

## **Sleep-disorders in children and adolescents**

### **Abstract**

### **Introduction**

A considerable amount of knowledge has accumulated in recent years regarding the pediatric aspects of sleep with its associated disorders being understood.

Health education for parents and prospective-parents frequently pay little attention to sleep.

In addition medical students and specialist-trainers receive little instruction about sleep disorders despite the fact that many of them have contact with children and adolescents who have sleep disturbances.

The ICSD-2 describes nearly 100 sleep-disorders many of which are seen among children and adolescents.

### **Aim**

The aim of this Article is to review sleep-disorders in children and adolescents, in the clinical-aspect beside epidemiology and disease-burden.

### **Methodology**

Literature retrieved through Google Scholar, EMBASE, Medline and PubMed were reviewed independently by the authors towards a consensus.

### **Results**

Sleep-disorders treatable, yet a large proportion remains of cases remain undiagnosed. Sleep-disorders are not uncommon among children and adolescents.

Factors which contribute to sleep-disorders include extensive television viewing increased social recreational activities as well as academic demands all of which may contribute to sleep deprivation and sleep problems.

Patterns of sleep behaviours and disorders differ between children and adults.

Additionally some sleep-disorders previously thought to be seen mainly or exclusively in adults are now being recognized in children.

30 Explanations of the causes of sleep-problems at any age, both physical and  
31 psychological possibilities should be considered whilst at the same acknowledging  
32 that parenting practices play a major role part in children's sleep-problems.

33 This is important because persistent sleep disturbance can have harmful outcomes  
34 which can impact on mood, behavior, performance, social-function and physical  
35 health.

36 The treatment of most sleep disorders in children is, in principle, straight-forward  
37 and is more likely to be effective if it is appropriate and carefully implemented.

38 Medication should not be the first line treatment for a sleep disorder but instead  
39 should be used as a last resort. Behavioural methods such as sleep hygiene and  
40 counselling is preferable.

41 There is evidence to suggest that insufficient sleep might impair motor skills and  
42 reaction time as well as decision making and general concentration levels leading  
43 to an impact on academic achievement.

44 Persistent sleep-loss is becoming increasingly associated with an adult's physical  
45 health

46 The authors mainly discuss:

- 47 1. Insomnia of childhood
- 48 2. Obstructive sleep apnea
- 49 3. **Parasomnias**
- 50 4. Sleep-related movement disorders: Restless legs syndrome/periodic limb  
51 movement disorder and rhythmic movements
- 52 5. Narcolepsy
- 53 6. Delayed sleep phase disorder

#### 54 **Conclusion and Recommendations**

55 In view of the morbidity, mortality, loss of Quality of Life, and the disease burden  
56 including the economic cost of sleep-disorders, cost-effective Prevention Programs  
57 are needed. Such Programs should educate parents, parents-to-be, teachers and  
58 healthcare professionals.

59 **Key-words:** sleep-disorders; health-education; children; adolescents; parenting-  
60 practices; mood; behavior; performance; social-function; physical health;  
61 medication; behavioral-methods; cognitive-function; motor-skills; insomnia

62

63

## 64 **Introduction**

65 **Currently there is a greater empathy exists in the field of Medicine for sleep-**  
66 **disorders that is gaining ground, however the progress is still considered to be**  
67 **slow.** A considerable amount of knowledge has been accumulated but it remains  
68 underutilized mainly because there is a lack of awareness by both the general  
69 public and medical-professionals particularly the field of pediatrics [1 – 3].Hence  
70 knowledge in pediatric sleep-disorders lags behind that of adults.’

71 **Health education programs for parents and prospective-parents frequently miss the**  
72 **importance of sleep hygiene. Medical-students and specialist-trainees, including**  
73 **pediatricians and child psychiatrists, health visitors, child-psychologists, and**  
74 **teachers do not receive enough instruction despite the fact that they have frequent**  
75 **contact with children and adolescents with sleep disturbance, which if left**  
76 **untreated may result in serious health implications. [1 -3].**

77 The 2005 revision of the International Classification of Sleep Disorders (ICSD-2)  
78 [6] improved **upon** previous classifications but children's disorders remain  
79 inadequately referenced to.

80 The ICSD-2 describes nearly 100 sleep disorders - **many are found in children and**  
81 **adolescents [1, 6].**

82 **Sleep-loss and sleep disorders are common and easily treatable yet they are**  
83 **frequently over-looked. It is estimated that 50 to 70 million Americans**  
84 **(approximately 20%) chronically suffer from a disorder of sleep and wakefulness,**  
85 **hindering daily functioning and adversely affecting health and longevity (NHLBI,**  
86 **2003). [4, 5]**

87 **Such patients suffer from chronic sleep-disorders affecting daily-functioning and**  
88 **negatively affecting health and longevity, all of which is made worse with an**  
89 **ageing population.(NHLBI 2003) [4, 5].**

90 Doctors seldom ask the patients about their sleep patterns (Namen et al., 1999,  
91 2001) [4, 5].

92 It is thought that around 80 to 90 percent of adults in the U.S. have a sleep disorder  
93 but have not been clinically diagnosed.[4 - 7]. Not recognizing sleep-problems not  
94 only dampens diagnosis and treatment but it also impedes prevention of serious  
95 Public Health consequences.

96 Sleep disorders are prevalent which affect every key indicator of Public Health  
97 which include the following:

- 98 • Mortality, morbidity, performance, accidents and injuries, functioning  
99 and Quality of Life, family well-being, and health-care utilization[4,  
100 5].

101 **Table 1** below shows the US National Sleep Foundation’s Expert panel-  
102 recommended sleep-durations for the various age-groups (Hirshkowitz, 2015). [put  
103 the number of this reference]

104 **Table 1: Expert panel recommended sleep durations.**

Age	Recommended, h	May be appropriate, h	Not recommended, h
Newborns 0-3 mo	14 to 17	11 to 13 18 to 19	Less than 11 More than 19
Infants 4-11 mo	12 to 15	10 to 11 16 to 18	Less than 10 More than 18
Toddlers 1-2 y	11 to 14	9 to 10 15 to 16	Less than 9 More than 16
Preschoolers 3-5 y	10 to 13	8 to 9 14	Less than 8 More than 14
School-aged children 6-13 y	9 to 11	7 to 8 12	Less than 7 More than 12
Teenagers	8 to 10	7	Less than 7

14-17 y		11	More than 11
Young adults	7 to 9	6	Less than 6
18-25 y		10 to 11	More than 11
Adults	7 to 9	6	Less than 6
26-64 y		10	More than 10
Older adults	7 to 8	5 to 6	Less than 5
≥65 y		9	More than 9

105

106 In adults, sleep-loss is defined as sleep of shorter-duration than the average  
 107 minimum requirement of 7 to 8 hours per night [4, 5].

108 One of the main consequences of sleep-loss is excessive daytime-sleepiness, but  
 109 different symptoms include depressed-mood and reduced memory/concentration  
 110 [4, 5, 8].

111 In the past, there have been insufficient nationally-representative surveys which  
 112 offer reliable-data on sleep-patterns in populations [4, 5].

113 Adolescents are among the population who frequently suffer from insufficient  
 114 sleep. Contrary to common perceptions, adolescents need as much sleep as pre-  
 115 teens [4, 5].

116 One survey which involved 3,000 adolescents in Rhode Island observed that only  
 117 15 percent reported sleeping 8.5 or more hours on school-nights, whilst 26 percent  
 118 had no more than 6.5 hours [4, 5, 11].

119 The optimal sleep-duration for adolescents is about 9 hours per night, and is based  
 120 on research about alertness, sleep-wake cycles, hormones, and circadian rhythms  
 121 [4, 5, 12]

122 Among adolescents, much time spent on television and the growing social,  
 123 recreational, and academic demands are reasons for sleep-loss or sleep problems  
 124 [4, 5, 11, 13].

125

126

## 127 **Methodology**

128 Literature, in the English language, retrieved through Google Scholar, EMBASE,  
129 Medline and PubMed databases were reviewed independently by the authors  
130 towards a consensus.

