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

To our dear S.I.N enthusiasts, we know it has been a while since the last edition, but your long wait is now over! We are pleased to present to you this Yeppoon edition, which provides you with both the detailed Symposium program and presentation overview, as well as the full book of abstracts. Those who were unable to attend this very well run and scientifically stimulating program can still reap some of its benefits.

We continue to develop S.I.N. to make it as useful and widely accessible as possible. Given that this is a tool to help build capacity and is typically not the only reason why someone would want to join the WTS, the editors recommended, and the executive board agreed, that the electronic version of the newsletter is now free. As a searchable PDF file, it can be easily e-mailed or pulled off of our WTS website while retaining the ability to quickly locate information of interest. Paper versions of the newsletter will still have a cost associated with it, so national libraries and other institutions that require a physical document will be given instruction on how to purchase it.

With regard to newsletter content, there continues to be interest in developing new columns and further developing the ones that we currently have, including the popular Viewpoints column. We are seeking material for the next newsletter, which should be out by the end of the calendar year. Please consider writing an opinion piece (the more controversial the better!) or provide ideas or suggestions about S.I.N., WTS, and how we can become more integrated and more valuable to corporate and government decision makers. There is a world of talent in our organization - literally! - and it seems as though we should be putting that to as good use for the shiftworking workforce as possible.

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

President's Report

Dear Members and Friends

The organisation of the 19th International Symposium on Shiftwork and Working Time (Venice, August 2-6, 2009) is in process. You are welcome to visit the website www.shiftwork2009.it where you can retrieve all the information regarding the event. As you know, it will be organised by myself and my co-workers of the Department of Occupational and Environmental Medicine of the Milano University, and will be held in the small and charming island of S. Servolo in the Venetian lagoon.

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President's Report (continued)

I am confident that also on this occasion, as has happened in the previous ones, we will be able to spend some fruitful days exchanging our ideas and studies, discussing old and new topics, and establishing and strengthening collaboration and friendship, in a pleasant location and a friendly atmosphere.

Incidentally, I am pleased to inform you that our ICOH Scientific Committee on Shiftwork and Working Time will organize two Special Sessions on "Shiftwork, working hours and health" and "Sleep problems in shiftworkers" within the 29th ICOH Congress, to be held in Capetown (March 22 – 29, 2009). Oral and poster sessions are also scheduled. I do hope that some of you are able to attend.

In the latest years working hours have become crucial in work organisations in relation to fast developments in technologies and new economies as well as in the changing demands from market globalisation and working populations.

Concern is growing as to the impact of "non-standard" working hours on health and well-being as evidenced by the increasing literature on work-life balance and social well-being, and on work stress with consequent impact on health. In particular, sleep deterioration, metabolic and cardiovascular disorders, as well as cancer (as reported in the recent statement on the probable cancerogenic risk of "shiftwork that involves circadian disruption" by the International Agency for Research on Cancer) are main issues at stake.

Our aim is to have in-depth discussions on these aspects in Venice, also thanks to the presence of experts from other disciplines and representatives of international associations and institutions. Hence, some special sessions dedicated to circadian disruption, sleep, cancer, metabolic and cardiovascular disorder, work/non-work conflicts will be organised.

We expect to be able to draw more attention from the scientific and the institutional worlds on this topic also via some consensus documents and scientific directives. It is time in fact that all the scientific knowledge produced in the latest years be profitably used by national and international institutions, in addressing the regulatory aspects of working hours.

As agreed by the WTS Board, the Working Time Society (as well as ICOH) members in good standing will benefit from a reduced fee for participation and accommodation at the 19th Symposium. Also graduate students will pay a reduced fee and some support is foreseen for participants from developing countries, in compliance with ICOH indications.

We expect a high and qualified participation from all of you and we promise we will do our best to make this conference an unforgettable scientific and social event..

As you can see on the website, the call for papers is now open, and the deadline for submission of abstracts is February 2009: do not forget to mark the Symposium in your 2009 agenda.

We look forward to hearing from you and say to all of you:

Arrivederci in Venezia in August!

Giovanni Costa

MEETING NOTICE!

The U.S. Department of Transportation is hosting the fifth International Conference on Fatigue Management in Transportation Operations in Boston, Massachusetts USA on March 24-26, 2009. The focus of this meeting will be A Framework for Progress and will consist 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.

This conference is 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 will be provided by senior decision makers from the U.S. National Transportation Safety Board, National Institute for Occupational Safety and Health, and Liberty Mutual Research Institute for Safety. For more information regarding this conference please point your web browser to http://www.fatiguemanagement09.org.

18th INTERNATIONAL SYMPOSIUM ON SHIFTWORK AND WORKING TIME

27-31 August 2007 - Yeppoon, Australia

The 18th Symposium was held in August 2007 in the seaside town of Yeppoon, Australia. The organizing committee worked long and hard to create a meeting that blended a strong scientific program with plenty of time to enjoy the company of their friends and colleagues.

A total of 117 abstracts were received from 20 countries which underlines that this meeting is truly an international meeting. The scientific committee accepted 108 abstracts for either oral or 3-minute poster presentations. Of these, 91 presentations were delivered over the four-day meeting. The meeting had 121 registrations from across academia and government. Some 60% of the delegates had not previously attended a WTS meeting. In keeping with Professor Rutenfranz's rules for holding these symposia, the venue provided the right atmosphere for keeping the delegates together. The social committee arranged a number of activities to ensure delegates also took time out to have fun. The opening ceremony allowed for a 'welcome' from Australia's aboriginal people. Their music, song and dance provided some insight into their rich culture.

Following dinner one night, a debate was held on the 'existence' (or otherwise) of shiftwork sleep disorder. This was a lively affair with plenty of alcohol to lubricate the vocals of the delegates. The majority of people opted to take the island cruise and sadly the weather was not at its typical best. Nonetheless, we enjoyed the rollercoaster ride offered by the one metre seas and the opportunity to explore Great Keppel Island. Others chose to visit a local zoo to see Australian native animals. The conference dinner as usual was enjoyed by everyone with plenty of frantic dancing (and drinking)! If you have not visited the website to see photos from the night and the cruise please visit www.shiftwork.cqu.edu.au.

The special issue editors worked hard to publish the manuscripts in record time. Both issues are now available; Chronobiology International, 25 (2/3); Applied Ergonomics, 39 (5). The editors wish to thank all reviewers and authors for their cooperation.

You would have seen the announcement for the 19th symposium to be held in Venice 2009. Professor Costa and his team are hard at work on the preparations. I look forward to seeing you in August, 2009!

SYMPOSIUM PROGRAM AND PRESENTATION OVERVIEW

Monday, 27th August

18.30 – Welcoming ceremony

Tuesday, 28th August

9.00 – **Chair: Lee Di Milia**
Opening Keynote: *Giovanni Costa* - *Ageing and shiftwork: a complex problem to face.*
Work scheduling systems and software
9.45 – Härmä, M; Partinen, M and Repo, R - The effect of a 6-6 and 4-8 watch system on sleepiness among watch keeping officers
10.00 – Gaertner, J; Wahl, S; Horsak, R; Pilgerstorfer, O and Schafhauser, W - *Time Intelligence Solutions*
10.45 – **Chair: Anne Pisarski**
Work scheduling systems and software
Jansen, B and Baaijens, C.— *Update Aviation RRPA: the case of Dutch pilots*
11.00 **Circadian rhythmicity**
Folkard, S; Robertson, KA and Spencer, MB— *A Fatigue/Risk Index to assess work schedules*
11.15 — Knauth, P; Watrinet, C; Karl, D; Elmerich, K and Rott, M - *Effects of breaks on the fatigue and alertness of shiftworkers in a continuous shift system*
11.30 — Robertson, KA and Spencer, MB - *The fatigue of air traffic controllers: the difference between working single and consecutive nights*
11.45 — Powell, D; Spencer, MB; Holland, D; Broadbent, E and Petrie, KJ - *Factors associated with aircrew fatigue in two-crew operations*
12.00 — Tucker, P; Dahlgren, A; Åkerstedt, T and Waterhouse, J - *The impact of free-time activities on sleep and stress*
12.15 — Bohle, P; Pisarski, A and Brook, C - *Multiple Jobbing or One Job: A Comparative Cost-Benefit Analysis in a Health Care Industry*
12.30 — Lunch
13.30 — Chair: Shantha Rajaratnam
Extended working hours
Rueters, I; Nachreiner, F; Horn, D and Schomann, C - Effects of extended working hours on health and well-being – a cross validation study
13.45 — Sakai, K; Kogi, K; Suzuki, K and Oyama, H - Effects of irregular long-hour driving shifts of truck drivers and suggested improvements
14.00 — Poster Presentations
Age and responses to working hour
Fischer, FM; Nagai, R; Balian, AC and Teixeira, LR - The burden of teenage work: effects on sleep duration
Bobko, N - Age, experience and time-of-day effects on cognitive performance in control room shiftworkers
Karl, D; Elmerich, K; Watrinet, C; Pluto, R; Nasterlack, M; Zober, A and Knauth, P - Effects of different shift systems on subjective and objective health
Teixeira, LR; Moreno, CRC; Lowden, A; Turte, SL; Nagai, R; Latorre, MRDO and Fischer, FM - *Chronotype and tolerance to the double burden of working and studying among adolescents*
Conway, PM; Sartori, S; Dotti, R; Campanini, P and Costa, G - *Interactive effects of shiftwork, age and work stress on health and well-being*
Smith, L and Iskra-Golec, I - *Age-related shiftwork exposure effects*
Circadian rhythmicity
offshore shiftworkers working 19.00-07.00 h
Folkard, S - Do permanent night workers show circadian adjustment?
James, FO and Boivin, DB - The distribution of REM sleep and circadian adaptation of the salivary melatonin rhythm in night shift workers.
Back, FA; Moreno, CRC; Louzada, FM and Menna-Barreto, L - Light exposure patterns and biological adjustment to early working times among indoor and outdoor workers
Shanahan, TL; Neri, DF and Czeisler, CA - Bright-light facilitates adaptation of the melatonin rhythm to a slowly rotating shift work schedule
McLaughlin, C; Bowman, M; Bradley, CL and Mistlberger, RE - Seasonal variation in adaptation to shiftwork.

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Fatigue management
Stewart, S; Holmes, A; Majumdar, A and Turner, C - *An example of evidence-based fatigue risk management in a short-haul airline*
Folkard, S; Åkerstedt, T and Christian, P - *Should we encourage shift-workers to shorten their last night's sleep before their first night shift?*
Sleep loss, performance & well-being
Gander, PH; Van den Berg, MJ and Signal, TL - *Sleep and Sleepiness of Fishermen on Rotating Schedules*
Atake, M; Higashihara, A; Hashimoto, H and Kurihara, N - *Sleep duration, sleep time and study efficiency in university students*
Dorrian, J; Tolley, C; Lamond, N; van den Heuvel, C; Pincombe, J and Dawson D - *Australian Nurses' Sleep and Errors*
Sasaki, T; Iwasaki, K; Otsuka, Y and Mori, I - *Association of sleeping hours with sleepiness, fatigue, and depression among Japanese workers*
De Mello, MT; Paim, SL; Bittencourt, LR; Pires, MLN; Silva, R and Tufik, S - *Sleep disorders in sleep complainants: study with nuclear power plants shiftworkers*
15.00 Poster Preview Time
15.15 Tea/Coffee
15.30 **Chair: Rebecca Loudoun**
Sleep loss, performance & well-being
Moreno, CRC; Voltz, GP; Borges, FNS and Marqueze, EC - *A two-year follow up study of work ability among College educators.*
15.45 Schroeder, DJ; Bailey, L; Manning, C and Pounds, J - *Work time and operational errors in air traffic control*
16.00 Sallinen, M; Hiltunen, J; Hirvonen, K; Holm, A; Härmä, M; Koskelo, J; Letonsaari, M; Müller, K and Virkkala, J - *Recovery of multitask performance and alertness from acute sleep debt*
16.15 Axelsson, J; Åkerstedt, T; Kecklund, G and Lekander, M - *5 days with partial sleep restriction: effects on performance and ratings of sleepiness and effort.*
16.30 Härmä, M; Kaila-Kangas, L; Kivimäki, M; Lallukka, T; Sarlio-Lähteenkorva, S; Luukkonen, R and Leino-Arjas, P - *Sleep complaints, physical activity and shift work as predictors of weight gain: a 10-year follow-up of Finnish industrial employees*
16.45 **Circadian rhythmicity**
Giebel, O; Wirtz, A and Nachreiner, F - *The interference of flexible working time with the circadian rhythm as a predictor of impairment to health and well-being*
17.00 Son, M; Yum, M and Härmä M - *Cumulative effect of circadian disruption among weekly rotating 2-shift workers in Korea*
17.15 Iskra-Golec, I; Domoslawski, J and Smith, L - *Four hour period rhythms in right hemisphere information processing*
17.30 **Personal/email time**
19.00 **Buffet Dinner – Billabong Restaurant**
20.30 **Board Meeting – Brolga Room**

Wednesday, 29th August

7.30 Registration Desk Open
8.50 Housekeeping
9.00 **Chair: Phil Bohle**
Keynote - *Simon Folkard* - *Shiftwork, Safety and Ageing*
Shift design and work hours: Implications for shift and non-shift well-being
9.45 Viitasalo, K; Kuosma, E; Laitinen, J; Härmä, M - *Effects of a rapidly forward and a flexible backward rotating shift systems on employees' day time alertness and cardiovascular risk factors*
10.00 Barnes-Farrell, J; Davies-Schrils, K; McGonagle, A; Walsh, B; Di Milia, L; Fischer, FM; Hobbs, B;
Kaliterna, L and Tepas, D - *What aspects of shiftwork influence off-shift well-being of healthcare workers?*
10.15 Tea/Coffee
Chair: Adam Fletcher
Shift design and work hours: Implications for shift and non-shift well-being
10.45 Biggi, N; Consonni, D; Galluzzo, V; Sogliani, M and Costa, G - *Metabolic syndrome in permanent night workers*
11.00 Camerino, D; Sartori, S; Conway, PM; Costa, G and the NEXT group - *Factors affecting work ability in day and shift working nurses*
11.15 Kecklund, G; Åkerstedt, T and Eriksen CA - *Attitude to different shift systems: the importance of individual differences*
11.30 Gibbs, M; Hampton, S; Morgan, L and Arendt, J - *Three different shift schedules worked offshore: timing and production of 6-sulphatoxymelatonin, sleep and light exposure*
11.45 Ingre, M; Åkerstedt, T; Kecklund, G; Bildt, C and Falkenberg, A - *A 25% work-hour reduction for two years with full time pay in a relatively large sample experimental field study: effects on health, sleep and fatigue.*
12.00 Hinnenberg, S; Zegger, C; Nachreiner, F and Horn, D - *The utility of time – revisited after 25 years*
12.15 Wirtz, A; Giebel, O and Nachreiner, F - *The interference of flexible working time with the utility of free time – a predictor of social impairment*
12.30 Lunch
Chair: Anne Pisarski
Shift design and work hours: Implications for shift and non-shift well-being
13.30—Puttonen, S; Kivimäki, M; Härmä, M; Sallinen, M and Vahtera, J - *Shift work and rheumatoid arthritis Incidence*
13:45 Hermansson, J; Gillander-Gådin, K; Karlsson, B; Lindahl, B; Stegmayr, S and Knutsson, A - *Ischemic stroke and shift work*

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

14.00 **Poster Presentations**
Work scheduling systems and software
Gaertner, J - *Observations of high variance of actual staffing and workload within shift systems*
Gaertner, J - *Designing Proper Shifts & Rosters – A case study in the field of care for the elderly*
Measuring individual differences
Keown, NTG and Murdoch, JC - *Psychological health of miners: The influence of intrinsic and extrinsic work factors on health outcomes*
Åkerstedt, T; Kecklund, G and Axelsson, J - *Subjective sleepiness during partial sleep loss depends on the context*
Åkerstedt, T; Ingre, M; Axelsson, J and Kecklund G - *Modifying the three-process model of alertness regulation to account for accumulation of fatigue*
Brook, C; Pisarski, A and Bohle, P - *The Impact of Emotional Intelligence on Shiftworkers Health.*
Pisarski, A; Bohle, P and Brook, C - *Shiftwork Intolerance: A longitudinal study of social & organisational factors*
Kandelaars, K; Dorrian, J and Fletcher, A - *Predicting Sleep Strategies Using Social And Circadian Factors*
Borges, FNS; Fischer, FM; Moreno, CRC; Benedito Silva, AA; Pires, MLN; Rotenberg, L; Soares, NS; Fonseca, MB; Smolensky, M; Sackett-Lundeen, L and Haus, E - *Differences between more and less tolerant night healthcare workers, in relation to the mean concentration of urinary 6-sulphatoxymelatonin, sleep duration and sleep quality on work and off days.*
Borges, FNS; Fischer, FM; Moreno, CRC; Rotenberg, L; Soares, NS; Fonseca, MB; Smolensky, M; Sackett-Lundeen, L and Haus, E. - *Effects of nap on sleepiness of nursing personnel submitted to 12-hour night shift*
Elmerich, K; Karl, D; Watrinet, C and Knauth P - *Long-term time accounts and demographic change – a critical assessment*
Smith, L - *Morningness-eveningness and lifetime shiftwork exposure*
Shift design and work hours: Implications for shift and non-shift well-being
Goudswaard, A; de Leede, J; Klein Hesselink, J and de Leeuw, M - *Changing shifts at Corus: a choice between health and leisure?*
Ingre, M; Kecklund, G and Åkerstedt, T - *Individual differences in sleep length during morning shifts in an irregular shift schedule*
Takahashi, M; Iwakiri, K; Sotoyama, M; Higuchi, S; Kiguchi, M; Hirata, M; Hisanaga, N; Kitahara, T; Taoda, K and Nishiyama, K - *Work schedule differences in sleep problems of nursing home caregivers*
Collins, JA and Knowles, SR - *Exploring the relationship between psychological well-being, family contentment, and job satisfaction amongst nurses and their partners.*
Thorne, H; Hampton, S; Morgan, L; Skene, D and Arendt, J - *Differences in sleep between two (18.00-06.00 h and 19.00-07.00h) offshore shift schedules?*
Jungsun, Park - *Working time in Korea: The results of 2006 Nationwide Working Conditions Survey*
Romeiser, H and Gaertner, J - *Visualizations for the design of shift systems*
Extended working hours
Rotenberg, L; Banks, B; Griep, RH and Landsbergis, P - *Paid and domestic work among nurses: another aspect of extended work hours*
15.00 Poster Preview Time
15.15 Tea/Coffee
15.30 **Extended working hours**
Iwasaki, K; Sasaki, T; Otsuka, Y and Mori, I - *Association of long working hours with sleeping hours, sleepiness, fatigue, and depression among Japanese workers*
15.45 Lauridsen, O; Bjerkebaek, E and Danielsen, I - *Work hours and serious occupational injuries in the Norwegian offshore industry*
Chair – Naomi Rogers and Shantha Rajaratnam
Sleep Symposium
16.00 Torbjörn Åkerstedt - *title TBA.*
Wright, KP; Dinges, DF; Roth, T; Arora, S; Walsh, JK and Czeisler, CA - *Influence of internal circadian phase on excessive sleepiness and behavioral alertness in patients with shift-work sleep disorder (SWSD)*
Gander, PH; Briar, CJ; Garden, AL and Woodward, A - *Gender and the effects of work patterns on junior doctors*
Steven Lockley - *US resident work hour limits adversely impact patient safety and resident health*
16.45 **Personal/email time**
19.00 **Buffet Dinner – Billabong Restaurant**
20.30 **Shiftwork/sleep disorder discussion –** *venue to be advised*
Title: Early Shift Starts and Shift Work Sleep Disorder
Presenters:
Kenneth P Wright Jr. - *University of Colorado at Boulder [Introduction]*
Torbjörn Åkerstedt - *IPM & Karolinska Institute*
Giovanni Costa - University of Milan
Charles A. Czeisler - *Brigham and Women´s Hospital, Harvard Medical School*
Mikko Härmä - *Finnish Institute of Occupational Health*
Anders Knutsson - *Mid Sweden University*

Thursday, 30th August

7.30 Registration desk open
8.55 Housekeeping
9.00 **Chair: Sally Ferguson**
Keynote - *Stephen Popkin* - *An age old question: are current transportation operator age restrictions prudent or necessary?*
Measuring individual differences
9.45 Knowles, SR and Tucker, P - *Evidence for the process model of shiftwork: review of the standard shiftwork index (SSI) and survey of shiftwork (SOS) literature.*
10.00 Dahlgren, A; Åkerstedt, A; Åkerstedt, T; Kecklund, G and Theorell, T - *Day-to-day variation in saliva cortisol and its relation to stress, sleep, physical exercise and other factors*
10.15 Tea/Coffee
Chair: John Axelsson
Measuring individual differences
10.45 Rotenberg, L; Griep, RH; Fischer, FM and Landsbergis, P- *Working at night and work ability among Brazilian nurses at public hospitals: when contractual employment makes the difference*
11.00 Åkerstedt, T; Connor, J and Kecklund, G - *Predicting accidents from the three-process model of alertness regulation*
11.15 Lowden, A and Åkerstedt, T - *Full spectrum light intervention to promote alertness and sleep in Adolescents*
11.30 Signal, TL; Ratieta, D and Gander, PH - *Managing Fatigue in a More Flexible Regulatory Environment: The New Zealand Aviation Industry*
11.45 Ferguson, SA; Lamond, N and Dawson, D - *The impact of short, irregular sleep opportunities at sea on the alertness of marine pilots working extended hours.*
12.00 ***Social Activities - Island Cruise or Garden/Zoo Tour***
17.30 **Personal/email time**
19.00 Conference Dinner
Jucarra/Golden Cane/Alexander Rooms

Friday, 31st August

7.30 Registration desk open
8.55 Housekeeping
9.00 General Assembly - **Giovanni Costa**
Chair: Claudia Moreno
Age and responses to working hour
9.45 Marquié, JC; Ansiau, D; Tummino, S; Rico Duarte, L and Blaise, D - *Ageing, shift work, and sleep disorders: results from the VISAT longitudinal study*
10.00 Elmerich, K; Karl, D; Knauth, P and Watrinet, C - *Multiperspective shift rota evaluation*
10.15 Tea/Coffee
Chair: Phil Tucker
Age and responses to working hour
10.45 Loudoun, R and Allan, C - *An examination of the temporal pattern of adolescent work and injuries sustained at work*
11.00 Richardson, K - *Age and working hours: creating safe environments for child workers in Queensland*
11.15 Bourgeois-Bougrine, S; Folkard, S; Mollard, R and Beslot, P - *Flexible work hours and age*
11.30 Closing Keynote - **Philippa Gander - *Who is too old to do shiftwork? Developing better criteria***
12.00 Symposium Close
12.30 Lunch

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Influence of Internal Circadian Phase on Excessive Sleepiness and Behavioral Alertness in Patients with Shift-Work Sleep Disorder (SWSD)

Predicting accidents from the three-process model of alertness regulation

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Objective

Mathematical models for alertness or performance prediction have been developed to estimate the consequences of deviation from normal sleep/wake patterns. They usually contain a component that accounts for the circadian influence (time of day) and a second component that accounts for the homeostatic influences due to time since prior awakening and duration of prior sleep. Several models of this type have been developed and are reasonably well validated against (laboratory) performance measures. The most important validation, that pertaining to safety, has not been carried out. The purpose of the present work was to use existing accident data for validation of the Sleep Wake Predictor (Åkerstedt et al 2004).

Method

Accident data were obtained from the Auckland Accident Car Crash Injury Study (Connor et al 2002) . 571 crashes were investigated with interviews on prior sleep pattern, alcohol etc. A similar amount of control subjects were cluster sampled at all times of day and surveyed in the same way. The time of accident and the time of retiring and awakening from prior sleep was sent (blinded with respect to accident or control group) to Karolinska Institutet. The data for each individual were fed into the SWP for a prediction of sleepiness at the time of the crash/survery. The predicited sleepiness was then sent to the University of Otago for a logistic regression analysis using accident/ no accident as outcome and predicted sleepiness as the main predictors. The results were adjusted for age, gender, alcohol intake, ethnic group and educational level.

Results

The logistic regression showed that predicted sleepiness from the SWP model was is a highly significant predictor of the log-odds of crashing ($p<0.001$) with an Odds Ratio of 1.72 and 95% Confidence interval of 1.40-2.10. The OR represents the (exponential) increase in risk for each step on the 9-level output scale. Thus, a one-unit increase in predicted sleepiness increases the odds of crashing by 1.72. A level 9 (very high sleepiness) on the scale would involve an OR of 76, using level 1 (extreme alertness) as the reference. However, normal alertness levels during daytime activities preceded by normal sleep would be at level 3 or 4, and using the former as the reference level the risk at level nine would be 25.9.

Discussion

The results indicate that predicted output from the SWP is a highly significant predictor of accident riskt. It also suggests that the predictor algorithms may be useful feed-back output from sensor devices developed for sleepiness and sleep monitoring.

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Modifying the three-process model of alertness regulation to account for accumulation of fatigue

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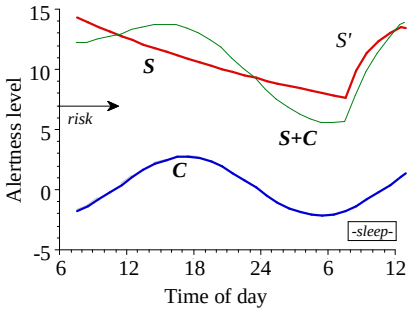


Objectives

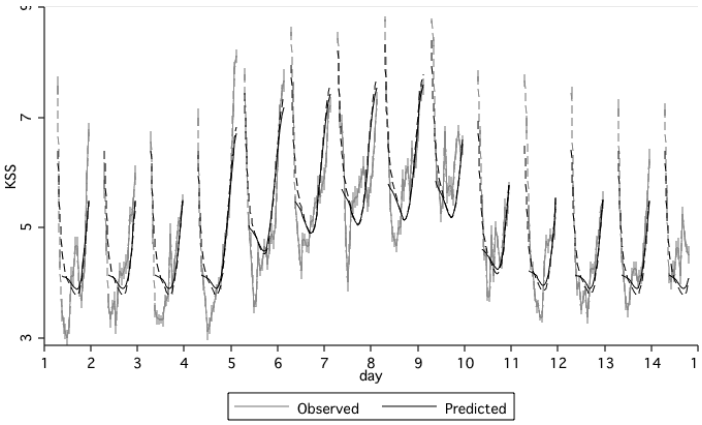
Mathematical models for alertness or performance prediction usually contain a component that accounts for the circadian influence (time of day – labeled "C") and a second component that accounts for the homeostatic influences due to time since prior awakening ("S") and duration of prior sleep ("S' ") (see figure left). For prediction S and C are added. Most models, however, have problems accounting for accumulation of fatigue during for example partial sleep loss since the speed of recovery (S') is inversely exponential, meaning that at high levels of sleep loss the recovery function becomes too steep and recovery becomes too fast account for accumulation of fatigue. The present study was designed to find a way of adjusting the steepness of S'.

