

# A review on 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.

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

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

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

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

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

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

The authors mainly discuss:

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

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

*Keywords:* Sleep-disorders; health-education; children; adolescents; parenting-practices; mood; behavior; performance; social-function; physical health; medication; behavioral-methods; cognitive-function; motor-skills; insomnia.

## INTRODUCTION

55 Currently there is a greater empathy exists in the field of Medicine for sleep-disorders that is gaining  
 56 ground, however the progress is still considered to be slow. A considerable amount of knowledge has  
 57 been accumulated but it remains underutilized mainly because there is a lack of awareness by both the  
 58 general public and medical-professionals particularly the field of pediatrics [1 – 3].Hence knowledge in  
 59 pediatric sleep-disorders lags behind that of adults.  
 60

61 Health education programs for parents and prospective-parents frequently miss the importance of sleep  
 62 hygiene. Medical-students and specialist-trainees, including pediatricians and child psychiatrists, health  
 63 visitors, child-psychologists, and teachers do not receive enough instruction despite the fact that they  
 64 have frequent contact with children and adolescents with sleep disturbance, which if left untreated may  
 65 result in serious health implications. [1 -3].  
 66

67 The 2005 revision of the International Classification of Sleep Disorders (ICSD-2) [6] improved upon  
 68 previous classifications but children's disorders remain inadequately referenced to.  
 69

70 The ICSD-2 describes nearly 100 sleep disorders - many are found in children and adolescents [1, 6].  
 71

72 Sleep-loss and sleep disorders are common and easily treatable yet they are frequently over-looked. It is  
 73 estimated that 50 to 70 million Americans (approximately 20%) chronically suffer from a disorder of sleep  
 74 and wakefulness, hindering daily functioning and adversely affecting health and longevity (NHLBI, 2003).  
 75 [4, 5]  
 76

77 Such patients suffer from chronic sleep-disorders affecting daily-functioning and negatively affecting  
 78 health and longevity, all of which is made worse with an ageing population.(NHLBI 2003) [4, 5].  
 79

80 Doctors seldom ask the patients about their sleep patterns (Namen et al., 1999, 2001) [4, 5].  
 81

82 It is thought that around 80 to 90 percent of adults in the U.S. have a sleep disorder but have not been  
 83 clinically diagnosed.[4 - 7]. Not recognizing sleep-problems not only dampens diagnosis and treatment  
 84 but it also impedes prevention of serious Public Health consequences.  
 85

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

- 88 • Mortality, morbidity, performance, accidents and injuries, functioning and Quality of Life,  
 89 family well-being, and health-care utilization[4, 5].  
 90

91 Table 1 below shows the US National Sleep Foundation’s Expert panel-recommended sleep-durations for  
 92 the various age-groups (Hirshkowitz, 2015). [put the number of this reference]  
 93  
 94  
 95

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

96 In adults, sleep-loss is defined as sleep of shorter-duration than the average **minimum requirement of 7 to**  
97 **8 hours per night [4, 5].**

98  
99  
100 **One of the main consequences of sleep-loss is excessive daytime-sleepiness, but different symptoms**  
101 **include depressed-mood and reduced memory/concentration [4, 5, 8].**

102  
103 **In the past, there have been insufficient nationally-representative surveys which offer reliable-data on**  
104 **sleep-patterns in populations [4, 5].**

105  
106 **Adolescents are among the population who frequently suffer from insufficient sleep. Contrary to common**  
107 **perceptions, adolescents need as much sleep as pre-teens [4, 5].**

108  
109 **One survey which involved 3,000 adolescents in Rhode Island observed that only 15 percent reported**  
110 **sleeping 8.5 or more hours on school-nights, whilst 26 percent had no more than 6.5 hours [4, 5, 11].**

111  
112 The optimal sleep-duration for adolescents is about 9 hours per night, and is based on research about  
113 alertness, sleep-wake cycles, hormones, and circadian rhythms [4, 5, 12]

114  
115 Among adolescents, much time spent on television and the growing social, recreational, and academic  
116 demands are reasons for sleep-loss or sleep problems [4, 5, 11, 13].

