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Insomnia and Its Correlates: Current Concepts, Epidemiology, Pathophysiology and Future Remarks

Yuichiro Abe^{1,2} and Anne Germain³

¹*Department of Psychophysiology,
National Institute of Mental Health, NCNP, Tokyo,*

²*Policlinique, ASM13, Gentilly,*

³*Department of Psychiatry, University of Pittsburgh,
School of Medicine, Pittsburgh, Pennsylvania*

¹*Japan*

²*France*

³*USA*

1. Introduction

Insomnia is a common sleep disorder. People suffering from insomnia generally report not only sleep-related symptoms such as difficulty initiating, maintaining, obtaining sufficient restorative sleep, but also experience various daytime impairment reflective of sleep deficits (Buysse, 2008; Riemann et al., 2011). The generic term “insomnia” as a diagnostic entity is defined as a complaint of sleep problems coupled with impairment of daytime functioning, including reduced alertness, fatigue, exhaustion, dysphoria and other symptoms. The complaints have to endure for at least 4 weeks to be diagnosed as insomnia, according to the current diagnostic classification manual (Abe & Mishima, 2008).

Chronic insomnia is a “24-hour disease”, meaning not only reduces the quality of sleep during the night, but also causes a variety of impairments in mental and physical functioning during the daytime (Bonnet & Arand, 1995, 2011). Although some patients who have this problem may not report it as such, inadequate sleep has been associated with reduced physical health and mental health (Morin & Espie, 2004; LeBlanc et al., 2007). Thus, many people are likely those who are in the “pre-insomnia” moment, and do not even consider themselves insomniacs (Bastien et al., 2004). Chronic insomnia is also associated with both human and socioeconomic costs, such as increased long-term absenteeism at work, reduced performance and productivity, and increased industrial accidents and health-care costs. This impact could be explained by three points: 1) comorbid mental (psychiatric) conditions, 2) comorbid medical conditions and 3) socioeconomic impact of insomnia (Mai & Buysse, 2008).

In primary care, practitioners usually prescribe medication such as hypnotics without for such insomnia complaints. However, the use of these sedative agents is often problematic, especially when patients have kept a good QOL activity in daily life (Riemann et al., 2011).

The mere augmentation of medication runs a risk of exacerbating daytime impairment itself. The continued widespread use of sedative medication to treat insomnia raises concern about the potential for long term tolerance and addiction, particularly where insomnia is the presenting complaint of missed diagnoses such as comorbid depression and anxiety disorder, or when adverse effects might be a problem—for example, falls in older adults (Riemann et al., 2011).

We will review about insomnia in terms of several aspects: its concept, epidemiology, pathophysiology, psychobehavioral correlates and possible psychiatric interventions. At the same time, we will show our own epidemiological study about Japanese people with insomnia based on the general population sample, and present some clinical case studies in order to describe several aspects of insomnia comorbid with mental disorders. We will also mention the correlates of nightmares, sleep disturbances related to suicidality and alcoholism as current important clinical and research topics. Finally, we will comment on future remarks based on the current society in Japan aftermath of Tsunami disaster in March 2011. In discussing mainly insomnia and nightmare, we used the terms “sleep disturbances” and “sleep problems” interchangeably in this paper, following the context.

2. Current definition and prevalence of insomnia

The reported prevalence of insomnia in the general population varies widely, ranging between 4.4% and 48%, depending on sample characteristics and the definition of insomnia (Ohayon, 2002). According to the American Sleep Disorders Association International Classification of Sleep Disorders (ICSD-2) published in 2005, its coding manual, insomnia refers to “a repeated difficulty with sleep initiation, duration, consolidation, or quality that occurs despite adequate time and opportunity for sleep and results in some form of daytime impairment and lasting for at least one month.” (AASM, 2005).

2.1 DSM-5 proposed criteria of insomnia

The major current diagnostic systems ICD-10 (International Classification of Disorders 10th edition) and DSM-IV (Diagnostic and Statistical Manual of Mental Disorders, APA) includes sections on insomnia and several sleep disorders. Both ICD-10 and DSM-IV are currently under review (Riemann et al., 2011). Contemporary psychiatry has been greatly influenced by these nosographic changes. In 2010, the DSM-V proposed criteria were tentatively manifested, which might be expected to increase the significance of the notion of sleep disturbances, after the presumable publication of DSM-V in 2013. It is under discussion whether the category primary/secondary insomnia should be replaced by the term « insomnia disorder ». In any case, this would emphasize the independence of the category in favor of the insomnia comorbidity concept, as suggested by the State of the Science conference on insomnia (NIH, 2005).

The concept and diagnostic criterion of insomnia are still fluctuating. In order to become familiar with the current nosographic controversy, we show Table 1, which explains the general criteria for insomnia in ICSD-2, as well as the draft criteria for insomnia disorder in DSM-5 draft published in 2010 (Proposed DSM-5 Draft, 2010).

ICSD-2 General Criteria for insomnia (2005):

- A. A complaint of difficulty initiating sleep, difficulty maintaining sleep, or waking up too early or sleep that is chronically unrestorative or poor in quality. In children, the sleep difficulty is often reported by the caretaker and may consist of observed bedtime resistance or inability to sleep independently.
- B. The above sleep difficulty occurs despite adequate opportunity and circumstances for sleep.
- C. At least one of the following forms of daytime impairment related to the nighttime sleep difficulty is reported by the patient: fatigue or malaise; attention, concentration, or memory impairment; social or vocational dysfunction or poor school performance; mood disturbance or irritability; daytime sleepiness; motivation, energy, or initiative reduction; proneness for errors or accidents at work or while driving; tension, headaches, or gastrointestinal symptoms in response to sleep loss; concerns or worries about sleep.

DSM-5 proposed Insomnia Disorder (2010).

- A. The predominant complaint is dissatisfaction with sleep quantity or quality made by the patient (or by a caregiver or family in the case of children or elderly).
- B. Report of one or more of the following symptoms:
 - Difficulty initiating sleep; in children this may be manifested as difficulty initiating sleep without caregiver intervention
 - Difficulty maintaining sleep characterized by frequent awakenings or problems returning to sleep after awakenings (in children this may be manifested as difficulty returning to sleep without caregiver intervention)
 - Early morning awakening with inability to return to sleep
 - Non restorative sleep
 - Prolonged resistance to going to bed and/or bedtime struggles (children)
- C. The sleep complaint is accompanied by significant distress or impairment in daytime functioning as indicated by the report of at least one of the following: fatigue or low energy; daytime sleepiness; cognitive impairments (e.g., attention, concentration, memory); Mood disturbances (e.g., irritability, dysphoria); behavioral problems (e.g., hyperactivity, impulsivity, aggression); impaired occupational or academic function; impaired interpersonal/social function; negative impact on caregiver or family functioning (e.g., fatigue, sleepiness).
- D. The sleep difficulty occurs at least three nights per week.
- E. The sleep difficulty is present for at least three months.
- F. The sleep difficulty occurs despite adequate age-appropriate circumstances and opportunity for sleep.

* Duration: i. Acute insomnia (< 1month); ii. Sub acute insomnia (1-3 months); iii. Persistant insomnia (> 3 months).
* Clinically Comorbid Conditions: i. Psychiatric disorder; ii. Medical disorder; iii. Another disorder.

Table 1. General criteria for insomnia in ICSD-2 (2005) and insomnia disorder in proposed DSM-5 (2010)

2.2 Japanese general population sample, re-analysed

Following this current insomnia concepts, we reanalyzed our Japanese population representative sample of 24,551 adults performed in 2000 (Abe et al., 2011). The present study was conducted using partial data from the Active Survey of Health andWelfare performed in June 2000 by the Ministry of Health, Labour and Welfare. To provide a representative sample of the general population in Japan, the survey was conducted through public health centers in 300 target areas randomly selected from the 881, 851 national census areas nationwide. The self-administered questionnaire consisted of 44 items covering the general health status, physical and psychological complaints and sleep habits and problems. We first selected cases reporting the presence of both insomnia symptoms and physical/psychological complaints during the past one month, identified based on the responses to the survey questionnaire about sleep problems and daytime functioning during the past one month. Then we excluded cases reporting a common comorbid sleep disorder (sleep-disordered breathing and restless leg syndrome).

The result was that we found a fairly high prevalence of insomnia (43.4%) as defined in this study (see Table 2) compared to before in the general population sample in Japan. Although previous studies have pointed out that Japanese people tend to underreport their sleep problems, because of cultural reticence compared with those in Western cultures, our results did not necessarily align with these studies (Abe & Mishima, 2008; Abe et al., 2011).

Possible reasons for the higher prevalence of insomnia obtained in our study include the following. First, following the ICSD-2 criteria, an item on “nonrestorative sleep” was added to our definition of insomnia. Secondly, our sample may have included cases with short-term insomnia occurring in less than the past one month (e.g. adjustment insomnia) in the absence of specifications on the duration and frequency of insomnia symptoms. The case definition of insomnia based partially on the ICSD-2 and DSM-IV was more liberal than the original definitions of the disorder. Lastly, the greatest factor responsible for such a higher prevalence rate was the inadequate assessment of daytime impairments associated with insomnia (Ohayon & Lemoine, 2004).

Age class (years)	Insomnia			Insomnia comorbid with depression		
	Subtotal % (n)	Male % (n)	Female % (n)	Subtotal % (n)	Male % (n)	Female % (n)
20–29	37.1 (1661)	33.4 (716)	40.7 (945)	5.6 (252)	4.9 (106)	6.3 (146)
30–39	41.7 (1881)	38.8 (834)	44.4 (1047)	4.4 (198)	3.3 (72)	5.3 (126)
40–49	41.5 (1911)	42.3 (953)	40.6 (958)	5.1 (236)	4.5 (102)	5.7 (134)
50–59	45.5 (2290)	45.1 (1107)	45.8 (1183)	5.0 (253)	4.6 (112)	5.5 (141)
60–69	48.1 (1653)	46.1 (780)	50.0 (873)	4.5 (155)	4.6 (78)	4.4 (77)
≤70	50.3 (1257)	48.8 (488)	51.3 (769)	10.5 (263)	9.0 (90)	9.8 (173)
Total	43.4 (10653)	41.7 (4878)	44.9 (5775) [†]	5.5 (1357)	4.8 (560)	6.2 (797) [†]

[†]Significant difference between men and women (P < 0.001, chi-square test).

Table 2. Presence of insomnia and insomnia comorbid with depression, by age, group and sex in a sample of the general Japanese adult population, conducted in 2000 (n=24, 551) .

It is possible that the complaints from participants were related to physical or psychological problems, which are separate issues from insomnia. However, as far as we know, there is no validated self-reporting tool about which researchers are in consensus for accurately measuring daytime impairments due to insomnia (Ohayon & Lemoine, 2004; Shekleton et al., 2010). One of the main reasons for this overdiagnosis of insomnia is that we used « daytime impairment » related to insomnia, including various items such as fatigue. This result implies one important subject, that is to say, “fatigue” itself can be regarded as a core symptom of insomnia (Choquet et al., 1993; Riemann et al., 2011). In recent literature, daytime sleepiness, hypersomnia and fatigue are common symptoms of depression (Franzen & Buysse, 2008). But, such symptoms can occur independently, or they may occur secondarily to insomnia comorbidity, as well as short- or long-term side effects of antidepressant medications themselves (Riemann et al., 2011).

3. The current psychobiological model of insomnia: Hyperarousal model

Although pathophysiology of insomnia remains to be explored, physiological hyperarousal evidenced by cognitive, endocrine, and neurophysiologic variables has been revealed to be involved in onset and development of insomnia (Bonnet, 1995, 2010; Riemann et al., 2010). Patients with insomnia suffer from cognitive deficit. Characteristically, they report their sleep and psychoperformance to be worse than are objectively measured (Endo, 1962; Orff et al., 2007). This “perceived” deficit is exactly what aggravates the QOL of insomniac patients and let them fall in a vicious cycle (Abe & Mishima, 2008). Also, insomnia is often induced by stressful events, and is assumed to develop by the 3P model (predisposing, precipitating and perpetuating factors), proposed by Spielman that is widely used to explain the onset mechanism of insomnia (Spielman et al., 1987; Ellis et al., 2011).