## 131 **Discussion**

132 Unlike in adults, there are profound changes in sleep-physiology during childhood  
133 and adolescence. Rapid eye movement (REM) sleep is particularly seen a lot in  
134 very young children, possibly because of its relationship to early brain-  
135 development. The circadian body-clock needs time to develop but from about 6  
136 months should not impede reasonably continuous night-time sleep, without the  
137 need for repeated feeds at night [1 – 3].

138 Sleep-requirements gradually reduce throughout childhood until puberty when the  
139 need for sleep increases slightly. This, combined with a physiological delay in the  
140 sleep-phase at puberty (opposite to the sleep-phase advance in the elderly) and  
141 late-night social activities, brings about potentially severe sleepdeprivation and  
142 excessive daytime-sleepiness (the delayed sleep phase syndrome, or DSPS) which  
143 can lead to educational and social difficulties in adolescence [1 – 3].

144 Certain sleep-disorders happen much more frequently in children and adolescents,  
145 particularly bedtime-settling and troublesome night-waking in young children (the  
146 result of not acquiring proper sleep-habits and demands on parental attention).  
147 Besides adolescent DSPS, more examples include rhythmic-movement disorders  
148 (such as head-banging), nocturnal-enuresis, and arousal-disorders seen in pre-  
149 pubertal children mainly [1 – 3].

150 Also, some sleep-disorders previously seen mainly or exclusively in adults are now  
151 being seen in children, eg., obstructive sleep apnea, restless legs syndrome, and  
152 periodic limb movements in sleep [1 – 3].

153 In finding an explanation for sleep-problems at any age a bio-psychosocial  
154 approach should be considered whereby physical, psychological and social factors  
155 are considered. In children, as in adults, neurological, respiratory, metabolic,  
156 endocrine, genetic, medication, or more physical-factors may have an influence.  
157 Besides that, parenting-practices play a big part in many children's sleep-problems.  
158 Parental knowledge, attitudes, and emotional-state frequently decide whether a  
159 child's sleep pattern is a problem or not. Certain parents perceive normal behavior

160 as a problem, while many do not seek help when they should, mistakenly thinking  
161 there is no treatment available [1 – 3].

162 Where obesity is a frequent observation in obstructive sleep apnea (OSA) in adults,  
163 enlarged-tonsils and adenoids are the cause in children. Obesity may be an  
164 increasingly prominent factor at all ages, but only a small proportion of children  
165 with OSA are overweight – and conversely, very early onset may cause low body-  
166 weight from failure to thrive [1 – 3].

167 Adult OSA causes sleepiness and reduced-activity. In contrast (as in different  
168 causes of excessive-sleepiness such as narcolepsy), certain sleepy children are  
169 abnormally active. Such could lead to misdiagnosis of attention-deficit  
170 hyperactivity disorder (ADHD), and consequent inappropriate treatment with  
171 stimulants [1 – 3].

172 There remains a risk that a few sleep-disorders will be misdiagnosed at any age.  
173 Possibly, this risk is greater in children than adults because of the bigger range of  
174 clinical-manifestations and alternative-explanations for the behavioral-changes  
175 involved both as primary manifestations of the sleep-disorder but also because of  
176 secondary-complications. Narcolepsy is an example. Diagnostic-problems could  
177 also arise because polysomnography (PSG) basis for OSA and narcolepsy  
178 diagnoses are not very clear-cut and are different compared with adult-patients [1 –  
179 3].

180 Many childhood sleep-disorders frequently resolve spontaneously unlike in adults.  
181 But in the meantime (as at any age), persistent sleep-disturbance can bring about  
182 harmful outcomes on mood, behavior, performance, social-function, and possibly,  
183 physical-health. Inadequate management of childhood sleep-problems can also be  
184 persistent into adult-life [1 – 3].

185 But, children's sleep-disorders are generally not as much associated with  
186 psychiatric-illness. Parents should realize that the strange sleep-related behavior  
187 (in, for example, head-banging or sleep terrors) is very unlikely to mean that the  
188 child has a serious psychiatric or medical-disorder [1 – 3].

189 Differences concerning sleep and sleep-disorders between children and adults need  
190 to be discussed in both clinical practice and research [1 – 3].

191 Managing most sleep-disorders in children is, in principle, straightforward and  
192 likely to be effective if appropriately chosen and implemented with much thought  
193 [1 – 3].



194 Unfortunately though, many parents are not aware of frequently simple ways in  
195 which sleep problems in young children can be prevented or minimized by the  
196 manner the child is dealt with at bedtime or during the night [1 – 3].

197 **Effective treatment in adults is not as readily achieved than in children because the**  
198 origins of the sleep problem and, thus the management required, is more  
199 complicated. Particularly in the treatment of insomnia or sleeplessness, medication  
200 plays a smaller part in children than in adults. Instead, behavioral methods (also  
201 frequently important for adults) are much more appropriate and effective [1 – 3,  
202 14].

203 The relevant specialties and disciplines on which it is necessary to draw for  
204 assessment and management of children with disturbed-sleep are wider than in  
205 adults. In the case of young patients, developmental psychology, and child and  
206 family psychiatry, frequently are also needed to participate. Different influences  
207 may be conspicuous at different ages because of the many changes in a child's  
208 development [1 – 3].

209 From the early years to adolescence, about 30% of children have a sleep-  
210 disturbance which is thought of by parents, or the children themselves, to be a  
211 problem. But, because the nature of the sleep-problem varies very much with age,  
212 bedtime-difficulties and problems with night-waking are frequently seen up to  
213 about 3 years of age while, nightmares and sleepwalking for example, manifest  
214 more in older children, and many adolescents suffer from the delayed sleep phase  
215 syndrome [1 – 3].

216 One of the key-aspects in doctor-patient care is the application of the bio-  
217 psychosocial model proposed by Engel (1977) in which the causes and treatment  
218 of medical-disorders may be considered within a framework of biological,  
219 psychological and social factors [15].

220 Recently Dunbar, Mirpuri, and Yip, 2017[16] carried out a study in the US using  
221 the bio-psychosocial model in which they explored school-engagement among a  
222 group of ethnically diverse adolescents with a mean age of 14.47 years. They  
223 assessed academic outcome, sleep quality, duration and grades. They found that  
224 inadequate sleep-quality had an impact on their grades. The authors suggested that  
225 because sleep is fundamental to the development of a young-adult it is in concern  
226 to explore all causes of a sleep-disorder, including sociocultural issues. That study  
227 suggested that factors such as stress could have an impact on an individual's ability  
228 to manage conflicts and that any continual-stress could have implications from a



229 physiological-perspective. The study could be seen as one example of how the bio-  
230 psychosocial model can be applied to understand the complex-interaction of a  
231 range of factors which could impact the health of an adolescent, particularly with  
232 regards to sleep-quality [16].

233 In a manner such problems are common in children overall, certain groups have  
234 sleeping-difficulties much more frequently [17].

235 Children with learning disabilities, different neurodevelopmental-disorders  
236 including autism, or psychiatric-conditions almost all of a time have their lives  
237 (and those of their parents) further complicated by disturbed-sleep and its  
238 aftermath. Similarly, children with types of chronic pediatric-illness [1].

239 Physical-factors may be big in the etiology of the sleep-problem in many of these  
240 conditions (e.g. OSA in Down syndrome) but behavioral factors (e.g. failure to  
241 develop satisfactory sleep-habits) **are more common**[1 – 3].

242 Similarly, these groups of children can generally be expected to respond to the  
243 same types of treatment as in different children, providing the treatment-programs  
244 are correct for the sleep-disorder in question [1 – 3].

245 Educating parents and professionals alike would increase the use of the various  
246 types of available treatments [1 – 3].

