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# Occupational Injuries related to Sleepiness in Indian Traditional Industries

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## *ABSTRACT*

*A cross-sectional study was done to evaluate the rate of sleepiness and its relation to occupational injuries in Indian Traditional Industries. Data was collected using pretested and structured questionnaire about eight sleep habits, symptoms of depression, occupational injury due to fatigue, demographics, presence of diseases and lifestyle factors from 920 workers between the ages of 18–65 (mean 433.5) year in small scale industries. Occupational injury was assessed by asking subjects 'Have you ever been injured during your work, including minor scratches and cuts (Yes/ No)? Both sleep and injury were assessed over the previous one year period. One-third of workers answered that they had experienced injury. Workers with sleep features of DIS, sleeping poorly at night, insufficient sleep, and insomnia had a significantly higher prevalence for injury after adjusting for multiple confounders. The findings suggest that poor nocturnal sleep habits are associated with self-reported occupational injury.*

***Key words:*** *Occupational injury, Epidemiology, Safety, Sleep, Small scale industries.*

## INTRODUCTION

Do you have a good sleep refreshing you for your daily work? Are we alert enough to be productive? These are central questions for accomplishing a better quality of working life. Many lines of evidence indicate that workers are not having enough sleep. It is a well known fact that sleep and health are closely related (Pilcher et al. 1997, Pilcher & Ott 1998, Phillips et al 1991).

Sleepiness/fatigue reduces performance capability induced by slow information processing, increased periods of non-responding or delayed responding during attention-based tasks, increased reaction times, reduced vigilance, reduced accuracy of short-term memory, and accelerated decrements in performance with time on- task. This leads to human error and potentially increases the risk for accidents (Bedard et al 1991, Dinges 1995, Dinges et al 1997, Redline et al 1997). Sleep loss, insufficient sleep during the night or having poor sleep habits undoubtedly induce sleepiness which could affect daytime functioning and

performance and possibly impair safety at work. When workers performance is also impaired due to fatigue as it reduces (deactivates) the electrical activity of some regions of brain (see Figure 1). Reductions in activation are especially evident in prefrontal cortices (the highlighted region to the right)—which control functions like situational awareness and problem-solving; the inferior temporal cortices (the highlighted region to the left) which are important for mental tasks such as mathematical calculation; and the thalamus (central highlighted region) which controls general alertness levels and attention (Thomas et al., 2006).

In the working population, inadequate sleep could induce not only deterioration of health but could also lead to sleepiness during work which is associated with increased risk of accident at work, absenteeism, low work productivity, and less job satisfaction (Leger 1994, Gislason & Almqvist 1987 , Jenkins 1985, Lavie 1981). Sleep is therefore essential for worker's health and welfare as well as for their safety and productivity in the workplace.

Insufficient sleep and impaired alertness are the most common problems with non- physiological working hours (Ministry of Labour and Employment 2008, Ministry of Health 2009). Most studies in different countries revealed that sleeping disorder, job stress and job dissatisfaction are the major risk factors for the occurrence of occupational injuries among industrial workers (Nearkasen et al 2002, Li CY, 2001). Consequences of occupational accident and injuries include increased absenteeism and use of medical care services, reduced productivity, lost working time, and disabilities.

A number of occupational as well as social factors have been reported to be associated with the risk of being injured. These include poor work condition (Melamed et al 1999), shift/night work (Gold et al 1992, Smith et al 1994, Hossain et al 2004), sleep problems (Lavie et al 1982, Balter & Uhlenhuth 1992, Leger et al 2002, Akerstedt et al 2002, Doi et al 2003, Chau et al 2004 ),young age (Cloutier 1994, Laflamme et al 1996, McCaig et al 1998, Breslin et al 2003), increase in accident rate in white collar workers (Doi et al. 2003), job stress (Murata et al 2000, Salminen et al 2003), long working hours (Akerstedt 1995, Hanecke et al 1998), lack of experience or training (Wong 1994), fatigue (Swaen et al 2003), and unhealthy lifestyle e.g. smoking and alcohol consumption (Macdonald et al 1998, Ryan et al 1993, Wells and Macdonald 1999), also, Chau et al. (2004) reported that worker 'sleeping poorly' is more associated with occupational injury than merely 'sleeping less than 6 hour per day' and also stated that workers under the age of 30 year, current smokers, and those suffering from sleep disorders were significantly more likely to sustain occupational

injuries.

