortable standing position. A repeated measurements ANOVA was applied to identify differences between groups (NG vs. DG) and within-group (before and after work). The analysis was done for the two test conditions (eyes open and eyes closed) and the significance level set at $p=0.05$.

Results: An interaction effect of time of day and type of shift in both conditions: eyes open ($p<0.01$) and eyes closed ($p<0.001$) for amplitude of mediolateral movements was observed. No differences were observed related to the other postural variables.

Conclusion: Postural stability, measured by force platform, seems to reflect sleep deprivation, suggesting it could be a simple and fast indicator of sleepiness at the workplace. Nevertheless, it is not clear what postural variable best indicates sleep deprivation and other studies are required.

Keywords: postural control, sleep deprivation, truck drivers.

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Stop the bus, driver!

About the importance of br(e)aking before traffic lights turn red

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Within the VHH PVG Company Group (regional public transportation) in Hamburg, Germany, the work place health promotion is based on the use of the Work Ability Concept and the Work Ability Index (WAI). In 2007, we started discussing that even the change of leadership style which has the biggest influence on the promotion of work ability will not be able to compensate the problems the drivers have (and will have in the future) with increasing age. Bus driving is considered moderate to heavy work (physical, mental and social) by the leadership as well as the drivers, and with increasing age there is a growing need for recuperation: So an "alarm system" was created to assess the services according to the position of minor breaks, position of the largest break and actual driving time within the single service (labour efficiency). "Red" means: service is not acceptable according to occupational sciences; "yellow" means: problematic result, has to be developed; "green" means: you can go on up to pension age as far as we know, preserve!). After a successful pilot study, we started the project in spring 2008. First, the complete timetable (about 1,600 services) of 2008 has been analysed to get a basis we can work with. In a second step, the results will have to be discussed separately with the management, members of the works council and several bus drivers. On the one hand we want to find out what these groups think about the general idea. On the other hand we want to discuss suggestions for improvement in order to achieve that the created scheme will be accepted by the company's majority. Until January 2009, several workshops took place, but this part has not been completed yet. Until today, we can say that all groups generally accept the project. Suggestions for improvement occur concerning the length of single shifts, night-work, divided shifts and shift-rotations. The length of shifts and night-work could be added to the scheme, divided shifts and shift-rotations will have to be investigated separately. A first success has been reached for a depot with many "red" services. To relieve the drivers, the company decided to provide an additional bus during the day since September 2008. Thus, bus drivers can get an additional break to recover and fulfil personal needs. Further results will be presented in 2009.

Keywords: Public transport, shift work, ageing drivers, minor breaks, major break, labour efficiency

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Study of sleep-wake cycle - sleep and chronotype of night university students in a higher level technology course

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The aim of this study is to analyze the sleep standard of night university students. A total of 139 undergraduate students in esthetics technology will be invited to participate in this research. Three questionnaires will be used: a- one for collecting individual information and data relative to the students' general health state, b -another one for evaluating the sleep-wake cycle (sleep diary); c- and the Horne and Ostberg's Chronotype Questionnaire (1976). From this research, the sleep diaries will be analyzed in order to obtain individual characteristics and to find if the students have sleep habits, correlating with chronotypes. After the data analysis, the students will be oriented regarding the methods that facilitate their improvement, and it will be identified if there is sleep interference in the formal process of teaching/learning, verifying the learning score and the academic performance in the course, which has prevalence of females. Considering that women predisposed to invest in their capability for the labor market exert more roles, such as domestic chores, children care, and formal work, the knowledge about sleep disturbances and biological rhythm might help them in the organization and elaboration of learning plans, taking into account preferences, needs and possibilities of choice for the study period.

Keywords: sleep, chronobiology, learning, educational evaluation.

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Changing working time and well-being

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The aim of the paper is to examine changes in working time, the relationships between working time and well-being, and to what extent these vary with socioeconomic status and gender. Changes in working time are usually described as flexibilisation, fragmentation and shift from industrial towards post-industrial working time regime. Earlier studies show that long working week, unsocial working hours and high working time tempo have usually negative and working time autonomy positive effects on employees' well-being. Usually these effects have been studied separately. This study involves several aspects of working time and compares their relations to well-being. Empirical analyses are based on representative Finnish working conditions surveys (1977, 1984, 1990, 1997, 2003 and 2008). Sample size has been 3000-4500 employees.

We separate four dimensions of working time: the number of hours worked (duration), when (timing) the hours are worked, work-time intensity (tempo), and the degree of time autonomy individuals have over their working hours (time autonomy). Well-being involves psychological and social well-being. Psychological well-being is defined as work-related psychological symptoms. Social well-being is defined as work-life interaction. The relationships between working time dimensions (antecedents) and well-being (consequences) are analysed by using logistic regression analysis.

According to the results, changes in working time vary with socioeconomic status and gender. Long working hours have become more common among upper-level white collar workers and men, while unsocial hours have increased among blue-collar and lower-level white-collar workers. At the same feelings of time pressure and working time autonomy have increased in all groups. All four dimensions of working time predict well-being, although in different extent. Psychological well-being is best predicted by high tempo of working time. Social well-being is best predicted by long working week, unsocial hours and high tempo.

Keywords: working time, well-being, working conditions

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Individual differences in susceptibility to shift work

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There is limited knowledge as to why some individuals tolerate shift work and others do not. Another problem is how to find intolerant shift workers as early as possible, which is essential if we are to prevent future health problems. We therefore conducted a series of studies with the aim to characterize intolerant shift workers at an early stage.

In a series of studies of more than 400 paper mill workers we found that intolerant shift workers (tolerance was characterized by the workers satisfaction with his/hers working hours) experienced more problems to overcome short sleep, had more sleepiness problems, and took longer to recover after a period with night work than their tolerant counterparts (1). The differences in sleepiness (between those two groups) got worse across working periods, suggesting that these differences were not only trait related but also related to state like changes induced by the present shift system. It was also found that intolerant workers had a larger sleep need and (in men) lower testosterone levels than tolerant shift workers (2). Although these differences may not be the actual mechanisms causing intolerance, rather a result, they may prove to be important signs helping us to find susceptible shift workers at an early stage.

In a follow-up study of the same workers, but two years later and with a slightly changed shift schedule, it was found that many of the intolerant and tolerant workers had changed groups (data in prep.). These data suggests that susceptibility to shift work is dependent on the particular shift system. Hence, it is likely that many intolerant shift workers would be helped by a changing shift system.

It is suggested that the workers attitude/satisfaction to their shift system may be an easy and feasible measure to find workers susceptible to their present working hours. We also propose that problems overcoming short sleep, low testosterone levels (amongst men), and a long recover need after a period with night work are signs that will help us to identify workers susceptible to this particular shift system; and should be included in recurrent screening of shift working personnel.

With respect to finding tolerant shift-workers, the majority of workers seemed to tolerate this working schedule well. These workers were highly satisfied with their working hours, had little or no problems to manage short sleep periods, showed low levels of on-shift sleepiness, recovered fast after a working period, and (amongst men) showed normal to high levels of testosterone.

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Keywords: shift-work, tolerance, vulnerability, susceptibility, individual differences

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Napping in operational settings

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Napping is common in operational settings. Although the majority of naps seem to be compensatory in nature (i.e. a result of sleepiness/sleep pressure), the large number of naps occurring before the first night shift suggests that many workers also take prophylactic naps to counteract future sleepiness. Napping should be implemented when severe sleepiness is most likely to occur. In relation to the night shift, the worst periods coincide with the circadian trough, around 3-6 in the morning, and on the way home after work. In relation to day work, naps should be seen as a good alternative (or complement) to caffeine to avoid the afternoon dip, particularly for those suffering from hypersomnia, disturbed sleep or non-coffee drinkers.

Napping interventions have perhaps been most successful in settings with long working shifts, where several studies have shown beneficial effects of naps on early morning performance. Importantly, these studies have shown that up to 90% of the participants can manage a nap during the night shift. In addition, epidemiological data has indicated that it is crucial to manage a nap before the night shift if one has had a morning shift the same day; accidents were increased in the group not taking these naps.

In real life situations the workers are free to combine several countermeasure to improve their on-shift alertness. However, only one study has studied the combined effect of naps and caffeine in the field (1). This study found that a two hour nap before the night shift had very good effects on early morning performance if combined with a strong dose of caffeine (300 mg) at the beginning of the shift. Despite this promising results, further studies are needed if we want to understand the full potential of the combination of naps and caffeine, for example on sleep inertia. It is also important to further explore individual choices and combination of strategies if we are to appreciate what strategies are most effective and how contextual such strategies are.

Taken together, napping is the only effective strategy to reduce real sleep pressure/sleep need.

Napping can also reduce future sleepiness, particularly in combination with other countermeasures. The combination of several strategies seem very promising, but needs further exploration. Data from real life settings also highlight that napping are particularly important amongst workers with extreme working hours, such as very long shifts (e.g. 16h shifts) and when the night shift is preceded by a morning shift. Lastly, napping advice should be a natural part of all fatigue management.

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Keywords: Naps, napping, countermeasures, caffeine, night shift, performance

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Implications of job design for worker well-being in international context: cross-nation patterns of work ability, work demands, and work strain of healthcare professionals

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As our global workforce ages, it is important for healthcare organizations to monitor the capabilities of their employees and intervene as necessary to maintain effective functioning of their staff. Employees in the healthcare sector often work under physically, mentally, and interpersonally demanding conditions. Moreover, features of their work schedules have the potential to interfere with their ability to respond to these demands. Systematic national differences in healthcare job design introduce another level of complexity to our understanding of the work conditions healthcare professionals experience and the consequences of those conditions for their work ability and well-being. A primary goal of this study was to integrate information from two international surveys of healthcare workers to learn more about patterns of national differences in work ability, work demands, and work strains as they relate to two key features of work schedules: night work and non-fixed schedules. Previous work that we have conducted using the international Survey of Healthcare Professionals (SHCP) demonstrated national differences in self-reported work ability, work demands, and well-being among healthcare workers from Brazil, Croatia, Poland, Ukraine and USA (n = 876), as well as some differences in the degree to which night shift work impacts the worker well-being^{1, 2}. In a subsequent survey, additional data relevant to these questions were collected from healthcare workers in six countries, including independent samples of healthcare workers from four of the five countries that participated in the original SHCP. The Survey of Work and Time (SWAT), which includes measures of job design and worker reactions to a variety of on-the-job and off-the-job issues, was administered to convenience samples of healthcare workers in Australia, Brazil, Croatia, Poland, United Kingdom and the USA (n = 1314). Work ability was assessed with a subset of items from the Work Ability Index. In addition, composite indices assessed work demands and work strain, and information about participants' work schedules was used to classify them with respect to chronic night work (yes/no) and work schedule stability (fixed/not fixed). The ability to replicate our analyses of work ability in healthcare professionals with new samples from a subset of the original countries that participated in the SHP is a key contribution of this study. Of particular interest, the level and pattern of national differences in work ability and in the impact of night work and non-fixed schedules on work ability, work demands, and work strain was remarkably stable across the two data sets. Moreover, we now introduce data from two more countries, Australia and UK, as additional points of comparison.

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Keywords: work ability, healthcare, work schedule

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Subjective somnolence perception and sleep in shift workers

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Aim: The aim of the study was evaluate the subjective perception of somnolence versus the subjective sleep time of professional train drivers.

Methods: This study was previously approved by the Research Ethics Comittee at Universidade Federal de São Paulo (CEP-UNIFESP). For this study was selected 13 professional train drivers of a Brazilian cargo transportation company to fill a sleep diary during 15 consecutive days. This diary consists of a question about the time of sleep and 7 questions related to the satisfaction of sleep (analog scale from 1 to 5), and, beyond that, informed the ideal time of sleep to feel completely refreshed in the sleep questionnaire UNIFESP. The results of those data collected were divided in 2 groups: 1) Sleep Less (SL) than the necessary for complete restoration according to informed in the sleep questionnaire, 2) Sleep More (SM) than the necessary. The statistical analysis utilized was the Test t of Student for independent samples, using $p \leq 0.05$.

Results: The mean age were 40.0 ± 6.8 years. The results showed statistical difference when the worker sleep less than the necessary needed (does not feel refreshed for the next journey) when compared with the group that sleep more than the necessary (mean of 3.75 versus 4.26, respectively). However, it was not found significant difference regarding feel more somnolence when is slept less than is informed regarding when sleeps more than the necessary for a complete refresh (mean of 2.71 versus 2.57 $p > 0.05$).

Conclusion: Although our hypotheses were not confirmed this result is in according to the literature, that general population has difficulty to correct report or describe the characteristics sleep. Therefore, the employers must be aware if their shift workers are well rested or not, especially due to increase of accidents during the conduction of the train.

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Keywords: Subjective Perception of Sleep, Sleep, Sleepiness, Somnolence

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Bright light treatment for shiftwork

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Night work is associated with increased sleepiness and reduced performance while at work, and sleeping problems following the shift. The reason for these difficulties is that the circadian rhythm is not adapted for night work. Several studies indicate that workers may not adapt their circadian rhythm even following weeks of consecutive night work.

Several carefully executed studies show that timed exposure to bright light will facilitate adaptation of the circadian rhythm. Most of the studies involve simulated night work, but also field studies have been encouraging. The effect of light depends on the timing of exposure relative to the nadir of the endogenous body temperature rhythm, which is usually located 1-2 hours before the habitual time of awakening. When bright light is given at the wrong circadian phase, adaptation to night work is impeded. I will in this symposium discuss the effects of bright light on adaptation of the circadian rhythm, and especially cover night shift studies.

Keywords: bright light, nadir, circadian rhythm

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Blood circulation in electricity distribution network controllers depending on age, experience and tiredness of the rotating shifts

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Physiological price of working increases at night time, with an increase in age and experience of workers, intensity and tiredness of a work load, number of consecutive shift, etc. The purpose was to reveal the effects of age, experience of shiftworkers and tiredness of the rotating shifts on bloodcirculation in electricity distribution network controllers.

Heart rate (HR), systolic (SBP) and diastolic blood pressure were registered in 17 electricity distribution network controllers (aged 25-63, work experience 3-40, shiftwork experience 3-38, controller experience 0-31 years) each 2 hours during 12-h working shifts over a 3-week period under 2-day shift rotation (N=1224 subject-observations). Controllers evaluated fatigue using a 5-anchor scale. Data were analysed at a p-value of 0.05.

It was found that both over-shift and remaining (at the second consecutive 12-h shift) fatigue leads to the deformation of the bloodcirculation circadian rhythms.

Against the background of the known age changes in bloodcirculation (decrease in myocardium capacity, bloodcirculation volume, increase in peripheral vessel resistance) there were found also specific age-experience changes. Both ones were most pronounced at the second night shift.

Under tiresome day work the most expressed was the growth in both parasympathetic regulation and bloodcirculation insufficiency index (SBP/HR). Under tiresome night work the most expressed was ageing in bloodcirculation selfregulation (contribution of cardiac part decreased while contribution of vascular part increased). Under unfatiguing work (except for the first day shift) with an increase in age and experience the part of sympathetic influences in bloodcirculation regulation increased that testified the infringement of biologically expedient mechanism of the heart function safety raising during an ontogenesis (age increase in the heart parasympathetic responsiveness against the background of the increase in sympathetic nervous system activity and decrease in vagally mediated responsiveness in a body functioning [1]; increase in the risk of coronary artery spasm, sudden death, hypertension under increase in sympathetic activity without corresponding increase in parasympathetic effects [2,3]).

The revealed regularities actualise the development of special regimes of work and rest considering age and experience of workers, shift tiredness and shift position within the work schedule.

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Keywords: cardiovascular system, ageing, fatigue, control room shiftworkers

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Flexible work in call centres: Effects on working hours, work-life conflict, and health

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Background and Aim: It is well established that many call-centre workers encounter substantial psychosocial pressures, such as high work intensity and limited task control. Little is known, however, about whether these pressures vary with employment status and have differential effects on health. This paper examines the structural relationships between employment status, irregular working hours, work-life conflict and health.

Method: Questionnaire data were collected from 187 marketing and customer service operators (98 full-time permanent, 40 part-time permanent, 49 casual) in 10 metropolitan call centres in Sydney, Australia. 128 (68%) of respondents were female, 55 (29%) were male, and four (2%) did not report their gender. Data were collected on demographic characteristics, employment status, work characteristics, working hours, work-life balance, psychosocial pressures, injury and health. Working hours data collected included starting and finishing times for the preceding fortnight. Mean absolute deviations of starting times, finishing times and daily working hours were used as measures of irregularity of working hours. These indices were combined with items on control and satisfaction with hours to create measures of variability (irregularity under organisational control) and flexibility (irregularity under workers' control) of hours.

Results: Structural relationships between employment status, working hours, control, work-life conflict and health were examined using ANOVA and partial least squares modelling. All employment groups reported poor psychological well-being (high GHQ-12 scores). However, casuals had significantly shorter tenure in call centres and significantly shorter weekly working hours than both full-time and part-time permanent employees. Although casuals had more variable hours and greater perceived job insecurity, they reported less occupational stress, the same level of control over hours, and no greater work-life conflict than permanent workers (part-time or full-time). Partial least squares models reveal significant structural relationships between flexibility and variability of working hours, control over hours, work-life conflict and health.

Conclusions: The results indicate that the more variable hours of casuals were associated with no greater work-life conflict, probably because they reported as much control as permanent workers and worked fewer hours. These findings suggest the irregular hours of casuals reflected flexibility for workers, rather than variability. The longer hours of permanent workers were also associated with greater occupational stress. Labour market factors and the undesirability of longer hours in a stressful, high work intensity job appear to have contributed to the results.

Keywords: working hours, flexible employment, work-life conflict, health

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New approaches in predicting and optimizing workforce requirements

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Objectives: In both the service industry (e.g., call-center, retail) and in manufacturing operations, where processes are less uniform (e.g., bio-pharmacy), it is not enough to calculate overall hours to be worked. It is necessary to predict workloads for each time of day, weekday, etc. for work that can't be reasonably delayed or done earlier and then design fitting shifts and staffing levels. Understaffing at specific times causes high workload and quality problems. Overstaffing causes avoidable costs. Concurrently, there is sometimes some 'moveable' work. Optimizing time slots to do such movable work may allow for better shifts.

With the increased use of software for running day to day business of companies, large amounts of time-stamped data become available that relate to workforce requirements (e.g. ticket sales, overtime data, calls). However, such data must be understood as indicative only because the kind of underlying work often varies (e.g., business versus charter flights) or has delays (e.g., arrival of aircrafts).

The objectives of this study were: 1) to develop better methods for predicting workforce requirements by exploiting historical data; 2) to develop methods to optimize the timing of moveable work.

Results: We will discuss the results with three cases: aviation, retail and transportation. In the case of aviation there is a strong difference between workforce requirements based on standard procedures (the flight schedule and a table of process times) and the workforce requirements based on actual flight times and the same table of process times. The standard procedure led to very high peaks in workforce requirements and correspondingly to problematic shifts (one had to combine very short, very long and split shifts). Analyzing log files led to a workforce requirement curve rather looking like a "hilly landscape" than "high mountains". More "normal" shifts could be used and thus the quality of rosters improved, understaffing could be reduced.

In the case of retail we developed a model that predicts workforce requirements not with standard process times and sales numbers but by considering differences in the kind of sales. This helped to avoid over- and understaffing. In the case of transportation low wages often make overtime very attractive for workers. This results in long work hours and short rest times. In this business case, a multi-moment recording of the work load, together with an analysis of historical working times, helped to find work processes that could be rearranged so that the resulting workforce requirements curve had a more even form. This allowed for shorter shifts than before (thereby decreasing the overtime to a legal amount).

Conclusions: The methods developed contribute to better working times because they allow for a better prediction of demand as well as its temporal optimization.

Keywords: workforce requirements, shift design, staffing, forecast

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Health care staff's opinions about an individually controlled and flexible working time arrangement

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Introduction: In the health care sector shift work is common and a variety of flexible working hour arrangements have been implemented and evaluated. High variability of working hours is repeatedly being related to ill health, especially if the variability is company controlled. In order to minimize the harmful effects on health and psychosocial wellbeing individually controlled flexible working time arrangements have been put into practice.

Aim: The aim of this study was to explore health care staff's opinions about their individually controlled and flexible working time arrangement.

Methods: Eight focus group interviews were conducted, between November 2002 and February 2003, at a medical emergency ward in a medium sized Swedish hospital. Sixteen nurses and 19 assistant nurses were mixed in the eight groups. The interviews aimed at being unstructured and the main question emanated from the aim of the study. The analysis was influenced by qualitative content analysis. Five interviews were chosen through a condensation process and these interviews were transcribed verbatim by an external secretary.

Results Two patterns of employees' opinions were revealed. Some of the participants expressed a positive attitude towards their individually controlled and flexible working time arrangement. They enjoyed the possibility to adjust their working schedule to their family situation and leisure activities. The positive ones were also talking about a health promoting possibility for reflection and learning, emanating from frequently working with different co-workers, as a result of the flexibility. These participants emphasised an importance of everyone taking part in the planning process and taking turns in adjusting their schedule after the needs of the establishment. Other participants linked the individually controlled and flexible working time arrangement to a negative experience. They talked about a time consuming planning process resulting in less predictable working hours. These participants wanted to have a permanent schedule so that they could adjust their private life after their working hours. The negative ones wanted work to be characterised by predictability and efficiency. They linked this type of work to knowing their co-workers well, so that they knew what the other ones were doing without having to communicate while working. The latter group of participants were reluctant to adjusting their schedule after the needs of the establishment.

Conclusions: It seems as if an individually controlled and flexible working time arrangement can result in either positive or negative experiences. Negative feelings form the base for psychological and biological processes that might have a negative impact on health. It is therefore important to reflect on how we implement and organise individually controlled and flexible working time arrangements for employees to have positive experiences with opportunities for sustained or improved health.

Keywords: individually controlled flexible working time arrangement, health

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Shift work, work-family conflict and effectiveness of prevention

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Aim: Shiftwork may be a demanding condition as it possibly imply a problematic conciliation between work and non-work activities and also difficulties in designing and implementing preventive actions at the workplace. Taking advantage of an investigation on working conditions among nurses undertaken in six health institutions in the Lazio Region (Italy) during March-June 2007, the following research questions were formulated: 1) are levels of work-family conflict equivalent in different work schedules?; 2) are low levels of work-family conflict associated to some extent with the existence of a preventive culture at the workplace?; 3) is the existence of a preventive culture associated with lower work-family conflict only directly or also indirectly through reduced demands and increased control on one's own work schedule?; 4) is work-family conflict associated with specific health and well-being indicators? When there is an association, has work-family conflict a higher effect size if compared with other potential determinants?

Methods: Six institutions were contacted to obtain agreement on study participation. For each institution, a list including all registered nurses was obtained; 750 subjects (circa 10% of the total) were then randomly selected due to financial constraints. Selected nurses freely accepted to take part in the research, after being assured on anonymity and confidential treatment of the data. Nurses were administered the Italian version of the NEXT questionnaire plus newly developed items concerning existing prevention practices in the respective institutions. Data were first explored by means of Random Forest Analysis with the aim of detecting associations, grading factor impact and selecting variables to include in subsequent models. An explorative analysis using Bayesian Networks were then conducted to identify patterns of relationship existing among demands, prevention practices and work-family conflict. Linear regression analyses were also conducted to test the relationships between work-family conflict and demands, prevention practices, control on one's own work time planning, type of time schedule and also their interactions. Finally, after testing the specificity of the different outcomes (Burnout, Quantitative and Qualitative Sleep, Disability, Absenteeism, Presenteeism), the impact of work-family conflict was compared with other working conditions commonly associated with lower well-being.

Results: 664 nurses answered the questionnaire (89,73%). Different types of time schedule did not imply different levels of work-family conflict. Rather, they acted as effect modifiers in the relationship between work-family conflict, quantitative demands and prevention culture. Quantitative demands, having to take over shifts at short notice, number of weekends per month spent at work, possibility to influence planning of duty rota and preventive culture were all strongly associated with work-family conflict. Preventive culture and work-family conflict were inversely associated, but only when a certain level of preventive culture is reached. Quantitative demands played a role as a mediator (40% of total effect is mediated) in the relationship between preventive culture and work-family conflict. Out of the five outcomes, only burnout and sleep were highly interrelated, while the others showed high specificity. Work-family conflict was significantly associated with burnout, sleep and presenteeism, and its association was higher with burnout compared to other precursors. Disability and absenteeism did not result to be associated with work-family conflict.

Conclusions: Compared to other work schedules, shiftwork with nights included implies different demands and preventive culture. A preventive culture reduces work-family conflict directly and also indirectly through lowered demands. Burnout seems more importantly associated with work-family conflict compared to other factors related to the quality of social relationships at the workplace.

Keywords: nurses, shiftwork, work-family conflict, random forest analysis

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Experience in the evaluation and intervention of a work shift system at a high altitude mine site, 2000-2007: model for the protection of the health of workers

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Introduction: Minera Los Pelambres (MLP) started up operations in 2000 using a shift system of seven days on the job and seven days off with a daily time schedule of 12-24 hours and 00-12 hours. A surveillance plan was implemented to evaluate the impact of this on health variables of interest among our operators for and provide early warning of risk factors.

Methodology: Measurements were made of melatonin, cortisol, heart rate variability, accident rate, disease rate and a survey of quality of sleep in a sample of 36 workers and a control group (n=43) in the 2000-2005 period, and, following a change in times for going on and off shift, in the 2006-2007 period.

Results: The following table shows the average values of variables studied in the 2000-2005 period:

Mina Operators Control Group

VARIABLE 12-24 hours 00-12 hours 20-08 hours 08-20 hours

Melatonin 4.6 (0.9) 3.5 (0.5) 17.9 (1.9) 28.7 (3.2)

Cortisol 105 (9.7) 109 (10.1) 169.8 (13.9) 178.7 (15.2)

Hours of sleep 5.9 (0.4) 5.4 (0.5) 6.1 (0.3) 6.6 (0.4)

Heart rates in the 00 to 12 hour shift declined between 03-04 hours and 07-09 hours. On the 12-24 hour shift, the greatest decline was between 15-17 hours and 22-23 hours.

The highest cumulative accident rate between 2000 and 2005 was on the 00-12 hour shift (75.8% of all cases) while in the control group, 88.2% occurred between 08-20 hours.

The disease rate, and specifically digestive pathologies, was 3.9 times greater than in the control group. These results and opinions of labour unions led to a change in times for going on/off shift to 09-21 and 21-09 hours. The following are the values of these variables measured afterwards:

Mina Operators 2006-2007

VARIABLE 09-21 hours 21-09 hours

Melatonin 60.8 (26.6) 35.4 (13.0)

Cortisol 175.5 (12.7) 121.3 (8.9)

Hours of sleep 7.8 (0.3) 7.5 (0.6)

The digestive pathology disease rate was cut back by 65%, and one work accident occurred on the 21-09 hour shift. From the production standpoint, the change netted an average increase of 5657 tons per cycle, which in two years has provided more than 8 million extra tons using the same number of operators and equipment.

Conclusions: Following the change in the times for going on and off shift, major improvements were noted in melatonin, cortisol, hours of sleep, digestive pathology disease rate, accident rate and production. An essentially preventive model was developed for tracking the health of mine operators working in a 12-hour shift system to provide sustainability for our workers and production process. The participation of labour unions in decisions of this kind is a key for their success.

Keywords: model: Strategy and methodology to undertake the topic

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Transportation professionals - from drivers to control room operators: common features about working time and its effects

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Aim: In recent years a set of field studies have been carried out in Portugal covering different transportation contexts: two studies involving truck drivers, one with coach drivers and another one involving tramway drivers and control room operators. The common aim was to provide health and safety guidelines, based on ergonomics analysis of working conditions, paying special attention to working time and exposure to fatigue and stress factors. Comparing all cases it is possible to identify some common results in despite of each context's specific characteristics.

Methods: In a first step, interviews were used for assessing working conditions in all situations. The number of subjects was 78 and 73 truck drivers, 156 coach drivers, 54 tramway drivers and 12 control room operators. In a second step, a job analysis was carried out in selected situations, monitoring the driver's activity in instrumented vehicles for video recordings, allowing for self-confronting interviews. Sleep and activity logs were completed together with self-rating scales of vigilance and sleep quality.

Results: Long working hours and driving periods are common for road transportation professionals. Truck drivers have a mean duty time per day of 10.86 hours, the driving duration being about 6.5 hours. In a second study, with more international service, these values increase, respectively, to 11.92 and 8.42 hours. For coach drivers the values are 12.3 and 7.9 hours. However, these mean values can be very much increased in some cases, sometimes being above the legal driving limits. In the tramway situation there are less working hours, however shift work increases some constraints.

In general, all subject groups perceived high levels of fatigue and stress. Reduced sleep is also a common result, particularly for morning shifts that start too early. On the road, it was revealed that mountain roads and highways are the most tiring ones due, respectively, to the involved risks and monotony. As a result of exposure to bad weather conditions, prolonged driving with short recovery periods and stress, drivers perceived a decrease in their performance. The occurrence of driving errors and violations that can compromise safety is also referred in all groups. In the tramway both groups report high mental and visual demands. Concerning video analysis, frequent periods of fatigue and drowsiness were registered, sometimes with closed eyes for one or more seconds.

Conclusions: The data suggest that in the transportation field workers are frequently exposed to conditions with long working hours and irregular schedules, accompanied by fatigue, stress, and reduced sleep. These situations could compromise health, performance and safety. Strategies to manage and prevent these risks are clearly needed.

Keywords: Transportation ergonomics, working time, driving safety, fatigue and stress

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Shiftworking and the Temporal Personality

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Once we accept time as a social construct then it is possible that there may be substantial disparity between clock time i.e. as measured by technology and organisational time synchronising, sequencing and allocating temporal resources compared to employee time perception which may be several (biological, home, family, social etc) concomitant versions.

Shiftworkers are the archetype of workers at temporal odds with the world: working at times when the rest of society; community; and family are socialising and sleeping. An extensive research tradition of the effect of shiftwork on the individual experience in terms of health, biology, psychology, and social activities exists. Using shiftworkers and non-shiftworkers to investigate the effect of time on employees and organisations makes sense given the comparable organisational context i.e. environment, job design, employment contract, etc.

Part of the discussion of shiftworker work tolerance is their capacity to adapt to living a different social and organisational time. Additionally, personality effects may be important in shiftwork tolerance and such ideas have previously been considered. There are ideas from the empirical studies in the sociology of time that could elucidate the phenomenon of the shiftworker experience of time relating to shiftwork tolerance by considering the temporal personality. The concept of polychronicity suggests different temporal personalities. Polychronicity is described as a cycle view of time with less concern for strict scheduling of activities and is characterised preference to manage several tasks simultaneously and by a social embeddedness and high-context culture. Individuals prefer to be given tasks but left to determine how they are scheduled. Monochronicity is a more linear view of time where one job is managed at a time to schedule and is characterised by more alienated social contacts and a low context culture. Individuals have scheduled activities that they perform in the manner they choose.

Some discussions surrounding shiftwork is the shiftworker tendency to social isolation, home-centredness and individual activities. However, this has been countered by the description of shiftworkers preference for shifts, especially nightshifts because of the friendly, smaller, closer community and the comparative lack of supervision, less pressured pace and often more varied activities. This study therefore seeks to test whether there is a shiftworker temporal personality type that can be used to consider job design or organisational fit. A quantitative data approach to establish linkage between polychronicity and shiftworking is the suggested approach. There are established and validated measures that can be used to investigate correlation between them. The Polychronic Attitude Index (PAI).investigating individual polychronic preferences, the Inventory of Polychronic Values (IPV) for organisational polychronic preferences and the Survey of Shiftworkers (SOS) or the Standard Shiftwork Index (SSI) are suitable.

Hence two burgeoning research areas appear to have some commonality that could be utilised in seeking extend the understanding of the relationship between time, the organisation and the shiftworking employee experience.

Keywords: shiftwork, polychronicity, monochronicity, time, personality, job design, organisational culture

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Shiftworking and the Employee Organisation Relationship

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There are many aspects of the shiftworking experience requiring exploration. It has been shown through extensive studies across various disciplines that shiftwork has a significant effect on the lives of employees. As these employees are so strongly affected by their work type experience in comparison to other groups, it would seem logical that this fact should have a significant effect on the nature of the Employee Organisation Relationship (EOR). This study explores the relationship between shiftworkers with their employers, which represents an advance in research.

Shiftwork research demonstrates that there are biological, physiological, social, and psychological effects of shiftworking on the individual worker. These can manifest in symptoms, diseases and adaptations as wide ranging as greater susceptibility to gastrointestinal diseases; depressive illnesses; work:life conflict; sleeping problems; social isolation; burnout and home-centredness than non-shiftworkers. There are many contingent aspects that may have ameliorating or deleterious effects, so the effects on the individual are variable. These factors are as diverse as individual personality characteristics; ability and degree of adaptation to shiftwork; working environment; and degree of perceived control over the work schedule and task; size of workplace; and social connection at work amongst others. Some of these aspects are clearly related to the management, culture and nature of the employment organisation. If the organisation affects the shiftworkers experience then it seems essential to understand the relationship between the employee and the organisation and how that may differ from non-shiftworking employees. Pisarski, Lawrence, Bohle & Brook (2008) and Pisarski & Bohle (2008) have highlighted that organizational support based on social and team support and identification may diminish the effects of shiftworking on work life conflict and health. This study will use the concept of the psychological contract to explore the EOR. The psychological contract is a construct that is based on the reciprocity or social exchange between the employee and the employer. Both parties to the psychological contract have expectations, obligations and perceived promises arising from the employment relationship. A breach or violation of those expectations or perceived promises can materially affect the relationship whereby the employee may leave; renegotiate or withdraw from active participation in their work. With shiftwork materially affecting the shiftworker experience this relationship should be significantly influenced by the work type and the content of the psychological contract should demonstrate this. Research has demonstrated links between the psychological contract and organisational commitment (OC) and organisational citizenship behaviour (OCB) amongst other constructs so there are further links that can be made to organisational connections. Quantitative data from the Standard Shiftwork Index (SSI) and the Psychological Contract Inventory (PCI) will be used as this study seeks to initially demonstrate the content of shiftworkers' psychological contract. Some initial data should be available for August 2009. This study represents an attempt to situate and contextualise the shiftwork experience in the organisational relationship.

Keywords: shiftwork; employee organisation relationship; psychological contract

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Shiftwork, Hours of Work, and Modifiable Health Risk Factors

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Aims: There is limited research on the impact of shiftwork and long work hours on behaviors that may affect worker health. The study's purpose is to compare the health behaviors of workers on 8-h day shifts, to those of workers on night shifts, rotating shifts, and extended work hour schedules. Compared behaviors include smoking, exercise, body mass index (BMI) as a behavioral indicator, alcohol use, and hours of sleep. Additional analyses will compare readiness to change behaviors, and examine associations between work schedules and predictors of chronic disease.

Methods: Data from a voluntary Health Risk Assessment (HRA) survey were collected on-line, during 2000-2008, from 30,234 employees in a multinational manufacturer with a stable workforce of approximately 34,000. Responses of 26,442 were sufficiently complete for analysis. Rates of heavy smoking (1 pack/day), lack of exercise (less than twice/month), moderate to high alcohol use (2 drinks/day, 1-3 days/week for women, 4-5 days/week for men), BMI of 30 or more, and short sleep (less than 7 hours/day) were compared by type of work schedule (day, night, and rotating shift) and daily work hours (8, 10, and 12). Generalized linear models with log link and a Poisson distribution assumption were employed to estimate rate ratios and 95% confidence intervals adjusting for age group, sex, marital/living status, worksite, and occupational group (3-5 broad groups).

Preliminary Results: Prevalence of heavy smoking is substantially higher among 12-hour shift workers, and is generally higher among rotating shift workers. High BMI is modestly associated with night schedules. Lack of exercise is somewhat more prevalent among rotating shift workers and shows some tendency to increase with length of shift. Moderate to high alcohol consumption tends to be less prevalent among night workers. Low sleep hours is associated with long shifts and night and rotating shifts. Differences among work schedule groups were reduced when rates were adjusted, particularly with respect to occupational group. A higher proportion of night and rotating shift workers are in blue collar occupations with higher smoking and high BMI rates, while white collar occupations had higher alcohol consumption.

Discussion: Observed patterns largely conformed to our hypothesis that demanding schedules are associated with adverse health behaviors. Higher smoking rates among 12-hour and rotating shift workers could be due to attempts to counteract fatigue and stress, while lack of exercise among these same groups could be due to time constraints (12-hour shifts) or difficulty maintaining an exercise routine (rotating shifts). High BMI among night workers could be due in part to lack of access to healthy food and/or sleep disturbance impact on metabolism and hunger hormones. Lower alcohol consumption among night workers may be due to lack of social opportunities for drinking.

Conclusion: The associations of health behaviors with differences in work schedule suggest that it may be useful to tailor health promotion efforts to the circumstances of employees on different schedules. Additional investigation is needed into the sources of behavior differences and ways to assist behavior change in the context of non-standard schedules.

Keywords: Shiftwork, Health, Risk Factors, Behavior

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Need for a better evaluation of exposure for assessing cancer risk in shiftworkers

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In December 2007, the International Agency on Research on Cancer (IARC) has classified “shiftwork that involves circadian disruption” as “probably carcinogenic to humans” (Group 2A) on the basis of “limited evidence in humans for the carcinogenicity of shift-work that involves nightwork”, and “sufficient evidence in experimental animals for the carcinogenicity of light during the daily dark period (biological night)”.

The limited evidence in humans was related to breast cancer in female shiftworkers and based on 6 positive studies out of 8, published in the latest 15 years, which reported a slightly but significantly higher incidence in women (mostly nurses) with a longer exposure to night work, and in work sectors with a higher prevalence of shiftwork including nightwork.

Two main problems emerge in examining existent epidemiological studies: the very rough estimation of exposure, and the scarce assessment of other concurrent risk factors.

