Industrial Health 2005, **43**, 11–19

Review Article

Socioeconomic Impact of Insomnia in Working Populations

Arnaud METLAINE[1*], Damien LEGER[1] and Dominique CHOUDAT[2]

[1]Sleep Disorders Center, Hotel Dieu de Paris, Assistance Publique Hôpitaux de Paris, Université Paris V, and Paris Sleep Group (PSG), 1, place du parvis Notre-Dame, 75181 Paris Cedex 04, France
[2]Department of Occupational Medicine, Hopital Cochin, University of Paris V, School of Medicine, Paris, France

Received November 2, 2004 and accepted November 18, 2004

Abstract: To determine whether insomnia impact the professional life of patients and have an economical weight, this review article focused on the socioeconomic impacts of sleep related problems in working populations. The goal is to summarise the work that has been accomplished in that field. Several occupational factors have an impact on insomnia: the work schedules (shift work and night work), the physical environment at work and the occupational stressors. Insomnia is also a common problem in daytime workers. The daytime functioning of insomniacs is a key point to understand the impact of insomnia on workers. Absenteeism is one major target in the evaluation of severe insomnia at the workplace. Most of the studies find a higher rate of work accidents in insomniacs. The economic impact is severe in term of direct and indirect costs. Insomnia is a common problem at the workplace. The negative impact is not only on individual but also at the societal levels. More epidemiological studies appear warranted to demonstrate a reciprocal link between work conditions and sleep disorders.

Key words: Insomnia, Working population, Work accidents, Socio-economic impact

Introduction

Sleep disturbances seem to be highly prevalent in industrial countries[1–9]. Many studies have i.e., demonstrated that insomnia is statistically linked to a worse health status, compared to good sleep[10–18]. One could reasonably hypothesize that insomnia promotes fatigue which could participate to the occurrence of some diseases or more simply, decrease the threshold of others that could more easily appear. This hypothesis has been, i.e., clearly demonstrated for the development of mental diseases, by Ford and Kamerow[11], in a group of 705 people under 65 who had been followed for three years. The individuals who suffered from insomnia at the beginning were more than three times as likely as those without sleep problems to develop depression two years later.

The impact of insomnia on daytime alertness[15, 19–22], performance[13, 23, 24] and quality of life[4, 5, 25, 26] is sometimes more difficult to ascertain. Patients suffering from insomnia do usually complain of an impaired day time functioning[21]. However, it is often difficult to demonstrate whether insomnia by itself impact objective measurements of daytime functioning[27]. Insomniacs seem to have no disturbances in multiple latency tests compared to good sleepers[28]. It is also not obvious that insomnia affects short term performance. However the impact of insomnia on Quality of life (QOL) and on absenteeism has been more clearly supported by studies which hypothesize the economical weight of insomnia[9–29].

This review article focused on the socio-economic impacts

*To whom correspondence should be addressed.

of sleep related problems in working populations. The goal is to summarize the work that has been accomplished in that field and to underline what could be undertaken to better understand social and economic consequences of insomnia.

Epidemiology

Studies on General population

In order to assess the socio-economic implication of insomnia, it is necessary to overview the epidemiological aspect of this sleep disorder. Several epidemiological studies have been done to assess the prevalence of insomnia, but have yielded variable results. The prevalence of insomnia varies approximately from 9% to 50% according to population based surveys from the general population of adults in Europe and in the United States[9]. Earlier studies were made in small community groups including less than 2,000 subjects[10, 30–32]. In 1996, Ohayon *et al.*[33] conducted a study with a representative sample of the French population of 5,622 subjects of 15 years old or more. An epidemiological questionnaire survey of a representative sample of the French population included 12,778 individuals[34]. The most extensive prevalence study on insomnia was made by Partinen *et al.*[35] in the twin cohort of Finland (31,140 individuals). Almost all studies showed an increasing prevalence of insomnia with age and a sex ratio in favour of insomnia for women[36].

When more severe criteria are used, the prevalence rate vary less widely between 9% to 19% in the general population[1, 11, 37–39]. These studies are not similar regarding the definition of insomnia and this is why it has been recommended to adopt a common classification (DSM-IV or ICSD) in epidemiology[16, 29, 36, 39–41]. In a recent review, Ohayon *et al.*[36] have categorised the prevalence data of insomnia of over 40 epidemiological studies. They show that, the more restrictive the criteria, the lowest the prevalence rate. When the definition of insomnia symptoms includes daytime consequences, the prevalence was between 9% to 15%, while studies employing DSM-IV criteria had the lowest rates (4.4–6.4%)[9]. According to the DSM-IV and ICSD, insomnia is not only a complaint of poor sleep reported by patients, but is also serious enough to induce severe fatigue or signs attributable remarked on by such as irritability or disability in daytime functioning"[42, 43].