Sleep loss, insufficient sleep during the night or having poor sleep habits undoubtedly induce sleepiness which could affect daytime functioning and performance and possibly impair safety at work. Lavie et al (1982) reported that workers complaining of excessive daytime sleepiness had the highest numbers of accidents (49.3%) followed by frequent mid-sleep awakenings (42.9%) and difficulty falling asleep (34.8%).

Leger (1994) suggested that as many as 52.5% of all work-related accidents and injuries are potentially related to sleepiness in the US working population, indicating a strong contribution of sleep factors to the occurrence of accidents and injuries. Sleepiness and reduced vigilance could be some of the most important risk factors for traffic and industrial accidents (Connor et al 2002). According to the U.S National Transportation Safety Board Report, 57% of the accidents were due to Sleepiness (Summala 1994). In another study carried out by J. Shen shift workers encountered more fatigue than non shift workers, but there was no much difference between the severities of sleepiness for the two groups (Shen J et al 2006 ). Knowledge about the influence of shift works on fatigue and sleep disturbances are still limited. Also their relations to the incidence of occupational accidents are not known.

In the present study, a cross-sectional survey in small scale enterprises was conducted, mainly consisting of manufacturing plants (88%). Researcher focused on this population because manufacturing in India had the highest number of occupational injuries among all industry sectors in 2007 (Ministry of Labour and Employment 2008, Ministry of Health 2009). It also has been reported that small and medium scale enterprises were more likely to engage in dangerous and hazardous work, and suffer from occupational accidents and occupational health problems than large-scale enterprises (Ikeda et al 2002, Kumagai et al 2000, Hirata et al 1999, The small and medium enterprise agency 2003). Daily sleeping hours, length of time to fall asleep, frequency of awakening during sleep, early morning awakening, difficulty waking up in the morning, sleeping well at night, sufficiency of sleep, and difficulty in breathing during sleep were investigated in this study. Socio-demographics, lifestyle, physical/ psychological conditions were included as confounding factors. Therefore, it was decided to study fatigue and sleepiness in a group of workers & the incidence of accidents was studied in relation to fatigue and sleepiness so as to help plan better preventable measures. Researcher analyzed males and females individually in addition to both combined, since males are reported to have a higher incidence of injury compared to females (Dimich-Ward et al 2004).

## SUBJECTS AND METHODS

The data were collected in a cross-sectional study with a self-rating questionnaire from May to December 2008. The study subjects were small scale enterprises (1 to 135 workers) in two District of Uttar Pradesh, India.

For Varanasi district, subjects were selected randomly for a sampling of 6.2 to 19.0% of workers corresponding to the distribution of types of businesses in the Varanasi district. Varanasi district have a representative percentage of small scale manufacturing plants and highest percentage of people working in Banarasi sarees manufacturing unit. Employees and employers of 28 factories, a total of 895 people, were recruited as subjects. Questionnaires were distributed to 585 workers of 21 factories. The questionnaire could not be distributed (non-distributed number) to 310 workers for several reasons: the person responsible for the worksite did not have time to recruit workers, the workers declined participation, the factory was too far to visit, or the worker had retired. Finally, responses were obtained from 519 (response rate 88.72%).

For Mirzapur district, questionnaire was distributed to all employees and employers of small scale enterprises. This area is so-called a "Carpet industrial area", which is known as one of the unique area with small scale enterprises. There were 16 enterprises with a total of 725 workers, including 11 carpet weaving unit, 3 carpet dyeing unit, and 2 raw material unit which mostly employed fewer than 50 workers per factory. A total of 401 workers responded to the questionnaire (response rate 55.3%).

A total of 920 workers from both districts responded for an overall response rate of 70.23%. The workers completed a questionnaire asking about demographics, current job and business type (Table 1), occupational injury, sleep, symptoms of depression, lifestyle factors, and presence of diseases (Table 2). One hundred and twenty-seven workers were either shift or night workers. Questionnaires from 12 workers with a missing response to questions about demography and current job type were eliminated from the analyses. There were also some missing values for other individual items; for example, about 13.8% of the values for Center for Epidemiologic Studies Depression (CES-D) scale were missing. None of the other variables had a non-response rate of more than 5.4%. All participants signed an informed consent. The study protocol was approved by the Ethical Committee of the Department of Anthropology, University of Delhi, Delhi, India.