As concerns exposure, both cohort and case-control studies ground their risk assessment either on one simple question on being or not involved on rotating shift work including night (with the very likely paradox of including permanent night workers in the control group), or on the rough attribution of exposure provided by an “expert”. Moreover, studies based on national cancer registers determine attribution of exposure according to the prevalence of shiftwork in various work sectors, adopting different cut-off for labeling subjects as “exposed” or “not exposed”, i.e. >60% vs. <40% in one case, and <40% vs. <30% in another, with a resulting scarce specificity and an high chance of misclassification in both groups.

Also quantification of exposure (in terms of years spent on shiftwork) results as not homogeneous, and the cut-off separating the different groups is defined mainly in terms of numerical distribution of the sub-groups: i.e., the cut-off of the sub-group with the longest exposure was set at >3.1, >4.6, >6, >20, and >30 years in the different studies.

No studies take into consideration the other main organizational factors characterizing the different shift system, that are known to influence biological adjustment, tolerance and negative consequences on health. These include: length of shift cycle, direction and speed of rotation, number of nights worked in a row, start time of shifts, associated overtime, number and position of rest days, regularity/irregularity of the shift schedules. Only few studies consider the amount of nights worked per months, and no studies distinguish between continuous and semi-continuous shift systems.

Considering the relevance of the problem, both from the medical and the social perspectives, it is therefore necessary and urgent defining a proper protocol for recording more precisely and systematically all the important information about the shift schedules worked and the amount of years actually spent in shift/night work.

Keywords: Shiftwork, cancer, risk assessment

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Possible epigenetic effects on blood DNA in shiftworkers

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We used a candidate-based approach to assess whether there were changes in the methylation of sequences previously recognized as important component of the inflammatory and cancer pathways. In particular, global hypomethylation of repetitive genomic sequences (Alu and LINE-1) has been associated with chromosomal instability. Glucocorticoid receptor (GCR) is a gene involved in hypothalamic-pituitary-adrenal axis functioning and susceptible to stress-related programming. Tumor necrosis factor (TNF α) is a multifunctional cytokine that plays important roles in diverse cellular events such as cell survival, proliferation, differentiation, and death. Interferon-gamma (IFN γ), is the most important trigger for the formation and release of reactive oxygen species, crucially involved in the pathogenesis of atherosclerosis and cardiovascular disease.

Aim and Method: To assess whether shift work could lead to a genome-wide hypomethylation, and to a hypermethylation or hypomethylation of specific genes, we tested the degree of methylation of five sequences (Alu, LINE-1, GCR, TNF α , IFN γ) in DNA obtained from whole blood sample of a group of 150 male workers (mean age 41.0, sd 9.0), employed in two chemical plants; 100 were 3x8 rotating shiftworkers (mean age: 40.4, sd 8.7; mean job seniority 11.6, sd 8.6) and 50 were dayworkers (mean age: 42.2, sd 9.4; mean job seniority 16.6, sd 9.8). We used pyrosequencing to estimate repetitive elements and gene specific methylation on bisulfite-treated DNA.

Results: No significant differences between shift and day workers were detected as concerns Alu (25.4% vs. 25.1%), LINE-1 (82.3 vs 82.5), GCR (44.9 vs. 44.7), TNF α (12.1 vs. 11.7), and IFN γ (81.4% vs. 82.1%). Multiple regression analysis, adjusted for (shift)work, age, BMI and job seniority, did not find any significant association between the 5 methylation markers and shiftwork; on the other hand, job seniority, in all subjects, was significantly associated with ALU (Coef. -0.019, p=.033), GCR (Coef. 0.092, p=.064), and IFN γ (coef. -0.224, p<.001), whereas TNF α was inversely correlated with age (coef. -0.093, p<.001).

Considering only shift workers, the multiple regression analysis, adjusted for age, BMI and job seniority showed a significant difference between morning and evening types as concerns TNF α (mean MT 11.42 vs. ET 12.97, p=.006; Coef. 1.31, p=.022). No difference has been recorded between people with good and poor tolerance to shiftwork. Comparing workers with different shiftwork seniority (<5 yrs, 5-15 yrs, >15 yrs), ALU significantly decreased with increasing years of shiftwork (F=2.95, p=.057), even after adjustment for age, BMI and morningness/eveningness (Coef. -.858, p=.006). The same resulted for IFN γ (F=4.70, p=.011; Coef. -5.778, p=.004). On the other hand, GCR significantly increased with length of shiftwork (Coef. 3.330, p=.05).

Keywords: DNA Methylation, Cancer risk, Morningness, Tolerance

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Recovery brief naps and prefrontal cognitive performance in partially sleep deprived subjects

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Introduction: Daytime napping has shown to be beneficial in several studies on vigilance and performance during shift work conditions. Literature data suggest that a short nap could counteract the decline of cognitive performance due to restricted sleep. The purpose of this study is to test the efficacy of a restorative 10 minute nap used as countermeasure for sleepiness and to the decline of cognitive performance due to a partial sleep deprivation.

Methods: Eight healthy subjects (M = 5, F = 3) aged between 23 and 30 years (mean age 26.3 ± 2.8) were subjected to a partial sleep deprivation (5 hours, 02.00-07.00). During the next day (11.00-19.00), their levels of subjective and objective sleepiness were assessed by the Karolinska Sleepiness Scale (KSS) every 15 minutes and the Multiple Sleep Latency Test (MSLT), while performance was examined every hour with a Reaction Time task at three levels of complexity (simple, complex and multiple) and the Random Letter / Number Generation Task. The subjects were submitted to two experimental conditions, one characterized by a continuous wake in a controlled environment through the entire day, and another one where a 10 minute nap was included during the eight hours wake period at 14.00.

Results: A tendency of improved scores was found in the nap condition with regard to the errors of the Random Letter Generation Task ($F = 4.3$, $p = 0.09$) and in the amount of the correct sequences of the Random Number Generation Task ($F = 6.0$, $p = 0.07$), but no significant effects were found for the factor "condition" for any of the other variables.

Discussion: Our results do not strongly indicate a significant effect of a short nap on vigilance and performance after partial sleep deprivation. This may partly reflect the fact that, in general, the reduction of vigilance and performance levels were too small after a few hours restriction of sleep in order to detect a real beneficial effect of naps. We can assume that the moderate effect of the nap on the random generation tasks is partly due to the higher cognitive complexity of the test.

Keywords: Naps, Prefrontal cognitive performance.

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Train driving and sleepiness: the influence of age and alerting devices

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Introduction: Driving a train is generally considered a very stressful condition that involves a complex set of tasks. It requires high levels of competence, ability, experience and responsibility, not only because the high cost of transport activities, but also because of the associated risks to human life.

It also demands high levels of alertness in order to perform a complex set of activities that involve considerable skills and cognitive functions (eg. information processing, decision making, problem solving, etc). The present study had the purpose to assess the alertness level and the psycho-physical performance of 12 train drivers, representing 3 different age groups (30-35; 40-45; 50-55) of 3 transport divisions (Regional, Cargo and Passenger trains), during their usual work shifts, both day and night. There was also three different conditions using different alertness maintenance systems a) the VACMA b) the SCMT c) and No system (Control). The VACMA system, also called the "Dead Man's Switch", monitors, by a pedal, the driver press and release time on the control devices. Any detection of the vigilance lack will trigger the emergency stop of the locomotive and the emission of an alarm. The SCMT is, mainly, a speed control system that calculates the braking curve of the train and the speed limit the train should respect, depending on the different section of the track. Driver's failure of keeping the speed under the imposed braking curve speed causes the command emergency braking.

Methods: Twelve subjects, divided according to age group and type of work, were examined: first group of 4 drivers aged between 30 and 35 of which 1 driver of "regional" division, 2 drivers of "cargo" division and 1 driver of "passengers" division; second group of 4 drivers aged between 40 and 45 years, including 2 drivers of "regional" division, 1 driver of "cargo" division and 1 driver of "passenger" division; third group of 4 drivers aged between 50 and 55 years, in which 1 driver of "regional" division, 1 driver of cargo division and 2 drivers of "passenger" division. All subjects were submitted to three different driving modes, depending on the alerting devices that they were allowed to use, a) VACMA, b) SCMT or c) Base (no device), both on night shift and day shift. Continuous polysomnographic (EEG, EOG, EMG and ECG) recordings were made during the whole driving sessions. In the beginning and at the end subjects were subjected to a test of psychomotor performance (Color Word Vigilance test). Furthermore, in order to evaluate subjective sleepiness, the Karolinska Sleepiness Scale (KSS) was filled in before, in between and after each driving session.

Results: In order to measure objective sleepiness on EEG recordings, we have used two different indexes a) a hypovigilance density index, which is calculated as the amount of alpha waves shown on each 20 sec. EEG epochs, and b) an alertness frequency index, which is the amount of epochs that don't show any hypovigilance signs during the entire recording. Younger subjects (age group between 30 and 35) showed significantly higher hypovigilance density levels ($F = 3.86$, $p < .05$), and significantly lower alertness frequency ($F = 3.68$, $p < .05$) compared to the other two groups of age. No significant differences were found between day/night conditions or between the work conditions (Base, VACMA, SCMT). With respect to the Color Word Vigilance test, we found that the oldest subjects (50-55) showed a longer reaction time latency, both before ($F = 17.43$, $p < .001$) and after ($F = 17.07$, $p < .001$) the driving period, and a greater number of errors both in the beginning ($F = 5.24$, $p < .01$) and at the end ($F = 7.48$, $p < .01$) of the shift, as well as a greater number of omissions, both before ($F = 7.48$, $p < .01$) and after ($F = 8.45$, $p < .001$), compared to the other groups. There was no significant difference between the safety system conditions for the reaction time or for omissions, but we found a significant increase of errors (before/after) at the end of the shift for VACMA ($t = -1.65$, $p < .06$) and BASE ($t = -2.19$, $p < .05$). Subjective sleepiness, measured by the Karolinska Sleepiness Scale, increased progressively during the shift ($z = -6.45$, $p < .001$) in all three groups, without significant differences between age groups. KSS was higher before ($\chi^2 = 8.94$, $p < .01$) and after ($\chi^2 = 20.09$, $p < .001$) the night drive. With respect to driving modes (Base, VACMA, SCMT), KSS was significantly higher before driving the VACMA system ($\chi^2 = 6.46$, $p < .05$) although there was no significant difference at the end of the shift between the three modes.

Discussion and conclusion: The results suggest that younger subjects show higher physiological sleepiness than older drivers. No conclusion could be drawn about differences on the efficiency of the two alerting systems.

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Geophysical, social, and sleep-dependent determinants of sleep timing and duration following transmeridian travel

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Aim: Providing adequate sleep opportunity to commercial aviation pilots is central to mitigating fatigue-risk in flight operations. A model that predicted pilots' sleep behaviour would improve the capacity for aviation companies to assess the risk involved. The aim of this study was to investigate the sleeping patterns exhibited by pilots during international operations and to identify factors that could be used in a general model to predict the timing and duration of sleep for this population.

Methods: Pilots were recruited from a commercial aviation company that operates international flight and duty patterns around the world. A sample of 110 participants (44 Captains, 45 First Officers, and 21 Second Officers) recorded duty/rest schedules and sleep/wake times in a study diary and wore a wrist activity monitor throughout a minimum 15-day data collection period. Participants operated 132 flight and duty patterns with destinations in Hong Kong (N = 20), London (N = 43), Frankfurt (N = 25), Johannesburg (N = 12), Los Angeles (N = 13) and New York (N = 19). The flight and duty patterns included a combined total of 451 duty periods, 319 layovers, and 1011 sleep periods.

Results: To assess the relationship between total sleep time across layovers (TST-layover) and layover length, a single layover period was randomly selected for each participant. A simple linear regression using TST-layover as the dependent variable ($M = 14.0$ h, $SD = 5.5$) and layover length as a predictor variable ($M = 44.4$ h, $SD = 18.7$) revealed a significant R-square value of .79, $F(1,107) = 392.1$, $p < .01$. Within layovers, the majority pilots adjusted their sleep times to coincide with the appropriate geophysical and social zeitgeber of the local time zone, irrespective of flight direction or the number of time zones crossed. Where possible, night-time sleeps were supplemented with shorter sleeps in the time periods occurring immediately after arrival and prior to departure.

Conclusions: The pattern of sleep behaviour exhibited by pilots would not be expected solely on the basis of sleep physiology as outlined in the two-process model of sleep regulation. Instead, the results suggest that geophysical and social zeitgebers, strategic decision-making, and sleep physiology all play a role in determining the timing and duration of sleep in pilots. These findings are discussed in relation to ongoing efforts to develop a predictive model of sleep behaviour for pilots.

Acknowledgements: This study was financially supported by the Australian Research Council.

Keywords: sleep, aviation, flight, time zone

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Contribution of Core Body Temperature, Length of Prior Wake and Sleep Stages to Cognitive Throughput

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Aim: Shiftworkers are often required to sleep at inappropriate phases of their circadian timekeeping system, with implications for the dynamics of ultradian sleep stages. The independent effect of these changes on cognitive throughput performance are not well understood. This is because the effect of sleep on performance is usually confounded with circadian factors that cannot be controlled under normal day/night conditions. The aim of this study was to assess the contribution of core body temperature, length of prior wake, and sleep stages to cognitive throughput performance under conditions of forced desynchrony.

Methods: A total of 11 healthy young adult males resided in a sleep laboratory in which day/night zeitgebers were eliminated and ambient room temperature, lighting levels, and nutrition intake were controlled. The protocol included 2 training days, a baseline day, and 7x28 h FD days (FD1 to FD7). Throughout the FD days, a 1:2 rest-to-wake period ratio was imposed (9.3 h rest, 18.7 h wake). Sleep was assessed using standard polysomnography scoring criteria during rest periods. Core body temperature was sampled in continuous 1-minute epochs using rectal thermistors. Cognitive throughput was measured on a 5-minute serial addition and subtraction (SAS) task in test sessions held every 2.5 h across the wake periods of each FD day.

Results: Analyses were based on a single beat period encompassing FD2 to FD7. On average, participants obtained 7.6 h (SD=1.3) of total sleep time during rest periods. This included 4.1 h (SD=1.1) hours of Stage 1 and Stage 2 sleep (S1-S2 sleep), 1.7 h (SD=0.6) hours of slow wave sleep (SWS), and 1.7 h (SD=0.7) of rapid eye movement sleep (REM sleep). A mixed-model regression with five covariates indicated significant fixed effects on cognitive throughput for length of prior wake, $F(1,396) = 15.6$, $p < .01$, core body temperature, $F(1,396) = 11.7$, $p < .01$, and REM sleep, $F(1,396) = 4.2$, $p = .04$. Performance was improved when the length of prior wake was shorter, core body temperature higher, and the amount of REM sleep greater. Significant fixed effects for the remaining covariates (S1-S2 sleep and SWS) were not found.

Conclusions: The results demonstrate that variations in core body temperature, time awake, and amount of REM sleep are associated with changes in cognitive throughput. The absence of a significant effect for SWS may be attributable to the truncated range of sleep periods sampled in this study. However, since the mean and variance for SWS were nearly identical to that for REM sleep, these results suggest that cognitive throughput is more sensitive to variations in REM sleep than in SWS.

Acknowledgements: This study was financially supported by the Australian Research Council.

Keywords: forced desynchrony, sleep, circadian, core body temperature, REM sleep

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Comparative analysis of lapses of attention and errors in professional train drivers, performing more or less than 12 daily work hours

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Aim: The purpose of this study was to compare lapses of attention rate between professional train drivers before and after an usual work shift during more or less than 12 hours.

Methods: This study was previously approved by the Research Ethics Committee at Universidade Federal de São Paulo (CEP 0547/08). The total amount of volunteers was 77, all of them shiftworkers at a Brazilian cargo transportation company. The instrument elected to conduct testing was Psychomotor Vigilance Task (PVT). The tests were performed at two different moments: before work (BW) and after a regular (AR). Volunteers were allocated in two groups: those who work less than 12 hours daily ($J < 12h$) and those who work more than 12 hours a day ($J > 12h$). A t-Student Test for dependent samples was conducted in order to analyse the relative lapses of attention rate (RLA10) and the relative errors rate both in 10 minutes (RER10). Differences of 5% were considered statistically significant.

Results: The analysis showed no statistical differences for both ALR10 and RER10 results, for $J < 12h$ comparing volunteers before and after a work shift. However, there was a significant difference between BW and AW for RER10 when $J > 12h$ (1.00 ± 1.38 versus 1.51 ± 1.84).

Conclusion: Results suggest an errors rate's increase regarding those train drivers who work more than 12 daily hours. Therefore, as the work time increases there is also a progressive increasing errors risk. One can conclude that as long as shifts are these can negatively influence attention and as the engines need to be carefully conducted these long hours of working can though raise accidents in the railway.

Keywords: shift work, psychomotor vigilance task, human error, lapses of attention.

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Environmental and organizational conditions affecting napping/rest during nurses' night work: a qualitative approach

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Introduction: Night work schedules influence directly on sleep-wake cycle. The allowance to sleep during the night shift can contribute to compensate for the shorter night sleep at home among nurses. A previous napping study among nurses (Borges et al, 2009) showed nappers were able to maintain higher alertness during night work than non-nappers. **AIM:** The aim of this study was to characterize the environmental and organizational conditions favorable or unfavorable to sleep/rest during the night shift among nurses.

Methods: This study has a qualitative approach with in-depth interviews carried out with registered nurses and nurse assistants during their night shifts in a hospital of São Paulo, Brazil. Criteria of inclusion were: females keeping only one night-time job, time on the job higher than 12 months, and no reports of sleep disturbances. The interviews were conducted only with women, n=8, mean age 35 years old (3.9) and working an average of 9 years in night shift. They work only one 12-hour night job, 19:00-07:00h, followed by 36-hour off-work period.

Results: The participants mentioned the nursing team had a formal allowance to sleep/rest during the night shift. However, sleep/rest was not possible when there was a high demand of work and/or limited number of nurses to perform the tasks. Moreover, there was not a specific place, with beds, comfort, and privacy, and away from light and noise to rest. It was common to nap and/or only to rest (without falling asleep), at the same place they work, in office doctors, meeting rooms or even in storage rooms. The participants reported sleeping/rest in mats, mattresses, couches or empty patient's beds. Although the environmental conditions were not adequate, participants reported napping/ rest as an important time for physical and mental rest, and to maintain performance during night work.

Conclusions: Although there is a permission to nap/rest during night work, the hospital does not provide an appropriate place. The statements of the participants reinforce that should be implemented adequate rooms for nurses to rest/nap. The evaluation of environmental and organizational conditions that is favorable or unfavorable for napping/rest at the hospitals, can provide to hospital managers, useful information to improve quality programs for nurses and patients' care.

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Keywords: napping, night work, nurses, work organization

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Long hours, shift, and overtime: their associations with occupational injury and illness among nurses in the Philippines

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Aims: nurses often endure long work hours, shift work, and excessive overtime. While these work characteristics are examined as potential risks for workers' safety and health in other occupations, in nursing a major focus tends to be their impact on patient safety. This study investigates how these work characteristics are associated with injury and illness among nurses.

Methods: Cross-sectional data were collected using a questionnaire from a sample of 655 registered nurses in the Philippines. Multiple logistic regression was used to assess associations of work hour and work schedule measures with four self-reported health outcomes: work-related injury in the past year (none/1 or more), work-related illness in the past year (no/yes); missed more than two days of work in the past year due to a work-related injury or illness (no/yes); and, back pain (no/yes). Two indicators of work hours, shift length and weekly number of hours worked, were collected. Work schedule characteristics were measured by primary work shift (day shift/non-day shift) and times per month worked overtime. Control variables included age, type of work setting, additional jobs, time spent in direct patient care activities, employer-provided safety information, and availability of protective equipment.

Results: Nurses with non-day shifts were more likely to report a work-related injury (OR=1.54; 95% CI: 1.07, 2.24) and work-related illness (OR=1.48; 95% CI: 1.02, 2.16). Also, frequency of working mandatory or unplanned overtime was associated with increased odds of work-related injury (OR=1.22; 95% CI: 1.06, 1.41), work-related illness (OR=1.19; 95% CI: 1.04, 1.37), and missing more than two days of work because of a work-related injury or illness (OR=1.25; 95% CI: 1.08, 1.44).

Conclusions: By focusing on health outcomes for nurses (rather than patients) and considering the context of a developing country, this study offers a unique perspective in examining nurses' work schedule characteristics. Our findings are consistent with previous studies of other occupations, suggesting that non-day shifts and frequency of overtime may be understudied risk factors related to the well-being of nurses in the Philippines.

Keywords: long hours, shift, overtime, nurses, Philippines

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Implementing a new shift schedule in a large steel plant: critical success factors of the change process

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Aim: According to most theoretical work and some empirical studies the common recommendation is to create a participative process in implementing new shift schedules (Knauth & Hornberger, 2003; Smith et al, 1998). However, in practice the problem is how to involve large numbers of employees in creating and implementing new rosters, especially in large firms. In this contribution we present the process how Corus in the Netherlands implemented a new fast forward rotating schedule in its steel plant at IJmuiden.

Method: The authors were heavily involved in the process, one as a chairman of the project group, the other as a researcher who performed the evaluation. Direct observation and participation were the methods in collecting the data.

Results: The first discussion for a new roster came from the health department: the old backward rotating scheme with three consecutive night shifts was unhealthy. Then a project group was started with management, HR and the Health Department involved. They consulted a technical work group, had some conferences with experts and came up with three alternative forward rotating schedules. Also a side group with unions and managers of all factories were consulted. After a process of information, communication and discussion sessions with unions, the existing schedule and the three alternatives were voted by all the employees involved. A second voting was needed to decide which of the two most popular schedules got the majority. The experiment with the new schedule lasted one year. At the end (after nine months) a last voting was organised. 56% of the shift workers were in favour of the new schedule, so it was decided to make it the normal schedule.

Conclusions: What were the critical success factors? Due to the number of involved employees (more than 4600 shift workers) the process was managed carefully. The voting process was organised in a careful but strict and straightforward way. Lots of communication and many sessions with all stakeholders involved were organised. Another important factor is the honest and open way of leading the whole process. Thanks to all these aspects the voice of the opponents was heard. However, the democratic principle of the majority was also in place: the silent majority decided for the experiment and for the final schedule. Last but not least, an independent evaluation (after six months of implementation) was organised and communicated to the stakeholder group in detail and the employees in general.

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Keywords: Implementation; change process; participation; largest shift change in the Netherlands

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Performance, work load and shift work tolerance at different ages in a large production company

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Aim: Many organizations start to feel the effects of ageing populations. Among others, higher wages of older workers put serious economic pressure on organizations, particularly if the productivity is less at higher ages. But the latter is no fact. It largely depends on function demands (Costa and Sartori 2007). One issue that may jeopardize the work ability of older workers is shift work, particularly if night shifts are included. It has been suggested that workers at a higher age have a lower tolerance for shift work. In a Dutch production company (producing metal cans), the operator's work comprises both mental and physical loads, and is performed in day as well as shift work (2-shift, 3-shift, and 4+-shift). Aim of this study was to determine the differences between age groups in work performance, work load and shift-work tolerance.

Methods: A specific questionnaire was developed comprising validated question modules and new sets of questions. These new questions were related to the determination of the work performance; we therefore interviewed production managers to define the most relevant performance-related items, which were then incorporated into the questionnaire. The questionnaire was returned by 235 workers (response: 84%).

Results: All age groups rated their performance better in comparison to others, but the younger age groups (45-) were even more positive compared to the older (45+). On the other hand, the youngest group (21-35) gave less ratings to their attitude, motivation and behaviour than other age groups. Similarly, in the evaluation of the performance-related function-specific items, the younger age groups showed lower rating values. Another finding was that more than half of the respondents considered themselves not be able to work in their job until the age of 65. With respect to mental and physical work load, no clear differences existed among the various age groups. However, we did find age-related difference in shift work tolerance. In particular, sleeping and fatigue problems in older people were more pronounced in older people, particularly in the 3-shift schedule. The 4+-shift was the most stressful schedule for everyone irrespective of age.

Conclusions: In this production company, we did not find indications for a drop in productivity at higher ages. The self-experienced productivity did not decrease at higher ages, while these self-experiences were confirmed by the production managers. Because of a healthy worker effect, however one should be careful in this respect. The type of shift did show some age-dependent effects on the workers. More flexible shifting schedules are currently discussed within the company as an outcome of this study.

Keywords: performance, work load, age, shift work

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A preliminary analysis of the Time Awareness Scale

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Aim: Circadian rhythms can be measured in terms of phase, amplitude and stability. However, questionnaires have focussed on assessing phase differences. The Time Awareness Scale (TAS) builds upon the early/late preferences scale (Smith et al. 2002) by assessing two additional dimensions; the strength of these preferences and time awareness. Both were considered to be potential indicators of amplitude. The current aim was to examine the psychometric properties and partial construct validity of the TAS.

Methods: The TAS is proposed as a 38 item measure consisting of three factors; morningness (14 items), strength of preference (14 items) and time awareness (10 items). Four-hundred and twenty-one North American students completed the TAS and a nine-point alertness scale (1=very alert; 9 = very sleepy) at 2-hourly intervals during a work day and on a rest day. Rest days were included since they allow greater flexibility in use of time and thus allow individual differences to be more clearly expressed.

Results: We first examined the factor structure by setting a minimum loading of .40 and checking reliability for item-total correlations that meet .33. This resulted in the loss of four items. After listwise deletion (N=351) we repeated a principal components analysis and extracted three components that explained 39% of the variance. The morning factor (13 items) explained 20%, followed by time awareness (10%; 10 items) and strength of preference (9%; 11 items). Cronbach's alphas were .88, .84 and .73 respectively.

A MANOVA was used to test for differences in alertness by time-of-day for those at or beyond the 25th and 75th percentile on each scale. For work-day alertness, the preference scale detected significant differences in alertness ratings as expected ($p < .001$). Morning types were significantly more alert from 08:00 to 12:00 while evening types were more alert from 20:00 to 24:00. Students with a stronger awareness of time were significantly more alert from 08:00 to 12:00 only. In considering rest-day alertness significant differences were again found for morningness ($p < .001$). Morning types were significantly more alert from 08:00 to 14:00 while evening types were more alert from 20:00 to 24:00. Stronger time awareness was associated with significantly greater alertness at 08:00 and 12:00 only. No significant differences were found for strength of preference in alertness ratings for either work or rest days.

Conclusion: The results support the posited factor structure for the TAS but with 34 items. The three components explained 39% of the variance and scale reliability was good. Construct validity was found for the morningness scale on both work and rest days. Time awareness and strength of preferences (as potential indicators of rhythm amplitude) were not reliably or strongly linked to alertness differences over time of day. These preliminary results will be assessed in a large working sample.

Keywords: alertness, circadian, morningness

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Assessing the risk for different kinds of impairment as a function of the design of flexible work schedules

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Aim: Risk assessment including the risk associated with the design of work schedules is a legal requirement in the FRG. However, there are no validated and easy to handle tools available for this purpose. Within the context of implementing a tool his study addressed the research question whether it is possible to find and specify characteristics of work schedules which can be used for predicting different kinds of impairments, which could then be used in the implementation of the required tool. In an earlier approach one single summative index has been used, with the weighting of the criteria based on expert judgments. This index showed moderate to high correlations with selected health impairments. The question, however, is, whether specific predictions for specific impairments can be made, using a combination of specific characteristics of the work schedule which are combined on the basis of statistically derived weighting models.

Method: Analyses were based on an available data base from an inquiry on the effects of flexible working hours (Janßen & Nachreiner, 2004). In a first step correlations have been calculated between different characteristics of the respondents' work schedules, among others the proportion of morning, evening and night work, and a set of health complaints to identify relevant characteristics. These were then combined in multiple or logistic regressions to estimate their predictive validity in combination. Based on the regression equations cut off models have been explored to yield the best separation of respondents with vs without the impairments, e.g. sleep disturbances.

Results: The results show a number of significant correlations between different characteristics of the work schedules and reported impairments. Combining the relevant characteristics by regression analyses resulted in acceptable predictions for most complaints. As hypothesized different impairments can thus be predicted by a differential selection and weighting of these characteristics, supporting the assumption and requirement of a more specific prediction of impairments and evaluation of work schedules. Establishing cut off points for a yes/no prediction appears to be helpful for the implementation of an evaluation tool.

Conclusions: The results support the idea of constructing differential predictor models for different health impairments and their implementation into a computer or internet based tool, in order to allow companies or individual workers to evaluate their work schedules against ergonomic criteria. A comparable approach for social impairments will be tested in the near future.

Keywords: flexible working hours, risk assessment, impairments

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Work hours, workload, sleep and fatigue in Australian Rail Industry employees

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Background and Aim: Research suggests that less than 5h sleep in the 24h prior to work[1] and/or more than 16h of wakefulness[2] can significantly increase the likelihood of fatigue-related impairment and error at work. Studies have also shown exponential safety declines with time on shift, with roughly double the likelihood of accident or injury after 12h relative to the first 8h[3]. While it is acknowledged that reduced sleep, increased wakefulness and longer work hours produce work-related fatigue, few studies have examined the impact of workload on this relationship. This study investigated these issues in a large sample of Australian Rail Industry Employees.

Methods: Subjects were from 6 companies (n=123: 116m, 7f; 19-58y: mean(+sd)=40.1+-9.0y). They had a mean BMI of 29.1 (+5.2), had worked in shiftwork for 15.7y (+9.6y), and drank 4.1 (+2.6) caffeinated drinks per day. Data was collected on a total of 927 shifts. Subjects wore wrist actigraphs and completed sleep and work diaries for 14-days. They also completed the Samn-Perelli Fatigue Scale at the beginning and end of shifts, and the NASA-TLX workload scale at least twice during each shift.

Results: Average (+sd) sleep length (7.2+-2.6h), prior wake at shift end (12.0+-4.7h), shift duration (8.0+-1.3) and fatigue (4.1+- 1.3, ""a little tired, less than fresh"") were within limits generally considered acceptable from a fatigue perspective. However, participants received 5h or less sleep in the prior 24h on 13%, were awake for at least 16h at the end of 19% and worked at least 9h on 8% and 12h on 4% of shifts. Subjects reported that they felt ""extremely tired, very difficult to concentrate,"" or ""completely exhausted, unable to function effectively"" on 15% of shifts. Mixed effects regression indicated that sleep length ($F[1,429.3]=5.0$, $p<0.05$), shift duration ($F[1,465.0]=4.0$, $p<0.05$) and workload ratings ($F[1,489.6]=7.2$, $p<0.01$) were significant predictors of fatigue.

Conclusions: While on average, sleep loss, extended wakefulness, longer work hours and work-related fatigue do not appear problematic in this sample, there is still a notable percentage of shifts that are likely to be associated with high levels of work-related fatigue. Given the size of the Australian Rail Industry, with thousands of shifts occurring each day, this is potentially of operational concern. Further, results indicate that, in addition to sleep length, wakefulness and work hours, workload significantly influences fatigue. This has possible implications for bi-mathematical predictions of fatigue and for fatigue management more generally.

[1] Dawson & McCulloch, Sleep Med. Rev. 2005, 9(5):365-380; [2] van Dongen et al., Sleep 2003, 26:117-126; [3] Folkard & Tucker, Occupational Medicine 2003, 53:95-101.

Keywords: work hours, workload, sleep, fatigue, rail

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Sleepiness, Stress and Compensatory Behaviours in Nurses and Midwives

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Aim: Shiftwork schedules of nurses and midwives typically result in reduced sleep, increased sleepiness and stress. Compensatory behaviours often include caffeine, alcohol and sedative use. Long work hours, sleepiness and stress may be contributing to the critical shortfall in the nursing and midwifery workforce. This is investigated in a group of Australian nurses and midwives.

Methods: Nurses (n=41) and midwives (recruitment continues) in Australian metropolitan hospitals completed daily logbooks for one month (total of 1148 days), recording work hours, sleep length and quality, stress and exhaustion levels, caffeine and sleep aid use. They completed General Health and demographic questionnaires, including a job-satisfaction item. Midwives also wore actigraphs throughout the study.

Results: Initial analyses in the nursing cohort revealed moderate to high levels of stress and exhaustion on 30-40% of shifts. Nurses reported trouble sleeping on 30% of work days compared to 20% of days off. Nearly 60% of nurses reported taking a sleep aid, with 22% using prescription medication and 44% using alcohol. Caffeine consumption (reported by 70% of nurses), stress and exhaustion were significantly higher, and sleep duration was significantly lower on work days compared to days off ($p<0.01$). Almost one third (27%) of participants reported being either indifferent to, or mildly unsatisfied with their job. Data collection in the midwife group is underway.

Conclusions: Initial results suggest that disrupted sleep, elevated stress and exhaustion, and lowered job satisfaction are prevalent. Also common are reports of medications and alcohol to aid sleep and caffeine to promote alertness. Ongoing analyses will further examine these factors among nurses and in the midwife cohort.

Keywords: sleep, sleepiness, stress, nursing, midwifery

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Depressed mood in the working population: association with work schedules and working hours

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Aim: The impact of working time arrangements on accompanying health problems have been studied extensively. Still, little is known about the interrelation between work schedules, working hours and depressed mood. For work schedules the underlying assumptions imply a disturbance of social and biological rhythms. Regarding working hours the assumptions relate to work load and work capacity. Conversely, depressed mood may urge an employee to adjust their work schedule and/or the amount of working hours a week. The aim of this study is to assess the associations between different work schedules and working hours with depressed mood.

Methods: Data from the baseline measurement of the ongoing Maastricht Cohort Study were used (n=12140). Two subgroups were selected. One subgroup was used to compare day work and different shift work schedules with respect to depressed mood, consisting of men and women working at least 26 hours a week (n=8843). The other subgroup was used to study the association between working hours a week and depressed mood, consisting of exclusively day workers (n=7343). Depressed mood was assessed with a single item: 'Did you feel down every day over the last 2 weeks?' Logistic regression analyses were conducted, with adjustments for potential confounders.

Results: Odd's ratios (with 95% CI) adjusted for age, educational level, living alone & long-term illness:

MEN, Work Schedules

Day work 1 (ref.)

Three-shift 2.05 [1.52-2.77]

Five-shift 1.34 [1.00-1.80]

Irregular shift 1.79 [1.27-2.53]

WOMEN, Work Schedules

Day work 1 (ref.)

Three-shift 1.02 [0.34-3.05]

Five-shift 5.96 [2.83-12.56]

Irregular shift 0.75 [0.37-1.50]

MEN, Working hours/wk

<26 h/w 2.65 [1.31-5.36]

26-35 h/w 1.10 [0.62-1.95]

36 - 40 h/w 1 (ref.)

>40 h/w 0.85 [0.65-1.11]

WOMEN, Working hours/wk

<26 h/w 0.86 [0.54-1.35]

26-35 h/w 0.90 [0.53-1.51]

36 - 40 h/w 1 (ref.)

>40 h/w 1.39 [0.71-2.72]

Conclusion: This study showed that different work schedules and working hours are associated with depressed mood. The associations were more pronounced for male employees. Working in shifts was related to higher depressed mood compared to day work. This study showed that depressed mood might be a relevant issue deserving further attention among shift workers. Regarding the amount of working hours a week, male employees working < 26 h/w had a significantly higher prevalence of depressed mood compared to men working 36 - 40 h/w. Conversely, in female employees the amount of working hours a week was negatively related to depressed mood (not significant). These findings indicate a possible reciprocal relationship between working hours and depressed mood. Our study illustrates that working time arrangements should be taken into account when studying depressed mood in occupational health.

Keywords: Working Time Arrangements, Mental Health, Depressed Mood, Epidemiology

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Chronic sleep deficit and performance of a sustained attention task: an EOG study

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Aim: Performance of a sustained attention task after 7-days partial sleep restriction (21 hours in total) was observed with use of an electrooculographic (EOG) system. Two types of errors: omission (lapses) and commission (false responses) were taken into consideration. Effect of the time of day on the sustained attention after chronic sleep deficit was investigated.

Methods: The study was performed on 12 young women (ages ranged from 21 to 27) in two conditions: after a normal-sleep week and under experimentally induced sleep debt of 3 hours a night during one week. Both conditions were separated by a two-week break. All the participants met inclusion criteria: right-handed, normal or corrected-to-normal vision, no physical and psychiatric disorders, no sleep-related disorders. They were all non-smokers and drug-free. The subjects were previously trained to ensure familiarity with the tasks. We used go/no-go type task consisting of two unpredictable conditions, one with a cue congruent to a target and the other with incongruent cue. The analysis focused on two types of error responses treated as top-down attentional control dysfunctions: omissions and commissions. Participants performed the top-down type sustained attention tasks four times during the day (10am, 2pm, 6pm, and 10pm). In each session 120 congruent and 34 incongruent stimuli were presented to each participant. The saccadic reactions on stimuli were registered using an EOG technique.

Results: Two types of erroneous reactions (omissions and commissions) in four sessions for two conditions (normal sleep vs. sleep debt) were analyzed. In case of each participant 1232 measurements were collected. The obtained results, analyzed with use of ANOVA model, clearly show that partial sleep restriction produces considerable performance decrements in sustained attention tasks. The results point to the fact that sleep debt significantly stimulates the appearance of errors of omission (congruent stimuli – $F=14.3$, $p=.0001$; incongruent stimuli – $F=13.37$, $p=.001$). Time of day effect on performance impairment was found at 2pm for both congruent and incongruent stimuli ($F=7.91$, $p=.013$; $F=6.46$, $p=.023$ respectively) and at 6pm for incongruent stimuli ($F=5.26$, $p=.039$).

Conclusions: The 7-days partial sleep deprivation affected the performance of sustained attention task and manifested itself in growing number of omission errors. The significant increase of omissions was observed at 2 pm. The dip in performance during the mid-afternoon hours may be linked to an increase in sleep propensity at that time of day (post-lunch dip syndrome) and to the sleep debt.

Keywords: chronic sleep deficit, sustained attention, saccadic eye movements, omission and commission errors

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Can short sleeps be predicted by work hours of Australian doctors?