There is a need for clarification of pathophysiology of insomnia for development of efficient treatment skills and critical prevention of chronic insomnia. Just recently, reductions in hippocampal volume size have been reported in patients suffering from primary insomnia in brain research (Riemann et al., 2009). In the light of neurobiological theories of sleep-wake regulation, insomnia may be conceptualised as the final common pathway of the interaction of a genetic vulnerability to an imbalance between arousing and sleep-inducing brain centres, which is triggered by psychosocial and/or medical stressors, with perpetuating mechanisms such as maladaptive behaviours, learned sleep-preventing associations and cognitive factors (Basta et al., 2007; Riemann et al., 2010).

3.1 Development of chronic insomnia: 3P model

According to Spielman, insomnia is often induced by stressful events, and assumed to develop by his 3P model (predisposing, precipitating and perpetuating factors), that is widely used to explain the onset mechanism of insomnia (Spielman et al., 1987). Factors leading to the onset and worsening of insomnia are multidimensional in nature, and many life events and life stresses can result in acute insomnia. Inadequate stress coping behavior also precipitates insomnia, and heightens uneasiness and tension around being unable to sleep, thereby perpetuating the sleeplessness (Abe & Mishima, 2008). Furthermore, insomniacs may often engage in poor sleep hygiene, such as having an inadequate sleep environment, lack of daytime activities, and excessive afternoon napping. It is reported that the majority of people with insomnia attempt to cope with sleep problems in various ways,

have fewer adaptive coping skills, rely more on emotion-focused coping strategies than on problem-solving strategies and report lower feelings of mastery (Vollath et al., 1989). Reduced quality of life associated with insomnia has already been reported in a general population sample (LeBlanc et al., 2007).

3.2 Brief empirical evidence about insomnia

Since the classical study of Monroe *et al.*, the validity of the hyperarousal concepts in patients with insomnia has been tested by measuring autonomous variables, including ECG-derived heart rate and heart rate variability, body temperature, whole-body metabolism and galvanic skin response (Riemann et al., 2010). The majority of studies measuring such variables in insomnia documented an increased arousal tone in this patient group. However, it is still unclear whether increased autonomic activity is causing insomnia or whether vice versa, insomnia and its sleep loss triggers increased autonomic activity.

Bastien *et al.* investigated a group of 285 patients evaluated for insomnia at a sleep medical clinic and found that 35% had a positive history for a sleep disturbances (Bastien & Morin, 2000). Dauvilliers *et al.* described that of 77 patients with primary insomnia, 72.7% reported familial insomnia compared to 24.1% in a non-insomnia control group in a French population sample (Dauvilliers et al., 2005). Similar result was reported by Morin's group from a Canadian population sample (Beaulieu-Bonneau et al., 2007). Drake *et al.* suggested that 37% of the variance in vulnerability to stress-related insomnia in siblings could be explained by familial aggregation (Drake et al., 2008).

Neuroimaging studies in insomnia are now widely used in human basic sleep research.. A PET study, conducted by Nofzinger *et al.*, acquired data from 7 chronic insomniacs and 20 good sleeper controls during wakefulness and during consolidated Non-REM sleep. Patients with insomnia exhibited increased global glucose metabolism during wakefulness and Non-REM sleep. Patients with insomnia exhibited smaller declines in relative glucose metabolism from wakefulness to Non-REM sleep in wake promoting regions including the ascending reticular activation system. Reduced relative metabolism in the prefrontal cortex was found in insomniac while awake (Nofzinger et al., 2004). Another recent pilot study, using manual morphometry of structural magnetic resonance images showed that out of several regions of interest only one significant difference concerning a bilateral reduction of hippocampal volumes was found between 8 chronic insomniacs and 8 healthy control sleepers (Riemann et al., 2007). It remains to be determined whether these alterations of hippocampal structures are directly related to the insomnia. Nevertheless, these studies referred to above have taught us that the development of chronic insomnia is associated with measurable alterations of brain function pointing to Central Nervous System hyperarousal with a vulnerable familial aggregation.

The study of daytime performance in patients with insomnia has been driven by the assumption that short-term or chronic sleep loss has a negative impact on daytime functioning. Thus, such a compensatory effort might play an important role in the opposing effects of sleep deficits and hyperarousal that influence daytime performance.

The study of Orff *et al.* showed no impairments at all objective measures of cognitive performance in insomnia patients, with a discrepancy between subjective reports of deficits and objective neuropsychological tests (Orff et al., 2007). Despite the fact that there might be

only minor deficits in this population, investigating neuropsychological tests in large sample sizes might reveal stable deficits in the insomnia patients population (Edinger et al., 2008).

4. Symptomatic overlap: Insomnia-depression-anxiety connection

4.1 Insomnia-depression

In terms of descriptive symptomatology, insomnia symptoms often coexist with depressive and anxiety symptoms. As many as 90% of patients with depression will have sleep quality complaints (Tsuno et al., 2005). Alongside insomnia being the most common symptom of depression and anxiety disorder, persistent insomnia is a risk or exacerbating factor of depressive disorders (Riemann et al., 2003).

In a Japanese general population sample, the presence of insomnia comorbid with depression was 5.5% with a rate of 12.7% among the sample of people with insomnia (Abe et al., 2011). In line with this, Ford & Kamerow reported 14.0% as a prevalence of insomnia co-occurring with depression in a study based on 7954 American households (Ford & Kamerow, 1989). These studies showed that the frequency of insomnia comorbid with depression observed in Western countries is stable among Japanese adults as well (approximately one seventh of the insomnia population). Vollarath *et al.* state that insomnia constitutes an independent syndrome (Vollath et al., 1989), and Buysse *et al.* suggest that insomnia and depression are commonly comorbid, and insomnia comorbid with depression is an important intermediate phenotype (Buysse et al., 2008). Following the current insomnia-depression literature, we can consider as follows: (1) Insomnia and depression are bidirectionally related; (2) Insomnia is a risk factor for developing depression and (3) Insomnia is a risk factor for poor depression outcomes. Taken together, treating insomnia may favorably impacts the trajectory of depression (Franzen & Buysse, 2008).

4.2 Insomnia-anxiety

In general, insomniacs manifest their multi-complaints and they often have a comorbidity with anxiety disorders. Harvey *et al.* proposed her cognitive model of insomnia, explaining that excessive worry about insomnia itself exacerbates insomnia. Bader *et al.* suggested that adverse childhood experiences are associated with sleep in primary insomnia (Bader et al, 2007), and Gregory *et al.* reported that familial conflicts in childhood predicted later insomnia, a modest but robust longitudinal link between family conflict during childhood and insomnia experienced at 18 years of age. (Gregory et al., 2006).

With regard to the comorbidity with anxiety disorder, the potential pathological link between insomnia and PTSD (posttraumatic stress disorder) and alcohol dependence should be more investigated. Especially, sleep disturbances have been considered the hallmark of PTSD for decades. Since insomnia has been observed in 90% of PTSD cases, both pharmacologic and psychosocial context of sleep of trauma should be needed to improve comorbid insomnia (Hendin et al., 2008).

4.3 Case Study 1; PTSD coexist with sleep disturbances

Clinically, sleep disturbances are common among individuals with posttraumatic stress disorder (PTSD), which are often resistant to first-line recommended treatments

(Singareddy & Balon, 2001). Recently, many studies and clinical experiences have suggested that sleep disturbances mainly representing insomnia and nightmare, have a distinct risk of suicide (Nadorff et al., 2011). If not, as some Holocaust survivors presented, impaired sleep and frequent nightmares had been considerable problems, even 45 years after the liberation (Rosen et al., 1991).

This PTSD patient, a 40 year-old careered woman, still suffered from her residual sleep disturbance, even if she partially recovered from her PTSD symptoms and improved her quality of life again, resulting in returning to her work environment. She was firstly presented an anxiety related with insomnia in the context of the accidental loss of her husband in front of her, at the age of 36. This event led her to consult a psychiatrist for the first time, and she has continued to be treated with medication and an individual psychotherapy regularly once a month. Her insomnia, nightmare and occasional suicidal ideation made her continue to maintain her treatment. Of importance, this patient exacerbated suicide ideation every year the day of incident approached. Outside her stabilized period, every time the clinician tried to reduce her nocturnal treatment, she exacerbated her sleep complaints and related somatic complaints, alluding to the clinician her suicidal ideations.

For more than three decades, sleep disturbance had been considered the hallmark of PTSD (Hendin et al., 2008; Nadorff et al., 2011). Since insomnia has been observed in 90% of PTSD cases and nightmare related to the trauma in 70%, this is understandable (Hendin et al., 2008). In this case, the clinician has mainly prescribed paroxetine (10-20 mg) and trazodone (25-50 mg) at night to improve subjective sleep disturbances. One of the paradoxical difficulties in psychopharmacology is that there has been increasing awareness of psychotropic-related sleep disruptions in PTSD patients. Especially, it is reported that selective serotonin reuptake inhibitors (SSRIs), usually prescribed as a first-line medication to PTSD, have conversely been associated with clusters of side effects, including insomnia and nightmare symptoms (Li et al., 2010). Trazodone, prescribed at low dose, may reverse the SSRI-induced insomnia; increases the antidepressant effects of SSRIs; promotes sleep through its sedative properties; and suppresses rapid eye movement sleep, thus reducing nightmares associated with PTSD (Singareddy & Balon, 2001). This case showed that the residual symptoms related with sleep in PTSD resisted, even though the traumatic event had passed away and the patient recovered on a social function level. Probably, most experienced psychiatrists must have had the same treatment impressions before. It is true that sleep disturbance should be more than a marker of PTSD and hence may be important in the identification of suicidal ideation (Nadorff et al., 2011). Recently, Hendin et al. (2008) have insisted on the equal importance of the psychosocial context of trauma in treating sleep disturbance associated with PTSD. It is stressed again that sleep assessment should be considered in the evaluation of suicide risk in PTSD. Both pharmacological and psychotherapeutic approaches to the disorder have concentrated on improving sleep complaints. This case showed us the necessity of long-term sleep-focused approach in order to treat patients suffering from PTSD with suicidal ideation. That implies that incorporating individual psychotherapy, combined with sleep hygiene approach, can lead the patient to recovery from traumatic event in the long term setting. The emotional consequence of suicide will be devastating to the victim's family, friends, community, and society. Studies of incidence, risk and protective factors related to sleep disturbances need to be high on the research agenda across many countries.

4.4 PSQI-A scale

As this case description shows, PTSD patients report a wide variety of subjective complaints. These subjective sleep disturbances are non-specific and also observed in other sleep disorders and psychiatric clinical samples. For example, PTSD and depressed patients show similar global score on The Pittsburgh Sleep Quality Index, one of the most frequently used self-report instruments to assess sleep quality. Disruptive nocturnal behaviors (DNB), such as trauma-related nightmares, may represent more specific sleep disturbances in PTSD. Recently, Germain *et al.* developed the PSQI Addendum for PTSD (PSQI-A), a brief sleep scale for PTSD, to evaluate DNB (Germain et al., 2005). This self-report instrument consists of 7 items that focus on the frequency of seven DNB, and includes three additional items regarding the frequency of anxiety and anger accompanying DNB and the timing of these events during tht night (Table 3). Such an assessment may support the clinical utility of assessing DNB to determine the need for further PTSD evaluation and intervention.

PSQI Addendum for PTSD	
1.	During the past month, how often have you had troubles sleeping because you...
a.	Feel hot flashes:
b.	Feel general nervousness:
c.	Had memories or nightmares of a traumatic experience:
d.	Had severe anxiety or panic, not related to traumatic memories:
e.	Had bad dreams, not related to traumatic memories:
f.	Had episodes of terror or screaming during sleep without fully awaking:
g.	Had episodes of “acting out” your dreams, such as kicking, punching, running , or screaming:
2.	If you had memories or nightmares of a traumatic experiences during sleep
a.	How much anxiety did you feel during the memories/nightmares?
b.	How much anger did you feel during the memories/ nightmares?
c.	What time of night did most memories/nightmares occur?

Table 3. Pittsburgh Sleep Quality Index Addendum for PTSD (PSQI-A) (Germain et al., 2005)

4.5 Stress coping and sleep hygiene among Japanese people with insomnia

Factors leading to the onset and worsening of insomnia are multidimensional in nature, and many life events and life stresses can result in acute insomnia. Inadequate stress coping behavior also precipitates insomnia, and heightens uneasiness and tension around being unable to sleep, thereby perpetuating the sleeplessness. Furthermore, insomniacs may often engage in poor sleep hygiene, such as having an inadequate sleep environment, lack of daytime activities, and excessive afternoon napping (Abe et al., 2011). The majority of people with insomnia attempt to cope with sleep problems in various ways, have fewer adaptive coping skills, rely more on emotion-focused coping strategies than on problem-solving strategies and report lower feelings of mastery (LeBlanc et al., 2007). Reduced quality of life associated with insomnia has already been reported in a general population sample. We have recently studied specific daily stress coping behaviors (SCBs) and sleep hygiene practices (SHPs) of people with insomnia in our Japanese population based sample.