Method

Data was obtained from a partial sleep deprivation study where 9 young and healthy males participated with 3 days of normal sleep (23h-07h), 5 days of restricted sleep (03h-07h) and four days of recovery sleep (23h-07h). Sleepiness ratings were collected every hour awake using the Karolinska Sleepiness Scale (KSS, 1=very alert, 9=very sleepy, fighting sleep, difficult staying awake). The idea was to change the exponential s' function into a linear one at some point at which this would permit an accumulation of fatigue. Predictions were made from the model, with the level of the break function varied from 6-14.2 in steps of 0.1. To estimate the optimal function, regression analyses were performed to evaluate the fit of the predictions of sleepiness (KSS) in terms of the smallest root Mean Squared Error (RMSE). To evaluate the model on the subject level, a set of mixed effects regression analyses were performed.

Results

The results showed that a break level of 12.2 yielded the lowest RMSE. The constant (a) and coefficient (b) for the linear transformation between the alertness score predicted by the model and KSS ratings was estimated to a=8.54 and b=-0.37. The resulting fit of the prediction to empirical sleepiness is illustrated in the figure to the left. Sleep loss occurs on days (5-9).



Discussion

Preventing the exponential recovery function from becoming too steep at low levels of alertness by switching it to a linear function seems to make it possible to describe accumulation of fatigue during partial sleep loss.

Subjective sleepiness during partial sleep loss depends on the context

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Objective

The increase of subjective sleepiness during partial sleep loss seems to be less dramatic than, for example, performance impairment. The reasons may be that the immediately preceding activity might affect ratings. The present study sought to compare ratings during 5 days of 4h sleeps after different types of activities.

Method

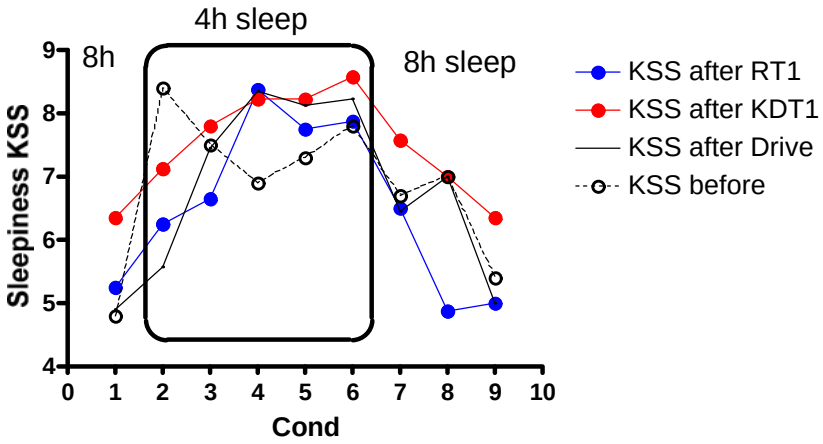
9 subjects were exposed to 5 days of 4h sleep (PSD) with a 3-day baseline and a 7 day follow-up. The subjects spent most of the time in the lab but were permitted to leave on certain days. Here sleepiness ratings using the Karolinska Sleepiness Scale (KSS, scale 1-9 very alert to "very sleepy, fighting sleep, an effort to remain awake") are presented. Ratings were obtained before a test battery and after a further: 5 minutes with open + closed eyes (Karolinska drowsiness test – KDT), a 30min driving simulator test, and a 6 minute reaction time test. All ratings were made during a one-minute break between tests, except for the "before" value which was obtained after breakfast. The data were analyzed using a repeated measures ANOVA with phase of experiment (baseline, fifth day of sleep reduction, third day of recovery) and type of activity as factors.

Results

The effect across days was highly significant ($F_{2,14}=38.7$, $p<.001$ after Huyhn-Feldt correction) as was the effect of activity ($F_{2,14}=17.8$, $p<.001$), but not the interaction ($F_{4,28}=1.3$, ns) (see figure below). The eyes closed activity varied from 5.8±.4 at baseline to 7.9±.3 the 5th day of sleep reduction to 5.6±.4 on the 3rd day of recovery. For the driving simulator the values were 4.7±.3, 7.7±.3, and 4.7±.2 and for reaction time 4.9±.3, 7.6±.3, 5.9±.2. The ratings 10 min after the test when the subject has moved from the test station to another station and interacted with the experimenters indicate a reduction of 1.7 units during the 5th day of PSD.

Conclusion

Subjective sleepiness during partial sleep loss will depend on the preceding activity, with maximum at the end of low level stimulation (KDT). Thus, the context needs to be controlled for when obtaining subjective ratings (as is normally done with performance or physiological measures)



The Influence of stress upon Brazilian aviation technicians´ sleep

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Keywords: sleep, maintenance technicians, stress, working conditions

Introduction

It is a common issue in aviation literature that many aspects may influence human performance and jeopardize safety. Fatigue, stress and some consequences of shiftwork are considered important factors to be investigated. In fact, stress has been considered, very often, an important contributor to accidents and incidents in the workplace. Therefore aviation community is concerned in developing strategies to minimize the effects of stress and its impact on sleep quality. Most accidents in the aviation context occur between 12am until 6am.

Objective

The aim of this study is to identify the influence of stress upon Brazilian aviation technicians´ sleep.

Methods

A cross-sectional research was developed with 436 maintenance technicians, aged 23 – 48 years old. The sample was probabilistic within a population of 1116 workers. For data collection, two questionnaires were used: Adults Stress Symptoms Inventory (Lipp, 1998) and Standard Shiftwork Index (SSI; Barton, Spelten, Totterdell, Smith, Folkard, & Costa, 1995) -modified by researchers at CAMI.

Results

The results showed that there is a significant relation between stress and some characteristics associated with sleep quality, such as; a) difficult to fall asleep (OR= 1,60; $p<0,025$); b) sleep disturbances caused by shiftwork (OR= 1,53; $p<0,05$); c) falling asleep during the day (OR=2,11; $p<0,01$); and, the uncontrollable need to sleep in inadequate moments (OR=2,02; $p<0,01$).

Conclusions

These results are consistent with the findings of Paulich et al (2005) that suggested that stress and sleep disturbances are strongly related to each other ($p<0,001$). In order to increase aviation safety it ´s crucial to develop programs concerning periods of controlled breaks during their work journey.

Sleep duration, sleep time and study efficiency in university students

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Background

Sleep duration plays an important role in the efficiency in a job. However, the difficulties in evaluating job efficiency prevent from examining the role. We suppose the changes in the scores of practical examinations before a certifying examination are useful to evaluate the study efficiency, since the changes in the scores directly indicate the outcome of learning for the certifying examination. We investigated the relationship among their sleeping hours, study hours and the changes in the practical examination scores in university students preparing for a certifying examination.

Methods

A questionnaire survey was conducted of 66 female students aged 21 to 23 yr, who all were preparing for a certifying examination for a national registered dietitian. The data of 53 students were available. The survey included items regarding usual sleep time, including bedtime and wake time, nap hour, and study hours, as well as the 2 scores of preparing examinations which were held 4 months ago and last month. We examined the relation of the answers for the items in the questionnaire to the increase rate of the score.

Results

The average of sleeping hours of the 53 students was 7.2 ± 0.8 (mean ± S.D) hours. The shortest hours was 5.8 hours, and the longest was 9.0 hours.

The relationship between the changes in the scores and the study hours was significant by χ-square test ($p<0.005$). The students who study longer than 1 hour per day showed the significant rise in the scores, while the students less than 1 hour did not show the rise. There was no significant relationship between the sleeping hours and the study hours.

Two students slept less than 6 hours, actually 5.8 hours, and had the greater rise in the score, compared with the other students, but it was not statistically significant. The relationship between the sleep duration and the changes in the scores showed no significances in the all students.

Bed time and wake time had no significant relation to the changes in the score. However, bed time showed the significant relation the score of both examination ($p<0.05$, both). The earlier they went to bed, the better marks they got.

There were no significant differences in the changes in the scores between with and without nap.

Conclusion

The changes in the practical examination scores in university students preparing for a certifying examination did not show any significant relations to sleep duration, bed time, wake time, nor study hours. It may be because the sleep duration more than 96% students were within 6 – 9 hours in this study. To confirm whether the changes in the scores are useful to evaluate the study efficiency, we are going to study on the students with more various sleep duration in the next step investigation.

This study also revealed that the students who went to bed earlier had better scores. Students preparing for examinations may be recommended for early bed time.

5 days with partial sleep restriction: effects on performance and ratings of sleepiness and effort

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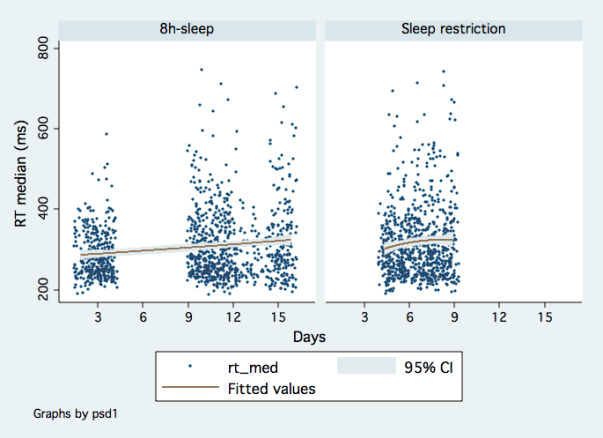
Well controlled laboratory studies show that neurobehavioural performance deteriorates across days when sleep is restricted to 6 hours or less. However, the possibility to generalise these results to the outside world are limited as the subjects are carrying out extensively long and monotonous test batteries and are, in addition, only exposed to limited sunlight, typically less than 100 lux. Hence, the aims were to study the effects of restricted sleep on performance and subjective ratings in a more natural environment with shorter and fewer tests and in subjects who were outside twice each day, but not exposed to sunlight 30 min before testing.

Nine healthy men with a mean age of 24 years participated in the protocol that included 11 night sleeps in the sleep laboratory, 1 habituation day (sleep 23.00-07.00h), 2 baseline days (23.00-07.00h), 5 days with restricted sleep (03.00-07.00h) and 7 recovery days (23.00-07.00h), of which the first 3 and the 7th night were spent in the lab. Simple reaction time tests (6min) were conducted at 08.00, 14.00 and 20.00h each day. Ratings of sleepiness and effort were made after each test. All data were analyzed using mixed models ANOVA and with subject as a random factor.

Although there was a large individual variation for all reaction time measures (intercept, p's<.01), there were no significant differences across days, neither for median, 1/mean, slowest 10% or lapses (responses >500ms; Figure 1 illustrates all median reactions on minute level across the protocol). On the other hand, ratings directly after each reaction time test changed dramatically. Sleepiness" (Karolinska Sleepiness Scale), "fighting sleep" as well as "effort to manage test" and "boredom" increased significantly across days (p's <.05) and time of day (p's p<.05). However, none of the subjective variables differed significantly between individuals. Subjective ratings increased across days with chronic sleep restriction and decreased across recovery days.



In this study, several days with restricted sleep did not affect short-lasting performance. In contrast, subjective sleepiness and effort increased across days with sleep restriction. This contradicts earlier laboratory findings, but also suggests that subjects can compensate performance impairment on short lasting tests through increased mental effort, i.e. fighting sleep attacks. The results may explain the lack of effects of shift work on performance in field studies that normally is found. Long-lasting performance tests carried out in the sleep laboratory may lack ecological validity, and the performance impairment may be related to monotony and lack of cognitive effort as well as sleep loss.

Light exposure patterns and biological adjustment to early working times among indoor and outdoor workers

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Natural light exposure has important resetting effects on the biological clock. One could suppose that this exposure could promote a better adjustment between biological rhythms and early working times among outdoors diurnal workers. In this present study this adjustment was evaluated through the differences between actual and ideal timing of sleep and work. The aim of this study was to compare the relationship between actual and ideal timing to sleep/to work on diurnal workers exposed to different light conditions. The study was conducted with 2 groups of workers (n=12) from a rural area in Paraná, Brazil. One group worked indoor (n=6, mean age 27.5 yrs; SD=4.9) exposed to a range from 130 to 760lx and the other worked outdoor (n=6, mean age 35.33 yrs; SD=2.9) exposed to 20,000lx all day long. The working time of the group indoor (IEG = indoor environment group) was 08:00-18:00h from Monday to Friday, and Saturday from 08:00-16:00h. The other group (OEG = outdoor environment group) works only from Monday to Friday (07:00-17:00h). The workers filled out a morningness-eveningness questionnaire (Horne & Östberg, 1976) and filled in sleep diaries during 9 consecutive days. A t-test for independent samples was carried out in order to compare morningness-eveningness scores between the two groups of workers. Differences between the actual and ideal sleep timing (onset and offset), and differences between the actual and ideal sleep duration were calculated, comparing the two groups (OEG and IEG) according to the day of the week. The mean score of the morningness-eveningness questionnaire was 66.5 (SD=8.0) for the OEG and it was 47.8 (SD=8.9) for the IEG. This difference is statistically significant according to the t-test ($p<0.001$). The OEG would like to postpone the working time by 10 minutes, while the IEG would postpone by 100 minutes their actual working time. The differences between actual and ideal timing can be seen on the table below.

	Weekdays	Weekends*				
Groups	SONTdiff	SOFFTdiff	TSDdiff	SONTdiff	SOFFTdiff	TSDdiff
OEG	-33	158.3	193	-170.3	26.7	197.1
IEG	62.8	175	112.2	-7.5	75.4	82.9

Only Sundays were considered for the IEG. SONTdiff: Ideal sleep onset minus actual sleep onset; SOFFTdiff: Ideal sleep offset minus actual sleep offset; TSDdiff: Ideal total sleep duration minus actual total sleep duration.

The workers exposed to natural light during working time are earlier types than the workers from the indoor group. This fact could explain why the differences between the ideal and actual working time are smaller on this group, considering they started to work one hour earlier than the IEG. We detected larger group differences on sleep onset than sleep offset. These differences seem to be more prominent during the days off work. Natural light exposure could thus be associated to better adaptation to early working hours. During weekends social influences seem to impact more strongly.
Support: FAPESP Grant: 05/57597-2.

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What Aspects of Shiftwork Influence Off-Shift Well-being of Healthcare Workers?

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The length, timing and stability of work schedules are features of shiftwork that have implications for time, physical resources, and emotional resources that workers have at their disposal to meet family and personal responsibilities and to engage in valued roles outside work. With this in mind, the ramifications of shiftwork for off-shift well-being were explored in a study of healthcare workers from Australia, Brazil, Croatia, and the USA. We examined the extent to which shiftwork features (including length of daily shifts, number of work days per week, length of the work week, and stability of shift schedules) are associated with three aspects of off-shift well-being: work-to-family conflict, personal health, and depletion of mental resources. Because the challenges that various shiftwork characteristics create for workers may depend on work contexts that differ among nations, we also investigated whether relationships between shiftwork features and off-shift well-being differed among the four nations that participated in the study.

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 developed and administered to samples of healthcare workers in Australia (n=217), Brazil (n=170), Croatia (n=189), and the USA (n=438). Off-shift well-being was assessed with a measure of work-to-family conflict (WFC), an index of physical and mental health (Healthy Days), and an index of mental well-being drawn from the Work Ability Index (Mental Resource Depletion). Setwise hierarchical multiple regression was used to test the hypothesis that shiftwork characteristics account for unique variance in well-being, beyond that accounted for by work demands, family demands, and personal characteristics (age, marital status). As hypothesized, shiftwork characteristics accounted for significant unique variance in all three measures of off-shift well-being. The pattern of standardized regression weights indicated that particular shiftwork characteristics have differential relevance to indices of work-to-family conflict, personal health, and mental well-being. Unique effects of shiftwork characteristics were most pronounced in the Australian and USA samples for WFC, and in the USA sample for Healthy Days.

Our findings provide support for the position that healthcare organizations should carefully consider the implications of shiftwork characteristics for the well-being of workers in the larger sphere of their family and personal lives. Because prevailing job demands, off-job demands, and demographics for healthcare professionals differ in systematic ways among nations, effective solutions may be context-specific.

Metabolic syndrome in permanent night workers

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Background
Nigh and shift work can be risk factors for metabolic and cardiovascular disorders due to interference with diet, circadian metabolic rhythms and life styles.

Aim
We explored the relationship between permanent night work and metabolic and cardiovascular risk factors in a retrospective longitudinal study of workers employed in a large municipal enterprise in charge of street cleaning and domestic waste collection.

All subjects who had been working on night shifts in the period 1976-2005 as hand sweepers, motorsweeper and delivery tricar drivers, have been compared with the subjects who always worked in the same jobs but on day shifts.

Methods
From the periodical medical surveillance files, we identified 489 male workers, who have been examined on average 5 times (min 2, max 13) in the period, for a total of 2,006 medical examinations: 161 had worked always on day shifts, 12 always on night shift, and 316 on both, initially on day and subsequently on nigh shifts. Their age ranged from 17 to 60 years, and work seniority from 1 to 22 years.

Lifestyle habits (smoking, alcohol consumption), body mass index (BMI), serum glucose, total cholesterol, tryglicerides, hepatic enzymes, blood pressure, rest electrocardiogram, diabetes, coronary heart disease, hypertension, and related drugs were taken into consideration for the analysis.

We used generalized estimating equations (GEE) models (exchangeable correlation matrix) to analyse the relationship between night work and health effects while accounting for within-subject correlations and adjusting for study period, job, age and lifestyle.

Results
As a whole, nightworkers smoked more, had significantly higher BMI, serum total cholesterol and triglycerides, and showed a higher intake of anti-hypertensive, hypoglycemic and hypocholesterolemic drugs as compared to dayworkers.

Both the inter-individual comparison between day and night workers and the intra-individual comparison among the workers, who were day workers at the beginning of their employment and later became night workers, showed a significant increase in BMI, total cholesterol, and tryglicerides associated to night work. No consistent effect was seen on glucose, hepatic enzymes and blood pressure.

A decrease in serum lipids and blood pressure was recorded in the last five years: this may suggest the efficacy of preventive interventions introduced at the time.

Age, experience and time-of-day effects on cognitive performance in control room shiftworkers

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Ageing leads to the deterioration in many cognitive functions, especially those making the demands to the velocity of information processing. At the same time, occupationally vital functions like as semantic or logic memory, the possibility to compare, to group or combine the information could be maintained in mental workers by years. On the other hand, circadian variations in cognitive functions could interact with the multiyear changes. The purpose was to reveal the age and experience related changes in cognitive performance of control room shiftworkers at different time of day.

Cognitive performance was tested in 37 control room shiftworkers (aged 24-56) at a heat power plant during 8-hour shifts (375 subject-observations) and analysed at $p<.05$.

Complex visual motor reaction (CVMR), efficiency of information processing under time pressure (EIPTP), rings cancellation (RC) and reversal of attention (RA) worsened at any time of day with ageing and also with an increase in general work experience, less pronounced – with an increase in control room shiftwork experience. In this, age related correlations were found to be determining in regard to CVMR deterioration at any time of day, also EIPTP, RC and RA – at night, RC – in the morning shift. General experience related correlations were found to be determining in regard to deterioration in EIPTP, RC, RA and short-term memory (STM) for numbers and words in the evening shift, also EIPTP and RA – in the morning shift.

The most pronounced age-experience deterioration in CVMR, EIPTP, RA and STM was found in the evening shift, in RC – at night. STM and RA show the lowest scores in the evening shifts within the circadian cycle manifesting this period of day as a "biorhythmically weak" for this functions. Possibly, evening shift is also the most weak time of day to resist the negative multiyear changes in these occupationally vital cognitive functions. CVMR, EIPTP and RC showed no significant inter-shift changes within the circadian cycle. Nevertheless, velocity of information processing is the main target function in CVMR and EIPTP tests. This function along with the nerve conduction velocity was shown in literature to be the best in the evening. The minimal resistance to any signal / influence conduction could cause also the minimal resistance to the negative age-experience changes irrespectively professional demands. On the other hand, high dependence of RC efficiency on ageing at night could disclose this time of day as the most weak or sensitive one in regard to age deterioration in ability to concentrate the attention to select the information.

Thus, control room shiftworkers' ageing leads to the deterioration in cognitive performance at night, partially – in the morning shifts. Increase in general work experience is related mainly to the deterioration in cognitive performance in the evening, and partially, in the morning shifts. Increase in control room shiftwork experience does not determine the multiyear changes in cognitive performance for the worse, probably, owing to the training of professionally vital functions. Hence, age-experience indices contribute to the forming of multiyear circadian changes in cognitive performance in its specific manner. In this, general experience aggravates the age caused negative effects in some parameters at certain biologically sensitive time-of-day periods. The revealed regularities could be used to distribute the professional tasks between team members of different age and experience.

Multiple Jobbing or One Job: A Comparative Cost-Benefit Analysis in a Health Care Industry

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This study compares nurses working fulltime in one hospital with those nurses who choose to work in multiple, casual or part-time jobs and examines the costs and benefits of each choice. The crisis in turnover in the nursing industry has created opportunities for nurses to choose their working hours, shift schedules and places and conditions of employment. While some choose to maximise their income working up to 80 hours per week across multiple sites, others choose to work part-time hours that align more closely with their personal circumstances, such as childcare needs, etc. Yet others, choose to work in more traditional fulltime jobs on one site. This study compares the work life conflict, health effects and job satisfaction associated with these various choices and considers the impact these choices may have on the teams in which they work and the health care industry more generally. This study uses structural equation modelling to examine these variables on a sample of 1800 nurses working in 3 large metropolitan hospitals. The results indicate that the benefits of some choices outweigh the costs and vice versa. For example, those nurses who choose to work part-time hours of less than 30 hours per week, minimise their work life conflict but experience less support from co-workers. Those who choose to maximise their income often do so at the expense of their physical and psychological health and exacerbate the conflict between their work and home environments. Full time staff working on a single site experienced the greatest levels of co-worker support but often experienced the highest levels of work life conflict. The implications of these choices for the health care industry are discussed.

Differences between more and less tolerant night healthcare workers, in relation to the mean concentration of urinary 6-sulphatoxymelatonin, sleep duration and sleep quality on work and off days

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Objectives
To compare more tolerant and less tolerant night healthcare workers as to the mean concentrations of urinary 6-sulphatoxymelatonin, sleep quality and sleep duration on work and off day.

Methods
Three registered nurses and nine nurse assistants, all healthy females, agreed to participate (mean age: 35.7 y old; SD ± 9.3). The shift schedule was 12h night shift (19:00-07:00h) followed by 36 h off; twice a month nurses had one extra off day, resulting in three consecutive free nights. Urine was collected during waking in two different periods of four consecutive days, with and without an extra off day. The concentrations of 6-sulphatoxymelatonin were detected by ELISA, and were adjusted by mg/ml of creatinine. Participants wore an actigraph to monitor activity-rest times and filled out a daily log with a 10cm visual analogue scale to register perceived sleep quality. Sleep episodes were classified in two groups: diurnal and nocturnal sleep. Nurses were classified as more tolerant (n=8) and less tolerant (n=4) to night work based on the following parameters: perception of fatigue, sleep disturbances, sleepiness, insomnia, minor psychic disorders, and reduced availability of free time off-work. Workers presenting at least two of the aforementioned symptoms were considered less tolerant to night work. Mean comparisons were performed by Wilcoxon and Mann-Whitney tests, for dependent and independent samples, respectively.

Results
Among less tolerant workers, mean and ± SD concentration of 6-sulfatoxymelatonin per mg creatinine for working days, off days and extra off day were 52.23 ± 40.69ηg/mg, 79.18 ± 57.62ηg/mg and 92.20 ± 100.81ηg/mg, respectively. Significant differences were detected among working days and off days ($p<0.05$) and working days and extra off days ($p<0.05$). No significant difference was detected as to comparisons among more tolerant workers ($p>0.05$), with mean values of 85.24 ± 103.30 ηg/mg, 92.7 4± 81.53ηg/mg, and 95.19 ± 78.87 ηg/mg for working days, off days and extra off day, respectively. No significant difference in sleep duration was observed between more and less tolerant workers, neither for diurnal nor for nocturnal sleep. Subjective quality (mean ± SD) of diurnal sleep on work days was lower ($p<0.001$) for the less tolerant (4.5 ± 1.5) than for more tolerant (7.5 ± 0.80) workers. Similar results were observed for nocturnal sleep, with mean values of 7.1 ± 1.7 and 9.2 ± 0.5 for less and more tolerant workers, respectively. On days off, the less tolerant group showed lower subjective sleep quality for nocturnal sleep ($p<0.001$).

Conclusions
The **s**tudied variables showed different outcomes between the two groups, suggesting the procedure here used may be useful to classify workers as to their tolerance to night work.

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Effects of nap on sleepiness of nursing personnel submitted to 12- hour night shift

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Introduction

In Brazil, nursing personnel are usually submitted to 12- hour night shifts. Those who are under night and longer shifts can experience a chronic sleep debt and fatigue.

Objective

The aim of this study was to evaluate the effects of a nap during the work shift on sleepiness of nursing personnel submitted to 12-hour night shifts.

Methodology

Twelve female workers (3 registered nurses and 9 nurse aides/technicians) were selected to participate. They work at a University Hospital in São Paulo, Brazil, and held only one job (12 hour night shift [19:00h/07:00h] followed by 36 hour-off). Mean age was 35.7 years (SD ± 9.3 years). All participants answered the Karolinska Sleepiness Scale (KSS) every 3 hours since they were awake during the whole study period. Workers also wore an actigraph and filled out a daily log to register the sleep episodes during two periods of 4 days, one included an extra day off. This study compares data collected only during two night periods: 00:00h to 03:00h (1st span) and 03:01h- 06:00h (2nd span). They were allowed to take a nap during the night shift between 00:00h and 06:00h. The workers did not take a nap in all working nights, so the same worker was sometimes included in the "nap group" and sometimes not. If the nap happened between the two spans, just the second span was included at nap group data. The sleepiness levels were compared during the two spans for those who took a nap and those who remained awake. Non-parametric Mann-Whitney test was used to analyze the mean sleepiness levels.