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Aims: Significant emphasis has been placed on the design of work schedules of hospital doctors in an attempt to manage fatigue-related risk. Very little information exists however, to demonstrate any relationship between actual work and sleep measures. Where the relationship has been assessed, studies have used retrospective and subjective analysis of sleep patterns which are not ideal. The aim of the current study was to describe the relationship between actual work and actual sleep collected prospectively and objectively.

Methods: Sixty-five doctors working in Australian hospitals volunteered for the study. Doctors collected sleep and work information using diaries, and wore activity monitors for 14 consecutive days, including days off. A total of 380 work periods were included in the analysis. For each work period the following variables were calculated at the time of shift start: total work hours in the prior 24h and 48h, and total sleep in the prior 24h and 48h. Mixed model ANOVA (random effect=subject ID) was utilised to test for an effect of work on subsequent sleep and Binary Logistic Regression (for longitudinal data) was utilised to predict cases of restricted sleep.

Results: A significant effect of work in the prior 24h was found [$F(6,332.4)=4.4, p<0.01$], such that working for 14-15h (mean $\pm$ sd=6.2h $\pm$ 0.5) or >15h (5.1h $\pm$ 0.5) were associated with significantly less sleep than working <10h (7.0h $\pm$ 0.1, $p<0.05$). There was no significant relationship between work in the prior 48h and sleep in the prior 48h. Analysis was performed to specifically predict cases of <5h sleep in prior 24 (6.6% of total) and <12h sleep (20% of total) in prior 48 using prior work hours. In both cases the regression analyses did not demonstrate a significant relationship.

Conclusions: Doctors obtained less sleep when their total work hours in the preceding 24-hour period exceeded 14 hours, compared to when they worked less than 10 hours. However, no such relationship was found for work in the prior 48 hours. Instances of very low amounts of sleep (<5h in 24 or <12h in 48) could not be predicted simply by work history. Interestingly, there were very few instances of doctors starting a shift with less than 5 hours of sleep in the prior 24 hours (which may account for the absence of a statistical relationship). However, it is not possible to predict these occurrences based solely on total work hours. Further analysis will examine the possible contribution of time of day.

Keywords: Shiftwork, sleep, doctors, performance

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Performance on a simple reaction time task: is it about sleep or work for miners?

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Aim: The risk of incidents and accidents is known to be higher on night shift, to increase with increasing shift length and to increase with each consecutive shift worked. It is generally assumed that the acute and cumulative sleep disruption associated with night work contributes to the risk, however, this has not been well described. The current study examined the influence of both work- and sleep-related factors on performance on a reaction time task in the field.

Methods:

Participants (age: 42.1 ± 10.3 yr) worked one of three rosters:

- 4:4 (n=14) 4D4O4N4O
- 7:4 (n=10) 7D4O7N4O
- 14:7 (n=12) 7D7N7O

Participants wore activity monitors and kept sleep diaries for one rotation and completed a 5-min PVT on a personal digital assistant (PDA) at the start and end of each shift. Linear mixed models were used to analyse differences in pre- and post-shift RRT (reciprocal reaction time) and lapses. Models tested main and interaction effects of roster (4:4, 7:4 and 14:7), shift type (day and night shift), sleep in the 24h prior to shift start (sleep24) and subjective sleep quality (quality). All models specified subject ID as a random effect. Higher RRT equates to faster response times.

Results: Pre-shift RRT showed an effect of roster ($F(2,186)=7.0$, $p<.01$) and sleep p24 ($F(1,186)=7.1$, $p<0.01$). Pre-shift RRT was higher for participants working the 4:4 roster than those on the 14:7 and 7:4 rosters. Pre-shift Lapses showed an effect of roster only ($F(2,177)=5.7$, $p<.01$). Pre-shift lapses were less frequent in the 4:4 roster than the 14:7 and 7:4 rosters.

Post-shift RRT showed an effect of roster ($F(2,182)=4.8$, $p<.01$), work-time ($F(1,182)=7.01$, $p<.01$), and sleep p24 ($F(1,182)=3.9$, $p<.05$). Participants on the 7:4 roster had lower RRT compared to the 14:7 and 4:4 rosters. Post-shift RRT was lower at the end of night shifts, than day shifts. Lapse frequency at the end of shift showed an effect of roster ($F(2,171)=5.0$, $p<0.01$). The 7:4 roster showed significantly higher frequency of lapses at the end of shifts.

Conclusions: Night shift was associated with poorer performance than day shift, as expected. However, the amount of sleep that was obtained in the 24h period prior to the start of shifts was also an important mediator of performance. This has important implications as the design of rosters should have a focus on sleep opportunity, in addition to work hours. Further, the 7:4 roster was associated with longer reaction times and more lapses at the end of shifts. The results suggest that sleep and performance of individuals working 12h shifts may benefit from rosters that involve (a) fewer consecutive shifts (i.e. 4:4 roster), or an extended period of time off (i.e. 14:7 roster).

Keywords: Shiftwork, sleep, performance, rosters, mining

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The challenge of change: Digging deeper into the mining sector

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Changing shiftwork arrangements to control risk can be challenging with competing interests such as payment systems, productivity and utilisation of capital equipment just some issues for consideration. To address this, the mining industry in the state of NSW in Australia commissioned the Digging Deeper project, which sought accurate and reliable information about the manner in which the risks presented by shift work were being managed. The project represents the most comprehensive and thorough study of OHS management ever undertaken in the Australian mining industry and possibly in the industry worldwide (Shaw et al, 2007). It has provided detailed information about the effectiveness of OHS management with respect to hours of work and fatigue management across the industry. Data were collected from over 60% of workplaces in the industry and over 50 sites were visited for in-depth qualitative and quantitative data collection. A written survey (N=1667) provided detailed information about hours of work and perceived consequences for work, fatigue and family life. Participative industry workshops were used to validate data and to develop improvement strategies.

The OHS risks of shiftwork and extended working hours are well known in the NSW mining industry. Despite this, hours of work are extreme, with 78% of the industry working more than 45 hours per week. These excessive hours are not distributed across all occupational groups; those in management, professional and supervisory roles work significantly more than those paid by hourly rates (eg labourers, equipment operators). Digging Deeper showed that control of the resulting risks can be ineffective, focussing on those working less hours, aiming at individual behaviour change and neglecting the organisational processes that legitimise extreme hours of work for those in key decision-making roles. Extreme hours of work were seen as a requirement of particular jobs with the responsibility for controlling the resulting risks placed on the fatigued individuals, who report negative consequences for their work capacity and for home life.

Changing this approach to controlling the risks of fatigue is challenging, with most sites focussed on individual susceptibility to fatigue and creating procedures and management processes that aim to allow these susceptible individuals to be identified and managed. However, the weaknesses of this approach were well recognised. We found keen interest from the industry in a more interventionist approach by the OHS regulator to this issue, seeking clearer guidance on fatigue risk management and firmer boundaries for shiftwork arrangements.

Keywords: Shiftwork, work hours, mining, risk management

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Staying safe in the jungles of Borneo: five studies of fatigue and cultural issues in remote mining projects

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Introduction: The global mining industry continues to get larger, in terms of the size and number of projects. As this expansion occurs, projects have started in areas previously considered too remote and/or difficult. Communities located near mines often support 'progress' because of the economic benefits but any impacts on safety, culture and the environment are often poorly understood until after the projects start.

Methods: This paper reports on five previously unpublished studies done in Kalimantan, which is the Indonesian part of the island of Borneo in South-East Asia. The studies were completed in April 1998-August 2007 and their core themes were: 1) safety in continuous (24/7) operations, 2) sleep/recovery, and 3) managing fatigue within a diverse ethnic/tribal context. The research was commissioned by the host mining companies to help avoid fatigue-related accidents, which had previously caused the death of employees/contractors.

The studies used various qualitative and semi-quantitative methods including: measurement of sleep quality and quantity using diaries; assessment of attitudes, opinions and beliefs of all key stakeholder groups using semi-structured interviews; and, comparative assessment of work-related fatigue associated with hours of work using a bio-mathematical model.

Results: Sleep quantity was consistently found to be low; e.g. within 8-h shift rosters a mean of 5.9hrs (SD 1.4) sleep was achieved between night shifts (with lower amounts reported between 12-h shifts). The main reasons given for not achieving more sleep were: heat, poor ventilation, noise, spending time with visitors, and stress related to family, work or finances.

The interview results showed that some factors were specific to a single religion, such as Muslim prayer times, which ensured short sleeps between night shifts. Other factors were specific to a single type of living arrangement; e.g., it was considered rude to turn away visitors that arrived during sleep times when living in a village. Agreement between groups included: 1) minimum and desirable standards for sleeping accommodation, 2) requirements for leave to be available for attending death or burial events of a close family member, and 3) a need for better communication about safety.

Conclusions: Practical project outputs will be provided, including: the interview questions, the standards developed for sleeping accommodation, the relevant fields to use in accident investigations, and the key cultural factors identified. Confounding factors and other study limitations will be discussed. By undertaking research and implementing recommendations such as those developed, it is intended that the lives of local community people, and the safety records of the visiting projects, can be improved.

Keywords: fatigue, culture, risk management, social aspects, accident risk

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Measuring chronodisruption retrospectively

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Aim: Chronodisruption may be a risk factor for breast cancer and other hormone-dependent cancers. For a large case-control study of breast cancer in Western Australia, we are interested in measuring the degree of chronodisruption that subjects incurred in the past. Unfortunately there is a lack of information on the relevant time window of any causal effect. This means that we must obtain information across the lifetime of the women in order to examine the effect at different time periods. Most shiftwork questionnaires relate to only the current situation so are not suitable for use for this purpose.

Methods: In this case-control study, we are obtaining data in a two step process. First, the women provide a life-time occupational history in a written questionnaire. This includes job title, main tasks and years started and ended that job. Screening questions are used to identify jobs which involve shift work and frequent travel over time zones. For these jobs identified as potentially involving chronodisruption, further detailed questions are asked regarding the patterns of shiftwork and travel. An online application (OccIDEAS) is used by telephone interviewers to ask these more detailed questions about each job. Automatic rules will be used to assess the answers to these questions and classify each job as to the degree of chronodisruption involved. For each job, we will also ask about sleep, in particular the quality, duration, timing and any discontinuity. In addition, we will collect data on other covariates and factors that might modify the relationship between shiftwork and breast cancer such as alcohol and dietary habits.

Conclusions: Retrospective exposure assessment is always difficult, but for an exposure like shiftwork it is possible to ask standard questions to obtain appropriate estimates. This methodology will allow us to identify the time window of exposure that is most strongly associated with increased risk.

Keywords: chronodisruption, retrospective, jet lag, shiftwork, case-control

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Influence on own working hours and sleep - an intervention study

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Aim: Shift work is hypothesized to affect the risk of cardiovascular diseases (CVD) through sleep deficiency, desynchronization of biological rhythms, disruption of social patterns, and changes in health behaviour. Work-time control may be a mean to reduce the adverse health effects of odd working hours by enabling workers to adjust their work schedule to their individual needs and thereby decreasing the risk of CVD by preventing stress reactions and detrimental health behaviour. To evaluate the effect of work-time control on health and well-being an intervention study was conducted. In the present abstract the results of the effect of work-time control on biochemical risk factors for CVD are presented.

Methods: The intervention study was conducted among eldercare workers in the Danish eldercare sector with a 10-12 months follow-up. The participants primarily worked during the day, evening and/or weekends. The data collection consisted of questionnaires and blood samples. In the blood samples we measured total cholesterol, HDL-cholesterol, apo-lipoprotein AI, apo-lipoprotein B, glycated hemoglobin, and testosterone. Blood samples were collected from 233 participants at baseline and/or follow-up. At baseline, the mean weight was 73.0 kg. (SD 16.2), the mean age was 45.3 years (SD 10.1), and the females constituted 98.9% of the sample. The males were excluded from the analyses in the present abstract. During the study period, three types of interventions were identified:

- (1) High intensity [computer program],
- (2) Moderate intensity [courses, questionnaires, and work groups], and
- (3) Low intensity [meetings].

In the statistical analyses, these three groups were compared with the reference group, where no intervention related to work-time control was conducted, by use of the mixed procedure with repeated measures in SPSS version 17.0.

Results: Preliminary analyses demonstrated a significant increase in the degree of influence on one's own working hours in the intervention group compared with the reference group. None of the biochemical markers were significantly affected by the intervention under study.

Conclusions: The present study showed that employee influence on one's own working hours can be increased through workplace interventions. On the other hand, the intervention did not alter the biochemical risk factors for CVD in this group of eldercare workers. The implications of these findings are that work-time control does not appear sufficient for reducing the adverse physiological effect of demanding working hours. Due to the small sample size of the present study, however, we suggest that future research should aim at confirming or rejecting these results in a larger cohort.

Keywords: Eldercare, intervention, sleep, working time control

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Visual Analytics for Workforce Requirements

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Objective: The fit of workforce requirements (i.e., when are how many persons with a specific qualification needed) and actual staffing is a crucial element in designing proper shift systems. Understaffing causes high work pressure and quality problems. Overstaffing leads to avoidable costs. In many service industries (e.g., call-centre, care for elderly, retail) workforce requirements vary over the course of the day, the week, and the year. Therefore, temporal structures of workforce requirements are the basis for designing shift systems.

Corresponding analysis, however, is not straightforward. The main tasks are dealing with missing and erroneous data, and identifying temporal patterns of workforce requirements (for example, influence of holidays and seasons). Often no direct measures of workforce requirements exist, but only several indicators for over- and understaffing (e.g., queue length in a check-in area at the airport, overtime by employees).

Proper visual analytics (i.e., interactive visualisations in combination with (semi-)automatic analytical methods) can help to better understand workforce requirement. Interactions with the data ease its exploration, bring specific aspects into the fore, identify erroneous and missing data, and, thereby, support better analysis and prediction of workforce requirements.

Method: We investigated more than 50 existing visualizations that may be used as indicators for workforce requirements and built a coherent collection within [TIS] Time Intelligence Solutions®. The system enables users to apply the visualizations and analytical methods easily to new data sets. In a second step, we organized them in a map of methods to help users 'find' relevant visualisations and analytical methods for the specific task at hand. Focus group interviews were conducted to refine this map.

Results: The new visualisations (e.g., time map, GROOVE) helped to identify temporal patterns that were not detected with earlier visualisations. The newly developed organisation of these visualisations in a map helped novices and expert users to find relevant visualisations faster.

At the same time visualisations are often related to specific analytical approaches of workforce requirements and with substantial development going on in this field one can expect the map to grow. Part of this work was done within the DisCô project part of the program "FIT-IT Visual Computing" of the Federal Ministry of Transport, Innovation & Technology, Austria Project number: 813388.

Keywords: Explorative Data Analysis, Estimating Workforce requirement, Information Visualization, visual analytics

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Procedures for waking up spouses

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Aims: Very often couples (hetero- and homosexual) differ in their morningness. Long working hours, domestic duties as well as shift-work lead to different times of waking up. The person waking up earlier has to deal with the question whether and how to wake up his/her spouse. Waking up one's spouse may bring risks. In an exploratory study the overwhelming majority of persons did not like to be wakened up (75%). Only couples that had been together for less than 3 month enjoyed being woken up. On average it took 7.2 interventions from the 'waker'. Some people do like being alone in the morning. On the other hand, the person already awake faces a tough choice: Spend a lonely morning or risk emotional damage. Our exploratory study showed that in 66.6% of the successful awakenings couples subsequently had a severe dispute.

The aim of this project is to optimize the procedures for waking up one's spouse, such that emotional damage is minimized.

Methods: In a literature research we identified several possible approaches. We distinguished:

- 1) Soft intellectual approaches: "Darling, would you mind waking up."
- 2) Soft seductive approaches: "Darling would you mind letting me wake you up."
- 3) Soft emotional approaches: Playing their favorite music with increasing volume and offering coffee
- 4) Confrontational approaches: "If you don't get up I'll ...", loud music
- 5) Paradoxical interventions: "Please try not to wake up. There is nothing worth waking up for."
- 6) Depressive approaches: "I am so sad. I am always alone."
- 7) Physical approach (aka the "Costa approach"): Cold water poured over the partner
- 8) Sending in the dog (if applicable)
- 9) Indirect approaches: Organizing telephone calls, visits of friends
- 10) Reflexive approach: Would you like to participate in a study on ways to wake up one's spouse.

We developed a survey and sent it to couples that work long hours or do shift work and asked them on their approach and the corresponding results.

Results: No single approach led to good results. Even the reflexive approach - while promising in the evening - did not deliver morning results. However, publishing quasi-scientific papers brought some relieve to the early birds.

Conclusions: There is no straight forward approach to waking up one's spouse. An arrhythmic variation seems to be most promising. From the feedback two main approaches crystallized:

Be very friendly to your spouse regardless of what she/he is talking about vs. singing whale songs.

Keywords: Eveningness, Morningness, Shift work, Long Work Hours, Domestic conflicts

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Minimizing split shifts in highly flexible working time models

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Aim: Having two or more periods of work with a long break in between (e.g. 2 hours) is often called a "split shift". Typically, employees strongly dislike split shifts due to increased travelling and the potential waste of time during the break.

Split shifts are difficult to avoid if the shape of the personnel demand does not coincide with feasible maximal shift length and average working time. E.g., 40h per week, max 10h h per day and a demand for 2 persons from 6:00 - 18:00 leads to split shifts.

Several organizational factors have a possible impact on split shifts. E.g., demand profiles are influenced by planning strategies with regard to sick leave. Further issues include the amount of part-time work. Special difficulties arise with short term changes in personnel demand, personal availability etc.

The objective of our project was to identify, monitor and minimize the number of split shifts that can be influenced by individual planners.

Method: Sozial Global is an organisation that provides care for elderly persons. It employs approx. 700 persons working to cover 70.000 visits, and 12.000 duties per month. Approx 50% of their duties are changed after the original publication of the plan at the beginning of the month, while approx 25% of the duties are split-shifts. Using specialized software for time-data analysis (TIS - Time Intelligence Solutions) we analyze the data for each of the approx. 100 teams on a monthly base to test for the identified potential drivers for split shifts. Numerous possible aggregations are compared between the large number of teams to find outliers and patterns.

Results: Several factors have a surprisingly little or no impact: group size, amount of evening work, amount and distribution of leave or the amount of part-time work. However, the amount of evening and weekend work and the planning strategies applied have a strong impact.

Conclusion: While this study does not allow exclusion of organisational factors like group size or part time work as potentially strong drivers of split shifts, it strongly draws our attention towards improved planning strategies. By comparing the actual overall effect of planning strategies, within and between teams and at subsequent points of time, it is possible to improve the planning techniques applied and also to monitor how well an organisation is doing within its specific situation.

Keywords: Explorative data Analysis, Split Shifts, Shift Scheduling

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Do miners have lower risks of prostate cancer?

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Aim: Prostate cancer is less common in blind people than in fully sighted people, possibly because they have a free-running melatonin cycle. We wondered whether men working in underground mines would also have a free-running melatonin cycle and therefore have a lower risk of prostate cancer. The proposed mechanism would be that low light levels during the day in underground mines results in the circadian rhythm being less disrupted than for people who work in bright light.

Methods: Data was obtained from a population-based case-control study conducted from January 1 2001 to August 20 2002 at The University of Western Australia. Cases were men between the ages of 40 and 76 with histologically-confirmed prostate cancer notified to the Western Australian (WA) Cancer Registry. Controls were selected from the WA electoral roll, and frequency age-matched to the cases. Consenting study participants completed self-administered questionnaires on demographic and lifestyle factors. The occupational history section asked about each job held for one year or more with details on job title, employer, industry, start and finish years, number of hours worked per day and number of days worked per week.

Results: From the study population of 604 controls and 466 cases, 34 participants were identified as having ever worked in the mining industry with a total of 48 jobs as miners. After controlling for age, family history and military service in Vietnam, (factors found to be associated with prostate cancer in our data) miners had a statistically significantly reduced risk of prostate cancer (OR 0.35 95% CI 0.16-0.75).

Conclusions: A systematic literature search of studies examining mining and prostate found a reasonably consistent trend of a decreased risk of prostate cancer amongst miners in both case-control and cohort studies. None of the published articles discussed their results regarding mining and prostate cancer in detail, and a biological mechanism to support these results has not previously been suggested. The relationship between mining and prostate cancer deserves further investigation.

Keywords: prostate cancer, mining, underground mines, melatonin cycle

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Working Memory Capacity is Decreased in Sleep Deprived Internal Medicine Residents

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Background: Concerns about medical errors due to sleep deprivation during residency training led the Accreditation Council for Graduate Medical Education (ACGME) to mandate reductions in work schedules. While call rotations with extended shifts continue, effects on resident sleep-wake times and working memory capacity (WMC) have not been investigated. Objectives: Measure effects of call rotations on sleep-wake times and WMC in Internal Medicine residents.

Methods: During two months of an Internal Medicine training program adhering to ACGME work hour restrictions (between April 2006 and June 2007), residents completed daily WMC tests, wore actigraphy watches, and logged their sleep hours. This observational study was conducted during a call month requiring 30 hour call rotations every 4th night while the non-call (control) month allowed sleep/wake cycle freedom. Main Outcome Measures: Sleep hours/night and working memory capacity testing.

Results: Thirty nine residents completing the study had less sleep/night during their call month (6.4 vs. 7.3 hours/night-non-call, $p < .001$) and sleep/night varied from 3.7 to 10.1 hours. Call rotation caused greater self-assessed sleepiness, reduced WMC recall scores ($-2.6/\text{test}$, $p < .05$) and more math errors ($+1.07/\text{test}$, $p < .04$). Full recovery of WMC did not occur until the fourth day after call. A call rotation during the first study month had a confounding detrimental effect on WMC.

Conclusion: A month of call rotations reduced overall sleep/night, sleep hours/night were variable and WMC was adversely affected. Decreased WMC could explain impaired judgment during sleep deprivation although clinical error rates were not evaluated.

Keywords: Working memory capacity, Medical Residents, sleep deprivation

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The validity of the fatigue and risk index (FRI) for predicting impairments to health and safety under different shift schedules in the context of risk assessments

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Aim: In Germany a risk assessment of the working conditions, including the design of the working time arrangements, is legally required. However, such a risk assessment of work schedules is only very seldom performed, due to the complexities and the lack of suitable tools. In the context of a research project on predicting impairments to health and safety due to characteristics of the work schedule the FRI (Spencer et al., 2006, <http://www.hse.gov.uk/research/rrhtm/rr446.htm>) was considered a candidate to be used in evaluating the work schedules. The question was thus addressed whether these indices would be able to predict any detrimental effects to health and safety.

Methods: Data from an ongoing internet survey were used to check the predictive validity of the FRI. Respondents came from different branches of the industrial and service sectors. Until now an n of 246 respondents have been analysed. The questionnaire contained a description of the working hours for the last four weeks and questions on health complaints and the incidence of accidents within the last year. The working times were manually transferred to the FRI calculator (using default values for workload and rest breaks) and the results re-imported into the data file. Statistical analyses included simple correlations as well as multivariate analyses, using different parameters from the indices (FI_{max}, FI_{mean}, RI_{max}, RI_{mean}). It is intended to update the analyses for new respondents and to analyse data from an older survey to increase the sample size and the conditions observed.

Results: The correlations between the incidence of an accident and the FRI were rather moderate, ranging between .15 and .2, with the maximum correlation from the FI_{mean}. Correlations with factorised health complaints showed a moderate relation (up to $r = .27$) for sleep disturbances for the FI parameters, and again low correlations for musculo skeletal disorders, with the rest showing non-significant results. Multiple regression analyses resulted in moderate regression coefficients. The high intercorrelations of the indices lead to only one canonical correlation with the complaints, with a variance explained of about 1% from the set of indices to the set of complaints.

Conclusions: The results achieved so far would caution against using the FRI for predicting impairments to health and safety in its present form though it has to be admitted that only moderate correlations can reasonably be expected while other factors influencing risk besides working times are not controlled. However, the relations obtained would argue to continue with the approach by modifying some of the input variables, e.g. concerning work load. A larger sample including more night shift workers is urgently required to test for the stability of the results. Updated results will be presented at the symposium.

Keywords: risk assessment, work schedules, shiftwork

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Referred health of current, former and never-night workers: a study on female nurses

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Aim: To analyse three groups of nursing personnel - current, former and never-night workers - as to referred health problems.

Methods: A cross-sectional study was carried out with nursing teams at three hospitals, encompassing 1307 female workers. After excluding workers with missing data, workers were classified into four groups according to their experience on night work: never-night workers (N=281), former night workers (N= 399), and current night workers, divided into those who work up to five nights per fortnight (N=289), and those who work 6 or more nights/fortnight (N=252). Health problems were analyzed through three variables: (1) Self-rated health (SFH): "In a general way, compared to people your age, how do you consider your health to be?" (very good/good/regular/bad), (2) time-comparative (this year vs last year) SRH: "In comparison to 12 months ago, how do you consider your health to be?" (better than/equal to/worse than), (3) number of diagnosed diseases, based on the Finnish work ability index questionnaire (workers with three or more diseases as the risk group). Logistic regression was used to evaluate the association between the night work experience and referred health problems (never-night workers as the reference group).

Results: Former night workers and workers who work 6 or more nights/fortnight were more likely to report poor time-comparative SRH. Odds-ratio (and CI95%) were respectively 1.63 (1.06-2.49) and 1.67 (1.05-2.74) after adjusting for potential confounders (age, schooling degree, income, presence of children, marital status, professional and domestic worked hours/week, professional category, type of contractual employment, alcohol consumption, and smoking habits). Concerning the number of diagnosed diseases, the adjusted odds-ratio (and CI95%) were 2.05 (1.42-2.95), 1.74 (1.16-2.60) and 1.59 (1.01-2.51) for former and current night workers, considering those with few and many nights/fortnight, respectively. No significant association was observed for the SRH variable.

Conclusions: The similarity between former and current night workers suggests possible residual effects of night work on reported health that warrants a deeper investigation.

Financial support: Faperj; CNPq

Keywords: health, night work

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Determinants of melatonin among rotating shift nurses

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Aim: Long-term shift work has been assessed as a probable carcinogenic risk factor. It is hypothesized that increased light at night exposure reduces melatonin production, which is associated with increased cancer risk. Physical activity has also been associated with reduced risk of cancer at multiple sites and while the mechanism remains unknown, laboratory studies suggest exercise may increase melatonin levels. Finally, sleep duration has been hypothesized to influence both melatonin levels and cancer risk and it has been suggested that sleep duration could be used as a proxy for melatonin. Therefore, the aim of this study was to examine the relationships of light exposure, physical activity, and sleep duration with melatonin levels.

Methods: A cross-sectional study to assess the relationships of light at night exposure, physical activity and sleep duration with biomarkers of melatonin levels was conducted among 61 rotating shift nurses. Light intensity exposure was measured using a light intensity data logger, physical activity and sleep duration were assessed by self-report, and melatonin was assessed from urine and saliva samples.

Results: An inverse association ($p = 0.002$) between light exposure and urinary melatonin levels was observed in the full population; however, this was not significant when stratified by shift (day and night). There was no consistent relationship between physical activity and melatonin levels, and no correlation between sleep duration and melatonin production was observed. Analysis of salivary melatonin levels indicated circadian rhythms of melatonin production among nurses working at night were not altered, such that peak melatonin production still occurred at night while working.

Conclusions: This study suggests that this pattern of rotating shifts with two nights, two days and five days off may not change the timing of peak melatonin production to the day among those working at night. Sleep duration was not correlated with urinary melatonin levels, suggesting that in this population sleep duration is not a good proxy for melatonin production. Through this study, we determined the best way to obtain biomarkers for melatonin while taking into account circadian rhythms. We are now conducting a much larger study among nurses with repeated intra-subject measures in summer and winter, and during day and night shifts, and will be presenting preliminary results.

Keywords: shift work, circadian rhythms, light exposure, physical activity, sleep duration, melatonin

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Young workers and their working time

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Young workers representing the future workforce should be carefully treated in order to protect them. At work they often can be a particular risk because of their lack of experience, training and awareness. Therefore in Europe and many other countries worldwide special laws and arrangements shall grant safety and health at work especially for young workers under the age of 18. The objective is to prevent hazards, to minimize the risk of accidents, and last but not least to support their physical, mental and social development.

Especially working time for adolescents is regulated by law: In comparison to general working time arrangements daily and weekly working time is shorter, breaks and rest time is longer, and they should not work at night. In Germany young people should not work between 8 p.m. and 6 a.m. with exceptions for particular branches, like hotels and restaurants or bakery.

In the last years in Germany a discussion has risen to alter and open the limitation of night work restrictions. An investigation of scientific studies on this subject did not yield many supporting facts. Therefore a questionnaire study, supported by the German Federal Ministry of Labour and Social Affairs, should examine the effects of working hours in the late evening and early morning hours on young workers. The questionnaire focus on stress factors at work, job satisfaction, sleep behaviour, health complaints, family life, leisure time activities and friendship as well as on the real and preferred working times. Apprentices all over Germany in the sectors of hotels and restaurants, representing late working times, and bakery, representing early working times, will take part in the study. They work in different enterprises with different working time arrangements, and their age will probably vary between 15 and presumably 25.

In the results differences are expected regarding young workers under vs. above the age of 18, working in enterprises with shorter vs. longer opening hours, and urban vs. rural surroundings.

Keywords: young workers, working hours, young persons employment act, time budget

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Chronic responses of glucose metabolism in shift workers

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Introduction: Shift work has been associated with a higher propensity for the development with problems in glucose metabolism and a higher risk for the development of insulin resistance and diabetes. The aim of this study was to evaluate the cortisol and homeostasis model assessment (HOMA) levels and rates of appetite and hunger in different shift works schedules. **Methods:** Concentrations of glucose, insulin, cortisol and appetite rates were measured in 3 groups: fixed night shift work (n=9), fixed early morning shift work (n=6) and a fixed day-active group (n=7). Blood samples were collected every four hours within the 24 hours of the study, totaling 6 samples. It was evaluated the appetite rates by a validated questionnaire. The results are expressed as means $\pm$ SE. A repeated measures ANOVA and Tukey post hoc test were used for statistical analyses were $p = 0.05$ was considered statistically significant. **Results:** A significant circadian variation was found for cortisol and Homa and in all of the groups. The twenty four hour mean plasma cortisol were statistical higher in early morning than day-active subjects ($p=0.05$) . No significant variation was found for twenty four hour HOMA. Rates of appetite and hunger were statistical lower in the early morning than night and day-active subjects. **Conclusion:** Present study shows that shift workers, especially early morning subjects, present different levels of cortisol and appetite rates. Further studies are required so that the detailed needs of these individuals can be better understood.

Keywords: glucose metabolism; cortisol; insulin; shift work; food intake

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Assessment of relationship between macro ergonomic conditions and employees work and hours satisfaction

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Introduction: Macro ergonomics is a social - technical attitude which in the manner of top down proceeds to look at organization planning , work- system and also planning of human - machine , human -environmental , human- job interaction and emphasizes on employees participation and make plenty use of it. Limited employee involvement in schedule selection, long work days, and an excess of consecutive work days are all linked to increased risk of ergonomics-related injuries.

Poor work-life conditions and sleep deprivation also lead to ergonomics injuries and lost workdays, especially among employees in extended-hours positions regularly working outside the hours of 7 a.m. to 7 p.m.

This research shows that long work hours, high fatigue levels, and work schedules that fail to account for human physiological needs are linked to a 38 percent increased rate of workers' compensation claims among facilities with extended-hours operations. By applying macro ergonomics, many micro ergonomic principles are automatically considered and therefore optimum ergonomic conformance between system elements with general system structure is assured and obtained. Correct use of ergonomic methods can result in enhancing work satisfaction.

Method: This descriptive - analytical study is of cross - sectional type. Data gathering method is based on observation and questionnaire. The society under study includes 83 personnel (employees) of a factory which is a subsidiary of Iran Khodro. We used two questionnaires in this study. One is questionnaire to verify macro ergonomic situation which planned and consisted of 30 questions that investigated different factors in working environment and was verified in terms of stability and reliability (cronbach alpha = 0.72) and the other one was Minnesota job satisfaction questionnaire which was distributed among people, then the gathered information was analyzed and evaluated with the help of diagram statistical methods and different contribution analysis in spss10 software and finally some recommendations were offered by considering the results and by applying engineering knowledge concepts of human factors to improve the conditions and increasing individuals satisfaction.

Result: This research shows over 1,500 extended hour's male workers, 69 percent of whom reported "Chronic or Frequent" back pain, while 52 percent reported "Chronic or Frequent" wrist pain. Sleep deprivation could possibly be damaging in terms of muscle, ligament, or tendon injury. With the average extended-hours employee sleeping only 5.1 hours to 5.5 hours each day when working a night shift, they could face an increased risk of ergonomic injuries. Also long-held myths on work schedules and ergonomics, clearly finding that 12-hour schedules are not inherently more dangerous for employees. With 61 percent of extended-hours facilities using some form of 12-hour schedule in 2008, this conclusion is important to note when designing alternative work schedules.

The mean age of people under investigation is 30.8. Most people are in age group of 26-30 (44.6%) most individuals have 4 to 7 years working experience (56.6%). Macro ergonomic mean score in total society under study was obtained as 59.8. The maximum score the individual has given to this situation has been equal to 85 and the least one equals to 30. Also the mean score of job satisfaction in people under investigation was 60.5. The highest score of job satisfaction has been related to middle managers (69.2). Pearson correlation test showed that there was a direct relationship between general domain of macro ergonomic and job satisfaction.

Discussion: These conclusions raise significant new questions for managers of extended hour's facilities, in which overtime levels have reached all time highs, and in which employees regularly work evenings, nights, rotations, and long shifts. Manager of extended-hours operations can implement numerous interventions to address the increased risk of ergonomics injuries for the workers who regularly work nights, rotating shifts, irregular and on-call schedules. Involving employees in schedule selection, training workers on managing the work-life demands of working extended hours, and revisiting workplace policies such as breaking rules and resting periods can significantly decrease the risk of costly accidents and injuries Circadian ergonomics . Fatigue management initiatives to decrease employee fatigue while at work and commuting to the job, as well as improve sleep quality, also represent critical interventions for extended hour's employers.

There is a consistency between main enhanced results in our study in terms of macro ergonomic situation with the result of similar studies of barariyan (2006) and rajabzadeh (2002) that have used RSI (Relative Stress Index). Also there is a correlation between the result of our study job satisfaction with the results of similar studies such as Bassy's (2002) in Swedish employees , Garcia and Molina's (1999) in Spanish employees and the result of Partovi study (2006) in Esfahan steel plant employees and Davari's (2003) in employees of Esfahan Shahid Power-Station.

Keywords: Macro ergonomic, Micro ergonomic, working hours, work satisfaction

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Risk assessment and safety measures for working time:An excel-tool

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After the European law on the definition of on-call duty as full working time has been adopted to German law end of 2003, tariff agreements especially regarding working time of hospital doctors had to be adjusted substantially. The length of working times including on-call duty depends on different demands during that time. In hospitals the agreements still allow duties on call of 24 hours maximum presupposing an examination of alternative working times models, a risk estimation according to § 5 German Law on Work Security and Health and preventive measures, if necessary.

To evaluate in how far working time arrangements in hospitals are acceptable without any hazards, an instrument to identify risk factors of working time has been developed. Relevant aspects, like daily and weekly working time and rest time, breaks, working time on weekends, ergonomic principles on night- and shift work as well as flexibility and predictability of the working time arrangement can be assessed by using an excel formulary. The instrument allows an easy documentation of offences against the German working time law, tariff agreements and ergonomic criteria together with adequate preventive measures. The answers to each item are classified as green, yellow or red. A green mark means no risk at all. A yellow mark stands for a potential risk and recommendations are given to minimize this risk. In case of a red mark appropriate measures to eliminate this risk have urgently to be carried out. In case of risks arising from the planned working times and working time schedules adequate measures concentrate mainly on working time design. In the second place an analysis of stress and strain will help to decide, whether extended working hours can be accepted e.g. in case of working time including on-call duty. In case of risks arising from real working times a focus on organisational, structural, and personal conditions is required. Detailed in-house analysis has to be carried out, including e.g. the examination of man-power requirements, on-job observations and a specific task analysis.

Keywords: risk assessment, night- and shift work, on-call duty, safety measures

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Less quick returns means more well-being

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Aim: The aim of this study was to design ergonomically better shift schedules for nurses in primary health care in order to enhance their health and well-being in shift work. The main change applied was the reduction of quick returns (i.e. no more early shifts right after late shift) to ensure more recovery time between the work shifts.

Methods: Six municipal hospital units participated in the intervention. A questionnaire study included both Standard Shiftwork Index and Work Ability Index questionnaires. The initial survey was carried out in 2005 and the follow-up survey in 2006. The subjects (n=75) were divided into three age groups: 20-40, 41-52, and 53-62 years. The effect of the intervention and age was tested by the analysis of variance.

Results: The intervention of more recovery time between evening and morning shifts improved significantly nurses' sleep and alertness, well-being at work, perceived health, and leisure time independently from nurses' age. The effect on social and family life was also positive, but working in shifts was most disturbing for the youngest age group. The work ability index score depended on the age group and the type of shift work, it was lowest among the night workers and in the oldest age group. Work ability did not change during the intervention.

Conclusion: It seems that ergonomic working time arrangements have positive effects on the physical, mental and social well-being of nurses of all ages. Providing and ensuring adequate rest and recovery periods are of crucial importance to staff well-being.

Keywords: shift work, recovery, ageing

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Sleep and alertness of nurses in two-shift work

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Aim: The aim of this study was to measure the effects of changing rota rhythm on the sleep and alertness of nurses in two-shift work. The actual change was from the backward to forward rotation in order to reduce quick returns (-EMEM- or -EEMMM- to -MMME-, M=morning shift, E=evening shift, - =day off). Six in-patient wards in a municipal hospital participated in the study. Sixty people provided the data in both measurements; all were female nurses and their average age was 45+11 years.

Methods: Subjects recorded their sleeping times and quality of sleep, and their alertness at the start and the end of work shifts, before and at the end of the intervention. A sleep-log was filled in connection of morning shifts, evening shifts and days off, with the information of the day before and day after. The effects of intervention and shift combinations were tested by analysis of variance for repeated measures.