As a result, we clarified that Japanese adults with insomnia might also engage in various maladaptive SCBs and SHPs (Table 4). Most importantly, we found that people with insomnia may not necessarily engage in the same SCB as insomniacs comorbid with depression (Abe & Mishima, 2008). It has often been considered that treatment with insomnia played a bunch of treatments of depression. But, our findings indicated that novel therapeutic strategies need to be developed, taking into account both characteristics of insomnia and depression. These kinds of concrete findings about daily behaviors related with insomnia may offer critical insights for developing effective sleep educational preventive programs in public health, as reported by Morin’s group in Canada (Morin et al, 2006). For example, concerning substance dependence, the association between insomnia and its self-medication with alcoholism has been acknowledged (Brower et al., 2001). Our unpublished data in alcoholic groups in Japan also showed that the majority of middle-aged alcoholic patients entering treatment reported insomnia symptoms and recognized themselves their diminished quality of sleep (Asami et al., 2011).

	Insomnia (n = 10653)					Insomnia comorbid with depression (n = 1357)				
	N	Crude		Adjusted [†]		N	Crude		Adjusted [†]	
		OR	95%CI	OR	95%CI		OR	95%CI	OR	95%CI
Stress coping behaviors (SCB)										
Bearing the stress without taking any action (Bearing)	1576	1.97	1.78–2.18	1.69	1.52–1.88	378	3.49	2.96–4.10	3.44	2.92–4.05
Smoking (Smoking)	1954	1.22	1.12–1.33	1.26	1.15–1.38	317	1.48	1.24–1.76	1.73	1.44–2.08
Eating something (Eating)	1663	1.27	1.16–1.39	1.22	1.11–1.34	273	1.58	1.33–1.88	1.51	1.26–1.81
Watching TV/Listening to radio (TV/ Radio)	3650	1.26	1.17–1.35	1.18	1.10–1.27	537	1.57	1.35–1.83	1.52	1.30–1.78
Making an effort to solve problems actively (Problem solving)	1609	0.88	0.80–0.96	0.87	0.80–0.95	121	0.50	0.39–0.64	0.50	0.39–0.65
Taking it easy (Ease)	3630	n.s.	–	n.s.	–	354	0.72	0.61–0.85	0.74	0.63–0.87
Making plans to take time off (Time off)	734	n.s.	–	n.s.	–	65	n.s.	–	n.s.	–
Sleep hygiene practices (SHP)										
Drinking alcohol (Alcohol)	2961	1.24	1.15–1.34	1.27	1.18–1.38	349	n.s.	–	n.s.	–
Reading books/Listening to music (Books/ Music)	3747	1.20	1.12–1.29	1.24	1.15–1.33	460	1.36	1.16–1.59	1.39	1.19–1.63
Taking a bath (Bath)	4983	1.13	1.05–1.21	1.09	1.01–1.17	587	n.s.	–	n.s.	–
Trying to have regular daily habits (Regularity)	4114	n.s.	–	n.s.	–	420	0.69	0.59–0.80	0.64	0.55–0.75
Taking light exercise (Exercise)	2174	n.s.	–	n.s.	–	239	n.s.	–	n.s.	–

[†]Adjusted for sex, age, and presence of stress by multiple logistic regression analyses. CI, confidence interval; Crude, non-adjustment; OR, odds ratio (*P* < 0.01).

Table 4. Stress coping behavoir and sleep hygien practices in the Japanese general adult sample

Abe *et al.* have recently studied several specific daily stress coping behaviors and sleep hygiene practices of people with adult insomnia in the Japanese adult general population (Abe *et al.*, 2011). As a result, they clarified that Japanese adults with insomnia might also engage in various maladaptive conducts. They also found that people with insomnia may not necessarily engage in the same behaviors and practices as insomniacs comorbid with depression. Although this study mainly targeted adults, future research needs to examine these aspects among minors in order to clarify the onset of insomnia and its temporal development into chronic adult insomnia. Such minors may be characterized by vulnerabilities in how they perceive and experience stressful life events negatively during adolescent periods. Most of them are not seeking help, thus possibly they will continue to engage in self-help maladaptive practices, such as substance abuse, until they are finally diagnosed with chronic insomnia or depression later (Vollath *et al.*, 1989; Wong *et al.*, 2009).

4.5.1 Stress coping behaviors among people with insomnia

As far as we know, our study is the first report that investigates stress-coping behaviors among people with insomnia in the general adult population. According to the classical formulation by Lazarus and Folkman (1984), coping behavior refers to cognitive and behavioral efforts to manage external and internal demands (Morin & Espie, 2004). There are two types of coping behaviors: problem-focused and emotion-focused behaviors. With regards to the coping behaviors among people with insomnia, Morin *et al.* indicate that, compared with good sleepers, people with insomnia are apt to perceive their lifestyle as more stressful and choose more emotion-focused coping behaviors (Morin *et al.*, 2003). This does not contradict reports indicating that people with insomnia tend to internalize stress, affecting emotions (Basta *et al.*, 2007). Similar trends were observed in the sample of people with insomnia in this study (Abe *et al.*, 2011). Our multivariable logistic regression analysis revealed that, among the seven SCBs, insomnia was positively related to the emotion-focused coping behaviors of bearing, smoking, eating, and TV/radio. Bearing had the strongest positive correlation with insomnia (OR = 1.69), and an even stronger correlation with insomnia comorbid with depression (OR = 3.44). Therefore, this study indicates that problem-focused behaviors represented by Problem-solving could be helpful in overcoming insomnia. While Ease was not significantly related to insomnia, it had a significant relation with insomnia comorbid with depression (OR = 0.74). This indicates that people with insomnia may not necessarily engage in the same stress-coping behavior as insomniacs comorbid with depression. The present findings indicate that novel therapeutic strategies need to be developed, taking into account both characteristics of insomnia and depression. This study further revealed a strong positive association between Smoking and insomnia (OR = 1.26). Previous research in Europe and in the United States indicates a relationship between nicotine consumption through smoking and poor sleep quality (Morin & Espie, 2004). Furthermore, the strong association between Smoking and insomnia comorbid with depression (OR = 1.73) indicates that individuals with insomnia comorbid with depression tend to rely on more unhealthy coping strategies in their daily life. Our results might highlight the importance of strongly urging people complaining of insomnia to quit smoking. Eating was significantly related to insomnia. A previous epidemiological study reported that irregular eating habits and subjective sleep insufficiency were closely associated. TV/Radio is also significantly related to insomnia. Morin *et al.* indicated that many individuals initiate a variety of self-help strategies to alleviate insomnia, including listening to music and relaxation (Morin *et al.*, 2006). In fact, these individuals may

experiment with a variety of these passive emotional focused self-help remedies for a considerable period of time before seeking professional help (Morin & Espie, 2004).

4.5.2 Sleep hygiene practices among people with insomnia

There have been several studies that have shown that individuals with insomnia often engage in some inappropriate sleep practices. In a population-based sample of 258 insomniacs, Jefferson *et al.* reported that, compared with healthy people, insomniacs more habitually drank alcohol before going to bed (Jefferson *et al.*, 2005). Our study also demonstrated that alcohol consumption before going to bed is positively related to insomnia. Research in the United States suggests that drinking alcohol is an important risk factor for sleep problems. In their comparison of sleep habits among people in ten different countries, Soldatos *et al.* found that Japan ranked the highest in terms of the prevalence of alcohol use as a sleep aid (30.3%) (Soldatos *et al.*, 2005). Thus, it is critical to provide sleep hygiene education about minimizing alcohol consumption before bedtime to people with insomnia. Our analysis further found that Books/Music was also positively related to insomnia. Some previous studies have reported that reading behavior is significantly more frequent among groups with insomnia than control groups. Morin *et al.* found in their epidemiological survey of a general population in Canada that insomnia syndrome sufferers use music (OR = 2.6) and reading (OR = 1.8) as self-help strategies to facilitate sleeping (Morin *et al.* 2006). In our study, combining Books and Music into one item in the questionnaire may have comparatively reduced the odds ratio (Table 4). One epidemiological study among Japanese indicates that poor exercise habits are associated with insomnia. Based on this finding, we hypothesized that physical activity would be an inhibiting factor for insomnia symptoms; however, there was no significant relationship between Exercise and insomnia. Previous research suggests that daytime physical activity improves sleep. The inconsistency in the findings might be attributable to the lack of information available regarding the type (level), duration, and frequency of physical activity in our study. While Bath was slightly related to insomnia, it had no significant association with insomnia comorbid with depression. Subjective sleep sufficiency is better for individuals when they take a bath before going to bed rather than when they do not. Taken together, these observations may indicate that taking a bath improves the subjective quality of comorbid depression. By contrast with previous studies, our analysis found no significant association between Regularity and insomnia. This may be attributable to the fact that we did not define the behaviors belonging to this SHP in a concrete manner. Regular exposure to photic and nonphotic time cues (Zeitgebers) for the circadian clock system supposedly stabilizes the acrophases of the sleep-wake rhythm as well as the physiological rhythm, allowing one to fall asleep and maintain sleep more easily (Wirz-Justice *et al.*, 2009). The strong negative association between Regularity and insomnia comorbid with depression (OR = 0.64) found in the present study supports a treatment emphasis on regularity for mood disorders including bipolar disorder.

4.6 Future remarks about insomnia

The studies of the relationship between insomnia and suicidality started from investigating the relationship between depression and suicidality. It is still needed to clarify whether insomnia could be a distinct factor related to suicidality, even controlling for depression (Pigeon & Caine, 2010). Suicide prevention of depression often includes insomnia, but they are not always in line and insomnia has a distinct psychopathology, different from the one of depression. According to current etiological models of insomnia, a cognitive, emotional

and physiological hyperarousal may play an important role in the development and maintenance of the disorder. This hyperarousal concept has just recently been summarized in several review articles. Riemann *et al.* pointed out that it is important to note that two effects are, at least to some extent, opposing in chronic insomnia: on the one hand, sleep deficits or chronic minor sleep loss affects neurobiological processes and neuropsychological performance; on the other hand, there is the elevated arousal level which can be measured in several physiological systems (Riemann *et al.*, 2011). These opposing processes might construct the rather paradoxal psychopathology of insomnia (Baglioni *et al.*, 2010; Riemann *et al.*, 2010, 2011). Needless to say, further studies will be needed to clarify the relationship between insomnia related hyperarousal and suicidality. Perhaps, subtyping insomnia patients according to signs of hyperarousal and the intensity of daytime impairment, such as the intensity of fatigue, might offer a way to disentangle the pathology of suicidality. In this sense, attachment theory may provide a useful framework for considering how the socio-emotional climate influences affect and arousal across the lifespan, and may be particularly important for understanding psychopathology of insomnia. For example, anxious attachment styles which are characterized by 'hyper-activating' strategies during times of threat or stress, may predispose an individual to insomnia by influencing stress-arousal systems and cognitions related to the emotional and physical availability of the partner (Troxel & Germain, 2011).

5. Adolescent insomnia

Adolescents experience changes in their opposing societal demands, such as early school-start times and an increase in the significance of social roles coincide with these physiologic changes (Brand & Kirov, 2011; Liu & Buysse, 2006). These incongruous demands may explain why adolescents are prone to sleep disturbances, such as delayed phase sleep syndrome and insomnia. The multiple changes that adolescents experience can be very stressful, and serve as precipitating factors that activate biological and/or psychological diathesis, and subsequently, to the development of other mental health problems.

Studies in adults have already found that insomnia is associated with psychological problems (Singareddy & Balon, 2001). However, little research has explored the relationship between insomnia and mental health during adolescence and young adulthood. Substantially less research has evaluated insomnia and psychological disorders in adolescents. Safer D.J. suggested that adolescents differed from adults in suicidal behavior in their greater attempt rate, higher attempt/completion ratio, and lower rates of short and intermediate completion following psychiatric treatment. He claimed that the frequent practice of combining adult and adolescent suicide and suicide behavior findings can result in misleading conclusions (Safer, 1997).