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## METHODOLOGY

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

## DISCUSSION

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

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

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

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

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

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

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

There remains a risk that a few sleep-disorders will be misdiagnosed at any age. Possibly, this risk is greater in children than adults because of the **bigger range** of clinical-manifestations and alternative-explanations for the behavioral-changes involved both as primary manifestations of the sleep-disorder but also because of secondary-complications. Narcolepsy is an example. Diagnostic-problems could also

172 arise because polysomnography (PSG) basis for OSA and narcolepsy diagnoses are not very clear-cut  
173 and are different compared with adult-patients [1 – 3].  
174

175 Many childhood sleep-disorders frequently resolve spontaneously unlike in adults. But in the meantime  
176 (as at any age), persistent sleep-disturbance can bring about harmful outcomes on mood, behavior,  
177 performance, social-function, and possibly, physical-health. Inadequate management of childhood sleep-  
178 problems can also be persistent into adult-life [1 – 3].  
179

180 But, children's sleep-disorders are generally not as much associated with psychiatric-illness. Parents  
181 should realize that the strange sleep-related behavior (in, for example, head-banging or sleep terrors) is  
182 very unlikely to mean that the child has a serious psychiatric or medical-disorder [1 – 3].  
183

184 Differences concerning sleep and sleep-disorders between children and adults need to be discussed in  
185 both clinical practice and research [1 – 3].  
186

187 Managing most sleep-disorders in children is, in principle, straightforward and likely to be effective if  
188 appropriately chosen and implemented with much thought [1 – 3].  
189

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

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

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

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

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

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

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

228  
229 Children with learning disabilities, different neurodevelopmental-disorders including autism, or  
230 psychiatric-conditions almost all of a time have their lives (and those of their parents) further complicated  
231 by disturbed-sleep and its aftermath. Similarly, children with types of chronic pediatric-illness [1].  
232  
233 Physical-factors may be big in the etiology of the sleep-problem in many of these conditions (e.g. OSA in  
234 Down syndrome) but behavioral factors (e.g. failure to develop satisfactory sleep-habits) **are more**  
235 **common**[1 – 3].  
236  
237 Similarly, these groups of children can generally be expected to respond to the same types of treatment  
238 as in different children, providing the treatment-programs are correct for the sleep-disorder in question [1  
239 – 3].  
240  
241 Educating parents and professionals alike would increase the use of the various types of available  
242 treatments [1 – 3].  
243  
244 “Overtired” children are difficult to handle – such children become irritable, distressed, and even  
245 aggressive, much to the concern and exasperation of the parents. In a few children, such problems are  
246 frequent and seriously disrupt family-life. As said earlier, certain young children said to have ADHD  
247 characterized by over-activity, impulsiveness, and poor concentration, actually have a primary sleep-  
248 disorder. Stimulants are not appropriate in this group and could make matters worse by escalating the  
249 sleep-problem [1 – 3].  
250  
251 As stated earlier, persistent loss of sleep can have a depressing effect and lead to the problems at home  
252 and at school particularly among adolescents [1 – 3].  
253  
254 Disturbed-sleep can affect a child's emotional-state and behavior in many different **manners**. Bedtime can  
255 become a source of distress when there **is accompanying frightening thoughts** or experiences, including  
256 night-time fears [1 – 3].  
257  
258 There is convincing evidence that insufficient-sleep can impair concentration, memory, decision-making,  
259 and general ability to learn. Performance on tasks needing sustained-attention is particularly affected –  
260 and, also those requiring abstract-thinking or creativity. In a same manner, motor-skills and reaction-time  
261 can be impaired. Studies in the USA suggest that 80% of adolescents have sleep inadequate to  
262 recommended nine hours, 25% not more than 6 hours, while more than 25% fall asleep in class. Students  
263 with insufficient-sleep achieve lower school-grades, in general[1 – 3].  
264  
265 In addition to the effect of OSA on growth in children, persistent sleep-loss in particular is being  
266 increasingly associated in adults with physical ill-health such as impaired immunity, obesity, hypertension,  
267 and diabetes [17] Children would not be free of at least some of these risks [1].  
268  
269 There have been reports that relationships between parent and a child with a serious and persistent sleep  
270 problem can be severely tested to the point of increased use of physical punishment in extreme cases,  
271 marital-discord and family-disharmony [1, 18].  
272  
273 The affected child's interpersonal-problems may extend beyond her/his family. Irritable, difficult, or  
274 disturbed behavior can affect friendships [1 – 3].  
275  
276 Relationships with teachers can easily suffer, particularly when teachers are not aware that behavioral-  
277 problems can be the result of inadequate or disturbed sleep, for which effective treatment can usually be  
278 provided [1 – 3].  
279  
280 There is no reason to expect that children are free of at least some of the risks to common non-  
281 communicable diseases below [1 – 3].  
282