Results: Sleep length depended strongly on the shift combination. In connection with morning shifts, nurses slept about 6.9 hours, in connection with evening shifts and days off they slept more, about 8.9 hours. Rota rhythm did not alter sleep length. Self evaluated sleep quality was moderate, and it worsened during the intervention. The shift combination only slightly affected sleep quality. Awakening during sleep depended on the shift combination. Alertness at the start of the shifts depended greatly on the shift combination. Rhythm change did not alter alertness. Nurses were less alert at the beginning of morning shifts than evening shifts, and sleepest when returning to the morning shift right after the evening shift. Alertness at the end of the shifts was at the same level regardless of the shift combination or rota rhythm. The difference of alertness was largest between the start and end of evening shifts.

Conclusion: The working times of nurses are very irregular. In practice the reduction of strenuous shift combinations was carried out only partially. The results show that the daily timing of work and rest periods are more important than rota rhythm. In connection with morning shifts, awakening time was very early, and therefore sleeping time was short and nurses were less alert. A short time for recovery between evening and morning shift also increased sleepiness. Repeated short rest periods and long series of work shifts are the most harmful for well-being.

Keywords: sleepiness, sleep-log, intervention

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Shift-work and breast cancer risk among Danish employees

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There is growing evidence that disturbance of circadian rhythms by exposure to light-at-night and probably sleep deprivation due to non-day time work may increase the risk of breast cancer, at least partly explained by suppression of the pineal hormone melatonin which have cancer protective properties. Recently, IARC classified shift-work including circadian disturbance as probably carcinogenic to humans. This evaluation was, however based on relative few studies, and the majority of these included exclusively nurses, who in addition to shift-work may be exposed to potential confounders, e.g. radiation, ethylene oxide and chemotherapy. We conducted a nationwide nested case-control study, including female employees other than nurses.

All breast cancer cases (2002-3) born in 1935-78 were retrieved from the linked Cancer Registry and Pension Fund, including all cancers among former and present employees in Denmark. After exclusion of 350 registered nurses the study included 964 female employees with breast cancer. Each case was individually matched with two (non-nurse) employees born in the same year and free of cancer, randomly selected from the Population Registry. Detailed information on the occupational history, including information on work schedules for all jobs, and exposures to potential confounders, including lifestyle factors was obtained by telephone interviews. Relative risks were estimated by odds ratios (OR) using conditional logistic regression, and adjusted for potential confounders.

An adjusted significantly increased OR was observed for women ever having worked graveyard shift (1.6; 95% C.I.: 1.3-1.9; N=875). The OR appeared to increase with 2% per year of graveyard shift ($p<0.001$).

Similar to reported studies of nurses we observed significantly increased risk of breast cancer in other female workers with night shift-work. In contrast to studies among nurses the increased OR appeared also evident for short-term workers. A major concern may be recall bias which we, however, carefully attempted to minimize by study design.

Keywords: non-day time work, graveyard shifts, breast cancer

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Introduction: how can so many shift workers stay healthy?

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Shift work is related to insomnia, fatigue and occupational accidents. In the long run, shift work may increase the risk of cardiovascular and gastrointestinal diseases and e.g. breast cancer. Since the health risks of shift work are various and caused also by different mechanisms, one could ask why there is such a high variation in sleep-wakefulness among shift workers and how so many shift workers can still stay fully healthy and with no complaints. In fact, the percentage of the working population that is reported to fail to adjust to shift work is only from 10 to 20%.

The high individual variation of sleep-wakefulness in shift work is linked to several factors. First, the reporting of disturbances in sleep and wakefulness may vary according to expectations and subjective reference populations. Exposure to night- and shift work and its different characteristics varies between shift systems and working populations but also between individuals and different time periods of the same shift system. Individual coping mechanisms in relation to the timing of the main sleep length, napping, exposure to bright light, physical exercise, meal times and nutrition can exacerbate or compensate the effects of shifts on sleep-wakefulness. Permanent inter-individual differences in adaptation to shift work have also been described, related with aging, circadian rhythmicity and permanent personal and other characteristics of the shift workers. Recently, the genetic differences in the ability to sustain sleep loss and circadian disturbances have proved to be significant and may explain the observed differences in adaption to specific shift systems.

Keywords: individual differences, sleep, wakefulness, health

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Circadian Disruption and Carcinogenesis

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Epidemiologic investigations have revealed a moderately increased incidence of breast cancer, colon cancer and endometrial cancer in women and prostate cancer in men subjected to circadian disruption through night and shift work, and in airline personnel involved in transmeridian travel. Most recently non-Hodgkin's lymphoma has also been reported to show an increased incidence under working conditions involving circadian disruption. However, most of the epidemiologic investigations have to be qualified due to the rather generic approach to shift work observed over a long time span without characterization of the type of shift, direction of rotation and extent of involvement. A more quantitative and specific approach to circadian disruption and observation of circadian-infradian interactions will allow to pinpoint a more precise nature of the chronopathologic mechanisms linking circadian disruption by night and shift work to carcinogenesis. There are several different, but in many aspects linked pathophysiologic mechanisms. The direct interaction of circadian clock genes with cell cycle genes is well documented. Alterations in the clock gene *Per3* appear to be a risk factor in the development of breast cancer in women and the clock gene *Per2* has been shown in several animal models to act in-vitro and in-vivo as tumor suppressor gene. Circadian clock genes regulate cell proliferation and apoptosis through control of cell cycle genes, cell cycle checkpoints, controls of tumor suppressor genes and mediate DNA damage response, transcription factors and mitochondria. In the endocrine system, suppression of the pineal hormone melatonin by light during the night appears to favor carcinogenesis and tumor promotion. This has been shown in numerous in-vitro and in-vivo animal models. The lowering of melatonin, e.g., by pinealectomy or by prolonged or continuous light favors tumor occurrence and/or tumor growth. The growth of human breast tumor xenograft could be suppressed by perfusion with physiologic night time concentrations of melatonin. However, melatonin effects are strictly circadian phase dependent and given at certain circadian stages have even been found to promote tumor growth. This factor has to be considered in any therapeutic use of this substance in human subjects and especially in shift workers with altered circadian timing. In addition to its direct effects at the cellular and receptor level, melatonin has an immunostimulant effect, directly and also indirectly over stimulation of the nocturnal secretion of prolactin. Sleep deprivation found in shift workers may contribute to the internal desynchronization among oscillators and leads to changes in the immune system with suppression of NK cell numbers and activity, and shift in cytokine production from Th1 to Th2 cytokines with lowering of immune-surveillance favoring tumor development. There is multifactorial interactions between clock related changes, melatonin suppression and other endocrine and immunologic factors favoring or counteracting carcinogenesis. There is no single factor identified which alone seems to be responsible for the increased tumor incidence and tumor growth related to circadian disruption. Due to the considerable potential public health impact, further investigations have to aim to explore the circadian mechanisms and in addition through circadian-infradian interactions find the most favorable and least damaging shift work schedules.

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Shifting the human sleep-wake cycle using monochromatic blue light: a shift work simulation study

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A sleep-wake cycle (SWC) forced by shift work often dissociates with physiological rhythms. It is therefore desirable to shift human SWC. We propose to a model which outputs time of sleep onset and wake up and allows to adapt SWC due to the influence of ambient light. Several model parameters were optimized utilizing Genetic Algorithms to account for chronotypes, i. e. individual differences in timing of sleep habits. Monochromatic blue light has much stronger circadian effects than polychromatic white light. Therefore portable blue-light sources should be utilized to shift the individual SWC effectively. Our combined model is able to simulate both sleep homeostasis and circadian phase shifts under real light influences and shift work schedules. We show that adaptation to a 4-week night shift (of a chronotype who never worked night shifts before) results in severe sleep deprivations. Selective application of 400 lux of monochromatic blue light leads to an increased phase shift and a reduction of drowsiness during working by 32.8%.

Keywords: sleep homeostasis, circadian rhythm, modeling and simulation, shift work, phase-response-curve

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The Effectiveness of Exercise and Naps as Countermeasures to Night Shift and Post Shift Sleepiness

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Shift work and night work invert activity/rest patterns and affect millions of workers. Sleep loss is a major shift work-related health problem and leads to daytime sleepiness and accidents. Shift workers are the second highest group at risk for car accidents due to sleepiness; the effects of being awake for 24 hours are similar to being legally intoxicated. A recent pilot study examining and comparing naps and exercise on subjects' alertness, sleepiness, activity, temperature and driving errors (impaired driving) during four 9-hour overnight shifts was completed. Seven healthy subjects (n=7) divided into two groups (n=3, n=4) completed the study. Each subject completed two 96-hour sessions. Each session (Wednesday 0800-Sunday 0800) included two 9-hour overnight shifts. Low fidelity video driving simulators were used to test subjects' driving errors during three 15-minute driving periods. Each subject completed three video driving periods (1, 2, and 3) between 0700-0800, 0700-0715, 0720-0735, and 0740-0755, following each over-night shift. Five minutes of data collection followed each driving period. For each driving period, driving errors were recorded and tallied. Driving errors were defined as 2-wheels crossing over-the-white line, 4 wheel errors and accidents. Two-wheel errors were considered low-risk errors; 4-wheels or any accident were established as high-risk driving errors. Odds ratios and risk ratios were calculated for each driving period and compared to each subject's daytime driving errors (baseline). The average number of driving errors per period compared to baseline revealed that subjects were nearly four times as likely to experience a high-risk error in periods 2 and 3. Period 2 was 20-35 minutes after ending work; period 3, 40-55 minutes. Risk of impaired driving, defined as any single incidence of either 4 wheels crossing a white line or having an accident was also calculated. There was a four times greater risk for a single incident of either 4-wheel errors or an accident for periods 2 and 3 compared to baseline. These findings suggest that night workers, who drive more than 15 minutes returning home or to their next destination, may be at greater risk for driving errors and accidents.

Keywords: drowsy driving, countermeasures, night work

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A strategy towards age-related working time arrangements

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Introduction

Demographic trends are confronting companies with many and varied challenges. One key aim of overall demographics-related company strategies is to maintain the employees' health, performance and ability to work right up to retirement age. The fundamental fields of activities and measures required for this - work organisation, continuous skills development, health promotion and leadership - were identified by Finnish researchers as long ago as the late nineties, and since then have served as orientation aids both in research and in practice (e.g. Ilmarinen & Tempel 2002).

Age-related working hours - what does it mean?

The area of age-related working hours plays a key role in coping with demographic change. But what does an "age-related" working time arrangement mean, and how can it be achieved?

As a result of demographic change, companies are faced with both an ageing workforce and a shortage of young skilled workers. Demography-related working time arrangements should therefore aim not only at helping to maintain the health and efficiency of the employees, but also at enhancing the attractiveness of the working conditions for skilled workers, and their commitment to the company. From the aspect of the demographic relevance of existing working time models, or of those still to be developed, it is therefore important to examine whether they permit workload-related differentiation, adaptation to the individual strain, organisation based on the phases of life, and individual autonomy. More individualised working time options are required, permitting tailored solutions according to the individual situation. One practical example that can be cited is the procedure at AUDI AG. In the project "Individual Working Time Flexibility", the emphasis in the first phase was placed on working hours based on the phases of life, these hours being intended to enable flexible adaptation of the individual working hours to fluctuations in workload, personal interests and phases of life. Measures to increase the use of existing workload-reducing working time arrangements, such as part-time or sabbatical, above all by elder employees, have thus been identified and implemented. At the same time managerial tools for the organisation of working hours in the phases approaching retirement age have been developed; in particular a concept for age-related reduced working and a long-term time account model.

To sum up: Demography is a necessary focus for consideration, not only in the "age-related" organisation of working hours. It is just as essential for the people actively involved in personnel decisions and work organisation to take into account demographic relevance in the decision-making and organisational processes in all areas and on all levels. Demographic relevance must become a kind of filter by means of which projects, concepts, measures and everyday decisions are examined, checked for their specifically demographic effects and "fine-tuned" in this respect.

References

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Keywords: working time, demography, fields of activities, individualisation

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Subjective age and assessment of work and non work stress, work ability and burnout

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Aim: The study was aimed at finding out whether shift working nurses differing in the discrepancy between personal (PA) and chronological age (CA) differ in the assessment of work and non work stress and in stress outcomes (burnout) as well.

Method: Two hundred of nurses employed in hospitals of a big polish town completed Survey of Work and Time (Barnes-Farrell et al., 2008) and Maslach Burnout Inventory (Maslach and Jackson, 1981). Nurses were divided into 3 groups according to the degree of PA and CA discrepancy.

Results: Analyses of variance (ANOVA) were performed on the data. The nurses with the biggest discrepancy between PA and CA were the oldest and had the longest experience in working shifts. They did not differ from the other groups in work stress and work ability assessment, number of days and hours on shifts per week. The nurses with the biggest PA and CA discrepancy reported more domestic responsibilities than the other groups ($F(2,178) = 1.276, p = .015$), and assessed higher work-family ($F(2,178) = 4.482, p = .013$) conflict. They scored significantly higher on the professional efficacy ($F(2,178), p = .003$) dimension and tended to have higher scores in emotional exhaustion and depersonalization than the other groups.

Conclusion: The discrepancy between PA and CA may be associated with stress stemming from work/family conflict.

Keywords: subjective age; burnout, family/work conflict

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Daytime intermittent bright light effect on the ultradian rhythms of hemispheric information processing speed

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Aim: Ultradian rhythms were found in the indices of brain hemispheres information processing and asymmetry of these rhythms with regard to phase and frequency. There is also some evidence that bright light can affect ultradian rhythms. The aim of the study was to find out whether an applied regime of intermittent bright light can differently influence ultradian rhythms of hemispheric information processing speed.

Method: A counter-balanced, within-subject study design was applied. Performance of 20 students volunteers was measured every 30 minutes starting from 08.00 and ending at 20.30 in the intermittent bright light conditions (IBL-pulses of 15 minutes of 4000 lux light and breaks 60 minutes of 500 lux light) and in the ordinary room light conditions (ORL-500 lux light). Speed and accuracy of laterally exposed stimuli was measured and recorded by purposely designed computer software. Processing speed at consecutive measurement times for each subject was analyzed using nonlinear least-squares technique. Three factorial analysis of variance (factors: light conditions (LC), visual field (VF), stimulus (S)) was performed on the ultradian rhythms period lengths.

Results: Close to statistical significance main effect of LC was found on the ultradian rhythms periods. The ultradian rhythms of shorter periods were found in ORL conditions ($m=2.41$ hour, $SD=0.79$ hour) when compared to IBL conditions ($m=7.75$ hour, $SD=1.05$ hour). Close to statistical significance interaction of LC and VF was found on ultradian rhythm periods. The effect of IBL was more pronounced on the rhythms of processing of stimuli addressed to the right hemisphere when compared to the those addressed to the left.

Conclusion: The pulses of bright light tend to organize information processing ultradian rhythms of higher frequency into ultradian rhythms of lower frequency. This seems to be more pronounced in the rhythms of processing speed of stimuli addressed to the right hemisphere than in those addressed to the left hemisphere.

Keywords: bright light; ultradian rhythms; information processing

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Work-family conflict as a predictor of changes in work schedules and working hours

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Aim: Existing longitudinal studies on the relationship between working time arrangements and work-family conflict (WFC) have mainly focused on the normal causal relationship, that is, the impact of working time arrangements on WFC over time. So far, however, the reversed relationship, that is, the effect of WFC on adjustments in working time arrangements over time, has hardly been studied. Since WFC is highly prevalent in the working population, further insight also in this reverse relationship is invaluable to gain insight into secondary selection processes. The aim of this study is to investigate whether WFC is prospectively related to adjustments in work schedules and working hours over time.

Methods: Data of the Maastricht Cohort Study (n=12,140 at baseline) were used. To study the effect of WFC on a change from shift work to day work over 32 months of follow-up, male three-shift workers (n=727), five-shift workers (n=932) and irregular shift workers (n=451) were selected. To study the effect of WFC on a reduction of working hours over one year follow-up, only day workers were selected, capturing 5,830 fulltime workers (≥ 36 hours/week) and 1,419 parttime workers (< 36 hours/week).

WFC was measured at baseline with the following item: Are you able to adequately combine work and family life?. Changes from shift work to day work and changes in working hours were inventoried in the follow-up questionnaires.

Cox regression analyses were performed with adjustments for age, educational level, and the presence of a long-term illness.

Results: WFC was associated with a significantly increased risk of changing from shift work to day work over 32 months follow-up in three-shift workers (RR 1.77, 95% CI 1.19-2.63) but not in five-shift workers (RR 1.32, 95% CI 0.78-2.24) and irregular shift workers (RR 0.99, 95% CI 0.67-1.46). Within day workers, WFC among fulltime workers was associated with a significantly increased risk of reducing working hours over one year follow-up in women (RR 2.23, 95% CI 1.15-4.31) but not in men (RR 1.34, 95% CI 0.81-2.22). In parttime workers, WFC was associated with a significantly increased risk of reducing working hours over one year follow-up both in women (RR 1.96, 95% CI 1.05-3.66) and men (RR 4.03, 95% CI 1.28-12.68).

Conclusions: This study shows that WFC has important consequences in terms of adjustments in work schedules and working hours over time, with considerable gender differences in this relation. The study thereby clearly illustrates secondary selection processes both in shift and day workers, with significant implications for labor force participation, emphasizing the need for primary prevention of WFC.

Keywords: work-family conflict, working time arrangements, reversed causation

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Well-functioning working times in knowledge-intensive work

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Aim: Knowledge-intensive work often requires self-controlled, autonomous work, but also co-operative skills. In order to achieve good results, many people, groups, and networks with other organizations are usually needed. This leads to continuous interruptions (polychronity) and work becomes fragmented. Earlier it was possible to concentrate on one issue at a time (monocronity). Polychronity often correlates with feelings of haste and longer working times. Even though interaction and co-operation are important aspects of work, it is also important to provide time for another type of work, one requires personal concentration. This is not an either-or situation; quite the contrary, it is possible to realize both, when co-operation is planned using commonly planned time-tables (Perlow 1999).

Method: Time management was developed in one large telecommunication company in Finland, using the controlled intervention design. Six teams, with 88 employees took part in the six-month long development process. Another seven teams, comprising 73 employees formed the control group; they only filled in the questionnaires before and after. The central idea of the development process was to create common rules to support personal solutions. In order to develop working time, the teams handled both team-specific development issues, and those common to all teams. Important issues were setting the goal of the team and the interconnection of team goals and one's own work goals. General planning of work and timetables as well as the need for uninterrupted working time, e.g., "quiet time" were important aspects of the time management development process. Each of the six teams had five development meetings where they used the participatory planning method. Keeping a "working time diary" for one month, and using lists such as "things to do this week" were recommended.

Results: After the six month development process, working time length did not change dramatically; long work hours without compensation decreased somewhat and overtime work compensated by free time increased. More than half (54%) of the intervention group estimated that time management had become easier, which was significantly more than in the control group (22%, $p < 0.01$). Improved time management correlated positively with superior support ($r = 0.29$), reduced tiredness at work (0.49) and reduced stress (0.48). After the intervention period, the working time norm changed in the development group so that regular working hours were preferred to the earlier norm, where people turned a blind eye to extending working hours.

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Keywords: time management, controlled intervention, participatory planning

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Work load among female construction workers during night time in construction industry of Uttarakhand, India

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Construction is one of the important economic activities in India. The labour force comprises of both males and females who work collectively in an industry. Women suffer discrimination in terms of employment opportunities and wages, irregularities and uncertainties in the employment are rampant. As they do not have any specific skills, they are assigned the manual tasks of lifting and carrying loads without giving due consideration to their individual capability and limitations. Poor working posture have a great impact on musculoskeletal system of the body and results in various illnesses. The objectives of this study were to find out the physiological cost of work in the construction activities and to find out the accidents occurred and the related health problems. Descriptive data were taken with the help of pre-coded interview schedule, whereas experimental data were taken with the help of heart rate monitor, anthropometric kit, weighing scale, flexi curve. The U. S. Nagar district of Uttarakhand was selected for the present study. Women workers were selected randomly. Different parameters were taken for the measurement were physiological cost of work, cardiovascular stress, and postural stress. The following table summarises the percent increase and the maximum heart rate (HR) recorded in the younger and older groups, for the different tasks:

Task	% HR increase		max HR (bpm)	
	older	younger	older	younger
basket of mud transported on shoulder	21.8	19.5	129	122
bricks carried on head	20.8	18.8	129	124
mortar transported on head	20.7	18.8	129	124
water was carried on head	15.4	14.8	120	116
water transported on shoulder	16.8	14.8	121	118
water transportation by hand,	15.5	13.4	116	121
concrete mixture transported on head	19.3	17.5	126	122
concrete mixture transported on shoulder	20.8	18.5		
concreting over the floor in erect standing body posture	19.5	14.6	117	112
same activity performed in standing-cum-bending posture	20.5	18.5	118	114
transporting bags of cement or sand on head	20.8	18.9	138	130
bag carried on shoulder	25.6	22.9	140	137
bags transported on back	21.9	17.1	132	136
climbing up the ladder with heavy load on head	22.9	19.8	136	151
cleaning of implements in bending posture	17.3	13.9		
same activity performed in squatting posture	20	17.1	106	103
sprinkling of water in erect standing position	13.9	17.5	106	102
same activity performed in standing-cum-bending posture	18.5	15.2	108	103

Approximately 95 per cent of women construction workers were suffering from back ache. Nearly 85 per cent and 62.5 per cent of women construction workers were suffering from limb pain and chest pain respectively. Approximately 70 per cent and 62.5 per cent of women construction workers were suffering from palm pain and forearm pain respectively. About 27.5 per cent of older group were suffering from head ache.

Work rest allowance is important to improve the output ratio of work and at the same time it reduces the cost of operation. It aims at taking adequate amount of rest after activity and also performing task using correct mode and task in correct posture, so that the energy loss is minimum and they perceive less fatigue. If women construction workers take adequate amount of rest after activity or heavy activities are followed by light activities, it will help in regaining energy while performing activity.

Keywords: construction work, long hours requirement, night work in construction industry

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Work time control, shift work and disturbed sleep

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Aim: Low work time control, i.e. low possibilities to influence start and finishing times of the workday etc., predicts subjective health and sickness absence. The aim of the present study was twofold: (1) to explore whether shift work is associated with lower work time control, and (2) whether work time control modifies the association between shift work and disturbed sleep. **Methods:** The sample included 9,142 individuals (4,947 were females) who filled in the SLOSH (Swedish Longitudinal Occupational Survey of Health, which is a nationally representative survey of the Swedish working population) questionnaire. The questionnaire was distributed in 2008 and the response rate was 62%. 7,689 of the participants were daytime workers (84%). The sample was randomly selected and the data collection was carried out by Statistics Sweden. Work time control (WTC) was measured with the questions developed by Ala-Mursula et al. Thus, seven questions formed an index (1 very low control - 5 very high control). Disturbed sleep was measured with the Karolinska Sleep Questionnaire (KSQ). Two indices were calculated: (1) disturbed sleep index (DSI: 1 low-6 high, insomnia complaints) and (2) difficulties awakening (AI: 1 low-6 high, e.g. not being well rested from sleep). In addition, a question of whether one gets sufficient sleep (1 no problems-5 large problems) was also used.

Results: Shift workers reported lower WTC (mean: 2.4, sd: 0.75) than daytime workers (3.2 ± 1.0 , $p < 0.001$). There was no difference between shift workers on a roster schedule and between those on a more regular shift system. There was also a gender difference and females reported lower WTC (full sample: 2.8 ± 1.0 vs. 3.2 ± 1.0 , $p < 0.001$). The interaction between "gender x work hours" was significant ($p < 0.001$) and the sex difference disappeared for shift workers. The sleep variables were subjected to a multiple regression analysis (adjusted for age and gender) with WTC and shift work as independent variables. The results showed that WTC removed the effect of shift work. Thus, WTC was a significant predictor of DSI, AI and insufficient sleep (betaH^{-0.10}, i.e. low control was associated with disturbed sleep) whereas shift work only became a significant predictor for the AI (shift work was associated with more awakening difficulties). The amount of explained variance was low (approximately 5%) for all sleep variables.

Conclusions: Shift work was associated with lower work time control, which may have negative consequences for long-term health. Work time control also modified the relationship between shift work and sleep. Thus, the negative effects of shift work on sleep may be weaker if one has high possibilities to influence the shift schedule, e.g. through individual-based flexible work hours.

Keywords: Flexible work hours, gender, stress

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Truck driving and sleepiness: a quasi-experimental study

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Aim: Sleepiness due to irregular work hours is a common risk factor for truck crashes. The aim of the present study was to compare the effects of daytime and nighttime driving on different measurement of sleepiness.

Methods: The study involved 10 experienced male truck drivers. The design involved two conditions: daytime (between 13.00h and 17.00h) driving and nighttime (00.30h and 04.30h) driving. The driving scenario was the same during both conditions and involved mainly driving in rural areas. During the second half of each condition a fatigue warning system was used. There was a 20-minute break in the middle of each condition. The truck was instrumented with a lane tracker, video cameras etc., however, these data will not be reported in the present study. The drivers rated their sleepiness (Karolinska Sleepiness Scale: KSS, 1 very alert - 9 very sleepy) level every 5th minute during the drive. Physiological sleepiness (EEG and EOG) was continuously monitored during the drive. The latter data consisted of 20-sec epochs, which were visually scored according to the Karolinska Drowsiness Score method (KDS, 0% sleepiness - 100% sleepiness during the whole epoch). The experiment leader observed the driver's sleepiness level according to the "Observer Rated Sleepiness" (ORS) method. ORS yields a score between 0 (no signs of sleepiness) and 4 (frequent micro-sleep events, driving is seriously impaired).

Results: All three sleepiness measurements showed higher sleepiness during nighttime driving ($p < 0.001$). Thus, mean KSS increased from 3.9 (sem: ± 0.33) to 6.5 (± 0.35) for the nighttime condition. The prevalence of severe subjective sleepiness (ratings ≥ 7) increased from 5% (± 3) to 50% (± 12). Subjective sleepiness peaked towards the end of the nighttime drive and the prevalence of KSS ratings ≥ 7 was 67% for the second half of the drive (33% for the first half). The mean ORS score for the night condition was 1.25 ± 0.24 , (daytime: 0.04 ± 0.04). The mean KDS score was 1.8% (± 1) for the nighttime condition and 0.45% (± 0.20) for the daytime condition. Seven drivers did not complete the full nighttime drive. These drivers reported severe subjective sleepiness, i.e. KSS 7 or higher (5 of them rated KSS 9), immediately before they terminated driving. They also showed a higher mean KDS-value during the second half of the night condition (3.5% vs. 0.8%). **Conclusions:** Sleepiness increased during nighttime and during the second half of the night-drive severe sleepiness (KSS ≥ 7) comprised two-thirds of all ratings. Physiological sleepiness showed considerable inter-individual variation and, in general, KDS events (similar to micro-sleep) were few. However despite this, 7 drivers had to terminate driving towards the end of the night condition.

Keywords: night work, individual differences, fatigue

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Evaluation of the new 5-shifts roster at Corus steel in The Netherlands

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Background: Corus steel in The Netherlands produces steel and aluminium by means of washing and extracting the metal from the raw ore and rolling it into large plates to be applied as a semi manufactured product by other metal processing industries. The company employs about 9,000 people.

Aim: Corus implemented a new 5-shifts roster in 2006. Before implementation, the company applied a backward rotating NNN--EEE--MMM-- roster, with two days off after each sequence of duties. Because of health risks in this roster, the medical department proposed a new fast forward rotating MEE-NN--- roster that was implemented as an experiment. The first evaluation six months after implementation the new roster revealed positive effects. These results were fed back to the organization and an opinion poll among all involved shift workers favoured the new system. In our presentation we present the evaluation of the new roster one year after implementation.

Method: The effects of the roster are described by means of data present in the registers at the company site: occupational accidents, sickness absence and health check data. Data cover one year before and one year after implementation of the new roster, and involve all employees in the 5-shifts system (n=4600) and all day time workers in technical and maintenance jobs (n=1400) as a control group.

Results: Compared to the old roster, the new roster revealed positive effects on health status and sickness absence, in particular for the employees of 50 years and older. Musculoskeletal complaints and work stress declined in the 5-shifts workers group in the year after implementation. Fatigue and the relationship between work and health did not change in the 5-shifts workers group, but increased in the day workers group. Sickness absence duration is positively affected in the group of employees working with the 5-shifts roster. Older employees in the 5-shifts roster group reported less fatigue, less musculoskeletal complaints, and perceive the relationship between work and health as less burdening than the younger employees. The raise of the sickness absence in all groups (general percentage and percentage of 28+ days cases) is the strongest in the older day-time workers.

Conclusions: Positive effects are found, but the explanation of results is limited by the small number of variables available in the registers. Data also may contain selection effects because shift workers with health problems are placed in the day work group. In particular the positive effects of the older age group are interesting, because it compares employees in the same situation. During the congress new follow-up data on two years of working with the new roster schedule will be presented.

Keywords: shift work, roster, occupational accidents, sickness absence, health effects

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Working time of the ageing workforce. Lessons learned from the KRONOS research project

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Under the DFG-sponsored KRONOS research project, working-time models for the ageing workforce were developed, implemented, and evaluated in five German enterprises. This paper presents a summary of the conclusions we drew from a total of ten sub-projects in each of the following working-time design field.

a) Number of working hours per day, week or year.

Uniformly reducing the daily working hours of all older employees does not make sense as personal health and work ability vary very widely among individuals in the older age groups.

b) Adequate rest periods.

Older employees tend to rate the recovery value of breaks less highly than younger workers. This appears to corroborate the demand for more breaks for elderly persons.

c) Shift work

Shift systems designed to conform to ergonomic recommendations (fast forward rotation) tend to have a more favourable effect on work ability (WAI) than traditional shift systems that rotate backwards once a week. As the night shift is the most critical of all as far as sleep, tiredness, performance, and health are concerned, it makes sense to reduce the number of night shifts per person and year. One way to reduce night shift manning levels is to re-schedule certain activities from the night to the morning and afternoon shifts.

d) Employee influence on working-time design.

Models that permit employees to switch between various weekly or annual working times in the course of their active life are meaningful and attractive not only to older workers but also to younger employees who might wish for more leisure time.

e) Long-term time accounts.

From the ergonomic point of view, sabbaticals that promote regeneration make more sense than models under which employees work very many hours of overtime to enable them to retire early later on, when their health may already have been impaired. Options to pay into and withdraw from long-term time accounts must be tailored to the needs of the target groups.

f) Beginning and end of the daily working time.

If the morning shift begins too early (before 6 a.m.), this will have a negative impact on the quality of sleep before the morning shift as well as on a person's tiredness and reaction time during it.

Keywords: working time, shift work, ageing workforce

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Is there an association between shift work and cancer?

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Cancer is due to impairment in the system that regulates gene expression in the cell. Cancer can also be the result of weakening of the immune system. Among the established external risk factors for cancer are ionizing radiation (leucemia, lung cancer), ultraviolet light (skin cancer), chemical carcinogens (benzene - leucemia), viruses (papilloma virus - cervix cancer). The overall risk of inherited cancer is relatively low (retinoblastoma in children, breast cancer, colon polyposis). In recent years a new possible risk factor has been suggested - night work. The mechanism is unclear, but some researchers have suggested that light exposure in the night would increase the risk of cancer due to inhibition of melatonin production. Another possible mechanism could be desynchronization of the biological rhythms, which is more common in shift worker than in day workers. During 2008 ""The International Agency for Research on Cancer (IARC)"" has classified shiftwork that leads to disturbance of the circadian rhythm as a probable carcinogen in humans. This conclusion was based on both animal experiments and epidemiological studies on humans.

Eight studies have investigated breast cancer. Six of those demonstrated association between cancer and shift- or night work. In addition, a few papers have reported association between shiftwork and other cancer types. Analyses of the Nurses' Health Study showed increased risks for endometrial cancer and colon cancer (Viswanathan 2007, Schernhammer 2003). A Japanese cohort study demonstrated increased risk for prostatic cancer. The results, however, was based on less than ten exposed cases (Kubo 2006). An additional study was carried out in Ontario, ISA The results showed that the risk of prostatic cancer was somewhat increased among shift workers (OR 1.2, 95%CI 1.0-1.4)(Conlon 2007). More studies are needed to get conclusive evidence on an association between shift work and cancer. Especially interesting cancers are hormone dependent cancers, since melatonin is orchestrating the function of a network of hormonal glands. It is also important to explore mechanisms, because that is the key to prevention. The WOLF study was initiated in 1992 in a working population in Stockholm and was extended in 1996 to the counties of Västernorrland and Jämtland. The study included 5,698 participants from Stockholm and 4,715 from the north of Sweden. The study population comprised employees from 60 companies and represented different branches and a wide variety of occupations. In a current analysis incidence rates of different cancers in relation to shift work exposure will be calculated.

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Keywords: Shiftwork, cancer

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Managing Fatigue at Nuclear Power Reactor Sites: A Systems Approach

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Aim: The purpose of this paper is to report on an effective risk management system identified through field research conducted during the implementation of fatigue management rules set forth by the U. S. Nuclear Regulatory Commission (NRC) to manage the physical and cognitive fatigue experienced by shift personnel at nuclear power stations. These risk management strategies and preventive actions are reducing fatigue-related incidents that could have serious consequences for public health and safety.

Methods: Field data were gathered from six different nuclear power reactor sites across the United States using site observations, interview protocols, employee surveys, document reviews, and a proprietary fatigue assessment tool, Managing Fatigue Assessment.

Results: The nuclear power industry operates on a 24/7/365 basis, with all of the concomitant risks to public health and safety that occur from physical fatigue, low alertness, sleep deprivation, circadian desynchronization and other shiftwork challenges. This large-scale, NRC-induced change in staffing designs, shift scheduling, worker assessment and worker training practices provided a unique opportunity to understand how workplace fatigue among shiftwork populations can be managed effectively. This field research revealed that there are six key factors essential to establishing effective fatigue management policies and practices at both the organizational and individual levels of risk management. These six factors are:

- Focus on both structural and behavioral root causes of workplace fatigue;
- Cover contracted workers and vendors as well as company personnel;
- Regulate the minimum number of required offdays as well as total hours of work in specified time periods;
- Design work schedules to provide the best duration, frequency and sequencing of shifts for preventing cumulative fatigue and circadian desynchronization;
- Require fatigue assessments that examine a worker's rolling 14-day work and rest history, including any moonlighting activities;
- Institute required worker training that teaches shift personnel about sleep and circadian rhythms as well as cognitive and physical fatigue.

Conclusions: Other regulatory and voluntary efforts to manage the risks created by workplace fatigue can benefit by the integrated structural and behavioral approaches that make the NRC's fatigue management rules an effective risk management system.

Keywords: fatigue, workplace fatigue, fatigue management, risk management, shift personnel, nuclear power, health, safety, workplace, hours of work, work schedules, shiftwork, training, sleep, circadian rhythms

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Joint change strategy for improving work schedules and job content

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Interest is growing internationally in improving work schedules and job content in a combined manner. This is based on the awareness that both work hours and job content need to be adjusted in achieving decent work in diversifying work settings. This trend reflects globalizing economy, diverse employment structure and increasingly complex risks and stress at work. The effective types of action-oriented approaches experienced in making joint change of work schedules and job content are examined.

These approaches usually address flexible working time arrangements, participatory risk management and stress prevention at work in various work redesign activities. Examples include participatory programmes for improving small workplaces, rearranging flexible working time arrangements, stress prevention activities in various settings and workplace interventions in health care and nursing work. Notable common key features of these approaches involve (i) adopting a locally adjusted intervention strategy to meet both business and worker preferences in work organization, (ii) focusing on a broad range of workplace improvements and (iii) providing opportunities for worker participation in decision making. Attention is drawn to the participatory, stepwise improvement steps commonly taken to take advantage of these features in undertaking joint change of work schedules, work methods and work organization.

These steps as a rule rely on (a) action-oriented toolkits and (b) support for facilitating group work. Among the toolkits used, particularly effective is the use of action checklists and associated checkpoints listing practical improvement options in multiple aspects. This helps managers and workers look into available options in both working time options and workplace improvements such as ergonomic work methods, better work environment and constructive measures related to psychosocial factors. As support measures for facilitating group work steps, we may mention commitment of top management, training of volunteer facilitators and stepwise progress comprising serial group work steps. Improvements in reduced workload, ergonomic workstations, comfortable work environment, better teamwork and welfare facilities are often implemented with simultaneous improvements in resting periods, shift schedules and holiday plans. Providing feedback of step-by-step achievements through serial workshops involving managers and workers is found important.

In conclusion, these recent experiences point to the effectiveness of participatory steps addressing the joint change of work schedules and job content. These steps are facilitated by using action-oriented toolkits and serial group steps aimed at broad changes addressing work hours, ergonomic conditions and stress at work. It is suggested to undertake group work steps by focusing on multi-area improvements and by facilitating group work through the use of group work toolkits and stepwise progress.

Keywords: Joint change, work schedules, job content, work stress, participatory steps, group work toolkits, health care

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Cardiovascular prevention on the workplace: effectiveness of two-stage intervention

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Objective: to investigate 1-year effectiveness of work-site intervention for primary and secondary prevention of hypertension consisted of screening and three types of health education.