## Measurement Methods

### Sleep questionnaire

The sleep assessment was based on Eight questions about sleep habits developed by Akinori et al. (2005) (Table 3). The subjects were also queried on various question related to self-reported sleep habits with occupational injuries (Table 4). These questions were adapted and modified from those used in previous epidemiological studies of sleep (Bixler et al 1979, Bliwise et al 1992, Ohayon 2002, Nakata et al 2004).

### Occupational injury Data

A question to assess occupational injury was "Have you ever been injured during your work, including minor scratches and cuts in the previous year?" The possible response was either yes or no.

### Depressive symptoms

Depressive symptoms were evaluated using the Center for Epidemiologic Studies Depression (CES-D) scale. This scale was taken from the National Institute for Occupational Safety and Health (NIOSH) Generic Job Stress Questionnaire (GJSQ) (Nakata et al 2004, Hurrell & McLaney 1988, Haratani et al 1996). The CES-D scale cut-off score of 16 differentiates the depressed from the non-depressed patient with both high sensitivity and specificity (Weissman et al 1977).

### Other covariates

Other covariates included age, gender, marital status, years of education, smoking, alcohol consumption, caffeine intake (cups of coffee or tea/day), and presence of self-reported physical and/or psychological diseases (Table 2). Subjects were asked about the number of drinks that they consumed a week, where one drink consisted of about 9 g of pure ethanol (grams of ethanol/week). One item asked the number of cigarettes usually smoked a day. The subjects were also asked about history of physical and/or psychological diseases. These included hypertension, diabetes mellitus, depression, menopausal syndrome, and other diseases including heart disease, cancer, liver disease, renal disease, peptic ulcer, gastrointestinal diseases, neurological diseases, musculoskeletal disorders, and psychiatric illnesses.

Table 1. Characteristics of 920 workers in small scale enterprises.

| Variable | | Percentage (%) |
|---|---|---|
| **Age Group (in years)** | 18–29 | 19.8 |
| | 30–39 | 22.2 |
| | 40–49 | 20.8 |
| | 50–59 | 25.7 |
| | 60 + | 11.5 |
| **Gender** | Male | 63.9 |
| | Female | 36.1 |
| **Marital status** | Married | 69.3 |
| | Not married | 30.7 |
| **Education (in years)** | Illiterate | 22.1 |
| | 5–9 | 20.7 |
| | 10–12 | 37.1 |
| | After 12 | 20.1 |
| **Job type** | Managerial/clerical | 17.4 |
| | Sales/service | 8.5 |
| | Technical | 7.2 |
| | Manufacture | 46.2 |
| | Driving | 4.4 |
| | Others | 16.3 |
| **Business type** | Manufacture | 90.9 |
| | Transportation | 5.6 |
| | Construction | 1.5 |
| | Service | 0.4 |
| | Others | 1.6 |

Table 2. Occupational injuries, self-reported sleep habits, depressive symptoms, and other covariates of workers in small scale enterprises (n=920).

| Variable | N (%) | Mean (SD, range) |
|---|---|---|
| **Occupational injuries** | | |
| Yes | 264 (28.7) | |
| No | 656 (71.3) | |
| **Subjective sleep habits during the last 1-yr period** | | |
| Daily sleep duration: Fewer than 6 hours | 362 (39.4) | |
| 6–8 hours | 505 (54.9) | |
| More than 8 hours | 53 (5.7) | |
| Taking more than 30 min to fall asleep (DIS) | 155 (16.8) | |
| Awakening during sleep more than 3 times/week (DMS) | 76 (8.3) | |
| Early morning awakening more than 3 times/week (EMA) | 61 (6.6) | |
| Difficulty waking up in the morning (Considerably/somewhat) | 223 (24.2) | |
| Sleeping poorly at night (very poorly/not so well) | 151 (16.4) | |
| Insufficiency of sleep (definitely/somewhat) | 432 (46.9) | |
| Difficulty breathing during sleep (more than once a week) | 26 (2.8) | |
| Insomnia symptoms* | 218 (23.7) | |
| Depressive symptoms (CES-D score) | | 15.4 (8.2, 0–52) |
| CES-D 16 >= | 355 (38.6) | |
| **Other covariates** | | |
| Smoking (number of cigarettes smoked/day) | | 11.3 (13.7, 0–100) |
| Alcohol consumption (ethanol (g)/week) | | 73.6 (96.6, 0–972) |
| Caffeine intake (cups of coffee or tea/day) | | 3.2 (1.1, 0–6) |
| Presence of physical/psychological diseases (Yes) | 252 (27.4) | |