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

285

### 286 **Sleep Loss and Physical Health**

287

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

290

- 291 • Obesity in adults and children
- 292 • Diabetes and impaired glucose tolerance
- 293 • Cardiovascular disease and hypertension
- 294 • Anxiety symptoms
- 295 • Depressed mood
- 296 • Alcohol use

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298

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

300

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

302

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

306

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

310

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

312

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

315

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

319

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

321

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

324

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

327

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

329

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

332

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

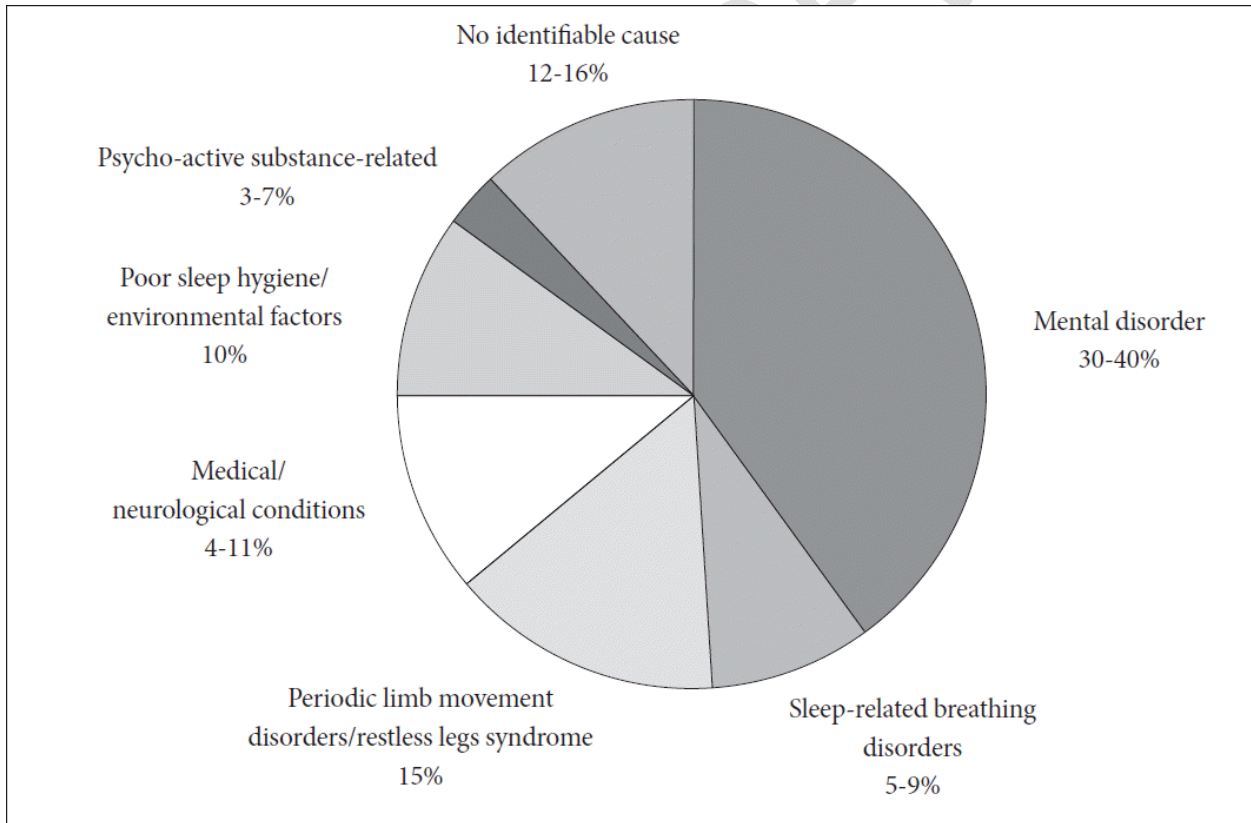
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336 Several studies of adolescents, including one with more than 3,000 high-school students, found that  
337 inadequate-sleep is associated with higher-levels of depressed-mood, anxiety, behavior-problems, lower  
338 self-esteem and alcohol use [30,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

339  
340 Several types of sleep-disorders are commonly seen among adolescents. These include insomnia, hyper-  
341 somnolence disorder, narcolepsy, breathing-related disorders and restless-leg syndrome.