5.1 Epidemiology: Prevalence of adolescent insomnia

Youth and adolescent suicidality constitutes a major public health problem, ranking among the leading causes of death for young people in many countries worldwide. Risk for completed suicide increases dramatically during adolescence, and research implicates an array of associated factors from genetic, biological, psychosocial, and cognitive domains (Bridge *et al.*, 2006; Brand & Kirov, 2011). Sleep disturbances are prevalent not only among adults but also among 10–40% of adolescents (Liu *et al.*, 2000; Johnson *et al.*, 2006; Roane & Taylor, 2008). An estimated 10.7% of adolescents in the general population experience insomnia according to

DSM-IV criteria (Johnson et al., 2006). Roane & Tayler also showed that insomnia symptoms were reported by 9.4% of the 4495 adolescents, 12 to 18 years old, suggesting that one out of ten adolescents met the criteria for insomnia (Roane & Taylor, 2008). The authors examined adolescent insomnia as a risk factor for mental health problems in a longitudinal study. They concluded that insomnia should be treated with specific interventions as an independent disorder in adolescents (Taylor & Roane, 2010). The Japanese research team of Ohida *et al.* has performed large-scale epidemiological studies on the sleep status of Japanese adolescents (Ohida et al., 2004; Kaneita et al., 2006). In a survey of approximately 106,300 Japanese junior and high school students, 30.6% reported an average sleep duration of less than 6h per night. Of these, 12.5% reported excessive daytime sleepiness, and 40% were not satisfied with their sleep quality (Ohida et al., 2004). Another survey reported that 23.5% of adolescents experienced symptoms of insomnia (Kaneita et al., 2006). Most studies of sleep disturbances among adolescents have focused on sleep deprivation and insomnia, and other types of sleep disturbances have not been adequately addressed.

5.2 Adolescent insomnia and suicidality

Sleep undergoes substantial changes during adolescence and suicide risk begins to increase during this period as well (Liu & Buysse, 2006; Wong et al., 2011). Adolescent sleep is characterized by widespread sleep restriction, irregular sleep schedules, daytime sleepiness, and elevated risk for sleep disturbances (Gangwisch et al., 2010). Sleep is indispensable in terms of brain maturation and learning for adolescents. Maladaptive sleep habits prevent them from growing, even run a risk of increasing suicide ideation. Sleep loss or disturbances are likely to signal an increased risk of future suicidal action in adolescents. Large-scale prospective studies and neurobiological studies are needed for a better understanding of the complex relationship between sleep, psychopathology, and youth suicidal behavior.

Research with adolescents has demonstrated a clear relationship between suicidal ideation and sleep problems. Cross-sectional studies have found that adolescents with insomnia experience more depressive symptoms, and suicide ideations and attempts and are more likely to use alcohol, cigarettes, illicit drugs, or a combination of these substances. In a provident epidemiological study of French teenagers, Choquet *et al.* found that adolescents with suicidal ideation reported more insomnia as well as more nightmares than adolescents who denied suicidal ideation (Choquet & Menke, 1990). In their subsequent study, suicidal ideation was linked to more sleep difficulties and frequent feelings of daytime tiredness (Choquet et al., 1993). It follows that the findings linking sleep disturbance with suicidality may serve as a proxy for severity of insomnia comorbid with depression more generally.

Better understanding the relationship between disturbed sleep and suicidality in adolescents may also serve for suicide prevention with this population (Goldstein et al., 2008). There is evidence to suggest that some factors associated with adolescent suicide may be different from adult suicide (Safer, 1997). For example, although impulsive-aggressive behavior is a common risk factor for both adult and teenage suicide, aggression and impulsivity are traits highly related to suicidal behavior in adolescents (Apter et al., 1995). Higher levels of impulsive aggressiveness play a greater role in suicide among younger individuals with importance decreasing with age. Adolescents with aggression and conduct disorders may be suicidal even in the absence of depression. Psychosocial factors associated

with adolescent suicide, such as stress and contagion, bullying and peer victimization may also be different from adults. Alcohol and drug abuse contribute significantly to the risk of suicide in teenagers (Apter et al., 1995). Additional potential contributors to suicidal behavior in depressed adolescents are early defined traits such as temperament and emotional regulation. One recent study suggests that suicidal youth are characterized by highly maladaptive regulatory responses and low adaptive emotional regulation responses to dysphoria (Tamas et al., 2007).

5.3 Sleep problems in highschoolers, students and youth sample

College students will be an ideal population to examine sleep disturbances and mental health relationships (Yang et al., 2003; Taylor et al., 2010; Nardoff et al., 2011). Yang *et al.* investigated the 1,922 first year college students' coping strategies for sleep disturbances and their effectiveness in Taiwan (Yang et al., 2003). They pointed out the relative lack of effective coping strategies for the management of such problems in this population. The results showed that taking naps and adjusting sleep schedules were coping strategies associated with better sleep quality. As mentioned throughout, the young adult age group is particularly susceptible to the onset of major psychiatric disorders. If so, the next logical step would be to develop primary and secondary sleep prevention programs for behavioral changes in this population (Liu & Buysse, 2006).

Brand *et al.* evaluated the effect of early stage intense romantic love on sleep quality in 113 adolescents (mean age: 17.8) (Brand et al., 2007, 2010). The research showed that adolescents reported significantly less daily sleepiness, higher daily concentration, more physical activity, and better mood compared to the other groups. Intense love in adolescents seems to be comparable with hypomanic state of bipolar mood spectrum. Intense positive emotions could disturb sleep quantity through the presence of heightened psychophysiological arousal, while improving perceived sleep quality and daytime activity. At least, combined PSG or actigraphic studies may be needed to understand the effects of such intense and positive emotions on sleep among adolescents and youth adults.

6. Another symptomatic aspect: Insomnia and nightmare, distinct suicide risk?

Clinical observations have showed that nocturnal sleep disturbances, including insomnia and recurrent nightmares, represent common distressing sleep complaints that might have important prognostic and therapeutic implications in psychiatric patients. Epidemiological studies have demonstrated that insomnia, nightmares, and sleep insufficiency are associated with elevated risk for suicide. Several studies have suggested an independent predictive role of nightmares in future suicidal behavior. It should be more noticed that nightmares may be more than a marker of PTSD and really important in the identification of suicidal ideation in primary care.

6.1 Sleep disturbances in mental health epidemiology

There is a consensus that one growing area of research in mental health includes the study of the relationship between sleep disturbances and suicidality in this decade (Ağargün & Beşiroğlu, 2005; Bernert et al., 2005; Bernert & Joiner, 2007; Pigeon & Caine, 2010). Increasing evidence in both clinical and epidemiological studies suggests that disturbances in sleep are

associated with an elevated risk for suicidal behaviors. Both sleep disorders and general sleep complaints appear to be linked to greater levels of suicidal ideation and depression, as well as both attempted and completed suicide (Fawcett et al., 1990; Ağargün et al., 1997; Krakow et al., 2000). As these provident studies have already stressed, one major expected suggestion is that sleep disturbances may have prognostic significance in predicting suicide among patients with depression. A recent study conducted in Japan, Fujino *et al.* showed that, among 13,259 middle-aged adults, only difficulty maintaining sleep (sleep maintenance insomnia), compared to other sleep disturbances (e.g., difficulty initiating sleep, nonrestorative sleep), significantly predicted death by suicide 14 years later (Fujino et al., 2005). But, depression was not accounted for when examining the association between sleep and completed suicide. Such findings would often elucidate whether sleep disturbances stand alone as a risk factor for completed suicide or, conversely, whether such sleep complaints simply vary with increased depressive symptoms (Ağargün & Beşiroğlu, 2005; Fujino et al., 2005). Sleep problems and more specifically, significant changes in sleep, have been considered as warning signs of suicide in many mental health policies. Thus, improvement in the identification of risk factors for suicidal behaviors and possible early intervention and postvention thus ultimately enhance our competence to intervene and prevent death by suicide (Krakow et al., 2011).

Fawcett *et al.* conducted the first study to prospectively examine sleep, depression and suicide in 1990 (Fawcett et al., 1990). They considered insomnia to be one of the ‘modifiable risks’ for suicide in patients with depression. Ağargün *et al.* demonstrated a significant association between poor sleep quality and suicidal behavior in depression (Ağargün et al., 1997). Further studies will be needed to the possible intervention with regard to suicidality.

Again, does insomnia (sleep disturbances) still manifest distinct suicide risk, even controlling after several confounding factors? During several years, many studies and clinical experiences have tried to investigate this concern (Wojnar et al., 2009; Li et al., 2010; Pigeon & Caine, 2010). But, this question was already asked nearly one century ago by a British doctor. In 1914, in the medical journal *Lancet*, Pronger wrote an epoch-making article, entitled “Insomnia and Suicide” (Pronger, 1914). His clinical intuition still impresses us enormously, even about one century afterwards. A recent clinical case report stressed again that sleep assessment should be considered in the evaluation of suicide risk in depressed patients (Mahgoub, 2009).

6.2 Chronobiological factors and diurnal fluctuation of suicidality

The study of chronobiological factors in the relationship between sleep and suicidal behaviors remains a largely unexplored, yet fruitful area of research (Ağargün & Beşiroğlu, 2005; Bernert & Joiner, 2007). A diurnal variation in the timing of self-injurious behaviors and completed suicide is supported by several reports. Blenkiron *et al.* prospectively assessed 158 patients presenting at a hospital referred for psychiatric assessment due to deliberate self-harm (Blenkiron et al., 2000). The authors classified these deliberate self-harm incidents as suicide attempters, and concluded that the frequency of these acts were higher in the evening and lower in the early morning hours. They also showed a bimodal peak in frequency for deliberate self-harm among older and younger adults. And they concluded that the severity of deliberate self-harm appeared to vary according to the time of day (Blenkiron et al., 2000). In another study in Japan, ambulance report records were

retrospectively reviewed for a 7-year period in Tokyo to examine time-of-day and documented suicide attempts. Results indicated that suicide attempts showed a peak earlier in the evening (18h00) compared to the morning (Motohashi, 1990).

Selvi *et al.* assessed 80 patients clinically diagnosed with major depression and 80 healthy subjects who were demographically matched with the patient group (Selvi *et al.*, 2010). Results showed that morningness-type circadian rhythm may play as a significant relief factor after the onset of major depression, but sleep variables of chronotype and sleep quality did not significantly predict suicide ideation after controlling for depressive symptoms in the major depression group. They concluded that suicide ideation and poor sleep quality were antecedents of depression symptom severity in patients with major depression. They discussed these findings under the theoretical assumptions concerning possible relations between chronotype, sleep quality, depression, and suicidality (Selvi *et al.*, 2010).

In studying time-related risk factors, additional research is needed, particularly studies that better define the severity of suicidal behaviors. It will be important for such studies to carefully distinguish suicide attempts and deliberate self-harm with an intent to die from self harm behaviors without suicidal intent. Investigation of the timing of sleep and suicidal acts may inform risk assessment procedures, emergency responding and surveillance, as well as treatment (Bernert & Joiner, 2007). There is an association between circadian rhythms and suicidality. This topic has always been investigated in terms of diurnal fluctuation of symptoms related to depression or Seasonal Affective Disorder (Wirz-Justice *et al.*, 2009). Future research will also be necessary to thoroughly evaluate chronobiological correlates of suicidality in non-clinical samples for preventative purposes.

6.3 Sleep homeostasis hypothesis and suicidality

Sleep abnormalities are common in patients with suicidal behavior. Sleep complaints such as insomnia, hypersomnia, nightmare, and sleep panic attacks are frequent in suicidal adolescents and adults. Results from school-based survey in the USA indicate that whereas insomnia and hypersomnia independently increase risk for suicidal ideation in adolescents, the presence of both insomnia and hypersomnia incurs further increased suicidal risk in this population (Roberts *et al.*, 2001). In another study, a significant and temporal relationship between sleep problems and completed suicide has been observed (Goldstein *et al.*, 2008). Considerable evidence supports a strong link between sleep disturbances and suicidality but the pathway remains to be established (Sher, 2008).