Results

The sleep offset prior to night work was up to 10:00 a.m. and they did not sleep in the afternoon before going to night shift. The mean nap duration during the night shifts were 138.3 min (SD ± 39.8 min). The results of KSS were: for the 1st span, the mean sleepiness level was 3.3 (SD ±1.6) when the workers took a nap and 6.6 (SD ± 1.0) when they remained awake. At the 2nd span the means of sleepiness level were 3.6 (SD ± 0.9) when they napped and 7.0 (SD ± 1.1) when they did not. The sleepiness increased significantly (1st span $p<0.001$ and 2nd span $p<0.001$) on both spans compared when they took a nap and when they didn't.

Conclusions

Night workers might reach long awaken times, around 20 to 22 hours, at the end of a night shift if they are forbidden to sleep at work. This fact associated to a chronic sleep debt and a poor quality of daily sleep episodes, usual for night workers, might lead the sleepiness to critical levels, being one of the main causes of work-related accidents and incidents. To avoid this critical situation it is necessary to discuss the work organization at the hospitals, and the impact of the night shifts upon the workers´ health. The results presented here showed that napping during the night shift is related to reduce sleepiness levels among night workers.

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Flexible work hours and age

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Objective
This study formed part of a European project called EQUAL that aims to tackle discrimination and inequality at work based on factors such as age, sex, disability, etc. The aim of the present study was to analyse the response to flexible work schedules of highway toll collectors according to their age, and to implement a set of chronobiological rules for better scheduling.

Method
The study had two main phases. First, analyses were undertaken of the work schedules of a total of 145 workers over a period of 4 months. Secondly, questionnaires and interviews were used to evaluate the feelings of the workers and their wishes with respect to the main features of their work schedules. Fifty-nine workers participated in this survey. Of these, 63% were female, 76% were married and 63% had children. Their average age was 43 years and their average experience of shift work was 16 years.

Results
The analyses of the work schedules indicated that there were several kinds of shifts with great variability in their timing and duration. The rosters had no specific pattern or rhythm, there were as many rosters as workers. The monthly ratio of shifts to days off varied from 0.74 to 2.86 indicating an uneven distribution over the 4 months. The number of consecutive shifts varied from 1 to 9, and the distribution of days off was essentially random (e.g. 1 day off after 6 shifts, 4 days off after only 1 or 2 shifts, etc.). Finally, we identified a number of problematic shift sequences.

With respect to the survey results, the reported effects of work schedules on sleep and fatigue confirmed reports in the literature, i.e. sleep duration was low (<6 hours) before morning shifts and after night shifts. Fatigue was highly correlated with sleep deprivation. The main difference related to age was a significant increase in the amount of recovery sleep during days off in older workers (³ 45 years). Regarding health, females and younger workers (£ 45 years) showed significantly higher complaints of gastrointestinal disorders than males and older workers. Job and work hour satisfaction were significantly higher for older workers (³ 45 years). Amongst the problematic shift sequences, the following were the most tiring: (i) morning shifts (starting at 4 or 5 am) following a night shift without a day off; (ii) 6 consecutive shifts; and (iii) up to five early morning shifts in row.

Conclusions
The various shifts were intended to cover the highways' traffic variations over the day, week and year. The analyses of the work schedules resulted in the elaboration of a set of practical recommendations that should not interfere with the scheduling of shifts but should help in optimising the "distribution" of these shifts across the workers. Training sessions were conducted to help the work schedule designers to implement these recommendations. In addition, the survey results suggested that the young workers had greater problems in reconciling their flexible working schedules with their family life, probably because of the presence of small children. This result emphasises the need for good practices to help young workers to reconcile their work and private life.

The Impact of Emotional Intelligence on Shiftworkers Health

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This study reports on the effectiveness of a 3 year intervention study aimed at improving shift-working nurses' tolerance of shiftwork by improving their working environment and job satisfaction in a private metropolitan hospital. Researchers from the project team conducted a series of intervention workshops in 2005, preceded by a baseline survey (time 1) and a follow up survey (time 2) that evaluated the changes, using structural equation modelling and analysis of variance, that could be attributed to the intervention. In total 68 nurse managers attended one of 3, two day intervention workshops that focused on building their capacity to understand their own emotions and the emotions of others and manage their own and others emotions more effectively. Workshop participant's emotional skills or emotional intelligence predicted their ability to increase the support they could provide to their team and the way they managed their staff. The knowledge, insights and skills gained from the workshops improved the effectiveness of these nurse managers and resulted in positive changes in their behaviour. This in turn, resulted in nurse managers providing increased support to their teams, decreased work life conflict and improved health in shift-working team members. The results of the time 2 survey indicate that the intervention workshops have had a significant impact on not only those staff that attended the workshops but on the staff that they manage. This paper will discuss the intervention content and reasons for its effectiveness.

Factors affecting work ability in day and shift working nurses

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Background
Satisfactory work ability is sustained and promoted by good physical and mental health, as well as by favourable working conditions.

Aim
This study was aimed at assessing whether work schedule significantly interacts with satisfaction with working time, good sleep, motivation, work perspectives and adequate on-the-job rewards in affecting work ability among European nurses.

Methods
The study sample consisted of 7443 nursing staff (registered and aid nurses) from 7 European countries (BE, DE, FR, IT, NL, POL, SLK), working in state-owned and private hospitals, involved in the follow-up of the Nurses' Early Exit Study - NEXT (1). 85.9% were women, 14.1% men; their age ranged from 18 to 63 years (mean 37.2) and work seniority from 1 to 43 years (mean 14.5). 10.8% were dayworkers, 4.2% permanent nightworkers, 21% shiftworkers without nights, and 64.1% shiftworkers with nights. Subjects were administered a questionnaire at baseline (T0) and one year later (T1). The Work Ability Index - WAI (2) at T1 was used as outcome, while sleep, rewards (ERI), satisfaction with pay, work motivation and involvement, satisfaction with working hours and career perspectives, as measured at baseline, were considered as potential determinants of WAI. Univariate and multivariate regression analyses were carried out after adjusting for the following confounders: country, age, sex, type of employment (fixed/temporary), family status (single, with children, with adults, with adults and children), and possibility to find another job in the same area.

Results
As a whole, prevalence of satisfaction with working time was the highest in dayworkers (86%), and it gradually lowered in shiftworkers without nights (77%), permanent night workers (69%), and shiftworkers with night shifts (62%; Chi square=232.1, p<.001); however, scores on motivation and satisfaction with pay were the highest in permanent nightworkers and the lowest in rotating shiftworkers. Permanent nightworkers showed the lowest sleep but the highest reward scores.

Irrespective of work schedule, all potential determinants considered were significantly associated with work ability (p<.001). Work schedule significantly impacted on work ability in interaction with rewards [$F_{(3,5957)}$=7.55, p<.000], intrinsic motivation [$F_{(3,6030)}$=5.20, p.<001], and satisfaction with working time [$F_{(3, 5957)}$=2.91, p=.03].

Conclusions
When attempting to sustain and promote a satisfactory work ability of their staff, organizations should also consider, besides work time scheduling, the necessity to safeguard sleep and support subjective motivation, adequate work perspectives and self-mastery.

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Exploring the relationship between psychological well-being, family contentment, and job satisfaction amongst nurses and their partners

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The current investigation explored the impact shiftwork on shiftworker well-being and the family unit. Thirty-six casual nurses and their partners completed a series of questionnaires assessing the impact of shiftwork on the shiftworker and the family unit. Specifically, differences in individual psychological well-being (stress, anxiety, and depression), family contentment (relationship satisfaction, and work-family/family-work conflict), and job satisfaction across Nurse type (specialist vs. general) and Couple (Nurse vs. Partner) were assessed. As hypothesised, results revealed a trend indicating that specialist nurses reported higher levels of work-family conflict, family-work conflict, stress, anxiety, and slightly lower levels of relationship satisfaction and job satisfaction in comparison to general-medical nurses. However, contrary to expectation, general-medical nurses reported slightly higher levels of depression when compared to specialist nurses. As expected, when compared to partner's perceptions of general-medical nurses, partners of specialist nurses reported higher levels of work-family conflict, family-work conflict, stress, anxiety, and depression. Additionally, as expected, partner's of specialist nurses reported lower levels of relationship satisfaction when compared to partners of general-medical nurses. Finally, partner's reported perceiving shiftworkers' as experiencing significantly higher levels of stress when compared to shiftworkers own reported levels of stress. The findings of this investigation have provided further evidence for the substantial impact shiftwork has upon the family unit, specifically, the nursing population. Theoretical and practical implications of the current investigations findings will be discussed.

Interactive effects of shiftwork, age and work stress on health and well-being

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Introduction
While being a relevant risk factor in itself, shiftwork may also interact with age and workplace psychosocial stressors in exerting its potential negative effects on health and well-being. Ageing may decrease tolerance to shiftwork due to reduction in chronobiological, psychophysical, social and work-related adaptability. Moreover, work stress may increase the negative effects of shiftwork on health as it may further impair the capacity to recover due to prolonged physiological internal overactivation, which may be also sustained by cognitive processes such as ruminative and anticipatory thoughts about stressors.

Aim
The aim of this study was to assess, in a sample of non-medical healthcare workers, whether shiftwork on the one hand, and age and work stress on the other hand, significantly interact in affecting several health outcomes such as sleep, chronic fatigue, job satisfaction, work ability, absenteeism, injuries, cardiovascular, gastrointestinal and mental disorders.

Methods
2412 non-medical healthcare workers (nurses, midwives, rehabilitation staff and health technicians), employed in seven state-owned and private hospitals in Northern Italy, were recruited for the study. 1842 workers took part in the survey (response rate=76.4%); 81.3% were women and 18.7% men, with age ranging from 22 to 63 years and work seniority from 2 to 40 years. 49.4% were dayworkers, 4.6% shiftworkers without nights, and 46.1% shiftworkers with nights. The Standard Shiftwork Index -SSI- (1), the Work Ability Index -WAI- (2) and the Effort/ Reward Imbalance -ERI- (3) questionnaires were the main assessment instruments. Data were analyzed by means of multiple logistic regression analyses (Stata 9.2 package), including gender, marital status, number of children and workload as potential confounders.

Results
As a whole, 33.9% of the workers reported poor or moderate work ability, 22.2% chronic fatigue, 15.3% severe sleep troubles, and 10.2% job dis-satisfaction. Effort/Reward Imbalance resulted as the most important predictor of work ability, chronic fatigue, job satisfaction, and gastrointestinal disorders. Shiftwork including nightwork was the most relevant factor related to severe sleep troubles and significantly interacted with age in affecting job satisfaction and chronic fatigue, and with ERI for gastrointestinal disorders. Age had the highest impact on cardiovascular and musculoskeletal disorders, and it was also related to increased absenteeism, job dis-satisfaction and gastrointestinal disorders. Finally, gender was the most prominent factor in predicting absenteeism, and played a significant role also in relation to work ability, musculoskeletal disorders and chronic fatigue.

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Day-to-day variation in saliva cortisol and its relation to stress, sleep, physical exercise and other factors

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Objectives
The aim was to describe the day-to-day variations in cortisol within individuals. Furthermore we wanted to explore how the day-to-day variation in cortisol was related to variables such as self rated stress, fatigue, sleep, exercise and alcohol. Moreover, the objective was to examine what characterised the days with the highest morning values of cortisol.

Design
During four consecutive weeks participants made diary ratings and provided saliva samples for cortisol analysis each day. Saliva samples were made at awakening, fifteen minutes after awakening and at bedtime.

Methods
Fifteen subjects (mean age 45±12 years) participated in the study. For logistic reasons they were recruited from the Karolinska Institute. Each day they also filled in a diary reporting their awakening and bed times, sleep quality, workload, fatigue, stress, health, alcohol intake and physical exercise.

Results
The results indicated considerable variation in cortisol values within subjects but also between subjects. Results from multiple regression analysis showed that differences between individuals could describe 28.5 % of the day-to day variation in cortisol at awakening, 25.2% at 15 minutes after awakening and 18.5% for values taken at bed time. T-test comparisons between the day with the highest and the lowest values of cortisol fifteen minutes after awakening showed that the high cortisol day was associated with being mentally energetic (not being worn out or exhausted), ease of awakening and good subjective health. There were no significant differences in stress, sleep quality or length, physical exercise or alcohol. On-going analyses of the day-to-day variation using multiple regression analysis showed similar results. After controlling for individual differences and time of sampling it was shown that higher cortisol levels at 15 minutes after awakening were associated with less sleepiness at awakening (Beta=-0.12, R^2 change=0.01, $p<0.05$). The levels of cortisol at bed time showed the opposite pattern. High cortisol levels at bed time were associated with feeling worn out (Beta=-0.13, R^2 change=0.013, $p<0.02$), exhausted (Beta=0.13, R^2 change=0.013, $p<0.02$) and poor health (Beta=-0.24, R change=0.029, $p<0.001$). Furthermore was a long working hours (Beta=0.13, R^2 change=0.013, $p<0.04$) and late finishing time (Beta=0.13, R^2 change=0.012, $p<0.04$) were associated with higher cortisol levels at bedtime.

Conclusion
Cortisol values within individuals varied from day-to-day. High levels of cortisol fifteen minutes after awakening were associated with being mentally energetic and ease of awakening and better health, i.e. lower morning values seems to be related to fatigue. High cortisol levels during the evening were associated with long working hours and symptoms of being worn out and exhausted.

Sleep Disorders In Sleep Complainants: Study With Nuclear Power Plants Shiftworkers

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Objective
It is widely recognized in the literature that shift workers present more health complaints than the general population. This study aimed at diagnosing the various sleep complaints of shift workers at the two Brazilian Nuclear Power Plants.

Methods
328 shift workers participated in the study. They worked in three shifts: afternoon (15:00 to 23:00hrs), morning (7:00 to 15:00 hrs) and night (23:00 to 07:00). We carried out a subjective evaluation through the application of a sleep questionnaire (De Mello et al., 2000). Based on the results, the interviewers who reported sleep-related complaints more than three times a week were referred to a Polysomnographic Evaluation. Out of the 328 volunteers initially evaluated, 158 were referred to Polysomnography.

Results
Out of the 158 volunteers, 122* workers presented some kind of sleep disorder, being: 35 regarding Obstructive Sleep Apnea Syndrome (OSAS) and 30 regarding Periodic Limb Movement and Restless Leg Syndrome (PLM/RLS). 57 presented an association of the two disorders, and 34 presented no sleep disorders.

The table below presents the distribution of the workers and the means of the indices according to the severity of the disorders:

Severity of the Disorder	OSAS (n - mean)	PLM/RLS (n – mean)
Mild	26 – 9,72	27 - 11,85
Moderate	7- 19,80	2 – 34,50
Severe	2 – 38,80	1 – 63,2

*All the workers with a diagnosis of sleep disorder were referred to treatment.

Discussion
The present study shows that 37,19% of the population evaluated present some sort of sleep disorder. This high index should be analyzed together with other aspects such as working hours, working schedule, time performing shift work and access to health services. In this sense, due to the strong association between sleep disorders and the incidence of fatigue and sleepiness, and therefore a higher probability of accidents, the evaluation of the sleep patterns and complaints of shift workers is essential, and should be faced as one of the basic strategies in the accident prevention plan of the companies.

Key Words
Sleep Complaints; Sleep Disorders; Shift Workers; Polysomnography.

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Australian Nurses' Sleep and Errors

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As in other shiftworking industries, nurses work extended and unpredictable hours which render them vulnerable to fatigue-related impairment. Currently, there is a paucity of information regarding Australian nurses' sleep and fatigue levels, and whether performance and safety are affected. A recent pilot study (n=23) indicated that Australian nurses experience sleepiness and related physical symptoms at work and during their trip home. Further, results suggested that reduced sleep was associated with increased error likelihood (1). This study expands on this initial pilot work.

Forty-one full-time nurses in an Australian metropolitan hospital completed daily logbooks for one month (total of 1148 days, 693 work days). Nurses recorded their scheduled and actual work hours, sleep length and quality, sleepiness and fatigue levels. Frequency and type of nursing errors, near errors, and observed errors (made by others) were recorded as well as a short narrative describing the circumstances surrounding each error.

Nurses reported problems falling asleep, frequent arousals and waking too early on approximately one third of work days (30%, 35% and 29% respectively). Struggling to stay awake was reported during 32% of shifts. Moderate to high levels of stress, physical exhaustion and mental exhaustion were reported on 27%, 42% and 39% of shifts respectively. On 70 occasions, extreme drowsiness when driving or cycling home was reported, with seven near accidents. Overall, 40 errors, 44 near errors and 63 observed errors were recorded. While the majority of errors were perceived to have minor consequences, there were 33 associated with moderate and seven with potentially severe consequences. Nurses had significantly less sleep during the 24 hours prior to shifts where an error or near error was reported ($t_{87.9}$=-1.98, p£0.05).

Results are consistent with the pilot analyses (1), suggesting that reduced sleep, stress and exhaustion may negatively impact on the safety of nurses and patients in Australian hospitals. Ongoing analyses further examine the relationships between work hours, sleep, fatigue and errors.

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Multiperspective Shift Rota Evaluation

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As demographic change progresses, resulting in an increasing diversification of workforces and the workers' personal needs, employee-oriented working-time models are becoming indispensable for maintaining and promoting the employees' health and, consequently, their work ability in the long run. It is true that all shift workers are exposed to the same stresses in objective terms as they have to work at times that are not congruent with the diurnal periodicity of essential bodily functions and clash with the habits of society. At the same time, the extent of each individual's exposure depends on intervening factors and their interactions.

Against this background, an investigation in one of the enterprises participating in the DFG research project 'KRONOS' concerned itself with the question of whether any differences might result if shift rotas were investigated from various perspectives (family, leisure, health) as well as in relation to sociodemographic data. For this purpose, talks were conducted with experts (n = 14) to identify items on which the evaluation might focus and to obtain indications of the existence of groups with different needs. Following this qualitative analysis, all employees involved were given information about ergonomic recommendations on shift-rota design. This item was included in the design of the study to ensure a comparable level of knowledge among the sample. The next step was an employee survey (n = 104) which addressed the following issues:

- Working time
- Stress at work (standard shiftwork index)
- Sleep and fatigue (standard shiftwork index)
- Health and well-being (work ability index)
- Shift rota evaluation
- General biographical data

The results of this quantitative analysis include, first, a consideration of ergonomic criteria such as, for example, a low number of successive night shifts (cf. Knauth, 2005) from the family, health, and leisure perspective and, second, the evaluation of these characteristics in relation to sociodemographic data. At the same time, certain factors were extracted whose individual assessment was analysed.

In parallel with the empirical survey, existing evaluation models were analysed for their potential usefulness in a multiperspective evaluation of shift rotas.

The results demonstrate that age as such is not an adequately distinctive criterion in the design and evaluation of shift rotas. Rather, other individual data need to be consulted as well to develop employee-oriented shift rotas that enable people to grow older at work without losing their health.

Long-term Time Accounts and Demographic Change – a Critical Assessment

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The consequences of demographic change and the expiry of the partial-retirement arrangement in 2009 are motivating German enterprises to develop alternative options to current leave-of-absence schemes, particularly for older employees. One approach that is much debated at the moment but has hardly been researched empirically so far is long-term time accounts. They are supposed to enable employees to combine early retirement with additional leaves of absence during their professional lives (e.g. for educational purposes).

Under a DFG project entitled 'KRONOS – life working-time models, their opportunities and risks for enterprises and employees', the first analytical step consisted of talks with experts (n = 19) to explore long-term time accounts in two German enterprises. Enterprise 1 had been practicing this concept on exempt employees for two years when the investigation was launched. For enterprise 2, a concept for industrial long-term time accounts was developed under the project. The qualitative survey focused on the following aspects:

- Opportunities to add to and withdraw from accounts
- Advantages and drawbacks of long-term time accounts
- Attractiveness to specific groups of persons
- Launch strategies
- Relevant success indicators
- Implementation of long-term time accounts

Based on the qualitative analysis, an opinion poll was conducted among employees on the above-mentioned issues (n = 52) to identify relevant impact and success factors from which adequate recommendations on the design of long-term time accounts could be derived.

Results show that it is not helpful to introduce long-term time accounts solely for the purpose of facilitating early retirement, as this is not attractive enough. While this approach may serve to replace partial retirement to some extent, it ignores the other opportunities offered by this model. All in all, long-term time accounts should not be considered an all-round tool to counteract the effects of demographic change as it is to be feared that both the health and the social life of workers might be impaired by self-exploitation for the purpose of amassing a time account.

Thus, this analysis offers guidance with regard to the consequences of restricted account-crediting and debiting options and the establishment of a demography-oriented overall strategy in an enterprise.

The impact of short, irregular sleep opportunities at sea on the alertness of marine pilots working extended hours

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The aim of this study was to examine the impact of brief, unscheduled naps during work periods on alertness and vigilance in coastal pilots along the Great Barrier Reef (GBR). A series of guidelines govern the working time arrangements of this group of coastal pilots with the specific emphasis on sleep opportunity and fatigue-related risk. However, on certain routes the duration of the work period can extend well beyond 24-hours. Thus, during work periods, the coastal pilots must manage their own levels of fatigue-related risk. A major method for doing this is through the use of frequent, opportunistic short naps. As coastal pilots utilise a range of skills and competencies known to be affected by fatigue, it was important to determine whether the napping strategies being employed were effective in managing fatigue.

Seventeen coastal pilots volunteered for the study, representing almost one third of the pilots contracted to work in the areas of compulsory and recommended pilotage. Participants collected sleep/wake and performance data for 28 days using a sleep and work diary, the palmPVT task during work periods on ships; and wore the activity monitor for the entire period. Data were analysed using SPSS v11.0.2. For each sleep period, an objective record of Time in Bed and Total Sleep Time was obtained from the activity monitor data, in combination with the sleep diary data. Separate mixed model Analysis of Variance (ANOVA) were used to systematically assess differences in sleep and fatigue measures. Systematic changes in performance on the palmPVT were assessed separately using mixed model ANOVA.

The average length of sleep on board was 1.4±1.0 hours in an average time in bed of 1.9±1.2 hours. For 76% of sleep periods on board the length of the sleep period was less than two hours. The naps were taken regularly such that the average length of time awake between sleep periods on board a ship was 5.3±4.3 hours with a maximum of 19.8 hours. There was no change in performance on the palmPVT measured using mean reaction time or lapse frequency across either the length of a pilotage or across the 24-hour day.

The results indicate that even though the naps were taken opportunistically, they tended to cluster at the high sleep propensity times. Further, frequent, opportunistic naps appeared to provide adequate recovery such that PVT performance remained stable. Pilots did report increases in subjective fatigue ratings at certain times of the 24-hour day and at the end of a work period, however these did not reach the high range. The fatigue-risk minimisation strategies employed by AMSA and the coastal pilots appear to be effective in maintaining alertness an vigilance while on board.

The burden of teenage work: effects on sleep duration

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Objective
The aim of this study is to assess the factors associated to reduced sleep duration among high school students.

Methods

This is a cross sectional study carried out in a public school, in a middle class neighborhood in São Paulo, Brazil. All students aged 14 to 21 years attending school in the evening (19:00h to 22:30h) were invited to participate in this study. Out of 565 students, 491 students participated in this study and answered two questionnaires: a questionnaire about living and health conditions (including sleeping habits and sleeping times) and questionnaire about working conditions. The last questionnaire was answered only by the students who reported work (73.9%) or unemployment (11.9%) at the time of the data collection. Unemployed students reported information about their last job. Initially the data were submitted to descriptive statistics (frequency distributions, means and standard deviation). The data was submitted by the Shapiro-Wilk test to detect its normality. The variables were first tested using univariate linear regression. Those showing $p<.20$ were selected for the multivariate linear regression. A stepwise forward selection was performed. In all analysis it was considered a=5%.

Results
The multiple linear regression model showed a significant association ($p<.001$) between daily working times (over than 6.1 hours) and reduction of sleep duration from Monday to Thursday.

Considering the interval 6.1-8.0 hours of work, the sleep duration decreases 41.16 min ($p=.003$). Above 8.1 hours of daily work, the reduction of sleep worsens: 80.56 min ($p=.000$). The sleep duration for those who did not work was higher compared to those who work: 142.08 minutes ($p=.000$). The regression analysis showed that office boys, clerks and housekeepers had an associated factor for higher sleep duration, respectively, 29.01 min ($p=.045$), 29.48 min ($p=.027$) and 88.36 min ($p=.000$), compared to receptionist, general helper and telemarketing operator. Those who reported tiredness in the morning showed reduced sleep duration: 13.87 min ($p=.002$). Those who reported alcohol consumption (1-5 g alcohol per kilo) showed higher sleep duration: 72.22 min ($p=.000$). The final model was adjusted by age, sex and smoking habits.

Conclusions
Teenage work has negative effects on sleep duration, and it is mediated by demographic and life style variables. These effects can compromise educational, social life and work of adolescents.

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Do permanent night workers show circadian adjustment?

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"Permanent" or "fixed" night shifts offer a potential benefit over rotating shift systems in that they may serve to maximise circadian adjustment, and hence minimise the various health and safety problems associated with night work. Various authors have argued in favour of permanent shift systems (1), but their arguments assume at least substantial, if not complete, adjustment of the body clock. While conceding that rapidly rotating systems were the most popular, Wilkinson concluded that permanent shift systems were certainly better with respect to sleep duration, and marginally so with respect to the other measures (1).

There are, however, substantial problems in assessing the degree of adjustment to permanent night work based on either day sleep duration or physiological rhythms such as body temperature that comprise both endogenous and exogenous components. We have therefore reviewed the literature on the adjustment to permanent night work of the circadian rhythm in the secretion of melatonin, which is generally considered to be the best known indicator of the state of the endogenous body clock. We deliberately excluded studies of workers in "abnormal" environments such as oil-rigs and remote mining operations since they might serve to assist adjustment.

The results of this review indicated (i) that only a small minority (<10%) of permanent night workers shows evidence of "good" adjustment of their endogenous melatonin rhythm to night work, (ii) that less than one-third of permanent night workers show evidence of sufficient adjustment to derive any benefit from it, and (iii) there is no evidence of a gender difference in the adjustment to permanent night work. We conclude that in normal environments permanent night shift systems are unlikely to prove beneficial for most individuals.

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Should we encourage shiftworkers to shorten their last night's sleep before their first night shift?