342  
343 There are various classifications of Sleep-disorders including the International Classification of Sleep-  
344 disorders (ICSD) [6].A modified-version found in the Nelson Textbook of Pediatrics 20e. 2016 classifies  
345 Common Sleep Disorders in Children as [34]:

- 346  
347 1. Insomnia of childhood  
348  
349 2. Obstructive sleep apnea  
350  
351 3. Para-somnias  
352  
353 4. Sleep-related movement disorders: Restless legs syndrome/periodic limb movement disorder and  
354 rhythmic movements  
355  
356 5. Narcolepsy  
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358 6. Delayed sleep phase disorder  
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360  
361  
362 **Fig. 1. The pattern of sleep-disorders observed**  
363

364 **Insomnia of Childhood**  
365

366 The most common are insomnia-disorders which may be either transient or persistent. Brief episodes of  
367 insomnia are most often associated with anxiety and among adolescents it may be due to either an



368 anxious experience or in anticipation of an anxiety-provoking experience; a typical example might be the  
369 fear of impending exams in school or college [1].

370  
371 Persistent Insomnia is a group of conditions whereby the patient may experience difficulty in falling or  
372 remaining asleep. No clear anxiety-episodes may be present but at the same time the reason(s) may be  
373 exacerbated by stress from other sources such as personal-matters or school-stress [1].

374  
375 Psycho-physiological insomnia typically presents with a complaint of difficulty in falling asleep. In such  
376 cases, it may be associated with objects associated with the sleeping-environment such as the bedroom  
377 itself or the bed. Unlike insomnia which is related to an underlying psychiatric-disorder day-time  
378 adaptation such as studies and relationships are not affected. In such cases, patients usually complain of  
379 not being able to sleep even when they force themselves. Additionally, they may also experience  
380 rumination while trying to fall asleep. On the other hand patients are able to sleep better when they are  
381 away from the usual sleeping-environment - a typical example of such could be whilst watching television  
382 [1].

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

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

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

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

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

### 413 414 **Obstructive Sleep Apnea**

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

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

423

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

426 OSA-prevalence is found to increase with age. Adults 65 to 90 years of age had a threefold greater  
427 prevalence than middle-aged adults [35], while the prevalence in children is estimated around 2 percent  
428 [36, 37], with larger estimates seen in ethnic-minorities in the US [37, 38].

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

434  
435 Since data such on children such as above is not forthcoming in literature-searches, the authors here use  
436 data on adults in an attempt to reflect on the overall situation.

437  
438 In the same manner, children's OSA frequently remains undiagnosed also, partly because the  
439 implications of snoring frequently being not recognized by pediatricians.

440  
441 Although OSA could be found in children of all ages, it is most common among preschool-ages - a time  
442 coincident with tonsils and adenoids being largest in size relative to the underlying-airway (Jeans et al.,  
443 1981).

444  
445 The main risk-factor for OSA in children is tonsillar hypertrophy, although OSA may also be found in  
446 children with congenital and neuromuscular disorders, and in children born prematurely (Rosen et al.,  
447 2003).

448  
449 Asthma, a common childhood respiratory-illness, is also seen associated with OSA in children (Sulit et al.,  
450 2005).

451  
452 Treatment modalities in OSA in children include [40]:

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

474  
475 The CHAT Study (Marcus CL 2013) showed that in comparing a plan of watchful-waiting,  
476 surgical-treatment for the obstructive sleep apnea syndrome (OSAS) in school-age children did  
477 not significantly improve attention or executive-function as measured by neuropsychological-  
478 testing, but did reduce symptoms and improve secondary-outcomes of behavior, quality of life,

479 and polysomnographic findings - thus providing evidence of beneficial outcomes of early adeno-  
480 tonsillectomy[41].

481  
482 The Tucson Children's Assessment of Sleep Apnea Study (TuCASA) (Budhiraja R and Quan SF,  
483 2009) is a longitudinal cohort-study of 503 6-12 year old Caucasian-children and Hispanic-  
484 children who had polysomnography and neurocognitive testing initially. Subsets of the cohort had  
485 additional MRI-imaging and pulmonary physiologic-testing. Cross-sectional analyses indicated  
486 that Sleep-disordered Breathing (SDB) is associated with behavioral-abnormalities, hypertension,  
487 learning-problems and clinical-symptoms such as snoring and excessive daytime-sleepiness. The  
488 Study feels future follow-up of the cohort will assess the impact of SDB on subsequent childhood-  
489 development [42].

490  
491 **Sleep-related Movement Disorders**

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

495  
496 **Table 2. ICSD-3 Classification of the SRMDs.**

497

---

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

---

498  
499 **Restless-leg Syndrome**

500  
501 RLS, or the Willis Ekbohm syndrome, is a group of chronic neurological-disorders characterized by feeling  
502 of discomfort in the legs and an uncontrollable-need to move them.