Studies on working population

There are few studies about the prevalence of insomnia at the workplace[44–56]. Several occupational factors may have an impact on sleep: the work schedules, the physical environment at work (noise, heat, light)[54] and the occupational stresses (mental load, working organisation, stress)[57], however it is difficult to evaluate the weight of working conditions in the appearance and in the development of sleep disturbances, more especially as it is well admitted that the natural history of insomnia depends on predisposing factors and of precipitating factors[58].

The most detailed study was done in a population including 21,000 French workers, using a sleep disturbance index and logistic regression. It was demonstrated that shift work, a long working week, exposure to vibrations, and "having to hurry" appeared the main risk factors for sleep disturbances[54]. Shift work and night work are probably the most significantly severe precipitating factors of insomnia at the workplace[53, 59–63].

In the daytime working population, the overall prevalence of insomnia varies between 16% to 30%[46–54]. Most of the studies focused on the prevalence of subtypes of insomnia such as Difficulties Initiating Sleep (DIS), Difficulties of Maintaining Sleep (DMS), and Early Morning Awakening (EMA). In a study of 1,502 male industrial workers in Israel, Lavie *et al.* (1981) found a prevalence of 6.6% for DIS, 10.8% for DMS and 28.3% for total sleep complaints[53]. Tachibana *et al.*[49] reported rates of 10% for DIS, 15.9% for DMS and 13.3% for EMA in 271 male industrial workers with an overall prevalence of insomnia of 27.7%. In a recent prevalence study including a sample of 1,161 Japanese white-collar workers, Nakata *et al.*[48] found an overall prevalence of sleep problems of 23.6%; the prevalence of subtypes of insomnia was 11.3% for DIS, 14,2% for DMS, and 1.9% for EMA. In a cross sectional survey including 7,629 wage earners from 2,769 small or medium sized firms in Paris area, Jacquinet-Salord *et al.*[47] found that 6.1% men and 11.3% women consumed sleeping tablets. Most of the epidemiological studies show a significant positive relationship between age and the prevalence of sleep disturbance. Almost all studies suggest that ages 50–55 yr to be a critical age group for sleep problems in male workers. Jaquinet-Salord also demonstrated that these sleep disturbances related to the age were not linked to the physical working load[47]. The different values of prevalence found in the surveys on subtypes of insomnia might be explained by the different methodological approachs used to target populations, sample size, case definitions and setting.

As we already pointed out, several occupational factors may have an impact on sleep. Job categories can influence the prevalence of insomnia. In a questionnaire survey of 6,268 persons of 40 different occupational groups, Partinen *et al.*[44] found that complaints of difficulties of falling asleep

were more frequent in bus drivers (18.9%), female cleaners (18.8%), and male teachers (18%). Twenty eight per cent of male laborers, 26.6% female cleaners and 26.4% of female hospital aides complained of disturbed nocturnal sleep, whereas only 1.6% male physicians and 7.4% of male directors were reported difficulties of falling asleep. Complaints of early morning awakening were more common among female laborers (13.2%), male construction workers (9.1%), and female cleaners (8.4%) than among male physicians (1.6%), male directors (1.8%), and nurses in outpatient wards (1.2%). Sleeping pills were used especially by male gardeners (7.1%), female social office workers (5.8%), and male construction workers (5.4%).

In a retrospective study of older individuals above 75 years old, Geroldi *et al*.[45] showed that former blue-collar workers reported worse sleep than white-collar workers. Nakata *et al*.[50] found no significant differences in sleep problems amoung job categories, except for sleep insufficiency. In their study, clerical workers had a prevalence of definite insufficiency of sleep of 1.5%, whereas the prevalence was between 7.2% to 8.7% in other groups of workers (managerial, technical). Leger *et al*.[34] also demonstrated that the prevalence of insomnia, (using the DSM-IV definition) among socio-professional categories was the highest in the white-collar group (20.8%). They found a trend towards lower rates of insomnia in upper level executives, liberal professions and in farmers group. Doi *et al*.[46], in a cross sectional study including 4,868 day time white-collar workers also found that poor sleep was significantly more prevalent in white-collars (30 to 45%) than in the Japanese general population.

Psychosocial factors can also affect the prevalence of insomnia in workers. The relationship between percieved job stress, and social support and prevalence of sleep disturbances has been established by several studies[47, 48, 52]. Nakata *et al*.[50] showed that workers whith interpersonal conflict with close co-workers had a high prevalence of sleep maitenance insomnia (OR= 1.6, 95%CI: 1.1–2.3). Workers who perceived the atmosphere at work as bad have a two-fold increase in the prevalence of sleep disturbances and a higher consumption of sleeping tablets, compared to workers who perceived a good atmosphere at work[47]. Several studies also suggested that job dissatisfaction and poor job performance could be an important risk factors of insomnia in daytime workers[46, 48, 55].