SD= standard deviation; DIS= difficulty initiating sleep; DMS= difficulty maintaining sleep; EMA= early morning awakening; CES-D= Center for Epidemiologic Studies Depression scale.

*Defined by at least one positive response to questions regarding DIS, DMS or EMA

Table 3. Questions regarding sleep habits as stated on questionnaire

| | |
|---|---|
| 1. On the average, how much sleep per day did you usually take during the last year? | (i) less than 5 h (ii) 5 to 6 h (iii) 6 to 7 h (iv)7 to 8 h (v) 8 to 9 h (vi) 9+ h |
| 2. How long does it usually take you to fall asleep in bed? | (i) 0–10 min (ii) 11–30 min (iii) 31–59 min (iv) 1–2 hours (v) 2+ h |
| 3. How often do you have difficulty staying asleep? | (i) never (or almost never) (ii) few times a year (iii)more than once a month (iv) more than once a week (v) more than three times a week (vi) almost every day |
| 4. How often do you wake up too early and can't fall asleep again? | (i) never (or almost never) (ii)few times a year (iii) more than once a month (iv)more than once a week (v) more than three times a week (vi) almost every day |
| 5. Do you feel difficulty waking up in the morning? | (i) considerably (ii) somewhat (iii) a little (iv) not very (v) rarely (vi) not at all |
| 6. Do you think your daily sleep is sufficient? | (i) definitely insufficient (ii) somewhat insufficient (iii) fairly sufficient (iv) very much sufficient |
| 7. Do you usually sleep well at night? | (i) very poorly (ii) not so well (iii) fairly well (iv) very well |
| 8. Have you ever felt difficulty breathing during sleep or has anyone in your family told you that you have this? | (i) never (or almost never) (ii) few times a year (iii) more than once a month |

**Statistical Methods**

Associations of sleep habits and occupational injury were identified with a series of individual univariable and multivariable logistic regression analyses. The models were adjusted for age (continuous variable), gender, marital status, years of education, presence of diseases, smoking (continuous variable), alcohol consumption (continuous variable), caffeine intake (continuous variable), depressive symptoms (continuous variable), and job types. To see any gender differences, researcher also analyzed males and females separately. The significance level of all statistical analyses was $p<0.05$ (two-tailed test). All data were analyzed by the Statistical Package for the Social Sciences version 13.0.

Table 4. Association of self-reported sleep habits with occupational injuries in workers in small scale enterprises (n=920)

| | **Occupational injury (Yes)[#]** | |
|---|---|---|
| **Variable** | **Unadjusted** | **Adjusted [##]** |
| **Sleep habits:** | **OR (95% CI)** | **OR (95% CI)** |
| Less than 6 hr of daily sleep (yes vs. no) | 1.0 (0.8–1.1) | 1.1 (0.9–1.3) |
| Over 30 min to fall asleep (DIS) (yes vs. no) | 1.5 (1.2–1.8)*** | 1.4 (1.1–1.9)* |
| Awakening during sleep more than 3 times/wk (DMS) (yes vs. no) | 1.2 (0.9–1.6) | 1.0 (0.6–1.5) |
| Early morning awakening more than 3 times/wk (EMA) (yes vs. no) | 1.1 (0.8–1.5) | 0.9 (0.5–1.4) |
| Considerably/somewhat difficulty waking up in the morning (yes vs. no) | 1.3 (1.1–1.6)** | 1.1 (0.9–1.5) |
| Sleeping very poorly or not so well at night (yes vs. no) | 1.5 (1.2–1.8)*** | 1.5 (1.1–2.0)** |
| Definitely or somewhat insufficiency in sleep (yes vs. no) | 1.4 (1.2–1.7)*** | 1.4 (1.1–1.7)** |
| Difficulty breathing during sleep more than once a week (yes vs. no) | 1.0 (0.6–1.7) | 1.4 (0.7–2.6) |
| Insomnia symptoms [###] (yes vs. no) | 1.4 (1.2–1.7)*** | 1.3 (1.0–1.7)* |
| OR, odds ratio; CI, confidence interval; DIS, difficulty initiating sleep; DMS, difficulty maintaining sleep; EMA, early morning awakening. | | |
| *p<0.05, **p<0.01, ***p<0.001. | | |
| # Reference category is no occupational injuries in the last 1-year period. | | |
| ## Adjusted for age, gender, marital status, years of education, presence of diseases, smoking, alcohol drinking, caffeine intake, depressive symptoms, and job type in multiple logistic regression analyses. | | |
| ### Defined by at least one positive response to questions regarding DIS, DMS or EMA. | | |