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A member of the UK's Health and Safety Executive recently came across a shiftworker who deliberately shortened their last night's sleep before their first night shift in order to facilitate a nap during the afternoon prior to that night shift, and asked us about the advisability of this strategy (1). This seemed to us to be an extremely interesting question since there would appear to be three important parameters that will interact in determining the advisability of this strategy. Thus the last night's sleep could be shortened by going to sleep later than normal, by waking up earlier than normal, or by a combination of the two. Further, the extent to which the night sleep is shortened will clearly be important, as will the length of the nap taken during the afternoon.

We have used the three-process model of alertness (2) to attempt to answer this question. We simulated shortening the night sleep by 0-4 hours (in one hour steps), either by delaying sleep onset or by advancing wake-up time, and allowing an afternoon nap of between 0 and 120 minutes (in 30 min steps). The simulations clearly indicate that shortening the night's sleep by delaying sleep onset results in considerably less increase in sleepiness on the night shift than a similar shortening by advancing wake-up time. This stems from the fact that the individual will have been awake for longer if they advance their wake-up time. Perhaps more importantly, our simulations indicated that an afternoon nap can more than compensate for this increase in sleepiness due to shortening the night's sleep, although longer naps were needed if sleep was shortened by advancing wake-up time. Thus a 30-minute nap more than compensated for a 2-hour shortening of the night's sleep when sleep onset was delayed, but only for a 1-hour shortening when wake-up time was advanced. Likewise, a 90-minute nap more than compensated for a 4-hour shortening of the night's sleep when sleep onset was delayed, whereas a 120-minute nap was needed to do so for a 4-hour shortening when wake-up time was advanced.

The results of these simulations suggest that the strategy of shortening the night's sleep prior to the first night shift in order to facilitate the taking of an afternoon nap may indeed be an appropriate one. However, its appropriateness clearly depends crucially on whether it does indeed facilitate the taking of an afternoon nap. It should be emphasised that taking an afternoon nap without restricting the previous night's sleep would be even more beneficial. Finally, our results were based on the use of the three-process alertness model and would clearly need to be verified in field studies before this night sleep shortening strategy could be recommended.

1. Lucas, D. (2006) Personal Communication to SF dated 10/7/2006
2. Åkerstedt, T., Folkard, S. & Portin, C. (2004) Predictions from the three-process model of alertness. **Aviation, Space and Environmental Medicine**. 75 (Supp. 1), A75-A83.

A Fatigue/Risk Index to assess work schedules

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This paper will describe our recent development of new Fatigue and Risk Indices for the UK's Health and Safety Executive. These indices are designed to be user-friendly and to allow users to assess the likely fatigue and risk associated with any given work schedule, in particular 24/7 operations, using a simple spreadsheet. Both of the indices are based on literature reviews and take account of recent developments in the field, especially those related to cumulative effects.

The Fatigue and the Risk Indices were both constructed from three separate components. The first is a cumulative component (C) which reflects on the pattern of work leading up to any given shift. The second is a duty timing component (T) which reflects on the start time of the shift in question, its length, and the time of day throughout the shift. The third is a job type / breaks component (J) which relates to the workload and work pace of the activity being undertaken, its requirement for continuous attention, and the frequency and duration of breaks during the shift. In both Indices these three components are combined to give an estimated value for each shift within a sequence. Summary tables are also available that give the mean, minimum and maximum estimated values over the entire sequence of shifts.

The new Fatigue and Risk Indices provide users with a simple method for assessing and comparing work schedules based on the sophisticated mathematical modelling of trends in fatigue and risk measures. A particular strength of the Indices is that they take account not only of basic sleep/wake regulation factors such as time awake and circadian phase, but also of shift length, cumulative fatigue and the job type/breaks pattern. The output can inform users' decisions about the desirability of particular work schedules, and the Indices allow the user to vary the various parameters of a work schedule until fatigue and risk are judged to be within acceptable limits.

Observations of high variance of actual staffing and workload within(!) shift systems

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Objectives

It is well known that actual working times of shift workers vary between shifts, but also due to overtime, on-call duties, etc. Earlier work addressed the analysis of corresponding working hours of individuals over several weeks, e.g., (1). This analysis focuses on the actual working hours of employees over long periods of time and on the variance in their workload.

Approach and methods used

We analyzed actual working times of 30 organizational units (the number of employees per unit varied between 15 and 500). The primarily Austrian and German organizations were from the healthcare (approx. 50%), transport (approx. 30%), production (electronics), retail and cleaning industries. The records of all working hours (including overtime, etc) for each employee over a long period of time (at least ½ year, typically 1-2 years) formed the basis of the analysis. The records were provided by the companies directly from their HR-systems or operational systems; these records should include all paid times and be relatively reliable (with the possible exception of unpaid overtime). In approx. 50% of the cases information on the services provided by these organizational units was also available.

The method used in the analysis consisted of two main steps. The first step comprised a cleansing and normalization process (e.g., considering bank holidays, missing data, and erroneous data). In the second step we applied time projections of the data by applying a specialized software package (Time Intelligence Solutions).

Results obtained

1) Actual staffing for the same time of the day, day of week varied strongly between weeks. A variation of up to +/- 20% was quite usual, often higher (e.g., the actual staffing of physicians varied in the most extreme case for the same time of day from 11 to 17 physicians – with outliers as low as 9 or as high as 19). We found strong variance of actual staffing in 26 out of 30 units analyzed.

2) It was not leave on very short notice that contributed most strongly to this variation of staffing.
3) In those cases where we had data on actual service provided, the expected or actual services provided had little or no correlation with the number of employees at work.
4) The ratio of work/staffing varied in several cases tremendously over the day.

Conclusions

It seems highly probable that such variations in the relation of work/staffing have an impact on health and safety. Correspondingly, it seems reasonable to extend descriptions of shift systems, questionnaires regarding workload, and the design of experiments to consider such variations of actual staffing. In scheduling, workload should be considered in shift design and short term scheduling, as well as in building up reserves to minimize very high workload situations.

1. Gärtner J., Popkin S., et al. (2004). Analyzing Irregular Working Hours - Lessons Learned in the Development of RAS 1.0 - The Representation & Analysis Software. **Chronobiology International**, 21(6), 1025-1036.

Designing proper shifts & rosters – a case study in the field of care for the elderly

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Objectives

The design of shifts, i.e. the begin and end-time of duties and staffing levels, is the basis for the design shift systems and, especially in the service industry, is quite a difficult task. Many decisions have to be made and the relative importance of ergonomic recommendations with respect to each other has to be evaluated under the specific circumstances. This is done by example of a real case study. The idea is not to go for a single best solution but to exemplify approaches.

Approach and methods used

The case study will be sent to the mailing list of the Working Time Society and will be for open participation. Questions by participants and answers regarding the case will be published on the website of the Working Time Society (www.workingtime.org) and shown during the poster session. Each participant is asked to describe a solution for the shifts/staffing as well as for the shift system/roster and to give a reasoning for his/her choice, optionally also a brief description of the software used. The author of the case either does not participate or will be the first to publish a solution (depending on the preferences of other participants). The contributions may be the basis for a later joint publication.

The case

The organization provides care for very senior citizens who are no longer able to live at home. Correspondingly, the employees cover a range of tasks– from housekeeping to low level medical care. The residents live in rooms/ small flats for six months to one year and receive food and other services. After this time they often have to be taken to hospital; many pass away.

The demand for a unit of 20 patients is equal on all days of the week. From 07:00 - 4 employees are needed until - 10:00, then - 3 employees are needed until 12:00; 4 - 13:00, 2 - 17:00; 3 - 19:30; 2 - 20:30; 1 - 07:00 (so in total it is 50 hours of work every day and 350 hours per week). Shifts/ staffing that do not meet this demand profile are not permitted. As this organization is in a rather poor financial situation, overstaffing is allowed for at most 10 hours per week.

The number of employees for this unit is 12; they work approx. 30 hours a week. Payment is low; a reduction of the weekly working hours is not possible. The maximum shift length from a legal point of view is 12 hours, however, employees think that this is very demanding. Each shift that is more than 6 hours long has to include 30 minutes of breaks. Employees may work different hours per week as long as they reach the average working hours throughout the shift cycle.

Simplifications: Breaks are paid. It is not necessary to plan for substitution for when employees are on their breaks (i.e. if staffing needs require 2 persons, and one person is on their break, it is not necessary for another person to cover the break). It is not necessary to plan for different qualifications or part-time work. It is not necessary to deal with sick leave or vacation. Several legal requirements are not considered.

Results

The results will be shown during the poster session at the conference and on the website of the Working Time Society (www.workingtime.org).

Conclusions: Will be drawn at the conference.

Time Intelligence Solutions 1.0 – TIS: A collaborative approach between open source and proprietary software development

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Objectives

The working hours and workload of employees, particularly in the service industry, vary widely from day to day and week to week. With the dissemination of planning software and time & attendance systems as well as other processing systems, such as the times of customer calls, events and sales data – large data sets with information on actual working hours as well as information regarding the actual workload were created. In order to use this data for risk analysis, demand forecasting, scheduling, etc., made to measure software solutions are necessary.

The objectives of Time Intelligence are twofold: 1) to facilitate the development of company specific analysis and planning tools and 2) to facilitate the development of add-ins by third parties. The core idea here is that a group that excels e.g. in a specific risk modelling or forecast should not have to deal with other issues like data-import, printing, user rights management, etc. It should be possible to focus on one's core tasks, without necessarily sharing these algorithms, while using the other elements.

Approach and methods used

From a technical point of view, several interconnected and innovative concepts were applied. 1) A very general concept of operations that are applied on data sets is used (similar to spreadsheets where functions are applied). The storage, import, export, update etc. is done by the software automatically. Operations can be anything that produces numbers and/ or graphics (e.g., a forecast, a statistical function). 2) With little additional knowledge, third parties can develop and maintain their own operations (e.g., input parameters for the operation can be specified via a simple XML-definition, the input window is then generated). The advantage is that every operation that is developed within this framework (and that is not defined to be proprietary) can be used by anyone working on the platform. 3) Company specific solutions can be developed quickly by applying operations to data and by defining various user roles and rights with an extensive user-rights management system.

Results

The software supports the fast, interactive analysis of large time-related data sets and is used by approx. 10 companies for planning and controlling (2007/03). Furthermore, it is used extensively in consulting. The software scales well, 500,000 records can be processed in seconds. It is easy to import data sets and append them later on with automatic updates of calculations. More than 80 'public' operations are available, most of them very powerful. Three companies and three research organisations are developing software within this framework (e.g., operations for visual analytics, data mining, optimisation, evaluation of schedules, demand).

Conclusions

From a technical and intellectual property rights point of view, the platform allows for a collaborative software development. It will be interesting to see in which areas this approach will be successful.

Gender and the effects of work patterns on junior doctors

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Introduction and Objectives
As in many countries, the proportion of women in the New Zealand medical workforce is steadily increasing, from 20% in 1984 to 35% in 2004, at which time 51% of house officers were women (1). However, little consideration has been given to possible gender differences in the effects of the work demands of medical training, although issues regarding work-life balance are starting to be raised (2).

Methods
In 2003/2004, a survey was mailed to all registered Resident Medical Officers nationwide. Questions addressed how often participants got enough sleep and woke feeling refreshed (choices: never, rarely, often, always), the Epworth Sleepiness Scale (ESS: ref 3), sleepiness while driving, and recall of fatigue-related clinical errors. Participants were also asked "In general, to what extent does your work pattern cause you problems with your social life? home life? personal relationships? and other commitments?" (choices 0='not at all' to 4='very much': ref 4), They were also invited to make written comments.

Results
Respondents included 1366 RMOs working ≥ 40 hrs/week (response rate 63.4%). As expected, women (48.5% of participants) were over-represented in some specialties (obstetrics and gynaecology 72%; paediatrics 65%, pathology 59%), and markedly under-represented in surgery (28%). Overall, they were less likely than men to report living with dependents (20.0% versus 34.1%; c^2=31.9, p<0.0001). Men were more likely to live with children (0-5 yrs, c^2=45.6, p<0.0001; 6-12 yrs, c^2=14.3, p<0.001). However, women were more likely to live with people older than 60 yrs (c^2=5.2, p<0.05).

Women were more likely to report never/rarely getting enough sleep p(c^2)<0.05), never/rarely waking refreshed p (c^2)< 0.001), excessive sleepiness (ESS>10: p(c^2)<0.05), and that work caused problems with their other commitments (p(c^2)< 0.05). Being female was a significant independent risk factor for excessive sleepiness (OR=1.37, 95% CI=1.00-1.87), after controlling for work patterns, having dependents at home, commuting time, and age.

Conclusions
These findings suggest that medical training affects women disproportionately with regard to effects on life outside work, including women being less likely to have children and more likely to report inadequate sleep and excessive sleepiness (ESS>10). In contrast, in the general NZ adult population, being male is an independent risk factor for ESS>10 (5). Since the majority of students entering medicine are now women, these issues need to be better understood and addressed.

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Sleep and Sleepiness of Fishermen on Rotating Schedules

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Introduction and Objectives

Between 1985-2000, the death rate on New Zealand fishing vessels was estimated to be 33.4 times higher than the estimated average death rate for all occupations (1), with fin fishing accounting for 80% of the fatalities and about 20% of the fishing workforce. Seafarer fatigue has been estimated to contribute to 16% of critical vessel accidents and 33% of personal injury accidents in maritime operations (2). This study monitored sleep and sleepiness of hoki fishermen during peak seasonal workload, with a view to developing fatigue management strategies for this workforce.

Methods

Sleep (wrist actigraphy and sleep diaries) and sleepiness (Karolinska Sleepiness Scale (3) before and after each sleep period) of twenty deckhands were monitored at home and while working 12-hrs on/6 hrs off during trips lasting 5-9 days.

Results

Comparing the last 3 days at home and the first 3 days at sea, fishermen were more likely to have split sleep at sea ($p<0.001$), and the median sleep per 24 hrs was 5.9 hrs, compared to 6.7 hrs at home ($p<0.1$). On 23% of all days at sea, fishermen obtained <4 hrs of actigraphically determined actual sleep, compared to 3% of days at home ($p<0.01$). Sleepiness scores improved less after sleep at sea than after sleep at home ($p<0.05$). For 24% of sleep periods at sea, post-sleep KSS was ≥7, compared to 10% of sleep periods at home ($p<0.01$).

Conclusions

On a quarter of days at sea, the 12-on/6-off roster was accompanied by high levels of acute sleep loss, and there were high levels of residual sleepiness after sleep (KSS ≥ 7), suggesting that that impairment due to acute and cumulative sleep restriction (4,5) would have been relatively common.

Fatigue and shift work are workplace hazards that must be managed under New Zealand occupational safety and health legislation, which was extended in 2003 to cover seafarers. Recommendations to reduce fatigue-related risk in these operations include: that crews maximise their sleep before trips, since very short sleep was not uncommon particularly on weekend nights on shore; that a tri-partite committee develop and monitor contingency planning for occasions at sea when the majority of the crewmembers become extremely sleep restricted; and that all staff associated with the fishing fleet receive fatigue risk management education.

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Three different shift schedules worked offshore: timing and production of 6-sulphatoxymelatonin, sleep and light exposure

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Introduction

Our objectives were to assess timing and possible suppression of the melatonin rhythm as 6-sulphatoxymelatonin (aMT6s) in urine, during 3 shift schedules worked on oil rigs, and to identify any factors predicting circadian responses. Activity/sleep and light exposure were also evaluated.

Methods

The participants (healthy men) worked 14 days (14D), 0600-1800h (N=20, 60°N, February to May), 14 nights (14N), 1800-0600h (N=12, 60°N and 54°N, August to November), 7 nights:7 days (7N7D), 1800-0600h:0600-1800h (N=23, 53°N, 59°N, 60°N, August to March). Throughout the period offshore they wore an Actiwatch-L (Cambridge Neurotechnology, Cambridge, UK) to record light exposure and activity (1min epochs) except 11 of 7N7D group, and collected sequential urine samples (3-4 hourly and oversleep) for circadian phase assessment (peak time, phi, cosinor analysis of aMT6s, RIA). Average daily production of aMT6s for the first week and the second week offshore was calculated. Data from a pilot study of 7N7D, N=11 (2) has been combined with new data to enable a detailed analysis of circadian response. Sleep timing, duration, efficiency and fragmentation were derived from actigraphy using the manufacturers' software. Statistical analysis was by ANOVA, post hoc tests, two-tailed paired Students t-test and linear regression.

Results

14D: no changes were seen in any variable. 14N: aMT6s adapted by delay (phi 5.24±1.66h (D2) to 12.69±1.74h (D13), X ± SD, $p<0.001$), with increased aMT6s production D8 to D13 (15%, $p<0.05$). 7N7D: 19/23 participants adapted to 7N by delay (phi 04.95h ± 2.2h (D2) to 10.90h ± 2.98h (D7) $p<0.001$). During 7D, 6 night adapters phase advanced, 6 phase delayed, 7 showed no phase change. Initial phase offshore (D2) predicted rate of adaptation to 14N ($p<0.05$) and rate and direction of adaptation to 7D after 7N (phi, delayers 6.34±1.12h, no change 4.71±1.64h, advancers 2.43±0.65h, $p<0.01$). Dayshift desynchrony was associated with some suppression of aMT6s (20%, $p<0.05$) during bright daylight exposure. Sleep duration was short in all schedules (14D, 6:16±70, 14N, 6:22±62, 7N7D, 6:04±70 h:min) compared to published values in healthy men, with few differences in other sleep variables.

Conclusions

Initial circadian phase and light exposure influence adaptive responses to different shift schedules offshore. Adaptation to night work led, during subsequent daytime activity, to desynchrony and some melatonin suppression in most subjects. Strategies to hasten readaptation to days are required.

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The interference of flexible working time with the circadian rhythm as a predictor of impairment to health and well-being

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Objectives

Previous research has shown that classifying flexible work schedules according to their periodic components can be used for predicting impairments to health and well being (Giebel et al., 2004). The question, however, is whether health impairments can even better be predicted using the suppression of certain periodic components of the flexible work schedules as well as their interference (phase shift) with the circadian rhythm of biological processes, here modelled e.g. by the temperature rhythm.

Methods

Work schedules from a survey on flexible work hours (Janßen & Nachreiner 2004) have been converted into time series indicating working hours and time off work. Together with a time series of the mean temperature rhythm these time series have then been submitted to univariate as well as bivariate spectral analyses, in order to determine the power of the 24 and the 168 h components in the work schedules and their phase shift of the 24h component with the respective component in the rhythm of the body temperature. These parameters were then related to reported physical impairments using multiple regression analyses.

Results

The results show that (1) a suppression of the 24 and the 168 h components in the work schedules, i.e. a lack of periodicity, can predict some of the reported physical impairments, and (2) that even if there is still a relatively strong 24 h component in the work schedules, their phase shift with the temperature rhythm, as compared to "normal" working hours, also predicts impairment, but where the association is specific for specific impairments. It becomes obvious that for predicting physical impairments more complex models need to be developed and tested.

Conclusions

The results indicate that the amount of physiological desynchronisation induced by flexible work schedules – here operationalized via the interference of work hours with the temperature rhythm, – can be used for predicting the amount of impairment to the well being of the worker.

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Changing shifts at Corus: a choice between health and leisure?

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Corus, an international steel and aluminium producer, has started a new shift system for all shift workers of the company in the Netherlands. Following the company policy on health and safety, the new system consists of a forward rotating, short cycle in stead of the old backward rotating long cycle roster. It is the largest changeover in shiftwork in the Netherlands. The new system was democratically chosen by the workforce and started in September 2006. An evaluation will be finished in March 2007, after which the results will be presented to the workforce and a new election will take place for the continuation of this new system.

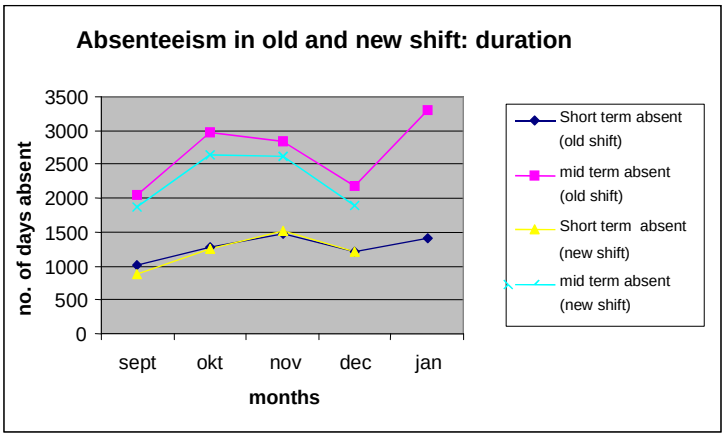
In order to evaluate the outcome of the new shift system data are gathered from all shiftworkers (4800) and non-shiftworkers (3500) within the company. Figures on absenteeism, accidents, fatigue, quality of sleep, stomach complaints and stress are compared for these two groups of workers and between two time periods (representing the old an new system). The non-shift workers are used as a comparison to rule out the impact of other health management measures taken by the company.

The results so far are positive in the field of absenteeism: the frequency and duration of short term absenteeism has decreased with 3% and the frequency and duration of mid term absenteeism has decreased with 10% (see the figure); the control group of the office workers showed an increase of 9% in mid-term absenteeism. The other outcomes show more divergent results. The gathering and analysis of the data will continue until March 2007.

In our presentation we will present these results. In addition, differences will be shown between physically demanding and less demanding functions and between age groups.

It appears that the older workers are more positive about the new system then the younger workers. Despite the positive impact on absenteeism and fatigue, experienced by the workforce, those opposed to the new system feel that the new systems leaves them less leisure time than the old system: they use more time for sleep!

The presentation will also discuss the dilemmas that became visible in the process of implementing a healthier work schedule in a democratic way.



Sleep complaints, physical activity and shift work as predictors of weight gain: a 10-year follow-up of Finnish industrial employees

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Objectives
The prevalence of obesity and insomnia has increased considerable among the working population during the last decades. The current study aimed to examine the effect of insomnia, physical activity and some work-related factors like shift work and physical work load on weight gain among industrial employees

Methods
A cohort of 902 participants was drawn from the group of 4570 metal engineering employees by systematic sampling. The increase in body mass index (BMI) during 10 years (from 1973 to 1983) was predicted by the difficulties in falling asleep/waking up at night or the occurrence of nightmares during the past 12 months, using a multivariate logistic regression. The change in BMI was classified as small (< 1.5) or higher (≥ 1.5).

Results
Among women, those with difficulties in falling asleep/waking up at night had a 2.8-fold (95% confidence internal 1.3-6.2) risk for higher weight gain after controlling for age, BMI, marital status, smoking, physical exercise, healthy choices of food, depressive symptoms, shift work and physical work at baseline. Age was not related to the weight gain of women but shift work and physical work combined with the sleep complaint had an additive effect on the weight gain (3.96, CI 1.47-10.68, compared to subjects with day- and mental work and with no sleep complaints). Sleep complaints did not predict weight gain among men.

Conclusions
It is concluded that insomnia is a powerful predictor of weight gain among working women. Shift work alone was not an independent predictor but the interaction of shift work and insomnia had a strong association with future weight gain.

The effect of a 6-6 and 4-8 watch system on sleepiness among watch keeping officers

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Objectives
During the last 10 years, severe sleepiness or falling asleep of the watch keeping officers has been a direct or a contributing factor in a number of naval accidents in Finland. This study aimed to analyze the relationship of the used watch systems to the fatigue of the bridge officers.

Methods
A questionnaire and sleep diary was sent to a representative sample of the Finnish Maritime Officer Association. 185 bridge officers answered a questionnaire of sleep, working hours and safety, including also a Skogby Excessive Daytime Sleepiness -rating (SEDS). 42% of the bridge officers had two 4-hour watches a day (4-8) and 26% had two 6-hour watches a day (6-6). 95 of the subjects filled up a sleep diary during seven consecutive days on the sea. The timing of the watch duties and sleep was recorded, as well as subjective sleepiness every two hours according to the Karolinska Sleepiness Scale (KSS).

Results
17.6% of the subjected had fallen asleep at least once while on duty. Compared to the 4-8 watch system, the officers in the 6-6 watch system were older (median 45 vs. 33 years) and reported more often nodding-off on duty (7.3% vs. 1.5%) and excessive sleepiness (32% vs. 16% with SEDS >14). Based on a logistic regression analysis, high SEDS was significantly related with a probable obstructive sleep apnea (OR 5.7), 6-6 watch system (OR 4.0) and morningness-eveningness while controlling simultaneously several individual and sleep-related factors. Based on the diary, KSS was highest at 04 and 06 (with the mean of 5 and SD of about 2) based on the total of 2850 KSS ratings. In a multivariate analysis, KSS was significantly related with the time of the day, time since awaking, sleep length, and the interactions of the watch systems with age, morningness-eveningness, and the Epworth sleepiness scale (ESS). Severe sleepiness at 04-06 was especially high in the 6-6 watch system among evening types and the bridge officers with high ESS.

Conclusions
The results suggest that the 6-6 watch system is related with a higher risk for severe sleepiness during the early morning hours compared to the 4-8 watch system. Severe sleepiness among watch keepers is a risk for maritime safety.

Ischemic stroke and shift work

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Only a few studies have analysed the potential association between shift work and stroke with inconsistent results [1], [2]. Karlsson et al. (2005) did not find any statistically significant difference between shift and day workers in a Swedish study cohort [1], while Virtanen and Notkola (2002) found shift work to be the most influential factor on the risk for cerebrovascular deaths in a Finnish cohort [2].

Objectives
This study analyses the potential association between shift work and ischemic stroke (IS).

Methods
This analysis was done using a nested case-control study consisting of 138 shift workers and 469 day workers from the Northern Sweden MONICA registry and the Västerbotten Intervention Programme. Logistic regression analysis was used to analyse the risk estimate for day workers compared to shift workers and the risk for IS.

Results
The results did not show any differences between day and shift workers with respect to the risk for IS. The odds ratio did not increase significantly for male shift workers when adjustments were done for high blood pressure or for high job strain. The crude odds ratio for shift workers risk of getting IS was 1.0, 95 % confidence interval (95% CI) 0.6 – 1.8 for both men and women. We tested logistic models both with age as continuous variable and with age groups as an indicator variable, without affecting the result. We also tested blood lipids, job strain and a number of other recognised risk factors for stroke without any affect on the results.

Conclusions
The findings of this study do not indicate a higher risk for shift workers to develop IS compared to day workers. The risk estimate was consistent despite the introduction of a number of recognised risk factors for IS.