The study by Kalimo *et al*. (2000) included 3,079 subjects from the Helsinki Heart Study[52]. The aim of this study was to describe the relationship between job stressors[64] and sleep disorders. The authors found that the hightest prevalence of insomnia was found in workers with high job strain characterized by high demands and low job control.

The Impact of Insomnia

Daytime functioning and loss of productivity

The daytime functioning of insomniacs is a key point to understand the impact of insomnia on the daily lives of workers[27]. The loss of productivity may partially result of this impairment. In 1991, a Gallup poll, made in a representative sample of the American adult population reported that insomnia had a direct impact on the daily lives of one-third of the patients[65]. Addison *et al*.[66] found that 27% of a national representative sample had their daytime activities affected by poor sleep at least twice per week. Lugaresi *et al*.[67] also found that the prevalence of daytime somnolence was higher among insomniacs than among good sleepers (15% vs. 8.3%). In the Ohayon *et al*.[21]'s survey, the repercussions of insomnia on daytime functioning were reported by 67% of the subjects. A decreased efficiency was more likely to be reported by subjects between 15 and 44 yr of age, those using CNS drugs, those reporting at least three insomnia symptoms a week and by women more than men. In another study of 691 persons with untreated insomnia, it has been showed that insomniacs severely complained of their impaired daytime functioning. Eigthy three percent reported being "easily upset, irritated or annoyed", 78% reported "being to tired to do thing", 59% reported having more trouble to remembering" and 43% reported being "confused in their thinking"[68]. Lavie *et al*.[53], in a large and detailed study of the lifestyle, health, sleep, and work habits of 1,502 employees, has concluded that sleep habits directly affect the workplace. They have shown that workers with daytime fatigue had significantly more complaints of somnolence during work breaks than other workers (14.2% vs. 3.5%, $P<0.001$), higher frequency of napping at work (16.8% vs. 1.4%, $P<0.0001$), and significantly less job satisfaction. Johnson and Spinweber[13], in an original study in Navy men, have demonstrated than insomniacs were slower at work and had poorer career advancement than good-sleepers. The association between insomnia and reduced efficiency was supported by the results of a 1992 survey, which recorded two to three times as many days of poor productivity and concentration in individuals with insomnia as in good sleepers[69].

Absenteeism

Absenteeism is one major target in the evaluation of severe insomnia at the workplace. It is however difficult to link

directly insomnia and absenteeism without considering the other disease which may result in secondary insomnia and in absenteeism. A few studies have tried to concentrate on this aspect[65, 69–75].

Leigh[73] analyzed the correlation between sociodemographics, health, job characteristics and absenteeism. This study was done in a large cross sectional sample of 1,308 workers employed at least 20 h per week. He found that, among 37 independent variables (job characteristics, hazardous conditions and health variables), the complaint of insomnia was one of the best significant predictors of absenteeism. He found that insomniacs had an average monthly sick absence rate of 1.4 times the one of persons who do not reported sleep trouble. In this study, Leigh suggested that the most predictive factor of absenteeism at work was "being a mother with small children" and the second strongest factor was insomnia.

Leger *et al.*[71] has compared a group of 240 severe insomniacs to a group of 391 good sleepers. They concluded that severe insomniacs were work twice often absent at work than good sleepers. The authors also assessed that there was an increased accident rate in the co-workers of insomniacs due to the fact that the workers who were replacing the absentee had to perform additional and unfamiliar work. Lavie *et al.*[53] also found a higher rate of absenteeism in insomniacs, which is significantly linked to a higher rate of work accidents. Philip *et al.*[76] demonstrated that poor sleep quality ($P<0.001$) and nocturnal restless syndrome ($P<0.1$) were associated with subsequent more sickness absenteeism. They also found a clear association between subjective daytime somnolence (3 d or more a week) and absenteeism (OR=2.2, 95%CI: 1.3–3.8).