247 “Overtired” children are difficult to handle – such children become irritable,  
248 distressed, and even aggressive, much to the concern and exasperation of the  
249 parents. In a few children, such problems are frequent and seriously disrupt family-  
250 life. As said earlier, certain young children said to have ADHD characterized by  
251 over-activity, impulsiveness, and poor concentration, actually have a primary  
252 sleep-disorder. Stimulants are not appropriate in this group and could make matters  
253 worse by escalating the sleep-problem [1 – 3].

254 As stated earlier, persistent loss of sleep can have a depressing effect and lead to  
255 the problems at home and at school particularly among adolescents [1 – 3].

256 Disturbed-sleep can affect a child's emotional-state and behavior in many different  
257 **manners**. Bedtime can become a source of distress when there **is accompanying**  
258 **frightening thoughts** or experiences, including night-time fears [1 – 3].

259 There is convincing evidence that insufficient-sleep can impair concentration,  
260 memory, decision-making, and general ability to learn. Performance on tasks  
261 needing sustained-attention is particularly affected – and, also those requiring

262 abstract-thinking or creativity. In a same manner, motor-skills and reaction-time  
263 can be impaired. Studies in the USA suggest that 80% of adolescents have sleep  
264 inadequate to recommended nine hours, 25% not more than 6 hours, while more  
265 than 25% fall asleep in class. Students with insufficient-sleep achieve lower  
266 school-grades, in general[1 – 3].

267 In addition to the effect of OSA on growth in children, persistent sleep-loss in  
268 particular is being increasingly associated in adults with physical ill-health such as  
269 impaired immunity, obesity, hypertension, and diabetes [17] Children would not be  
270 free of at least some of these risks [1].

271 There have been reports that relationships between parent and a child with a  
272 serious and persistent sleep problem can be severely tested to the point of increased  
273 use of physical punishment in extreme cases, marital-discord and family-  
274 disharmony [1, 18].

275 The affected child's interpersonal-problems may extend beyond her/his family.  
276 Irritable, difficult, or disturbed behavior can affect friendships [1 – 3].

277 Relationships with teachers can easily suffer, particularly when teachers are not  
278 aware that behavioral-problems can be the result of inadequate or disturbed sleep,  
279 for which effective treatment can usually be provided [1 – 3].

280 There is no reason to expect that children are free of at least some of the risks to  
281 common non-communicable diseases below [1 – 3].

282 Sleep-loss affects health, and recent-research has overturned any concept that  
283 sleep-loss has no health-outcomes apart from daytime-sleepiness [4, 5].

### 284 **Sleep loss and physical health**

285 Studies suggest that sleep-loss (less than 7 hours per night) may have wide-  
286 ranging outcomes on the cardiovascular, endocrine, immune, and nervous systems,  
287 including the following [4, 5]:

- 288 • Obesity in adults and children
- 289 • Diabetes and impaired glucose tolerance
- 290 • Cardiovascular disease and hypertension
- 291 • Anxiety symptoms
- 292 • Depressed mood
- 293 • Alcohol use

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Studies find that the greater the degree of sleep-deprivation, the greater the adverse-outcome [4, 5].

**Sleep-loss Is Associated with Obesity**

When a person sleeps not more than 7 hours a night, there is a dose-response relationship between sleep-loss and obesity - the shorter the sleep, the greater the obesity as measured by body mass index (BMI) [4, 5].

By age 27, individuals with short sleep-duration (less than 6 hours) were 7.5 times more likely to have a bigger BMI, after controlling for confounding-factors such as family-history, levels of physical-activity, and demographic-factors [4, 5, 20].

**Sleep-loss Is Associated with Diabetes and Impaired Glucose Tolerance**

Two large epidemiological-studies and one experimental-study found an association between sleep-loss and diabetes, or impaired glucose-tolerance.

In the Sleep Heart Health Study, which is a community-based cohort-study, adults (middle-aged and older) who reported 5 hours of sleep or less were 2.5 times more likely to have diabetes, compared with those who slept 7 to 8 hours per night [4, 5].

**Sleep-Loss Is Associated with Cardiovascular-morbidity**

Sleep-loss and sleep-complaints are associated with heart-attacks (myocardial infarction) and perhaps stroke, according to several large epidemiological-studies [21 - 26].

Several potential-mechanisms could explain the link between sleep-loss and cardiovascular-events, including blood-pressure increases, sympathetic-hyperactivity, or impaired glucose-tolerance [4, 5].

**Sleep-loss, Mood, Anxiety, and Alcohol Use**

Sleep-loss is associated with adverse outcomes on mood and behavior. Adults with chronic sleep-loss are found to have excess mental-distress, depressive-symptoms, anxiety, and alcohol-use [27, 28, 20].

323 A meta-analysis of 19 Original Articles found that partial sleep-deprivation  
324 changes mood to an even greater extent than it does cognitive or motor functions  
325 [29].

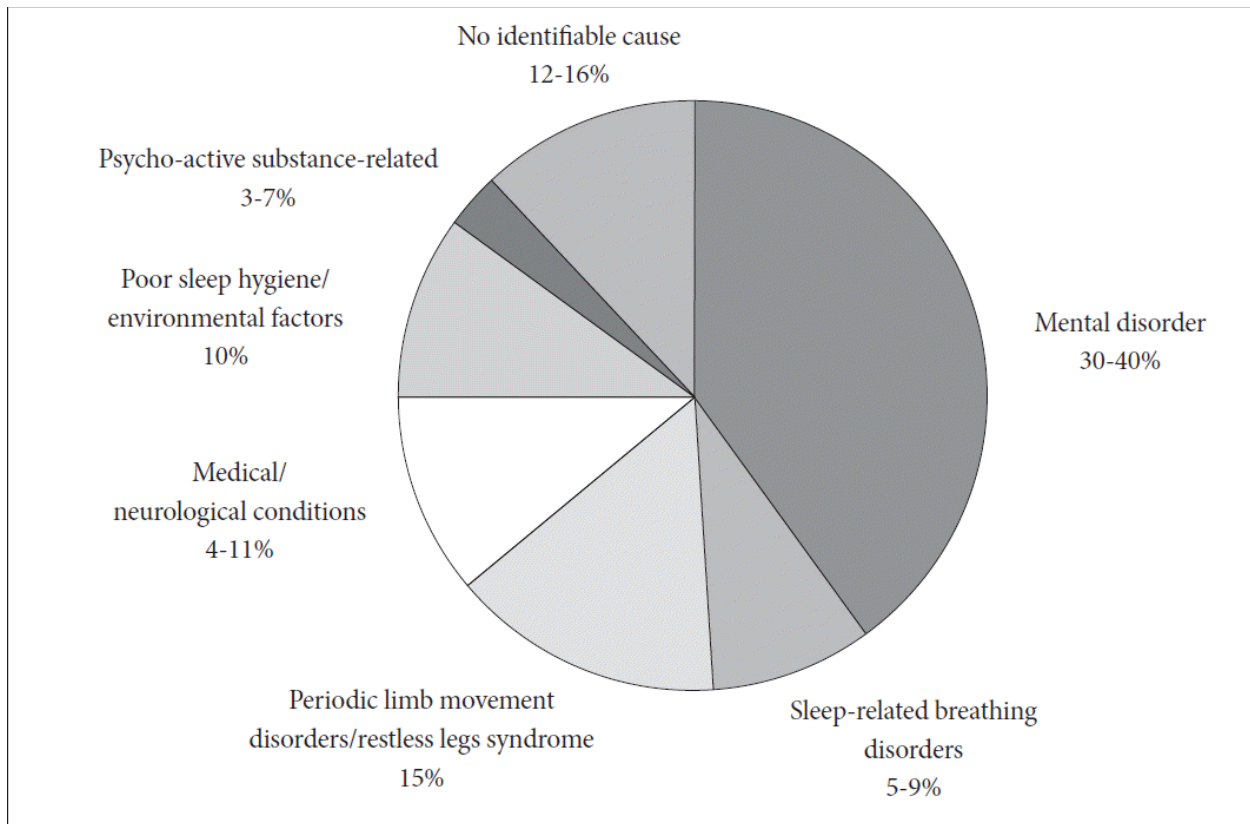
326 Several studies of adolescents, including one with more than 3,000 high-school  
327 students, found that inadequate-sleep is associated with higher-levels of depressed-  
328 mood, anxiety, behavior-problems, lower self-esteem and alcohol use [30, 32], and  
329 attempted suicide [33].