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The utility of time – revisited after 25 years

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Objectives

About 25 years ago Wedderburn (1981), Baer et al. (1981) and Baer (1982) independently presented results on the usability of time across the day and the week, showing that there is a distinct pattern in the value of time off work. The resulting pattern clearly indicated that there is something like a social rhythm – representing an evening and weekend society. The results have been confirmed by a study by Hornberger in 1994 and have been used for the evaluation shift systems, with a view to the extent of social desynchronization. Taking into account social change and the move towards a 7 x 24 society the question arises whether the pattern of this social rhythm can be still be replicated 25 years later – or whether this rhythm has faded away.

Methods

About 250 respondents from different branches of industry and services in Germany answered a questionnaire on the utility of time, using the original method of graphic analogue scales for indicating the value of hours off work.
In a second study, an internet survey has been conducted, using essentially the same questionnaire as before in an internet format. The study is still in progress, but first results have already been achieved.

Results

The results clearly indicate that there is still this pattern in the value of time off work, indicating an evening and weekend society. This pattern is quite stable across different across individual / social characteristics, showing that this represents a stable normative structure of the use of time. Comparing the results of the different studies over the last 25 years shows that there seems to be an increase in the value of time on workdays, especially in the late afternoon and early evening hours, whereas there seems to be no change at all at the weekends during the last 25 years.
First results from the internet study, based on about 100 respondents show a comparable pattern as with the paper based version. Final results will be based on a quite higher number of respondents, allowing for a much more solid estimate of the social rhythm in Germany.

Conclusions

Despite any intentions to move towards a 7 x 24 society there still exists (at least in Germany) the rhythm of an evening and weekend society, showing the normative structure of the use and usability of time off work. The results clearly indicate that treating hour by hour in a bank of hours is definitely unfair if their differential usability is not taken into account. The data can also be used for attempts to quantify the social desynchronization introduced by abnormal working hours in analyzing their effects on health and well being (see the proposal by Wirtz et al.).

The internet version seems to allow for an easy adaptation to other languages, allowing for a cross cultural research design, for which partners might be found at the symposium.

Validation and Calibration of a Work Schedule Fatigue Assessment Tool

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This report summarizes the results of a project to demonstrate a method to validate and calibrate a fatigue model. The project examined 30-day work histories of locomotive crews prior to 400 human factors accidents and 1000 nonhuman factors accidents. A biomathematical fatigue model estimated crew effectiveness (the inverse of fatigue) based entirely on work schedule information and opportunities to obtain sleep. A reliable linear relationship existed between crew effectiveness and the risk of a human factors accident

(r = - 0.93); no such relationship was found for nonhuman factors accidents (see Figure 1). This result satisfied the criteria for model validation.

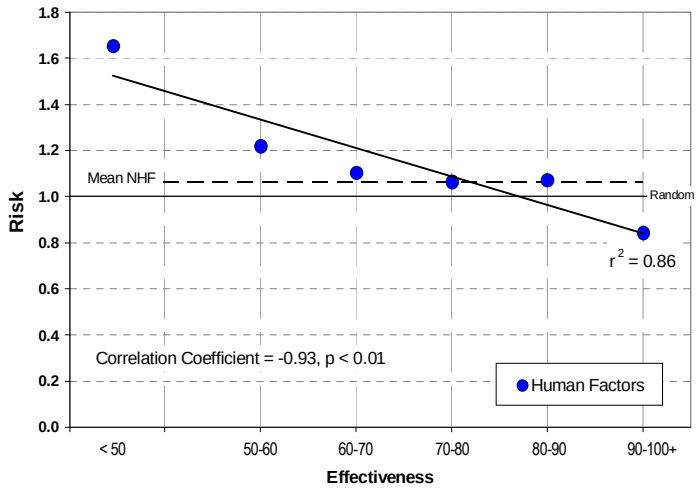

Figure 1: Five Railroad Human Factors Accident Risk as a Function of Effectiveness

A reliable time of day variation occurred in human factors accidents (r = 0.71) but not in nonhuman factors accidents. The risk of human factors accidents was elevated at any effectiveness score below 90 and increased progressively with reduced effectiveness. At an effectiveness score £ 50, human factors accidents were 65 percent more likely than chance. Human factors accident risk increases reliably when effectiveness goes below 70, a value that is the rough equivalent of a 0.08 blood alcohol level or being awake for 21 hour following an 8-hour sleep period the previous night. Below an effectiveness score of 70, accident cause codes indicated the kinds of operator errors consistent with fatigue, confirming that the relationship between accident risk and effectiveness was meaningful.

A 25% work-hour reduction for two years with full time pay in a relatively large sample experimental field study: effects on health, sleep and fatigue

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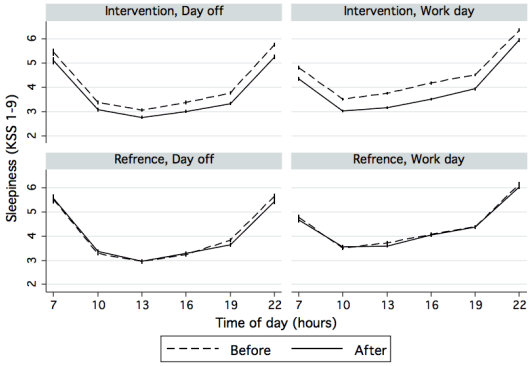
The few studies of reduced work hours that are published are either too small or lack longitudinal design/control group. The present study is the first to fill this gap by presenting data from a two year follow up of a work hour reduction study of Swedish employees in the public sector.
A total of 449 (362 females) subjects were recruited to an intervention group and 372 (289 females) subjects to a reference group. Mean age±sd was 44±10 years in both groups. The intervention group received a 25% work hour reduction and the reference group stayed on their normal work hours. The intervention group kept their full time salary during the study period and extra personnel was hired to compensate for the loss of work hours. Questionnaire data, daily diary data for one week and a medical examination was collected before, after one year and after two years.



	Intervention group	Reference group			
Variable	**before**	**after**	**before**	**after**	**p-value**
Sleep length	7.21±0.69	7.60±0.69	7.35±0.71	7.32±0.86	<.001
bedtime	22.74±0.69	22.71±0.65	22.66±0.65	22.71±0.69	0.184
Wake time	5.98±0.65	6.31±0.71	6.02±0.63	6.03±0.62	<.001
Work shift length	8.49±0.76	6.68±0.82	8.78±0.83	8.51±0.91	<.001
Work shift begin	7.75±0.59	8.37±0.80	7.76±0.60	7.82±0.52	<.001
Work shift end	16.20±0.83	15.05±1.00	16.48±1.04	16.29±0.99	<.001

The results showed no effect on physiological data from the medical examination (blood pressure, stress hormones, physical exertion etc). There were however, large effects on subjective indicators of health and well being: subjects were very satisfied with reduced work hours and had more time for relaxation and social activities. There were also effects on sleep length (see table) and sleepiness (se figure). Sleep length was increased with 24 minutes during work days and sleepiness was reduced on both work days and days off. The increased sleep length was partly due to the fact that start time of the shift was delayed but mixed effect regression analyses suggest that the reduced work hours increased sleep length even when controlling for start time of the shift (P=.007).

Individual Differences in Sleep length During Morning Shifts in an Irregular Shift Schedule

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The objective with the present study was to investigate individual differences in sleep length during morning shifts (beginning 03-09h) in a very irregular shift system.

46 male train drivers (mean age 50 years) were studied with a diary during 14 days. The diary included questions about the timing of sleep and work periods, and bi-hourly ratings of subjective sleepiness using the Karolinska Sleepiness Scale (KSS) 1=very alert, 9=very sleepy, fighting sleep, an effort staying awake. A questionnaire was used to collect background data.

Sleep length was modelled as a function of the start of the shift by means of a mixed effect regression analysis. The predicted sleep length at 09h was 7.76h±27h (mean±se) with an average shortening of 0.57h±.07h for every hour earlier the shift started. The results also indicated individual differences (p=.011) in sleep length (sd=0.55h±.15h) independent of the start time of the shift.

Best Linear Unbiased predictors (BLUP) of individual differences were correlated against questionnaire items (age, satisfaction with work hours, diurnal type, habitual sleep need, sleep quality, complaints with insufficient sleep and self-rated health). The significant correlations were: self-rated health (r-.41 and sleep quality (r=-.34). Self-rated health added to the prediction of sleep length (p<.001) and reduced individual differences (sd=.45±16) but they were still marginally significant (p=.04).

In conclusion the result indicated that sleep length was shortened with 0.57 hours for every hour earlier the start of the shift. Poor self-rated health was related to individual differences and predicted longer sleep length during the morning shift.

Four hour period rhythms in right hemisphere information processing

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Ultradian rhythms in human performance with a variety of frequencies have been found but it is not clear what factors determine the frequency of these rhythms. As part of a larger study published elsewhere (1), the aim of this study was to examine whether more frequent performance measurement in the same experimental conditions and with the application of the same tasks may result in different frequencies of the rhythms found previously. During a 24-hour constant routine the cognitive performance (encoding and recognition) of 10 participants was measured 24 times at hourly intervals starting at 06.30 h. Parallel sets of words and pictures were displayed on a computer screen in random order in either the left or the right visual field during the encoding phase and in the centre of the computer screen during the recognition phase. The task was to press one of two buttons in response to a picture or to a word (encoding phase) and to already seen or new stimuli (recognition phase). Individual time series of encoding and recognition speed of words and pictures in the right and the left visual field were analysed using Cosinor Analysis. Two significant ultradian components (dominant and non-dominant) in encoding and recognition speed were found. Within the dominant components there was a prevalence (70%) of short period (around 4 h) ultradian rhythms (M=3.92h, SD=1.79h) and a smaller amount (30%) of longer period rhythms (M=14.03, SD=2.52). There were fewer rhythms of longer periods than those of shorter periods in speed of stimuli encoding addressed to the right hemisphere and in the speed of stimuli recognition. The dominant ultradian period found in this study was shorter than that found in the earlier study carried out with the same conditions and tasks but differing in frequency of performance measurement (1). However, compared to previous research there was a similar profile of rhythms of shorter and longer periods for speed of encoding of stimuli addressed to the left hemisphere which agreed with the earlier study that found slower ultradian rhythms (12 h) in the processing speed of stimuli addressed to the left hemisphere. Thus, it seems that frequency of performance measurement might determine frequency of the rhythms found if there are rhythms of higher frequencies to be found. In this study it concerns right hemisphere information processing.

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Association of long working hours with sleeping hours, sleepiness, fatigue, and depression among Japanese workers

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Objectives

Late in the 1970s, serious social concern over health problems due to long working hours arose in Japan. National statistics show that more than 6 million people worked for 60 hours or more per week between the years 2000 and 2005. Approximately three hundred cases of brain and heart diseases were recognized as labour accidents resulting from overwork (Karoshi) by the Ministry of Health, Labour and Welfare between 2002 and 2005 (1).

Methods

A self-administered questionnaire was mailed to 2000 workers, aged 20 to 65 years, who were members of a pre-recruited market research panel. Of the 2000 workers, 1350 employees (796 males and 554 females) were analyzed. Working hours were classified into four categories: <=50, 51–60, 61–65, and >=66 (h/wk). Daytime sleepiness was quantified using the Epworth Sleepiness Scale (ESS) (cut-off score of 11 or more). Subjective fatigue was evaluated using the subjective symptoms of Accumulated Fatigue Checklist (0–7 points as grade A, 8–15 points as grade B, or >=16 points as grade C) (2). Depressive symptoms were evaluated using the Center for Epidemiologic Studies Depression (CES-D) scale (cut-off score of 16 or more).

Results

Sleeping hours were shortened with increased working hours (the percentages of subjects who sleep <6 h/day: <=50 h/wk, 14%; 51–60 h/wk, 27%; 61–65 h/wk, 28%; and >=66 h/wk, 44%). The percentages of subjects who had daytime sleepiness were <=50 h/wk, 13%; 51–60 h/wk, 13%; 61–65 h/wk, 20%; and >=66 h/wk, 27%. Subjective fatigue increased with the increase of working hours (the percentages of subjects who were evaluated as grade C: <=50 h/wk, 11%; 51–60 h/wk, 15%; 61–65 h/wk, 20%; and >=66 h/wk, 20%). The percentages of subjects who had depressive symptoms were <=50 h/wk, 19%; 51–60 h/wk, 19%; 61–65 h/wk, 27%; and >=66 h/wk, 28%.

Conclusions

These results suggest that long working hours (more than 60 hours per week) increase daytime sleepiness, fatigue, and depressive symptoms among Japanese workers.

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The distribution of REM sleep and circadian adaptation of the salivary melatonin rhythm in night shift workers

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The alignment of the circadian pacemaker with the sleep/darkness schedule significantly affects the occurrence of REM sleep [1]. Night shift workers may demonstrate a misalignment between hormonal rhythms and the atypical sleep/wake schedule that persists despite a number of shifts worked [2]. We hypothesized that the degree of circadian misalignment in night shift workers influences the temporal organization of REM sleep during daytime sleep. Polysomnography was performed in night shift workers (mean age ±SD: 41.8 ±7.9 years) who underwent a laboratory investigation before and after ~12 night shifts worked over ~19 days. Ten workers received a comprehensive light/darkness treatment designed to improve circadian adaptation to night shifts, while nine control group workers did not. The 8-hour baseline sleep episode was scheduled at the workers' habitual sleep times while on vacation. The final sleep episode was timed according to the sleep schedule kept by all workers: the 8-hour sleep/darkness episode began 2 hours after the end of each night shift. In between laboratory evaluations, treatment group workers were intermittently exposed to bright light (mean ±SEM: 3243 ±928 lux) during the first 6 hours of each night shift, wore dark sunglasses during the morning commute home and slept in darkened bedrooms. Sleep was scored in 20-second epochs according to established criteria. The percentage of REM-scored sleep (REM sleep%) was calculated for 2-hour bins as the percentage of all sleep epochs scored as REM sleep. Salivary melatonin was sampled hourly under dim light (< 7 lux) conditions during 36-hour constant routines scheduled after both baseline and final daytime sleep recordings.

ANOVA detected a significant effect of time for REM sleep% during the sleep episode ($F(1,3)=17.34, p<0.01$). The distribution of REM sleep throughout the daytime sleep episode became flattened in the control group only. Melatonin levels exceeded the daily mean during the projected daytime sleep episode for (±SEM) 3.4 ±1.2 hours in the control group and 6.8 ± 0.3 hours in the treatment group ($P=0.05$). A significant positive correlation was also detected between these values and REM sleep% in the last quarter of the sleep episode ($R=0.6$, $P=0.01$).

Our results suggest that a more appropriate phase relationship between the sleep schedule and the endogenous circadian pacemaker can preserve the temporal distribution of REM sleep in the daytime sleep episode of night shift workers. These results support the importance of considering the pattern of light and darkness exposure in the organization of the daytime sleep of night shift workers.

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Update Aviation RRPA: the case of Dutch pilots

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Numerous studies have shown that rosters differ with respect to the potential risks they cause for individuals. Thus, tools are needed to optimize rosters ergonomically. The RRPA is a computer program which determines the physical and social risks of working schedules. To this end rosters are summarised by nine criteria: regularity, periodicity, load per shift, load per week, opportunity for rest at night, predictability, opportunity for care activities, opportunity for evening recreation and opportunity for weekend recreation. The first RRPA was made in the mid-80s (1) to:

- obtain a coherent picture of the physical and social risks individuals might run when working certain hours;
- pinpoint any possible harmful effects working hours might have on the individual;
- distinguish various rosters from a quantitative point of view.

In 2000 the RRPA was updated to allow for transmeridian flight operations. To distinguish between both programs, the new version was called the Aviation RRPA (2). The first major adjustment was that the program is now able to encompass the effects related to multiple time-zone changes. Secondly, a tenth criteria was added to the existing list of criteria: opportunity for lay-over recreation (intrinsic to long haul flight operations).

Based upon practical experiences and new scientific insights it was decided in 2006 that the Aviation RRPA was ready for an extensive update. As part of this update, all algorithms have been adjusted. In order to validate the updated Aviation RRPA, in 2006 a study was carried out at a Dutch airline company, consisting of a questionnaire and pilots' flight schedules. The questionnaire was send to 200 randomly selected pilots, resulting in a response of 50% (N=100 pilots). Then, flight schedules of the 8 weeks prior to the questionnaire were gathered for the 100 pilots that had filled in the questionnaire. Thus, the design allows for a direct and individually based comparison of the outcomes of the questionnaire with RRPA scores on the ten criteria. The questionnaire consisted of three parts: background information, a series of questions directly aimed at the ten criteria (for example rate on a scale of 1-10 the opportunity for resting at night during the last 8 weeks) and a series of questions aimed at known harmful effects of working irregular hours (irregular hours are for example known to hamper family and social relations and are associated to several health troubles and disorders). Within the same company similar information is collected on day workers, in order to be able to compare those working irregular hours with those working only daytime hours.

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Working time in Korea: The results of 2006 Nationwide Working Conditions Survey

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Objectives

Working hours have received much legislative concerns throughout the world and is now the subject of a growing body of research activity (1). Although Korea introduced 40 legislative weekly working hour 2 years ago, Korea is still considered to one of countries with long working among OECD countries. This report aimed to provide an overview of the status of working time in Korea.

Methods

KOSHA carried out the first survey on working conditions in 2006 in Korea. For the survey, a total 10,043 workers were interviewed in face-to-face interviews, which were conducted in their own homes. A representative sample of the economically active population aged 15-64 year, i.e. persons who were either employees or self-employed workers at the time of interview, was sought. The basic sample design is a multi-stage random sampling, called 'random walk'. We used the Enumeration Districts in the 2005 Population and Housing Census for sampling. The questionnaire included 14 items on working time.

Results

(Standard working hours) Over 75% of all workers work the same number of hours every day and over 80% work the same number of days every week. Over 75% have fixed starting and finishing times. (Part-time work) Four % of all workers work part time. (Long working hours) 59% of all workers work more than 45 hours per week. The self-employed work average 57 hours per week, compared to over 47% of employee. (Work-life balance) Over 70% of workers report that they are satisfied with **how** their working time arrangements fit in with their non-work responsibilities. (Commuting time) Workers spend average 50 minutes per day in commuting.

Conclusion

Korean workers work regularly and longer than workers in EU countries (2).

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Predicting Sleep Strategies Using Social And Circadian Factors

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Objectives

The complex interactions between social and biological factors which determine the timing and duration of sleep during break periods has been investigated and an initial model published using data obtained from an international aviation environment (1). This model has since been refined and further developed in order to account for various sleep strategies undertaken by aviation flight crew during layovers at international destinations.

Approach

Sleep/wake data from 106 (103 Males, 3 Females) flight crew consisting of Captains (n=43), First Officers (n=28) and Second Officers (n=35), were included in the analysis (mean age ± S.D.; 43.51 ± 9.72 years). Crews flew either Boeing 747 or 767 aircraft on selected international patterns into and out of Australia. The large dataset was grouped into subsets according to break length (short, medium and long). Sleep timing was simulated using the author's previous model (1) for each group. Monte Carlo analysis was used to determine the stability of the model parameters. These parameter estimates were then compared using sensitivity analysis, to determine whether any individual or groups could be attributed to large variation in the estimate. Where sensitivity analysis indicated a significant difference in parameter estimates, the raw sleep timing data was analysed to determine whether these differences could be attributed to differences in sleep strategy.

Results

The results indicated that there were significant differences in the parameter estimates of groups of individuals. These differences in parameter estimates were attributed to significant differences in the mean sleep timing and duration for each group (i.e. the mean sleep strategy).

Conclusion

The sensitivity analysis and subsequent investigation indicated that the predictive ability of the model was increased when separate parameter estimates were used for different sleep strategies. Further work is required to determine the proportion of international pilots employing each strategy for large data sets. These findings could be used to more accurately predict the fatigue levels experienced by flight crew undertaking international patterns based on their selected sleep strategies.

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Effects of different shift systems on subjective and objective health

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The key question of the research Project „KRONOS“ is: How can we sustain or even promote the work ability and health of an ageing workforce?

One important influencing factor besides leadership, culture, work demand and qualification is working time.

We therefore studied the effects on health of three different shift systems (3 x 12 hours, 4 x 12 hours, normal daytime work) at BASF Aktiengesellschaft in Ludwigshafen. At BASF, regular medical examinations are offered to all shiftworkers. In this research project we combined these medical examinations with a questionnaire study. The study group consists of more than 900 persons. We assumed that different factors such as age, type of schedule, and working time autonomy would influence the health of workers and also their work ability. All participants were examined by company physicians to get objective medical data and were given questionnaires to obtain an insight into their perceptions and attitudes.

The questionnaires focused on working time, satisfaction, stress, sleep, health (WAI), personal values, and biographical data. By means of the data material resulting from the parallel medical survey, correlations between objective and subjective data are to be expected.

This analysis appear to indicate, that work ability indices do not differ significantly between age groups. This finding could be the result of selection (healthy workers effect), the acquisition of coping strategies, and perception shifts.

Tentative analyses of the data material show that a combination of
aggravating factors could influence the probability of a negative WAI index.

The next step of the evaluation will be to relate the objective medical data to the work ability index and to analyse the impact of different factors, such as the perception of physical and psychological work stress, personal value priorities, and familial context factors on subjective health.

Attitude to different shift systems: the importance of individual differences

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The ergonomic shift system criteria recommend that a schedule should be rapidly rotating and avoid quick returns, long work spells and extended work shifts. However, it is often claimed that shift workers prefer compressed shift systems and give priority to social benefits. The aim of this study was to investigate police officers' attitudes to different shift systems, and explore whether attitudes were related to health, demographics and the present shift schedule.

The study included 619 randomly selected three-shift workers of which 25 % were females. Mean age was 41 years. The subjects filled in a questionnaire that included questions on demographics, attitudes to work hours, sleep, health etc. There was also a section that presented 6 shift work systems. 5 of the systems included night work, whereas the 6th system was a 2-shift schedule without night shifts. 3 of the shift systems were compressed with quick returns. One system was a rapidly rotating system with no quick returns and long (> 8 hours) work shifts. The last three-shift system was a slowly rotating schedule with 7 work shifts in a row. The task of the shift workers was to evaluate these systems (1 very negative, 3 neither negative or positive, 5 very positive). The three-shift systems had similar weekly working hours (≈35 hours) and the same frequency of night shifts. The weekly working hours was higher (38 hours) for the two-shift system.

The rapidly rotating shift system received the highest rating (mean: 3.1, sd: 1.1) followed by the 2-shift system (2.9±1.2). The slowly rotating shift system received the lowest rating (1.7±1.0) and the ratings for the compressed shift systems varied between 2.3 and 2.7. The differences in attitudes were highly significant ($p<0.001$). There were no gender differences in attitude to shift systems. Age was, however, significantly associated to the attitude of the shift systems. The youngest age group (<34 years) was more positive to the rapidly rotating system, whereas the oldest age group (55-65 years) was more positive to the compressed shift systems. Subjective health and insomnia showed no association with attitude to the shift systems. However, those who had a negative attitude to the present work hours were more positive to the 2-shift system than those who liked their work hours. Their existing shift schedule also influenced the ratings. Thus, those who already have compressed shift schedules were more positive to such shift systems, whereas those who already have rapidly rotating shift system showed higher ratings for such systems.

In conclusion, the recommendations of the "best" shift system, according the ergonomic shift design criteria, correspond well with shift workers' attitudes to the shift systems. However, there were also clear individual differences in the attitude to the shift systems. Some of these differences could be explained by their existing shift system. Thus, one favored such systems that were most similar as the present shift schedule, and disliked the other systems. Other determinants of the individual differences were age and the attitude to the (present) work hours, whereas health and sleep problems lacked significance.

Psychological health of miners: the influence of intrinsic and extrinsic work factors on health outcomes

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This investigation evaluated the health of male mine workers and the influence of intrinsic (work hours & shift systems) and extrinsic work factors (coping strategies, negative affectivity, sleep disturbance, job and family characteristics) on chronic fatigue, psychological distress and role limitation due to emotional health problems.

This was a cross-sectional study where 744 workers from 29 mining organisations participated in either a semi-structured interview or the completion of a self-report questionnaire. In 2005 a representative sample of 510 aged between 18 and 65 years completed the questionnaire. Sampling was stratified by job level (professional, skilled, and unskilled workers).

Various shift systems (e.g., permanent days or a mixture of days and nights) and hours of work (e.g., 8, 10 or 12 hours) did not guard the onset of distress and chronic fatigue. Thirty nine-percent were detected as possible cases for minor psychiatric disorders such as anxiety and depression. A similar percentage was reported for moderate or higher levels of chronic fatigue. Professional workers faired better in terms of overall health outcomes. Multiple regression analysis identified negative affectivity as the strongest predictor of the outcome measures. Other individual differences including sleep disturbance, job and family stress, and avoidant coping strategies such as substance use were significantly associated with the work-health relationship. The complex relationship between these job and individual differences underscore the difficulties in the management of fatigue and treatment of depression and support the need of preventative interventions.

Effects of breaks on the fatigue and alertness of shiftworkers in a continuous shift system

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Twelve years ago we covered the change from a weekly backward- to a quicker forward-rotating shift system in the steel industry (Knauth and Hornberger, 1998). After the pilot period, 100 per cent of the workforce voted in favour of the new shift system. In a new project ("KRONOS"), we look for further improvements to the shift system. As the workforce is ageing, and as older workers need more time to recover from strain than younger ones, we first discussed additional short breaks for older workers. However, this could not be realised. In a second step, we proposed to study the effects of breaks and in particular the splitting-up of a 30-minute break into two 15-minute breaks.

A total of 227 shiftworkers were given vigilance tasks before and after the morning, evening, and night shifts (3,853 measurements). Furthermore, they assessed their fatigue on a 10-cm visual analogue scale and their physical complaints at two-hour intervals during work (8,324 measurements).

Fatigue was highest at the end of the night shift and the beginning of the morning shift. The following significant correlation between age and the subjective recovery effect of breaks has been found: the younger the shiftworker the better the recovery. Recovery after breaks was better during the evening shift compared to the other two shifts. There is a high correlative coherence between recovery after breaks and the objective alertness at the end of a shift. In a comparison of different departments, workers in departments with many waiting periods felt less fatigued and rated their recovery after breaks highest.

A separation of the main break (30 minutes) into two short breaks (15 minutes each) did not result in significant differences in fatigue and recovery. Recovery was rated better when the break was spent in a separate recreation room compared to breaks spent at the working place.

Summing up, recovery after breaks is dependent on stress at work, time of day, break timing, autonomy and, last but not least, age.