Work accidents

Disturbed sleep is a potential cause of accident[77, 78]. The prospective study by Kripke *et al.*[14] showed that individuals with very short or very long sleep had an increased mortality in a number of diagnoses including accidents. In a 5-yr follow up study, Martikainen *et al.*[78] found changes in the prevalence of sleepiness related road accidents. To our knowledge only one prospective study focused on fatal accidents at work and on its relation to sleep disturbance. This 20-yr follow up survey included a national sample of 47,860 individuals from the Swedish National Survey of Living Conditions (ULF). In this study, Åkerstedt *et al.*[79] analyzed 166 fatal occupational accidents, and found that "having a trouble in sleeping during the last two week" was significantly associated with an increased risk of fatal occupational accident: RR=1.89 (95%CI: 1.22–2.94). Other predictors were being a male and having a non-daytime work. Léger *et al.*[71] found seven times higher rate of work accidents in insomniacs than in good sleepers. Traffic accidents did not seem significantly different between the same groups. They explained the discrepancy between work accident and traffic accident by the fact that insomniacs may have avoided driving for personal purpose. In this study, insomniacs had a significantly lower average driving mileage than good sleepers. Lavie *et al.*[53] also showed that insomniacs had more work-related accidents than good sleepers (52.1% vs. 35.6%) and were 5% vs. 2% that had motor vehicle accidents due to fatigue in the past year. The difference observed between the higher risk of accidents at work and the lower risk at the wheel could be explained by the more monotonous conditions at work, which could promote inattention and accidents. In a population of small-and medium-sized enterprises, Nakata *et al.*[89] (in this issue) found that workers with trouble falling asleep, sleeping poorly at night, insufficient sleep, and insomnia symptoms had higher occupational injury rate than workers without these sleep features.

Economics of insomnia

The economic impact of insomnia can be divided into direct costs, indirect costs, and related costs. Direct costs of insomnia are charges for medical care or self-treatment that are borne by patients, government, organised healthcare providers, or insurance companies. Indirect costs refer to patient- and employer-borne costs that result from insomnia-related morbidity and mortality. Related costs are other costs which can be rationally associated with the illness, such as the cost of property damage resulting from accidents associated with insomnia[80–85].

The total cost of insomnia

At this time there are very little published studies to address the economic consequences of insomnia. The National Commission of Sleep Disorders Research (NCSDR) in the United States gave an estimate of the direct cost of insomnia in 1990 of $15.4 billion, extrapolating from available data[86].

However, in the judgement of the Commission, "the absence of hard epidemiological data makes it impossible to calculate the precise cost of sleep disorders, but some data do exist to show that the costs are substantial". Léger has examined in 1988, for the NCSDR, the cost of accidents related to sleep disorders in the United States and has estimated its cost between $43.15 billion and $56.02 billion[81]. Stoller[84] made an estimate of the total cost of insomnia in 1988, in the United States, based on a literature review on

the economic costs and effects associated with insomnia. Her cost estimate was from $92.5 billion to $107.5 billion.

Direct Costs of Insomnia

Direct costs of insomnia include out-patient visits, sleep recordings, and medications directly devoted, to insomnia. There is very little knowledge about this kind of cost. Walsh *et al*.[82] estimated the direct costs of insomnia to be $10.9 billion in 1990. The cost of substances to promote sleep was $1.1 billion. Health services for insomnia constituted $9.8 billion of the direct costs, $800 million for diagnosis and treatment of insomnia, and $9 billion for nursing home care of the elderly with insomnia. The other estimate of the direct costs of insomnia made by the NCSDR ($15.4 billion) was based on a literature review (NCSDR, 1993)[87]. However, the direct costs related to sleep disorders evaluation by practitioners, seem to be a small part of the total cost of insomnia. The Gallup study (NSF, 1991) found that only 5% of insomniacs had ever visited a physician to discuss specifically their sleeping problem and that only 21% had ever taken a prescription medication for sleep[65]. Léger *et al*.[72] found when studying the impact of insomnia in France that 53% of severe insomniacs vs. 27% of subjects with occasional sleep problems had ever visited a doctor specifically for insomnia (p<0,0001). A lot of persons with sleep dissatisfaction are just watching television, reading, using non-prescription medication, or drinking alcohol to promote sleep. In a 1996 survey in the Detroit area of a representative sample of 2,181 adults aged 18–45, Johnson *et al*.[88] found that 13.3% used alcohol as a sleep aid in the past year and 10.1% an over-the-counter prescription. Fifteen percent of those who used alcohol as a sleep aid did it for at least one month; however the duration of use was short for the majority of users (less than one week). Only 5.3% used a prescription medication. However, 10.8% of French adults regularly used prescription medication to promote sleep. The cost of these prescriptions seems very little compared with other costs[80].

Indirect Costs of Insomnia

The indirect costs of insomnia are the potential consequences of insomnia on society, such as health problems, professional consequences (loss productivity, and absenteeism) and accidents. The only estimate of the cost of accidents related to sleep disorders ($46–52 billion in 1988) was more focused on sleepiness at the wheel than on insomnia[84]. More information is needed to show if insomniacs are more sleepy at the wheel than good sleepers. We previously reported that Johnson and Spinweber[13], in Navy men, demonstrated than insomniacs were slower at work and had poorer career advancement than good-sleepers. Based on this study, Stoller[84] estimated the loss of productivity due to insomnia in the United States to be $41.1 billion in 1988. The cost of absenteeism was evaluated among non managerial personnel and was estimated of about $143 per day, or more than $57 billion per year[9].