In 2003, an innovative theoretical model, called “sleep synaptic hypothesis”, reflecting on the significance of slow-wave activity and its homeostatic regulation was proposed (Tononi & Cirelli, 2003). According to this hypothesis, neuroplastic processes occurring during wakefulness result in a net increase in synaptic strength in many brain circuits. The role of sleep is to downscale synaptic strength to a baseline level that is energetically sustainable, makes efficient use of gray matter space, and is beneficial for learning and memory. Thus, sleep is the price we have to pay for plasticity, and its goal is the homeostatic regulation of the total synaptic weight impinging on neuron (Tononi & Cirelli, 2003, 2006). It has been suggested that wakefulness is associated with synaptic potentiation in several cortical circuits; synaptic potentiation is tied to the homeostatic regulation of slow-wave activity;

slow-wave activity is associated with synaptic downscaling; and active synaptic downscaling occurring during sleep is beneficial for cellular functions and is tied to overnight performance improvement.

Hence, many aspects of behavioral performance improve after sleep and are negatively affected by sleep deprivation, and it is conceivable that avoiding synaptic overload by maintaining synaptic homeostasis would be beneficial for many cellular processes, such as energy metabolism and membrane maintenance. Clinically, sleep deprivation may affect fatigue complaints and the production of dreams, which is particularly important for adolescent's development. It is possible that disruption of synaptic homeostasis underlies sleep abnormalities, leading or contributing to suicidal behavior. Serotonergic mechanisms may affect sleep regulation, are implicated in the pathophysiology of suicidal behavior, and may be involved in the relation between sleep abnormalities, synaptic homeostasis and suicidal behavior (Sher, 2008). Taken together, theoretically, sleep difficulties should be considered in prevention and intervention effort for patients at risk for suicide. Prevention effort should target good sleep hygiene and early detection and treatment of problematic sleep patterns in order to decrease risk for suicide (Liu & Buysse, 2006). Better understanding of the relationship between disturbed sleep and suicidality may serve to inform effort for suicide prevention.

7. Nightmares

7.1 Nightmare; Definition and epidemiology

Both insomnia and nightmare showed classical and, at the same time, a novel symptomatic aspect in psychiatric epidemiology. Clinical observations have showed that nocturnal sleep disturbances, including insomnia and recurrent nightmares, represent common distressing sleep complaints that might have important prognostic and therapeutic implications in psychiatric patients. Epidemiological studies have demonstrated that insomnia, nightmares, and sleep insufficiency are associated with elevated risk for suicide (Hasler & Germain, 2009).

Dreams are a remarkable experiment in psychology and neuroscience, conducted every night in every sleeping person. They show that the human brain, disconnected from the environment, can generate an entire world of conscious experiences by itself (Nir & Tononi, 2010). Both DSM-IV and ICSD-2 criteria converge on defining nightmares as intensely disturbing dreams that awaken the dreamer to a fully conscious state and generally occur in the latter half of the sleep period (Table 5.).

Lifetime prevalence of nightmares in the general population is unknown, but large epidemiological studies indicate that about 85% of adults have experienced at least one nightmare within the past year (Levin & Nielsen, 2007). Further investigations suggest that the prevalence may almost approach 100%! The estimated frequency of clinically significant nightmares (occurring at least weekly) is 4–10% in the general population (Nielsen et al., 2006). Similar rates are reported from different cultures. There is a significant gender difference in nightmare frequency, with women of all ages reporting nightmares more frequently than men. Age is also relevant: nightmares are less frequent among the elderly (Levin & Nielsen, 2007; Nielsen et al., 2006).

Nightmare Disorder
A. Repeated occurrences of extended, extremely dysphoric and well-remembered dreams that usually involve efforts to avoid threats to survival, security or physical integrity and that generally occur during the second half of the major sleep episode.
B. On awakening from the dysphoric dreams, the person rapidly becomes oriented and alert.
C. The dream experience, or the sleep disturbance produced by awakening from it, causes clinically significant distress or impairment in social, occupational, or other important areas of functioning.
D. The dysphoric dreams do not occur exclusively during the course of another mental disorder (e.g., a delirium, Posttraumatic Stress Disorder) and are not due to the direct physiological effects of a substance (e.g., a drug of abuse, a medication) or a general medical condition.

Table 5. DSM-5 proposed criteria for nightmare disorder ([84], 2010).

7.2 Nightmare; Etiology

Because nightmares are often, but not necessarily, associated with PTSD, many specialists distinguish post-traumatic and non-traumatic (idiopathic) nightmares (Hasler & Germain, 2009; Levin & Nielsen, 2009). Post-traumatic nightmares reflect the long-lasting effect of a wakeful traumatic experience, whereas the cause of non-traumatic nightmares is unknown. Numerous studies have found that nightmare frequency is associated with psychopathological symptoms (Levin & Nielsen, 2007), but because most of these studies do not strictly distinguish between post-traumatic and non-traumatic nightmares, the interpretation of the results is ambiguous. Levin & Nielsen described six broad psychopathological categories that are associated with nightmares: anxiety symptoms, neuroticism and global symptom reporting, schizophrenia-spectrum disorders, other psychiatric disorders, behavioral health problems and sleep disturbances, and PTSD (Levin & Nielsen, 2007). A common feature of these pathologies is notable waking emotional distress, suggesting that nightmares may play a role in processing of these experiences. The studied reviewed above also suggest that the connection between early experiences, brain development, and nightmare experiences might involve failures in emotion regulation (Nielsen et al, 2006; Levin & Nielsen, 2009). Current models of nightmare production seem to emphasize negative emotionality as having a central role in determining dream affects. Ağargün *et al.* previously reported that the prevalence of childhood traumatic experiences was higher among adult who “often” had nightmares than among adults who “sometimes” or “never” had nightmares (Ağargün et al., 2003). With regard to the associations between nightmares and mental health status, Nielsen *et al.* studied adolescents (aged 13–16) and reported a significant association between the frequency of nightmares and the level of anxiety (Nielsen et al., 2006). To date, very few studies have investigated the prevalence of nightmares in adolescents, compared to adults. In Japan, analyzing 90,081 nationwide adolescent sampled data, Munezawa *et al.* showed that the prevalence of nightmares was 35.2% among Japanese adolescents (more than one third) (Munezawa et al., 2011). The results of this study should be considered in the prevention of nightmares among Japanese

adolescents. They concluded that it is important to maintain regular sleep habits for preventing this symptom, and proposed that health education about regular sleep habits should be promoted among Japanese adolescents in a near future.

7.3 Nightmare and attachment

Interestingly, from the viewpoint of both attachment theory and epidemiology, Csóka *et al.* have hypothesized that adults who experienced early maternal separation (before one year of age and lasting at least one month) would report more frequent nightmares and bad dreams (Csóka *et al.*, 2011). In the frame of the Hungarostudy Epidemiological Panel, 5020 subjects interviewed, significant associations were found between early maternal separation and both frequent nightmare experience in adulthood and increased frequency of oppressive and bad dreams. Current depression scores fully mediated the association between early separation and nightmares, but not the association between early separation and negative dream affects. The authors interpreted these findings as a trait-like enhancement of negative emotionality in adults who experienced early maternal separation. This enhancement influences the content of dreams and, when it takes the form of depression, also influences the frequency of nightmares. The effect of early maternal separation on nightmares and bad dreams is relevant, which merits further attention (Csóka *et al.*, 2011).

7.4 Nightmare and suicidality

As we have mentioned above, frequent nightmares have been noted to be related to suicidality in depressed patients, particularly among women (Ağargün *et al.*, 1998). A prospective follow-up study in a sample drawn from the general population also reported that the frequency of nightmares is directly related to the risk of suicide (Tanskanen *et al.*, 2001; Turvey *et al.*, 2002; Bernert, *et al.*, 2005; Sjöström *et al.*, 2007; Nadorff *et al.*, 2011). Among those, Bernert *et al.* directly addressed the real question regarding research indicating that sleep disturbances may be specifically linked to suicidal behaviors: Is this link largely explained by depressive symptoms or how are specific symptoms of sleep disturbances relate to suicidal symptoms when controlling for depression? The 176 outpatients completed measures on sleep disturbances, suicidal symptoms. They controlled for depressive symptoms to establish a link between sleep disturbances and suicidality. They found that insomnia and nightmare symptoms were associated with both depressive symptoms and suicidality before controlling depressive symptoms. After controlling for depressive symptoms, only nightmares demonstrated an association with suicidal ideation. Another significant finding was that nightmares were particularly associated with suicidality among women compared to men. Before controlling for gender, a non-significant trend emerged between nightmare symptoms and suicidality, and this relationship remained after controlling for depression. After controlling for gender, the link between nightmare symptoms and suicidal ideation was statistically significant. This finding indicates that the association between nightmares and suicidality, while controlling for depression, was somewhat stronger among women versus among men (Bernert, *et al.*, 2005).

For more than three decades, sleep disturbance had been considered the hallmark of posttraumatic stress disorder. Since insomnia has been observed in 90% of PTSD cases and

nightmare related to the trauma in 70%, this is understandable (Hendin et al., 2008). Besides, recently, Nadorff *et al.* clearly showed that nightmare symptoms may be “more than” a marker of PTSD, and hence may be important in the identification of suicidal ideation following several previous literatures (Nadorff et al., 2011).

8. Future remarks and treatment implications

8.1 Acute insomnia, the emergence of sleep psychiatry

Despite significant contributions made in the area of chronic insomnia, the area of acute insomnia has received comparatively little attention (Ellis et al., 2011). Overall, the findings from the review will highlight the need for a structured diagnosis of acute insomnia as the first step in a research and treatment strategy. Psychiatric and medical disorders are often associated with sleep disorders, especially acute insomnia which is a crucial element in clinical practices. Therefore, clinicians have to organize specific remedies for co-occurring acute insomnia itself. Recently the notion of sleep psychiatry (psychiatric therapeutic approach, both biologically and psychologically, based on sleep science) has gathered much attention worldwide (Goblin et al., 2004). Taking these points into account, when addressing potential treatment implications based on this conceptualisation of acute insomnia, three questions emerge: 1) Is it possible that acute insomnia can be identified and/or responded to in a timely manner?; 2) Is it possible that an intervention for acute insomnia has the potential to derail the occurrence of chronic insomnia?; 3) What would the optimal treatment approach be? Here, we will present a case study in order to show the possible efficiency of early sleep psychiatric intervention, mainly focusing on the subjective experience of the individual with acute insomnia (Abe et al., 2012).

8.1.1 Case study 2

Mr. T., a 25-year-old man, had a long history of OCD (Obsessive-Compulsive Disorder) with recurrent obsessive thoughts of touching dirt and compulsive cleaning since his preadolescence. Firstly, at the age of 18, he consulted a psychiatrist for the purpose of treating his depressive symptoms after his father’s sudden death. His depressive symptoms improved and then stabilized for several years with the aid of pharmacologic treatment (sulpiride 30mg, clorazepate 7.5mg and paroxetine 20mg). After graduating from professional school, he was able to work as a computer engineer in an urban company in spite of the persistence of his obsessive symptoms. One winter, he was addressed to our outpatient clinic by his general practitioner. His symptoms had already stabilized because of the same medication as a long-term maintenance treatment for OCD.

After four months of our follow-up, that spring, he was transferred to another section in his company. This change of social environment made him cogitate about his interpersonal relationship with other colleagues, which provoked acute insomnia symptoms, such as difficulty falling asleep and nighttime awaking. Additionally, he also suffered from daytime impairment related to his insomnia, especially hypersomnia and daytime sleepiness. He said, “I can’t concentrate on my work because I have to fight to get to sleep” and “I feel afraid of falling asleep”. Typically, the fear of insomnia was exacerbated. In other words, he was very afraid of losing his career position in his new section caused by the daytime impairments (e.g., losing concentration and diminished performance), which he attributed to his insomnia.

In order to improve acute insomnia symptoms, we treated him mainly with an early sleep psychiatric approach as a non-pharmacological intervention. Intentionally, we avoided increasing medication, because his principal concerns were strongly related with daytime impairment of insomnia. Adding another medication to improve sleep might run a risk of exacerbating daytime consequences of insomnia. In this situation, we treated him, making use of a home-monitoring actigraphy and an oxygen saturation tool. After two days of monitoring, the actigraphy always measured total sleep time and number of nighttime awakenings, so data showed that he had slept sufficiently during the night contrary to his complaints. As a first step, we supported him by showing him recorded sleep data, which suggested that his objective quality of sleep was different from his subjective complaining. This manifestation explained by itself a typical psychopathology of insomnia. This monitoring continued for a week. During this period, he was encouraged to visit our clinic 3 times a week for evaluation. Over nights, his actigraphic records always suggested longer and more consolidated sleep efficiency compared with his subjective intensity of insomnia complaints. As a next step, one night he was asked to get installed a portable oxygen saturation tool. The obtained data showed that some presence of hypoxemia during his sleep, which could partially explain the fragility of his sleep function. Also, he was found drinking alcohol and smoking just before going to bed. Moreover, he often surfed the web in eating snacks during the night on weekends. Therefore, we considered this above data as important evidence to strongly stop him from smoking and drinking before bedtime, and urging him to keep regular habits even at the weekend. With this intervention equipped with the home-monitored objective data, also based on sleep hygiene education (e.g. avoid bedside drinking, smoking, snacking and surfing the internet), his anxiety and fear of insomnia diminished dramatically and he spontaneously recovered from acute insomnia.