Evidence for the process model of shiftwork: Review of the Standard Shiftwork Index (SSI) and Survey of Shiftwork (SOS) literature

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The development of the Standard Shiftwork Index (SSI) and its abridged version, the Survey of Shiftwork (SOS) has provided shiftwork researchers with a standardised set of questionnaires that can be used to assess the impact of shiftwork on an individual's psychological and physiological well-being. Underlying the development of the SSI/SOS was a theoretical framework derived by Barton, Spelten, Totterdell, Smith, Folkard, and Costa (1995). In brief, according to the SSI theoretical model, shift systems influence disturbances in biological rhythms, sleep and family and social life through the moderating influence of individual and situational differences. These resultant disturbances in biological rhythms, sleep, family and social life can then cause acute effects on mood and performance. In turn, this affect on mood and performance can then cause changes to an individual's coping style, and consequently affect their psychological and physical well-being. Since its initial publication over 20 years ago, the SSI/SOS has been utilised by a number of independent researchers and resulted in the publication of at least sixty-eight publications. The aim of the following investigation is to review the published SSI/SOS literature and evaluate the extent to which the results of these publications support the model underpinning the SSI.

Nocturnal Eating: prevalence, working hour features and night sleep among Binge Eating Disorder and Bulimia Nervosa patients in Israel

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Objective

Nocturnal Eating Syndrome (NES) is a rare clinical syndrome comprising both eating and sleeping disorders. BED (Binge Eating Disorder) and BN (Bulimia Nervosa) have similar clinical features characterized by uncontrolled binge eating episodes. Nocturnal Eating among BED and BN patients demonstrated binge eating episodes after sleep onset.

The aim of this study was to examine differences between BN vs. BED patients with respect to nocturnal sleep-related eating disorders.

The study will highlight clinical characteristics of the syndromes, and describe their peculiar psychopathological versus physiological aspects of this syndrome, and the effect of working hours on night time eating rates and its effects.

Method

Twelve BED and ten BN patients suffering from Nocturnal Binge Eating were studied. All patients who were monitored by Actigraph for one week, completed the Mini Sleep Questionnaire and demographic and clinical data.

Results

The objective sleep monitoring presented no significant differences between BN vs. BED despite differences in demographic, clinical data, and levels of functioning during work time hours.

Discussion

To our knowledge, this study is the first investigation to compare BED vs. BN patients who suffered from nocturnal binge eating episodes. The results may present a new sub-group of Nocturnal Sleep and Eating disorder.

This research will provide an updated perspective and increase the clinical knowledge regarding the relationship between eating, work time hours and behavior, and sleep disorders, for multidisciplinary researches and clinicians.

Work Hours and Serious Occupational Injuries in the Norwegian Offshore Industry

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Background and objectives

The shift arrangements in the Norwegian offshore petroleum industry consist mainly of 12 hours shifts for 14 consecutive days followed by a 3 or 4 week of–duty period. It is a concern that night work introduces increased risk of mistakes which in a safety critical industry can lead to severe accidents (1). The employees are normally accommodated on the offshore installation during the work periods. This means that the offshore communities to a large extend may facilitate shift work, e.g. control of daylight conditions, proximity of work place and accommodation, and relief from domestic duties (2). The objective of this paper is to examine the relationship between night work and incidence of serious occupational injuries in the offshore industry, and to discuss this in relation to the employees self reported experience of sleep quality.

Approach and methods

From 2001 to 2006 we registered 265 serious occupational injuries from a total of 2732 compulsory reported occupational injuries (3). The 265 serious injuries are allocated to the night and day shift based on the time for the accident and the shift start time for the injured employees. 86 serious injuries were allocated to the night shift and 179 injuries to day shift. Questionnaire surveys were carried out every second year amongst all offshore employees comprising occupational health and safety issues including work time and accommodation conditions (4). Based on 8567 respondents in 2003 and 9820 respondents in 2005 (response rate 50%) the proportion of night work is estimated to be between 24% and 27% which match with procured information from the companies. The higher estimate i.e. 27% night work is used as conservative basis for the calculation of activity level adjusted accident rates.

Results

The activity level adjusted proportion of serious occupational injuries was 30% higher for the night shift compared to day shift. The questionnaire responses show significant differences between day and night shift with regard to perceived sleep quality and level of fatigue during the offshore period. For day and night shifts the cabin noise level and the opportunity for undisturbed sleep influenced the level of fatigued/sleep deprivation. However, the negative effects of disturbances were significant larger for the night shift.

Conclusion

The data demonstrate an increased risk for serious occupational injuries during night shift compared to day shift when the injury rates are corrected for the shift activity level. Although offshore installations may facilitate shift work in a number of ways, there are also accommodation related factors that have significant adverse effects on fitness for work. Some of these issues must be addressed through facility and organizational design, while other should be pinpointed by operational HSE-management. Consequently we currently advise a reduction in the amount of work carried out by night to a minimum, and that the activities that are necessary to perform at night should receive special risk management attention. Furthermore the results demonstrate the importance of implementing measures that could improve quality of sleep.

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An examination of the temporal pattern of adolescent work and injuries sustained at work

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A growing proportion of young people are working. Using Australia as an example labour force participation rates for teenagers have increased by nearly 10 per cent in the last three decades to 61 per cent in 2003 (1). This increase in participation is entirely in the part-time and casual labour force where nonstandard work hours are becoming the norm. Indeed the percentage of teenagers with casual job has doubled since 1984 (2).

The increased labour force participation of adolescents is coupled with a growing realisation of their vulnerability in the labour market. It is commonly accepted in the literature that children and young people are an especially high-risk group in terms of occupational injury and disease with some research indicating that they are at the highest risk of lost time injuries compared to all other workers (3).

Despite recent evidence that time of day may be an important determinant of adolescent injuries (4), the impact of nonstandard and night work on adolecent injury rates has received scant attention to date. The current study aims to address this shortcoming by examining injury patterns of working minors on day and night work. Data collected by the Queensland Injury Surveillance Unit from 16 remote, provisional and metropolitan hospital emergency departments in Queensland are used for the study. Data were collected on a range of demographic variables related to the presenting patient such as age, gender and occupation and on variables related to the type, severity, mechanism and place of injury and time of day. These data are used to compare the temporal pattern of injuries sustained by adults (n=24,214) and adolescents (n=2,972) between 1999 and 2005 while engaged in paid work.
Results revealed that adolescents are between 3 and 5 times more likely to be injured at work than adults depending on the shift performed. Female adolescents who perform work during the evening are particularly at risk. Adolescents are more likely to sustain injuries, particularly burns, during the early hours of the evening and to have more severe injuries at midnight and the early hours of the morning. These findings point to the value of considering the temporal pattern of adolescent work in future research aimed at minimising injuries at work and improving the work experience of tomorrow's workforce.

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Full spectrum light intervention to promote alertness and sleep in adolescents

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Introduction
Sleep problems appear to be significant and growing in children and adolescents. The increase has been four-fold in Sweden since the middle of the 90-ties. In a representative sample of children aged 16-18 years 44% of the girls and 36% of the boys reported to have a bad sleep at least once a week. This is problematic since it is connected to a number of problems at school, including learning. The increase of problems has been associated to life style factors such as late evening activities, increased demands on performance at school, lack of exercise and lack of exposure to light, etc. One outcome of such influences may be a delay of circadian rhythms that will negatively affect sleep and alertness levels.

Objective
To promote sleep/alertness by exposing adolescents to full spectrum light during the first school hours during the dark season.

Methods
In this study 53 adolescents (two classes in two rooms), aged 14-15 years, were exposed to a changed light environment during two weeks. The old classroom ceiling lights (32 lights, 2900K, Ra 56) were replaced with white light, full spectrum lights (41 lights, 5500K, Ra 91-96, TrueLite®). The study was carried out during the Scandinavian winter, and the classroom provided very little natural daylight since it was positioned to the north and shadings were in use at all times. Adolescents were given light sensors and actigraphs to wear during a baseline week (a) and during the second week with new lights (b). Saliva samples for measures of melatonin were taken in the morning at 07.00, 08.00, 09.00hrs once a week. Sleep diary and ratings of sleepiness (Karolinska Sleepiness Scale, KSS, at 09.00, 13.00, 17.00, 21.00hrs) were collected during the baseline week, preceding the change, during two exposure weeks and then during another week when the normal lights were reintroduced (c). ANOVA for repeated measurements with Huyhn-Feldt corrections for sphericity was used in calculations.

Results
The result showed that sleep efficiency measured with actigraphs increased during the week with changed lights (interaction condition/weekday, $F=3.41$, $p=0.0262$) and morning melatonin decreased (interaction condition/day, $F=3.90$, $p=0.0049$, mean $a=35.6\pm3.4$ vs. $c=28.2\pm4.7$). Alertness decreased during school days in the mornings (mean $KSSa=5.35\pm0.13$ vs. $KSSb=4.84\pm0.12$) and sleepiness increased before bedtime in the evening (interaction condition/time, $F=8.90$, $p=0.0030$, mean $KSSa=5.17\pm0.12$ vs. $KSSb=5.41\pm0.12$).

Conclusions
In summary some positive effects of artificial full spectrum lights could be observed on sleep efficiency, alertness levels and melatonin levels suggesting that a change of "classroom lighting" should be considered especially during the dark season. In further work it would be of importance to also include measures of learning capabilities.

Ageing, shift work, and sleep disorders: results from the VISAT longitudinal study

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Introduction

The goal of the current study was twofold. First to specify several time-related, sleep disorder parameters: (i) effects of age, as assessed through cross-sectional (inter individual) data, (ii) age changes as assessed through longitudinal (intra individual) data, (iii) the historical context, and (iv) their interactions. Longitudinal studies are the only way to distinguish between these influences. Secondly, longitudinal studies are also a way of overcoming several methodological difficulties when assessing the short- and long term consequences of working conditions on sleep. Using follow-up data, we examined the effects of shift work and of retirement on sleep changes over time as a way of testing the hypothesis that some sleep disorders are more age-dependent and others more work-dependent.

Method

Data were taken from the VISAT longitudinal study (Ageing, Health, & Work; see [1]). The sample included 2,300 employed and retired wage earners from both genders who were 32, 42, 52 or 62 years old at the time of the first measurement (1996), and who were seen again in 2001. Several self-reported sleep characteristics and past and current working conditions were recorded on both occasions. Data were analysed using X^2, ANOVAs and Logistic Regressions.

Results

Analyses confirmed that some sleep-difficulty symptoms are more age-dependent ("Difficulty staying asleep" and "Hypnotic use"), while others ("Difficulty falling asleep", "Difficulty Getting back to sleep" and "Early awakening") are more work-dependent. The latter stabilize or even decrease between the ages of 52 and 57 and between the ages of 62 and 67, because of a positive retirement effect for a significant part of the workers in these age classes. Compared with the "Never" ones, "Current" shift workers reported more aggravation over time of "falling asleep" and "Early awakening" disorders, while "Past" shift workers reported more trouble in "Staying asleep" and "Getting back to sleep". Age effects on sleep disorders, which are quite clear in the "Never" shift workers, tended to disappear in the "Current" ones both because of increased disorders in the young shift workers and of an exclusion process in the older ones. The extrapolated results were found to be compatible with a model that suggested historical influences with, at the same age, greater sensitivity to sleep disorders in more recent measurements.

Conclusion

The findings shed light on the relative contribution of endogenous and exogenous factors in age-related sleep changes. They allow us to formulate new hypotheses about the mechanisms underlying such disorders and possible ways of preventing them.

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Seasonal variation in adaptation to shiftwork

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This study examined the effects of seasonal changes in daylength on adaptation to shiftwork. Shiftwork can be problematic when work hours conflict with the daily rhythm of sleep-wake and physiology. As synchronization of the internal clock that drives circadian rhythms is achieved primarily through exposure to the light-dark cycle, shiftwork schedules during the winter months, which significantly restrict shiftworkers' exposure to daylight, were expected to have particularly adverse effects on shiftworker health and well-being. A longitudinal study was conducted at the Vancouver International Airport in British Columbia, Canada from December 2001 through January 2003. Eighty-eight shiftworkers completed the Standard Shiftwork Index (SSI) and the 21-item Hamilton Depression Rating Scale in the summer, when daylight hours were longest, and in the winter, when daylight hours were shortest. The SSI provides six measures of shiftwork adaptation and four measures of individual difference factors associated with shiftwork adaptation. As predicted, there was a significant increase in psychological distress and depressed mood during the winter months, while sleep was more disturbed in the summer. Measures of physical health and psychosocial well-being, and relationships among explanatory and outcome variables, showed no seasonal effects. Across both seasons, neuroticism was the strongest predictor of adaptation to shiftwork. These results provide evidence of a seasonal pattern of shiftwork adaptation and suggest that shiftworkers may be at risk for seasonal-type depression.

A two-year follow up study of work ability among College educators

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Objectives
The aim of this study was to evaluate the work ability among College educators before and after an intervention at the workplace.

Methods
The work ability and job satisfaction were evaluated among 154 College educators in 2004, 78 (50.6%) were males and 76 (49.4%) females. The mean age was 39.3 (SD=8.2). Data collection was performed by three questionnaires: socio-demographic and functional data, occupational stress indicator (OSI), and work ability index (WAI). A follow up study was conducted in 2006. Out of 154 studied in 2004, 60 College educators and an additional 44 took part in a new evaluation. They filled out a socio-demographic questionnaire and the WAI (total n=104).

Results
A significant statistical correlation between job satisfaction and work ability was found ($r=0.23/p<0.01$) in 2004. The psychosocial factors related to lower job satisfaction levels were the following: administrative workload, degree of job stability, extent to which his/her capabilities are put to use, and wages. An administrative re-structuring at the workplace started to be implemented in 2005. The psychosocial factors observed in relation to lower job satisfaction are improving. A t-test comparing the WAI score of the 60 educators who took part of the data collection on both phases showed a trend of improving ($p=0.06$; WAI average in 2004 was 41.58 and 43.33 in 2006). The number of educators who had administrative work was reduced from 50 to 31, and the mean number of teaching classes increased from 13.42 to 15.40 h/week. Also, the prevalence of slight emotional disturbances was reduced by 62.5%, as well as the total number of diagnosed diseases by 33.9%. Moreover, the administrative re-structuring was associated to the improvement of work ability of the total studied population. Thus, the administrative re-structuring was found a protective factor against decreasing of work ability (OR=0.58; $p<0.05$).

Conclusion
Although the increasing of the WAI seems to be a trend, it can be concluded that the psychosocial factors related to the administrative re-structuring positively influenced work ability. It is also possible that 2-year follow up is insufficient time to have an optimum improvement. Even so, the association between the re-structuring and the increase of WAI reveals the relevance of changing administrative factors in the workplace.

Support: Deep South University of Santa Catarina.

Shiftwork Intolerance: a longitudinal study of social & organisational factors

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Many industries in Australia and elsewhere experience high rates of voluntary turnover that is associated with job dissatisfaction. In nursing, organisational factors are the leading causes of turnover and dissatisfaction. The most critical include shiftwork (and its negative health effects), inadequate control over rosters and workload, work-life conflict, lack of autonomy, inadequate support from managers and co-workers and insufficient recognition of professional skills and knowledge. This study explores the generalisability of a model of nursing shiftwork intolerance over time and across industries. The study uses Structural Equation Modelling to test Pisarski & Bohle's (2001) model of the proposed relationships between the variables on a large sample of nurses and IT professionals. Then, determines the points in the model where intervention may reduce the impact of work life conflict on the job dissatisfaction, turnover intention and negative psychological and physical health effects for both shiftwork and non-shiftworking populations. The resultant model which showed a good fit, indicated the robustness of the model for nurses and IT professionals longitudinally and provided information to guide the development of interventions that potentially may reduce turnover and dissatisfaction.

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Factors associated with aircrew fatigue in two-crew operations

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Objectives of the study

Airline pilots are involved in many different types of operation, and their patterns of work vary considerably. On the one hand, those on long-haul operations fly continuously for many hours, often across many time zones and typically spend several days at their destination before returning home. On the other hand, individual flights for the short-haul pilot may only last one or two hours, but crews may be required to undertake four or more in rapid succession in a single period of work, before returning home. Between these two extremes, are a large number of operations, usually confined to a single continent, where the flights are too long to be considered 'short-haul', and not long enough for the crew to be augmented by a third crew member. Because of the lack of crew augmentation, this type of operation has the potential to be extremely fatiguing. The purpose of this study was to investigate the some of factors that may be associated with aircrew fatigue on these longer-range two-crew operations.

Approach and methods

As part of a larger study covering all Air New Zealand flights over a three-month period, pilots were asked to complete a brief questionnaire at the top of descent on the last flight of each duty period. On the questionnaire, pilots recorded duty start time, current time (top of descent), sectors flown, and completed the seven-point Samn-Perelli (SP) fatigue scale. The data were analyzed using a stepwise least squares procedure to determine which factors were correlated with the subjective measures. The factors that were considered were: the number of flights in the duty period (one or two); the time of day at the top of descent; the duty duration (i.e. the difference between the current time and the duty start time); and interactions between these factors.

Results

A total of 3022 questionnaires were analyzed, of which 69% were return flights to and from New Zealand. They covered all times on the 24-hour clock, and the average duration of duty was 7.8h (range 2.1h-15.3h). The following factors were associated with an increase in fatigue (all $p<0.001$): a duty involving two flights rather than one (associated with an increase of 0.5 on the SP-scale), the time of day at top of descent (average fatigue mid-morning was approximately two points higher than in the early evening) and the duration of duty (an increase of approximately 0.2 per hour of duty). In addition there was an interaction ($p<0.001$) such that the effect of the duration of duty was greatest for flights landing close to midday and least for those landing close to midnight.

Conclusions

This study has demonstrated the relative significance of the timing of duty and the number of flights on the fatigue of pilots at a critical time during a flight, namely at the start of the landing phase. The highest levels of fatigue tend to occur after a long two-sector duty, landing at the end of the night (around 08:00h).

Shift work and rheumatoid arthritis incidence

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Objectives
Little is known about the environmental predictors of rheumatoid arthritis. We studied the effects of shift work on newly-diagnosed rheumatoid arthritis in a working population.

Methods
A prospective cohort study with a two to four year follow-up (from 2000-2002 to 2004) of initially healthy hospital employees in day work (n=4230) and shift work (n=4852) aged 18-70.

Results
There were a total of 72 (0.8 % incidence) new cases of rheumatoid arthritis in the follow-up. Shift work was associated with an increased incidence of doctor diagnosed rheumatoid arthritis (odds ratio = 1.69, 95% confidence interval = 1.026 to 2.794) after adjustment for age, sex, and occupational group. In addition, the length of exposure to shift work predicted the incidence of rheumatoid arthritis when the influence of age, sex, and occupational group was taken into account. The employees who had over 15 years of shift work experience were at an increased risk of rheumatoid arthritis diagnosis compared to employees with five or less years of shift work experience (odds ratio = 5.19, 95% confidence interval = 1.551 to 17.399).

Conclusions
Shiftwork is suggested to be related to an increased incidence of doctor-diagnosed rheumatoid arthritis that is not accounted for by age, sex, or occupational group. In addition, there appears to be an association between the years of exposure to shift work and rheumatoid arthritis disease. Additional studies are needed to confirm our findings.

Age and working hours: creating safe environments for child workers in Queensland

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On 1 July 2006 Queensland's *Child Employment Act* ("the Act") came into operation. The purpose of the Act is to safeguard children working in Queensland (section 4) through legislative provisions which seek to ensure that work does not interfere with children's schooling and by preventing children performing work that may be harmful to their health and safety or physical, mental moral or social development.

The *Child Employment Act* was precipitated by a Review of Child Labour conducted in 2005 by Queensland's Commission for Children and Young People and Child Guardian. As part of the report the Commission conducted a survey of children and young people (some 584 students aged between 14 and 17) to gauge how and why children were employed in Queensland. The Commission's Report noted that from their research into children's work that the specific issues of excessive hours, working late nights and early in the morning, the spread of hours, the control of hours or rostering by employers and the striping of hours once a worker turned 18 were issues which affected child workers in Queensland. The *Child Employment Act*, in order to overcome these issues seeks to prescribe the number of hours and times at which work may be performed by school-aged and young children.

The Commission's Report also highlighted (at page 16) that children and young people face a greater risk of occupational harm whilst at work. This greater risk is directly related to issues such as maturity, developmental stage, experience and training. Queensland has a piece of occupational health and safety legislation, the *Workplace Health and Safety Act* 1995 which imposes upon employers the obligation to ensure that the employer's workers are not exposed to risks to their health and safety (section 29A). The provision provides for the protection of all people at Queensland workplaces which necessarily includes children and young workers. The *Workplace Health and Safety Act* promotes risk management approach requiring employers to identify risks and implement control measures to eliminate hazards at the workplace. In order to assist employers with implementing this risk management approach for young workers and children a Code of Practice has been developed highlighting the special characteristics of young workers and particular hazards that may be present in a workplace with respect to young workers.

This paper looks at the legislative provisions relating to children's working hours and the legislative provisions relating to the creation of occupationally safe working environments for children. The paper examines and comments upon the risk management approach suggested by the Queensland Government as appropriate for creating safe working environments for children. That the legislative regime is new leaves a number of avenues for further research.

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The fatigue of air traffic controllers: the difference between working single and consecutive nights

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Objectives of the study

The majority of air traffic controllers in the UK who are engaged in round-the-clock operations follow patterns of five or six consecutive shifts ending with two nights. They are then required by the regulations to have at least 54 hours free of all duty. The question has been raised whether such a long period off is required when the duty sequence is terminated by only a single night. The UK Civil Aviation Authority commissioned a study involving a reanalysis of data previously collected to determine whether there was any evidence for a relaxation of the rules in such circumstances.

Approach and methods

In a previous study [1], 141 air traffic controllers completed a diary of their sleep and alertness over a period of between 15 and 20 days. They provided information on their fatigue and performance at various times during each duty period, and on the duration and quality of their sleep, including on days off. These data were reanalyzed to determine (i) whether there were differences in subjective fatigue and performance between the first and second nights in a sequence of two consecutive nights; (ii) whether there were differences between a single night and the first of a pair of two; and (iii) whether there were differences in the sleep pattern following a single or two consecutive nights.

Results

(i) There were no differences between levels of fatigue at the end of the first night and at the end of the second night. However, more individuals rated their performance as poorer on the second night compared with the first ($p<0.01$). (ii) Performance was rated as poorer and fatigue higher after a single night compared with the first of two (both $p<0.05$). (iii) There was no significant difference in the timing or duration of sleep on recovery. After a single night, individuals reported an average of 4.2h recovery sleep, followed by 8.0h and 7.8h on the following two nights. After working two consecutive nights, they reported an average of 3.9h, followed by 8.1h and 7.9h.

Conclusions

The controllers in this study have coped as well with two consecutive nights as with a single night, and there is no evidence to support a relaxation in the guidelines to cover single nights.

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Visualizations for the design of shift systems

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Objectives

The design of shift systems comprises many different tasks, such as understanding the demand on different days of the week and times of the day; designing shifts, developing rhythms of working days and days off as well as developing sequences of duties. Typically, these tasks are algorithmically complex and a proper representation is crucial in understanding the problem and the options of addressing it. Visualization is a powerful method in examining problem features and possible solutions, and has a strong impact on the solution space (i.e. the number of solutions that can be represented) as well as the complexity of finding solutions (1). Many different visualisations exist in the field of shift systems design. Differences exist in the focus, structure and content of the visualisation. These differences of visualisations between countries, industries and companies may reflect different problems in scheduling, traditions, inventions, etc. The objective of this paper is to broaden the understanding of possible approaches to visualization and their advantages/disadvantages/specifics.

Approach and methods used

In a first step, a number of different visualizations will be published on the website of the Working Time Society (www.workingtime.org) and annotated with respect to country, occupation, and a discussion of the advantages/ disadvantages of the different scheduling tasks. An invitation will be sent to the mailing list of the Working Time Society to further amend the collection and discuss published visualisations.
The main categories for visualisations are:

- Representing demand for workforce over time (time of day, day of the week, seasonal…)
- Representing shifts
- Representing shift systems
- Representing features of shift systems

Results

The results and examples will be shown during the poster session at the conference and on the website of the Working Time Society (www.workingtime.org).

Conclusions

The selection of a good visualization facilitates the solution of design problems. By building up a landscape of possible approaches, schedulers are provided with more options to select the optimal visualization.

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Paid and domestic work among nurses: another aspect of extended work hours

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Brazilian nurses often have two jobs, leading to long working hours. They thus define a peculiar group when work hours and its impact on health are concerned, as they may associate a long professional journey to the activities carried out at home. This study aims to analyze the association between working hours and health among nursing personnel considering both professional and paid work, as well as their combination. A cross-sectional study was carried out by means of a comprehensive questionnaire completed by nurses and nursing assistants at three public hospitals. The Brazilian version of the Finnish questionnaire for work ability index (1) was used to measure the number of diagnosed diseases. Work hours both at the hospital(s) and at home were assessed from a daily record of the week before the interview, so as to calculate paid work hours, domestic work hours and the total workload (paid plus domestic work hours). Corresponding values (hours/week) were organized so as to create two groups (cut point at the 3rd tertile), one with long work hours and the other with short work hours (reference group). Stratified analyses for female and male workers were carried out. Logistic regression was used to evaluate the association between work hours and the number of diseases. The following mean values were observed for female and male workers: paid work hours: 46.86±19.43hr and 52.13±22.23hr, respectively; domestic work: 16.16±15.11hr and 7.63±11.17hr; total workload 63.02±21.81hr and 60,13±23.70hr. The only significant association between work hours and the number of diseases concerned total workload among women (Table 1).

Table 1: Adjusted odds ratio (and CI95%) for the association between work hours and the number of diseases (adjusted for age, marital status, income, race and job category)

Variable related to work hours	**Female workers** (N=1268)	**Male workers** (N=186)
Paid employment	1.15 (0.90-1.47)	0.83 (0.42-1.63)
Domestic work	1.20 (0.94-1.54)	1.19 (0.62-2.27)
Total workload	1.34 (1.05-1.71) *	1.10 (0.54-2.25)

* $p<0.05$

Neither paid nor domestic work hours were associated to the number of diseases among women, when they were analyzed in isolation. The high work overload due to the combination of paid and domestic work may contribute to a situation of extended work hours that should be viewed as a potential risk factor for female workers' health.

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Acknowledgements: CNPq, FAPERJ, Mount Sinai School of Medicine (Int. Training Program on Environment and Occupational Health and Int. Exchange Program for Minority Students).