## RESULTS

### Characteristic of workers

The age of participants ranged from 18 to 65 (mean 32.5) yr. Thirty seven percent of workers were

higher than 50 yr in age. Sixty-four percent of workers were males. As job types, manufacturing and managerial/clerical possessed more than 60% of all workers. Ninety-one percent of workers were working in manufacturing plants.

**Prevalence of occupational injuries, poor sleeps habits and depressive symptoms**

The frequency of occupational injuries, subjective sleep habits, and depressive symptoms is shown in the Table 2. A total of 264 workers (28.7%) responded that they had experienced an occupational injury in the last 1-yr period (39.3% and 20.2% for males and females, respectively). Thirty-nine percent of workers slept fewer than 6 h, and the prevalence of DIS was 16.8%, DMS was 8.3%, and EMA was 6.6%. Nearly twenty-four percent of this population showed insomnia symptoms. Nearly a quarter of the workers reported difficulty waking up in the morning, 16.4% reported sleeping very poorly and/or not so well at night, while 46.9% of the subjects reported sleep that was definitely and/or somewhat insufficient. The percentage of workers having difficulty breathing during sleep more than once a week was 2.8%. The average score for the CES-D scale was 15.4 and the prevalence of depressive symptoms (CES-D 16 >=) was 38.6% in this population.

**Association of sleep habits with occupational injury**

The unadjusted logistic regression analyses indicate that workers with sleep features of DIS, difficulty waking up in the morning, sleeping poorly at night, insufficient sleep, and insomnia had a significantly higher prevalence for occupational injury (Table 4). In the multivariable logistic regression analyses, DIS (odds ratio (OR) 1.5, 95% confidence interval (CI) 1.2–1.8), sleeping poorly at night (OR 1.5, 95% CI 1.1–2.0), sleep insufficiency (OR 1.3, 95% CI 1.1–1.7), and insomnia symptoms (OR 1.5, 95% CI 1.1–1.9) remained significant. In males, this tendency was similar, while females showed a weaker relationship, as shown in the Table 5.

## DISCUSSION

This experimental analytical study was done to determine sleepiness and its relation with the rate of injury of workers of Indian Traditional Industries. This study demonstrates that the sleep problems such as difficulty initiating sleep, sleeping poorly at night, sleep insufficiency and insomnia symptoms are moderately but significantly associated with the occurrence of occupational injuries in small and medium-scale enterprises. A weak association was also found between difficulty waking up in the morning and occupational injuries. Males showed a similar pattern with the analysis of the total subjects, while females showed a weaker

association. In this study, insomnia symptoms and its subtype, difficulty initiating sleep, were associated with the occurrence of occupational injuries.