330 Several types of sleep-disorders are commonly seen among adolescents. These  
331 include insomnia, hyper-somnolence disorder, narcolepsy, breathing-related  
332 disorders and restless-leg syndrome.

333  
334 There are various classifications of Sleep-disorders including the International  
335 Classification of Sleep-disorders (ICSD) [6].A modified-version found in the  
336 Nelson Textbook of Pediatrics 20e. 2016 classifies Common Sleep Disorders in  
337 Children as [34]:

- 338  
339 1. Insomnia of childhood
- 340  
341 2. Obstructive sleep apnea
- 342  
343 3. Para-somnias
- 344  
345 4. Sleep-related movement disorders: Restless legs syndrome/periodic limb  
346 movement disorder and rhythmic movements
- 347  
348 5. Narcolepsy
- 349  
350 6. Delayed sleep phase disorder

351



**Fig 1: The pattern of sleep-disorders observed**

### **Insomnia of childhood**

The most common are insomnia-disorders which may be either transient or persistent. Brief episodes of insomnia are most often associated with anxiety and among adolescents it may be due to either an anxious experience or in anticipation of an anxiety-provoking experience; a typical example might be the fear of impending exams in school or college [1].

Persistent Insomnia is a group of conditions whereby the patient may experience difficulty in falling or remaining asleep. No clear anxiety-episodes may be present but at the same time the reason(s) may be exacerbated by stress from other sources such as personal-matters or school-stress [1].

Psycho-physiological insomnia typically presents with a complaint of difficulty in falling asleep. In such cases, it may be associated with objects associated with the sleeping-environment such as the bedroom itself or the bed. Unlike insomnia which is related to an underlying psychiatric-disorder day-time adaptation such as studies and relationships are not affected. In such cases, patients usually complain

374 of not being able to sleep even when they force themselves. Additionally, they may  
375 also experience rumination while trying to fall asleep. On the other hand patients  
376 are able to sleep better when they are away from the usual sleeping-environment -  
377 a typical example of such could be whilst watching television [1].

378  
379 Idiopathic insomnia frequently begins at an early-age and may continue throughout  
380 life. Its cause is unknown but there have been some suggestions that it might be  
381 caused by a neuro-chemical imbalance in the brainstem reticular-formation,  
382 impaired regulation of brainstem sleep-generators and basal-forebrain dysfunction  
383 [1].

384  
385 Primary insomnia is when the underlying-cause is not due to either medical or  
386 psychiatric disorders. Patients complain of difficulty in initiating or maintaining  
387 sleep. Such patients are also preoccupied with getting enough sleep and may  
388 become distressed when this does not happen - in turn causing further stress [1].

389  
390 Managing insomnia depends upon the duration of the affliction and how severe it  
391 is. In brief-episode insomnia, specific-treatments more than simple-advice may not  
392 be necessary. When treatment using sedative-hypnotics is needed, it must be done  
393 through good-understanding by the patients that the treatment is of a short-duration  
394 [1].

395  
396 For longer-duration primary insomnia, it usually improves with sleep-hygiene and  
397 relaxation-therapy. Pharmacological-treatment such as benzodiazepines, sedating-  
398 antidepressant and zolpidem can be prescribed - but (because of side-effects) be  
399 used for short-durations only and prescribed only when psychological-treatment  
400 alone does not help the patient's condition [1].

401  
402 One manner in which a sleep-disorder such as insomnia can be managed is by  
403 sleep-hygiene, which comprises a number of strategies commonly applied to foster  
404 good sleeping-habits. Such strategies include limiting the use of mobile-phones  
405 and various yet technological-equipment a few hours before bedtime, and not  
406 engaging in strenuous physical-activity. In cases where sleep-hygiene does not  
407 work, a referral to a psychologist may also be appropriate. Additional treatment  
408 includes the use of sleep-diaries which can be used to measure the patient's  
409 understanding of sleeping-habits, besides providing an opportunity for formulating  
410 a discussion about specific underlying-matters related to the patient's complaint  
411 and condition. Psychological-treatment is often used alongside pharmacological-  
412 treatment, such as those described above [1].

## 413 **Obstructive sleep apnea**

414 OSA is found in at least four (4) percent of men and 2 percent of women in the  
415 middle-aged workforce, according to the first major United States population-  
416 based study of the condition conducted about 15 years ago [1, 4 – 5, 7].

417 Those prevalence-figures are based on a cut-off apnea-hypopnea index (AHI) of 5  
418 or more, plus a requirement for daytime-sleepiness. The prevalence is greater - 9  
419 percent of women and 24 percent of men - with the same AHI cut-off but without  
420 the daytime-sleepiness requirement [1, 4, 5].

421 Granted the epidemic-increase of obesity in recent years, these numbers could  
422 possibly underestimate the present prevalence [1, 4, 5].

423 OSA-prevalence is found to increase with age. Adults 65 to 90 years of age had a  
424 threefold greater prevalence than middle-aged adults [35], while the prevalence in  
425 children is estimated around 2 percent [36, 37], with larger estimates seen in  
426 ethnic-minorities in the US [37, 38].

427 Under-diagnosis of OSA is common, with only about 10 to 20 percent being  
428 diagnosed in adults [7]. Not more than 1 percent of older-adults in primary-care are  
429 seen referred for polysomnography [39], although these numbers could have  
430 increased in recent-years because of increased public-knowledge of the disease.

431 **Since data such on children such as above is not forthcoming in literature-searches,**  
432 **the authors here use data on adults in an attempt to reflect on the overall situation.**

433 In the same manner, children's OSA frequently remains undiagnosed also, partly  
434 because the implications of snoring frequently being not recognized by  
435 pediatricians.

436 Although OSA could be found in children of all ages, it is most common among  
437 preschool-ages - a time coincident with tonsils and adenoids being largest in size  
438 relative to the underlying-airway (Jeans et al., 1981).

439 The main risk-factor for OSA in children is tonsillar hypertrophy, although OSA  
440 may also be found in children with congenital and neuromuscular disorders, and in  
441 children born prematurely (Rosen et al., 2003).

442 Asthma, a common childhood respiratory-illness, is also seen associated with OSA  
443 in children (Sulit et al., 2005).

444 Treatment modalities in OSA in children include [40]:



- 445 • Medications. Topical nasal steroids, such as fluticasone (Dymista, Flonase  
446 Allergy Relief, Xhance,) and budesonide (Rhinocort), eases sleep-apnea  
447 symptoms for some children with mild, obstructive sleep-apnea. For children  
448 with allergies, montelukast (Singulair) helps relieve symptoms when used  
449 alone, or with nasal-steroids.
- 450 • Removal of the tonsils and adenoids. Adeno-tonsillectomy improves OSA  
451 by opening the airway. Yet different forms of upper-airway surgery may be  
452 required based on the child's condition.
- 453 • Positive airway-pressure therapy. In continuous positive airway-pressure  
454 (CPAP) and bi-level positive airway-pressure (BPAP), small machines  
455 gently blow air through a tube and mask attached to the child's nose, or nose  
456 and mouth. The machine sends air-pressure into the back of the child's throat  
457 to keep the child's airway open. Positive airway-pressure therapy is the  
458 commoner modality. Proper fitting of the mask, and refitting as the child  
459 grows, can help the child tolerate the mask over the face.
- 460 • Oral appliances. Oral appliances, such as dental-devices or mouthpieces,  
461 move the child's bottom-jaw and tongue forward to keep the upper-airway  
462 open. Only some children benefit from such devices.
- 463 • Avoiding airway irritants and allergens. All children, but especially those  
464 with pediatric obstructive sleep-apnea, must avoid tobacco-smoke or the  
465 various indoor allergens or pollutants, as such could cause airway irritation  
466 and congestion.
- 467 • Weight loss. The child must lose weight when she/he is obese, based on diet  
468 and nutrition information, including referral to various specialists having  
469 expertise in managing obesity.

