

## 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.

### 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.

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

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

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

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

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

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

45 The authors mainly discuss:

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

### 53 **Conclusion and Recommendations**

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

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

61

62

## 63 **Introduction**

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

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

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

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

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

86 **Such patients suffer from chronic sleepdisorders affecting dailyfunctioning and**  
87 **negatively affecting health and longevity, all of which is made worse with an**  
88 **ageing population.(NHLBI 2003) [4, 5].**

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

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

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

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

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

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

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

104

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

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

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

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

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

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

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

124

125

## 126 **Methodology**

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

## 129 **Discussion**

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

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

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

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

151 In finding an explanation for sleep-problems at any age a bio-psychosocial  
152 approach should be considered whereby physical, psychological and social factors  
153 are considered. In children, as in adults, neurological, respiratory, metabolic,  
154 endocrine, genetic, medication, or more physical-factors may have an influence.  
155 Besides that, parenting-practices play a big part in many **children's** sleep-problems.  
156 Parental knowledge, attitudes, and emotional state frequently decide whether a  
157 child's sleep pattern is a problem or not. Certain parents perceive normal behavior  
158 as a problem, while many do not seek help when they should, mistakenly  
159 thinking there is no treatment available [1 – 3].

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

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

170 There remains a risk that a few sleepdisorders will be misdiagnosed at any age.  
171 Possibly, this risk is greater in children than adults because of the widerrange of  
172 clinicalmanifestations and alternativeexplanations for the behavioralchanges  
173 involved both as primarymanifestations of the sleep-disorder but also because of  
174 secondarycomplications. Narcolepsy is an example. Diagnostic-problems could  
175 also arise becausepolysomnography (PSG) basis for OSA and narcolepsy  
176 diagnoses are not very clear-cut and are different compared with adult-patients [1 –  
177 3].

178 Many childhood sleepdisorders frequently resolve spontaneously unlike in adults.  
179 But in the meantime (as at any age), persistent sleepdisturbance can bring about  
180 harmful outcomes on mood, behavior, performance, socialfunction, and possibly,  
181 physicalhealth. Inadequate management of childhood sleep-problems can also be  
182 persistent into adult-life [1 – 3].

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

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

189 Managing most sleepdisorders in children is, in principle, straightforward and  
190 likely to be effective if appropriately chosenand implemented with much thought  
191 [1 – 3].

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

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

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

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

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

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



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

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

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

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

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

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

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

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

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

258 There is convincing evidence that insufficient-sleep can impair concentration,  
259 memory, decision-making, and general ability to learn. Performance on tasks

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

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

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

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

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

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

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

### 283 **Sleep loss and physical health**

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

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

292                   • Alcohol use

293

294

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

### 297 **Sleep-loss Is Associated with Obesity**

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

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

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

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

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

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

311 Sleep-loss and sleep-complaints are associated with heart-attacks (myocardial  
312 infarction) and perhaps stroke, according to several large epidemiological-studies  
313 [21 - 26].