Methods: The study was conducted in the technical research institute with 575 workers. First stage included health screening of cardiovascular risk factors, cardiovascular diseases and total cardiovascular risk by standardized methods. Total number of study participants was 468. The second stage of the study all participants with high cardiovascular risk and cardiovascular risk factors were proposed to take part in educational programs for primary and secondary prevention of hypertension. All workers with hypertension were proposed to take part in education programs for secondary prevention of hypertension (self control of blood pressure, risk factors modification, medications and so on). All workers with hypertension who agreed to participate were randomized to interventions and control group). All workers without hypertension, but with cardiovascular risk factors were proposed to participate in educational program for eating habits modification and stress correction. The workers who agreed also were randomized in intervention and control group. **Results:** The mean age of study participants was $51,2 \pm 12,9$ (52,8% men and 47,2% women). Cardiovascular screening revealed 274 (58,6%) persons with high and very high cardiovascular risk, 287 persons with hypertension and 187 persons with cardiovascular risk factors. 101 workers with hypertension agreed to participate in educational program for hypertensive people. 98 workers with risk factors agreed to participate in educational program for weight reduction and 87 - in program for stress correction (25 from them took part in both programs). After one year observation the effectiveness of total intervention was the following: in intervention group mean systolic blood pressure decreased comparing with baseline value ($128,9 \pm 13,0$ vs $137,9 \pm 22,9$, $\bar{d} < 0,05$) and control group ($128,9 \pm 13,0$ vs $134,3 \pm 18,4$, $\bar{d} < 0,05$). The same changes were in diastolic blood pressure. Also in intervention group mean plasma cholesterol level decreased comparing with baseline value ($4,9 \pm 0,8$ vs $5,6 \pm 1,1$, $\bar{d} < 0,05$) and control group ($4,9 \pm 0,8$ vs $5,6 \pm 1,0$, $\bar{d} < 0,05$). The same changes were in plasma glucose level and depression scale of HADS questionnaire. There were no significant changes in body mass index and anxiety scale of HADS questionnaire. In the hypertension group separately, in intervention group mean systolic blood pressure decreased comparing with baseline value ($133,2 \pm 11,4$ vs $144,9 \pm 21,9$, $\bar{d} < 0,05$) and control group ($133,2 \pm 11,4$ vs $142,9 \pm 18,7$, $\bar{d} < 0,05$). Also hypertensive participants achieved significant reduction of diastolic blood pressure, plasma cholesterol and plasma glucose). In total intervention group the baseline proportion of high cardiovascular risk participants was 68,4%, after one year it became 40,4% ($p < 0,05$).

Conclusion: Work-site intervention for primary and secondary prevention of hypertension is effective in cardiovascular risk factors and total risk decreasing.

Keywords: workplace, education, cardiovascular

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Retrospective Cohort Study of the Risk of Obesity among Shift Workers: Findings from the Japan Shift workers' Health Study

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Backgrounds: Epidemiological studies regarding shift work are usually confronted by common issues. Firstly, long-term follow up of work schedule is rarely realized. Secondly, Healthy Worker Effect (selection bias) could bias the result significantly. Due to occupational health policy, healthy workers might be selected as shift workers. Thirdly, socioeconomic gaps between shift workers and daytime workers might exist and could confound the results. In order to cope with those problems, we established new retrospective cohort study: the Japan Shift workers' Health Study.

Aim: The aim of this presentation is to investigate the effect of shift work on the risk of obesity using the dataset of the Japan Shift workers' Health Study.

Methods: The study was established based on a health care database system which belongs to a certain manufacturing enterprise in Japan. Results of annual health checkups (including body mass index: BMI) and work schedule of every worker have been recorded since 1981. Currently more than 23,000 workers are registered and it is still on updating. Long-term exposure information of shift working can be precisely obtained by referring to the database. In January 2009, records of health checkup and work schedules of 20,529 male workers were extracted from the database. In order to isolate the appropriate data for our analysis, the subjects were restricted to 9,912 male workers, whose work schedule were consistent during the follow-up period and who were younger than 30 years old and without obesity (BMI<25.0) at the time of baseline (mean age 23.7, standard deviation 2.7; mean BMI 21.2, standard deviation 1.8). Those of 8,892 workers were permanent daytime workers and 920 workers were permanent rotating three shift workers. Body mass index (BMI<25.0) was used for the case definition. During the 135,399 person-years of follow-up of them (mean follow-up period 13.6 years), a total of 3,319 obesity incidences were recorded. Kaplan-Meier survival analysis was used for analysis.

Results: Kaplan-Meier survival curves revealed the risk of obesity among the shift workers compared to the daytime workers (p=0.0049). Stratified analysis regarding smoking, alcohol drinking or exercise did not alter the result materially.

Conclusion: Risk of obesity among male shift workers was visually demonstrated. Our study has some strong point. Firstly, long-term follow up information of work schedule and BMI was obtained. Secondly, study design of cohort study could reduce the influence of Healthy Worker Effect compared with cross-sectional study. Thirdly, it was expected that socioeconomic status might have relatively small effect on the result because all the workers were belongs to the same company and employment convention.

Keywords: work schedule tolerance, obesity, historical cohort study, Japan

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Risk of Prostate Cancer among Rotating-Shift Workers: Findings from the Japan Shift Workers' Health Study

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Aim: We conduct a nested cohort study to investigate the association between shift work and the incidence of prostate cancer within the Japan Shift Workers' Health Study.

Methods: The Japan Shift-worker'Health Study was established based on a health care database which belongs to a certain manufacturing enterprise in Japan. Results of annual health checkups and work schedule of workers have been recorded since 1981. Currently more than 23,000 workers are registered and it is still on updating. Long-term exposure information of shift working is precisely obtained by referring to the database. Additionally, prostate specific antigen (PSA) screening test has been provided for applicants in the enterprise since 2005, and 6,489 workers underwent the PSA test to date. Subjects of this study are 5,245 male workers (mean age 55.5 years old, standard deviation 4.7). They all ever have undergone the PSA test. Their work schedules were followed up retrospectively (mean follow-up period 25.2 years, standard deviation 4.3). Of the subjects, 4,357 workers belonged only to daytime work during their career (daytime workers), and 888 workers have belonged to rotating three shift work more than 80% of their career (shift workers). Prostate cancer incidences were detected by the record of health insurance in 16 subjects (twelve cases of daytime workers and four cases of shift workers). Comparing the two groups, multivariate logistic regression was used to estimate the odds ratio for prostate cancer with adjustment for age, alcohol drinking (current drinker or not), smoking (smoker, non-smoker, ex-smoker), exercise (≥ 3 days/week, ≤ 2 days/week), body mass index (BMI of recent health check up) and marriage status (married or not).

Results: Compare to the daytime workers, the odds ratio for prostate cancer among shift workers was elevated however the result was not significant (odds ratio=1.82, 95% confidence interval: 0.58, 5.74, p value=0.305).

Conclusions: Among late middle aged shift workers, non-significant increase in prostate cancer risk was observed. Prostate cancer is most prominent in old age men, thus further follow-up of the cohort will be desirable. However, our study is constructed on the database of an enterprise and will not be able to follow the subjects after their retirement. Long term follow-up including period after retirement might be needed to address this issue.

Keywords: prostatic neoplasms, work schedule tolerance, historical cohort study, Japan

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How do the length and timing of night time napping have an impact on sleep inertia?

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Aim: Nighttime napping during a nightshift is one of the effective strategies for sleepiness and fatigue among night-shift workers. However, the potential disadvantage is sleep inertia, a state which appears as a decline in performance and/or mood immediately after awakening from sleep. To determine a more sophisticated napping strategy, we examined how the length and timing of napping taken during a simulated nightshift would have an impact on sleep inertia.

Methods: Twelve male university students (Mean 21.6, SD 2.8, years old) participated in this experiment. They were required to do simulated nightshifts, each of which lasted three consecutive days with one simulated nightshift (22:00-8:00), followed by daytime sleep (11:30-17:30) and nocturnal sleep (0:00-7:00), under five different conditions of the timing and length of napping. The examined five nap conditions were 0:00-1:00 (Early 60-min; E60), 0:00-2:00 (Early 120-min; E120), 4:00-5:00 (Late 60-min; L60), 4:00-6:00 (Late 120-min; L120) and no nap (Control). Participants completed all the experimental conditions in a counterbalanced order. Participants were also required to complete a visual vigilance test (VVT) for RTs and lapses (> 5s), and a visual analogue scale for sleepiness (VAS) every hour during the simulated nightshift. For each nap condition, VVT and VAS results obtained from two 15-minute blocks (15 minutes before and after the nap) were analyzed by two-way repeated-measures ANOVA (condition [nap, control] ~ time [pre-nap, post-nap]). Post-hoc analysis was done using paired t-test at each time point.

Results: Marginally significant interactions were observed in RTs and lapses in VVT under the L60 nap condition ($F_{1,11} = 3.983$, $p = 0.071$, $F_{1,11} = 4.027$, $p = 0.070$, respectively). However, those effect sizes were moderate (partial $\eta^2 = 0.266$, 0.268 , respectively). The post-hoc analyses showed significantly longer RTs ($p = 0.028$) and greater number of lapses ($p = 0.043$) after the L60 nap than after no nap. In contrast, there was no significant difference in VAS sleepiness under the L60 condition. No significant differences were observed between each of the other conditions and no nap condition at post-nap sessions.

Conclusions: Our findings suggested that the effect of sleep inertia on VVT performance was profound, but not on subjective sleepiness, in L60 condition. It is considered that the dissociation between performance and sleepiness might reflect an unstable state that participants can not realize a decline in their performance by themselves.

Keywords: sleep inertia, night shift, nighttime napping, sleepiness

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Association between working hours and complaints of musculoskeletal pain in the spine among truck drivers

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Introduction: The static body position at work is clearly a risk factor for musculoskeletal pain to occur in the spine. However, pain can also be aggravated due to other factors, some of which have received less attention, such as working hours and sleep quality.

Aim: To verify the association between working hours and complaints of musculoskeletal pain in the spine among truck drivers during the week before the study was conducted. Other factors related to work and life style which could be associated with musculoskeletal pain in the spine were investigated as well.

Methods: This is a cross-sectional study involving all truck drivers of a transportation company (n=470); average age 39.7 years old at the time the research was conducted, 98.0% of them male. Most of them (54.4%) had irregular working hours, including night work. The average body mass index (BMI) was 26.8 kg/m² (SD 4.3 kg/m²). The drivers filled out a questionnaire on social-demographic and professional data, musculoskeletal pain, obstructive sleep apnea, and questions related to sleep quality and nap taking habits. Univariate and multivariate logistic regression analysis were used to verify the factors associated with musculoskeletal pain in the spine, and adherence was verified using the Hosmer-Lemeshow test.

Results: The prevalence of complaints of musculoskeletal pain in the spine during the week before the study was 18%. The factors associated with feeling pain were poor sleep quality (OR 3.15; CI 95% 1.85-5.40; p=0.000), a habit of not taking regular naps (OR 2.62; CI 95% 1.46-4.70; p=0.001), an increase of body weight during the last year (OR 1.86; CI 95% 1.06-3.29; p=0.030), and irregular working hours (OR 1.83; CI 95% 1.04-3.24; p=0.037).

Conclusions: Poor sleep quality and the habit of not taking naps, as well as irregular working hours, may aggravate spinal musculoskeletal pain, which also makes carrying out physical activities difficult. Moreover, the lack of exercise may lead to an increase in body weight, which is also associated with musculoskeletal pain in the spine. Support: CNPq.

Keywords: working time, musculoskeletal pain, truck drivers

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The European Working Time Directive and Junior Doctors: Safe implementation of a 48-hour work week

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From August 2009, junior doctors across Europe will be limited to 48-h work weeks (per 6 months) and 13 hours continuous duty. Much discussion has occurred about the wisdom of such limits and how best to implement them. The US medical profession has debated concurrently whether an 88-h limit (per 4 weeks) and 30-h work shifts are sufficient to train its doctors, culminating in the recent Institute of Medicine report which recommended 16-h duty limits but no change to weekly hours. While numerous opinions have been published opposing reductions in work hours, there are remarkably few objective data available in support. We therefore conducted studies in both the US and UK to study the impact of work-hour reductions on patient safety and physician sleep.

Using prospective experimental designs, we implemented interventions to test the hypothesis that reducing weekly work hours and the duration of continuous duty would increase physicians' sleep and reduce serious medical error rates. In the US study, conducted in a Medical and Cardiac ICU, we used a within-subject (n=20) cross-over design to compare a schedule that limited duty to 16h versus the traditional 'on-call' schedule which routinely included scheduled 30-h shifts(1,2). The UK study was conducted in an Endocrinology and Respiratory ward, and used a between-subject (n=19) parallel design to compare a 48-h EWTD-compliant schedule with 12-h duty limits versus a schedule with 56-hour work weeks and 12.5 h shifts(3). Sleep and work hours were measured with a validated diary. Medical errors were measured in the UK study via chart review which was the primary method of medical error detection in a more comprehensive multifaceted approach used in the US. Events were classified independently by two physicians blinded to study condition.

The interventions decreased weekly work hours (US: 84.9 ± 4.7 v 65.4 ± 5.4 h/wk; UK: 52.4 ± 11.2 v 43.2 ± 7.7 h/wk; both $p < 0.05$) and increased average daily sleep duration (US: 6.6 ± 0.8 v 7.4 ± 0.9 h/day, $p < 0.02$; UK: 6.8 ± 0.4 v 7.3 ± 0.4 h/day, $p < 0.1$). Medical error rates also reduced under both interventions. During the US traditional schedule, doctors made 35.9% more serious medical errors than when working on the intervention (136.0 v $100.1/1000$ patient days; $p < 0.001$). A similar result was observed in the UK study with doctors making 48.6% more medical errors on the 56-h versus the 48-h rota (41.0 v $27.6/1000$; $p = 0.006$).

These studies show that reducing weekly work hours and continuous duty hours can improve patient safety and physician sleep, and that care can be provided safely on a 2009 EWTD-compliant rota if schedules are designed to incorporate the biological principles underlying sleep. Such data are necessary to inform evidence-based policy decisions on work hour reform.

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Keywords: medical errors, sleep, work hours, shift-work, performance

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Daily sleep, weekly working hours, and risk of work-related injury: US National Health Interview Survey (2004-2007)

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Aims: The impact on health and safety of the combination of chronic sleep deficits and extended working hours has received worldwide attention. Using the National Health Interview Survey (NHIS) we estimated the effect of total daily sleep time and weekly working hours on the risk of a work-related injury in the United States

Methods: The NHIS is an in-person household survey using a multistage, stratified, clustered sample design representing the US civilian, non-institutionalized population. During the survey period 2004-2007, 64,274 adults (ages 18-74) sampled within households, were asked whether they worked at a paid job and also reported their total work hours during the prior week and total daily sleep hours. Complete responses were available for 62,266 (96.9%) workers. Weighted annualized work-related injury rates were estimated across a priori defined categories of both average total daily sleep hours and weekly working hours. To account for the complex sampling design, weighted multiple logistic regression (SAS Proc SurveyLogistic) was used to predict the estimated risk of an injury as a function of daily sleep time controlling for weekly working hours, age, sex, race/ethnicity, education, type of pay, occupation (proxy for job risk), body mass index, and interaction among age, sleep time, and work hours.

Results: There were an estimated 129,241,820 workers annually at risk and 3,710,142 work-related injury episodes (overall injury rate 2.87/100 workers). Unadjusted annualized injury rates across weekly work hours were 1.91 (<20 hours per week), 2.79 (20-30 hours), 2.52 (31-40 hours), 3.61 (40-50 hours), and 4.17 (50+ hours). With regards to sleep time, the estimated annualized injury rates (per 100 workers) were: 9.33 (<5 hours sleep), 4.96 (5-5.9 hours), 3.57 (6-6.9 hours), 2.22 (7-7.9 hours), 2.75 (8-8.9 hours), 1.59 (9-9.9 hours), and 5.89 (>10 hours). After controlling for weekly work hours, and aforementioned covariates and interactions, significant increases in risk per decrease in sleep hour category were observed. Using a 7-7.9 hours of sleep as the referent period, the adjusted injury risk (odds-ratio) for a worker sleeping a total of <5 hours per day was, OR = 4.89 (95% CI: 2.30-10.40), for those sleeping 5-5.9 hours, OR=2.33 (95% CI: 1.31-4.14), and for 6-6.9 hours, OR=1.64 (95% CI: 1.20-2.24). No other sleep hour categories were significantly different than the referent, however for >10 hours of daily sleep the OR was elevated, 1.50 (95% CI: 0.57-3.93).

Conclusions: These results suggest significant increases in injury risk with decreasing total daily sleep hours after adjusting for weekly work hours, type of pay, gender, age, education, occupation, body mass, and interactions among age and sleep and work hours.

Keywords: long work hours, sleep, injury risk

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Adolescent Shiftworkers: Different shifts, different risks

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Aims: This study presents phase two of a three-part project investigating the hazards and risks associated with shiftwork for adolescents in Australia. Phase one of the study indicated that adolescents are between 3.1 (males) and 4.7 (females) times more likely to sustain an injury on night shift than their adult counterparts when total work hours are taken into consideration. The purpose of phase two of the research was to more fully understand the reasons for the increased likelihood of injury.

Method: In total sixty semi-structured interviews were conducted with adolescent (aged 16-19 years) and adult shiftworkers to develop understanding of: differences in the work performed by students and adults on night-shifts and attitudes to their work tasks and working environment. Snowball sampling was initiated by independent response to advertisements placed in university lecture theatres.

Results: Results indicate that the students are performing the same tasks throughout their night shift as a standard day shift and the same tasks as their adult counterparts but the risks they face are different. There are two main themes appearing through an analysis of our interview data. These themes centre on concerns about safety in general terms, and fatigue. In relation to the general safety, adolescents indicate that they are often left alone at night and face an increased risk of confrontation with problem clientele, including intoxicated customers. They indicate a heightened level of concern associated with closing stores at night, taking responsibility for the day's financial takings and getting home. When our sample talk about fatigue, many refer to their work as being one part of many responsibilities, including sporting involvement, family responsibilities and school or university commitments. Hence, when they arrive for their evening shift they start work fatigued and that fatigue is recognised as contributing factor to many accidents in which they have been involved. Interviews with adult workers supported comments from adolescents about fatigue. They also mentioned risky behaviour exhibited by those workers and concern about their safety in terms of how they went home after work, saying that it was often up to them to wait after work with adolescents until their lift arrived.

Conclusion: The findings provide further evidence of the substantial impact shiftwork has upon adolescents, who are already considered a group at high risk of occupational injury compared to adult workers. In response to concerns about fatigue levels reported by adolescents in this study, Phase 3 of the research uses time diaries to examine the time spent on total work (paid and unpaid) by adult and adolescent shiftworkers.

Keywords: adolescents, night shift, risks

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Nursing, sleep and readaptation after night work by use of light boxes

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Introduction: Shift work that include night shifts are increasingly common in 24-hour societies. The adaptation to night work is initiated already by the first night shift by a phase delay of circadian rhythms. The need for readaptation to diurnal rhythms during days after night work is important for adapting to day-oriented work schedules and for social reasons. Disturbances of the circadian rhythms have negative effects on health and sleep and a quick readaptation to normal diurnal rhythms could therefore be important. During the dark Scandinavian winter a natural morning day light exposure is not possible at travel home from work.

This present study aimed to evaluate the effect of bright light exposure on sleep and readaptation of the circadian rhythm after working nights during winter.

Methods: Fifteen female night nurses were exposed to both moderate intensity light (ML, 2200lux), and bright light (BL, 7000lux), for 2 consecutive free days preceded by 2 night shifts. Light was administered for 30-60 minutes in the morning at a distance of 50 cm from the eyes by use of light boxes at home. Both two light conditions were compared to a baseline condition with normal home light conditions. Sleep and sleepiness were assessed through motion loggers and sleep diaries.

Results: After BL exposure workers reported enhanced alertness (effect of condition; $F=4.62$, $p=0.0187$). Sleep length and sleep efficiency was not affected as measured through motion loggers but subjective sleep quality improved (effect of condition; $F=6.59$, $p=0.0052$) in connection to both BL and ML conditions.

Conclusion: Bright light treatment through light boxes seemed to have a mild positive effect on self-evaluated sleep. An elevated alertness may indicate an accelerated readaptation by bright light treatment. A detectable difference was observed comparing a moderate bright light box or bright light box, the alerting effects being stronger with a strong light intensity dosage.

Keywords: Sleep, shift work, circadian rhythms

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The Prevalence of Short Sleep Duration by Industry and Occupation in the National Health Interview Survey

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Aim: To explore whether employment in certain industries and occupations is associated with an increased risk of short sleep duration using data from the 1985, 1990, and 2004-2007 administrations of the National Health Interview Survey (NHIS).

Methods: The NHIS is an annual cross-sectional household-based face-to-face survey of US residents. Our study population consisted of currently employed sample adults aged 18-65 (n=59,891), excluding those who reported average sleep durations of greater than or equal to nine hours per day. We calculated the weighted prevalence of self-reported short sleep duration, defined as less than or equal to six hours per day, by industry and occupation categories for 2004-2007 and for all workers in 1985, 1990, and 2004-2007. The average hours worked per employee by industrial sector, based on 1990 Current Population Survey and the 2004-2007 NHIS data, were also calculated.

Results: The overall weighted prevalence of self-reported short sleep duration among workers from 2004-2007 was 30.8%. Among industry categories, the prevalence was greatest for management of companies and enterprises (weighted prevalence =43.1%), followed by transportation and warehousing (38.0%). Among occupation categories, the prevalence was highest for transportation and material moving occupations (37.2%), followed by production occupations (37.0%). In an analysis of industry-occupation pairs, transportation and material moving occupations were found to have a high prevalence of insufficient sleep when paired with 11 different industries, and installation, maintenance, and repair occupations and construction and extraction occupations each exhibited a high prevalence when paired with 6 different industries. In the combined sample from 1985 and 1990, 24.3% of workers reported short sleep duration; the prevalence was significantly lower during this earlier time period compared to 2004-2007 for seven of the eight industrial sectors studied. Average work hours were not substantially different between the two time periods.

Conclusions: Self-reported short sleep duration among US workers varies by industry and occupation, and has increased over the past two decades, even though the average number of hours worked per week has slightly decreased. These findings suggest the need for further exploration of the relationship between work and sleep, and development of targeted interventions for specific industry/occupation groups.

Keywords: Sleep duration, occupational groups, work

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Intolerance to shift work and health in hospital workers

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Objective: Night workers may have serious health risks due to their non-physiological work shifts. This study is aimed at identifying the effects of night shift duty on the health and wellbeing of hospital workers in order to make recommendations on ways of ameliorating them.

Methods: A cross sectional study by self-administered questionnaire. The observed sample included 210 workers (74 male workers, 35,2%; 136 female, 64,8%), mean age 42,4±8,6 yr.

Workers expressed their tolerance of night work by a single item derived from the Workplace Organization Assessment Questionnaire (WOAQ). Perceived job strain was measured by the Karasek's Job Content Questionnaire (JCQ); employee wellbeing was assessed by the General Health Questionnaire (GHQ12).

Results: Workers who negatively perceived night work showed lower psychological well-being ($p=0.04$), higher job strain ($p=0.001$), and lower social support at work ($p=0.006$) than other workers. The correlation of intolerance to shift work with perceived job strain and decreased well-being was confirmed after correction for age and gender in a logistic backward stepwise conditional selection model.

Conclusion: Night shift duty may cause both medical and psychological problems on the less tolerant workers. There is a need for medical surveillance, educational programme and the application of sleep hygiene techniques for shift working health care workers.

Keywords: shift work, night work, strain

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Humans are diurnal: what shiftworkers are?

Analysis of individual contribution for accidents in a general hospital

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Aim: The purposes of this study were to verify these hypotheses: occupational accidents are more common in shiftworkers among shiftworkers, the morning types are more prone to occupational accidents there is a correlation between the chronotype and daytime sleepiness in injured shiftworkers among shiftworkers, psychological symptoms, like anxiety, depression, introversion, work dissatisfaction, contribute for a larger accident risk.

Methods: A cross-sectional survey using an administered, structured questionnaire. The participants were a convenient sample of nursing and medical staff. A total of 220 questionnaire were collected.

Identical, anonymous questionnaires were used, including some tests:

General Job Satisfaction, Cognitive-Somatic Anxiety Questionnaire, The Quality of Life Survey, Coping Questionnaire, Eysenck Personality Inventory, Morningness-Eveningness, Questionnaire self-assessment version, Fatigue Severity Scale, Epworth Sleepiness Scale. We asked information about: age, sex, life habits, ward and duties, past and recent occupational accident, their timing and their cause, work organization. We asked moreover to judge the physical and mental workload in each kind of shift (morning, evening, night).

Results: The frequency of accidents among shiftworkers doesn't seem different from that of workers without shift ($P > 0,05$). About the distribution of chronotype: there are significant differences between accident/not accident groups ($P < 0,05$) and shiftworkers injured/shiftworkers not injured ($P < 0,05$). Looking at the median values for all the variables, we could note:

- workers without shift have worse scoring about anxiety scale
- workers without shift and shiftworkers without past accidents have better scores about coping
- shiftworkers have worse scores about coping than workers without shift; this difference is less or not significant considering the shiftworkers without history of accident
- shiftworkers with history of accident have the worst scores about job satisfaction
- workers without shift have less sleepiness
- workers without shift and shiftworkers with history of accident feel more fatigued
- chronotype shows a trend to higher values in workers without shift and in shiftworkers.

The test z or Student t test were used to verify the differences of the median values:

- workers without shift have more sleepiness and fatigue than shiftworkers ($P < 0,05$)
- the same about anxiety ($P < 0,05$)
- shiftworkers without accident have best score about coping than their colleagues with previous injury ($P < 0,05$)
- job satisfaction is higher in workers without accidents than those who had them ($P < 0,05$).

Discussion: The morning type should be unfavourable to shiftwork. We chose accidents as a measure of this relation. This is credible; the mechanism should include the effects on cognitive and psychomotor capabilities. These effects are well described in unselected samples and in desynchronized workers. The chronotype doesn't seem to correlate with the exposition to a shift system or with the frequency of occupational injuries. However, it's of interest the chronotype distribution among shiftworkers with or without accidents. We measured also individual characteristics about personality and the interaction with the environment. The aim was to both control many more variables than before and analyse their relation with accidents' susceptibility. We found a protective effect of coping, being correctly engaged. That should mean a better control of one's own interaction with people and environment, against the unfavourable changes by shiftwork. Again, the job satisfaction seems to have the same protective effect, but through the complex gratification and motivation networks. In literature, there aren't definite arguments on the importance of these individual contributions about adverse outcomes, as occupational accidents. Besides that, it could be helpful in improving the workers' occupational training.

Keywords: Keywords: shiftwork, accidents, chronotype, coping, job satisfaction.

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The contributions of work hours and work schedule on psychological distress, depression and burnout

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Aims: When analysing workers mental health, choosing mental health instruments that best evaluate mental health status and studying how contractual demands defined by working hours and work schedule relate to the outcome are still a matter of debate.

Methods: We report preliminary results obtained from a sample of 410 municipal employees working in Quebec (Canada). Mental health was measured with three instruments: The General Health Questionnaire short-form 12 items (GHQ-12), the Beck Depression inventory (BDI-21) 21 items, and the three components of the Maslach Burnout Inventory General Survey (MBI-16 items). Working hours were measured per week and work schedule was evaluated by the frequency of exposure to day, evening, and night shift, and exposure to irregular work schedule. Other work factors controlled for in the analysis came from the Karasek's Job Content Questionnaire (JCQ) evaluating skill utilisation, decision authority, psychological demands and social support from colleagues and supervisor.

Results: A correlation analysis reveals small to moderate positive associations between mental health instruments. Further analyses show stronger associations between working hours, work schedule and the three components of MBI-16. In separate regression analysis adjusting for JCQ, sex and age, evening shift was associated with higher score on the GHQ-12, working hours with higher BDI-12, and evening shift with lower emotional exhaustion. Cynicism was associated with lower working hours and higher exposure to irregular work schedule. Last, higher number of working hours and lower exposure to irregular work schedule were predictive of higher professional efficacy.

Conclusion: Overall, these preliminary results suggest that the number of working hours and the work schedule may contribute differently to workers mental health depending on the instrument used to evaluate what is going wrong in the worker's psyche. If workplaces turn out to be a target for interventions on work hours and schedule, choosing one of the workers mental health screening instruments must be carefully evaluated and tested to avoid arriving at ambiguous conclusion regarding the contribution of working hours and work schedule.

Keywords: work hours, work schedule, mental health, instruments, evaluation

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Diurnal patterns of activity of orienting and executive control neuronal networks in subjects performing monotonous vs. demanding driving task: an fMRI study

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Aim: The purpose of the study was to analyze, from the perspective of diurnal changes, the activity of neuronal networks involved in orienting and executive control processes. Activities of orienting (Pulvinar, Parietal Lobe) and executive control network (supplementary and presupplementary motor area [SMA, preSMA]; rostral, dorsal, caudal anterior cingulate cortex [rACC, dACC, cACC]; ventrolateral and dorsolateral prefrontal cortex [VLPFC, DLPFC]) were registered in the MR scanner.

Methods: Fifteen healthy right-handed male volunteers (mean age 27,4 years) participated in the experiment. Participants performing a Stroop-like task in the MR scanner five times a day (6 am, 10 am, 2 pm, 6 pm, and 10 pm) were instructed to name in mind the ink colours of presented words (evoking negative emotions), restraining from vocalizing them. Between the sessions they were carrying out cognitively demanding (8 subjects) or monotonous (7 subjects) tasks in a driving simulator. The data were acquired with a GE Signa 1.5-T scanner using fMRI (BOLD signal) in BLOCK design paradigm and processed using SPM, Matlab 2007a package.

Results: The diurnal patterns of orienting and executive control networks activity were analyzed using ANOVA model. Received profiles, both in left and right hemispheres, at 5 time points showed noticeable similarity regarding both significant domination of Parietal Lobes activity, as well as general activity profiles of all considered neuronal structures. An interesting profile was observed at 2 pm. In the left hemisphere, apart from significant domination of Parietal Lobe ($F=7,94$, $p=.001$), there were differences in activation between participants performing demanding vs monotonous task, with a higher activation in the former group ($F=4,30$, $p=.04$). The rACC was significantly less activated than preSMA and DLPFC. In the right hemisphere, significant domination of Parietal Lobe and DLPFC was noticed ($F=9,31$, $p=.001$). Several interaction effects were found: in the group performing monotonous task, DLPFC presented higher activation than cACC, Pulvinar, rACC, and VLPFC, while in the group with a cognitively demanding task, DLPFC was more activated only in comparison with rACC.

Conclusions: The profiles of activity of considered brain structures measured in different times of the day show great similarity. Nevertheless, at 2 pm there are significant changes in neuronal activity profiles and differences between effects of workload types probably linked with post-lunch dip syndrome.

Keywords: Pulvinar, Parietal Lobe, SMA, preSMA, rACC, cACC, VLPFC, DLPFC, post-lunch dip, fMRI

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Seniority at night work and weight increase among nursing professionals

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Introduction: Working at night is known as a risk factor for reduction in sleep duration, which has also been associated with body weight increase. Consequently, it might be suggested that the seniority in night work could be also associated with the increase in weight among night workers. **Aim:** To verify the association between working factors with weight increase among nursing professionals.

Methods: This study included 401 registered nurses (31.67%) and nurse assistants (68.33%) of a public hospital, average age 35.35 years old (SD 9.76 years) and working for an average of 10.14 years (SD 8.04 years). Almost half of them worked on day shifts (52.12%). Those who worked at night (47.88%), from 19:00 to 07:00, worked for 12 hours and rested for 36 hours. The workers filled out a questionnaire about socio-demographic data and work conditions. After the descriptive analysis of the data, a univariate linear regression was performed, having the body mass index (BMI) as the dependent variable.

Results: Most workers were female (86.53%), lived alone (52.62%), did not have another job (86.3%). An average body mass index (BMI) of 25.39 kg/m² (SD 4.17 kg/m²) was observed. A total of 53.62% of nursing professionals were normal (adequate nutrition), and 46.38% were overweight or obese. The average work seniority as a nursing professional was 10.14 years (SD 8.04 years); 4.95 years (SD 5.08 years) for the day shift and 6.26 years (SD 5.57 years) for the night shift. The linear regression analysis showed a BMI increase of 0.165 kg/m² for each year of life (CI 95% 0.13-0.20), a BMI increase of 0.172 kg/m² for each year of work as a nursing professional (CI 95% 0.12-0.22), a BMI increase of 0.147 kg/m² for each year of work during the day (CI 95% 0.04-0.26), and a BMI increase of 0.231 kg/m² for each year of work during the night (CI 95% 0.13-0.33).

Conclusion: There is an expected increase in body weight with age and years worked, both day and night work. Nevertheless, night work appears to result in a higher body mass index than day work. Support: CNPq-309441/2007-2.

Keywords: night work, increase in weight, nursing professionals.

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Long-term effects of shift work on sleep quality as a function of age: results from the VISAT longitudinal study

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This study examined age-related changes in subjective sleep quality in an occupational setting, and tested the hypothesis of persistent sleep troubles in former shift workers. Data were taken from the VISAT longitudinal study (Aging, Health, & Work), which allowed both cross-sectional and longitudinal aspects of age-related changes to be examined. The cohorts comprised male and female, employed and retired wage earners who were 32, 42, 52 and 62 years old at the time of the first measurement (t1, 1996), and who were seen again five (t2) and ten (t3) years later. Most analyses were performed on the 1257 participants who took part on all three measurement occasions, but some were based on the larger t1 and t2 samples. Subjective sleep quality, past and current experience of shift work, and perceived stress were recorded on all three occasions. The design of the VISAT longitudinal study allows an examination of three types of time-related effects, namely: (i) Age effects, (ii) Historical context effects, and (iii) Birth cohort effects.

Our preliminary analyses showed sleep troubles to be increased in workers in their thirties and forties and to then stabilize over the next two decades. The results suggested that the stabilization of sleep troubles in the older groups was due to decreased overall stress in those approaching retirement and in those already retired. Comparing within-person and between-person changes revealed an effect of cohort, with more sleep problems reported at a given age than ten years ago at the same age. There was evidence of some persistent effects of sleep troubles in still-employed former shift workers, but not of permanent effects since no differences were found between older or retired former shift workers and their controls. These results support the view that still-employed former shift workers are typically those who have quit shift work because of their poor sleep quality and tolerance to shift work. In contrast, amongst the older and retired former shift workers there is a higher proportion of good sleepers who have tolerated shift work better and longer.

Keywords: age, sleep, shift work, long term effects, retirement, longitudinal study, VISAT.

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The Influence of the Internal Body Clock and Prior Wake on Low Order Cognitive Performance

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Aim: Previous studies have demonstrated that cognitive performance varies throughout the circadian cycle and with different magnitudes of prior wake. Questions remain on the relative magnitude of these two influences and whether they combine in an additive or interactive manner. By desynchronising these two systems, this study aims to investigate the distinct influences of both the circadian system and prior wakefulness on low order cognitive performance.

Methods: Eleven male participants (22.6, SD 2.4yrs.) of healthy BMI (22.3, SD 2.6) were tested at seven different levels of prior wakefulness: 1.5, 4, 6.5, 9, 11.5, 14, and 16.5 hours after waking. Using a 28h forced desynchrony protocol, each prior wake condition occurred once at six different 60° divisions of the circadian cycle. Circadian phase was estimated from core body temperature readings collected from continuously worn rectal thermistors. Performance was quantified by a 10 minute psychomotor vigilance test (PVT) with the reciprocal reaction times assessed. During the 28h days, the sleep/wake ratio was set to 1:2 (9.3h sleep:18.7h wake). With the manipulated days subsisting eight (24h) days, after adding two training days and a baseline day, the participants were temporally and socially isolated for a total of 11 days. In order to further restrict Zeitgebers, the participant's living space was sound attenuated, temperature controlled ($22 \pm 1^\circ\text{C}$) and dimly lit (10 to 15 lux) during wake periods.

Results: A repeated-measures mixed models analysis of variance was used to analyse the results. Between subject variability (subject ID) was held as a random effect, while a covariate of sleep efficiency was also incorporated. Against the dependent variable of PVT performance (reciprocal reaction time), there were significant main effects for both circadian phase ($F(5,410)=19.23, p<.001$) and prior wake ($F(6,410)9.66, p<.001$) with an additional interaction effect ($F(30,410)=1.68, p<.015$).

Conclusion: The significant interaction effect provides a strong argument that the affects of circadian and sleep/wake processes on neurobehavioral function are nonlinear rather than additive. The strength of the findings is found within the analysis model used. Unlike other studies, it had the ability to account for much of the variability innate to the protocol. The findings also depict a circadian phase point where the interaction of prior wake and circadian phase is greatest. This critical point corresponds to the established peak accident risk time in several shift-work industries.

Acknowledgments: This study was financially supported by the Australian Research Council.

Keywords: forced desynchrony, circadian rhythm, prior wakefulness, cognitive performance, psychomotor vigilance test, core body temperature

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Effects of flexible employment and insecurity on work-life conflict and health amongst hotel workers

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Background and Aims: A growing body of research has identified a disparity in OHS outcomes for temporary and permanent workers performing the same tasks. Temporary or insecure work is associated with a range of adverse outcomes such as a lack of control over scheduling, increased work-life conflict, and stress. The rise in flexible or temporary employment is most marked in the expanding service sector but very little research has been done on the health effects of employment status in this sector. To address this gap, this study compares permanent and temporary workers in the hotel industry in which working hours are highly variable and unsocial. The effects of employment status on perceived security, control over working hours, and work-life conflict are investigated. It also explores the effects of control over working hours on work-life conflict and subsequent health outcomes. The pressure component of the PDR model (Quinlan & Bohle, 2004) is used to measure the impact of economic pressures and work intensity on perceived control over working hours.

Methods: Survey data were obtained from a sample of 211 hotel workers. The mean age of the sample was 31.5 (SD=11.2), 44% of respondents were male, while 57% were female. Participants were drawn from eight 3-Star hotels in urban and regional parts of New South Wales. Most participants completed the survey online during work breaks, but some surveys mailed to the individual hotels and distributed by hotel managers. Once completed these hard copy surveys were returned to the managers' office in unmarked envelopes, which were then mailed to the researcher.

Results and Conclusions: Partial least squares modelling illustrates the complex structural relationships between the variables examined. The fit indices obtained indicate that the model fit the data very well (maximum $R^2=0.55$). As expected the temporary workers perceived themselves as less secure than permanent co-workers. In turn, they also perceived less control over their working hours. As control over working hours decreased there was an increase in work-life conflict, which resulted in negative effects on health. Younger workers were also more likely to perceive a lack of control over their hours, thus highlighting young temporary workers as a vulnerable group.