503  
504 A family-history is found in 72 % of cases with the mother three times more likely to suffer from the  
505 disorder than the father [44]. The mode of inheritance is complex.

506  
507 Iron stores may be low. Diabetes mellitus, end-stage renal disease, cancer, rheumatoid arthritis,  
508 hypothyroidism and pregnancy may be associated, as well as drugs like nicotine, antihistamines, tricyclic  
509 antidepressants, selective serotonin reuptake inhibitors, cimetidine and caffeine [45, 46].

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

515  
516 The symptoms are worse when resting and in the evening or bedtime, and when travelling in a car for  
517 prolonged periods. These are partially relieved by movement such as stretching, walking, rubbing or  
518 massage [45].

519  
520 Children wake up frequently from sleep, and may be tired and inattentive during the day.

521  
522 The International Restless Legs Study Group [47] (IRLSSG) reviewed the 1995 diagnostic-basis  
523 (criteria)for RLS and developed new consensus. These are shown in Table 3 here below. The separate

524 set for the diagnosis of RLS in children, found in ICSD-2, has been eliminated. Pediatric diagnostic-  
525 considerations are discussed in the ICSD-3 developmental-section of RLS [43].  
526

527 **Table 3. International Restless Legs Syndrome Study Group consensus diagnostic criteria for**  
528 **restless legs syndrome**  
529

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)

530  
531 Diagnosing RLS in children can be difficult as it depends on the patient's ability to describe core-  
532 symptoms. Diagnosis can be made if the history is consistent with the condition, and at least two of the  
533 following are present [6]:  
534

- 535 • a sleep disturbance,
- 536 • a first-degree relative with RLS, or
- 537 • five or more periodic limb-movements per hour of sleep during poly-sonography

538  
539 Conservative treatment includes avoiding exacerbating factors.

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

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

543 A: avoidance of exacerbating factors – caffeine, drugs

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

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

547 S: Sleep – regular and appropriate sleep-for-age  
548

549 There aren't any medications approved for treating restless legs syndrome in children. But drugs that  
550 increase CNS dopamine levels, such as ropinirole and pramipexole are found effective in adults [45].  
551

### 552 **Periodic Limb Movement Disorder**

553  
554 Periodic limb-movement disorder (PLMD), previously known as sleep-myoclonus or nocturnal-myoclonus,  
555 comprises repetitive limb-movements during sleep that disrupt sleep. Usually involves the lower-limbs,  
556 rarely the upper-extremities. The movements may involve extension of the big-toe, or flexion of ankle,  
557 knee and hip. The movements happen during light non-REM sleep, are repetitive and are separated by  
558 intervals of 5-90 seconds with night-to-night variability in the frequency of limb-movements. PLMD may be  
559 asymptomatic [48]. Patients are usually not aware until a parent, family-member or partner calls attention  
560 to the limb-jerks, restless-sleep, moving-around or falling-out of bed. Frequent awakenings, non-  
561 restorative sleep, daytime-fatigue, daytime-sleepiness are the usual symptoms [45].  
562

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

- 568  
569 PLMD is diagnosed when the following are present [48 – 49]:  
570 1. PLMs documented by polysomnography  
571 2. PLMs exceeds norms for age (>5/h for children),  
572 3. Clinical sleep-disturbance or daytime-fatigue  
573 4. Absence of any different primary sleep-disorder or reason for PLMS, including RLS and OSA  
574

575 Diagnostic-workup includes a good clinical-history and a thorough neurological-examination, followed by  
576 an overnight-polysomnogram (PSG). Respiratory-monitoring is required to rule out sleep-disordered  
577 breathing as a cause. Thyroid function, magnesium levels, folic acid, and vitamin B<sub>12</sub> levels need to be  
578 determined [50 - 51].  
579

580 Avoidance of caffeine, chocolate, tea, coffee, soft drinks is needed. Antidepressants can cause  
581 worsening. Regular and appropriate sleep-for-age is encouraged. Dopamine-agonists are used as the  
582 first-line of defense; various drugs including anticonvulsants, benzodiazepines, and narcotics are used.  
583 No cure is available - medical treatment needs to be continued for relief [50 - 51].  
584

### 585 **Central Disorders of Hyper-somnolence**

586

587 The International Classification of Sleep Disorders characterizes central-disorders of hypersomnolence  
588 (CDH) by their feature of excessive daytime-sleepiness (EDS) or hypersomnolence that is defined as  
589 daily-episodes of an irrepressible-need to sleep or daytime-lapses into sleep that is not attributable to the  
590 different sleep-disorders, e.g., sleep-related breathing-disorders or abnormalities of circadian-rhythm, and  
591 interferes with normal daily-functioning [43].  
592