Discussion about the costs of insomnia

Despite these several evaluations on the topic, the total costs of insomnia remain mainly unknown and it is actually difficult to have a general view on the impact of insomnia on economics. The studies on direct costs have been made only in two countries[81, 89] and it is difficult to apply these results to other parts of the world. The studies on indirect costs are based on hypotheses which have still restricted bases and have to be confirmed by larger studies in more representative samples. The same amount of insomnia may not necessarily have the same impact in different countries and there is a need of cross-cultural studies to better understand the daily economic impact of the diseases in insomniacs around the world. Future studies might try to adopt economical values such as the national gross product for a better and more comprehensive implication of the results at each country level.

Conclusion

Despite a large consensus of specialists and patients about the impact of insomnia on daytime functioning and on the daily lives of patients, there is already a small amount of work on the subject. This is clear that work conditions (noise, heat, light and psychological context) may have an experimental impact on sleep. It is also obvious that sleep deprivation may result in daytime somnolence and increase the risk of accidents. There is however a need of more epidemiological studies at the workplace to demonstrate a reciprocal link between work conditions and sleep disorders.

References

1) Ancoli-Israel S, Roth T (1999) Characteristic of insomnia in the United States: results of the 1991 National Sleep Foundation Survey, 1. Sleep **22** (Suppl 2), S347–53.
2) Balter MB, Uhlenhuth EH (1992) New epidemiologic findings about insomnia and its treatment. J Clin Psychiatry **53** (Suppl), 34–9.
3) Breslau N, Roth T, Rosenthal L, Andreski P (1996) Sleep

disturbance and psychiatric disorders: a longitudinal epidemiological study of young adults. Biol Psychiatry **39**, 411–8.
4) Hatoum HT, Kong SX, Kania CM, Wong JM, Mendelson WB (1998) Insomnia, Health- related quality of life and healthcare resource consumption a study of managed-care organization enrollees. Pharmacoeconomics **14**, 629–37.
5) Hohagen F, Rink K, Kappler C, Schramm E, Riemman D, Weyerers S, Berger M (1993) Prevalence and treatment of insomnia in general practice: a longitudinal study. Eur Arch Psych Clin Neurosci **242**, 329–36.
6) Patrick DL (1992) Health related quality of life in pharmaceutical evaluation: forging progress and avoiding pitfalls. Pharmacoeconomics **2**, 76–8.
7) Stephens DN, Sanger DJ (1996) The abuse and dependence liabilities of zolpidem. In: Zolpidem: An Update of Its Pharmacological Properties and Therapeutic Place in the Management of Insomnia. eds. by Freeman H, Puech AJ, Roth T, 73–86, Elsevier, Paris.
8) Ustun TB, Privett M, Lecrubier Y, Weiller E, Simon G, Korten A, Bassett SS, Maier W, Sartorius N (1996) Form, Frequency and burden of sleep problems in general health care. Eur J Psychiatry **11**, 5s–10s.
9) Walsh JK (2004) Clinical and Socioeconomic Correlates of Insomnia. J Clin Psychiatry **65** (Suppl 8): 13–9.
10) Bixler EO, Kales A, Salvados CR, Kales JD, Healeys S (1979) Prevalence of sleep disorders in the Los Angeles metropolitan area. Am J Psychiatry **136**, 1257–62.
11) Ford DE, Kamerow DB (1989) Epidemiologic study of sleep disturbances and psychiatrie disorders an opportunity for prevention? JAMA **262**, 1479–84.
12) Gislason T, Almquist M (1987) Somatic disease and sleep complaints. Acta Med Scand **221**, 475–81.
13) Johnson LC, Spinweber CL (1983) Quality of sleep and performance in the Navy: a longitudinal study of good and poor sleepers. In: Sleep-Wake Disorders: Natural History, Epidemiology, and Long-Term Evolution. eds. by Guilleminault C, Lugaresi E, 13–28, Raven Press, New York.
14) Kripke DF, Simons RN, Carfinkel L, Hammond E (1979) Short and long term sleep and sleeping pills: is increased mortality associated? Arch Gen Psychiatry **36**, 103–16.
15) Klink ME, Quan SF, Kaltenborn WT, Lebowitz MD (1992) Risk factors associated with complaints of insomnia in a general adult population. Influence of previous complaints of insomnia. Arch Intern Med **152**, 1634–7.
16) Léger D, Janus C, Pellois A, Dreyfus JP (1995) Using DSMIV to assess insomnia in epidemiological surveys. Sleep Res **24**, A48.
17) Schramm E, Hohagen F, Kappler C, Grasshoff U, Berger M (1995) Mental comorbidity of chronic insomnia in general practice attenders using DSM III R. Acta Psychiatr Scand **91**, 10–7.
18) Walsh JK, Fillingim JM (1990) Role of hypnotic drugs in general practice. Am J Med **88** (Suppl 3A), 34S–8S.
19) Edinger JE, Fins Al, Sullivan RJ Jr, Marsh GR, Dailey DS, Hope TV, Young M, Shaw E, Carlson D, Vasilas D (1997) Do our methods lead to insomniacs'madness? Daytime testing after laboratory and home based polysomnographic studies. Sleep **20**, 1127–34.
20) Mendelson WB, Garnett D, Linnoila M (1984) Do insomniacs have impaired daytime functionning? Biological Psychiatry **19**, 1261–3.
21) Ohayon MM, Lemoine P (2004) Daytime consequences of insomnia complaints in the French general population. Encephale **30**, 222–7.
22) Roth T, Roehrs TA, Carskadon MA, Dement WC (1994) Daytime sleepiness and alertness. In: Principles and Practice of Sleep Medicine. eds. by Kryger M H, Roth T, Dement WC, 40–9, WB Sauders, Philadelphia.
23) Dinges DF, Kribbs NB (1991) Performing while sleepy: effects of experimentally induced sleepiness. In: Sleep, sleepiness and performance. ed. by Monk TH, 97–128, John Wiley & Sons, New York.
24) Katz HC, Kochan TA, Gobeille KR (1982) Industrial relations performance, economic performance and quality of working life efforts: an interplant analysis, Data on file, Massachusetts Institute of Technology, **20**.
25) Léger D, Janus C, Pellois A, Quera-Salva MA, Dreyfus JP (1995) Sleep morning alertness and quality of life in subjects treated with zopiclone and in good sleepers. Study comparing 167 patients and 381 good sleepers. Eur Psychiatry **10** (Suppl 3), 99–102.
26) Léger D, Quera Salva MA, Philip P (1996) Health related quality of life in patients with insomnia treated with zopiclone. Pharmaco Economics **10** (Suppl), 39–44.
27) Roth T, Roehrs T, Bonahoom A, Rosekind M, Koshorek C, Rosenthal L (1998) Cumulative effects of sleep loss. Sleep **21** (Suppl 3), 239.
28) Stepanski E, Zorick F, Rohers T, Young D, Roth T (1988) Daytime,alertness in patients with chronic insomnia compared with asymptomatic control subjects. Sleep

