

## Topic : Sleep health issues in Japan and overseas: from evidence to action

<Review>

### Global perspectives on sleep and health issues

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#### Abstract

Sleep loss is an important factor in the global burden of disease with collateral effects on cardiovascular and mental health as well as injury and violent death through human error. This disease burden is poorly recognized due to a range of factors. The paper argues that improving world-wide sleep health needs to match efforts currently being made in combating obesity and other non-communicable diseases.

**Keywords:** sleep, non-communicable diseases, sleep loss, sleep disorders

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#### I. Introduction

There is growing awareness that healthy sleep needs to be integral to quality of life in all societies. Sleep research is a relatively new field of scientific endeavor and translation of this research has taken place mainly in developed economies with clinical management of sleep disorders such as obstructive sleep apnea and insomnia. However, the increasing breadth of sleep research and the recognition of the growing importance of non-communicable diseases across all economic strata in society is highlighting the importance of healthy sleep globally.

Non-communicable diseases (NCDs) pose a major threat to global health and economic development [1]. Internationally around 57 million people died in 2008, and 33 million (58%) of these deaths were due to chronic (non-communicable) diseases (mainly cardiovascular disease, diabetes, cancer and chronic respiratory diseases). It is estimated that they cause 36 million deaths a year of which one-quarter are premature and 80 per cent occur in low- and middle-income countries. The burden of such diseases in low-income and middle-income countries is rapidly increasing and already has major adverse social, economic, and health effects [2]. Substantial challenges to the health

systems of such countries as China and Russia have been identified as a result of NCDs [3]. There is evidence that NCDs occur more commonly among the poor and are a common cause of tipping households into poverty. Poorer communities tend to develop cardiovascular disease at much younger ages, leaving destitute dependants.

Mental health problems are an important component of the burden of non-communicable disease. Neuropsychiatric conditions are the leading cause of disability worldwide, accounting for 37% of all healthy life years lost from disease; they are the most disabling conditions even in low- and middle-income countries, which may be least able to bear such burdens [4]. The neuropsychiatric conditions that contribute the most disability-adjusted life-years are affective disorders, substance-use and alcohol-use disorders, schizophrenia, and dementia. Limited capacity in quality data collection possibly results in underestimation of the burden of disease due to mental health disorders in many countries.

Road traffic accidents are responsible globally for about 1.2 million deaths and 10 million permanent disabilities each year [5]. Three-quarters or more of these deaths are in developing countries, where numbers of accidents and fatalities have been increasing rapidly. Not surprisingly, within low-income and middle-income countries, poor

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people (pedestrians, passengers in buses and trucks, and cyclists) suffer a higher burden of morbidity and mortality from traffic injuries.

## II. Adequate Sleep – A Basic Need and Right

In considering what is important globally for health we consider the importance of adequate nutrition and water (amount and safety from infection). Even with respect to nutrition, global health agencies recognise that over-nutrition may be as important in the world as under-nutrition. Nevertheless, the right to food and water are fundamental human needs.

Can we advocate that there is basic right for adequate sleep? Sleep is a biological necessity but different to food and water in a fundamental way. We obtain food and water from our own environment – humans (and animals) cannot produce their own food and hydration. However humans need to generate their own sleep – with total sleep deprivation, the innate drive to sleep builds up internally and becomes dominant and unless generated, leads to increasing sleepiness and then sudden sleep episodes to recover lost sleep. Even with shortened bursts of sleep that are inadequate for proper homeostasis, the sleepiness and sleep attacks may be more subtle but ever present risks to health and safety. We cannot hunt for sleep like animals to do for food, we cannot “buy” sleep (despite the efforts of the pharma industry!) – sleep is an innate need that we must provide time for its “production”. In that sense, we need the right environment to generate sleep. This environment needs to be safe and free of disturbing noise or light or temperature extremes. Therefore ability to provide good quality shelter/housing is fundamental to good sleep. However to maximise sleep also requires low level of mental stress as well as low environment stress. Conditions such as urbanisation with crowding, long work schedules, shift work and especially night work are all contributors to potential sleep loss [6].