Keywords: temporary work, job insecurity, work-life conflict, control over working hours

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Adaptation of working schedule to the customers

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Globalization and competition have demanded changes in working schedules in services. The content of the work has changed. Due to the customer's demands banks have to prolong the opening hours in the late afternoon. The lunch break is longer, or the beginning of work in the morning is later. In our research the well being of financial workers working in different working schedules was analyzed on the basis of perceived fatigue, stress and depressed mood on the questionnaire. According to the results of analyses of well being for 1631 financial workers the most important influence factors shaping the well being of workers are the age and the sex of these workers; majority of workers are women.

Younger female workers with smaller children want to come earlier home due to family obligations - in Slovenia there are only modest experiences with a half day work. Majority of these women report perceived stress and overloadness. Older workers, workers above 50, with worst psychophysical condition report fatigue and exhaustion due to longer absence from home. These workers do not have adequate education for more demanding working position. They have to work for the following 10 to 15 years on the position they do not like and they perceive it as not respectable one.

As the results of the research and professional work the possible adaptation were suggested: Flexible working schedule, combination of crews from the workers of different age groups, enrichment of work content, permanent offer of shorter working hours for mothers with small children, adopted education program for older workers with special concern to the limited learning capabilities of older persons. These programs take into account more repetitions and longer repeating times. Offering of the work place near the place of residence reduce the journey time from home to work and offers possibilities to use well the longer lunch break also for resting. Introduction of experience grey hair financial customer consultants working in the afternoon offers possibility to improve financial consulting service for customers. Older workers due to less home obligations have better possibilities to work in the afternoon. They are more experienced, but they are also slower. For the consulting work this combination is the advantage. All those suggestions are focused to the work place and demand adaptation of working processes to the new situations. They demand mutual adaptation of workers and work place. There are still enough places for community support of this working organization. Adaptations of kindergartens offers, schools, and spare time activities for children would be welcome. Due to the move of the working possibilities to the services, wider communities will have to support this new working reality.

Keywords: adaptation, customer service, well being, older worker, young female worker, stress, fatigue

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Long working hours, night work and occupational stress in an Italian Offshore Company

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Since September 2008, in Italy a terminal operates for the unloading, storage and regasification of liquefied natural gas. The terminal is located in Rovigo, 15 km off the Italian coast.

Work on offshore installations is generally regarded as a stressful occupation due to shiftwork, long working hours, isolation, possible problems related to work-family interface, etc.

Workers are also exposed to physical stressors such as noise, whole body vibrations from metal structures, chemicals used for maintenance, confined living and working spaces, and exposure to adverse weather conditions. They are also under the risk of serious accidents, such as fires, explosions, and accidents while traveling on helicopters and ships.

Most workers (Organization Managers, Maintenance Mechanics, Electrical and Instrument Technicians, Control System Operators, Safety Security Health Environment Coordinators) work dayshifts of 12 hours (0700-1900), for fourteen consecutive days. Control Room and Process operators (n=19 workers) work 12-hour night shifts (1900-0700), still for a period of fourteen consecutive days.

Procedures concerning health, safety and emergency are very strict on the terminal and the respect of measures of prevention extremely rigorous; seven health and safety and environment protection foremen are on board as full-time employees; the whole personnel participate in health and safety meetings held on a weekly basis.

In the framework of the health surveillance program, we recently performed medical examinations along with occupation-related instrumental exams (audiometry, electrocardiography) and the administration of three questionnaires:

- the Work Ability Index (WAI) questionnaire, to evaluate fitness to the job in relation to both physical and mental health status;
- the short form of the Effort-Reward Imbalance (ERI) questionnaire, to assess work-related stress;
- a reduced version of the Standard Shiftwork Index (SSI), to assess problems with sleep, social and family life, and work performance.

Forty nine workers (96%) completed the questionnaires. The mean age of respondents was 36.2 (range 23-58); as far as nationality is concerned, the vast majority were Italian (n=43); there were also Americans (n=3), Norwegians (n=2) and one British worker.

Preliminary analyses showed that, among cases, WAI resulted as "moderate" for the 10%, "good" for the 36.6%, and "excellent" for the 53.5%. No cases resulted as having a "poor" WAI. Twenty two per cent of the workers reported high effort/reward imbalance (ERI>1). The median value of overcommitment was 12. With reference to the SSI questionnaire, respondents complained about problems with social life caused by job engagements in 47% of the cases, and nearly as many complained about problems concerning their family life; 18% of the whole group had problems with sleep; in only few cases (less than 5%), problems with work performance were reported. Sleep disturbances were more common among the nineteen subjects working on night shifts (30%).

Keywords: shiftwork, stress, work ability, offshore

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Influence on own working hours and risk factors for cardiovascular disease – an intervention study

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Aim: Degree of influence on own working hours has been shown to have positive effects on health and symptoms in population based studies. One possible mechanism is through improved sleep quality. The aim of the present study was to examine if increased influence on own working hours among shift workers in the Danish eldercare led to better health and well-being. For this purpose an intervention study was designed. Results for sleep quality are presented.

Methods: Questionnaire data were collected before and a year after the intervention. Analyses are restricted to participants, who filled in the questionnaire both at baseline and follow-up (n=205 from 20 work teams). Based on a score of the intensity of the intervention, teams were categorized into four groups: High intensity (introduction of PC-program, n=20), moderate intensity (course on working time arrangements and/or policy for working hours, n=37), low intensity (local meetings, n=15) and reference (usual procedure, n=133). A single item question (5 response categories) on influence on own working hours was included. Sleep quality (single item), disturbed sleep index (DSI, 5 items) and awakening index (AWI, 3 items) were derived from the Karolinska Sleep Diary (KSD). The mixed procedure with repeated measures in SAS vs. 9.1.3 was used for statistical testing of the interaction term between intervention intensity and time.

Results: The intervention led to increased self-reported influence on own working hours ($p < 0.001$ for the interaction term). Higher intensity of the intervention was associated with higher increase in self-reported influence. The mean difference was 1.7 point (sd=0.32 point) between baseline and follow-up in the high intervention intensity group. There were no effects on sleep quality ($p = 0.593$ for the interaction term), DSI ($p = 0.617$ for the interaction term), or AWI ($p = 0.794$ for the interaction term).

Discussion: Although the intervention led to higher self-reported influence on own working hours, there were no overall effects on the three measures of sleep quality, indicating that influence on own working hours does not affect sleep quality within this group of shift workers. This may be due to low degree of change in the actual work schedules. Future analyses will include subgroup analysis to examine if different subgroups, e.g. singles or young, benefited from the increased influence whereas others did not.

Keywords: eldercare worker, shift work, biomarkers, work-time control

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The importance of individual preferences when evaluating the associations between work schedule characteristics and intention to leave the workplace

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Aim: Previous research on work schedule characteristics and health show mixed results which may be explained by individual differences in preferences and tolerance towards different working hours. Thus, a measure of the individual acceptability of a given work schedule characteristic could constitute the missing link between some work schedule characteristics and the adverse outcomes. We therefore took a new approach in the assessment of the effect of work schedule characteristics by combining information on employees' work-time preferences and their actual work schedules obtained from the workplaces. Our aim was to investigate whether a misfit between preferences and actual working hours increased the adverse effect of actual working hours on intention to leave the workplace due to one's working hours.

Methods: We used (cross-sectional) baseline data from an intervention study among employees working in the Danish eldercare sector. A total of 273 eldercare workers from eight workplaces (71% of those eligible for inclusion) completed the questionnaire, and we collected actual work schedules during a four week period for 192 participants. Questionnaires and work schedules were available for 173 female eldercare workers working day or evening shifts. In the analyses we combined self-reported questionnaire data on work-time preferences with actual work schedules as regarded several workdays in a row, long workdays, non-day work, weekend work, and having long periods off. The outcome measure was intention to leave due to the present working hours.

Results: The results showed that in the adjusted analyses the odds ratio (OR) for intending to leave was 5.55 (95% confidence intervals (CI) 1.68-18.31) when comparing those with non-day work who did prefer day work (=misfit) with those with non-day work who did not exclusively prefer day work (=fit). Misfit combined with weekend work was also associated with increased odds for intending to leave (OR=4.84, 95% CI 2.02-11.59).

Conclusions: Our results supported the hypothesis that there is interplay between individual preferences and actual working hours with respect to intention to leave the workplace. Further, preferences may be most important in relation to non-day work and weekend work. Employees should therefore be offered the opportunity to influence these aspects of their working hours. Future studies, however, should aim at supporting or rejecting these findings in prospective studies with larger samples and more exposure contrast.

Keywords: shift work, turnover, weekend work

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Lifetime working time - effects on health and fitness for duty: results from a pilot study

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Aim: Germany has increased its retirement age from 65 to 67, extending the exposition to work load from the job for 2 years. Ergonomics results or principles have not been involved in the discussions, e.g. addressing the question whether this will increase people with impaired health or fitness to do their jobs. The question has thus been addressed, whether there are any relations between the duration of the lifetime working time and fitness for duty or health impairments, and whether this depends on moderating variables, e.g. working shifts. This question has been raised in connection with discussions of an increase in the retirement age of police officers from 60 to 62 years in the German police force.

Methods: This research question was addressed in a pilot study in three states of the FRG using an internet survey which asked, besides demographic data, for specific dates, if applicable: reduction in fitness for duty (as assessed by a medical examination), changes from operative duties to office duties, (early) retirement. Data from n=1675 respondents were analysed using survival analyses to test for the effects of covariates like shift work, years in shift work, kind of duty, age, gender etc.

Results: The results show that there is a clear decline in the probability of being still fit for the job as a police officer, especially beyond the age of 50 - 55. Changes from operative to office duties increase as well, but less pronounced than the decrease in fitness. Since the last component, retirement, starts even later there is an increasing discrepancy between fitness, requirements of the job and the possibility to leave the job. This is especially marked in police officers from one state where the retirement age has already been increased to the age of 62.

Shift work has a clear effect on the time to impairment, as well as the fact of working in operative duties.

Conclusions: Obviously the aim of unimpaired performance until the age of retirement (at least for 95% of the population under observation) cannot be reached at the moment. Depending on the covariates (e.g. workload, shift work) the time to impairment is clearly shorter than the actual retirement age. It is thus questionable whether an increase of the retirement age is both effective and efficient. The methods used appear to be quite promising for such research questions, although more retired people should be included in the sample to reduce the effects of censoring.

Keywords: Life time working time, shift work, impairments

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Sleep length, sleepiness and reaction time of working college students, males and females, during working days and free days

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Introduction: Data from Brazilian Institute of Geography and Statistics (2003) shows that 15,1% of people aged 20-24 years old both study and work. As result this population seems to be chronically sleep deprived. It might lead to excessive daytime sleepiness and low performance at school and at work.

Objectives: The objective of this study is to detect sex differences in sleep length, sleepiness and performance of working college students, in connection to workdays and free days.

Methods: The study was conducted in a public college (School of Economics, Business, and Management) in São Paulo, Brazil. The participants were engaged in full-time jobs (6 hours or more) from Monday to Friday and attended evening classes (19:30-22:30h). The study group consisted on 40 healthy males and 37 females, aged 21-26 yrs. The participants wore for seven consecutive days an actigraph, to obtain information about the sleep wake cycle. Karolinska Sleepiness Scale (KSS) and Psychomotor Vigilance Task (PVT) were used to obtain data of sleepiness at three different moments: wake up time, mean of the whole day and at bedtime. An ANOVA yielded main effects of sex, day and time of day and interactions effects using Huynh-Feldt whenever possible. Time of the day was evaluated just for sleepiness and PVT measures. The analyses were made separately for working days (Monday to Friday) and free days (Saturday to Sunday).

Results: The analysis found sexes differences in the sleep length, sleepiness and performance. In both work days and free days a main effect of sex was found: females slept about 40 min more than males. The analysis also showed a day effect for working days as students slept more on Friday night. The sleepiness analysis revealed, upon awakening time on work days females were sleepier than males. During free days, females were sleepier at bedtime compared to males. Regarding performance, on work days, a main effect of sex was found, as reaction time was slower for females compared to males. During free days sex effect disappeared.

Conclusions: Females sleep length was longer than males during the whole week, but even so, they seemed to be sleepier and showed a poorer performance. The restricted time to sleep during the work days possibly leads to a sleep rebound during free days in both sexes.

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Keywords: college students, working students, sleep length, sleepiness, simple reaction time

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Effects of high-carbohydrate and high-protein diet on night security guard's sleepiness

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Introduction: Studies indicate that night work is associated with metabolic alterations. These include obesity, elevated serum lipids, hypertension among others. In addition, a few laboratory studies have been performed to evaluate the effects of different diets on sleepiness. It has been suggested that there is a decrease of alertness with a high-carbohydrate diet.

Aim: This study aims to compare the effects of high-protein and high-carbohydrate night meal on sleepiness among night security guards, according to their body mass index.

Methods: Twenty-four night security male guards who work from 00:00 to 08:00h (Monday to Friday) volunteered to participate on this study. The guards average age was 30.8 yo (SD= 5.5 yo); body mass index was 28.7 kg/m² (SD= 4.0 kg/m²) and waist was 106.2 cm (SD= 10.4 cm). They wore an actigraph for three weeks, five days a week (Monday to Friday), to estimate their sleep-wake cycle, which was confirmed by a daily sleep log. Karolinska Sleepiness Scale (KSS) was used to self-record sleepiness every three hours from waking up to going to bed. The first week was considered the baseline and the workers had the night meal they usually ate at work. In the second week, the night meal was exchanged by a high-carbohydrate diet, and in the third week the content of the night meal was high-protein. The workers did not know about the contents of the meals. An ANOVA considering time as repeated measurement (before and after the night meal), and body mass index as a factor (above 30 kg/m² and below 30 kg/m²) was performed for each condition. Pos-hoc tests were calculated whenever necessary.

Results: The analysis found a time borderline effect for the baseline week ($p=0.05$). It was also found an interaction effect between time and body mass index for the week with high-carbohydrate meal ($p<0.05$). The workers with body mass index above 30 kg/m² were sleepier than the others after eating the high-carbohydrate meal. There were no significant effects observed for the week with high-protein night meal.

Conclusions: The results suggest that night meal content does have an effect on night worker sleepiness. However, this effect seems to be modulated by weight.

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Keywords: night work, sleepiness, diet.

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The influence of shift work in military air traffic controllers' decision making

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Aim: The purpose of this project was to evaluate the effect of shift work in military air traffic controllers' decision making.

Methods: The data was obtained from a total amount of 27 air traffic controllers, most of them ranked as sergeants, with approximately 20 years of service record and an average of 8,7 years in air traffic controlling. A Vienna Test System's decision making test battery was used to evaluate those volunteers. Decision making was measured through three different types of tests: a cognitive (COG), a simple reaction (RT) and a multiple reactions one (DT). All of the tests were conducted inside a Brazilian military base, into seven distinct moments: immediately before and immediately after each type of shift (morning, afternoon and night shifts) and during one single day-off. All data was processed using SPSS for Windows and this project was approved by the Research Ethics Committee at Universidade Federal de Minas Gerais, Brazil (0160/07).

Results: Air Traffic Controlling was considered by most volunteers as a stressful activity. However, the working environment was rated as proper and interpersonal relationships were evaluated as good or optimal.

A decision making performance score was created based upon a wide range of the Vienna Test Systems variables, as mentioned above.

There were no significant differences between the beginning and end of each shift type. By comparing the results of each kind of test separately, before and after each shift type, there were no significant differences either. When it comes to the workload and subjective perception data analysis, both revealed low physical and mental demand. As the decision making performance was not affected when comparing the three shift types, there are evidences of insufficient workload or work demand to promote such effect.

Conclusions: Well-designed shift work scales, with proper workload and sufficient amount of intervals may reduce human errors during air flight controllers' work shift.

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Keywords: Keywords: air traffic controllers, decision making, shift work

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Chronotype, sleep loss, and diurnal salivary cortisol pattern in simulated driving task

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Aim: The study was focused on chronotype differences in subjective arousal and salivary cortisol patterns in subjects performing simulated driving task.

Methods: Twenty one healthy male volunteers (mean age 27.9 + 4.9 years) were staying in semi-constant routine conditions from early morning hours till midnight. They performed simulated driving tasks (various computer games) in four sessions, each lasting about 2.5 hours.

The saliva samples were collected after each of driving sessions, i.e. at 10:00-11:00, 14:00-15:00, 18:00-19:00, and 22:00-23:00. The participants also provided the samples taken 10-30 minutes after awakening (between 05:00 and 06:00) and at bedtime. Two subgroups of subjects were distinguished on the basis of Chronotype Questionnaire: morning- and evening-oriented types. Subjective data on sleep needs, sleeping time preferences, sleeping problems and the details of the preceding night were investigated with a questionnaire. Subjective measures of task load (NASA-TLX), activation (Thayer's AD ACL), and sleepiness (KSS) were applied at times of saliva samples collection.

Results: M-oriented and E-oriented types differed significantly as to the ideal sleep length (mean 6h54min + 44 vs. 8h13min + 50min), preferred sleep timing (midpoint at 03:19 vs. 04:26), and sleep index, i.e. 'real-to-ideal' sleep ratio before the experiment day (0.88 vs. 0.67). Sleep deficit proved to be integrated with eveningness.

Morning and evening types exhibited similar diurnal profiles of energy, tiredness, and tension assessed with AD ACL, but E-types estimated higher their workload (NASA-TLX) and level of sleepiness (KSS). M-types demonstrated higher mean cortisol levels than E-types ($F=4.192$, $p<.056$) and its' distinct diurnal variations ($F=2.950$, $p<.019$), while E- types showed a flattened curve. Cortisol values did not correlate with subjective assessments of workload, arousal, and sleepiness at any time of measurement. Diurnal cortisol pattern parameters (i.e. morning answer, mean level and difference between morning and evening levels) did show significant positive correlations with sleep length before experiment ($r=.51$, $.54$, and $.45$ respectively) and with sleep index ($r=.63$, $.64$, and $.60$).

Conclusions: E-oriented types showed lower levels of salivary cortisol and flattened diurnal curve in comparison with M-types. Interestingly, sleep loss was associated with lower morning cortisol and its lower mean diurnal level, and higher levels of cortisol were observed in rested individuals. If interpreted in the context of stress theory, it may be hypothesised that rested males perceived driving task as a challenge, while those with reduced sleep were not thrilled, but rather fed up with experimental situation.

Keywords: chronotype, salivary cortisol, sleep need, sleep length, sleep deficit

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The effects of homeostatic and circadian influences on sleep quality and quantity in humans living on a 28h day

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Aim: Sleep is regulated by two mechanisms; an endogenous circadian pacemaker and a homeostatic process determined by prior sleep/wake. A majority of forced desynchrony (FD) studies have examined the circadian and homeostatic influences on sleep over several beat periods. The aim of the current study was to perform a 28h FD with a single beat period to assess the effects of the homeostatic and circadian processes on sleep architecture in young healthy adults.

Methods: Eleven males (age: 22.7 ± 2.5 yr) lived in a sound attenuated, temperature and light controlled laboratory free from time cues for 12 days. Participants were scheduled to 3x24h baseline days (8h sleep, 16h wake) followed by 7x28h experimental days (9.3h sleep, 18.7h wake). Sleep was assessed using standard polysomnography techniques. Core body temperature (CBT) was measured by a rectal thermistor. Epochs of sleep were assigned a circadian phase (60 degree bins based on CBT: phase 0=CBT minimum), and an elapsed time into sleep episode (140 min intervals). Repeated measures ANOVAs with circadian phase (6 levels) and time into sleep episode (4 levels) were performed to assess the effects of circadian phase and time into sleep episode on sleep efficiency, slow wave sleep (SWS) and rapid eye movement sleep (REM).

Results: Sleep efficiency showed an effect of circadian phase ($F(5,50)=11.0$, $p<.01$) and time into sleep episode ($F(3,30)=29.7$, $p<.01$). Sleep efficiency was highest at 0 degrees ($93.6\% \pm 3.6$) and in the first quarter of the sleep episode ($93.8\% \pm 0.8$); and was lowest at 240 degrees ($68.9\% \pm 18.4$) and in the last quarter ($60.2\% \pm 4.5$). The percentage of SWS showed an effect of time into sleep episode ($F(3,30)=114.0$, $p<.01$): highest in the first quarter ($42.2\% \pm 4.0$) and the lowest in the last quarter ($4.8\% \pm 1.6$). The percentage of REM showed an effect of circadian phase ($F(5,50)=13.1$, $p<.01$) and time into sleep episode ($F(3,30)=5.6$, $p<.01$). The highest percentage of REM occurred at 60 degrees ($29.5\% \pm 5.6$) and in the last quarter of the sleep episode ($24.5\% \pm 2.4$); and the lowest at 240 degrees ($18.9\% \pm 4.9$) and in the first quarter ($15.3\% \pm 2.7$).

Conclusions: Sleep efficiency and REM varied with circadian phase. Further, REM increased with time into sleep episode, whilst SWS and sleep efficiency decreased. These results are consistent with previous 28h FD studies using several beat periods. Future studies looking at the effects and interactions of the circadian and homeostatic processes on sleep may not require the use of more than one beat period.

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Keywords: forced desynchrony, circadian phase, REM, Slow wave sleep, sleep efficiency

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Predicting Fatigue: Sleep quantity versus sleep quality in miners

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Aim: Shiftwork involving early morning starts and night work can lead to decreased sleep and subsequently increased sleepiness and fatigue. Whilst there has been extensive research into shiftwork and fatigue within the mining industry, the specific factors contributing to fatigue ratings are not well described. The current study assessed the factors predicting subjective pre and post-shift fatigue in a group of miners.

Methods: Participants (age: 42.1 ± 10.3 yr) worked one of three rosters:

- 4:4 (n=14) 4D4O4N4O
- 7:4 (n=10) 7D4O7N4O
- 14:7 (n=12) 7D7N7O

Day and night shifts were 12h in duration. Sleep was assessed using activity monitors and sleep diaries for a full roster cycle. Pre and post-shift fatigue was assessed using a 7-point Samn-Perelli Fatigue Checklist. Linear mixed models were used to analyse differences in pre and post-shift fatigue ratings (dependant variables). Models tested main and interaction effects of roster (4:4, 7:4, 14:7), shift type (day and night shift), sleep in the prior 24 hours (sleep p24) at the start and end of each shift and subjective sleep quality (quality). All models specified subject ID as a random effect.

Results: Pre-shift fatigue ratings showed an effect of roster ($F(2,227)=3.1$, $p<.05$) and quality ($F(1,227)=115.0$, $p<.01$). Pre-shift fatigue was higher for participants working the 7:4 (3.2 ± 1.1) roster than those on the 4:4 (2.7 ± 1.3) and 14:7 (2.9 ± 1.1) rosters. Post-shift fatigue ratings showed an effect of roster ($F(2,214)=4.8$, $p<.05$), shift type ($F(1,214)=12.4$, $p<.01$), and quality ($F(1,214)=19.5$, $p<.01$). Participants on the 7:4 roster (4.3 ± 1.2) had higher post-shift fatigue ratings compared to the 14:7 roster (3.7 ± 1.7). Fatigue was higher following a night shift (4.2 ± 1.2) than following a day shift (3.7 ± 1.2).

Conclusions: Subjective sleep quality was the major contributor to pre and post-shift fatigue ratings. This suggests that it is not the amount of sleep obtained but rather how sleep quality was perceived that affects fatigue. These results also confirm that fatigue is higher following night shifts than day shifts, though pre-shift fatigue ratings did not differ between day and night shifts. More frequent days off with fewer consecutive shifts such as in the 4:4 roster may minimise the accumulation of fatigue.

Keywords: shiftwork, subjective fatigue, subjective sleep quality, mining rosters

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Sleep perception, Age, Apnea-Hipoapnea Index and Sleep Efficiency in professional train drivers

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Aims: Although there are some cross-sectional studies showing that shift workers have an altered sleep perception. There is no clear evidence if the total time sleep perception (TTSP) would change with aging, Apnea-Hipoapnea Index (AHI) and Sleep Efficiency (SE) in professional train drivers.

Methods: A hundred and eighty four (184) male shift workers from a Brazilian railway, working in a sequential shift work agreed to participate. The schedules were composed by 3 sequential journeys of 12 hours followed by 14 hours of rest and after 3 consecutive journeys a period of 36 hours of rest. The train drivers were divided in 3 groups in accord with the total sleep time perception: 1) less than 8 hours, 2) equal 8 hours, 3) more than 8 hours. To compare the groups were used a Pearson's correlation and differences of 5% were considered statistically significant.

Results: The mean age were $36.1 \pm 7.7(\pm SD)$ and in the groups less than 8hs, equal 8 hours and more than 8 hours the mean age were 37.4 ± 7.8 ; 35.8 ± 7.5 ; 32.7 ± 7.4 , respectively. There were no statistical differences in the groups that reported sleep less and more than 8 hours for the studied parameters. There were significant correlations ($p < 0.05$), between TTSP and age (-0.30), TTSP and AHI (0.25) and TTSP and sleep efficiency (-0.30).

Conclusions: Although the weaker correlations found, the mean hours of sleep showed in this group is coincident with the mean hours of sleep needed for the Brazilian general population, showed in previous literature. Therefore, we can infer that besides being under the effects of rotating shift work system, these train drivers probably will show the same alterations in the sleep architecture, due to the aging process, as decrease of REM proportion, sleep fragmentation and decrease of sleep subjective perception that is expected for Brazilian general population. We suggest that more prospective studies must be conducted to avoid an increase risk of accidents between these groups of workers.

Keywords: Sleep, Aging, Sequential Shiftwork, Apnea-Hipoapnea Index

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How sleep loss and perception of workload influences self-reported mood in Australian midwives

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Aim: Research has focused on sleep loss and fatigue related risks in health care professionals such as doctors and nurses. Much remains unknown about the consequences of sleep loss for midwives, particularly in relation to their workload and mood. This study aims to determine how sleep, sleep loss and perceived workload affect mood in a sample of Australian Midwives.

Methods: Thirty midwives are being recruited from two metropolitan hospitals. Data collection spans 28 days. Participants are administered demographic and General Health questionnaires and sleep is measured via sleep diary and actigraphy. Participants complete the SF-POMS daily, (assessing happiness, activation, fatigue, anger, fear and depression) and the NASA-TLX (assessing perception of workload factors: mental demand, physical demand, time demand, performance, effort and frustration).

Results: Preliminary analyses (n=5) indicate participants receive an average of 7h (6-8h) sleep on working days compared to an average of 11h (9.5-14h) sleep on non-working days. In terms of perception of workload, participants rated Performance as the most important factor 88% of the time, choosing this factor as most important 22 out of 25 times. Time Demand (60%), Mental Demand (56%), Effort (56%) and Physical Demand (36%) were the second, equal third and fourth most important factors. Frustration was only chosen as important to perception of workload 4% of the time. Data collection continues.

Conclusions: The longer sleep duration reported by midwives on days off compared to work days may suggest that work hours prevent midwives from obtaining ample sleep. Over time, this may result in sleep debt and may have consequences for mood. Performance may be the most important contributing factor to workload perception, which may influence mood at work. Workload, mood and sleep history will be analysed in the full sample to determine (a) how prior sleep history impacts upon self-reported mood, (b) in what ways mood reports differ on working days compared to non-working days, (c) the relationship between perception of workload and mood and (d) the magnitude of individual differences in perception of workload and mood.

Keywords: shift work, mood, workload, sleep

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Mood regulation and individual differences during sleep loss

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Aim: Studies showing the negative impact of sleep loss on mood have focused on general changes in mood dimensions. The aim of the present study was to determine how sleep loss affects mood regulation (analytic approach adapted from [1]) and the magnitude of individual differences in mood regulation.

Methods: Healthy young adults (Age=22+/-3.9; 34m, 24f) experienced one of two experimental conditions; 39-42h (2 days) or 63-66h (3 days) of sustained wakefulness (SW2, SW3), or time-matched control conditions: 2 or 3 days with 9 hour sleep opportunities (C2, C3). Mood ratings (happiness, activation, depression, anger, fear, using SF-POMS) were collected 2-hourly and data were organised into frequency (number of times a participant reported experiencing an emotion 'mostly/generally') and intensity (average rating of an emotion) scores for each mood dimension across each 24h period. Frequency and intensity scores across mood dimensions were factor analysed, consistently revealing two factors, 'positive' and 'negative' mood (accounting for around 76% of the variance). This resulted in four dependent variables: frequency and intensity of positive and negative mood.

Results: Frequency and intensity of positive mood significantly declined as time in the lab increased in the C3, SW2 and SW3 conditions ($p<.05$). In the SW2 and SW3 groups, negative mood also became significantly more intense as time in the lab and time awake increased ($p<.001$). Individual differences in all mood variables (as assessed by intra-class correlation coefficients, ICC) ranged from moderate to almost perfect (57-94%). In general, the more severe or intense the intervention, the lower ICC values were found for each group.

Conclusions: Consistent with previous research, frequency and intensity of mood reports across several dimensions loaded onto two clear factors representing positive and negative mood [1]. Findings suggest remaining in the laboratory, even in a control condition, can reduce positive mood (frequency and intensity). Sleep loss appears to increase the intensity of negative mood. Individual difference analyses suggest the larger the intervention, the more mood reports can be explained by the effects of the intervention, as opposed to the individual.

[1] Carstensen et al. 2000, J Pers Soc Psychol, 79(4), 644-55.

Keywords: mood, sleep loss, individual differences, mood regulation

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Night shift work, melatonin metabolism and breast cancer risk factors - ongoing cross-sectional study in nurses in Lodz, Poland

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Background and aim: Epidemiological studies have found that long-term night-working women have a higher risk of breast cancer than women who do not work at night. According to the circadian rhythm disruption hypothesis the underlying mechanism involves suppression of melatonin production caused by exposure to light at night. Some evidence shows that melatonin has oncostatic and antioxidative properties, and also affects estrogen signaling and immune function. Artificial light at night might also disrupt circadian genes function, which can alter cell-cycle regulation. In order to investigate the potential mechanisms and associations between night shift work and breast cancer risk factors (including breast density that could be an early outcome of the exposure of interest) an epidemiological study has been undertaken among nurses in Lodz (Poland).

Methods: The cross-sectional study (supported by a grant from the Polish-Norwegian Research Fund) will include 350 nurses currently working night-shift and 350 nurses who work only during the day. The nurses are selected from the registry of the Chamber of the Nurses in Lodz, Poland. A personal interview is performed with each woman in order to collect detailed information on occupational history, demographics, breast cancer risk factors, sleep disorders, diseases, diet. Blood and urine samples are collected to determine plasma estradiol level, antioxidant status, morning and evening urinary 6-sulfatoxymelatonin (MT6s) as well as genetic polymorphism in melatonin metabolizing enzyme (CYPIA2) and circadian genes (Per, Cry, Bmal, Clock). Digital mammography is performed to determine mammographic breast density.

Results: During the first 6 months of the study (by January, 2009) as many as 218 (79%) agreed to participate, 59 (21%) refused. The mean of MT6s per creatinine (Cr) level determined in 47 nurses who took part in the pilot phase of the study (27 day-workers and 20 night-workers) shows differences in the expected direction (arithmetic mean = 53.92 ng/g vs 44.55 ng/g - in morning samples, and 25.89 ng/g vs 16.36 ng/g - in evening samples in day-workers and night-workers respectively).

Conclusions: The data collection, mammographies, biochemical and genetic analyses will be carried out throughout 2009. The project may provide an important contribution to the understanding of the role of shift work in breast cancer etiology. It provides a unique opportunity to study various night shift work outcomes and underlying gene related effect modifiers.

Keywords: night shift work, melatonin, breast cancer, breast cancer risk factors

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Sleep deficit, age and health in shiftworking nurses participating in the NEXT study

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Objective: The study aimed at the problem of the quantitative and qualitative sleep insufficiency in hospital nurses working in rotating shift systems and its consequences for the general health burnout, job satisfaction and work ability.

Material and methods: 77000 nurses from 10 European countries were approached with questionnaire aimed at work conditions, family life, and their potential health and psychological consequences. The overall response rate was 51.4%. Nurses were asked, among others, about sufficiency and quality of sleep during working days and the days off. The work ability was assessed with use of WAI (Work Ability Index-FIOH); general health (GH) and job satisfaction with the scales used in COPSOQ Copenhagen Psychosocial Questionnaire (SF-36), burnout (exhaustion) with CBI Copenhagen Burnout Inventory. The analysis comprised 15109 nurses working in rotating shift systems including night (aged 37.6±8.7), and a group of 1158 permanent night nurses (aged 42.5±8.5).

Results: In the group of shiftworking nurses 57% reports insufficient sleep in work periods, and 21,7% complaints about bad quality of sleep. Percentage of nurses reporting sleep deficit increases up to 35-40 age group with further decrease and this also the case for the burnout score, while job satisfaction mirrors this tendency. Percentage of complaints about sleep quality increases up to age of 30 years and remains almost constant. WAI and general health revealed moderate decrease with age. Relationships of studied variables and of quantity (QT) and quality of sleep (QL) were very distinct in all age groups. Sufficient quantity and good quality of sleep were associated with higher WAI, GH, job satisfaction and lower burnout in all age groups. Correlation analysis (Spearman rho) confirmed moderate but highly significant associations between studied variables and level of sleep quality and quantity - they were highest for burnout. WAI: 0.267 with QT and 0.345 with QL; GH: 0.246 with QT and 0.310 with QL; burnout: -0.400 with QT and -0.401 with QL; job satisfaction: 0.231 with QT and 0.256 with QL.

Similar picture was found in the group of permanent night nurses.

Conclusions: Studies confirmed the very important role of sleep quantity and quality in shiftworking nurses. The especially high association with burnout stresses the role of proper sleep in prevention of burnout in nurses.

Keywords: shift and night work.sleep deficit.nurses.health

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Napping opportunity and work ability, subjective health and job satisfaction in shiftworking nurses participating in the NEXT study

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Objective: Previous studies pointed to importance of sleep quality and quantity for shift working nurses. The present study aimed at the problem of the official napping opportunity as a preventative measure alleviating some problems of shift and night working hospital nurses.

Material and methods: 77000 nurses from 10 European countries were approached with questionnaire aimed at work conditions, family life, and their potential health and psychological consequences. The overall response rate was 51.4%. This study group was restricted to shift and night working nurses employed in acute intensive care, medical wards, pediatric, obstetric/gynecologic and surgical wards. The population was subdivided into two groups according to the answer to the question about possibility to lie down during the night shift: group A (non-nappers): newer (n= 8410, age 37.51±8.81, group B (nappers): every or most of nights (n=1204, age 37.51±8.47). Both groups were compared with respect to WAI (Work Ability Index - FIOH); general health (GH) and job satisfaction with the scales used in COPSOQ Copenhagen Psychosocial Questionnaire (SF-36). Analysis was done for whole population and separately for Poland.

Results: Possibility to lie down during every or most of night shifts had on average 8.44% of nurses (from 3.47% in Norway to 16.22% in Slovakia). More that 80% of nurses in Germany, Norway and The Netherlands reported no such a possibility at all. In Poland 8.54% belonged to B group and 40.79% to the group A. Polish nurses reported lower WAI, SF-36, higher fatigue when compared with participants from other countries. In Polish nurses WAI values were apparently higher in napping nurses in all age groups (<30: 40.55±5.54 vs. 38.06±6.19; 30+: 39.39±5.46 vs. 37.72±5.31; 40+: 38.42±5.08 vs. 36.06±6.21; 50+:36.92±4.94 vs. 35.69±7.88). It was not the case for the remaining EU group where napping nurses had slightly better WAI in two youngest groups and worse after the age of 50. SF-36 were apparently higher in Polish nappers (B > A). In remaining EU countries A and B group did not differ in two youngest groups with slightly better scores in older non-nappers (group A). In Polish nurses job satisfaction (as a whole, impact on well-being and private life) was higher in group B. Similar effect but much less pronounced was found in EU nurses younger than 40. Remaining EU nurses as compared to Polish ones, generally less frequently reported tiredness at work (napping group complained more). Generally, nurses in group B (napping) suffered less frequently from insufficient amount of sleep.

Conclusions: Beneficial effect of possibility to lie down during night duty (napping) was apparent in the Polish nurses and much less pronounced in remaining group. It is difficult to explain this phenomenon. Future analyses will address among others: napping as a positive factor, and napping as an effect of negative health and social influences. The more detailed information on the use of time spent in supine position (was it really napping?) is necessary.

Keywords: napping at work.work ability.subjective health.shift and night work.nurses

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Problems of Shiftworkers in health centres of India: Causes and Prevention

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Shiftwork and shifts with extended hours refer to any non-standard work schedule. The traditional eight-hour day worked between 7 AM and 6 PM has changed dramatically and many people now regularly work evening and night shifts and/or extended hours. Studies show that shiftwork and shifts with extended hours can have significant adverse effects on health, workplace accident rates, absenteeism and a worker's personal life. The shift system is often used in organisations that need to operate 24 hours a day, such as hospitals, police stations or airlines. Shift work is also done when machinery needs to operate continuously and in the retail sector where extended shopping hours are fast becoming commonplace.

Different shift systems may cause different social and health problems, while under a given shift system, some workers may have problems whereas others have none. There is no single optimum solution. The first step should always be to ask 'Can the amount of shift work or night work per person be reduced, e.g. by shorter working weeks, years, or working life, or, alternatively, by shift systems including more day work.

Night work disturbs the circadian rhythm in the human body. This is an internal body clock that is synchronised to a 24 hour period. It regulates a number of physiological functions such as body temperature, hormone secretion, heart rate, blood pressure, respiration, digestion and mental alertness. It lets us know, among other things, when to sleep and when to eat. Shiftworkers can have health problems because this internal clock is disturbed.

Shift workers and extended hour workers suffer from sleep disturbances and the physiological consequences that result from it. The social effects extend to their family and friends. Researchers have found several negative health effects in shift workers and workers on extended hours. Some of these are: increased heart disease, gastric ulcers and gastro intestinal problems, social problems and minor psychiatric disorders, sleep disorders and increased fatigue, increased error rates and accident rates. Some personal factors can make workers more susceptible to problems when doing shiftwork or extended hours. These include: a heavy domestic work load, psychiatric illness, a history of alcohol or drug abuse, epilepsy, diabetes, heart disease.