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

317

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

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

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

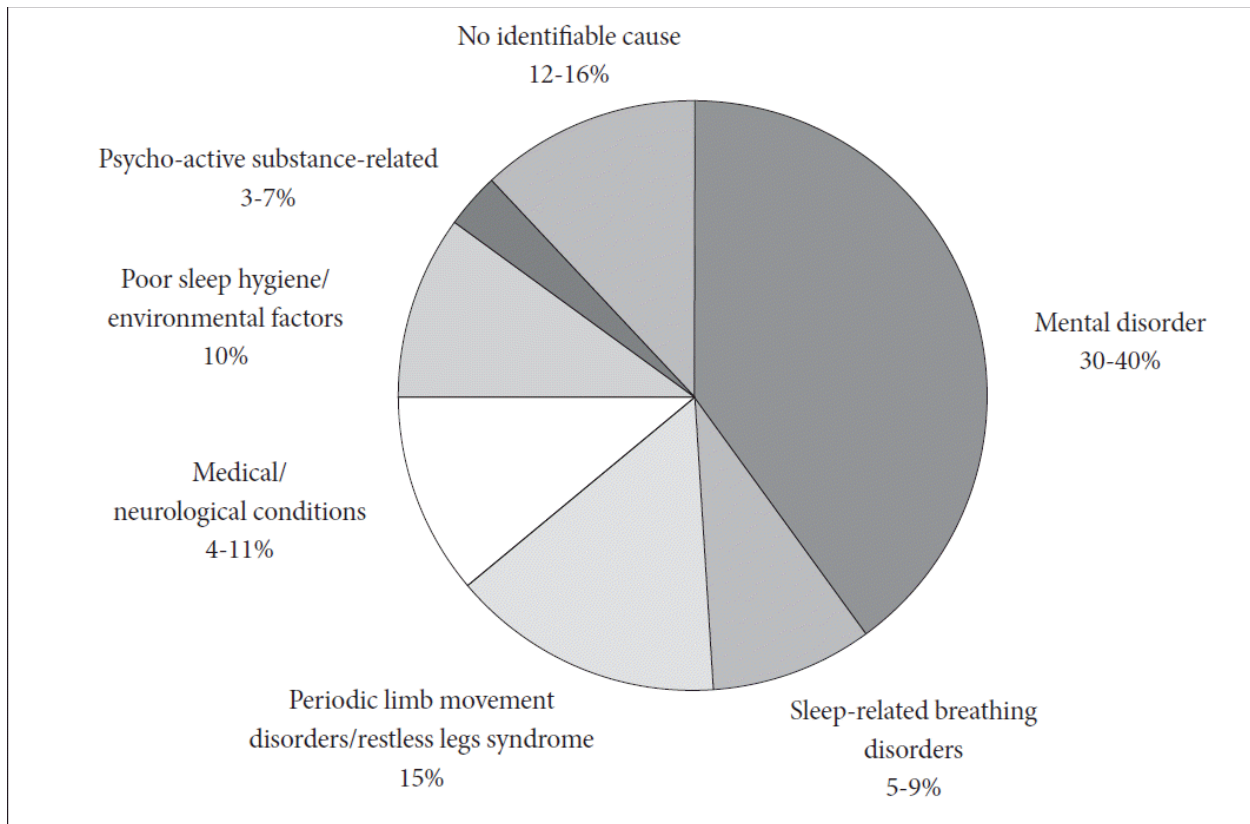
325 Several studies of adolescents, including one with more than 3,000 high-school  
326 students, found that inadequate-sleep is associated with higher-levels of depressed-  
327 mood, anxiety, behavior-problems, lower self-esteem and alcohol use [30, 32], and  
328 attempted suicide [33].

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

332  
333 There are various classifications of Sleep-disorders including the International  
334 Classification of Sleep-disorders (ICSD) [6].A modified-version found in the  
335 Nelson Textbook of Pediatrics 20e. 2016 classifies Common Sleep Disorders in  
336 Children as [34]:

- 337  
338 1. Insomnia of childhood
- 339  
340 2. Obstructive sleep apnea
- 341  
342 3. Para-somnias
- 343  
344 4. Sleep-related movement disorders: Restless legs syndrome/periodic limb  
345 movement disorder and rhythmic movements
- 346  
347 5. Narcolepsy
- 348  
349 6. Delayed sleep phase disorder

350



351  
352

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

353

### **Insomnia of childhood**

354

355

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].

356

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].

357

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

358

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

377  
378 Idiopathic insomnia frequently begins at an early-age and may continue throughout  
379 life. Its cause is unknown but there have been some suggestions that it might be  
380 caused by a neuro-chemical imbalance in the brainstem reticular-formation,  
381 impaired regulation of brainstem sleep-generators and basal-forebrain dysfunction  
382 [1].

383  
384 Primary insomnia is when the underlying-cause is not due to either medical or  
385 psychiatric disorders. Patients complain of difficulty in initiating or maintaining  
386 sleep. Such patients are also preoccupied with getting enough sleep and may  
387 become distressed when this does not happen - in turn causing further stress [1].

388  
389 Managing insomnia depends upon the duration of the affliction and how severe it  
390 is. In brief-episode insomnia, specific-treatments more than simple-advice may not  
391 be necessary. When treatment using sedative-hypnotics is needed, it must be done  
392 through good-understanding by the patients that the treatment is of a short-duration  
393 [1].

394  
395 For longer-duration primary insomnia, it usually improves with sleep-hygiene and  
396 relaxation-therapy. Pharmacological-treatment such as benzodiazepines, sedating-  
397 antidepressant and zolpidem can be prescribed - but (because of side-effects) be  
398 used for short-durations only and prescribed only when psychological-treatment  
399 alone does not help the patient's condition [1].