The term *sleep loss* is all encompassing including voluntary and involuntary short sleep hours, insomnia and other sleep disorders that result in the attenuation of the benefits of sleep. However preventing or managing sleep loss is rarely considered part of the global health agenda. It does not get the attention of world health agencies and even national organisations. Progress is often made in wealthier countries by consumer or more often industry driven action groups or professional groups with focus on funding of high end diagnostic and treatment services. However, despite the greater attention being paid to NCDs, it is fair to say the right to good quality sleep is not on the agenda.

## III. Sleep Health and the Burden of Non-Communicable Disease

When considering the rise of NCDs, focus has been placed on the change in diets in economically developing societies (more processed foods high in sugar, saturated fats and salt) and reduced work-related physical activity with urbanisation and change in work practices and transport methods. Appropriately, road accident reduction has focused on interventions such as helmets and seat belts.

However, an argument can be made for increasing attention to sleep health in reducing the global burden of NCDs. Inadequate hours or fragmented sleep contribute to worsening atherosclerosis, hard cardiovascular endpoints, hypertension, diabetes and premature mortality [7-11]. Similar disruption of normal sleep patterns results in loss of alertness, cognitive dysfunction, neurobehavioural failure and increased catastrophic events such as motor vehicle crashes, marine disasters and other catastrophic events [12-16]. Lack of sleep or insomnia are associated with development of many mental health disorders [17-19]. Sleep disturbances may be early markers of neurodegenerative disorders proving a way of selecting those who may benefit from neuroprotective therapies [20].

While, there is growing evidence that lack of sleep and sleep disorders exacerbate many of the non-communicable diseases that are of concern to groups such as WHO, there is inertia to change the agenda. There are several reasons – firstly, the view that sleep problems are problems of wealthier countries and not an issue to economically disadvantaged people. Often sleep disorders are seen as a problem of the neurotic “worried well” and not as fundamental as other health concerns. Another reason is the silo mentality of many medical disciplines. Organisations will argue that “cardiovascular diseases” or “depression” are the issue and not consider disorders that may contribute to these problems. Sleep crosses all organ-based and other health specialties and as such requires inter-disciplinary research and clinical care. The final reasons probably emanate from the sleep health field. The global sleep research agenda is young and we may not have the data or research systems in place to advocate the importance of global sleep health to policymakers. We need hard data to convince policymakers that sleep health is actually a health issue not just a problems of the “worried well” confined to highly rated economic societies. Finally, as a field our organisational structures are inadequate – there is only a very slowly emerging global presence for sleep professionals often hamstrung by the need to function locally as a priority and lacking in global vision.

In the next section, the impact of sleep on human health is briefly summarised and a future agenda to deal with global sleep health is discussed.

#### IV. Sleep Across the Globe

Sleep problems cannot be seen in isolation from societal change. This is not to say that sleep was perfect in agrarian societies hundreds or thousands of years ago but a number of modern trends have contributed to the problem widening from a poor physical environment to sleep to broader issues. Sleep health issues affect many different countries with differing levels of economic development both rural and urban and in niche areas as diverse from call centres in India, to industrial workers in China and to military forces.

Increasing urbanisation results in crowding with increasing noise from transport, pollution (light and particulate), stress and longer commute times as cities get bigger. This provides a poorer physical and mental environment for sleep. With "globalization" and the 24 hour society, workforces never stop and the cost is people working at times their biology is programmed to sleep. This provides a challenge to safety as it increases the risk of crucial periods of vigilance failure [21]. In turn, this is exacerbated by workforces (formerly from highly regulated high income countries) being outsourced to low and middle income countries with different and less regulated labour laws affecting work and sleep hours. The argument that less attention to sleep and safety will mean increased costs due to human error is rarely raised.