Partial sleep deprivation is the main problem that affects the health of shift workers. Shift work sleep disorder is a circadian rhythm sleep disorder which affects people who change their work or sleep schedules frequently or work long term on other than the day shift. The list of signs and symptoms mentioned in various sources for Shift work sleep disorder includes the symptoms.

A variety of strategies can be used by the health centers and the shift worker to prevent or reduce the problems caused by shift work. Measures for shift workers include ergonomic shift system design, shift worker participation, working conditions, alertness and wellness management, education of managers and shift workers, health care management, commuting, sleep at home, personal health related behaviour and resources, family and social support.

Keywords: shiftworkers, shiftwork, sleep disorders, strategies, preventive measures

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The role of experience in night work: Lessons learned from two ergonomic studies

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Aim: In many countries, expanded use of night work has coincided with demographic changes in the labour force. As a result, more and more employees are working the night shift until a fairly advanced age, while at the same time large numbers of young people are joining the workforce, so that two generations of employees, of different ages and different levels of experience, are now working together at night. This raises the issue of whether and how night shift workers develop and exhibit specific experience. This paper presents the findings of two studies carried out, respectively, in a steel mill and a hospital unit.

Methods: The two studies are based on a detailed analysis of the work performed by between 10 and 15 employees in each case. In the steel mill, observations focused primarily on movements around the shop floor, anticipation of tasks to come, communication among colleagues, comparisons between workers of different ages and comparisons between morning, afternoon and night shifts. In the hospital unit, our attention was focused on the way in which nurses achieve trade-offs between different and sometimes conflicting work objectives, which have specific features during the night shift: care compliance, rest and tranquility for patients and prevention of fatigue in nurses. In both cases, interviews were conducted to obtain the workers' views of their own working strategies.

Results: In both cases, workers have "night shift strategies" forged by experience. The steelworkers take action to anticipate emergency situations (defects in steel coil) and avoid them or at least prepare for them, because they have learned to their detriment that it is particularly difficult and tiring to take emergency action at night. Regarding nurses, observations reveal that they are increasingly able, as they gain night shift experience, to identify the action to be taken in order to reconcile diverging work objectives, for example by grouping care at certain times or by identifying essential information to be received and transmitted when communicating with day shift teams.

Conclusions: These observations highlight the advantage of understanding the diversity of working methods as a function of work shift and experience. This range of different methods must be taken into account in order to guide the design of plant and equipment and to foster a learning process enabling workers to better cope with the specific demands of night work.

Keywords: shiftwork, nightwork, experience

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Principal component structuring of inter-individual variation in waking EEG spectra provides a possibility to quantify sleep debt and sleep pressure

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Aim: The shift and night work regimen and nighttime activity become more and more common in modern 24-hour society. Research in the fields of sleep physiology and chronophysiology can offer the tools for quantitative differentiation of people on such advantageous traits as little need for sleep, resistance to sleepiness associated with sleep loss, and rapid adaptation to the alternations of the work-rest schedule. The aim of the present study was to assess, inter-individually, the relationships between the responses of sleep-wake regulation to sleep loss and the principal component structure of waking EEG.

Methods: Resting EEG was recorded 9 times at 3-hour intervals from frontal and occipital derivations with eyes closed and eyes open in the course of sustained wakefulness of 130 healthy subjects. Subjects also reported their levels of sleepiness, energy and mood at each EEG recording session, sleep history for a week preceded to the experiment, chronotype (scored on the morning and evening lateness scales), somnotype (scored on the anytime and nighttime sleepability scales), and trototype (scored on the anytime and daytime wakeability scales of the 72-item Sleep-Wake Pattern Assessment Questionnaire). The conventional spectral analysis was performed for the artifact-free 2-s epochs of EEG records using the Fast Fourier Transform. The ipsatized values of power density were calculated from the log-transformed absolute powers averaged across 10 frequency ranges (from slow delta to slow gamma). These sets of 10 values were further reduced by performing the principal component analysis that yielded the subjects' scores on the largest principal components (PCs).

Results: It was found that any EEG spectrum can be represented by only three scores on the PCs with eigenvalues greater or app. equal to 1. The PCs remained virtually invariant in terms of the order of their extraction and loading patterns. These patterns signify EEG amplifying (1st), EEG slowing (2nd), and EEG smoothing (3rd). In the course of wakefulness, the 1st PC score showed a link with sleep debt (i.e., with the self-reported sleep restriction in the morning preceding the experiment and with the corresponding traits of morning and evening lateness), while the 2nd PC score was associated with sleep pressure (i.e., with the perception of increased sleepiness caused by sleep deprivation and with the corresponding traits of anytime and daytime wakeability).

Conclusions: The PC structuring of the inter-individual differences in waking EEG provides a possibility to distinguish between the objective markers of two parameters of sleep-wake regulation, sleep debt and sleep pressure. EEG amplifying (1st PC score) permits the discrimination between people carrying high and low sleep debt, and EEG slowing (2nd PC score) can serve as an objective index of the subject's vulnerability/resistance to sleep loss.

Keywords: shift work; sleep deprivation; sleep-wake regulation; chronotype; trototype

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Working hours and biomarkers of inflammation

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Aim: Irregular working hours are associated with an increased risk of cardiovascular diseases, but the possible role of inflammation in this relationship is not well-known. We tested the hypothesis that irregular working hours would be associated with higher levels of C-reactive protein (CRP) and increased leukocyte count.

Methods: We studied the cross-sectional associations between work arrangements and low-grade inflammation in a sample of 1853 airline company employees (950 men and 907 women). The participants were classified into 5 categories according to the work schedule; day workers, former shift workers, 2 -shift workers, 3-shift workers, and in-flight workers.

Results: In the sex- and age-adjusted analyses CRP levels ($p = 0.042$) and leukocyte count ($p < 0.001$) differed between the working time groups. Compared to day workers, the 2-shift workers ($p = 0.012$) and 3-shift workers ($p = 0.026$) had higher CRP levels. Similar differences were found for leukocyte count between the day workers and the 2-shift workers ($p = 0.008$) and three-shift workers ($p = 0.037$), while the leukocyte count was lower among in-flight workers than among day workers. Additional adjustments for recent infectious diseases, smoking, education, alcohol consumption, physical activity, and obesity did not significantly influence the results.

Conclusions: Our results suggest that 2- and 3-shift work may be associated with increased systemic inflammation and the relationship appears to be largely independent on a set of established risk factors of cardiovascular disease.

Keywords: shift work, inflammation, epidemiology, CRP, leukocyte

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Pharmacological interventions for shiftwork: melatonin and its agonists

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Shiftworkers often experience sleep-wake disruption due to misalignment of the circadian system from the sleep-wake pattern that is dictated by the particular work schedule. Optimal treatments for sleepiness and/or insomnia in shiftworkers would improve alertness and/or sleep, and facilitate circadian readjustment where appropriate. We have conducted studies of the effects of exogenous melatonin and a melatonin agonist, tasimelteon, on sleep and circadian rhythms in protocols in which the light-dark and sleep-wake cycles were abruptly shifted. In the melatonin study (n=8), participants received either melatonin (1.5 mg) or placebo in a repeated measures design. The tasimelteon studies (study 1 n=39, study 2 n=412) used randomised, double-blind, placebo-controlled, parallel-group designs, with efficacy assessed by polysomnography. Healthy participants received tasimelteon (10, 20, 50, or 100 mg in study 1, and 20, 50, or 100 mg in study 2) or placebo. The findings demonstrate that melatonin and melatonin agonists are an effective line of treatment for improving sleep and promoting circadian readjustment following a phase advance shift of the light-dark cycle. We suggest that melatonin and its agonists may facilitate sleep during the early evening by effectively 'silencing' and shifting the wake maintenance zone. These compounds may be used to alleviate sleep complaints in individuals who need to wake early because of early work start times. In May 2004, according to the US Bureau of Labor Statistics, "early risers" (i.e., those who start work between 2.30 AM and 7.00 AM) represented 19.7% of the US work force.

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Genetic polymorphism of circadian genes in nurses - pilot study

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Background: Night shift work, which affects circadian rhythm has been indicated as a risk factor of breast cancer. A hypothesis of circadian disruption is based on observed alterations in melatonin production and action by exposure to light at night. Genetic polymorphism in circadian genes may have a significant influence of light-modulated carcinogenesis. The circadian clock is controlled by several genes, including Bmal1, Clock, Period (Per) and Cryptochrome (Cry). In humans, polymorphisms in clock genes have been implicated in sleep disorders, morning/evening preferences, mental health and probably shift work tolerance. The aim of this analysis, which is part of an ongoing cross-sectional epidemiological study in nurses, is to determine frequency of genetic polymorphism of selected clock genes by shift-work pattern.

Methods: The cross-sectional study of 350 nurses currently working night-shifts and 350 who work only during the day, is being carried out in Lodz, Poland. The pilot study included 47 nurses (27 day, and 20 night-shift). Genetic polymorphism of specific circadian genes was analysed in genomic DNA isolated from whole blood using RFLP (restriction fragment length polymorphism)-PCR and/or RT (real time)-PCR methods. Primers for target genes and TaqMan probes were designed with Beacon Designer 7.0 according to GenBank genetic sequence database. We selected single nucleotide polymorphisms (SNPs) in coding regions: hBmal1 (rs2279287), hClock (rs1801260), hPer1 (rs2735611), hPer2 (rs2304672), hPer3 (rs10462020), hCry1 (rs8192440), hCry2 (rs10838527). None of these SNPs have previously been investigated with regard to shift-work pattern. In the first course of the project we designed RFLP-PCR methods for hBmal1, Clock, hPer3 and hCry1 genotyping.

Results: In the group of day-shift nurses, 37% of women with wild-type Bmal GG genotype was found, while in the group of night-shift nurses, we found this genotype in 55% of the women. The frequency of variant Clock CC genotype was highest in night-shift nurses (10% vs 3,7 % in day-shift nurses). Variant Per3 GG genotype was observed only in day-shift nurses (11,1%). Wild-type Per3 TT was found in 59,3% of day-shift nurses and 80% of night-shift nurses. Cry1 CT heterozygotes were more frequent in night-shift (50%), than in day-shift nurses (33,3%).

Conclusions: Based on the literature review and Entrez SNP database we selected several clock SNPs in coding regions that might have functional significance. Investigating these clock polymorphisms, together with melatonin status in night- and day-shift women offers a unique opportunity to study mechanisms involved in circadian rhythm and to identify susceptible populations/individuals. Based on the observed differences in the distribution of the genotypes selected in this pilot study, clock SNPs analysis merit further investigation in a larger population. Acknowledgments: This project is supported from Polish-Norwegian Research Fund grant.

Keywords: shift work, circadian genes, genetic polymorphism

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The use of in-flight napping as a fatigue counter-measure by long-haul aviation pilots

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Aim: Previous research indicates that aviation pilots are likely to experience elevated levels of fatigue during long-haul flights. To provide pilots with an opportunity to sleep, long-haul aircraft are equipped with in-flight rest facilities and long-haul flights are crewed with one or two extra pilots. The aim of this study was to identify duty periods in which long-haul pilots were likely to experience elevated levels of fatigue and to examine the amount of in-flight sleep that they obtained during those duty periods.

Methods: Participants were 310 long-haul aviation pilots operating B744 or B747 aircraft for a major international airline. Pilots collected sleep/wake and work/rest data for at least 2 weeks while they worked their normal duty schedules. Data were collected using self-report diaries and a wrist-worn activity monitor. Three sleep/wake variables were calculated for all duty periods greater than 8h: the amount of sleep obtained in the 24h prior to the commencement of duty; the amount of sleep obtained in the 48h prior to the commencement of duty; and the duration of wakefulness between wake up and the end of duty. 'High-fatigue' duty periods were defined as those for which: (i) sleep in the prior 24h < 5h, or (ii) sleep in the prior 48h < 12h, or (iii) duration of wakefulness > sleep in the prior 48h. All other duty periods were defined as 'low-fatigue'. The amount of in-flight sleep obtained during high-fatigue and low-fatigue duty periods was compared using ANCOVA, controlling for the effects of duty duration.

Results: In a total of 1,649 duty periods, 77% were classified as high-fatigue and 23% were classified as low-fatigue. Pilots obtained sleep during 92% of high-fatigue duty periods and 76% of low-fatigue duty periods. Pilots obtained significantly more sleep [$F(1,1645)=20.6, p<.0001$] during high-fatigue duty periods (2.3h) than during low-fatigue duty periods (1.5h).

Conclusions: Consistent with previous research, these data indicate that long-haul pilots are likely to experience elevated levels of fatigue. Furthermore, the data indicate that pilots obtain more sleep during duty periods when their fatigue levels are likely to be elevated. The results of this study demonstrate that long-haul pilots use in-flight napping as a fatigue counter-measure.

Acknowledgements: This study was financially supported by the Australian Research Council.

Keywords: aviation, pilots, duty, sleep, wake, fatigue

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Is performance on the psychomotor vigilance task for a personal digital assistant affected by feedback or inter-stimulus interval?

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Aim: The 5-minute psychomotor vigilance task for a personal digital assistant (PDA-PVT) has been validated as a measure of neurobehavioural function for use in studies assessing the impact of fatigue. The PDA-PVT can be set up to either provide immediate feedback after each stimulus presentation or not, and to have a short or long inter-stimulus interval. There is some evidence to suggest that the provision of feedback may enhance performance on neurobehavioural tasks, but the relationship between feedback and inter-stimulus interval has not previously been examined. Consequently, the aim of this study was to determine the effects of feedback and inter-stimulus interval on PDA-PVT performance.

Methods: Fifteen participants (8 female, 7 male; age range = 18-27 years) slept in the laboratory overnight then remained awake for 28 hours from 0800h. Participants completed a test battery every two hours (i.e. 14 in total). The test battery included four versions of the 5-minute PDA-PVT, presented in random order. The four versions differed in terms of whether or not they provided feedback, and in the range of the inter-stimulus interval (ISI):

Version A - feedback = yes, ISI = 2-10 seconds

Version B - feedback = no, ISI = 2-10 seconds

Version C - feedback = yes, ISI = 1-5 seconds

Version D - feedback = no, ISI = 1-5 seconds

Results: Performance on the PDA-PVT was assessed using reciprocal reaction time and percentage of lapses. Data were analysed using repeated measures ANOVA with three within-subjects factors: feedback (yes, no), inter-stimulus interval (2-10 seconds, 1-5 seconds), and test session (14 test sessions over 28 hours). For reciprocal reaction time, there was a main effect of test session [$F(13,91)=16.8, p<.0001$], but no main effects of feedback [$F(1,7)=2.8, p=.14$] or inter-stimulus interval [$F(1,7)=0.1, p=.79$]. The only significant interaction was between feedback and inter-stimulus interval [$F(1,7)=6.9, p=.03$]. For percentage of lapses, there was a main effect of test session [$F(13,91)=15.3, p<.0001$], but no main effects of feedback [$F(1,7)=1.8, p=.22$] or inter-stimulus interval [$F(1,7)=0.03, p=.87$]. The only significant interaction was between feedback and inter-stimulus interval [$F(1,7)=8.9, p=.02$].

Conclusions: The significant interactions between feedback and inter-stimulus interval indicate that performance on the PDA-PVT was enhanced more by feedback when the inter-stimulus interval was long (2-10 seconds) than when it was short (1-5 seconds). It is possible that feedback was more effective when the inter-stimulus interval was long because participants had more time to think about their performance and thus had greater motivation to perform well.

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Keywords: sleep deprivation, neurobehavioural function, psychomotor vigilance task, feedback, inter-stimulus interval

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Persistent deleterious effects of night work on sleep

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Aim: Data on persistent effects of night work on sleep are scarce and controversial. The aim of this study is to investigate possible persistent effects of night work on sleep among female nursing personnel.

Methods: A cross-sectional study was carried out with female registered nurses and nurse assistants at three hospitals. Daytime workers (N=680) were classified into two groups: exclusive daytime workers, corresponding to those with no experience on night work (N=281) and former night workers (N=399). Sleep problems were evaluated through five variables: (1) difficulty falling asleep, (2) difficulty maintaining sleep, (3) early morning awakening, (4) insomnia, and (5) unsatisfactory sleep. Questions 1 to 3 were related to a four-week interval, with the following answers: never, rarely, sometimes, almost always, and always. Workers who answered "almost always" or "always" to any of those questions were classified in the respective sleep-problem group. The 4th variable - insomnia complaint - referred to workers who had any of the previously described sleep problem. Non-satisfactory sleep was analyzed through the question "How satisfied are you with your sleep?", derived from the WHOQOL-brief (possible answers: very unsatisfied, unsatisfied, neither satisfied nor unsatisfied, satisfied, and very satisfied). Workers were classified in the non-satisfactory sleep group if they reported to be "unsatisfied" or "very unsatisfied" with their sleep. Binomial logistic regression was used to evaluate the association between the night work experience and referred sleep problems (exclusive daytime work as the reference group).

Results: Significant associations were observed between the experience on night work and three out of the five studied sleep problems. Adjusted odds-ratio (and CI95%) for difficulty maintaining sleep, insomnia, and unsatisfactory sleep were 1.71 (1.05-2.79), 1.51 (1.01-2.25) and 1.59 (1.07-2.35), respectively, after controlling for potential confounders (age, schooling degree, income, presence of children, marital status, professional and domestic worked hours/week, professional category, type of contractual employment, hypertension, body mass index, alcohol consumption, and smoking habits).

Conclusions: Results suggest residual consequences of night work on some of the studied sleep problems. Complementary information on the time of exposure to night work will help clarifying these consequences, thus subsidizing the discussion on the adoption of legislative actions to limit exposure to night work.

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Keywords: night work, sleep, nurses

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Interventions for sleepiness and sleep disturbances caused by shift work: A Cochrane systematic review protocol

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Aim: To present the protocol for a Cochrane systematic literature review in which we want to synthesize all relevant and sufficient quality evidence about interventions to decrease sleepiness and sleep disturbances caused by shift work.

Methods: The making of a Cochrane systematic review entails three steps: title registration with a Cochrane Collaboration Review Group (CRG), peer-review and acceptance of the protocol by the CRG and peer-review and acceptance of the review written according to the protocol by the CRG. To develop the protocol we used the following methods that are prescribed by the Cochrane Handbook. The research question has to be defined according to PICO: population (P), intervention (I), comparison (C) and outcome (O). Clear inclusion and exclusion criteria have to be defined based on the research question and study designs to be included. These are then translated into a systematic literature search strategy. The assessment of study quality assessment has to be clear. Finally, methods for pooling the results need to be specified.

Results: For this review: P = workers who are subjected to non-standard/ changing working hours for extended periods, I = work- and person-directed interventions (e.g. shift schedules, napping, stimulants, bright light exposure) C = preferably a randomised no-treatment control group and O = validated measures of sleep length and quality, fatigue and vigilance. We defined sleepiness as either self-rated (subjective), physiological (EEG-based) or behavioural sleepiness (performance in a vigilance test). We chose to include all controlled clinical trials and interrupted time-series studies aimed at preventing or reducing sleepiness or sleep disturbances caused by being subjected to non-standard/ changing working hours for extended periods of time. We chose to search for studies from electronic reference databases, conference proceedings and topic experts. We chose to assess studies in terms of their risk of bias (degree of: randomisation, allocation concealment, blinding and attrition). High quality study results are then combined in a meta-analysis. If no sufficiently homogenous high quality studies are available, studies will be categorised into worker- and organisation-directed interventions and summarized narratively.

Conclusions: The protocol will result in a review of the evidence on work- and person-directed measures to alleviate sleepiness and sleep disturbances caused by shift work.

Keywords: systematic review, intervention studies, sleepiness, Shift work

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Individual coping in different shift systems by appropriate timing of sleep and naps

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An optimal sleep-wake rhythm is a key factor in coping with different shift systems. The optimal sleep-wake pattern can vary to a great extent depending on the characteristics of shift schedules and individual factors and preferences. Recent field studies have replicated the finding of previous laboratory studies that napping during a night shift is an effective sleepiness countermeasure and, for example, the Royal College of Physicians of London has recommended the practice for medical staff. Also in extended operations leading to the accumulation of sleep pressure already a 10 min afternoon nap may yield relatively long-lasting beneficial effects without indications of post-nap sleep inertia. Another common recommendation is that a worker should take a prophylactic nap prior to a night shift. However, research evidence of the benefits of prophylactic napping is less clear than that of napping during a night shift. With very irregular shift schedules, which are prevalent, for example, in the transportation sector, the rule of thumb is to sleep as much as possible. To facilitate the realisation of this instruction more attention should be given to the sleeping conditions during the transport operations.

In permanent night work, the optimal sleep-wake pattern could be to maintain a reversed sleep-wake pattern also on days off, but this is often an impractical solution for social and other reasons. A recent study suggests that so called a compromise circadian phase position could be a more practical solution to the problem of inadequate sleep during daytime between consecutive night shifts. In this intervention, the sleepest circadian time is only partially delayed by short duration bright light exposure during night shifts, use of dark sunglasses when outside, and a "light brake" during afternoons.

In the real world, the realisation of an optimal sleep-wake rhythm in a given shift schedule is not only dependent on nap opportunities or sleeping conditions, but also on individuals' choices. There is some evidence suggesting that improved sleep opportunities also result in an increased amount of sleep in shift workers. A number of retrospective questionnaire studies conclude that shift workers should receive education on the importance of sleep and optimal sleep-wake patterns. However, prospective intervention studies on the effectiveness of this type of education are largely lacking. In the future, research on means through which knowledge of optimal sleep-wake patterns in shift work can be transformed into the actual sleep/wake behaviour of shift workers is needed.

Keywords: optimal sleep-wake pattern, irregular working hours, individual coping mechanisms.

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Lost in transit: Measuring core body temperature using ingestible temperature capsules

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Aim: Ingestible temperature capsules have the potential to be used as an alternative to oesophageal/rectal thermistors for monitoring core body temperature (CBT). One difficulty when using this technology to monitor CBT over multiple study days is identifying when to administer a new capsule. It is recommended that a new capsule should be ingested at the same time each day. However, the efficacy and cost-effectiveness of this approach depends on the time it takes for a capsule to pass through the gastrointestinal tract (i.e. transit time). If a new capsule is ingested at the same time each day, transit times that are greater than 24h will result in data loss. Conversely, transit times that are less than 24h will result in redundant capsules. The aim of this study was to measure capsule transit time in a forced desynchrony protocol.

Methods: Eleven male participants (22.0 ± 2.8 yr) lived in a time isolation laboratory for 12 consecutive days on an imposed 28h forced desynchrony schedule with a sleep:wake ratio of 1:2. All meal and snack opportunities occurred at fixed times during wake. CBT was recorded continuously using an ingestible capsule that transmitted a temperature signal telemetrically to an external receiver. At 2.5h intervals during wake, and following all bowel movements, the status of the temperature signal was checked via the external receiver. Subsequent capsules were only administered upon loss of the current temperature signal.

Results: CBT data for each participant were analysed in 1-min epochs. For the group, mean transit time was 30.6 ± 11.1 h (SD). For individuals, mean transit time ranged from 16.8h to 51.9h; the shortest transit time ranged from 4.4h to 34.8h; and the longest transit time ranged from 25.5h to 82.8h. Of the 85 capsules administered to the group in total, two capsules failed prior to ingestion and one capsule failed 34 min after being ingested.

Conclusions: While the mean capsule transit time in the present study was ~30h, a wide range of transit times was observed. Based on this variability, administering a new capsule at the same time each day is not a suitable approach when using this system to monitor CBT over multiple days. For some individuals (e.g. mean transit time of 16.8h), this approach would result in considerable data loss; while for others (e.g. mean transit time of 51.9h), this approach would increase the number of redundant capsules. When using ingestible capsules to monitor CBT, we recommend checking the temperature signal at regular intervals during the study period and administration of a new capsule upon loss of the signal. This approach will maximise the value of the temperature capsules and minimise data loss.

Acknowledgements: This study was financially supported by the Australian Research Council.

Keywords: transit time, gastrointestinal tract, forced desynchrony

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The influence of circadian phase and prior wake on neuromuscular function

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Aim: Previous forced desynchrony studies have shown that neurobehavioural function is affected by circadian phase and the duration of prior wakefulness. There is some evidence that neuromuscular function may also vary with circadian phase and prior wake, but these effects have not been systematically investigated. The aim of this study was to examine the effects of circadian phase and prior wake on neuromuscular function using a 28h forced desynchrony protocol.

Methods: Eleven male participants (22.7 ± 2.5 yr) lived in a sound attenuated, light and temperature controlled time isolation laboratory for 12 days. Following three 24h baseline days, participants were scheduled to seven 28h forced desynchrony days. During forced desynchrony, the ratio between sleep opportunity and wake periods was kept constant (i.e. 9.3h sleep and 18.7h wake). Neuromuscular function was assessed using two measures: maximal grip strength and balance. Maximal grip strength of the dominant hand was measured using a dynamometer. Balance (i.e. changes in centre of pressure) was measured during one minute of quiet standing on a force platform. These two measures were obtained every 2.5h during wake. Core body temperature was continuously recorded with rectal thermistors and was used to determine circadian phase.

Results: For both measures of neuromuscular function, individual data points were assigned a circadian phase and a level of prior wake. Data were analysed using a repeated measures ANOVA with two within-subjects factors: circadian phase (6 phases) and prior wake (7 levels). For maximal grip strength, there was a main effect of circadian phase [$F(5,50)=6.3$, $p<.01$], but no main effect of prior wake [$F(6,60)=2.1$, $p=.14$]. For balance, there were no main effects of circadian phase [$F(5,50)=1.7$, $p=.21$] or prior wake [$F(6,60)=1.7$, $p=.18$]. There were no interactions between circadian phase and prior wake for maximal grip strength or balance.

Conclusions: Previous studies examining neuromuscular function have confounded the effects of circadian phase and prior wake. In the present study, we were able to separate the effects of these two factors by employing a forced desynchrony protocol. We found that maximal grip strength varied with circadian phase but was not influenced by prior wake. In contrast, balance was not influenced by circadian phase or prior wake. These results show that the effect of prior wake on maximal grip strength and balance is minimal when the ratio between sleep and wake is maintained at 1:2. In future forced desynchrony studies, we will reduce this ratio (e.g. 1:3) and examine the effect of sleep loss on neuromuscular function across the whole circadian cycle.

Acknowledgements: This study was financially supported by the Australian Research Council.

Keywords: forced desynchrony, maximal grip strength, balance, core body temperature

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Break optimization in shifts

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Aims: Breaks are important to help employees recover. In particular service industries (e.g., call-centre, flight controllers), a fixed set of mandatory breaks must be scheduled within each shift. Scheduling of these breaks to avoid understaffing and to keep costs low is complex. Con-currently, scheduling breaks has to consider planning constraints, (e.g., minimum distance to start and end of shift; maximum distance between breaks; minimum and maximum length of normal breaks and lunch breaks). When workforce requirements change, often within the course of the day, shifts or staffing levels and mandatory breaks must also be changed.

The objective of this project was to develop software tools that support the proper scheduling of breaks. In addition, short-term/within-day scheduling should be supported. Correspondingly the software should be able to quickly solve complex problems (within a few minutes at most).

The constraints to be considered vary strongly from company to company. This provided an additional challenge from a technical point of view. Despite this, the software should support the formulation and adaptation of all such constraints.

Methods and results - Step I: In a first attempt we tried to formulate the constraints and optimisation rules with 'normal' programming (Visual Basic, C++). This turned out to be extremely cumbersome. We also tried standard optimisation techniques. While formulation of problems with these techniques was easy, performance was bad.

Methods and results - Step II: Based on the requirements of two companies with differing constraints, the first working software solution was developed. Several optimization approaches were tested. These solutions were extensions to the existing Shift-Design Software [OPA]-Operating Hours Assistant. Finally, we applied artificial intelligence techniques to search for optimal break schedules and used the programming language and platform COMET for modelling constraints. The results were very good from a computational point of view. However, the formulation of rules was still very difficult and required substantial programming skills.

Methods and results - Step III: We developed a simplified language that eases the formulation of constraints for breaks (and shifts) and requires only basic programming skills. This reduced the time needed to specify and test the constraints for one company from several weeks to a few days.

Conclusions: In addition to optimizing shifts and staffing levels with these newly developed software tools, it is now possible for shift planners to formulate and test company specific constraints on scheduled breaks and run optimisations in reasonable time.

Keywords: Shift design, Shift scheduling, Break optimization

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Design and implementation of an internet based tool for the design and evaluation of shift systems

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Aim: There is a lot of research based ergonomics evidence for the design of shift systems. However, the implementation of that knowledge in the design of shift schedules on the shop floor is rare. Therefore a project has been started to develop and implement a tool supporting the actors on the shop floor as well as the social partners in the ergonomic design of shift schedules in the production sector. This includes a summary of the state of the art for different aspects (e.g. continuous shift work, discontinuous shift work, shift schedules for special groups, flexible working hours, etc.), a data bank with best practice solutions as well as a special tool for an internet based evaluation of shift schedules, where companies or even individuals can online evaluate their shift schedules against ergonomics criteria and special risks associated with the schedules.

Method: Based on reviews of the literature and interviews with those concerned relevant content has been implemented on a given platform using a browser interface and various elements of web design, after checking for readability and understandability of the content. There will be direct links to relevant legal regulations, scientific and praxeological publications and brochures.

Risk assessment has been modeled (to be reported elsewhere) and implemented after testing the models on available data bases. The platform will finally be tested for usability for the intended user group.

Results: At the time of the conference the system will be available on the internet (in German). The poster will show the structure and the main features of the tool. An online demonstration of selected features is intended.

Conclusions: The tool is intended to transfer ergonomics knowledge to the shop floor and to support those concerned there with the design of shift schedules. Available results and comments from the formative evaluation indicate that this seems possible.

Keywords: Shift system design, evaluation, risk assessment, computer based tools

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Correlation between Night Shift Work and Components of Health and Sleep in Employees of the Hotel Sector and the Bakery Trade

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Aim: Within the hotel sector and the bakery trade, shift work in various forms exists. Those types of shifts which contain a high proportion of night shift work may have a negative impact on the employees' health and sleep patterns. The working conditions of specific occupational groups as well as the correlations between shift workers with a varying degree of night shift work (night shift work index) and components of health and sleep patterns (bivariate, sector, age, sex) were investigated.

Methods: Based on a night shift work index, 122 employees from the hotel sector and 65 employees from the bakery trade were allocated to three shift work groups (G) (determined with a 4-week working time record): G1 (20%): regular shift, no night shift work (0h), G2 (40%): rotating shift, >0-2h night shift work, G3 (40%): night shift, >2-7h night shift work; mean age (years): G1: 33, G2: 32; G3: 38; mean years of shift work: G2: 10; G3: 16; proportion of women: G1: 78%; G2: 65%, 33%; proportion of employees from the bakery trade: G1: 5%, G2: 12%, G3: 78%. Based on a shift-work related occupational anamnesis, working conditions and sleep patterns were determined. Cardiovascular risk factors (blood pressure, lipometabolism, sport, smoking) and medical conditions served as health components.

Results: Whereas employees from the hotel sector do on average of 1.1h night work on a working day, employees from the bakery trade do 2.8h night work. However, night work within the hotel sector takes place predominantly in the late evening, while it takes place at night or in the early morning within the bakery trade. The cardiovascular risk slightly increases with the proportion of night shift work. As far as medical conditions within the shift work groups are concerned, there are no differences noticeable. In both industrial sectors 34% report no sleep disturbances, 59% report occasional sleep disturbances and 7% frequent sleep disturbances. There are only insignificant correlations between night shift work index and cardiovascular risk factors ($r = -.16$ to $.21$), medical conditions ($r = -.11$ to $.13$) and sleep patterns ($r = -.09$ to $.02$); with and without elimination of sex, industrial sector and age.

Conclusions: Compared with regular shift work, a high proportion of night shift work within the hotel sector and the bakery trade seems to have rather insignificant implications on the health and sleep patterns of employees. Social and geographical components might generate more information and facts about these aspects.

Keywords: shift work, hotel sector, bakery trade, health, sleep

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Effects of shift work on the health in employees of the catering trade

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Aim: In the scientific literature contradictory details on the effects of shift work on the health are reported. Not all regulations of working hours which require work at unusual times, have an adverse health effect. Therefore, it was studied in employees of the catering trade whether her health is impaired by shift-work.

Methods: Based on three shift systems in the context of working time, the state of health in 110 employees from the catering trade (37 men; 73 women) was compared. From these employees 29 worked in regular shift system, 25 in a permanent shift system (44% of them with high proportion of night-work) and 56 in a rotational two-shift system (7% with high proportion of night-work). Based on a shift-work related occupational anamnesis, working conditions and sleep patterns were determined. As health components cardiovascular risk factors (e.g. Procarn-Score, blood pressure, body mass index, waist hip ratio, parameters of lipo-metabolism, physical fitness, smoking), shift specific illnesses and medical symptoms as well as sleep disturbances were examined. The three shift systems groups (SSG) did not differ in age distribution (mean age: 33±10 years; p=.374) or marital status. On average, the employees were working all in all for 14±10 years (p=.812), but in the present working time regime they worked for 5 years (p=.812) in the mean.

Results: The employees dispose on average more than 6.4 ± 0.9 hours leisure time (less commuting to and from work, p=.532) and 8.0 ± 0.9 hours (p=.107) sleep on average per working day. The three SSG do not differ significant regarding to the health-related and sleep-related components: cardiovascular risk factors (e.g. hypertension: 9%; risk values for cholesterol: 35%; LDL: 7%; HDL: 12%; triglyceride: 12 %; physical inactivity: 62%; smoking: 51%; p=.120-.817), diseases (e.g. gastro-intestinal diseases: 4%; digestive trouble: 6%) and medical symptoms (e.g. frequent headache: 12%; frequent back troubles: 33%). More than half of the employees (58%) report no sleep disturbance, 35% occasional and 7% frequent sleeplessness (p=.335) regarding to all three SSG. There are only insignificant correlations between the SSG and healthy factors (R=-.14 to .21) and sleep patterns (R=-.09), respectively.

Conclusion: Compared with regular shift work, for the examined shift systems in the catering trade no health impairing consequences were established. The state of health and the sleep behaviour of the employees are not different between the SSG. The known negative effects of the shift work are probably relevant at higher share of night-work only. Moreover, shift-workers are informed about a healthy way of life well so that differences can be disguised in the comparison of SSG. The meaning of other professional and private influence factors remains unsolved. Nevertheless the medical results underline the need for prevention.

Keywords: shift work, health, catering trade

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Working and living conditions associated with quality of life of nursing professionals

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Health-related quality of life (HRQL) indicates the impact of health on a variety of life contexts. The psychosocial work environment influences the quality of life of nursing professionals and differences among job titles may lead to distinct perceptions of working conditions and health status.

Aim: To evaluate working and living conditions associated with physical functioning and mental health dimensions of health-related quality of life (HRQL) among nursing professionals.

Methods: Six hundred ninety six nursing professionals, registered nurses and nurse assistants, predominantly females (87.8%), working day or night shifts, participated in a study carried out in an University hospital of São Paulo, Brazil. Data collection took place during 2004-2005 and included a comprehensive questionnaire including sociodemographic characteristics, life styles, working and living conditions, and health outcomes. HRQL was evaluated using the short form questionnaire of quality of life (SF-36). Working conditions included the job stress scale, effort-reward imbalance (ERI), and other environmental and occupational stressors. Ordinal logistic regression of proportional ratios was used to evaluate each of SF-36 dimensions.

Results: Imbalance of the effort-reward ratio and high work strain were mentioned by 7.8% and 22.1% of the participants, respectively. The mental health dimension showed worse perceived scores compared with physical functioning. No significant differences were observed comparing job titles. The associated factors of negative outcomes associated with physical functioning were: age (the younger workers), family income (the sole-breadwinner) and high commitment at work. Regarding negative mental health dimensions, associated factors were: 1 or 2 night jobs, low social support, high commitment at work, passive work, and unfavorable effort and reward ratio.

Conclusions: All associated factors with mental health dimension of HRQL are related to negative aspects of the work organization. This was not observed with physical functioning. Overcommitment at work and effort-reward index (ERI 1.01 or more) was significantly associated and more relevant than passive work with negative outcomes of mental health dimension. In spite of it, these results showed the importance to jointly evaluate ERI and demand-control models to discuss professional roles, working conditions and HRQL of nursing professionals.

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Keywords: Health-related quality of life, psychosocial factors, work organization, nursing professionals.

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Recovery from work among nurses: is there an interaction between sleep/rest on the night-shift and domestic work?

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Introduction: Napping programs at workplaces are a reality in some industries particularly in Japan. In Brazil, several hospitals allow nurses to sleep during the nightshift, but this is rarely analyzed from the workers' health and well-being perspective.

Aim: To test the association between sleep/rest pattern during working nights and the need for recovery from work among female nurses, considering the role of domestic work as a mediator in this association.

Methods: A cross-sectional study was carried out at three Brazilian hospitals which are known to allow nurse teams to sleep for up to three hours during the night-shifts. The study encompassed 619 night workers. Workers who reported insomnia (n=152) were excluded from analysis. Considering differences within the sample as to sleep or rest pattern, the studied workers were classified into four groups: those do not sleep, nor rest during the night-shift, those who just rest on the night-shift, those who sleep for up to 2hr, and those who sleep for more than 2 hr (reference group). Workers were classified into two groups according to the values for the Need for Recovery From Work Scale (cut-point at the 4th quartile). The estimate of hours spent on housework was based on a recordatory of the hours dedicated to housework on the last week. Domestic work hours were dichotomized as follows: short domestic work hours (up to 10 hours/week) and long domestic work hours (more than 10 hours/week). Stratified analyses were carried out for workers with short and long domestic work hours. Binomial logistic regression was used to evaluate the association between the sleep/rest pattern and the need for recovery from work.