593 In classifying, CDHs are commonly caused by:  
594

- 595 1. Intrinsic-abnormalities of the CNS that controls the sleep-wake mechanism, e.g. narcolepsy and  
596 idiopathic hypersomnia (IH).
- 597 2. Extrinsic-causes, e.g. Kleine-Levin syndrome, hypersomnia due to medical or psychiatric  
598 disorders, ingestion of medications or substances, and insufficient-sleep syndrome [43]  
599

600 Diagnosis of narcolepsy and idiopathic hypersomnia (IH), requires demonstration of objective-sleepiness  
601 by the Multiple Sleep Latency Test (MSLT). A mean sleep-latency of 8 min on the MSLT is required for  
602 diagnosis. This criterion remains unchanged from the ICSD-2 [52 – 53]. Care needs to be exercised when  
603 making the diagnosis, since abnormal MSLT-findings may be present in actually normal, sleep-deprived  
604 subjects, especially those with longer sleep-requirements [54]. Conversely, some with genuine CDH may  
605 not achieve MSLT latencies of 8 min [55]. This test could be repeated subsequently to confirm objective-a  
606 sleepiness.  
607

### 608 **Narcolepsy**

609

610 Narcolepsy is characterized by the classic tetrad of excessive daytime-sleepiness (EDS), cataplexy (brief  
611 sudden loss of muscle tone), hypnagogic/hypnopompic hallucinations, and sleep-paralysis. Children  
612 rarely manifest all four (4) symptoms [56, 57].  
613

614 Diagnosis requires EDS-presence, that is the primary symptom of narcolepsy, to be present for at least 3  
615 months. Severe EDS leads to involuntary-somnolence that interferes with normal-functioning such as  
616 working, walking, driving, eating, or talking. Sleep-attacks characterized by regular severe sudden-  
617 episodes of falling asleep are seen.  
618

619 Mild catalepsy presents with partial-loss of tone, e.g. head-nodding, altered-speech or knee-buckling,  
620 while severe-disease is generalized and leads to falls. Respiration and extra-ocular movements are  
621 spared. Attacks may be triggered by emotions such as laughter or anger [56, 57].  
622

623 Sleep-paralysis manifests as the inability to move upon awakening, or less commonly, upon falling asleep  
624 with consciousness intact. Such may be accompanied by hallucinations. The paralysis happens not so  
625 frequently when the sleeping-position is uncomfortable. It does not affect the respiratory or extra-ocular  
626 muscles, and can be relieved by sensory-stimuli, e.g. touching or speaking to the affected-person [56,  
627 57].

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

633  
634 Cataplectic-facies have been described in children with narcolepsy and cataplexy, usually at disease-  
635 onset. The typical facies include repetitive mouth-opening, tongue-protrusion, and ptosis. The usual  
636 triggering-emotions, such as laughter or joking, are not always present, causing difficulty with diagnosis  
637 [57].

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

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

647  
648 As part of investigations, an overnight poly-somnogram (PSG) followed by a MSLT provides strong  
649 evidence of narcolepsy, while excluding the different sleep-disorders such as IH.

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

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

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

663  
664 An individualized multidisciplinary approach is recommended in treatment of narcolepsy.

665  
666 **1. Sleep hygiene**  
667 Most patients benefit from a regular nightly sleep-schedule of 7.5-8 hours, and scheduled-naps  
668 during the day.

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

676  
677 **3. Pharmacologic treatment**

678 Presently, there isn't any FDA-approved pharmacotherapy available for children with narcolepsy.  
679 But, medications, methylphenidate and modafinil have proved effective in children 6-15 years old  
680 [60].

681

#### 682 4. Non-pharmacologic measures

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

687

#### 688 5. Long-term monitoring

689

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

694

#### 695 Delayed sleep-phase disorder

696

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

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

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

705

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

710

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

714

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

720

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

725

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

729

730 Difficulties achieving and maintaining an improved sleep-wake schedule by these means are  
731 compounded if there is a vested-interest in maintaining the abnormal sleep-pattern, for example, to avoid  
732 school ("motivated sleep phase delay"). Psychological problems, including depression, may impede  
733 treatment success. The teenager's reluctance to go to bed earlier and to get up at the required time is

734 frequently misinterpreted as “typical difficult adolescent behavior” causing trouble in the family. If not, the  
735 condition could be mistakenly viewed as the usual form of school non-attendance, primary-depression, or  
736 substance-misuse [1, 4 - 5].