400  
401 One manner in which a sleep-disorder such as insomnia can be managed is by  
402 sleep-hygiene, which comprises a number of strategies commonly applied to foster  
403 good sleeping-habits. Such strategies include limiting the use of mobile-phones  
404 and various yet technological-equipment a few hours before bedtime, and not  
405 engaging in strenuous physical-activity. In cases where sleep-hygiene does not  
406 work, a referral to a psychologist may also be appropriate. Additional treatment  
407 includes the use of sleep-diaries which can be used to measure the patient's  
408 understanding of sleeping-habits, besides providing an opportunity for formulating  
409 a discussion about specific underlying-matters related to the patient's complaint  
410 and condition. Psychological-treatment is often used alongside pharmacological-  
411 treatment, such as those described above [1].

## 412 **Obstructive sleep apnea**

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

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

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

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

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

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

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

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

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

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

- 442 • Medications. Topical nasal steroids, such as fluticasone (Dymista, Flonase  
443 Allergy Relief, Xhance,) and budesonide (Rhinocort), eases sleep-apnea

444 symptoms for some children with mild, obstructive sleep-apnea. For children  
445 with allergies, montelukast (Singulair) helps relieve symptoms when used  
446 alone, or with nasal-steroids.

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

467  
468 The CHAT Study (Marcus CL 2013) showed that in comparing a plan of  
469 watchful-waiting, surgical-treatment for the obstructive sleep apnea  
470 syndrome (OSAS) in school-age children did not significantly improve  
471 attention or executive-function as measured by neuropsychological-testing,  
472 but did reduce symptoms and improve secondary-outcomes of behavior,  
473 quality of life, and polysomnographic findings - thus providing evidence of  
474 beneficial outcomes of early adeno-tonsillectomy[41].

475  
476 The Tucson Children's Assessment of Sleep Apnea Study (TuCASA)  
477 (Budhiraja R and Quan SF, 2009) is a longitudinal cohort-study of 503 6-12  
478 year old Caucasian-children and Hispanic-children who had  
479 polysomnography and neurocognitive testing initially. Subsets of the cohort  
480 had additional MRI-imaging and pulmonary physiologic-testing. Cross-



481 sectional analyses indicated that Sleep-disordered Breathing (SDB) is  
482 associated with behavioral-abnormalities, hypertension, learning-problems  
483 and clinical-symptoms such as snoring and excessive daytime-sleepiness.  
484 The Study feels future follow-up of the cohort will assess the impact of SDB  
485 on subsequent childhood-development [42].  
486

## 487 **Sleep-related Movement Disorders**

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

490 **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

491

## 492 **Restless-leg Syndrome**

493 RLS, or the Willis Ekbom syndrome, isa group of chronic neurological-disorders  
494 characterized by feeling of discomfort in the legs and an uncontrollable-need to  
495 move them.

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

499 Iron stores may be low. Diabetes mellitus, end-stage renal disease, cancer,  
500 rheumatoid arthritis, hypothyroidism and pregnancy may be associated, as well as

501 drugs like nicotine, antihistamines, tricyclic antidepressants, selective serotonin  
502 reuptake inhibitors, cimetidine and caffeine [45, 46].

503 RLS is underdiagnosed in children, often mistaken as growing-pains. It is seen in  
504 1-6% of children. It is more common in females. There is association with  
505 negative behavior and mood, and decreased cognition and attention. Greater  
506 prevalence of RLS is seen in those with attention-deficit/ hyperactivity disorder  
507 (ADHD).

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

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

513 The International Restless Legs Study Group [47] (IRLSSG) reviewed the 1995  
514 diagnostic-basis (criteria) for RLS and developed new consensus. These are shown  
515 in Table 3 here below. The separate set for the diagnosis of RLS in children, found  
516 in ICSD-2, has been eliminated. Pediatric diagnostic-considerations are discussed  
517 in the ICSD-3 developmental-section of RLS [48].

518 **Table 3: International Restless Legs Syndrome Study Group consensus**  
519 **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)
--

520

521 Diagnosing RLS in children can be difficult as it depends on the patient's ability to  
522 describe core-symptoms. Diagnosis can be made if the history is consistent with  
523 the condition, and at least two of the following are present [49]:

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

528

529 Conservative treatment includes avoiding exacerbating factors.

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

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

534 A: avoidance of exacerbating factors – caffeine, drugs

535 I: Iron supplement when indicated if serum ferritin < 50 ng/ml. Ferrous sulfate 3-6  
536 mg/kg/day for duration of 3 months is adequate.