11, 54–60.
29) Léger D (2000) Public Health and Insomnia: Economic Impact. Sleep **23** (Suppl 3), S69–85.
30) Karacan I, Thornby JL, Anch M, Holzer CE, Warheit CJ, Schwab JJ, Williams RL (1976) Prevalence of sleep disturbance in a primarily urban Florida county. Soc Sci Med **10**, 239–44.
31) Mellinger GD, Balter MB, Uhlenhuth EH (1985) Insomnial and its treatment. Arch Gen Psychiatry **42**, 225–32.
32) Quera Salva MA, Orluc A, Goldenberg F, Guilleminault C (1991) Insomnia and use of hypnotics: study of a French population. Sleep **14**, 386–91.
33) Ohayon M (1996) Epidemiological study on insomnia in the general population. Sleep **19**, S7–15.
34) Léger D, Guilleminault C, Dreyfus JP, Delahaye J, Israel AG, Ancoli-Israel S (2000) Prevalence of insomnia in a survey of 12778 adults in France. J Sleep Res **9**, 35–42.
35) Partinen M, Kaprio J, Koskenvuo M, Langinvaino H (1983) Sleeping habits, sleep quality and use of sleeping pills: a population study of 31,140 adults in finland. In: Sleep-Wake Disorders: Natural History Epidemiology, and Long-Term Evolution. eds. by Guillemenault C, Lugaresi E, 29–36, Raven Press, New York.
36) Ohayon MM (2002) Epidemiology of insomnia. What we know and what we still need to learn. Sleep Med Rev **6**, 97–111.
37) Ohayon MM, Roth T (2003) Place of chronic insomnia in the course of depression and anxiety disorders. J Psychiatr Res **37**, 9–15.
38) Shochat T,Umphress J, Israel AG, Ancoli-Israel S (1999) Insomnia in primary care patients. Sleep **22** (Suppl 2), S359–65.
39) Simen S, Hajak Q, Schlaf Q, Westenhüfer J, Rodenbeck A, Bandelow B, Pudel V, Rüther E (1995) Chronic sleep complaints. Results of a representative survey in Germany. Nervenarzt **66**, 686–95.
40) Buysse DJ, Reynolds CF 3rd, Kupfer DJ, Thorpy MJ, Bixler E, Manfredi R, Kales A, Vgontzas A, Stepanski E, Roth T (1994) Clinical diagnoses in 216 insomnia patients using the international classification of sleep disorders (ICSD), DSM IV and ICD 10 categories: a report from the APA/NIMH DSM IV Field Trial. Sleep **17**, 630–7.
41) Hajak G (2001) Epidemiology of severe insomnia and its consequences in Germany. SINE Study Group. Study of Insomnia in Europe. Eur Arch Psychiatry Clin Neurosci **251**, 49–56.
42) American Psychiatric Association (1994) Diagnostic and statistical manual of mental disorders, 4th ed (DSM IV). American Psychiatric Association, Washington, DC.
43) American Sleep Disorders Association (1990) International classification of sleep disorders: diagnostic and coding manual. Allen, Lawrence.
44) Partinen M, Eskilen L, Tuomi K (1984) Complaints of insomnia in different occupations. Scand J Work Environ Health **10**, 476–9.
45) Geroldi C, Frisoni GB, Rozzini R, De Leo D, Trabucchi M (1996) Principal lifetime occupation and sleep quality in the elderly. Gerontology **42**, 163–9.
46) Doi Y, Minowa M, Tango T (2003) Impact and correlates of poor sleep quality in Japanese white-collar employees. Sleep **26**, 467–71.
47) Jacquinet-Salord MC, Fouriaud C, Nicoulet I, Bingham A (1993) Sleeping tablets consumption, self reported quality of sleep, and working conditions. Group of Occupational Physicians of SPSAT. J Epidemiol Community Health **47**, 64–8.
48) Nakata A, Haratani T, Takahashi M, Kawakami N, Arito H, Kobayashi F, Araki S (2004) Job stress, social support, and prevalence of insomnia in a population of Japanese daytime workers. Soc Sci Med **59**, 1719–30.
49) Tachibana H, Izumi T, Horiguchi I, Manabe E, Takemoto T (1996) A study of the impact of occupational and domestic factors on insomnia among industrial workers of a manufacturing company in Japan. Occup Med **46**, 221–7.
50) Nakata A, Haratani T, Kawakami N, Miki A, Kurabayashi L, Shimizu H (2000) Sleep problems in white-collar male workers in an electric equipment manufacturing company in Japan. Ind Health **38**, 62–8.
51) Tachibana H, Izumi T, Honda S, Takemoto T (1998) The prevalence and pattern of insomnia in Japanese industrial workers: Relationship between psychosocial stress and typs of insomnia. Psychiat Clin Neurosci **52**, 397–402.
52) Kalimo R, Tenkanen L, Harma M, Poppius E, Heinsalmi P (2000) Job stress and sleep disorders: findings from the Helsinki Heart Study. Stress Med **16**, 65–75.
53) Lavie P (1981) Sleep habits and sleep disturbances in industrial workers in Israël: main findings and some characteristics of workers complaining of excessive daytime sleepiness. Sleep **4**, 147–58.