Table 5. Association of self-reported sleep habits with occupational injuries in male and female workers in small and medium-scale enterprises

| | Occupational injury (Yes)[#] | | | |
|---|---|---|---|---|
| | Male (n=1970–2,020) | | Female (n=792–820) | |
| Variable | Unadjusted | Adjusted [##] | Unadjusted | Adjusted [##] |
| Sleep habits: | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| Less than 6 h of daily sleep (yes vs. no) | 0.9 (0.8–1.1) | 1.1 (0.9–1.4) | 0.9 (0.7–1.3) | 1.0 (0.6–1.5) |
| Over 30 min to fall asleep (DIS) (yes vs. no) | 1.5(1.2–1.9)*** | 1.4 (1.0–1.8)* | 1.5 (1.0–2.4)* | 1.4 (0.8–2.5) |
| Awakening during sleep more than 3 times/wk (DMS) (yes vs. no) | 1.2 (0.8–1.6) | 1.0 (0.6–1.5) | 1.7 (1.0–2.9) | 1.2 (0.5–2.6) |
| Early morning awakening more than 3 times/wk (EMA) (yes vs. no) | 1.0 (0.7–1.5) | 0.9 (0.6–1.5) | 1.6 (0.9–2.9) | 1.0 (0.4-2.7) |
| Considerably/somewhat difficulty waking up in the morning (yes vs. no) | 1.3 (1.1–1.6)** | 1.1 (0.8–1.4) | 1.6 (1.1–2.4)** | 1.4 (0.9–2.4) |
| Sleeping very poorly or not so well at night (yes vs. no) | 1.6 (1.3–2.1)*** | 1.4 (1.0–1.9)* | 1.2 (0.8–1.9) | 1.3 (0.7–2.4) |
| Definitely or somewhat insufficiency in sleep (yes vs. no) | 1.5 (1.3–1.8)*** | 1.3 (1.0–1.7)* | 1.2 (0.8–1.7) | 1.2 (0.8–2.0) |
| Difficulty breathing during sleep more than once a week (yes vs. no) | 0.9 (0.5–1.4) | 1.4 (0.7–2.6) | / | / |
| Insomnia symptoms [###] (yes vs. no) | 1.5 (1.2–1.8)*** | 1.3 (1.0–1.7) | 1.5 (1.0–2.2) | 1.3 (0.7–2.1) |
| OR, odds ratio; CI, confidence interval; DIS, difficulty initiating sleep; DMS, difficulty maintaining sleep; EMA, early morning awakening. *p<0.05, **p<0.01, ***p<0.001. / Estimates could not be calculated. | | | | |
| # Reference category is no occupational injuries in the last 1-yr period. | | | | |
| ## Adjusted for age, marital status, years of education, presence of diseases, smoking, alcohol drinking, caffeine intake, depressive symptoms, and job type in multiple logistic regression analyses. | | | | |
| ### Defined by at least one positive response to questions regarding DIS, DMS or EMA. | | | | |

In the current study, we structured questioner about eight specific sleep habits; these habits were selected on the basis of the fact of sleepiness at work are considered as a serious occupational health problem. Jansen concluded that use of different fatigue questionnaires has a direct role on prevalence rates of fatigue in various investigations (Jansen et al 2003).

The results are consistent with several previous studies. Balter & Ulenhuth (1992) compared past- year prevalence rates for serious accidents/injuries in subjects with chronic untreated insomnia and normal controls and found 4.5 times higher rates in insomniacs (2% and 9%, respectively). Leger et al. (2002) also reported that severe insomniacs had more problems at work such as decreased concentration, difficulty performing duties, and work-related accidents than good sleepers. In the construction industry, where accidents tend to be serious, sleep disorders were reported to be the major factor contributing to occupational injuries (Chau et al 2004). Also, in white-collar workers, an increased accident rate (OR of 1.48) was found in subjects reporting poor sleep quality using Pittsburgh Sleep Quality Index, but the finding was not statistically significant because of the small number of accident cases (Doi et al 2003). Present study, together with those of others, suggests that insomnia symptoms could be an important risk factor for the occurrence of injuries.

Researcher observed a strongest association between DIS and occurrence of occupational injuries, while no significant association existed between DMS or EMA subtypes of insomnia symptoms. In contrast, Lavie et al. (1982) reported that frequent mid-sleep awakenings were more strongly associated with incidence of injuries than difficulty falling asleep (42.9% and 34.8%, respectively). It should be noted, however, that our definition of DIS was based on taking more than 30 min to fall asleep while Lavie et al (1982) used a more strict definition of 'more than 45 min' to fall asleep. In either case, the data suggest sleep difficulties are associated with injuries in the working population.