537 M: Muscle activity, increased physical activity, muscle relaxation, hot or cold  
538 compresses

539 S: Sleep – regular and appropriate sleep-for-age

540

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

#### 544 **Periodic Limb Movement Disorder**

545 Periodic limb-movement disorder (PLMD), previously known as sleep-myoclonus  
546 or nocturnal-myoclonus, comprises repetitive limb-movements during sleep that  
547 disrupt sleep. Usually involves the lower-limbs, rarely the upper-extremities. The  
548 movements may involve extension of the big-toe, or flexion of ankle, knee and hip.  
549 The movements happen during light non-REM sleep, are repetitive and are

550 separated by intervals of 5-90 seconds with night-to-night variability in the  
551 frequency of limb-movements. PLMD may be asymptomatic [50]. Patients are  
552 usually not aware until a parent, family-member or partner calls attention to the  
553 limb-jerks, restless-sleep, moving-around or falling-out of bed. Frequent  
554 awakenings, non-restorative sleep, daytime-fatigue, daytime-sleepiness are the  
555 usual symptoms [45].

556 Prevalence of PLMD is not known but it can be found at any age – and, not  
557 gender-related. It is found in 80% of those with RLS and in 30% of those aged >  
558 65 years. It is found commonly together with narcolepsy and REM behavior-  
559 disorder, OSA and during PAP-therapy. The associated medical-conditions are  
560 uremia, diabetes mellitus, OSA, and spinal cord injury. Symptoms may be  
561 aggravated by antihistamines, antidepressants, and antipsychotics.

562 PLMD is diagnosed when the following are present [50 – 51]:

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

568  
569 Diagnostic-workup includes a good clinical-history and a thorough neurological-  
570 examination, followed by an overnight-polysomnogram (PSG). Respiratory-  
571 monitoring is required to rule out sleep-disordered breathing as a cause. Thyroid  
572 function, magnesium levels, folic acid, and vitamin B<sub>12</sub> levels need to be  
573 determined [52 - 53].

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

575 Antidepressants can cause worsening. Regular and appropriate sleep-for-age is  
576 encouraged. Dopamine-agonists are used as the first-line of defense; various drugs  
577 including anticonvulsants, benzodiazepines, and narcotics are used. No cure is  
578 available - medical treatment needs to be continued for relief [52 - 53].

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

580 The International Classification of Sleep Disorders characterizes central-disorders  
581 of hypersomnolence (CDH) by their feature of excessive daytime-sleepiness (EDS)  
582 or hypersomnolence that is defined as daily-episodes of an irrepressible-need to  
583 sleep or daytime-lapses into sleep that is not attributable to the different sleep-

584 disorders, e.g., sleep-related breathing-disorders or abnormalities of circadian-  
585 rhythm, and interferes with normal daily-functioning [48].

586 In classifying, CDHs are commonly caused by:

587

- 588 1. Intrinsic-abnormalities of the CNS that controls the sleep-wake mechanism,  
589 e.g. narcolepsy and idiopathic hypersomnia (IH).
- 590 2. Extrinsic-causes, e.g. Kleine-Levin syndrome, hypersomnia due to medical  
591 or psychiatric disorders, ingestion of medications or substances, and  
592 insufficient-sleep syndrome [48]

593 Diagnosis of narcolepsy and idiopathic hypersomnia (IH), requires demonstration  
594 of objective-sleepiness by the Multiple Sleep Latency Test (MSLT). A mean sleep-  
595 latency of 8 min on the MSLT is required for diagnosis. This criterion remains  
596 unchanged from the ICSD-2 [54 – 55]. Care needs to be exercised when making  
597 the diagnosis, since abnormal MSLT-findings may be present in actually normal,  
598 sleep-deprived subjects, especially those with longer sleep-requirements [56].  
599 Conversely, some with genuine CDH may not achieve MSLT latencies of 8 min  
600 [57]. This test could be repeated subsequently to confirm objective-a sleepiness.

601

602

### 603 **Narcolepsy**

604 Narcolepsy is characterized by the classic tetrad of excessive daytime-sleepiness  
605 (EDS), cataplexy (brief sudden loss of muscle tone), hypnagogic/hypnopompic  
606 hallucinations, and sleep-paralysis. Children rarely manifest all four (4) symptoms  
607 [58, 59].