470  
471 The CHAT Study (Marcus CL 2013) showed that in comparing a plan of  
472 watchful-waiting, surgical-treatment for the obstructive sleep apnea  
473 syndrome (OSAS) in school-age children did not significantly improve  
474 attention or executive-function as measured by neuropsychological-testing,  
475 but did reduce symptoms and improve secondary-outcomes of behavior,  
476 quality of life, and polysomnographic findings - thus providing evidence of  
477 beneficial outcomes of early adeno-tonsillectomy[41].

478  
479 The Tucson Children's Assessment of Sleep Apnea Study (TuCASA)  
480 (Budhiraja R and Quan SF, 2009) is a longitudinal cohort-study of 503 6-12  
481 year old Caucasian-children and Hispanic-children who had

482 polysomnography and neurocognitive testing initially. Subsets of the cohort  
483 had additional MRI-imaging and pulmonary physiologic-testing. Cross-  
484 sectional analyses indicated that Sleep-disordered Breathing (SDB) is  
485 associated with behavioral-abnormalities, hypertension, learning-problems  
486 and clinical-symptoms such as snoring and excessive daytime-sleepiness.  
487 The Study feels future follow-up of the cohort will assess the impact of SDB  
488 on subsequent childhood-development [42].

## 490 **Sleep-related Movement Disorders**

491 ICSD-3 characterizes Sleep-Related Movement Disorders (SRMDs) by simple,  
492 often stereotyped movements occurring during sleep [43].

493 **Table 2: ICSD-3 Classification of the SRMDs.**

1.	Restless legs syndrome
2.	Periodic limb movement
3.	Sleep-related leg cramps
4.	Sleep-related bruxism
5.	Sleep-related rhythmic movement disorder
6.	Benign sleep myoclonus of infancy
7.	Propriospinal myoclonus at sleep onset
8.	Sleep-related movement disorder due to a medical disorder
9.	Sleep-related movement disorder due to a medication or substance
10.	Sleep-related movement disorder, unspecified

494

## 495 **Restless-leg Syndrome**

496 RLS, or the Willis Ekbom syndrome, is a group of chronic neurological-disorders  
497 characterized by feeling of discomfort in the legs and an uncontrollable-need to  
498 move them.

499 A family-history is found in 72 % of cases with the mother three times more likely  
500 to suffer from the disorder than the father [44]. The mode of inheritance is  
501 complex.

502 Iron stores may be low. Diabetes mellitus, end-stage renal disease, cancer,  
503 rheumatoid arthritis, hypothyroidism and pregnancy may be associated, as well as  
504 drugs like nicotine, antihistamines, tricyclic antidepressants, selective serotonin  
505 reuptake inhibitors, cimetidine and caffeine [45, 46].

506 RLS is underdiagnosed in children, often mistaken as growing-pains. It is seen in  
507 1-6% of children. It is more common in females. There is association with  
508 negative behavior and mood, and decreased cognition and attention. Greater  
509 prevalence of RLS is seen in those with attention-deficit/ hyperactivity disorder  
510 (ADHD).

511 The symptoms are worse when resting and in the evening or bedtime, and when  
512 travelling in a car for prolonged periods. These are partially relieved by movement  
513 such as stretching, walking, rubbing or massage [45].

514 Children wake up frequently from sleep, and may be tired and inattentive during  
515 the day.

516 The International Restless Legs Study Group [47] (IRLSSG) reviewed the 1995  
517 diagnostic-basis (criteria)for RLS and developed new consensus. These are shown  
518 in Table 3 here below. The separate set for the diagnosis of RLS in children, found  
519 in ICSD-2, has been eliminated. Pediatric diagnostic-considerations are discussed  
520 in the ICSD-3 developmental-section of RLS [43].

521 **Table 3: International Restless Legs Syndrome Study Group consensus**  
522 **diagnostic criteria for restless legs syndrome**

1.	Urge to move legs, usually but not always, accompanied by or felt to be caused by uncomfortable and unpleasant sensations in the legs
2.	Urge to move legs, and any accompanying unpleasant sensations begin or worsen during periods of resting or inactivity such as lying down or sitting
3.	Urge to move legs, and any accompanying unpleasant sensations are partially or totally relieved by movement, such as walking or stretching, at least while activity continues
4.	Urge to move legs, and any accompanying unpleasant sensations during resting or inactivity only seen or are worse in the evening or night rather than during the day

5.	Finding above manifestations are not solely accounted for as symptoms primary to different medical or a behavioral condition (e.g., myalgia, venous stasis, leg edema, arthritis, leg cramps, positional discomfort, habitual foot tapping)
----	---

523

524 Diagnosing RLS in children can be difficult as it depends on the patient’s ability to  
 525 describe core-symptoms. Diagnosis can be made if the history is consistent with  
 526 the condition, and at least two of the following are present [6]:

- 527 • a sleep disturbance,
- 528 • a first-degree relative with RLS, or
- 529 • five or more periodic limb-movements per hour of sleep during poly-  
 530 sonography

531

532 Conservative treatment includes avoiding exacerbating factors.

533 With Periodic Limb Movements (PLMs) < 5 per hour, no treatment is  
 534 recommended. With PLMs greater than 5 per hour, the decision to treat depends on  
 535 nocturnal-symptoms and daytime-sequel[45].

536 The acronym AIMS represents the approach to treatment of RLS:

- 537 A: avoidance of exacerbating factors – caffeine, drugs
- 538 I: Iron supplement when indicated if serum ferritin < 50 ng/ml. Ferrous sulfate 3-6  
 539 mg/kg/day for duration of 3 months is adequate.
- 540 M: Muscle activity, increased physical activity, muscle relaxation, hot or cold  
 541 compresses
- 542 S: Sleep – regular and appropriate sleep-for-age

543

544 There aren’t any medications approved for treating restless legs syndrome in  
 545 children. But drugs that increase CNS dopamine levels, such as ropinirole and  
 546 pramipexole are found effective in adults [45].

547 **Periodic Limb Movement Disorder**

548 Periodic limb-movement disorder (PLMD), previously known as sleep-myoclonus  
 549 or nocturnal-myoclonus, comprises repetitive limb-movements during sleep that  
 550 disrupt sleep. Usually involves the lower-limbs, rarely the upper-extremities. The

551 movements may involve extension of the big-toe, or flexion of ankle, knee and hip.  
552 The movements happen during light non-REM sleep, are repetitive and are  
553 separated by intervals of 5-90 seconds with night-to-night variability in the  
554 frequency of limb-movements. PLMD may be asymptomatic [48]. Patients are  
555 usually not aware until a parent, family-member or partner calls attention to the  
556 limb-jerks, restless-sleep, moving-around or falling-out of bed. Frequent  
557 awakenings, non-restorative sleep, daytime-fatigue, daytime-sleepiness are the  
558 usual symptoms [45].

559 Prevalence of PLMD is not known but it can be found at any age – and, not  
560 gender-related. It is found in 80% of those with RLS and in 30% of those aged >  
561 65 years. It is found commonly together with narcolepsy and REM behavior-  
562 disorder, OSA and during PAP-therapy. The associated medical-conditions are  
563 uremia, diabetes mellitus, OSA, and spinal cord injury. Symptoms may be  
564 aggravated by antihistamines, antidepressants, and antipsychotics.

565 PLMD is diagnosed when the following are present [48 – 49]:

- 566 1. PLMs documented by polysomnography
- 567 2. PLMs exceeds norms for age (>5/h for children),
- 568 3. Clinical sleep-disturbance or daytime-fatigue
- 569 4. Absence of any different primary sleep-disorder or reason for PLMS, including  
570 RLS and OSA

571

572 Diagnostic-workup includes a good clinical-history and a thorough neurological-  
573 examination, followed by an overnight-polysomnogram (PSG). Respiratory-  
574 monitoring is required to rule out sleep-disordered breathing as a cause. Thyroid  
575 function, magnesium levels, folic acid, and vitamin B<sub>12</sub> levels need to be  
576 determined [50 - 51].