The lifetime prevalence of OCD is comparatively high at 2-3.5% of the population. While neither the core syndromal manifestations nor prominent associated features of OCD include sleep disturbances, patients suffering from OCD often complain about their sleep disturbance. Clinical observations show that their complaints are non-specific and persist. Previous sleep studies among patients with OCD are sparse and results inconsistent, often confounding with their comorbid depressive illness. Psychiatric disorders, such as neurotic disorders including OCD, are often associated with sleep disorders, especially insomnia which is a crucial element in clinical practices. Characteristically, insomniacs often complain about their sleep more than about the lack of it objectively measured. Therefore, we have to organize specific remedies for co-occurring acute insomnia itself. Possible other reasons for explaining his diminished quality of sleep in this case, were as follows; 1) presence of co-occurring subclinical depressive symptoms, 2) negative consequences of core OCD symptoms of sleep habits, 3) concurrent diurnal side effects of long-term prescribed medication. Clinically, these aspects must always be taken into consideration for managing sleep disturbance comorbid with neurotic disorders including OCD.

In this case, we attempted to have an early intervention in the vicious cycle of acute insomnia. This early sleep focused intervention prevented him from entering the chronic vicious cycle of psycho/physiological hyperarousal, which was supposed to play a central role in the pathophysiology of insomnia. We emphasize several suggestions about acute insomniac state. "I can't sleep", "I don't get enough sleep": This kind of complaints have often led to the easiest solution of direct prescriptions of hypnotics. The accumulation of

hypnotics has eventually had negative consequences in their everyday QOLs, such as daytime sleepiness and diminished concentration. Traditionally, Morita Therapy, a unique psychotherapy originated in Japan was devised for treating classical neurotic disorder. That concept has evolved the phenomenology of insomniacs as a subjective fabricated nature, claiming that clinicians are liable to make an error by just giving hypnotics to help the patient's feeling of sleeplessness without attempting radical cure on him. In this case, theoretically we applied some conventional concepts of Morita therapy to the treatment, utilizing the latest home monitoring instruments. We have to understand the fundamental phenomenology of diminished quality of sleep, and then give feedback to the acute insomniacs themselves in an appropriate way. To explain this process in the Morita theory, we attempted to stop exacerbating "psychic interaction" of acute insomniacs. This way of feedback may have something in common with the current well-developing Mindful-Based Cognitive Behavioral Therapy for insomnia. Despite their nature of subjective-objective discrepancy, individuals suffering from acute insomnia are situated under a subjectively perceived overwhelming threat.

We may stress that focusing on how sleep state misperception could be a particularly central aspect of insomnia within the context of OCD. From this case study, it appears that the treatment was largely successful because the actigraphic records helped to correct the patient's misperceptions. Perhaps, such a focused intervention has a non-specific and positive psychotherapeutic effect. This could also have implications about the possible application of actigraphy to treat sleep problems within anxiety disorders. A home monitoring system, such as actigraphy, not only provides satisfactory objective evaluation, but also a supportive psychotherapeutic effect in diminishing fear and anxiety related with acute insomnia. Getting an individual to recognize at an early stage, and providing him with treatment pathway guided by actigraph to deal with, were crucial in this case.

8.2 Alcoholism and insomnia

Some researchers have investigated between sleep disturbances in an adolescent period and its temporal development of substance abuse. The role of alcohol in the suicidal process warrants special attention (Gromov, I & Gromov, D, 2009; Wong et al., 2010). Adolescents may also be considered to choose drinking habits and substance abuse as a self-help sleep habit in order to escape negative suicide ideation. The association between insomnia and its self-medication with alcoholism has been acknowledged. The relationship between sleep problems and substance use/abuse has been demonstrated in both adults and adolescents. Insomnia has been shown to prospectively predict alcohol problems among some adults (Brower et al., 2001).

One recent unpublished data in alcoholic groups in a psychiatric hospital in Japan also showed that the majority of middle-aged alcoholic patients entering treatment reported insomnia symptoms and recognized themselves their diminished quality of sleep (Asami et al., 2011). In the Epidemiological Catchment Area study in the USA (n= 7,954), individuals with persistent insomnia at baseline were more likely than individuals without insomnia to experience the first onset of alcohol abuse or dependence one year later (Ford & Kaminer, 1989).

Recently, Pieters *et al.* have investigated the associations between pubertal development, sleep preference, sleep problems, and alcohol use in 431 early adolescents (Pieters *et al.*, 2010). Then, they studied whether the associations changed when controlling for adolescent internalizing and externalizing problems. Results showed that pubertal development was positively associated with sleep problems and more evening-type tendencies (e.g., favouring later bedtimes), which in turn were positively related to alcohol use. From this study, it can be concluded that both puberty and sleep regulation are important factors in explaining alcohol use in early adolescence. This research has shown again a possible bi-directional relation between alcohol use and sleep, while profound puberty-dependent transitions regarding sleep patterns take place in early adolescence. Moreover, puberty has been associated with an increase in alcohol use of adolescents. They provided valuable data to understand the relationship among puberty, sleep problems, and alcohol use. Questions regarding that association, the possible reciprocal relationships among circadian phase preference, sleep problems and alcohol use, mediators and moderators of such relationships, as well as potential gender differences on these relationships were discussed (Wong, 2010). To understand the relationships among pubertal development, sleep problems, and alcohol use, researchers need to be aware of the physiological changes that take place in puberty, as well as the psychosocial factors that are associated with such changes (Pieters *et al.*, 2010).

To the best of our knowledge, Wong *et al.* s' several reports in the USA have been the only longitudinal study examining the relationship between childhood sleep problems and adolescent substance use (Wong *et al.*, 2004, 2009, 2010). Following their early works from a community sample of high-risk families and controls (292 boys and 94 girls), they have also tested whether adolescent sleep problems and poor response inhibition mediated the relationship between childhood sleep problems and substance (alcohol and drug) outcomes in young adulthood (Wong *et al.*, 2010). Eventually, longitudinal design should be useful. Prevention and intervention programs may want to consider the role of sleep problems and response inhibition on substance use and abuse.

8.3 Insomnia and trauma in current Japanese society aftermath of tsunami disaster

A massive 9.0-magnitude earthquake occurred in the Pacific Ocean near Northeast Japan on March 11, 2011, causing serious damage to Japan. The effect of the East Japan Earthquake will not terminate within months. Many survivors experienced observing the disaster of the tsunami wiping out everything, and those extraordinary experiences will surely cause trauma among many minors (children and adolescents) who survived this disaster (Takeda, 2011). Those affected adults and adolescents should be taken care of closely for the possible occurrence of post-traumatic stress disorder, in terms of daily stress coping and sleep hygiene parameters related with insomnia. How does such emotional affects predict insomnia and nightmare symptoms? Bereavement is a ubiquitous part of the human condition. Almost no person makes it through his or her life without having to cope with the loss of a loved one several different times. The loss of a parent, child, or grandparent can be very distressing. From now on, further research will be needed to investigate the relationship between bereavement, complicated grief and recovery sleep.

Before concluding this discussion, we cited another provident remark, proposed by a French psychologist. She challenged to develop an analysis of various external and intrapsychic

factors related to adult insomnia (Dollander, 2002). The author suggests some preventive perspective to face the etiology of adult insomnia, and points out limits of pharmacological treatment. From a clinical viewpoint, she succeeded in making methodological propositions to test the four exposed psychodynamic assumptions: 1) insomnia should be a result of anguish excess related to intrapsychic conflicts which can't lead to a mental elaboration; 2) insomnia should be a result of psychic functioning invalidation; 3) some insomnias are related to waking associated with repetitive nightmares, and 4) some insomnias are in relation with an impossibility to accept passive position. These aspects are still in a hypothetical model, but it should always be noted in constructing long-term treatment strategy targeting on insomnia especially in the aftermath of trauma.

9. Brief summary and conclusion

In summary, clinical and epidemiological studies suggest that sleep disturbances (insomnia) are closely associated with suicidality and other correlates both in adult, and probably more importantly, in adolescent. In some cases, this association appears to exist above and beyond depression and PTSD. Nightmare shows a unique association with suicide risk, whereas additional research is needed to clarify both pathophysiology and symptomatology of insomnia. Studies should also be undertaken to determine the effects of adequate sleep and sleep hygiene promotion on mental health and suicide prevention. As the association between alcohol use and sleep has also been well documented among adults, researchers need to be aware of the pubertal development that takes place in sleep problems and their coping strategies. Circadian and homeostatic factors drive sleep. The sleep focused intervention studies may help us learn more about the fundamental role and homeostatic process of sleep dynamics in psychiatric disorder. Issues regarding the relationship between puberty and insomnia, the possible reciprocal relationships among circadian phase preference, sleep problems and alcohol use, mediators and moderators of such relationships (i.e. risk, protective and resilient factors), as well as potential gender differences on these relationships were discussed in further research and clinical practices.

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11. References

- [1] Abe, Y. & Mishima, K. (2008). The concepts and pathophysiology of insomnia. *Brain* 21, 11, 62-68, [Article in Japanese].
- [2] Abe, Y.; Mishima, K.; Kaneita, Y.; Li, L.; Ohida, T.; Nishikawa, T. & Uchiyama, M. (2011). Stress coping behaviors and sleep hygiene practices in a sample of Japanese adults with insomnia. *Sleep and Biological Rhythm*, 9, 35-45.

- [3] Abe, Y.; Nishimura, G. & Endo, T. Early sleep psychiatric intervention for acute insomnia: Implications from a case of Obsessive-Compulsive Disorder (2012). *J. Clin. Sleep Med.*, in press.
- [4] Ağargün, M.Y.; Kara, H. & Solmaz, M. (1997). Subjective sleep quality and suicidality in patients with major depression. *J. Psychiatr. Res.*, 31, 377-381.
- [5] Ağargün, M.Y.; Cilli, A.S.; Kara, H.; Tarhan, N.; Kincir, F. & Oz, H. (1998). Repetitive and frightening dreams and suicidal behavior in patients with major depression. *Compr. Psychiatry*, 39, 198-202.
- [6] Ağargün, M.Y.; Kara, H.; Ozer, O.A.; Selvi, Y.; Kiran, U. & Kiran, S. (2003). Nightmares and dissociative experiences: The key role of childhood traumatic events. *Psychiatry and Clin. Neurosciences*, 57, 139-145.
- [7] Ağargün, M.Y. & Beşiroğlu, L. (2005). Sleep and suicidality: do sleep disturbances predict suicide risk? *Sleep*, 28, 1039-1040.
- [8] AASM (American Academy of Sleep Medicine). (2005). *International Classification of Sleep Disorders, 2nd Ed.: Diagnostic and Coding Manual*. American Academy of Sleep Medicine (ICSD-2). Westchester, IL.
- [9] American Psychiatric Association (APA). (2000). *Diagnostic and Statistical Manual of Mental Disorders*, 4th edn. Text revision. American Psychiatric Association: Washington, D.C.
- [10] Apter, A.; Gothelf, D.; Orbach, I.; Weizman, R.; Ratzoni, G.; Har-Even, D. & Tyano, S. (1995). Correlation of suicidal and violent behavior in different diagnostic categories in hospitalized adolescent patients. *J. Am. Acad. Child Adolesc. Psychiatry*, 34, 912-918.
- [11] Asami, M.; Abe, Y.; Suzuki, R.; Hasuo, R.; Nirasawa, H.; Jukuroki, H. & Kakibuchi, Y. (2011). A study on the subjective sleep evaluation and the related factors in the alcoholic, presented at the 36th Annual Meeting of Japanese Society of Sleep Research, Oct 16.
- [12] Bader, K.; Schäfer, V.; Schenkel, M.; Nissen, L. & Schwander, J. (2007). Adverse childhood experiences associated with sleep in primary insomnia. *J. Sleep Res.*, 16, 285-296.
- [13] Basta, M.; Chrousos, G.P.; Vela-Bueno, A. & Vgontzas, A.N. (2007). Chronic Insomnia and Stress System. *Sleep Med. Clin.*, 2, 279-91.
- [14] Baglioni, C.; Spiegelhalder, K.; Lombardo, C. & Riemann, D. (2010). Sleep and emotions: a focus on insomnia. *Sleep Med. Rev.*, 14, 4, 227-238.
- [15] Bastien, C. & Morin, C. M. (2000). Familial incidence of insomnia. *J. Sleep Res.*, 9, 49-54.
- [16] Bastien, C. H.; Vallières, A. & Morin, C. M. (2004). Precipitating factors of insomnia. *Behav. Sleep Med*, 2, 50-62.
- [17] Beaulieu-Bonneau, S.; LeBlanc, M.; Merette, C.; Dauvilliers, Y. & Morin, C. (2007). Family history of insomnia in a population-based sample. *Sleep*, 30, 1739-1745.
- [18] Bernert, R.A.; Joiner, T.E. Jr.; Cukrowicz, KC; Schmidt, N.B. & Krakow B. (2005). Suicidality and sleep disturbances. *Sleep*, 28, 1135-1141.
- [19] Bernert, R. A. & Joiner, T.E. (2007). Sleep disturbances and suicide risk: A review of the literature. *Neuropsychiatr. Dis. Treat.*, 3, 735-743.
- [20] Blenkiron, P; House, A. & Milnes, D. (2000). The timing of acts of deliberate self-harm: is there any relation with suicidal intent, mental disorder or psychiatric management? *J. Psychosom. Res*, 49, 3-6.