737

## 738 **Parasomnias**

739

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

745

746 Confusing between the different parasomnias seems common. For example, in pediatric textbook-  
747 accounts, sleep-terrors and nightmares (two very different types of parasomnia) are mistaken (for one  
748 another). Indeed, sometimes there is an inclination to call all dramatic-parasomnias a nightmare. Correct  
749 diagnosis is very necessary because different parasomnias each have an own significance, and call for  
750 contrasting-types of advice and treatment. The following brief-account is concerned with the main-  
751 manifestations to be recognized in reaching the correct diagnosis. Emphasis is placed on just some of the  
752 more dramatic parasomnias (namely arousal disorders, nightmares, and sleep-related epileptic seizures)  
753 as these frequently cause most confusion and concern [61]. Frequently, an accurate diagnosis can be  
754 made by means of a detailed-account of the subjective and objective sequence of happenings from the  
755 onset of the episode to its resolution, and of the circumstances in which the episode happened, including  
756 its duration and timing. Audiovisual-recording (including by means of home-recording by parents) can be  
757 very informative and frequently adds details that are missed in descriptions given at consultation [1, 4 - 5].  
758 For the most part (seizure-disorders generally being a main exception), physiological-recordings are  
759 required only when clinical evaluation is inconclusive or where the child might have more than one type of  
760 parasomnia. The meaning of the three categories is as follows [1, 4 - 5].

761

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

766

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

772

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

777

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

779

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

782

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

785

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

789



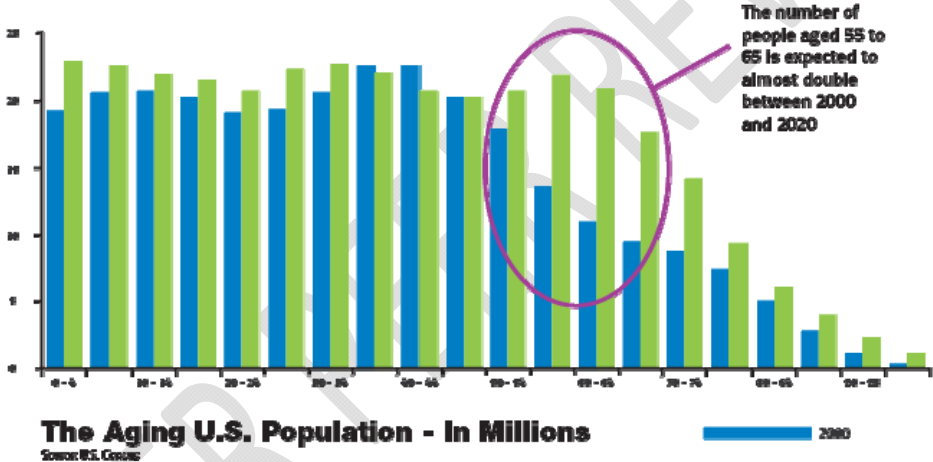
790 It is now realized that NFLE can present in a variety of forms [66], but a usual variety is frequently  
 791 misdiagnosed mainly because the complicated motor-manifestations (eg kicking, hitting, rocking,  
 792 thrashing, and cycling or scissor movements of the legs) and vocalizations (from grunting,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

798 In the first instance, diagnosis is based on being knowledgeable of this form of epilepsy and recognition of  
 799 its clinical-manifestations. EEG-recordings, even during the episodes, are of limited diagnostic-value.  
 800

801 The distinction between epilepsy and the different parasomnias is not without difficulty. Recently, the  
 802 Bologna's group of clinical-researchers attempted to set out clearly the (mainly clinical) criteria for  
 803 distinguishing between NFLE and the various parasomnias [67].  
 804