577 Avoidance of caffeine, chocolate, tea, coffee, soft drinks is needed.

578 Antidepressants can cause worsening. Regular and appropriate sleep-for-age is  
579 encouraged. Dopamine-agonists are used as the first-line of defense; various drugs  
580 including anticonvulsants, benzodiazepines, and narcotics are used. No cure is  
581 available - medical treatment needs to be continued for relief [50 - 51].

## 582 **Central disorders of Hyper-somnolence**

583 The International Classification of Sleep Disorders characterizes central-disorders  
584 of hypersomnolence (CDH) by their feature of excessive daytime-sleepiness (EDS)

585 or hypersomnolence that is defined as daily-episodes of an irrepressible-need to  
586 sleep or daytime-lapses into sleep that is not attributable to the different sleep-  
587 disorders, e.g., sleep-related breathing-disorders or abnormalities of circadian-  
588 rhythm, and interferes with normal daily-functioning [43].

589 In classifying, CDHs are commonly caused by:

590

- 591 1. Intrinsic-abnormalities of the CNS that controls the sleep-wake mechanism,  
592 e.g. narcolepsy and idiopathic hypersomnia (IH).
- 593 2. Extrinsic-causes, e.g. Kleine-Levin syndrome, hypersomnia due to medical  
594 or psychiatric disorders, ingestion of medications or substances, and  
595 insufficient-sleep syndrome [43]

596 Diagnosis of narcolepsy and idiopathic hypersomnia (IH), requires demonstration  
597 of objective-sleepiness by the Multiple Sleep Latency Test (MSLT). A mean sleep-  
598 latency of 8 min on the MSLT is required for diagnosis. This criterion remains  
599 unchanged from the ICSD-2 [52 – 53]. Care needs to be exercised when making  
600 the diagnosis, since abnormal MSLT-findings may be present in actually normal,  
601 sleep-deprived subjects, especially those with longer sleep-requirements [54].  
602 Conversely, some with genuine CDH may not achieve MSLT latencies of 8 min  
603 [55]. This test could be repeated subsequently to confirm objective-a sleepiness.

604

605

## 606 **Narcolepsy**

607 Narcolepsy is characterized by the classic tetrad of excessive daytime-sleepiness  
608 (EDS), cataplexy (brief sudden loss of muscle tone), hypnagogic/hypnopompic  
609 hallucinations, and sleep-paralysis. Children rarely manifest all four (4) symptoms  
610 [56, 57].

611 Diagnosis requires EDS-presence, that is the primary symptom of narcolepsy, to be  
612 present for at least 3 months. Severe EDS leads to involuntary-somnolence that  
613 interferes with normal-functioning such as working, walking, driving, eating, or  
614 talking. Sleep-attacks characterized by regular severe sudden-episodes of falling  
615 asleep are seen.

616 Mild catalepsy presents with partial-loss of tone, e.g. head-nodding, altered-speech  
617 or knee-buckling, while severe-disease is generalized and leads to falls.

618 Respiration and extra-ocular movements are spared. Attacks may be triggered by  
619 emotions such as laughter or anger [56, 57].

620 Sleep-paralysis manifests as the inability to move upon awakening, or less  
621 commonly, upon falling asleep with consciousness intact. Such may be  
622 accompanied by hallucinations. The paralysis happens not so frequently when the  
623 sleeping-position is uncomfortable. It does not affect the respiratory or extra-ocular  
624 muscles, and can be relieved by sensory-stimuli, e.g. touching or speaking to the  
625 affected-person [56, 57].

626 The main-symptoms of narcolepsy in children are restlessness and motor over-  
627 activity, accompanied by academic-deterioration, inattentiveness, and emotional-  
628 lability. At early stages, children with narcolepsy and cataplexy display a wide  
629 range of atypical cataleptic motor-disturbances like hypotonia or active perioral-  
630 movements, dyskinetic-dystonic, or stereotypic-movements.

631 Cataplectic-facies have been described in children with narcolepsy and cataplexy,  
632 usually at disease-onset. The typical facies include repetitive mouth-opening,  
633 tongue-protrusion, and ptosis. The usual triggering-emotions, such as laughter or  
634 joking, are not always present, causing difficulty with diagnosis [57].

635 Physical-examination findings are normal in patients with narcolepsy. A careful  
636 neurologic-examination is needed to exclude different causes. Obesity may be  
637 associated with the disorder. During a typical episode of cataplexy, patients  
638 typically demonstrate atonia of muscles of the limbs and neck and loss of deep-  
639 tendon reflexes [57].

640 **In differential-diagnosis, Idiopathic hypersomnia (IH)** and narcolepsy present  
641 similarly and can be difficult to distinguish. But, IH does not have sleep-onset  
642 rapid eye movement (REM) period, and the naps are unrefreshing. In addition, IH is  
643 not associated with cataplexy [57 - 58]

644 As part of investigations, an overnight poly-somnogram (PSG) followed by a  
645 MSLT provides strong evidence of narcolepsy, while excluding the different sleep-  
646 disorders such as IH.

647 Measurement of hypocretin (orexin) concentration in the cerebrospinal-fluid (CSF)  
648 may help establish the diagnosis of **narcolepsy when the** concentration is lower  
649 than 110 pg/mL, but, high CSF hypocretin **concentration does not** exclude the  
650 diagnosis [59].



651 Imaging-studies are generally unrevealing, but MRI is useful in excluding rare-  
652 cases of symptomatic-narcolepsy. Structural-abnormalities of the brain-stem and  
653 diencephalon may present as idiopathic-narcolepsy. In patients with secondary-  
654 narcolepsy, MRI of the brain may show abnormalities depending on the underlying  
655 cause.

656 Human leukocyte-antigen (HLA) typing is more useful for excluding the diagnosis  
657 if the patient does not have either DQB1\*0602 or DQA1\*0602, but is not so  
658 valuable for confirming the diagnosis, since HLA-DR2 and DQw1 are present in  
659 20-30% of the general population.

660 An individualized multidisciplinary approach is recommended in treatment of  
661 narcolepsy.

662 **1. Sleep hygiene**

663 Most patients benefit from a regular nightly sleep-schedule of 7.5-8 hours,  
664 and scheduled-naps during the day.

665 **2. Diet & activity**

666 Avoiding heavy-meals, and diets high in refined-sugars, may improve  
667 daytime-sleepiness. Participating in an exercise-programs helps. There is  
668 need to avoid driving, operating heavy-machinery, or undertaking  
669 potentially hazardous-activity that may place lives at risk. There is a need to  
670 wear a life-preserver when involved in water-activities and never to perform  
671 water-activities solo. There is a need to educate the group about narcolepsy  
672 and cataplectic attacks and to refrain from activities when feeling drowsy.  
673

674 **3. Pharmacologic treatment**

675 Presently, there isn't any FDA-approved pharmacotherapy available for  
676 children with narcolepsy. But, medications, methylphenidate and modafinil  
677 have proved effective in children 6-15 years old [60].  
678

679 **4. Non-pharmacologic measures**

680 This includes emotional support, career or vocational counseling, assisting  
681 with documentation for educational-enrolment, insurance, disability-forms,  
682 and attaining a driver's license. There is a need to inquire about high-risk  
683 behaviors such as alcohol and drug use that could exacerbate symptoms,  
684 depression, family-conflict, and various psychosocial-problems  
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## 5. Long-term monitoring

Children with narcolepsy need to be followed up by both the primary-pediatrician, pediatric-neurologist, and sleep-medicine specialist when available for monitoring drug-effectiveness, response to treatment, and potential adverse drug-outcomes. This should be done annually, and every 6 months if the patient is on a stimulant. He should also contact a narcolepsy support-group for support.