Many in the global workforce are active during the night hours. Busy mega-cities cannot afford to close their infrastructure during daylight hours, so road or other repairs are undertaken at night by often huge workforces. Society may respond to the challenge to sleep in strange ways - caffeine is now the world's most popular psychoactive substance in large part due to its temporary alerting effect and cultural acceptability [22].

One of the problems is capturing the impact of these changes. Some argue that there is evidence of reduced sleep hours in society over the past century or even in the past 20 years – others question this. It is likely that the proportions of extreme short and long sleepers are increasing [23,24]. We know even less about sleep quality changes over time but evidence is certainly increasing of the occupational risks of sleep loss[25].

In high-income countries, societal changes contributing to sleep loss particularly impact on adolescents and young adults. Technology such as the internet and mobile phones can contribute to the problem [26]. As these technologies become cheaper, they will contribute globally to the

problem of sleep loss and mental health and other health issues related to sleep loss.

#### V. Sleep Health and Disadvantage

Increasing data supports the view that poverty is independently associated with poorer sleep health [27-29]. The findings are robust and consistent across a diverse range of societies. These include studies from the USA (Figure 1) [27] showing clear-cut adjusted sleep differences between poor white and racial controls. In the UK, data from the British *Psychiatric Morbidity Survey 2000*, (n= 8578 men and women aged 16–74) found strong independent associations between sleep problems and four measures of socio-economic status (SES) - household income, educational qualifications, living in rented housing and not being in paid employment [28]. SES inequalities played a major part in accounting for gender differences in sleep problems and the direction and adjustment of the data indicated that disrupted sleep may be a mechanism through which low SES is linked to poor health. Other studies from developing countries highlight the diverse way sleep loss can impact on health. In a population-based cohort study in Sri Lanka sleeping < 8 hours per day was associated with impaired gestational weight gain after adjustment for confounders [29]. In Nigeria, insomnia rates appear similar to European and North American prevalence with higher rates in women and those with greater poverty [30].

A community based study of elderly slum dwellers in Mumbai found high rates of depression in the elderly with 62% of those depressed having sleep problems [31].

#### Sleep Quality and Social Disadvantage

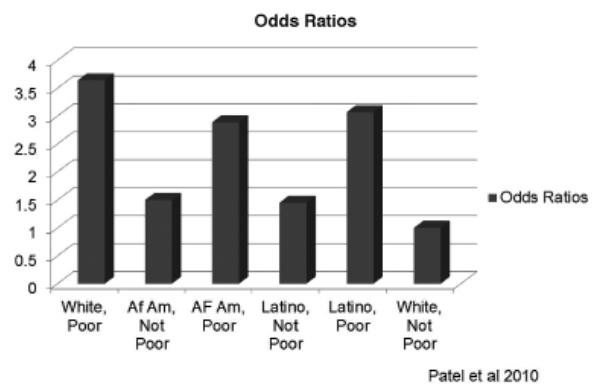


Figure 1 In a cross-sectional survey of 9,714 randomly selected subjects, social disadvantage in United States was associated with impaired sleep quality. Holding the odds-ratio for poor sleep quality for non-poor whites at 1.0, other racial and economic groups with the most marked problems in poor whites (adapted from Patel et al [27])

It is interesting to reflect that it not just the “worried well” of wealthier countries that express concern about sleep problems. Interesting data on the health domain of sleep/energy has been obtained from African and Asian centres (n=46,269) in the WHO Health and Demographic Surveillance System (HDSS) [32]. These surveys investigating differences in socio-demographic and economic characteristics related to self-reported health have shown a great deal of variability in the 8 domains of health complaints between different countries and genders. Sleep problems were rated highly in self-reported health in Ghana, Vietnam, South Africa and Kenya in men and Ghana, Vietnam, South Africa but not Kenya in women. In Indonesia, Bangladesh and India the sleep domain was less predominant. These data highlight that sleep problems are not insignificant issues to people living in these countries.