Results: Among the studied group, 3.2% do not sleep, nor rest on the job; 34.9% just rest on the job; 20.4% sleep for up to 2 hr and 41.5% sleep for more than 2 hr. Among nurses with short domestic work hours, those who just rest during the night shift were more likely to report a higher need for recovery from work, as compared to those who sleep for more than 2 hr. Adjusted odds-ratio and CI95% were 2.30 (1.01-5.22). All other associations were not statistically significant.

Discussion: Sleeping during the night-shift - regardless of sleep duration - may play a beneficial role in coping with night work provided that nurses present short domestic work hours. Recommendations to deal with sleep-deprivation among night workers should consider the complexity of gender roles on workers' recuperation.

Keywords: night work, nurses, sleep, recovery from work

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The IARC Monograph, Vol. 98: Shift-work that involves circadian disruption

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In October, 2007, the International Agency for Research on Cancer (IARC/WHO) convened a Monographs meeting to assess the carcinogenicity of shift-work. Summary findings and evaluations, particularly the Working Group's reasoning in making the final evaluations and critical research gaps will be highlighted.

About 15-20% of the working population in Europe and the USA is engaged in shift-work that involves nightwork, which is most prevalent (above 30%) in the health-care, industrial manufacturing, mining, transport, communication, leisure, and hospitality sectors. Among the many different patterns of shift-work, those including nightwork are the most disruptive for the circadian clock.

Six of eight epidemiological studies from various geographical regions, most notably two independent cohort studies of nurses engaged in shift-work at night have noted a modestly increased risk of breast cancer in long-term employees compared with those who are not engaged in shiftwork at night. These studies are limited by potential confounding and inconsistent definitions of shift-work, with several focused on a single profession. The incidence of breast cancer was also modestly increased in most cohorts of female flight attendants, who also experience circadian disruption by frequently crossing time zones. Limitations of studies in these flight attendants include the potential for detection bias, proxy measures of exposure, and potential uncontrolled confounding by reproductive factors and cosmic radiation.

Several different rodent models have been used to test the effect of disruption of the circadian system, reduced nocturnal melatonin concentrations or removal of the pineal gland on tumour development and most showed increases in the incidence or growth of tumours.

Exposure to light at night disturbs the circadian system with alterations of sleep-activity patterns, suppression of melatonin production, and deregulation of circadian genes involved in cancer-related pathways.

Inactivation of the circadian Period gene, *Per2*, promotes tumour development in mice, and in human breast and endometrial tumours, the expression of *PERIOD* genes is inhibited. In animals, melatonin suppression can lead to changes in the gonadotrophin axis. In humans, sleep deprivation and the ensuing melatonin suppression lead to immunodeficiency.

On the basis of "limited evidence in humans for the carcinogenicity of shift-work that involves nightwork", and "sufficient evidence in experimental animals for the carcinogenicity of light during the daily dark period (biological night)", the Working Group concluded that "shift-work that involves circadian disruption is probably carcinogenic to humans" (Group 2A).

Keywords: shiftwork, cancer, epidemiology, cancer bioassays, mechanisms of carcinogenicity

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Fatigue recovery, daytime sleepiness, and depressive symptoms in a working population: the role of worktime control

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Objectives: A general increase in control at work is shown to protect health. Recent studies in Finland indicate that control specific to work hours, i.e., worktime control, can reduce the unfavourable influences of excessive workload on and off the job (Ala-Mursula et al., 2002, 2004-2006). It is likely that the health benefits gained by worktime control depend upon work schedules and gender. The worktime control is also presumed to promote recovery from fatigue and workers' well-being. We investigated here the association between the worktime control and fatigue recovery, daytime sleepiness, and depressive symptoms in a sample of daytime and shift workers.

Methods: A questionnaire was sent to 5,000 workers (20 to 59 years) who were randomly sampled according to the distribution of gender, age class, and industry of the Labour Force Survey in Japan from a market research panel. Out of 4,669 responders (response rate = 93%), 3,681 permanent day workers and 599 shift workers were selected for the present analysis. Shift schedules included shift work involving night shifts (n=288), without night shifts (n=259), and permanent night shifts (n=52). We measured worktime control ("control over daily working hours" and "control over days off", Ala-Mursula et al., 2005), recovery from fatigue after a night's sleep (0=almost complete, 1=sometimes incomplete, 2=often incomplete, 3=always incomplete), daytime sleepiness (Epworth Sleepiness Scale), depressive symptoms (Center for Epidemiologic Studies Depression Scale), and other relevant variables. Scores for each subscale of worktime control were divided into tertiles to categorize low, moderate, and high levels. The data were analyzed by three-way analysis of variance (factors: worktime control, work schedule [day vs. shift], and gender), followed by the Bonferroni test.

Results: A main effect of both control over daily working hours and days off was significant for all the dependent variables. Any interactions relating to worktime control, however, were not significant. Adjustment for age and employment status did not alter these results. Overall, the scores of the three variables decreased as the worktime control became higher. The significant difference from the low control group was observed compared to the high control group for control over daily working hours. However, it was found even compared to the moderate control group for control over days off.

Conclusions: Elevated worktime control was associated with decreased levels of incomplete recovery from fatigue, daytime sleepiness, and depressive symptoms, possibly independent of work schedule and gender. The present data also suggest that an increase in control over days off rather than over daily working hours may be advantageous for health.

Keywords: worktime control, fatigue, recovery, sleepiness, depression

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Attentional lapses rate comparison between professional train drivers with and without sleep apnea syndrome

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Aim: The purpose of this study was to compare attentional lapses relative rate of professional train drivers with and without sleep apnea syndrome.

Methods: A total amount of 88 professional train drivers working in a brazilian cargo transportation company were evaluated. They are all shiftworkers performing their job activities in a sequential shift work system. A polysomnography examination (PSG) was performed in order to analyse sleep patterns and to determinate the apnea hypopnea index (AHI). The attentional lapses rate analysis in 10 minutes (ALR10) was assessed through tests using the Psychomotor Vigilance Task (PVT). Those tests were performed upon 4 different moments: before and after the Polysomnography (Pre-PSG and Post-PSG) and before and after a work shift (before work - BW and after work - AW). As a reference to the ALR10 analysis, the PVT testing post-PSG moment was elected. Due to the PSG results, volunteers were allocated into 2 distinct groups: those with sleep apnea (AHI > 5) and those without sleep apnea (AHI < 5).

Results: The data revealed that ALR10 was 1.48 at the pre-PSG moment, 1.66 at the BW and 3.15 at the AW. After defining the 2 different groups mentioned above, there was a significant increase in average number of lapses in 10 minutes. The momentarily ALR10 showed no difference at all, however the AHI >5 group happened to raise twice fold the number of volunteers failures in each moment.

Conclusions: Findings suggest a multiplying effect on attentional lapses rate concerning the apnea group in comparison with the other referred group. Therefore, an individual with sleep apnea syndrome is prone to perform six fold the number of attentional lapses then a healthy one (regarding the Post-PSG moment). Facing those results, the conclusion is that Sleep Apnea Syndrome can be an important influential factor when it comes to professional train drivers errors along a work shift.

Keywords: shift work, PVT, polysomnography, AHI

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Associated factors of working time and fatigue among college students

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Aim: Former studies showed negative effects of combining work and study among adolescents. The aim of the present study is to assess factors associated with daily working time and perceived fatigue among College working students.

Methods: This is a cross sectional study carried out in a public College of Sao Paulo, Brazil. All students aged 18 to 26 years old, who worked at least six hours per day, attended evening classes (19:30h to 23:10h) were invited to participate. Two hundred seventy four students voluntarily accepted to participate in this study. They answered a comprehensive questionnaire about living and working conditions (including detailed set of questions on occupational stressors, including work-control Karasek model, and working arrangements) and health symptoms. A Brazilian adapted version of the Yoshitake fatigue scale (Yoshitake, 1975) was included in the survey. Mean age of participants was 22 years old, and did not differ of the whole population. Initially, the data were submitted to descriptive statistics (frequency distribution, means and standard deviation), followed by linear regression analysis. Two linear regression models (stepwise forward selection) were used in order to know the associated factors with daily working time and perceived fatigue. In all analysis it was considered $\alpha=5\%$.

Results: According to the linear regression model daily working time increased 44,8 minutes to those with 21 years old and older ($p=.04$), and 48,4 minutes to those contributing to the family income ($p<.01$). The fatigue scale increased: 15 points for females ($p<.01$), 8 points when students reported body pains ($p=.01$), and 9 points when working in jobs without social support ($p=.01$). Fatigue decreased 15 points when students worked in jobs with low demands and high control, 11,5 points in jobs with low demand and low control.

The daily working time model was adjusted by sex, sleep duration, workplace, and work-related diseases. The fatigue model was adjusted by daily working time, sleep duration, BMI, daily alcohol and caffeine consumption.

Conclusions: Daily working time (6 hours/day and more) associated with College demands can pose a significant burden on students, interfering with their studies as well as their health and wellbeing. This study showed working time among College students is influenced by sociodemographic factors. Psychosocial factors as work demands, work control and social support seem to be relevant factors which should be taken into account to decrease fatigue at work, mainly among females who work and study.

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Keywords: College students, working conditions, working time, job stressors, fatigue

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Melatonin and breast cancer risk: A systematic review and meta-analysis

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Background: There are concerns that exposure to light during night shiftwork may disrupt production of the pineal hormone melatonin and increase the risk for breast cancer. Results from substantial experimental research in animal models and indirect evidence from observational epidemiological studies support a relationship between suppression of melatonin and breast cancer risk.

Aim: We conducted a systematic review and meta-analysis of observational studies to assess the association between melatonin and risk for breast cancer.

Methods: Relevant publications were identified from reviews and computer-aided literature searches [using PUBMED, with keywords breast cancer (incidence or mortality), melatonin, 6-sulphatoxymelatonin sulphate] up to January 31st, 2009. Relative risk estimates and 95% confidence intervals were extracted for the highest compared with the lowest exposure category. Summary relative risks were estimated by calculating the weighted average of the study-specific logarithms of the relative risks, with weights proportional to the inverse of the variances of the study-specific log relative risks.

Results: We identified four prospective studies on the risk of breast cancer in relation to the major urinary metabolite of melatonin, 6-sulphatoxymelatonin, which altogether included 852 women with incident breast cancer and 1972 matched control participants. Three studies used either first morning or 12-hour overnight urine and one study used 24-hour samples. When results from these studies were combined, the aggregate relative risk was 0.71 (95% confidence interval 0.56-0.89) for women with urinary melatonin in the highest compared with the lowest urinary melatonin category. There was no evidence for a significant difference in this association by menopausal status or the timing of the urine sample collection.

Conclusions: Meta-analysis of published results on urinary 6-sulphatoxymelatonin and breast cancer supports the hypothesis that low levels of endogenous melatonin are associated with an increase in the risk for developing breast cancer.

Keywords: Breast cancer; melatonin; 6-sulphatoxymelatonin; circadian rhythm disruption

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Shiftwork and diet

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Shiftworkers report higher prevalence of a range of health problems and impairments (e.g. cardio-vascular disease, gastro-intestinal and metabolic disorders, obesity), at least some of which may be linked to diet. Digestive and metabolic processes exhibit circadian rhythms and thus eating at an inappropriate phase (e.g. at night) may impair the normal processes of digestion and / or metabolism. (There is also the possibility that similar mechanisms play a role in reduced performance and increased accident risk.) Some of these rhythms are primarily influenced by such exogenous factors (e.g. opportunity for eating, presence of food in the gut, presence of foodstuffs in the blood) whereas others are primarily influenced by the body clock (e.g. activity of brain feeding centres, sensitivity of the gut, sensitivity of the metabolic response). Hence it is very difficult to predict how well the night worker's ability to metabolise food has adjusted to the altered sleep-wake cycle. Fully understanding these complex interactions presents a challenge to the formulation of dietary recommendations.

Food intake is strongly influenced by motivational factors and external factors such as the availability of food, having the time to eat and social / domestic influences. Hence we must consider not only how the body copes with irregular eating habits, but also how those habits are shaped by irregular work hours. We need to consider the factors which influence both the time at which the individual chooses to eat and the meal content that is chosen / preferred. Recommendations for a dietary regime that are based solely on what best suits the circadian rhythm of our digestive and metabolic processes will be of little practical use if the individuals choose to disregard them or are unable to follow them (e.g. because their work situation or workload prevents them from doing so).

Keywords: Circadian disruption, disease, digestion, eating habits.

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The Impact of Working Time Arrangements on Fatigue Among Junior Doctors

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Aim: The implementation of the European Working Time Directive (EWTD) in junior doctors' working time arrangements has brought about a radical re-organisation of the way trainee doctors work in the UK. One of the key changes has been the introduction of rotating shift systems. However, the implementation of the EWTD has not necessarily lead to an improvement in the situation in all cases. Instances of highly demanding, yet EWTD-compliant, work schedules have been reported. The current study examined the impact of the new working time arrangements on doctors' performance and well-being.

Method: A questionnaire survey compared groups of junior doctors working on different shift schedules (N = 336). It examined the impact of particular aspects of shift system design on risk (due to excessive fatigue), sleep duration, psychological well-being and work-life interference. It also looked at a range of potential moderating factors such as age, gender, domestic circumstances, individual differences in circadian rhythms, job grade, work experience and workload.

Results: Working seven consecutive night shifts was associated with an accumulation of fatigue-related risk which was, by the end of the week, higher than was experienced by those working up to four consecutive nights. However, those working fewer consecutive nights reported less work-life interference. A single rest day after a block of night shifts was associated with greater perceived risk on the return to day work. It was also associated with greater work-life interference, particularly among those studying for exams. Taking a nap during the day before starting night shifts was associated with lower risk during the subsequent night shifts. Those who had recently worked a weekend on-call between two successive work weeks (i.e. 11 or 12 days without a break) reported increased risk, work-life interference and psychological strain. Similarly, having to frequently work weekends (e.g. at least 1 in 4 weekends) was associated with higher work-life interference and psychological strain and, for some, greater risk. High frequency on-call working during the week (e.g. more than once a week) was also associated with greater work-life interference and psychological strain. Long shifts and short intervals between successive shifts were associated with restricted sleep. In the case of long day shifts, they were also associated with increased risk. Long weekly work hours were associated with increased risk on the nightshift and greater work-life interference.

Conclusions: The findings form the basis of a set of guidelines for the design of doctor's shift schedules. They provide some of the first evidenced-based support for recommendations concerning the design of EWTD-compliant shift systems for trainee doctors.

Keywords: Shift systems, junior doctors, fatigue, patient care, safety

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Changes in Body Mass Index in shift and daytime workers over time, preliminary results from the 10 years follow up of the Maastricht Cohort Study

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Aim: Shift work has been associated with an increased cardiovascular disease risk. It has been hypothesised that a mismatch between meal times and the 24-hour rhythm of digestive enzymes, due to eating at irregular times, as most shift workers do, might lead to increases in body mass and thus to an increased cardiovascular disease risk. But also a less healthy diet of workers working outside normal daytime hours has been implicated as a possible factor related to increases in body mass. The current study aims at addressing the impact over time of working outside normal working hours (in the Netherlands from 7:00 to 19:00 hours) and in shifts, including nights, on body mass index (BMI).

Methods: Data from the ongoing Maastricht Cohort Study was used. This cohort study was established in 1998, with, at baseline 12140 participants from 45 different companies. At baseline, 25.0 % worked in shifts, including nights. Another 7.3 % of the workers worked outside the normal working hours (from 7:00 to 19:00 hours). Data on BMI was available at baseline, and at 1, 2, 3 and (still preliminary) 10 years of follow up. Mixed model analysis was used to model the longitudinal relationship between shift work and body mass index, with adjustment for age, gender and educational level.

Results: Per year of shift work (including nights) the body mass index increased significantly with 0.043 kg/m² (95 % C.I.: 0.002 - 0.083), adjusted for year of observation, age, gender, and educational level, when compared to working at daytime. Working outside normal working hours (with exclusion of shift work with night time work) was associated with a slight, but not significantly yearly increase of 0.015 kg/m² (95% C.I.: -0.003 - 0.032).

Conclusions: So far, only few long term longitudinal studies have been described, addressing cardiovascular disease risk factors among shift workers. After 10 years of follow up we observed a slight, but significantly elevated, increase of BMI over time in workers working in shifts, as compared to workers in daytime. However, when estimating the excess cardiovascular risk which is related to this increase in BMI (from studies on the relationship between BMI and cardiovascular disease risk) 20 years of shift work would be related to a relative risk 1.03 in men and 1.04 in women for developing cardiovascular diseases. This means that, the possible cardiovascular disease risk among shift workers is not likely to be mediated by BMI.

Keywords: cardiovascular risk, shift work, body mass index, cohort study

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Work load, lifestyle and health: monitoring the health of employees with irregular working hours

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Aim: In occupational health, a shift has occurred from curation towards prevention. Therefore, signaling employees at risk at an early stage is necessary for successful prevention programs.

In contrast with research about shift work, not much research has been conducted on irregular working hours and its effects on sick leave and general health status is sparse. Little is known about predictive models including work load, lifestyle characteristics or personal characteristics as predictors for sick leave and health.

Possible risk factors for sick leave and health are work load, personal characteristics and lifestyle. Hypothetically, need for recovery and sleeping problems are the short term effects, whereas fatigue, reduced ability to work and health status are the intermediate effects. Eventually these will lead to long term effects as sick leave, accidents at the workplace and job turnover.

By following a cohort, this research aims to investigate the risk factors and the etiology of health problems, sick leave and job turnover related to shift work and irregular working hours.

Methods: During one year, all newly employed workers at a large Dutch company with 27.000 employees will be asked to enrol in the research and to fill in a questionnaire. The aim is to acquire a cohort of 1000 employees.

To determine the long term effects of the different risk factors the design of the study is longitudinal. We are avoiding the healthy worker effect by only including new employees which we continue to follow when they drop out.

After inclusion, we yearly ask the participants to fill in a questionnaire, for a period of 3 years. This questionnaire contains items about lifestyle, personal characteristics and the experienced work load and health. Administrative data by the employer and occupational health service provide additional information about work load, personal characteristics, sick leave, job turnover and accidents at work.

Results: The short-term effects of the different risk factors regarding irregular working hours will be known at the end of 2010. The long-term effects and the underlying mechanisms will be available in 2013.

Conclusions: A cohort of newly employed workers with irregular working hours will be followed for a period of 3 years. More insight in the risk factors and their long term effects on health and sick leave will originate from combining extensive questionnaire data with available administrative data. By the identification of these factors, employers and occupational health services can improve their support of the employee and subsequently prevent sick leave and health complaints.

Keywords: Irregular work, risk factors, health, sick leave, cohort study, newly employed workers.

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Relation of circadian profile on driving performance

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Aim: The major determinant of fatigue of the truck drivers has been identified in the duration of wakefulness, inadequate sleep and sleep disorders, extended working shifts and time of the day. It has been also suggested that interindividual differences in the spontaneous sleep-awake cycle may influence, at least at certain times of the day, the levels of performance; thus the chronotype of the drivers (morning or evening type) might be related to individual differences of alertness during the time of the day.

The aim of the present study is to evaluate the effects of psychophysiological factors such as age, personality traits, behavioural factors and urinary melatonin, taken as marker of circadian rhythm, on vigilance levels of professional drivers.

Methods: The study was carried out on male truck drivers recruited from private companies with a mean age of 47 years, ranging from 34 to 53 years.

On working days, before and at the end of driving shifts the drivers were submitted to the following measures: Drivers' performance was assessed by Vienna Reaction Test (RT) and Vienna Determination Test (DT), provided by Schuhfried (Austria).

Circadian rhythm was evaluated by measuring 6-sulfatoxymelatonin levels, in two urine specimens: a first morning urine and in a sample of urine excreted, over a period of about 4 hours, before the end of the driving shift.

Records of road and traffic conditions (motorways, suburban and urban roads, traffic jams, visibility), distance travelled and length of each driving shift was also collected.

Psychometric measures was carried out by the Italian version of the Big Five Questionnaire (BFQ).

Results: A significant improvement of reactive stress tolerance (reaction times and number of correct reactions by Vienna DT) has been observed at the end of the driving shift compared to measures made before starting, while no significant variation was observed in Vienna RT results.

The age of drivers resulted significantly related with motor times measured by Vienna RT both before ($r = 0.358$; $p = 0.025$) and at the end ($r = 0.416$; $p = 0.008$) of the driving period.

It was observed a significant relationship between reaction time measured by Vienna RT and urinary melatonin levels measured in urine collected before the driving shift.

Discussion: The negative relationship between the measures of drivers performance and the melatonin levels in the early morning observed in our study and the wide interindividual variability of this marker of circadian rhythm suggest the opportunity of scheduling the driving shift taking into account the personal differences of endogenous circadian profile. For what concern the role of personality factors it was also observed that emotional stability significantly impair the driving performance.

Keywords: circadian rhythm, melatonin, driver performance

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A Diversity-Focused Approach to Work-Family Conflict And Burnout among Hispanic-American Male Workers

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Aim: In conjunction with the tremendous growth of the work force in the United States, job demands have increased and many struggle with the competing demands of work and family. Work-family conflict (WFC) research addresses the effects of undertaking simultaneous roles- work and family- that require distinct values, behaviors, and norms. Recognizing role-identity formation as a culturally-specific value-based product is a new yet essential contribution to the study of WFC. Hispanics are now the largest immigrant group in the United States. The proportion of Hispanics living in the U.S. is projected to double between 2000 and 2050 from 12% to 24% (U.S. Census Bureau, 2004). As this immigrant population in the United States continues to grow, we must shift our focus of WFC to include the needs of culturally diverse populations.

Methods: The current study includes pilot data collected from a sample of 28 Hispanic-American male workers and examines WFC and burnout in light of this diverse population, drawing on data of 184 executive directors (89.1% Caucasian) as a means for comparison between the two races/ethnicities. The latter sample includes 23.9% males with only 2.2% Hispanic. Between the two samples, 13.3% of Hispanic-American workers and 43.4% of executive directors reported holding their current position for 3 years or more.

Results: Descriptive comparisons between the two samples show that both work-family conflict and burnout present themselves at different levels based on race/ethnicity. Work interference with family was significantly greater among Hispanic-American workers at 58.8% in comparison to 14.3% executive directors who reported work-family conflict. The disengagement component of burnout, however, was greater for executive directors at 25% reporting at least moderate disengagement while only it was only reported by 2.8% of Hispanic-American workers.

Conclusions: Our findings demonstrate the need to expand on the current theoretical framework of WFC research including a needs-based approach to role conflict among diverse populations. In conclusion, we highlight a basic theoretical structure for inclusion of culturally sensitive aspects within the WFC field of study. In addition, we offer recommendations for culturally-specific design programs to accommodate the diverse cultural needs affecting work-life and work-family policies. Future studies should advocate for a diversity-based approach to WFC research while equally promoting work-life satisfaction among all diverse populations of organizations.

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Keywords: Work-family conflict, burnout, diversity, role identity, Hispanics

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The effects of extended working hours on health and social well-being – a comparative analysis of four independent samples

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Aim: Results from previous studies have shown that the number of hours worked per week is substantially connected with the amount of reported social and health impairments (1, 2). These results were based on analyses of one European and one German study. Although the outcomes were quite robust, doubts about the comparability of the European and German data remained and validity was still questioned. Therefore the aim of this study was to systematically analyse the effects of the amount of working hours per week on health and social well-being, controlling for work load and individual characteristics. Furthermore, it was intended to substantiate the validity of our previous findings by cross-validating the results over two additional, i.e. four different data sets.

Methods: Secondary analyses of four different samples were undertaken, based on two European and two German cross-sectional surveys, which were conducted between 2000 and 2006 and contained data from 4.000 to 30.000 respondents. In each survey, data about working conditions and individual characteristics were collected, e.g. working time attributes, work load, health complaints, self-rated work-life balance and the amount of social activities (in the European surveys). Multivariate analyses of covariance structures were conducted, using the reported average of weekly work hours as independent and the amount of reported health impairments, social activities, and work-life balance as dependent variables. Additionally, moderating effects of work load and individual characteristics were analysed. Coefficients from the different data sets were compared for purposes of cross-validation.

Results: The results show that the amount of weekly working hours is substantially related to health impairments. Furthermore, with increasing working hours time for social activities decreases, which in turn is connected with a decrease in reported work-life balance. The outcomes are structurally similar across all four data sets, before and after controlling for work load and individual characteristics. Of all dependent variables, psycho-vegetative complaints and social activities show the strongest relation to the amount of hours worked per week.

Conclusions: The outcomes show that an increased number of weekly working hours is associated with a decrease in health and social well-being. Cross-validation across four data sets substantiates the robustness of the findings, independent of the specific methods and dates of the surveys.

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Keywords: long working hours, health impairments, work-life-balance

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Shiftwork Trends and Risk for Worker Injury in Canada

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Objectives: Workers in shiftwork arrangements may be at increased risk of workplace injury. Sleep disruption and poor quality of sleep are thought to compromise worker attention and lead to injury. The purpose of this study is to examine the trend and associations in shiftwork and workers' compensation claims as a surrogate measure for worker injury.

Methods: We used the annual cross-sections of the Survey of Labour and Income Dynamics (SLID), a representative longitudinal survey conducted by Statistics Canada to determine trends in shiftwork and workers' compensation. For the 2006 cross-section of the SLID we used logistic regression to examine whether shiftwork was associated with the likelihood of receiving workers' compensation after adjusting for potential confounders (e.g. demographics, socioeconomic status, industry, occupation, work contract and geography).

Results: In 1999 there were 2.3 million people working night shiftwork in Canada, representing 15% of the workforce (9% rotating shiftwork, 6% regular evening or graveyard). By 2005, there was an 18% increase in night shiftwork with a 16% increase among men and 22% increase among women. During the same period, compensation trends among day-time workers decreased by 25%, while the decrease among rotating shift workers was about 22% and with no decrease among evening or graveyard shiftworkers.

The unadjusted odds ratio (OR) of receiving compensation among evening or graveyard shiftworkers was 1.51 (95% CI: 1.15, 1.98) and for rotating shiftworkers was 2.31 (95% CI: 1.67, 3.21) compared to day-time workers. In the fully adjusted model, the OR for evening or graveyard shiftworkers was 1.65 (95% CI: 1.17, 2.35) and for rotating shiftworkers was 1.26 (95% CI: 0.94, 1.67) compared to day-time workers. There was effect modification by gender. The OR stratified for male evening or graveyard shiftworkers was 1.70 (95% CI: 1.08, 2.69), and for male rotating shiftworkers it was 1.10 (95% CI: 0.77, 1.56) for male rotating shiftworkers while for female evening or graveyard shiftworkers it was 1.59 (95% CI: 0.92, 2.75) and for female rotating shiftworkers was 1.61 (95% CI: 0.99, 2.61).

Conclusion: Night shiftwork is increasing in Canada, particularly among women. Shiftwork appears to be associated with reporting a compensation claim for regular evening or graveyard shiftwork for men and for all forms of night shiftwork for women. Ongoing surveillance and intervention is needed to understand the causes of occupational injury in shiftworkers and to reduce this risk.

Keywords: Shiftwork, Worker Injury, Compensation Claims

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A retrospective cohort study of shift work and longitudinal changes in systolic and diastolic blood pressure and body mass index in an Iranian cohort of workers

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Objective: To investigate whether any effect of shift work might be mediated through changes in systolic blood pressure (SBP), diastolic blood pressure (DBP) and body mass index (BMI) over time.

Methods: The data were extracted from a retrospective cohort study of workers who worked at Polyacryl Iran Corporation (PIC) company produces synthetic fibre. Cohort consisted of 1017 subgroups of an on going cohort, 949 (93.7%) blue and 68 (6.3%) white collar workers. They were employed by the company on average age of 26 years ranged 18 to 49 between 1 Sep 1989 and 28 Feb 2008 and still working there except 121 (11.9%) who retired.

Exposure data: shift status was extracted from personnel records and a shift worker(s) was defined as a worker who worked in 3-rotation-shift including night shifts. Other workers who defined as day workers worked at 2-shift (morning and evening) and days only. The duration of work status was determined accordingly for each group. All workers must have annually attended pre-employment medical health examinations and thereafter. SBP, DBP, and BMI were, on average, measured 4.4 times and pre-employment measures of SBP, DBP, and BMI, age at employment, marital status, and education level considered as covariates and confounding factors. MIWiN programme was used to apply a 2-level hierarchical model to assess within worker rate of change in SBP, DBP & BMI between shift & other workers.

Results: Among all workers, 55.7% worked in 3-rotation shift including night shift and 44.3% in days and evening (5.8% two-shift workers and 38.5% day workers). Adjusted age was significant predictor of longitudinal change in SBP ($\beta=0.62$, $p=0.008$, 95% CI: 0.15 – 1.09) but there was no difference in the rate of change per year of age between shift and day workers. However, there was a significance difference in mean SBP at age 29 for 3-shift workers than day workers ($\beta=1.33$, $p=0.006$, 95% CI: 0.34 – 2.32). The pattern of difference in SBP mean among day workers and different duration of shift workers (lower SBP mean for 1 to 10 years of shift) indicates the effect of healthy shift worker hire effect (HSWHE) which wears off after 10 years of shift work. Adjusted age was also significant predictor of longitudinal change in DBP ($\beta=0.64$, $p<0.001$, 95% CI: 0.27 – 1.01) and BMI ($\beta=0.12$, $p=0.0001$, 95% CI: 0.06 – 0.18) but there was no any evidence of difference between day and shift workers neither different level of duration of shift.

Conclusion: Adjusted age was predictor of SBP, DBP and BMI over time but there was no difference in the rate of change per year of age between shift and day workers. Comparing mean SBP between different level of duration of shift work and day workers indicates some evidence for HSWHE which wears off after 10 years. If there is such an effect, it is advised to control for HSWHE to get the least biased results.

Keywords: Shift work, Historical Cohort, Longitudinal Change, SBP, DBP, BMI

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Is health, measured by Work Ability Index, affected by 12-hour rotating shift schedules?

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Aim: Two forms of continuously forward rotating 12-hour shift schedules exist at BASF's Ludwigshafen site. These shift schedules were compared with a daytime working system to investigate potential differential effects on the employee's health status assessed with the Work Ability Index (WAI).

Methods: In the 3x12 system, a 12-hour day shift is followed 24 hours later by a 12-hour night shift. After a day off the employee returns to the day shift. The 4x12 schedule follows the same pattern except that there are two days off between the night shift and the next day shift. A total of 935 participants, 278 3x12, 321 4x12 shift workers, and 336 day workers were recruited for the study. A self-administered questionnaire was used to obtain information about the type of shiftwork, demographic characteristics, lifestyle factors, social factors, and the Work Ability Index. The outcomes of interest were the WAI sum score and its 7 dimensions. In relationship to WAI categories, a Proportional Odds Model (POM) was used to identify the potential determinants. Logistic regression models were used to estimate the impact of age on single dimensions of WAI after adjustment for potential confounding factors.

Results: In this study, increasing age and obesity (BMI ≥ 30) were the only significant determinants of poorer WAI. While a positive association of dimension 2 (work ability in relation to the demands of the job) with age was suggested in the univariate analysis, an inverse association was demonstrated consistently between age and dimensions 3 and 4, i.e. number of diagnosed diseases and the estimated work impairment due to disease, after adjustment for potential confounders. The age-dependency is weak overall, but seemed to be stronger in the shift than in the day workers, although this difference did not reach statistical significance.

Conclusion: There was no significant differential impact of the working time systems compared in our study on the WAI sum score or on the individual WAI dimensions. Thus, there is no indication of an excessive adverse health impact of these shift schedules compared to day work, to the extent that health can be measured by the WAI.

Keywords: shift schedules, Work Ability Index, determinants

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Improving nursing work using electronic medical records in an acute care unit

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Aim: Workload of health care workers is changing with the introduction of electronic medical record systems. While these systems reduce time-consuming paperwork and erroneous data entries, they require new work flow for patient care and time for documentation. It is useful to know the advantages and drawbacks of computerization in health care, with a focus on changing workflow and workload of nurses.

Methods: In a specialized cardiovascular acute care unit adopting two-shift systems, durations and locations of nursing activities were recorded for 14 nurses using the 30-sec snap reading method. The effects on workload of nurses were examined by comparing work flow patterns before and after the introduction of electronic medical records. Attention was drawn to overtime work, break periods, the time required for inputting medical data and the time spent to access the data during bedside care. The impact of new work flow patterns on workload of nurses was assessed.

Results and discussion: The workflow of nursing care changed extensively after the installation of an electronic medical record system. This was due to the need to arrange the time for computerization of medical information. The new system enabled physicians and nurses to effectively share up-to-date information about patients from anywhere in the hospital at any time. Time allocations for reading and inputting information differed between nurses, with less experienced nurses often doing overtime. Treatment protocols were still in paper form, and nurses were making care plans based on handwritten notepads they carried. While the time for patient care increased after computerization of medical information, difficulty was seen in inserting short breaks among less-experienced nurses. Based on the observations from the study, the need was noted for improving (a) treatment schedules based on electronic information, (b) scheduling of short breaks, (c) the effective use of communication devices such as inter-unit mobile phones and verbal instructions often overlapping, (d) storage systems of treatment materials and (e) team procedures so as to reduce the workload for nurses. It was also suggested necessary to ensure proper and efficient documentation, utilize portable electronic devices and improve work schedules adjusted to the new system.

Keywords: nursing, workload, work schedules, electronic medical records, breaks

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Inter-individual differences in performance across circadian cycle

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Aim: Neurobehavioural functioning is simultaneously modulated by the circadian pacemaker and sleep homeostat. The extent of modulation varies across individuals. While many studies have focused on inter-individual differences in neurobehavioral response to homeostatic sleep pressure, few studies investigated individual differences in response to circadian phase. Despite the demonstration of large inter-individual differences at a particular circadian phase, these results are likely to be confounded by inter-individual differences in response to homeostatic sleep pressure. More importantly, to be theoretically interesting, observed inter-individual differences need to be systematic, and to be considered as systematic, they need to be reproducible on separate occasions of the same or similar experimental conditions. The current study aimed to determine if inter-individual differences in neurobehavioural performance are systematic across circadian cycle.

Methods: In a temporal isolation laboratory, eleven healthy male (22.7 ± 2.5 yr) were scheduled to 7 x 28h sleep/wake cycle (A:N=1:2). Over these 28h days, the sleep/wake cycle and circadian cycle oscillated independently at different periods such that wake episodes were distributed across all circadian phases. Karolinska Sleepiness Scale (KSS) and 10min Psychomotor Vigilance Task (PVT) were given seven times at 2.5h intervals during each wake period such that performance at each wake duration was repeatedly measured across a circadian cycle. Independent circadian influence on performance was obtained by averaging performance over seven wake periods. All performance scores were expressed as “deviation from baseline performance” to indicate response to circadian phase.

Results: A linear mixed model ANOVA with a fixed term, “circadian phase” (6), and a random term, “participant”, indicated a main effect of circadian phase for KSS and PVT performance. Intraclass correlation coefficient (ICC), calculated as the ratio of between-participant variance to the total variance after removing the estimated circadian effect, was used to determine systematic inter-individual differences. The ICCs were .69 (Wald $Z=2.08$, $p=.04$) for KSS and .64 (Wald $Z=2.05$, $p=.04$) for PVT.

Conclusions: There were substantial stable, hence systematic, inter-individual differences in performance across circadian cycle. That is, relative to others, individuals who performed poorly at one circadian phase tended to perform poorly at other phases. The finding may suggest that similar as response to homeostatic sleep pressure, individual response to circadian modulation is trait-like.

Acknowledgements: This study was financially supported by the Australian Research Council.

Keywords: inter-individual differences, circadian phase, performance, intraclass correlation coefficient

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Inter-individual differences in performance over the development of homeostatic sleep pressure

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Aim: An elevated level of homeostatic sleep pressure after prolonged wakefulness impairs neurobehavioral performance. The extent of impairment varies across individuals. To be considered as systematic or trait-like, observed inter-individual differences need to be reproducible on separate occasions of the same or similar experimental conditions. While many studies have demonstrated systematic inter-individual differences in performance under a particular level of homeostatic sleep pressure, few studies investigated if these inter-individual differences are systematic across levels of homeostatic sleep pressure. Among these few studies, results are likely to be confounded by inter-individual differences in phase relationship between sleep/wake and circadian cycle. The current study aimed to investigate if inter-individual differences in performance are systematic across levels of homeostatic sleep pressure.

Methods: In a temporal isolation laboratory, eleven healthy male (22.7 ± 2.5 yr) were scheduled to 7 x 28h sleep/wake cycle (A:N=1:2). Over these 28h days, the sleep/wake cycle and circadian cycle oscillated independently at different periods such that wake episodes were distributed across all circadian phases. Karolinska Sleepiness Scale (KSS) and 10min Psychomotor Vigilance Task (PVT) were given seven times at 2.5h intervals during each wake period such that performance at each wake duration was repeatedly measured across a circadian cycle. Independent sleep homeostatic influence on performance was obtained by averaging performance over circadian cycles. All performance scores were expressed as “deviation from baseline performance” to indicate response to homeostatic sleep pressure.

Results: A linear mixed model ANOVA with a fixed term, “wake duration” (7), and a random term, “participant”, indicated a main effect of wake duration for KSS and PVT performance. Intraclass correlation coefficient (ICC), calculated as the ratio of between-participant variance to the total variance after removing the estimated wake duration effect, was used to determine systematic inter-individual differences. The ICCs were 0.67 (Wald $Z=2.07$, $p=.04$) for KSS and 0.87 (Wald $Z=2.19$, $p=.03$) for PVT.

Conclusions: There were substantial stable, hence systematic, inter-individual differences in performance across levels of homeostatic sleep pressure. That is, relative to others, individuals who performed poorly at short wake durations tended to perform poorly at long wake durations. This finding may suggest that individual response to increasing homeostatic sleep pressure is trait-like.

Acknowledgements: This study was financially supported by the Australian Research Council.

Keywords: Inter-individual difference, homeostatic sleep pressure, intraclass correlation coefficient

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