54) Ribet C, Derrienic F (1999) Age, working conditions and sleep disorders: a longitudinal analysis in the French Cohort E.S.T.E.V. Sleep **22**, 491–504.
55) Kuppermann M, Lubeck DP, Mazonson PD, Patrick DL, Stewart AL, Buesching DP, Fifer SK (1995) Sleep problems and their correlates in a working population. J Gen Intern Med **10**, 25–32.
56) Sateia M, Doghramji K, Hauri PJ, Morin CM (2000) Evaluation of Chronic insomnia. Sleep **23**, 243–308.
57) Åkerstedt T, Fredlund P, Gillberg M, Jansson B (2002) Work load and work hours in relation to disturbed sleep fatigue in a large representative sample. J Psychosom Res **53**, 585–8.
58) Roth T, Roehrs T (2003) Insomnia: epidemiology, characteristics, and consequences. Clin Cornerstone **5**, 5–15.
59) Åkerstedt T (2003) Shift work and disturbed sleep wakefulness. Occup Med **53**, 89–94.
60) Åkerstedt T (1998) Shift work and disturbed sleep wakefulness. Sleep Med Rev **2**, 117–28.
61) Costa G, Folkard S, Harrigton JM (2000) Shifwork and extended hours of work. In: Hunter's Diseases of Occupations, 9th ed. eds. by Baxter PJ, Adams PH, Aw TC, Cockroft A, Harrington JM, 581–9, Arnold, London.
62) Costa G (2003) Shift work and occupational medecine: an overview. Occup Med **53**, 83–8.
63) Ohayon MM, Lemoine P, Arnaud-Briant V, Dreyfus M (2002) Prevalence and consequences of sleep disorders in a shift worker population. J Psychosom Res **53**, 577–83.
64) Karasek RA (1979) Job demands, job decision latitude and mental strain: Implcation for job redesign. Am Sci Q **24**, 285–308.
65) National Sleep Foundation (1991) Sleep in America: a national Survey of U.S. adults. Los Angeles.
66) Addison RQ, Thorpy MJ, Rohers TA, Roth T (1991) Sleep/ wake complaints in the general population. Sleep Res **20**, 112.
67) Lugaresi E, Cirignotta F, Zucconi M (1983) Good and poor sleepers: an epidemiologic survey of the San Marino population. In: Sleep-Wake Disorders: Natural History Epidemiology, and Long-Term Evolution. eds. by Guillemenault C, Lugaresi E, 1–12, Raven Press, New York.
68) Balter MB, Uhlenhuth EH (1991) The beneficial and adverse effects of hypnotics. J Clin Psychiatry **52** (Suppl), 16–23.
69) Schweitzer PK, Engelhardt CL, Hilliker NA, Muehlbach MJ, Walsh JK (1992) Consequences of reported poor sleep. Sleep Res **21**, 260.
70) Jenkins R (1985) Minor psychiatric morbidity in employed youg men and women and its contribution to sickness absence. Br J Ind Med **42**, 147–54.
71) Léger D, Guillemenault C, Bader G, Levy E, Paillard M (2002) Medical and socioprofessionnal impact of insomnia. Sleep **25**, 625–9.
72) Léger D, Le Pen C, Thébault C, Loos F, Levy E, Paillard M (1997) Economical consequences of insomnia. Sleep Res **26**, 412.
73) Leigh JP (1991) Employee and job attributes as predictors of absen teeism in a national sample of workers: the importance of health and dangerous conditions. Soc Sci Med **33**, 127–37.
74) Goodman PS, Atkin RS (1984) Effects of absenteeism on individuals and organizations. In: Absenteeism—New Approaches to Understanding, Measuring and Managing Employee Absence. eds. by Goodman PS, Atkin RS, 276–321, Jossey-Bass, San Francisco.
75) Katz HC, Kochan TA, Weber MR (1982) Assessing the effects of industrial relations and quality of working life efforts on organizational effectiveness. Data on file, Massachusetts Institute of Technology, 21.
76) Philip P, Taillard J, Niedhammer I, Guilleminault C, Bioulac B (2001) Is there a link between subjective daytime somnolence and sickness absenteeism? A study in a working population. J Sleep Res **10**, 111–5.
77) Roth T, Ancoli-Israel S (1991) Daytime consequences and correlates of insomnia in the United States: results of the National Sleep Foundation Survey II. Sleep **22** (Suppl 2), S354–8.
78) Martikainen K, Partinen M, Hasan J, Urponen H, Vuori I, Laippala P (1998) Natural evolution of sleepiness. A 5-year follow study in a middle age population. Eur J Neurol **11**, 100–9.
79) Åkerstedt T, Fredlund P, Gillberg M, Jansson B (2002) A prospective study of fatal occupational accidents—relationship to sleeping difficulties and occupational factors. J Sleep Res **11**, 69–71.
80) Léger D, Levy E, Paillard M (1999) The direct costs of insomnia in France. Sleep **22** (Suppl 2), S394–401.
81) Léger D (1994) The cost of sleep related accidents: a report for the national commission of sleep disorders research. Sleep **17**, 84–93.
82) Walsh JK, Engelhardt CL, Hartman PG (1995) The direct economic cost of insomnia. In: Hypnotics and Anxiolytics: Bailliere's Clinical Psychiatry. eds. by Nutt D, Mendelson W, 369–81, Bailliere Tindall, London.