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

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

615 Respiration and extra-ocular movements are spared. Attacks may be triggered by  
616 emotions such as laughter or anger [58, 59].

617 Sleep-paralysis manifests as the inability to move upon awakening, or less  
618 commonly, upon falling asleep with consciousness intact. Such may be  
619 accompanied by hallucinations. The paralysis happens not so frequently when the  
620 sleeping-position is uncomfortable. It does not affect the respiratory or extra-ocular  
621 muscles, and can be relieved by sensory-stimuli, e.g. touching or speaking to the  
622 affected-person [58, 59].

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

628 Cataplectic-facies have been described in children with narcolepsy and cataplexy,  
629 usually at disease-onset. The typical facies include repetitive mouth-opening,  
630 tongue-protrusion, and ptosis. The usual triggering-emotions, such as laughter or  
631 joking, are not always present, causing difficulty with diagnosis [59].

632 Physical-examination findings are normal in patients with narcolepsy. A careful  
633 neurologic-examination is needed to exclude different causes. Obesity may be  
634 associated with the disorder. During a typical episode of cataplexy, patients  
635 typically demonstrate atonia of muscles of the limbs and neck and loss of deep-  
636 tendon reflexes [59].

637 In differential-diagnosis, Idiopathic hypersomnia (IH) and narcolepsy present  
638 similarly and can be difficult to distinguish. But, IH does not have sleep-onset  
639 rapid eye movement (REM) period, and the naps are unrefreshing. In addition, IH is  
640 not associated with cataplexy [59 - 60]

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

644 Measurement of hypocretin (orexin) concentration in the cerebrospinal-fluid (CSF)  
645 may help establish the diagnosis of narcolepsy when the concentration is lower than  
646 110 pg/mL, but, high CSF hypocretin concentration does not exclude the diagnosis  
647 [61].

648 Imaging-studies are generally unrevealing, but MRI is useful in excluding rare-  
649 cases of symptomatic-narcolepsy. Structural-abnormalities of the brain-stem and

650 diencephalon may present as idiopathic-narcolepsy. In patients with secondary-  
651 narcolepsy, MRI of the brain may show abnormalities depending on the underlying  
652 cause.

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

657 An individualized multidisciplinary approach is recommended in treatment of  
658 narcolepsy.

659 **1. Sleep hygiene**

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

662 **2. Diet & activity**

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

670  
671 **3. Pharmacologic treatment**

672 Presently, there isn't any FDA-approved pharmacotherapy available for  
673 children with narcolepsy. But, medications, methylphenidate and modafinil  
674 have proved effective in children 6-15 years old [62].

675  
676 **4. Non-pharmacologic measures**

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

682  
683 **5. Long-term monitoring**

684

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

### 691 **Delayed sleep-phase disorder**

692 In older children and after, early-morning waking may be part of an anxiety or  
693 depressive-disorder. If not, the child could have been woken-up too early by noise,  
694 or various different environmental-factors which intrude into her/his sleep [1, 4 -  
695 5].

696 The generally very efficient sleep of pre-pubertal children changes to not so  
697 satisfactory sleep in adolescence for both physiological and psychosocial reasons  
698 [1, 4 - 5].

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

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

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

711 The manifestations of DSPS are persistently severe difficulty getting to sleep  
712 (possibly until well into the night), uninterrupted sound-sleep for just a few hours,  
713 but then great difficulty getting up for school, college, or work because of not  
714 having enough sleep. This causes sleepiness and under-functioning, especially  
715 during the first part of the day. The abnormal sleep-pattern is maintained by  
716 sleeping in very late when able to do so on weekends and during holidays [1, 4 -  
717 5].



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

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

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

### 735 **Parasomnias**

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

742 Confusing between the different parasomnias seems common. For example, in  
743 pediatric textbook-accounts, sleep-terrors and nightmares (two very different types  
744 of parasomnia) are mistaken (for one another). Indeed, sometimes there is an  
745 inclination to call all dramatic-parasomnias a nightmare. Correct diagnosis is very  
746 necessary because different parasomnias each have an own significance, and call  
747 for contrasting-types of advice and treatment. The following brief-account is  
748 concerned with the main-manifestations to be recognized in reaching the correct  
749 diagnosis. Emphasis is placed on just some of the more dramatic parasomnias  
750 (namely arousal disorders, nightmares, and sleep-related epileptic seizures) as  
751 these frequently cause most confusion and concern [63]. Frequently, an accurate  
752 diagnosis can be made by means of a detailed-account of the subjective and

753 objective sequence of happenings from the onset of the episode to its resolution,  
754 and of the circumstances in which the episode happened, including its duration and  
755 timing. Audiovisual-recording (including by means of home-recording by parents)  
756 can be very informative and frequently adds details that are missed in descriptions  
757 given at consultation [1, 4 - 5].