## Delayed sleep-phase disorder

697  
698 In older children and after, early-morning wakening may be part of an anxiety or  
699 depressive-disorder. If not, the child could have been woken-up too early by noise,  
700 or various different environmental-factors which intrude into her/his sleep [1, 4 -  
701 5].

702 The generally very efficient sleep of pre-pubertal children changes to not so  
703 satisfactory sleep in adolescence for both physiological and psychosocial reasons  
704 [1, 4 - 5].

705 Worries, anxiety, and depression are commonly-quoted reasons for the difficulty in  
706 sleeping at this age. Nicotine, alcohol, and caffeine-containing drinks, besides  
707 illicit-drug use, are additional possible influences [1, 4 - 5].

708 But, inability to get off to sleep and to wake up in the morning is frequently part of  
709 the Delayed Sleep Phase Syndrome (DSPS), which was discussed earlier. This  
710 condition, which particularly common in adolescence, potentially very much  
711 disrupts education and social-mingling. As such, it needs be discussed further.  
712 DSPS is commonly misconceived as not a sleep-disorder.

713 The problem usually arises from the sleep-phase delay at puberty, besides  
714 habitually staying-up late for social or such reasons, especially on weekends or  
715 during holidays. The result is that it becomes not possible to go to sleep earlier by  
716 choice [1, 4 - 5].

717 The manifestations of DSPS are persistently severe difficulty getting to sleep  
718 (possibly until well into the night), uninterrupted sound-sleep for just a few hours,  
719 but then great difficulty getting up for school, college, or work because of not  
720 having enough sleep. This causes sleepiness and under-functioning, especially

721 during the first part of the day. The abnormal sleep-pattern is maintained by  
722 sleeping in very late when able to do so on weekends and during holidays [1, 4 -  
723 5].

724 “Chronotherapy” includes gradually changing the sleep-phase to an appropriate-  
725 time. In cases where the phase-delay, is about 3 hours (or less), bedtime can be  
726 gradually brought forward. More severe-forms of the disorder require progressive  
727 sleep-phase delay in 3-hour steps round the clock until a satisfactory-timing is  
728 achieved which then needs to be fixed [1, 4 - 5].

729 Additional measures to maintain the improved sleep-schedule include early-  
730 morning exposure to bright-light and firm-agreement with the adolescent to  
731 maintain a new pattern of social-activities and sleep. Melatonin in the evening may  
732 also help [1, 4 - 5].

733 Difficulties achieving and maintaining an improved sleep-wake schedule by these  
734 means are compounded if there is a vested-interest in maintaining the abnormal  
735 sleep-pattern, for example, to avoid school (“motivated sleep phase delay”).  
736 Psychological problems, including depression, may impede treatment success. The  
737 teenager's reluctance to go to bed earlier and to get up at the required time is  
738 frequently misinterpreted as “typical difficult adolescent behavior” causing trouble  
739 in the family. If not, the condition could be mistakenly viewed as the usual form of  
740 school non-attendance, primary-depression, or substance-misuse [1, 4 - 5].

#### 741 **Parasomnias**

742 Parasomnias are repetitive unusual behaviors or strange experiences that happen  
743 just before, during, or arising out of sleep, or on waking. The many parasomnias  
744 (some primary sleep-disorders, others secondary to medical or psychiatric-  
745 conditions) now officially recognized (over 30 in ICSD-2) indicate how commonly  
746 and in many ways (some subtle, others dramatic) sleep can be disturbed by  
747 episodic-events [1, 4 - 5].

748 Confusing between the different parasomnias seems common. For example, in  
749 pediatric textbook-accounts, sleep-terrors and nightmares (two very different types  
750 of parasomnia) are mistaken (for one another). Indeed, sometimes there is an  
751 inclination to call all dramatic-parasomnias a nightmare. Correct diagnosis is very  
752 necessary because different parasomnias each have an own significance, and call  
753 for contrasting-types of advice and treatment. The following brief-account is  
754 concerned with the main-manifestations to be recognized in reaching the correct

755 diagnosis. Emphasis is placed on just some of the more dramatic parasomnias  
756 (namely arousal disorders, nightmares, and sleep-related epileptic seizures) as  
757 these frequently cause most confusion and concern [61]. Frequently, an accurate  
758 diagnosis can be made by means of a detailed-account of the subjective and  
759 objective sequence of happenings from the onset of the episode to its resolution,  
760 and of the circumstances in which the episode happened, including its duration and  
761 timing. Audiovisual-recording (including by means of home-recording by parents)  
762 can be very informative and frequently adds details that are missed in descriptions  
763 given at consultation [1, 4 - 5].

764 For the most part (seizure-disorders generally being a main exception),  
765 physiological-recordings are required only when clinical evaluation is inconclusive  
766 or where the child might have more than one type of parasomnia. The meaning of  
767 the three categories is as follows [1, 4 - 5].

768 The term “arousal disorders” refers to childhood confusional-arousals,  
769 sleepwalking (calm and agitated forms of which are described) and sleep-terrors.  
770 Nightmare is the proper better term. As sleep-related epilepsy covers a number of  
771 seizure-disorders of different types, permissible-generalizations are limited [1, 4 -  
772 5].

773 The following types of epilepsy are, to varying degrees, related to sleep. The first  
774 four (4) types have been classified as benign in the sense that, despite the focal-  
775 origin in the brain, such are not typically the result of a structural abnormality and  
776 can be generally expected to remit spontaneously in time [62]. All five types can  
777 readily be confused with non-epileptic-parasomnias as their clinical-manifestations  
778 can be complex and dramatic.

779 Benign partial-epilepsy with Centro-temporal-spikes (Rolandic epilepsy) is a  
780 frequent form of childhood-epilepsy where 75% of patients have their seizures  
781 entirely during sleep. The seizures involve distressing oropharyngeal-facial  
782 movements and sensations in line with the anatomical-origin of the seizure some  
783 doubt exists about their entirely benign-nature [63].

784 Apparent terror and screaming happen in benign-epilepsy with affective-symptoms  
785 [64].

786 The child's reactions to the complex visual-experiences (including hallucinations)  
787 that can happen in benign occipital-epilepsy may involve dramatic-behavior.

788 In the Panayiotopoulos syndrome, seizures frequently involve distressing vomiting  
789 and various autonomic symptoms.

790 Nocturnal frontal-lobe epilepsy (NFLE) deserves special-mention because its  
791 clinical-manifestations make it particularly prone to misinterpretation as  
792 parasomnias. This also happens in children, although this is mainly described in  
793 adults [65].

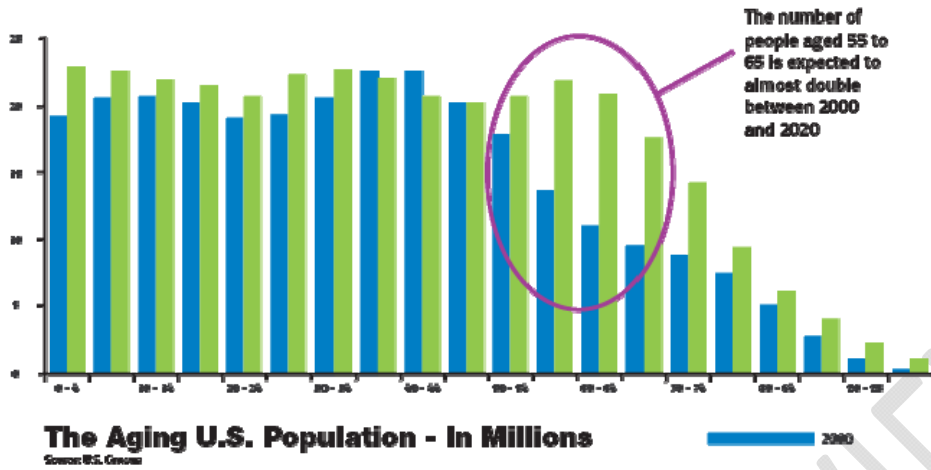
794 It is now realized that NFLE can present in a variety of forms [66], but a usual  
795 variety is frequently misdiagnosed mainly because the complicated motor-  
796 manifestations (eg kicking, hitting, rocking, thrashing, and cycling or scissor  
797 movements of the legs) and vocalizations (from grunting, coughing, muttering or  
798 moaning to shouting, screaming, or roaring) that characterize many attacks. As  
799 such, these are very different from the various seizure-types. The abrupt onset and  
800 termination, short-duration of the attacks (different from seizures of temporal lobe  
801 origin) and, sometimes, preservation of consciousness can also suggest a non-  
802 epileptic (even attention-seeking) basis for the attacks.