- [21] Bonnet, M.H. & Arand, D.L. (1995). 24-Hour metabolic rate in insomniacs and matched normal sleepers. *Sleep*, 18, 581-588.
- [22] Bonnet M.H. & Arand, D.L. (2010). Hyperarousal and insomnia: state of the science. *Sleep Med. Rev.*, 14, 9-15.
- [23] Brand, S.; Luethi, M.; von Planta, A; Hatzinger, M. & Holsboer-Trachsler, E. (2007). Romantic love, hypomania, and sleep pattern in adolescents. *J. Adolesc. Health.*, 41, 1, 69-76.
- [24] Brand, S. & Kirov, R. (2011). Sleep and its importance in adolescence and in common adolescent somatic and psychiatric conditions. *Int. J. Gen. Med*, 4, 425-442.
- [25] Bridge, J.A.; Goldstein, T.R. & Brent, D.A. (2006). Adolescent suicide and suicidal behavior. *Journal of Child Psychology and Psychiatry*, 47, 372-394.
- [26] Brower, K.J.; Aldrich, M.S.; Robinson, E.A.; Zucker, R.A. & Greden, J.F. (2001). Insomnia, self-medication, and relapse to alcoholism. *Am. J. Psychiatry*, 158, 399-404.
- [27] Buysse, D.J. (2008). Chronic insomnia. *Am. J. Psychiatry*, 165, 678-686.
- [28] Buysse, DJ; Angst, J; Gamma, A; Ajdacic, V; Eich, D. & Rössler, W. (2008). Prevalence, course, and comorbidity of insomnia and depression in young adults. *Sleep*, 31, 473-480.
- [29] Choquet, M. & Menke, H. (1990). Suicidal thoughts during early adolescence: prevalence, associated troubles and help-seeking behavior. *Acta Psychiatr. Scand.*, 81, 170-177.
- [30] Choquet, M.; Kovess, V. & Poutignat, N. (1993). Suicidal thoughts among adolescents: an intercultural approach. *Adolescence*, 28, 111, 649-659.
- [31] Csóka, S.; Simor, P.; Szabó, G.; Kopp, M.S. & Bódizs, R. (2011). Early maternal separation, nightmares, and bad dreams: results from the Hungarostudy Epidemiological Panel. *Attach Hum Dev.*, 13, 125-140.
- [32] Dauvilliers, Y.; Morin, C.; Cervena, K.; Carlander, B.; Touchon, J.; Besset, A. & Billiard, M. (2005). Family studies in insomnia. *J. Psychosom. Res.*, 58, 271-278.
- [33] Dollander, M. (2002). Etiology of adult insomnia. *L'Encéphale*, 28, 493-502 [Article in French].
- [34] Drake, C.L.; Scofield, H. & Roth, T. (2008). Vulnerability to insomnia: the role of familial aggregation. *Sleep Med.*, 9, 297-302.
- [35] Edinger, J.D., Means, M.; Carney, C. E. & Krystal, A.D. (2008). Psychomotor performance deficits and their relation to prior nights' sleep among individuals with primary insomnia. *Sleep*, 31, 599-607.
- [36] Ellis, J.G.; Gehrman, P.; Espie, C.A.; Riemann, D. & Perlis, M.L. (2011). Acute insomnia: Current conceptualizations and future directions. *Sleep Med. Rev.*, doi:10.1016/j.smr. 2011.02.002.
- [37] Endo, S. (1962). The Psychophysiological Study of Neurotic insomnia. *Psychiatria et Neurologia Japonica*, 64, 673-707.
- [38] Fawcett, J.; Scheftner, W.A.; Fogg, L.; Clark, D.C.; Young, M.A.; Hedeker, D. & Gibbons, R. (1990). Time-related predictors of suicide in major affective disorder. *Am. J. Psychiatry*, 147, 1189-1194.
- [39] Ford, D. E. & Kamerow, D. B. (1989). Epidemiologic study of sleep disturbances and psychiatric disorders: an opportunity for prevention? *JAMA*, 262: 1479-1484.

- [40] Franzen, P.L. & Buysse, D.J. (2008). Sleep disturbances and depression : risk relationships for subsequent depression and therapeutic implications. *Dialogues Clin. Neurosci.*, 10, 473-481.
- [41] Fujino, Y.; Mizoue, T.; Tokui, N. & Yoshimura, T. (2005). Prospective cohort study of stress, life satisfaction, self-rated health, insomnia, and suicide death in Japan. *Suicide Life-Threat Behav.*, 35, 2, 227-237.
- [42] Gangwisch, J.E.; Babiss, L.A.; Malaspina, D.; Turner, J.B.; Zammit, G.K. & Posner, K. (2010). Earlier parental set bedtimes as a protective factor against depression and suicidal ideation. *Sleep*, 33, 97-106.
- [43] Gau, S. F. & Soong, W.T. (1995). Sleep problems of junior high school students in Taipei. *Sleep*, 18, 667-673.
- [44] Germain, A.; Shear, K.; Monk, T.H.; Houck, P.R.; Reynolds, C.F.; Frank, E. & Buysse, D.J. (2006). Treating complicated grief: effects on sleep quality. *Behav. Sleep Med.*, 4, 3, 152-163.
- [45] Germain, A.; Buysse, D.J. & Nofzinger, E. (2008). Sleep-specific mechanisms underlying posttraumatic stress disorder: integrative review and neurobiological hypotheses. *Sleep Med. Rev.*, 12, 3, 185-195.
- [46] Germain, A.; Hall, M.; Krakow, B.; Shear, K. M. & Buysse, D.J. (2005). A brief sleep scale for Posttraumatic Stress Disorder: Pittsburgh Sleep Quality Index Addendum for PTSD. *J. Anxiety Disord.*, 19, 2, 233-244.
- [47] Goldstein, T. R.; Bridge, J.A. & Brent, D.A. (2008). Sleep disturbance preceding completed suicide in adolescents. *J. Consult. Clin. Psychol.*, 76, 84-91.
- [48] Goblin, A.; Kravitz, H. & Keith, L. eds. (2004). *Sleep Psychiatry*. Taylor & Francis, London.
- [49] Gregory, A.M.; Caspi, A.; Moffitt, T.E. & Poulton R. (2006). Family conflict in childhood: a predictor of later insomnia. *Sleep*, 29, 1063-1067.
- [50] Gromov, I. & Gromov, D. (2009). Sleep and substance use and abuse in adolescents. *Child. Adolesc. Psychiatr. Clin. N. Am.*, 18, 929-946.
- [51] Hasler, B. & Germain, A. (2009). Correlates and Treatments of Nightmares in Adults. *Sleep Med Clin.*, 4, 507-517.
- [52] Hendin, H.; Maltzberger, J.T. & Szanto, K. (2008). The psychosocial context of trauma in treating PTSD patients. *Am. J. Psychiatry*, 165, 28-32.
- [53] Jefferson, C.D.; Drake, C.L.; Scofield, H.M., Myers, E.; McClure, T.; Roehrs, T. & Roth, T. (2005). Sleep hygiene practices in a population-based sample of insomniacs. *Sleep*, 28, 611-615.
- [54] Johnson, E.O.; Roth, T.; Schultz, L. & Breslau, N. (2006). Epidemiology of DSM-IV insomnia in adolescence: lifetime prevalence, chronicity, and an emergent gender difference. *Pediatrics*, 117, 247-256.
- [55] Kaneita, Y.; Ohida, T.; Osaki, Y.; Tanihata, T.; Minowa, M.; Suzuki, K.; Wada, K.; Kanda, H. & Hayashi, K. (2006). Insomnia among Japanese adolescents: nationwide representative survey. *Sleep*, 29, 1543-1550.
- [56] Krakow, B. ; Artar, A. & Warner, T.D. (2000). Sleep disorder, depression and suicidality in female sexual assault survivors. *Crisis*, 21, 163-170.
- [57] Krakow, B.; Ribeiro, J.D.; Ulibarri, V.A.; Krakow, J. & Joiner, T.E. Jr. (2011). Sleep disturbances and suicidal ideation in sleep medical center patients. *J. Affect. Disord.*, 131, 422-427.

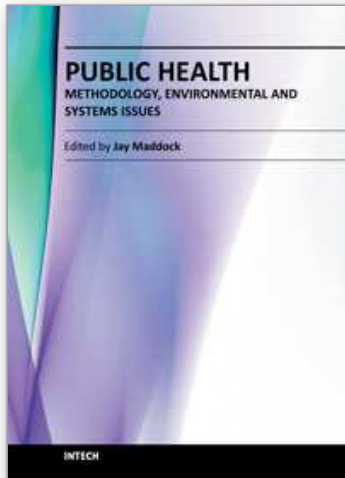
- [58] LeBlanc, M.; Beaulieu-Bonneau, S.; Mérette, C.; Savard, J.; Ivers, H. & Morin, C.M. (2007). Psychological and health-related quality of life factors associated with insomnia in a population-based sample. *J. Psychosom. Res.*, 63, 157-166.
- [59] Levin, R. & Nielsen, T.A. (2007). Disturbed dreaming, posttraumatic stress disorder, and affect distress: A review and neurocognitive model. *Psychological Bulletin*, 133, 482-528.
- [60] Levin, R. & Nielsen, T. (2009). Nightmares, bad dreams and emotion dysregulation: A review and new neurocognitive model of dreaming. *Current Directions in Psychological Science*, 18, 84-88.
- [61] Li, S.X., Lam, S.P.; Yu, M.W.; Zhang, J. & Wing, Y.K. (2010). Nocturnal sleep disturbances as a predictor of suicide attempts among psychiatric outpatients: a clinical, epidemiologic, prospective study. *J. Clin. Psychiatry*, 71, 1440-1446.
- [62] Liu, X.C.; Uchiyama, M.; Okawa, M. & Kurita, H. (2000). Prevalence and correlates of self-reported sleep problems among Chinese adolescents. *Sleep*, 23, 27-34.
- [63] Liu, X. & Buysse, D.J. (2006). Sleep and youth suicidal behavior: a neglected field. *Curr. Opin. Psychiatry*, 19, 288-293.
- [64] Mahgoub, N. A. (2009). Insomnia and suicide risk. *J. Neuropsychiatry Clin. Neurosci*, 2, 21, 232-233.
- [65] Mai, E. & Buysse, D.J. (2008). Insomnia: Prevalence, Impact, Pathogenesis, Differential Diagnosis, and Evaluation. *Sleep Med. Clin.*, 3, 2, 167-174.
- [66] Morin, C.M.; Rodrigue, S. & Ivers, H. (2003). Role of stress, arousal, and coping skills in primary insomnia. *Psychosom. Med.*, 65, 259-267.
- [67] Morin, C.M. & Espie, C. (2004). *Insomnia: A Clinical Guide to Assessment and Treatment*. Springer: New York.
- [68] Morin, C.M.; Leblanc, M.; Daley, M.; Gregoire, J.P. & Merette, C. (2006). Epidemiology of insomnia: prevalence, self-help treatments, consultations, and determinants of help-seeking behaviors. *Sleep Med*, 7, 123-130.
- [69] Morrison, D.N.; McGee, R. & Stanton, W.R. (1992). Sleep problems in adolescence. *J. Am. Acad. Child. Adolesc. Psychiatry*, 31, 94-99.
- [70] Motohashi, Y. (1990). Circadian variation in suicide attempts in Tokyo from 1978 to 1985. *Suicide Life Threat. Behav.*, 20, 533-539.
- [71] Munezawa, T.; Kaneita, Y.; Osaki, Y.; Kanda, H.; Ohtsu, T.; Suzuki, H.; Minowa, M.; Suzuki, K.; Higuchi, S.; Mori, J. & Ohida, T. (2011). Nightmare and sleep paralysis among Japanese adolescents: a nationwide representative survey. *Sleep Med.*, 12, 56-64.
- [72] Nadorff, M. R.; Nazem, S. & Fiske, A. (2011). Insomnia symptoms, nightmares, and suicidal ideation in a college student sample. *Sleep*, 34, 93-98.
- [73] National Institutes of Health (NIH). (2005). National Institutes of Health state of the science conference statement on manifestations and management of chronic insomnia in adults. June 13-15, 2005, *Sleep*, 28, 1049-1057.
- [74] Nielsen, T.A.; Stenstrom, P. & Levin, R. (2006). Nightmare frequency as a function of age, gender and September 11, 2001: Findings from an Internet questionnaire. *Dreaming*, 16, 145-158.
- [75] Nir, Y. & Tononi, G. (2010). Dreaming and the brain: from phenomenology to neurophysiology. *Trends Cogn. Sci.*, 14, 2, 88-100.