Working at night and work ability among Brazilian nurses at public hospitals: when contractual employment makes the difference

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In Brazil many hospitals adopt 12-h night shifts followed by 60h off. The small number of working nights at a given hospital is often associated with a high rate of "moonlighting" (at night or at daytime). Thus, there is a great diversity among night workers as to the number of nights worked. This study aims at analyzing the association between working at night and work ability among nursing personnel considering their type of contractual employment. A cross-sectional study was carried out by means of a comprehensive questionnaire including the Brazilian version of the Finnish questionnaire for work ability index (WAI) (1). The questionnaire was completed by nurses and nursing assistants involved in patient care at three public hospitals. The studied group was classified into: those who have never worked at night, ex-night workers, those who currently work up to 5 nights/2 weeks, and those who currently work at least 6 nights/2 weeks. Logistic regression was used for multivariate analyses. The cut-off point for adequate/inadequate work ability was based on median values. The sample comprised 1505 workers (736 permanent and 769 precarious employees; 87% female workers). Permanent and precarious employees were different as to job category (23% and 32% were registered nurses, respectively), age (49.8±7.57 and 30.7 ±9.02 years old), number of jobs (30% and 44% with more than one job), and WAI (40.9% and 53.9% showed inadequate WAI). A significant association between working at night and poor WAI was observed only for precarious employees. This association was observed only for current night workers, regardless of the number of nights (Table 1).

Table 1 – Crude (cr) and adjusted (ad) odds ratio for the association between working at night and poor WAI for permanent and precarious employees.

Night work	**Type of contractual employment**			
	Permanent employees		**Precarious employees**	
	OR_{cr}(IC95%)	**OR_{ad}(IC95%)**	**OR_{cr} (IC95%)**	**OR_{ad} (IC95**
Never	1.00	1.00	1.00	1.00
In the past	1.54(0.99-2.40)	1.57(0.99-2.47)	2.03(1.02-4.03)	1.83 (0.90-3
Up to 5 nights/fortnight	1.14(0.71-1.83)	1.13(0.70-1.84)	3.02(1.66-5.51)	2.67 (1.44-4
6 or more nights/fortnight	1.00(0.48-2.11)	1.02(0.48-2.16)	3.00(1.69-5.36)	2.77 (1.53-4

Adjusted for age, gender, education degree, income, race, marital status and job category.

Results reveal that night work - which has long been recognized as a risk to health - affects workers differently, depending on their contractual employment. The increasing prevalence of precarious work worldwide demands the inclusion of contractual employment as a variable to be considered as a risk factor in occupational health analysis.

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Acknowledgements: CNPq, FAPERJ, Mount Sinai School of Medicine.

Effects of extended working hours on health and well-being – a cross validation study

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Objectives

A previous study based on data from the 3rd European survey on working conditions has shown that there is a substantial association between the number of hours worked per week and the amount of reported physical and social impairments (Raediker, 2006). However, these were just results from one study using one data set. So the question arises, whether such results can be reproduced with a different sample and a different questionnaire. Since in Germany recently a survey has been conducted on working conditions using a more elaborated questionnaire suitable data were available to test the stability of the former results.

Methods

The study was conducted as a secondary analysis of the available data set, comprising a representative sample of about 6000 respondents from the Federal Republic of Germany. The questionnaire was intended to collect information on what employees would consider 'good work' and among others, e.g. work load, asked for temporal working conditions and preferences. These data have been analysed, using multivariate analyses, with health and social impairments as dependent and characteristics of the working hours as independent variables. Type and intensity of reported work load, as well as some other variables, have been used for testing moderating effects of working conditions.

Results

The results, in general, confirm the results from the European study. There is a substantial increase in psychovegetative complaints associated with an increase in the number of working hours per week. However, for musculo-skeletal disorders this relation is definitely less pronounced. Moderating effects can be shown for variables indicating type and intensity of work load, e.g. shift work or specific work load conditions, showing the expected interactive effects with working hours.

Conclusions

Analyzing the effects of the extent of hours worked per week on health and well-being clearly shows that extended work hours are associated with an increased number of physical as well as psychosocial complaints. Since these results have been found in independent sets of data it is clear that the association is not an element of chance but a substantial association, as would be expected by theoretical considerations using a dose effects model.

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Effects of irregular long-hour driving shifts of truck drivers and suggested improvements

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Effects of irregular long-hour shifts of truck drivers were studied to know necessary countermeasures. These long-hour shifts extending to early-morning or midnight hours had significant safety and health implications. Replies to a questionnaire were obtained in 2006 from 237 drivers working irregular shifts in 13 trucking companies located in Tokyo. Twenty of them were asked to keep their daily working and sleeping periods for two weeks. For eight drivers, polygraphic recordings including eye movements were taken during a long-hour driving shift extended to night hours.

These drivers were often engaged in long driving hours extending to early-morning or midnight hours. While they drove trucks on the average for 8.4h a day, 39% of the shifts included driving hours of 10h or more with 16% including those of 12h or more. The drivers were engaged on the average 6.8 times a month in midnight driving, 31% 10 times or more and 17% even 20 times or more a month. They reported the mean sleeping hours per day of 5.9h. Those who had 4 or less days off a month accounted for 70%. The degree of fatigue reported by the drivers was significantly negatively correlated with the mean sleeping time and with the number of days off per month. The majority reported that they could not secure sufficient napping periods.

Daily records of the twenty drivers showed that many of the long-hour shifts including continued driving in early-morning or midnight hours. These shifts were associated with the feeling of sleep shortage at the beginning of the shifts. The shortage of sleeping hours was particularly noteworthy in shifts starting in the early morning. The eye-movement records showed drowsy phases frequent during midnight driving.

The results suggested a strong need to improve the shift system by rearranging long-hour shifts and increasing days off. Improvements in driving cabins and resting facilities were also suggested. This required improved truck operations and appropriate sharing of midnight driving hours. The study results led to joint improvement actions of the trucking companies including group planning of shifts, insertion of breaks, improved resting facilities, materials handling equipment and better communication.

Recovery of multitask performance and alertness from acute sleep debt

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Objectives
In today's work life, multitasks are common in many safety-critical occupations, for example in process industry and transportation. In many of these jobs, worker's sleep is occasionally truncated by irregular or extended work hours. The present laboratory study examined whether a physically active rest pause could ease the possible detrimental effects of acute sleep debt on multitask performance and alertness. In addition, we explored whether 8 h of sleep on the subsequent night leads up to complete recovery.

Methods
16 healthy men (19-22 yr) completed normal sleep and sleep deprivation conditions in our laboratory in a counterbalanced order. Both conditions included a 2 or 8-h night sleep depending on the condition, a test day followed by an 8-h night sleep, and a morning test. The test day included four 70 min multitask sessions and every second session included a 10 min neck/shoulder exercise program. The multitask contained four simultaneously active cognitive subtasks, which were presented on one screen. Task difficulty was set individually after at least 2 hours of training with the task. Alertness was measured with continuous EEG/EOG recordings and the Karolinska Sleepiness Scale (KSS) during the multitask sessions. Sleep was measured with polysomnography.

Results
Sleep debt produced, on average, a 44% impairment in multitask performance ($p<.001$), a 8% increase in the amount of EEG/EOG-defined sleepiness ($p<.001$), and a two scale unit elevation on the KSS ($p<.001$) in comparison to the control condition.

The rest pause improved subjects' multitask performance ($p<.01$) and EEG/EOG-defined alertness ($p<.05$) during the first 15 min period after the pause, but no longer during the next 15 min period. The effects of the rest pause did not differ between the conditions.

After the recovery sleep, the mean level of multitask performance was still 11% lower ($p<.01$) and the mean KSS-rating one scale unit higher ($p<.05$) compared to the control condition. EEG/EOG-defined sleepiness did not differ in the two conditions.

Conclusion
The results strongly suggest that the beneficial effects of a physically active rest pause on multitask performance and alertness are quite limited, regardless of the amount of prior sleep. Secondly, it seems that some impairments of cognitive functioning and alertness from moderate sleep debt are still observable after one normal night sleep.

Association of sleeping hours with sleepiness, fatigue, and depression among Japanese workers

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Objectives

Shortage of sleep is one of the major reasons that long hours of work cause health problems in Japan (1). It is very helpful for understanding the health impacts of overwork to examine the association of sleeping hours with health among Japanese workers.

Methods

The data were same as those used in the abstract of Iwasaki et al. "Association of long working hours with sleeping hours, sleepiness, fatigue, and depression among Japanese workers" in the present symposium. 1350 employees (796 males and 554 females) were analyzed. Sleeping hours were classified into four categories: <6, 6–6.9, 7–7.9, and >=8 (h/day). Daytime sleepiness was quantified using the Epworth Sleepiness Scale (ESS) (cut-off score of 11 or more). Subjective fatigue was evaluated using the subjective symptoms of Accumulated Fatigue Checklist (0–7 points as grade A, 8–15 points as grade B, or >=16 points as grade C) (2). Depressive symptoms were evaluated using the Center for Epidemiologic Studies Depression (CES-D) scale (cut-off score of 16 or more). The chi-square test was used to determine the statistical significance of the associations between sleeping hours and the other indices.

Results

The percentages of subjects who had daytime sleepiness increased with decreases in sleeping hours (>=8 h/day, 8%; 7–7.9 h/day, 11%; 6–6.9 h/day, 14%; and <6 h/day, 23%). Subjective fatigue was increased in the shorter sleeping hours subgroups (the percentages of subjects who were evaluated as grade C: >=8 h/day, 11%; 7–7.9 h/day, 9%; 6–6.9 h/day, 14%; and <6 h/day, 19%). The percentages of subjects who had depressive symptoms were >=8 h/day, 18%; 7–7.9 h/day, 17%; 6–6.9 h/day, 21%; and <6 h/day, 27%.

Conclusions

These results suggest that shorter sleeping hours (less than 7 hours per day) increase daytime sleepiness, fatigue, and depressive symptoms among Japanese workers.

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Work Time and Operational Errors in Air Traffic Control

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Folkard and Tucker (1) provide clear evidence that the risk of incidents is influenced by shift, hours on duty, and minutes since breaks. In an industrial setting Tucker, Folkard, & Macdonald (2) found that relative risk increased with time on position before a break. Since most air traffic controllers work some type of a rotating shift schedule there is an interest in determining the potential role of shiftwork and fatigue on controller performance, specifically in the occurrence of operational errors (loss of prescribed separation between aircraft). Research by Della Rocco (3) who investigated the role of shift work on the error process in air traffic revealed that there was little evidence of any relationship between shift work and OE severity. Our investigation focused on a more in-depth assessment of the relationship between OE occurrence, workload, and temporal factors.

Method

Data concerning the time when an OE occurred at the larger en route air traffic control centers were extracted from the FAA OE database (1996 - 2004). Analyses were directed toward understanding the relationship between time-on-position and amount of traffic, time of day, day of the week and several other factors, including OE severity.

Results

Of the 8,877 errors in the database, 16% occurred in the first 10 minutes on position, another 16% took place during the next 10 minutes. The percentage (62%) that occurred during the first 30 minutes in the first hour of the workday was considerably more than the percentage that occurred in the first 30 minutes during each successive hour in the workday (38% to 47%). Controller workload (number of aircraft) remained relatively consistent across time-on-position, with 60% to 74% of OEs involving 9 or fewer aircraft. A smaller subset of the data revealed that the average severity rating and some of the temporal factors. The average severity rating remained relatively unchanged across time-on-position and time of day.

Conclusions

While temporal factors influenced OEs, these outcomes are inconsistent with the incident data reported by others (1, 2), who demonstrated that there was a gradual increase in incidents across time on position. Our results suggest that in air traffic control OEs are more likely to occur early on position rather than later. This could be due in part to the nature of the work - rest schedule for controllers as well as the nature of the work. The fact that the incidence of OEs is greater early in time on position and during the first duty period of the workday suggests that "readiness to perform" may play a role. However, additional human factors data are needed to clarify the importance and interactive nature of several of these factors.

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Bright-light facilitates adaptation of the melatonin rhythm to a slowly rotating shift work schedule

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Introduction

Nearly 6 million Americans regularly work at night on a permanent or rotating shift (1). The circadian pacemaker of most night shift workers fails to adapt to a schedule of night activity and day sleep (2). Timed exposure to bright light can facilitate adaptation from a day to a night work schedule by shifting circadian phase (2). We studied the melatonin rhythm to assess adaptation of the circadian pacemaker to a slowly rotating counterclockwise shift work schedule in laboratory subjects exposed to bright light-treatment or ordinary room light during laboratory work episodes and darkness during day sleep episodes at home.

Methods

After two weeks of baseline evaluation (sleep 22:00-06:00, work 07:00-15:00) ten subjects worked three weeks of the night shift (sleep 08:00-16:00, work 23:00-07:00), three weeks of the evening shift (sleep 01:00-09:00, work 15:00-23:00) and three weeks of the day shift (sleep 22:00-06:00, work 07:00-15:00). Five treatment subjects received bright light (up to 5,000 lux in the angle of gaze) during the work shift and were provided drapery liners to ensure darkness during their day sleep at home; five control subjects received ordinary room light (up to 150 lux in the angle of gaze) during the work shift. Subjects worked 5 days a week and slept at home 4 of the 5 days/nights each week. On the fourth day of each work week, a circadian phase assessment was conducted in a constant semi-recumbent posture, during which time subjects were allowed to sleep for eight hours at an appropriate time for their work shift. Small blood samples were collected hourly for analysis of plasma melatonin levels. Subjects were free to sleep at times of their own choosing during their two days off each week. On laboratory days, light levels simulated the dawn and dusk commuting light exposure the subjects would have normally received. The work episodes consisted of batteries of performance tests. Melatonin was assayed via radioimmunoassay (https://www.neurorelief.com/).

Results

At baseline, subjects' melatonin levels rose near the beginning of the sleep episode (22:00), peaked near mid-sleep (02:00-03:00) and returned to low daytime values shortly upon waking (06:00). Control subjects exhibited variable responses in the timing of the melatonin rhythm and—in one case—attenuation of circadian melatonin amplitude. In one case, melatonin continued to be released during nighttime hours, even when the subjects was working at night and sleeping during the day for three consecutive weeks. In the bright light group, all five subjects exhibited significant shifts of the melatonin rhythm.

Discussion

Bright light exposure during work shifts can facilitate circadian adaptation on a counterclockwise slowly rotating shift work schedule, including adaptation from both the day to the night shift and from the night shift back to the day shift, even when subjects return to the home environment following their work shifts.

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Managing fatigue in a more flexible regulatory environment: the New Zealand aviation industry

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Introduction and objectives

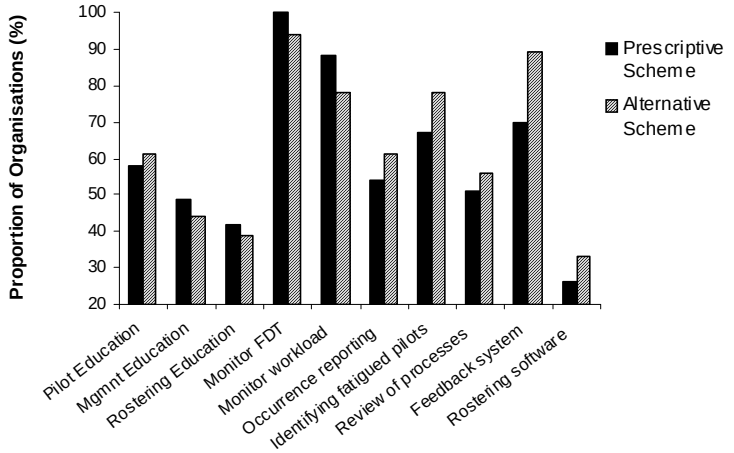
Over 10 years ago the New Zealand Civil Aviation Authority (NZCAA) altered the flight and duty time (FDT) regulations for flight crew, allowing commercial aircraft operators to meet their legal obligations by either complying with a standard prescriptive FDT scheme or by applying to the NZCAA to have a company specific FDT scheme approved. There has, however, been no assessment of this regulatory change and the impact it may have had on the management of fatigue. The present study sought to gather information on how aircraft operators in New Zealand were currently managing fatigue under either a prescriptive or an alternative FDT scheme.

Methods

All 160 commercial aircraft operators in New Zealand were sent 3 questionnaires to be completed by individual in line pilot, rostering, and management roles. The questionnaire addressed the use of specified fatigue management strategies, additional processes for managing fatigue, and an overall rating of how effectively fatigue was being managed.

Results

Small aircraft operators were more likely to employ a prescriptive FDT scheme (78%), while equal numbers of medium and large aircraft operators used each approach. Chi-square analyses indicated no difference in the proportion of companies using specified fatigue management strategies under either a prescriptive or alternative FDT scheme (see Fig 1). There were also no differences in the total number of strategies the two groups employed (prescriptive mean=6, SD=3 and alternative mean=6, SD=2), or in perceptions of how well fatigue was managed on a 100 point scale (prescriptive mean=67, SD=17 and alternative mean=65, SD=14).



Conclusions

These results indicate that allowing increased flexibility in an organisation's approach to FDT limits does not necessarily lead to improved or more comprehensive fatigue management. This unexpected finding suggests that the requirements the regulator places on companies approved to operate under alternative schemes do not meet internationally accepted best-practice (1). However, the regulations are now over 10 years old and the area of fatigue management has advanced rapidly in recent years, therefore it may be time for the regulator to revisit their policies and processes in this area. These results also suggest that, in New Zealand, the existing prescriptive scheme is considered to work well by many companies.

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Morningness-Eveningness and lifetime shiftwork exposure

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Morning (M) and evening (E) types vary in their preferences for the timing of rising and going to bed, sleep duration, levels of alertness, and in the capacity to perform certain tasks during the day (1). The differential in sleep and waking behaviour between M and E chronotypes is an expression of phase differences of the endogenous clock (2). M-types may find it harder to adjust to night work because they demonstrate a relatively earlier circadian phase than evening types. There is evidence that M types react to late shiftwork with sleep deficiency, negative impact upon well-being and decreased circadian adjustment to shiftwork (3). While research into accumulated effects of shiftwork as a function of length of experience has been lacking, particularly relative to age (4), this study examined the interactive effects of M-E and shiftwork exposure upon sleep-related variables. Data from a large sample of shiftworkers (n=2941) in a number of occupational sectors were analysed. Two-factor MANOVA was used to analyse interactive effects of M-E x two levels of lifetime exposure(<32% of life vs ≥ 32% of life) on shift-related measures of sleep quality, drowsiness, proportion of personal sleep need achieved and perceived shift workload. Table 1 illustrates the analyses for sleep quality and drowsiness.

Measure	Morningness			Exposure				
	M	E	F p	<32%	≥ 32%	F p	M-E x Exposure	
Sleep quality	n=307		n=737			n=538	n=506	
Day	5.22 (1.24)		4.97 (1.16)	10.73**		5.04 (1.18)	5.06 (1.20)	1.29ns 6.16*
Evening	5.61 (1.16)		6.16 (1.15)	41.64***		6.15 (1.19)	5.83 (1.15)	10.64** 0.02ns
Night	4.30 (1.33)		4.84 (1.19)	34.93***		4.79 (1.22)	4.58 (1.29)	7.60** 5.62*
Drowsiness	n=130		n=169			n=137	n=162	
Day	3.84 (1.39)		4.48 (1.47)	14.44***		4.19 (1.47)	4.21 (1.47)	.55ns 0.16ns
Evening	3.12 (1.43)		2.64 (1.15)	6.98**		2.69 (1.15)	2.98 (1.40)	2.59ns 2.90 ns (p=.08)
Night	4.77 (1.75)		3.90 (1.57)	16.79***		4.04 (1.63)	4.48 (1.74)	2.19ns .01ns

*=p<.05; **=p<.01; ***=p<.001

Table 1: The effects of M-E and shiftwork exposure on sleep quality and drowsiness on shift.

M-E and exposure interacted to affect sleep quality (around D and N shifts) but not drowsiness. Compared to E-types at both levels of exposure and M-types at the higher level of exposure, M-types reported better D shift sleep quality at a lower level of shiftwork exposure. E-types reported stable, better N shift sleep quality across exposure levels than M-types while at the same time M-types reported decrements in sleep quality at higher exposure levels. The proportion of lifetime exposure to shift work appeared to have most impact on sleep quality in relation to morning-oriented rather than evening oriented shiftworkers. Drowsiness on shift was most influenced by chronotype.

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Age-related shiftwork exposure effects

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Abstract
It has been argued that the number of shiftworkers over 45 years old is increasing dramatically (1) and research into the accumulated or interactive effects of age and shiftwork on health variables as a function of length of experience has been lacking (2). The aim of this study was to test the interactive effects of age and shiftwork experience (exposure - expressed as the proportion of a person's life spent shiftworking) upon sleep- and alertness-related variables. Data from a large sample of shiftworkers (n=2941; m=1723; f=1218; mean age=38.38, sd9.61; mean shiftwork experience=12.51 sd8.15) in different occupational sectors (nuclear, health and police samples) were analysed. All data were normally distributed. Two-factor MANOVA was used to analyse interactive (age x lifetime exposure) and main effects on global measures of sleep quality, drowsiness, proportion of personal sleep need achieved, mental health and social disruption.

Figure 1: Sleep quality

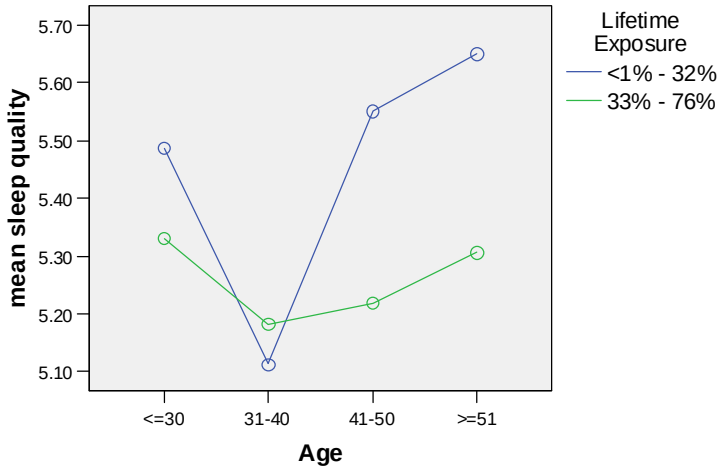

Figure 1 illustrates the output for sleep quality as a function of age and exposure. There were main effects of both age (df3,F-6.45, p<.001) and exposure (df1, F-5.62, p<.05) on sleep quality. Shorter life exposure was associated with better sleep quality. Post hoc tests showed the 31-40 age group to have sig. poorer sleep quality than the younger and 41-50 age groups.

No sig. interaction effect between age and exposure emerged.

Those shiftworkers with a smaller proportion of their lives exposed to shiftwork tended to report better sleep quality (apart from the 31-40 age group), with the differential most dramatic for older shift workers. Overall, age appeared to have the most systematic sig. effect on the outcome measures although some interactions were observed (social disruption and mental health). The study contributes findings with some practical relevance given ever-aging workforces exposed to non-standard work schedules (3) and the likelihood that this will increase rather than decrease in future.

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Cumulative effect of circadian disruption among weekly rotating 2-shift workers in Korea

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Objective

The objective of this study was to investigate the cumulative effect of 24-hour circadian rhythm over a sequence of night shifts longer than 5 or 7 days among the weekly rotating 12-hour day and night shift workers in the automobile factory in Korea. The hypothesis of this study was that the circadian disruption of heart rate variability is significant over the week of night shift.

Method

The study population consisted of 100 workers, who were randomly selected among 25,000 workers of in an automobile factory in Korea. 85 workers completed a 24-hour ECG recording (Marquette) for one day shift (08:00-20:00h) and 50 workers for one night shift (20:00-08:00h). We analysed 24-hour trend of the circadian variability of the heart rate variability (time and frequency domains) over a week of day and night shifts, considering the subjective ratings of severe sleepiness (Karonlinska Sleepiness Scale 7 or higher) and work intensity (Borg Scale 5 or higher).

Result

During the night shifts, the circadian variation of the HF and LF/HF ratio component of the heart rate variability decreased, reflecting a significant reduction in the cardiac parasympathetic and sympathetic activity for the night shift workers. The circadian variation of the heart rate variability showed that the high frequency of heart rate variability decreased during the day sleep after the night shift from the day of the second night shift onwards. It seemed that the workers in the night shift could not recover properly during the day sleep after the night shift. On the other hand, the LF/HF ratios of heart rate variability were increased during the day sleep after night shift from the day of second night shift onwards. The circadian disruption of the heart rate variability was significant, and the workers could not obtain a recovery time over a week of night work. In addition, this study also showed that the normal circadian rhythm of the autonomic activity was blunted among the night shift workers who were very sleepy or had intensive physical labouring work during the night shift over a week of night work.

Conclusion

The study indicates that the normal circadian rhythm of autonomic activity was blunted among the night shift workers. In particular, the disruption of circadian variation became worse from the day for the second night shift to the weekend. Also, the cumulative effect on the circadian disruption became more noticeable toward to the weekend than in the beginning of the week during 5 or 7 consecutive night shifts among the 12-hour shift workers in the automobile factory. This study implicates that this factory needs to reduce night working days as well as implementing a rest day in the middle of the 5 or 7 consecutive night days for the shift work.

An example of evidence-based fatigue risk management in a short-haul airline

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In June 2006 easyJet became the first European airline to implement a fatigue risk management system (FRMS). A key function of the system is to provide management with sufficient and easily assimilated information on fatigue risk to enable them to manage the risk in an informed manner. This paper describes a case study of the fatigue and workload encountered by easyJet Training Captains (TCs) to illustrate how we are working to collect the multi-layered data on fatigue risk that management demand.

TCs perform standard line flying duties and conduct training for flight crew. To explore the workload associated with training duties, 29 TCs completed a detailed work diary for 15 duties. Workload ratings (NASA-TLX) were significantly greater for training duties compared to flying duties. In particular, the workload associated with simulator training was not significantly different from that associated with flying in bad weather. Ultimately however, the study results were criticised for being subjective and were not deemed to be sufficient a reason to change the way in which TCs work was organised.

It was obvious that additional layers of evidence were required to support the workload study findings. We began by investigating existing data on crew fatigue. TC responses to a crew survey on fatigue were extracted and analysed. This analysis showed the prime contributors to fatigue reported by TCs to be: early start times; long duty days; duty transitions and insufficient rest. Second, we extracted fatigue report forms (FRFs) submitted by TCs to the company. In the forms TCs suggested that the roster stability figures in use did not account for the actual number of roster changes being experienced.