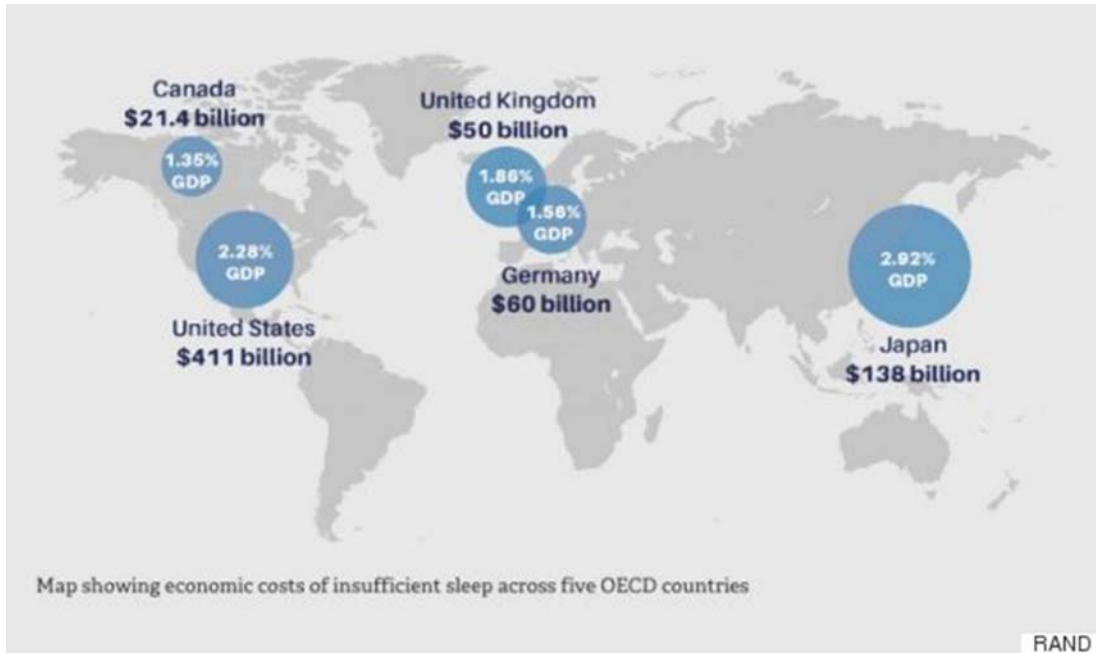
**The Epidemiology and Disease-burden of Sleep-disorders in Children**

805  
 806  
 807 The Figure 2 below shows the age-composition of the US population in the years 2000 and 2020. About  
 808 20% of adults and about 30% of children and adolescents are found to have sleep-disorders.



809  
 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  
817

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

	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>

818  
819  
820  
821  
822  
823  
824  
825

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

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

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

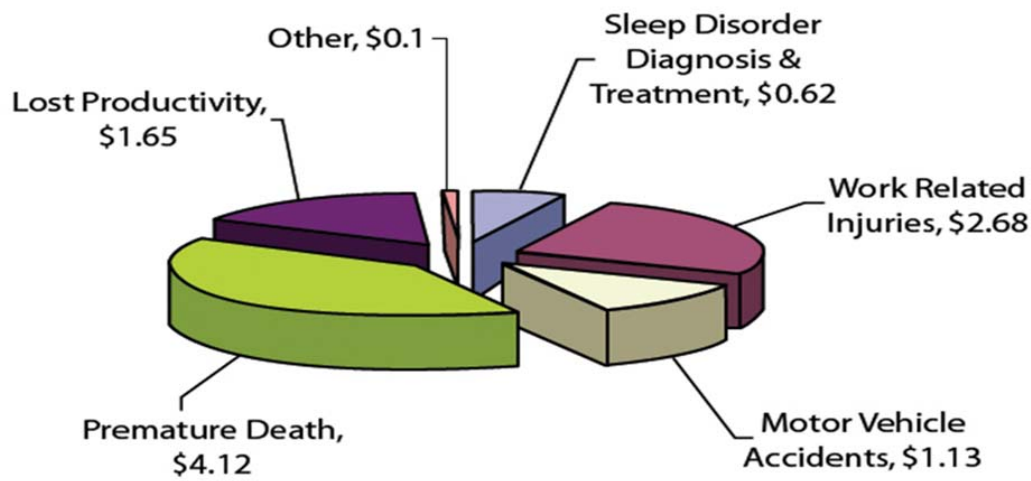


Fig. 5. The Composition of the Costs of Sleep-disorders in Australia

### CONCLUSION

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

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

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

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

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

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

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

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

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

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

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

873  
874 Medication has a smaller part to play in children than it has in adults – behavioral-methods being found  
875 additionally appropriate and effective.

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

880  
881 In view of these various potential-complications to the child's life everyone concerned must realize such  
882 could be at least partly be the result of sleep-disturbance to which effective-treatment exists in most  
883 instances.

884  
885 In view of the morbidity, mortality, loss of Quality of Life, and Disease-burden including economic-cost of  
886 sleep-disorders, cost-effective Prevention Programs, touching upon Primary, Secondary and Tertiary  
887 Prevention need to be planned, implemented and evaluated. Such Programs need to educate parents,  
888 would-be parents, teachers and health-care professionals.

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