- [76] Nofzinger, E.A.; Buysse, D.J.; Germain, A.; Price, J.C.; Miewald, J.M. & Kupfer, D.J. (2004). Functional neuroimaging evidence for hyperarousal in insomnia. *Am. J. Psychiatr*, 161, 11, 2126-2128.
- [77] Ohayon, M.M. (2002). Epidemiology of insomnia: what we know and what we still need to learn. *Sleep Med. Rev.*, 6, 97-111.
- [78] Ohayon, M. M. & Lemoine, P. (2004). Daytime consequences of insomnia complaints in the French general population. *L'Encéphale*, 222-227 [Article in French].
- [79] Ohida, T.; Osaki, Y.; Doi, Y.; Tanihata, T.; Minowa, M.; Suzuki, K.; Wada, K.; Suzuki, K. & Kaneita, Y. (2004). An epidemiological study of self-reported sleep problems among Japanese adolescents. *Sleep*, 27, 978-985.
- [80] Orff, H.J.; Drummond, S.P.; Nowakowski, S. & Perlis, M.L. (2007). Discrepancy between subjective symptomatology and objective neuropsychological performance in insomnia. *Sleep*, 30, 1205-1211.
- [81] Pandey, G. N. (2011). Neurobiology of adult and teenage suicide. *Asian Journal of Psychiatry*, 4, 2-13.
- [82] Pieters, S.; Van der Vorst, H.; Burk, W.J.; Wiers, R.W. & Engels, R.C. (2010). Puberty-dependent sleep regulation and alcohol use in early adolescents. *Alcohol Clin. Exp. Res.*, 34, 1512-1518.
- [83] Pigeon, W.R. & Caine, E.D. (2010). Insomnia and the risk for suicide: does sleep medicine have interventions that can make a difference? *Sleep Med.*, 11, 9, 816-817.
- [84] Proposed Draft Revisions to DSM-5 Disorders and Criteria. (2010). <http://www.dsm5.org/>.
- [85] Pronger, C.E. (1914). Insomnia and suicide. *Lancet*, 184: 1356-1359.
- [86] Riemann, D. & Voderholzer, U. (2003). Primary insomnia: a risk factor to develop depression? *J. Affect. Disord.* 76, 255-259.
- [87] Riemann, D.; Voderholzer, U.; Spiegelhalder, K.; Hornyak, M.; Buysse, D.J.; Nissen, C. ; Hennig, J.; Perlis, M.L.; van Elst, L.T. & Feige, B. (2007). Chronic insomnia and MRI-measured hippocampal volumes: a pilot study. *Sleep*, 30, 955-958.
- [88] Riemann, D.; Kloepper, C. & Berger, M. (2009). Functional and structural brain alterations in insomnia: implications for pathophysiology. *Eur. J. Neurosci.*, 29, 9, 1754-1760.
- [89] Riemann, D.; Spiegelhalder, K.; Feige, B.; Voderholzer, U.; Berger, M.; Perlis, M. & Nissen, C. (2010). The hyperarousal model of insomnia: a review of the concept and its evidence. *Sleep Med Rev.* 14, 19-31.
- [90] Riemann, D.; Spiegelhalder, K.; Espie, C.; Pollmächer, T. ; Léger, D.; Bassetti, C. & van Someren, E. (2011). Chronic insomnia: clinical and research challenges--an agenda. *Pharmacopsychiatry*. 44, 1-14.
- [91] Roane B.M. & Taylor, D.J. (2008). Adolescent insomnia as a risk factor for early adult depression and substance abuse. *Sleep*, 31, 1351-1356.
- [92] Roberts, R. E.; Roberts, C.R. & Chen, I. G. (2001). Functioning of adolescents with symptoms of disturbed sleep. *Journal of Youth and Adolescence*, 30, 1-18.
- [93] Rosen, J.; Reynolds, C.F.3rd.; Yeager, A.L.; Houck, P.R. & Hurwitz, L.F. (1991). Sleep disturbances in survivors of the Nazi Holocaust. *Am. J. Psychiatry*, 148, 62-66.
- [94] Safer, D.J. (1997). Adolescent/adult differences in suicidal behavior and outcome. *Ann. Clin. Psychiatry*, 9, 61-66.

- [95] Selvi, Y.; Aydin, A.; Boysan, M., Atli, A.; Agargun, M.Y. & Besiroglu, L. (2010). Associations between chronotype, sleep quality, suicidality, and depressive symptoms in patients with major depression and healthy controls. *Chronobiol Int.*, 27, 1813-1828.
- [96] Shekleton, J. A.; Rogers, N. L. & Rajaratnam, S.M. (2010). Searching for the daytime impairments of primary insomnia. *Sleep Med. Rev.*, 14, 1, 47-60.
- [97] Sher, L. (2008). Sleep disturbances, synaptic homeostasis and suicidal behaviour. *Aust. N. Z. J. Psychiatry*, 2008, 42, 1072-1073.
- [98] Singareddy, R. K. & Balon, R. (2001). Sleep and suicide in psychiatric patients. *Ann. Clin. Psychiatry*, 13, 93-101.
- [99] Sjöström, N.; Waern, M. & Hetta, J. (2007). Nightmares and sleep disturbances in relation to suicidality in suicide attempters. *Sleep*, 30, 91-95.
- [100] Soldatos, C.R.; Allaert, F.A.; Ohta, T. & Dikeos, D. G. (2005). How do individuals sleep around the world? Results from a single-day survey in ten countries. *Sleep Med.*, 6, 5-13.
- [101] Sampo Japan Research Institute Inc. Disease Management Reporter in Japan No. 17, May, 2010.
- [102] Spielman, A. J.; Caruso, L.S. & Glovinsky, P.B. (1987). A behavioral perspective on insomnia treatment. *Psychiatr. Clin. North Am.*, 10, 541-553.
- [103] Tamas, Z.; Kovacs, M.; Gentzler, A.L.; Tepper, P.; Gadoros, J.; Kiss, E.; Kapornai, K. & Vetró, A. (2007). The relations of temperament and emotion self-regulation with suicidal behaviors in a clinical sample of depressed children in Hungary. *J. Abnorm. Child Psychol.*, 35, 640-652.
- [104] Taylor, D. J. & Roane, B.M. (2010). Treatment of insomnia in adults and children: a practice-friendly review of research. *J. Clin. Psychol.*, 66, 1137-1147.
- [105] Taylor, D. J.; Gardner, C.E; Bramoweth, A.D; Williams, J.M.; Roane, B. M.; Grieser, E. A. & Tatum, J. I. (2011). Insomnia and Mental Health in College Students. *Behav. Sleep Med.*, 9, 107-116.
- [106] Tononi, G. & Cirelli, C. (2003). Sleep and synaptic homeostasis: a hypothesis. *Brain Res. Bull.*, 62, 2, 143-150.
- [107] Tononi, G. & Cirelli, C. (2006). Sleep function and synaptic homeostasis. *Sleep Med. Rev.*, 10, 49-62.
- [108] Tsuno, N.; Besset, A. & Ritchie, K. (2005). Sleep and depression. *J. Clin. Psychiatry*, 66, 1254-1269.
- [109] Takeda, M. (2011). Mental health care and East Japan Great Earthquake. *Psychiatry Clin. Neurosciences*, 65, 207-212.
- [110] Tanskanen, A.; Tuomilehto, J.; Viinamäki, H.; Vartiainen, E.; Lehtonen, J. & Puska, P. (2001). Nightmares as predictors of suicide. *Sleep*, 24, 844-847.
- [111] Troxel, W.M. & Germain, A. (2011). Insecure attachment is an independent correlate of objective sleep disturbances in military veterans. *Sleep Med.*, doi:10.1016/j.sleep.2011.07.005.
- [112] Turvey, C.L.; Conwell, Y.; Jones, M.P.; Phillips, C.; Simonsick, E.; Pearson J.L. & Wallace, R. (2002). Risk factors for late-life suicide: a prospective, community-based study. *Am. J. Geriatr. Psychiatry*, 10, 398-406.

- [113] Vollath, M.; Wicki, W. & Angst, J. (1989). The Zurich Study VIII. Insomnia: association with depression, anxiety, somatic symptoms, and course of insomnia. *Eur. Arch. Psychiatry Neurol. Sci.*, 239, 113–124.
- [114] Wirz-Justice, A.; Benedetti, F. & Terman, M. (2009). *Chronotherapeutics for Affective Disorders: A Clinician's Manual for Light and Wake Therapy*. Basel, Karger.
- [115] Wojnar, M.; Ilgen, M.A.; Wojnar, J.; McCammon, R.J.; Valenstein, M. & Brower, K.J. (2009). Sleep problems and suicidality in the National Comorbidity Survey Replication. *J. Psychiatr. Res.*, 43, 526-531.
- [116] Wong, M.M; Brower, K.J.; Fitzgerald, H.E. & Zucker, R.A. (2004). Sleep problems in early childhood and early onset of alcohol and other drug use in adolescence. *Alcohol. Clin. Exp. Res.*, 28, 578-587.
- [117] Wong, M. M.; Brower, K.J. & Zucker, R.A. (2009). Childhood sleep problems, early onset of substance use and behavioral problems in adolescence. *Sleep Med.*, 10, 787-796.
- [118] Wong, M. M.; Brower, K. J.; Nigg, J.T. & Zucker, R.A. (2010a). Childhood sleep problems, response inhibition, and alcohol and drug outcomes in adolescence and young adulthood. *Alcohol. Clin. Exp. Res.*, 34, 1033-1044.
- [119] Wong, M, M. (2010b). Pubertal development, sleep problems, and alcohol use: a commentary. *Alcohol. Clin. Exp. Res.*, 34, 2019-2021.
- [120] Wong, M.M.; Brower, K.J. & Zucker, R.A. (2011). Sleep problems, suicidal ideation, and self-harm behaviors in adolescence. *J. Psychiatr. Res.*, 45, 505-511.
- [121] Yang, C.M.; Wu, C.H.; Hsieh, M. H.; Liu, M.H. & Lu, F.H. (2003). Coping with sleep disturbances among young adults: a survey of first-year college students in Taiwan. *Behav. Med.*, 29, 133-138.

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Public health can be thought of as a series of complex systems. Many things that individual living in high income countries take for granted like the control of infectious disease, clean, potable water, low infant mortality rates require a high functioning systems comprised of numerous actors, locations and interactions to work. Many people only notice public health when that system fails. This book explores several systems in public health including aspects of the food system, health care system and emerging issues including waste minimization in nanosilver. Several chapters address global health concerns including non-communicable disease prevention, poverty and health-longevity medicine. The book also presents several novel methodologies for better modeling and assessment of essential public health issues.

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Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
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InTech China

Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

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