The next step was to develop objective rostering measures of the identified contributors to fatigue, for example counts of early start times. This data revealed that, compared to line crew, TCs worked on average 90 min longer per duty day and had 30 min less rest between duties. A new method for calculating roster stability confirmed that TCs were experiencing a high number of roster changes.

The multiple layers of evidence for an elevated risk amongst TCs were integrated and presented to the company Fatigue Safety Action Group. The combined weight of the evidence, and the fact that the rostering measures provided a plausible explanation for the identified risk, resulted in the implementation of a range of countermeasures. Most importantly, the rostering measures have been allocated acceptable thresholds and are now tracked for all crew, thereby enabling fatigue risk to be monitored in a continuous, cost-effective and pro-active manner.

Work schedule differences in sleep problems of nursing home caregivers

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Objectives

Providing 24/7 care to residents in nursing homes is possible by shift work. A close link of working shifts with sleep problems has been well documented for other health care professionals such as nurses and doctors. Recent research has focused on problems of sleep associated with caregiving (1, 2), but its setting is home-based. The present study examined how work schedules disturb sleep among caregivers who work in nursing homes.

Methods

A total of 775 nursing home caregivers (604 women; mean age 33.6 years) were selected from 4754 respondents of a questionnaire study (response rate of 72%). The shift group (n=536) worked under either a rotating two-shift system (n=365, duration of night shift: 10-17 hours [>=16 hours: 86.3%]), a rotating three-shift system (n=66), or other types of shifts (n=78). The questionnaire asked about work characteristics, sleep, daytime sleepiness, health, lifestyle, and demographic factors. Sleep questions covered sleep duration at night, difficulty initiating sleep (DIS), difficulty maintaining sleep (DMS), early morning awakening (EMA), sleep quality, sleep sufficiency, snoring, and sleep-disordered breathing during the previous one-year period. Insomnia was defined as reporting at least one of the three symptoms: DIS, DMS, or EMA. Associations between work schedules and sleep problems were assessed by multiple logistic regression analysis while adjusting for possible confounding factors (gender, age, occupation, length of workweek, years in caregiving, smoking, alcohol intake, and the presence of chronic diseases).

Results

The two-shift caregivers reported the highest levels of DIS (37.6%), insomnia (43.0%), and poor quality of sleep (24.9%) among the four groups of participants. Adjusted odds ratio for the above measures was 2 to 3 times greater for the two-shift caregivers than for non-shift counterparts: DIS (2.90, 95% confidence interval 1.60-5.28), insomnia (2.31, 1.35-3.95), and poor sleep quality (1.97, 1.01-3.84). No significant associations with the sleep problems were found for either the rotating three-shift system or other types of shifts.

Conclusions

Working under a rotating two-shit system, which inevitably makes night shifts longer than 8 hours, may be associated with an elevated risk of sleep problems among nursing home caregivers. The three-shift caregivers rotate shifts more often than the two-shift counterparts, and thus they experience more frequent displacement of sleep episodes. This might have a disruptive effect on sleep, but the present results did not support such a view.

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Chronotype and tolerance to the double burden of working and studying among adolescents

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Introduction
Adolescents who work during the day and study at night may suffer strong interference of their schedules on their individual sleep preferences. Previous studies showed a cumulative sleep debt in working students throughout the workweek (1). Considering the relationship between chronotype and sleep timing among adolescents, the consequences of this mentioned sleep deficit could be reflected on characteristics of sleep, psychological wellbeing and performance at school.

Objectives
The aim of this present study is to verify the correlation of morningness and characteristics of sleep, psychological wellbeing, and performance at school, comparing working and non-working students.

Methods
The study group consisted of working (n=51) and non-working (n=41) students, aged 14-21 yrs. The high-school students attended evening classes (19:00-22:30h) at a public school in São Paulo, Brazil. The students filled out a questionnaire about living conditions (including reported performance at school), a morningness-eveningness questionnaire (2), and a sleep diary (during one week) with visual analogue scales related to sleep quality, mood, and difficulty to wake up/to fall asleep. The correlations were calculated through the Spearman coefficient.

Results
It was found a significant statistical correlation between chronotype and difficulty to wake up on Sundays among non-working students ($R= 0.32$; $p<0.05$). There was also found a significant statistical correlation between the choronotype and mood on Sundays among working students ($R= 0.32$; $p<0.05$). The earlier type the less difficulty to wake up on Saturdays ($R=0.39$; $p<0.01$) and during three work days (from Tuesday to Thursday) among working students ($R=0.34$; $p<0.05$). Further analysis showed a significant statistical correlation between the chronotype and reported performance at school. The earlier type reported better performance among working students ($R=0.38$; $p<0.01$).

Discussion and Conclusion
Working students have to follow a stricter routine of their sleep-wake cycle than non-working students, due to their school-work duties. Although attending evening classes, early types seem to be more tolerant to a double-burden (work and school) than late types. These findings can be related to the higher sleepiness in the evenings among working students found on the previous study. It also seems that the sleep debt along the workweek lead the late types to have more difficulties to wake up early in the morning in order to work.

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Differences in sleep between two (18.00-06.00 h and 19.00-07.00h) offshore shift schedules?

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Introduction
Shiftwork is often associated with disrupted circadian rhythms, and as a result problems with sleep are common. Timing of actual work and leisure hours clearly influences circadian adaptation to nights (1, 2). We now have compared objective sleep parameters in individuals working 18.00-06.00h and 19.00-07.00h shift schedules offshore.

Methods
Seventeen subjects were studied offshore whilst working either a 2 or 3 week nightshift on 2 offshore installations (61 °N and 58 °N) during the summer months. Ten men, aged 46 ± 3.1 years (X ± SEM), body mass index (BMI) 27.9 ± 0.7 kg/m^2, worked 19.00–07.00h for 2 or 3 weeks. Seven men, aged 41 ± 4.5 years, BMI 26.6 ± 1.4 kg/m^2, worked 18.00–06.00h for 2 weeks. Each subject wore an Actiwatch-L (Cambridge Neurotechnology Ltd) during the last week offshore to monitor light and activity (1 min epochs) and completed sleep diaries. Parameters derived from the actigraphy using the manufacturers' software included sleep onset/offset, sleep latency, fragmentation index, sleep efficiency and sleep duration.

Results
Offshore sleep duration showed significant differences $p<0.05$ (unpaired t-test) between the 2 shift schedules with mean sleep duration, 19.00-07.00h: 5.21 ± 0.27h, and 18.00-06.00h: 6.82 ± 0.30h (X ± SEM, decimal hours). Other parameters studied were not significant, but those working 18.00-06.00h, along with a higher sleep duration had a higher sleep efficiency (82.2 ± 2.1%) compared to 77.9 ± 2.3% for those working 19.00-07.00h.

Conclusions
Sleep appears to be worse in those working 19.00-07.00h compared to 18.00-06.00h shift schedule. The differences observed between the two shift schedules may be due to differences in morning light exposure countering circadian adaptation to nights. It could therefore be predicted that these differences will be more prominent in summer compared to winter. The data also show that the sleep duration of both groups was shorter than that reported for healthy adults onshore (7.02 ± 1.55h (3)).

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Sleep, light and circadian phase in offshore shiftworkers working 19.00-07.00 h

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Introduction

Previous studies of shiftworkers in the North Sea oil industry have shown complete circadian adaptation to night work for those working a 2 week 18.00 - 06.00 h shift schedule (1, 2). We have now investigated circadian adaptation, sleep and light exposure in individuals during the last week of a 2/3 week, 19.00-07.00h schedule at 58 ° N (May-Aug) offshore.

Methods

Nine healthy men mean age 47 ± 3.2 years, BMI 28.1 ± 2.3 kg/m^2, X ± SEM) kept sleep diaries and wore Actiwatch-Ls (Cambridge Neurotechnology Ltd) to monitor light and activity/sleep (1 min epochs). Sequential urine samples (approximately every 4 hours and over the sleep period) were collected on the last 3 days offshore (72 h). Circadian phase was determined by measuring urinary 6-sulphatoxymelatonin (aMT6s) by radioimmunoassay, and calculating the peak time of excretion (acrophase by cosinor analysis, Dr DS Minors, University of Manchester, UK). Ten subjects were initially recruited but one subject was excluded from analysis due to possible free-run (aMT6s acrophase of 18.4h at the end of night shift).

Results

Two subjects did not adapt to the night shift (aMT6s acrophase 4.3 h and 5.3h), whereas adapted subjects' mean acrophase was 14.7 ± 0.52h. Actigraphic sleep duration for the last 6 days was shorter in non-adaptors (4.69 ± 0.2 h and 3.78 ± 0.41h), than adaptors (5.64 ± 0.20h, X ± SEM, $p<0.05$) with no other significant differences in sleep. Adapted subjects had higher average light levels at night (01.30-02.30h, 142.5 ± 31.6 lux) and lower light exposure in the morning between 09.30-11.00h (6.1 ± 3 lux) compared to non-adaptors (5 ± 1 and 145 ± 49 lux) respectively ($p<0.001$).

Conclusions

These differences in individual light exposure may explain the inter-individual differences in circadian adaptation. Adaptation to the 19.00-07.00h schedule with 2/9 non-adaptors, may be impeded by greater exposure to morning light, at least in the summer, compared to the 18.00-06.00h schedule.

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The impact of free-time activities on sleep and stress

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Our objective was to identify effective means of promoting recovery from work-related mental fatigue, by examining the nature of activity undertaken in the evenings between work days. Methodological issues within previous research have hindered the establishment of clear causal connections between leisure activities and recovery. We addressed these issues through an experimental field study, in which we compared the effects of different types of free-time activity on subjective and objective indices of sleep and stress.

Methods
Twelve participants spent four evenings (Monday to Thursday) in each condition, undertaking pre-specified types of activity for part of the evening between the end of the normal work day and bed-time. The 3 conditions were (1) quiet leisure activities at home e.g. watching TV, reading for pleasure; (2) active leisure e.g. going out to an entertainment, socialising; (3) working late / at home. Participants completed daily diaries that included self-assessments of sleep quality, anxiety and depression. Sleep was also monitored using actigraphy and salivary cortisol was measured at regular intervals.

Results
There were few differences between conditions. Daily ratings of rest & recuperation (1 'insufficient' - 5 'sufficient') were lowest in the Work condition (F [2,20] = 8.51, $p < .01$; *Work* = 2.4 (±0.3), *Active* = 2.8 (± 0.2), *Quiet* = 2.8 (± 0.2)). Actigraphy analysis suggested that the amount of waking activity (defined as the percentage of "out-of-bed" activity counts greater than the median "in-bed" count) in the Quiet condition was less than in the other two conditions (F[2,20]=8.03, $p < .01$; *Work* = 79.7 (±1.3), *Active* = 82.0 (± 1.4), *Quiet* = 74.2 (± 2.5)), but there was little evidence to suggest a difference in activity levels when in bed (i.e. no difference in sleep quality). However, further analysis examined the associations between subjective ratings of evening activity (blocking across all conditions) and outcome measures. There were significant associations between satisfaction with evening activities and subjective sleep quality (β = 0.29, Δ R^2 = .06, $p < .01$); reported time to fall asleep (β = - 0.20, Δ R^2 = .03, $p < .05$); and reported sleep duration (β = 0.23, Δ R^2 = .04, $p < .05$). There were also significant associations between mental effort of evening activities and subjective sleep quality (β = - 0.22, Δ R^2 = .03, $p < .05$); rating of recuperation next day (β = - 0.32, Δ R^2 = .07, $p < .01$); and reported fatigue symptoms next day (β = 0.22, Δ R^2 = .03, $p < .05$).

Conclusions
Spending freetime in preferred activities promotes superior recovery. The nature of activity *per se* (work, active or quiet pursuits) may be less important than whether the activity accords with individual preference. The daily work load did not differ between conditions and so this is unlikely to be a factor in these results. Theoretical and practical implications are drawn, regarding the nature of work-related fatigue and its effective management.

Reported sleep complaints are not corroborated by objective monitoring in nurses' working shifts

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Women shift workers complained more than similarly aged men about short sleep duration, also, they have been reported to suffer more than day workers from health problems, e.g. menstruation and fertility problems, breathing disorders, muscle discomfort, and had a higher risk of breast cancer than day workers. Sleep disturbances in nurses working on rotating shifts have been widely documented. However, subjective ratings and questionnaires on sleep disorders and sleep complaints were used in most studies.

The present study investigated subjective sleep complaints obtained by sleep questionnaires with objective sleep monitoring in nurses using two ambulatory devices, the Watch-PAT 100 and actigraphs.

Method

In the first phase of the study, all hospital nurses (N= 738) were interviewed to obtain subjective information about adaptation to the shift schedule, sleep problems, medical history, and life style. In the second phase of the study, ambulatory sleep recordings using the watch-PAT 100 (Itamar Medical Caesarea, Israel) for one night were performed in 120 randomly selected nurses, and one week of actigraphic (Mini-Act, AMA-32, Ardsley, NY) monitoring was conducted on 58 nurses.

Results

Shift-work nurses complained more of difficulties falling asleep and morning fatigue while day nurses complained more of snoring. Sleep-disturbed shift nurses complained significantly more about early morning awakenings and morning headaches and also higher usage of sleeping pills. However, none of the devices (neither the Actigraph or the Watch-PAT 100) revealed any differences between nurses who complained about their sleep and those who did not, either in sleep quality measures or in the quality of breathing in sleep.

Conclusions

The present study is one of a handful of studies investigating subjective, as well as objective sleep characteristics and found a discrepancy between subjective assessment of sleep quality and objective sleep measures in hospital nurses. In contrast to the sleep questionnaires' data that differentiated between two distinct groups of shift nurses with and without sleep complaints, neither of the ambulatory devices revealed any differences in sleep parameters between shift nurses with and without sleep complaints, nor between day nurses and shift nurses in general. An additional interesting result was that breathing events during sleep in female nurses increased with BMI and age, regardless of whether the nurses worked days or worked rotating shifts, and regardless of whether or not they reported disturbed sleep.

Effects of a rapidly forward and a flexible backward rotating shift systems on employees' day time alertness and cardiovascular risk factors

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Objectives

Shift work is related to a higher risk for sleep complaints and cardiovascular diseases (CVD) (1). Rapidly forward rotating shift systems improve alertness at work (2) and individual flexibility in working hours is related with long-term health (3). There is limited information on the effects of shift rotation on the risk factors for ischemic heart disease (3). The objectives of this study were to evaluate the effects of a change in shift rotation (direction and speed) and secondly, the effects of a change in flexibility of a shift system, on alertness and CVD risk factors

Methods

A controlled intervention study was carried out in a line maintenance unit of an airline company. 84 healthy men aged 43 ± 9 years (25 -58) working in a backward rotating shift system (3 mornings, 3 nights, 3 evenings) volunteered the study. 40 men changed to a rapidly forward rotating shift system (1 morning, 1 evening, 1 night) and 22 men changed to a more flexible (individual + company-based flexibility) shift system. 22 men persisted in the old shift system. The health effects were studied by blood tests of lipids, glucose and sensitive C-reactive protein; measurements of blood pressure, heart rate, body mass index and waist-hip ratio; and questionnaires including items of sleep-wakefulness, lifestyle and diet 5-6 months before and 7-8 months after the shift change. We used analyses of variance with repeated measures to study the associations of CVD risk factors and day time sleepiness with the change of shift systems.

Results

In the group of the rapidly forward rotating shift system the number of days on which workers reported sleepiness decreased from 2.9 to 2.1 per week ($p = 0.02$). In the group of the more flexible shift system the mean values of systolic blood pressure decreased from 142 to136 mmHg ($p = 0.04$) and of heart rate from 66 to 60 beats per min ($p = 0.03$). The new shift systems did not decrease the other CVD risk factors during the follow-up.

Conclusions

The study supports the earlier finding that a very rapidly forward rotating shift schedule alleviates day time sleepiness (2). The short-time favorable changes in blood pressure and heart rate due to increased flexibility in working hours indicate a possible decrease in psychophysiological stress.

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Experiencing the life: mid-life woman & shift work

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The effects of shift work and its associated lifestyle and occupational health issues on workforces faced with the demands of staffing a variety of industries throughout the 24 hour period are increasingly well documented. Although there is some work specifically addressing the effects of shift work on women less is focussed on the needs of older women (1). It is also likely that there is a physiological dimension to the experience of shift work during mid-life, as menopausal symptomatology interacts with an individual's ability to tolerate rotating rosters but this important issue has also received little attention to date.

Aims of study

This qualitative study was undertaken to develop understanding of phenomena that are assisting mid-life (peri-menopausal) registered nurses to successfully work rapidly rotating shift work rosters (Australian health sector), to uncover meaning within it and to articulate ways in which the participants responded to their shift working experience.

Method

The participants were mid-life (44 years of age or older) registered nurses who had worked a rotating roster for the previous three or more years. Snowball sampling was initiated by independent response to advertisements placed in a local professional journal and clinical settings (2005/6). The digitally recorded conversational style interviews commenced with the question "would you tell me about your experience of working shifts over the last few years?" Participants were thus able to self-identify issues that were of significance to them without being directed by the study's perceived framework of potentially significant issues. Interviews were transcribed and analysed for themes of qualitative significance using the methods of interpretation and phenomenological transformation described by van Manen (2). Identified themes were then explored in context of current knowledge of general concepts of occupational health, risk management and women's health.

Findings

The development of the following themes has provided new insight into the experience of mid-life shift working women and potentially provides a new framework to assist in both differentiating and supporting this group of shift workers.

- Juggling multiple temporalities: How many different time structures can one women deal with?
- Menopause – not me, not yet! Societal constructs of aging may be affecting personal perceptions of ability to tolerate shift work.
- Being or becoming a shift worker: Do I control my shifts or do they control me?
- Making shifts work for me – using time of day to adjust the physical load of work

Conclusion

The average age of registered nurses in Australia is 44 years. Such a nursing workforce age profile demands that these issues be explored in an effort to develop strategies to ensure a sustainable level of health care that is not solely dependent on the ability of the young to tolerate a shift working lifestyle.

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The influence of morningness and self deception on self-reporting driving ability

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Objectives

A number of studies have reported reliable differences between morningness and self-rated performance on a number of criteria (1, 2). A typical limitation of these studies is the assumption that these self estimates are unbiased. Bias is particularly problematic when the criterion variable is self rated driving ability. It is widely reported that drivers tend to overestimate (self-deception) their driving skill and that this overconfidence is one factor that results in road accidents (3). The objective of this study was to examine whether the link between morningness and driver performance by time of day are significantly influenced by self-deception.

Approach and methods

An on-line survey was completed by 120 participants. The survey required the participants to: a) complete some biographical details, b) complete the preferences scale (2), c) a driver self-deception scale (4), and d) rate whether or not their driving was 'optimal' a 2-hourly intervals using a seven point scale (1 = definitely not true; 7 = extremely true). Multivariate general linear model was employed to examine differences between groups.

Results

76% of participants were female and the mean age for all participants was 26.86 years (*SD* = 8.82). The majority of participants reported driving daily. Consistent with expectations morning types reporting significantly better driving ability at 06.00 (<.01), 08.00 (<.001) and 10.00 (<.05), while evening types reported better driving at 22.00 (<.01) and 24.00 (<.05). Non-significant and counter intuitive differences in driving ability were found for morningness when controlling for self-deception. Morning types with high self-deception rated their driving ability as better for the night period and evening types with high self-deception rated their ability as better during the morning period.

Conclusion

The findings suggest that the relationship between morningness and self-rated driving ability is not readily explained as a result of self-deception. While self-deception may result in some overestimate of performance, the results indicate that morning and evening types reliably differ in self-reported driving ability by time of day.

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The interference of flexible working time with the utility of free time – a predictor of social impairment

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Objectives

Previous research has shown that classifying flexible work schedules according to their periodic components can be used for predicting impairments to health and well being (Giebel et al., 2004). The question, however, is whether also social impairments can be predicted on the basis of the spectral characteristics of flexible work schedules and which components might be responsible for the amount of impairment. Another question is whether the interference of the spectral characteristics of a work schedule with the rhythm of the utility of time (see proposal Hinenberg et al, this conference) can be used for predicting social impairment.

Methods

Work schedules from a survey on flexible work hours (Janßen & Nachreiner 2004) have been converted into time series indicating working hours and time off work and the utility of time function has been adopted from Hinnenberg et al. These time series have then been submitted to univariate as well as bivariate spectral analyses, in order to determine the power of the 24 and the 168 h components in the work schedules and their phase shift with the respective components in the utility of time. These parameters were then related to reported social impairments by multiple regression.

Results

The results show that (1) a suppression of the 24 and the 168 hour components in the work schedules, i.e. a lack of rhythmicity, can predict reported social impairment, and (2) that even if there are relatively strong 24 and 168h components left in the work schedules, their phase shift with the utility of time, as compared to "normal" working hours, also predicts impairment. The best results in predicting social impairment have been obtained using the power, the phase shift and their interaction in multivariate regression analyses, with varying but substantial explained variances in different areas of social impairment.

Conclusions

The results thus indicate that the amount of (social) desynchronisation induced by flexible work schedules – here operationalized via the interference of work hours with the rhythm of social life – can be used for predicting impairing effects of a specific design of work schedules to social well being.

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Influence of Internal Circadian Phase on Excessive Sleepiness and Behavioral Alertness in Patients with Shift-Work Sleep Disorder (SWSD)

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Objectives
Failure of the circadian timekeeping system to adapt to shift work schedules is reported to be a primary factor contributing to impaired nighttime alertness and disrupted daytime sleep in shift workers. The current analysis evaluated the influence of internal circadian phase on excessive sleepiness and behavioral alertness in SWSD patients during a night shift.

Methods
We analyzed pre-treatment baseline data from a clinical trial of modafinil in SWSD patients. Patients who completed 3 consecutive regular nightshifts were assessed the following night during a simulated laboratory nightshift in dim light (<50 lux) from 2000 to 0800 h. Melatonin levels were measured from saliva samples collected hourly. The timing of when melatonin levels exceeded or fell below a threshold of 3 pg/mL, dim light melatonin onset (DLMO) or dim light melatonin offset (DLMOff), respectively, were used as markers of circadian phase. Sleepiness and alertness were assessed every two hours with the Multiple Sleep Latency Test (MSLT), Karolinska Sleepiness Scale (KSS), and Psychomotor Vigilance Test (PVT). Sleepiness on the commute home was assessed with an electronic diary (KSS) and daytime sleep in the sleep laboratory with polysomnography (PSG).

Results
Of 204 patients, 45% showed a DLMO and had high melatonin levels indicating little or no circadian adaptation to the nightshift schedule. Another 14% showed a DLMOff and had low melatonin levels during the latter part of the nightshift indicating a circadian phase advance. In 41% circadian phase estimates were not available as melatonin levels did not exceed threshold. Differences in circadian phase had no significant effect on MSLT scores (P=0.6693), an objective test that measures the time to fall asleep. However, compared to patients with DLMO, those with DLMOff showed improvement in subjective sleepiness (KSS, P=0.0554) and behavioral alertness (PVT transformed lapses P=0.02093). Consistent with this observation, KSS scores on the commute home indicated significantly lower subjective sleepiness in patients with DLMOff than DLMO (P=0.0042). On average, patients with either DLMO or DLMOff showed clinically significant disruption in daytime sleep; however, sleep efficiency was significantly worse in patients with DLMOff than DLMO (P=0.0037), as measured by PSG.

Conclusions
These results suggest that physiologic sleepiness during night shift hours as shown by the MSLT is similar for SWSD patients regardless of circadian phase relative to the work schedule. However, differences in circadian timing appear to influence subjective sleepiness and behavioral alertness levels during the nightshift, sleepiness on the commute home and daytime sleep.

List of Participants

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In Memoriam

W. Peter Colquhoun

18th August 1928 – 21st October 2005

Peter Colquhoun was an extremely gentle and kind man whose modesty concealed a very bright and agile mind. His career had major implications not only for the field of Psychology, but also for the whole of society. Peter's early, groundbreaking, research on the effects of alcohol on a simulated driving task informed the selection of the blood-alcohol limits in the UK and he also helped in the choice of the devices used to measure them. With regard to his contribution to Psychology, Peter's work on human performance as a function of circadian rhythms and shifted sleep-wake cycles predated the current explosion of interest in circadian rhythms by more than three decades. In particular, his series of experiments entitled "Experimental Studies of Shiftwork" published in the journal Ergonomics in 1968 and 1969 were seminal in the field, and demonstrated how the "real life" problems associated with shiftwork were amenable to laboratory investigation. These studies were followed by two edited books on the subject, published in 1971 and 1972, that have become oft-quoted classics and which have laid the groundwork for later work in the field of circadian rhythms in alertness and performance. His work on failures to sustain attention (vigilance) also had a major impact on the field of Psychology. During the 1960s, Peter, a prolific and always rigorous empiricist, made a very considerable contribution to the knowledge base of vigilance theory, identifying task features that affect the decline in vigilance over time. To the surprise of no-one but himself, the literature is still full of references to Peter's groundbreaking work in this field. He invariably used vigilance tasks in his studies on the effects of environmental stressors, individual differences, alcohol, drugs, sleep loss and time of day, thereby advancing general knowledge about stress and arousal, as well as about vigilance. As ever, his work reflected the symbiotic nature of pure and applied research, with his contributions applying to, and often stemming from, actual real-life tasks such as industrial inspection and sonar watchkeeping.

From the early 1970s until his early retirement in 1988 the three of us were very fortunate to have worked under Peter's leadership, originally at the Sussex outstation of the MRC Applied Psychology Unit in Cambridge, and later at the independent MRC unit which the outstation became, namely the MRC Perceptual and Cognitive Performance Unit at the University of Sussex. Peter was Unit Director, and also an Honorary Professor in the Laboratory of Experimental Psychology at the University of Sussex. Peter's leadership style was always low key, but was also incredibly supportive. He always (albeit very gently and with good humour) provided the strong scientific guidance needed to keep us on the straight and narrow path, typically over coffee which we regularly took together. His whole career was devoted to research, in particular the temporal determinants of performance efficiency, and to the training of researchers. He excelled at both. Given that he was such a nice man, people wanted him to succeed and helped him to do so. Honours included fellowships of the British Psychological Society, The Ergonomics Society, and the Working Time Society, and the Ergonomics Society's "Bartlett Medal" for his contribution to applied psychology. The support and honours that Peter received from his peers surprised him - they should not have. The world is poorer for his passing.

Angus Craig
Simon Folkard
Timothy H. Monk