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

762 The term “arousal disorders” refers to childhood confusional-arousals,  
763 sleepwalking (calm and agitated forms of which are described) and sleep-terrors.  
764 Nightmare is the proper better term. As sleep-related epilepsy covers a number of  
765 seizure-disorders of different types, permissible-generalizations are limited [1, 4 -  
766 5].

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

773 Benign partial-epilepsy with Centro-temporal-spikes (Rolandic epilepsy) is a  
774 frequent form of childhood-epilepsy where 75% of patients have their seizures  
775 entirely during sleep. The seizures involve distressing oropharyngeal-facial  
776 movements and sensations in line with the anatomical-origin of the seizure some  
777 doubt exists about their entirely benign-nature [65].

778 Apparent terror and screaming happen in benign-epilepsy with affective-symptoms  
779 [66].

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

782 In the Panayiotopoulos syndrome, seizures frequently involve distressing vomiting  
783 and various autonomic symptoms.

784 Nocturnal frontal-lobe epilepsy (NFLE) deserves special-mention because its  
785 clinical-manifestations make it particularly prone to misinterpretation as

786 **parasomnias.** This also happens in children, although this is mainly described in  
787 adults [67].

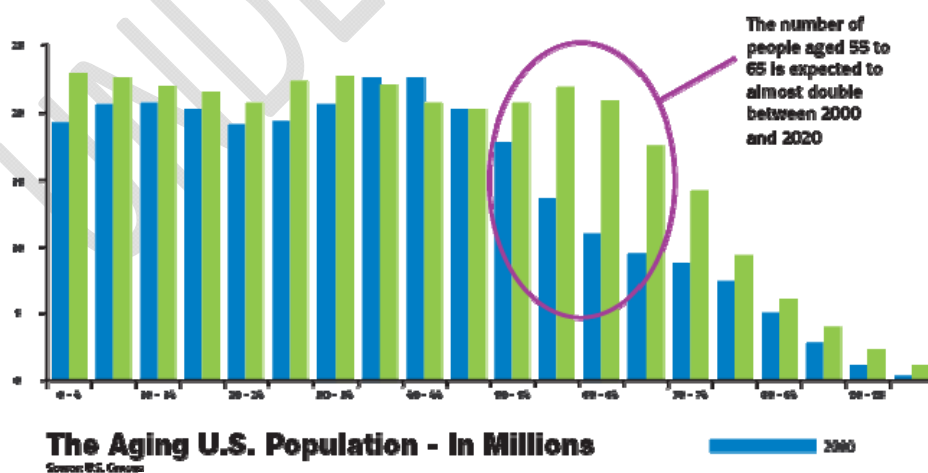
788 It is now realized that NFLE can present in a variety of forms [68], but a usual  
789 variety is frequently misdiagnosed mainly because the complicated motor-  
790 manifestations (eg kicking, hitting, rocking, thrashing, and cycling or scissor  
791 movements of the legs) and vocalizations (from grunting, coughing, muttering or  
792 moaning to shouting, screaming, or roaring) that characterize many attacks. As  
793 such, these are very different from the various seizure-types. The abrupt onset and  
794 termination, short-duration of the attacks (different from seizures of temporal lobe  
795 origin) and, sometimes, preservation of consciousness can also suggest a non-  
796 epileptic (even attention-seeking) basis for the attacks.

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

800 The distinction between epilepsy and the different parasomnias is not without  
801 difficulty. Recently, the **Bologna's group of clinical-researchers attempted to set** out  
802 clearly the (mainly clinical) criteria for distinguishing between NFLE and the  
803 various parasomnias [69].

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

805 The Figure 2 below shows the age-composition of the US population in the years  
806 2000 and 2020. About 20% of adults and about 30% of children and adolescents  
807 are found to have sleep-disorders.