Sleeping poorly at night also was significantly related to occupational injury with an OR of 1.5. The results are in agreement with the previous study by Chau et al (2004) suggesting that individuals who are 'not sleeping well' reported a higher incidence of occupational injury. They recorded an incidence of injuries that was twice as high in cases as in controls. Difficulties in sleeping strongly predicted fatal accidents (Akerstedt et al (2002). The strong predictors were male gender (OR 2.3, 95% CI 1.6–3.4), difficulties in sleeping (OR 1.9, 95% CI 1.2–2.9), and non-day work (OR 1.6, 95% CI 1.1–2.5). Workers with poor sleep should be cautious especially when they are engaged in dangerous and hazardous works.

In this investigation, there was significant relationship between shift work and accidents. In the study by Fransen, there was strong relationship between work accidents and shift work, also this study showed that even though interfering factors like occupational risks, sleepiness and mode of living are excluded, there is a significant relationship between fatigue and shift work (Fransen et al 2006). Smith declared that there is a 30–50% increase in the risk of accidents during night shifts (Smith et al 1989). The studies by Mitler showed that the Chernobyl disaster occurred at night was due to human error and mismanagement of human resources (Mitler et al 1988). In a study conducted in Australian Department of Minerals and Energy, more than 90% of the incidents in the occupations were possibly fatigue related (Mabbott et al 1999 ).

While a significant relationship was found between insufficiency of sleep and occupational injuries, no significant relationship emerged with daily sleep of fewer than 6 h. Although sleep duration is in most cases closely related to sufficiency of sleep, our data suggested that 'efficiency of sleep' may be as important as or more important than mere sleep duration.

A weak association between difficulty waking up in the morning and occupational injuries was found in the current study. Difficulty waking up could be induced either by sleeping poorly at night, insufficiency of sleep, or insomnia symptoms. Chronic fatigue may also induce difficulty waking up. However, the results of this study suggest that if one finds oneself having extreme difficulty in waking up in the morning, accidents or injuries may happen during the beginning of the work shift or even the work commute. Further studies should be undertaken to confirm this hypothesis.

The results of this study showed gender differences in the relationship between sleep habits and occurrence of injuries, though females report sleep problems more often than males about various sleep problems (Kuppermann et al 1995, Jacquinet-Salord et al 1993, Bliwise et al 1992, Doi & Minowa 2003, Kim et al 2000). Females showed significant associations only by unadjusted OR. The weaker association compared to male workers could be explained by the following reasons. First, females may be less likely to engage in dangerous work than males in this population. Secondly, females had one-half of injury rates compared to males (20.2% and 39.3% for females and males, respectively).

No significant association between difficulty breathing during sleep and occurrence of injuries was found. However, it has been reported that males suffering from obstructive sleep apnea syndrome (most common type of sleep apnea and is caused by obstruction of the upper airway. It is characterized by repetitive pauses in

breathing during sleep, despite the effort to breathe, and is usually associated with a reduction in blood oxygen saturation) showed 50% increase in occupational accidents (Ulfberg et al 2000) which may relate to difficulty in breathing during sleep. In order to learn more about this topic, Researcher attempted to analyze the data splitting at different criteria response (more than a few times/year versus never or almost never) in the 8th sleep question (Table 3). As a result, researcher found about 4-fold increase of injury rate (OR 4.5, 95%CI 1.0– 21.2, p=0.054). Treatment of difficulty breathing during sleep may reduce the number of injuries at work.

Several limitations of this study should be noted. First, the study design was cross-sectional, making it possible to identify only associations, but not directional relationships. Second, the record of occupational injury was self-reported. Third, some confounding variables that may have an impact on both sleep and injury, such as hours of working and habitual exercise, were not included.

## CONCLUSION

The present study showed that poor nocturnal sleep, such as difficulty maintaining sleep, insomnia symptoms, sleeping poorly at night, and insufficient sleep are related to occupational injury, which may have direct impact on safety at work, and long term business productivity. Feasible strategies such as taking a brief nap for 15–20 min during lunch time (Takahashi et al 2004, Takahashi 2003, Takahashi & Arito 2000) or reducing job stress (Nakata et al 2004, Nakata et al 2001) may be helpful in preventing sleep-related injuries at work.

Sleepiness has a stronger relationship with occupational injury and this is also true with workers in the Indian Traditional Industries; sleepiness reduced levels of alertness during operations are realities with potential safety risks.

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