Lower SES is linked to higher rates of obstructive sleep apnea in adults and children [33]. Moreover with growing world problems with overnutrition and increasing rates of obesity, future higher rates of sleep apnea will be expected. This would be magnified in those Asian countries such as India, China and Korea where racial differences in crano-facial morphology predispose to the development of OSA [34]. High rates of OSA are likely to be linked with higher rates of diabetes and hypertension.

There are many diverse ways that social disadvantage and sleep loss inter-relate to contribute to ill-health. Some of these concepts are listed in Figure 2.



Figure 2 Interdependent mechanistic processes related to sleep loss in poorer urban areas

## VI. Sleep Health, Inflammation and Vascular Disease

Sleep loss appears to favour the development of a pro-inflammatory state with increased risk of vascular damage and consequences of stroke, myocardial infarction and overall mortality. Epidemiological studies such as the Whitehall study [35] have shown intriguing links not only between long working hours and sleep disturbance but also sleep loss and increased mortality. Redline and Foody [36] argue to that sleep loss should be added to the top 10 potentially modifiable risk factors for vascular disease in addition to established factors such as tobacco smoking, overweight, dyslipidemia, hypertension, physical inactivity, poor diet, and psychosocial factors. This is based on research over the last decade provides linking short sleep hours, insomnia and sleep apnea to the development of vascular pro-inflammatory factors and subsequent heart disease. Even use of a simple question (after robust adjustment for confounders), “Have you had difficulties falling asleep in the last month?” identified a group of individuals at a significantly increased relative risk of experiencing a subsequent myocardial infarction with the more disturbed sleep, the greater the cardiac risk [7]. In the Coronary Artery Disease In Young Adults Study (CARDIA), the 5-year incidence rate of coronary artery calcium was inversely associated with sleep duration measured at an early time point [9]. In the MONICA Ausberg study of nearly 7,000 adults followed for a mean of 10 years, an almost 3-fold increased incidence of AMI was observed in women who reported sleeping <=5 hours compared with those sleeping 8 hours per night [37]. Longitudinal studies have associated obstructive sleep apnea with increased mortality and observational cohort studies of CPAP treatment support risk reduction from CPAP therapy [36]. There is even data linking restless legs syndrome/periodic limb movement disorder with increased cardiovascular risk [38].

## VII. “No Mental Health without Sleep Health”

A recent publication in Lancet strongly argued that mental health awareness needs to be integrated into all aspects of health and social policy, health-system planning, and delivery of primary and secondary general health care. The article was entitled “No Health without Mental Health” [4]. Given the strong links between sleep loss and worse mental health it could be argued that reduction in sleep loss may be an important underpinning of better mental health globally. This can be demonstrated across a range of mental health disorders.

For example, depression is the leading cause of disability in both women and men in the United States and worldwide and one of the 10 leading disorders for global disease burden. Major depression commonly co-occurs with symptoms of insomnia and the close link between insomnia and depression [17-19] suggests that the conditions are not just randomly associated. Insomnia is now considered not only a symptom of but also a possible predictor of depression. Meta-analysis [39] has shown that non-depressed subjects with insomnia have double the risk of developing depression compared to people with no sleep difficulties. In people with no sleep difficulties, the incidence of depression is much lower as compared to the general population. The different age-groups showed that the effect of insomnia in predicting subsequent depression is similar in children and adolescents, working-age individuals, and elderly individuals. While some epidemiologic studies have indicated that long work hours/overtime work is an important risk factor for depression, recent work has suggested that this may be a confound of associated short sleep hours and perception of insufficient sleep. Certainly the concept of "work burnout" is associated with sleeping problems.

The combination of short sleep or insufficient sleep with long work hours has a synergistic effect on depression [40] In the Whitehall II cohort study [41] working more than 55 hours per week, compared with working 35 to 40 hours per week, was associated with 1.98 times higher odds for shortened sleep hours (< 7 hours per day) while repeated exposure to long work hours was associated with up to 3.24 times higher odds for shortened sleep. In a Wisconsin-based prospective cohort study, shortened sleep (< 334 minutes per night) was associated with 3.18 times higher odds of depression as compared with sleeping 409 minutes per night [42]. Disturbed sleep and circadian rhythms are important features of mental health disorders [43].