808

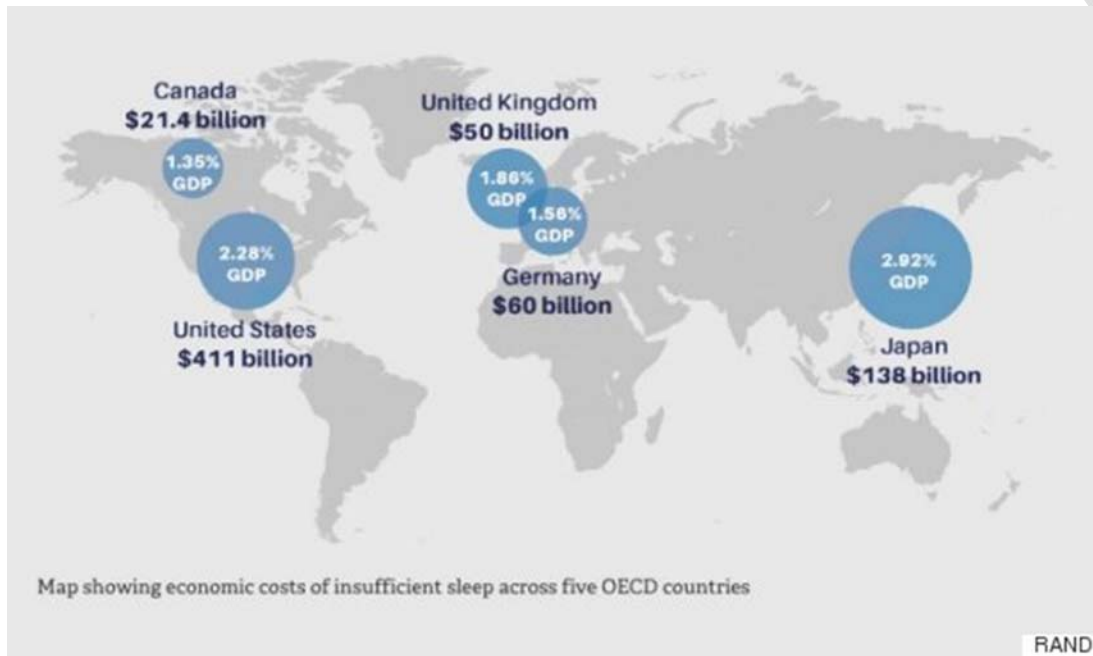
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810 **Fig 2. The Population of the US by Age-group, 2000 and 2020**

811

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

813



814

815

816 **Fig 3. Map showing economic costs of insufficient sleep across five OECD**  
817 **countries**

818

	Costs (millions \$)
Substances used for insomnia	
Prescription medications	809.92
Nonprescription medications	325.80
Alcohol	780.39
Melatonin	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>

819

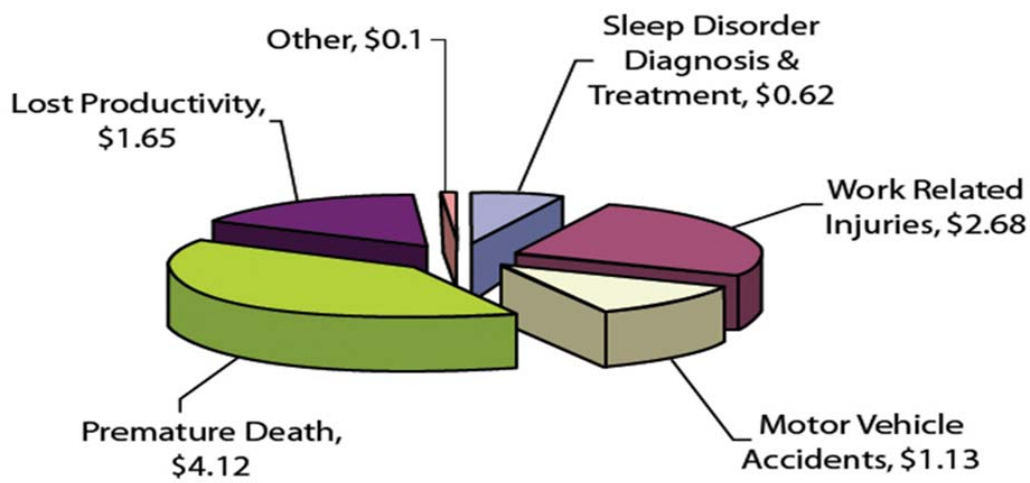
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821 **Fig 4. Table showing The Direct Costs of Insomnia in the US, 1995**

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

827

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



828

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

830 **Conclusion**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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