803 In the first instance, diagnosis is based on being knowledgeable of this form of  
804 epilepsy and recognition of its clinical-manifestations. EEG-recordings, even  
805 during the episodes, are of limited diagnostic-value.

806 The distinction between epilepsy and the different parasomnias is not without  
807 difficulty. Recently, the Bologna's group of clinical-researchers attempted to set  
808 out clearly the (mainly clinical) criteria for distinguishing between NFLE and the  
809 various parasomnias [67].

## 810 **The Epidemiology and Disease-burden of Sleep-disorders in Children**

811 The Figure 2 below shows the age-composition of the US population in the years  
812 2000 and 2020. About 20% of adults and about 30% of children and adolescents  
813 are found to have sleep-disorders.



814

815

816 **Fig 2. The Population of the US by Age-group, 2000 and 2020**

817

818 The following figures, 3 – 5, illustrate the economic-burden of sleep-disorders.

819



820

821

822 **Fig 3. Map showing economic costs of insufficient sleep across five OECD**  
 823 **countries**

824

	Costs (millions \$)
Substances used for insomnia	
Prescription medications	809.92
Nonprescription medications	325.80
Alcohol	780.39
<a href="#">Melatonin</a>	50.00
<b>Total Cost of Substances</b>	<b>1,966.11</b>
Health care services for insomnia	
Outpatient physician visits	660.00
Psychologist visits	122.40
Social working visits	75.30
Sleep specialist visits	18.20
Mental health organizations	153.00
In-patient hospital care	30.80
Nursing home care	10,900.00
<b>Total</b>	<b>11,960.70</b>
<b>Total direct costs</b>	<b>13,926.11</b>

825

826

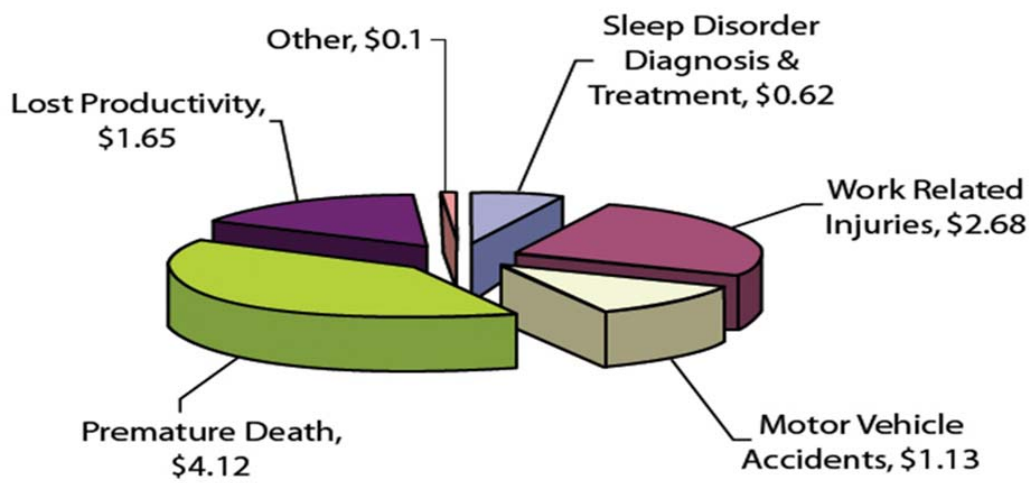
827 **Fig 4. Table showing The Direct Costs of Insomnia in the US, 1995**

828 In view of the morbidity, mortality, loss of Quality of Life, and Disease-burden  
829 including economic-cost of sleep-disorders, cost-effective Prevention Programs,  
830 touching upon Primary, Secondary and Tertiary Prevention need to be planned,  
831 implemented and evaluated. Such Programs need to educate parents, would-be  
832 parents, teachers and health-care professionals.

833



Composition of the Costs of Sleep Disorders  
(\$ Billions p.a.) in Australia



834

835 **Fig. 5. The Composition of the Costs of Sleep-disorders in Australia**

836 **Conclusion**

837 The considerable amount of knowledge accumulated in recent times on the  
838 pediatric aspects of sleep and its disorders remain under-utilized.

839 Health-education for parents and prospective-parents frequently pay little attention  
840 to sleep.

841 Medical-students and specialist-trainers including pediatricians and child-  
842 psychologist and teachers require better instruction/educationsince all these come  
843 in contact with many children and adolescents whose sleep is disturbed, sometimes  
844 with serious consequences. Doctors need to ask the patients additional questions  
845 about sleep towards better accuracy of diagnosis.

846 Adolescents need to be taught and advised to sleep adequately and avoid extensive  
847 television-viewing and recreational computer-use.

848 The pattern of sleep-behaviors and disorders differs between children and adults.  
849 Some sleep-disorders previously thought to be seen mainly or exclusively in adults  
850 are now being recognized in children.

851 The cause of sleep-problems at any age are both physical and psychological  
852 possibilities (perhaps in combination). In children, as in adults, neurological,  
853 respiratory, metabolic, endocrine, genetic, medication, and additional physical  
854 factors can influence.

855 Parenting practices play a major part in many children's sleep-problems due to  
856 reasons that parental knowledge, attitudes, and emotional state frequently  
857 determine whether a child's sleep-pattern is a problem or not.

858 Whereas obesity is a common feature of obstructive sleep apnea (OSA) in adults,  
859 enlarged tonsils and adenoids are usually responsible in children. Although obesity  
860 is becoming an increasingly important factor at all ages, **only a minority of**  
861 **children with OSA are** overweight and indeed very early onset may cause low body  
862 weight from failure to thrive.

863 Adult OSA generally causes sleepiness and reduced activity. In contrast (as in  
864 other causes of excessive sleepiness such as narcolepsy), some sleepy children are  
865 abnormally active.

866 Since persistent sleep-disturbance can have harmful-outcome on mood, behavior,  
867 performance, social-function, and (sometimes) physical-health due to impaired  
868 concentration, memory, decision-making, and general ability to learn in addition to  
869 impaired motor-skill and impaired reaction-time such could have particularly  
870 serious-consequences in young-people. In addition to that, deficient-treatment  
871 (management) of childhood sleep-problems could persist in adult-life.

872 Treatment of most children's sleep-disorders is, in principle, straightforward and  
873 likely to be effective if appropriately selected and implemented with earnestness  
874 but many parents are unaware of frequently simple-ways in which sleep-problems  
875 in young children could be prevented or minimized in the manner parents deal with  
876 children at bedtime or during the night.

877 Medication has a smaller part to play in children than it has in adults – behavioral-  
878 methods being found additionally appropriate and effective.

879 Since changes of behavior could result from sleep-disturbance, the affected-child's  
880 interpersonal-problems may extend beyond the family. Irritable, difficult, or  
881 disturbed-behavior could affect friendships and relationships with pedagogues  
882 could also suffer.

883 In view of these various potential-complications to the child's life everyone  
884 concerned must realize such could be at least partly be the result of sleep-  
885 disturbance to which effective-treatment exists in most instances.

886 In view of the morbidity, mortality, loss of Quality of Life, and Disease-burden  
887 including economic-cost of sleep-disorders, cost-effective Prevention Programs,

888 touching upon Primary, Secondary and Tertiary Prevention need to be planned,  
889 implemented and evaluated. Such Programs need to educate parents, would-be  
890 parents, teachers and health-care professionals.

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