83) Walsh JK, Engelhardt CL (1999) The direct economic costs of insomnia in the United State for 1995. Sleep **22** (Suppl 2), S386–93.
84) Stoller MK (1994) Economic effects of insomnia. Clinical Therapeutics **16**, 263–87.
85) Chilcott LA, Shapiro CM (1996) The socioeconomic impact of insomnia. Pharmacoeconomics **10**, 1–14.
86) National Commission on Sleep Disorders Research (1993) Wake up America: a national sleep alert, vol 1. Executive Summary and Executive R eport of National Commission of Sleep Disorders Research. US. Government Printing Office, Washington, DC.
87) Ohayon M, Caulet M (1992) Adinfer: experience of an expert system in psychiatry. In: Medical Informatics (MEDINFO 1992), ed. by Lun KC, 615–9, Elsevier Science, Amsterdam.
88) Johnson EO, Roehrs T, Roth T, Breslau N (1998) Epidemiology of alcohol and medication as aid sleep in early adulthood. Sleep **21**, 178–86.
89) Nakata A, Ikeda T, Takahashi M, Haratani T, Fujioka Y, Fukui S, Swanson NG, Hojou M, Araki S (2005) Sleep-related risk of occupational injuries in Japanese small and medium-scale enterprises. Ind Health **43**, 89–97.