There are high rates of depression in people with obstructive sleep apnea (OSA) in both community and clinical populations. A large community study reported a rate of 17% and reports for sleep clinic samples range between 21% and 41%. Both conditions share similar symptom clusters and confounders (eg obesity) and intervention trials are very limited [44].

If insomnia is indeed a predictor for depression, early and adequate treatment of insomnia might contribute to the prevention of the future development of depression [45,46]. This view seems to be supported by some studies showing that adding cognitive-behavior treatment for insomnia (CBT-I) is efficacious also in patients with both symptoms of insomnia and depression and guarantees a

better treatment outcome in this population than standard antidepressant treatment alone.

### **VIII. Sleep Loss, Human Error and Violent Death**

The links between sleep loss and injury and death are well established [12-16]. Sleep loss results in sleepiness, impaired judgement, risk taking and loss of alertness cumulating in human error that can result in individual or large-scale death. A number of disasters have in part or wholly been attributed to human error due to sleep loss. These range from exhausted shift workers at Chernobyl, overworked crew in Alaska with the Exxon Valdez to one driver over-using the internet at night with the Selby train disaster. There are huge economic consequences of sleep loss resulting in single or systems human error. Problems are exacerbated in societies where there are limited systems regulating works hours and rest for those involved in sustained operations. Often investigations of such catastrophic events in developing countries are limited and little attention paid to sleep loss compared with investigations by NTSB in US or transport in higher socio-economic countries where sleep loss is more frequently considered in investigations. Sleep disorders such as sleep apnea contribute to fall asleep crashes and human error [47]. Even on Canadian farms those who sleep less than 6 hours per night during the peak agricultural season has heightened work anxiety and stress and injury risk due to this sleep loss [48].

### **X. The Global Sleep Health Agenda Moving Ahead**

The only way to properly prioritise sleep health in the global health agenda is to continue on the pathway of large scale sleep and circadian research. This research agenda needs to extend to world regions that are not traditionally centres of sleep research. The involvement of such regions requires training and investment locally in research infrastructure not an easy task in times of worldwide economic difficulties. Such research is crucial to better engage international health agencies who, at this stage, have limited engagement with sleep health and professional organisations involved in the field. This paper has highlighted some of the growing evidence that lack of sleep and sleep disorders influence the development of and or worsening of non-communicable diseases/disorders. These sleep health issues are not confined to wealthier countries. However in poorer socio-economic countries the focus will be on simpler diagnostic tools and interventions that can be delivered at the population

level eg. Targeted investigation of sleep disorders in high risk groups, prevention of accidents in transport industry through health promotion, focused easily deliverable behavioural interventions to improve sleep health.

Key factors in this agenda are our professional organisations that can through expertise and advocacy influence policy. The World Sleep Federation (WSF), is an international organization that was founded in 1988 and is currently comprised of seven Charter members (American Academy of Sleep Medicine, Asian Sleep Research Society, Australasian Sleep Association, Canadian Sleep Society, European Sleep Research Society, Federation of Latin American Sleep Societies, and Sleep Research Society) representing about 53 sleep societies and organizations, and over 12,000 individual members. At our recent Congress in Kyoto, The WSF committed to building this global agenda for improving sleep health. We have seen similarly structured groupings such as the International Association for the Study of Obesity (IASO) achieve important outcomes in global ways of dealing with a major public health problem through research, powerful advocacy and policy change. Like obesity, sleep health crosses all organ-based and other health specialties and as such requires inter-disciplinary research and clinical care. This sometimes provides a challenge locally and especially when dealing with organisations internationally. The WSF's role in improving informatics and connectivity between world organisations will be crucial in addressing the global sleep health agenda.

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