

Sleep-disorders in children and adolescents

Abstract

Introduction

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

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

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

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

Aim

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

Methodology

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

Results

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

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

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

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

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

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

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

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

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

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

46 The authors mainly discuss:

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

54 **Conclusion and Recommendations**

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

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

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63

64 **Introduction**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

105

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

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

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

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

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

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

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

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127 **Methodology**

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

130 **Discussion**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Sleep-loss Is Associated with Obesity

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

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

Sleep-loss Is Associated with Diabetes and Impaired Glucose Tolerance

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

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

Sleep-Loss Is Associated with Cardiovascular-morbidity

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

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

Sleep-loss, Mood, Anxiety, and Alcohol Use

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

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].

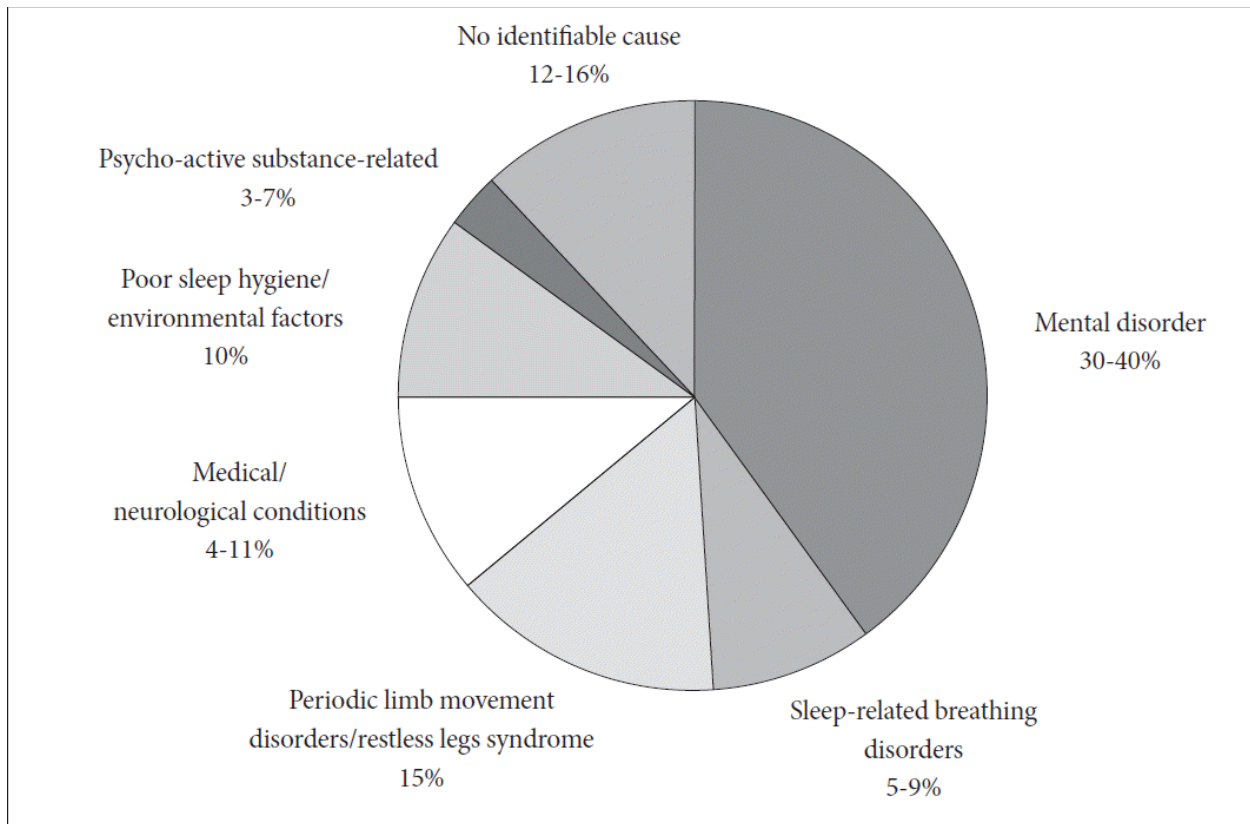
325 Several studies of adolescents, including one with more than 3,000 high-school
326 students, found that inadequate-sleep is associated with higher-levels of depressed-
327 mood, anxiety, behavior-problems, lower self-esteem and alcohol use [30, 32], and
328 attempted suicide [33].

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

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Fig 1: The pattern of sleep-disorders observed

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Insomnia of childhood

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

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

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

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].

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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].

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

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

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

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

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

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

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

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

477
478 The Tucson Children's Assessment of Sleep Apnea Study (TuCASA)
479 (Budhiraja R and Quan SF, 2009) is a longitudinal cohort-study of 503 6-12
480 year old Caucasian-children and Hispanic-children who had

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

489 **Sleep-related Movement Disorders**

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

492 **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

493

494 **Restless-leg Syndrome**

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

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

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

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

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

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

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

520 **Table 3: International Restless Legs Syndrome Study Group consensus**
521 **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)
----	---

522

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

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

530

531 Conservative treatment includes avoiding exacerbating factors.

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

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

536 A: avoidance of exacerbating factors – caffeine, drugs

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

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

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

542

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

546 **Periodic Limb Movement Disorder**

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

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

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

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

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

570

571 Diagnostic-workup includes a good clinical-history and a thorough neurological-
572 examination, followed by an overnight-polysomnogram (PSG). Respiratory-
573 monitoring is required to rule out sleep-disordered breathing as a cause. Thyroid
574 function, magnesium levels, folic acid, and vitamin B₁₂ levels need to be
575 determined [50 - 51].

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

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

581 **Central disorders of Hyper-somnolence**

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

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

588 In classifying, CDHs are commonly caused by:

589

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

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

603

604

605 **Narcolepsy**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

661 **1. Sleep hygiene**

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

664 **2. Diet & activity**

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

672
673 **3. Pharmacologic treatment**

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

677
678 **4. Non-pharmacologic measures**

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

684
685

686

687

688 **5. Long-term monitoring**

689

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

696 **Delayed sleep-phase disorder**

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

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

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

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

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

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

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

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

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

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

740 **Parasomnias**

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

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

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

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

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

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

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

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

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

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

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

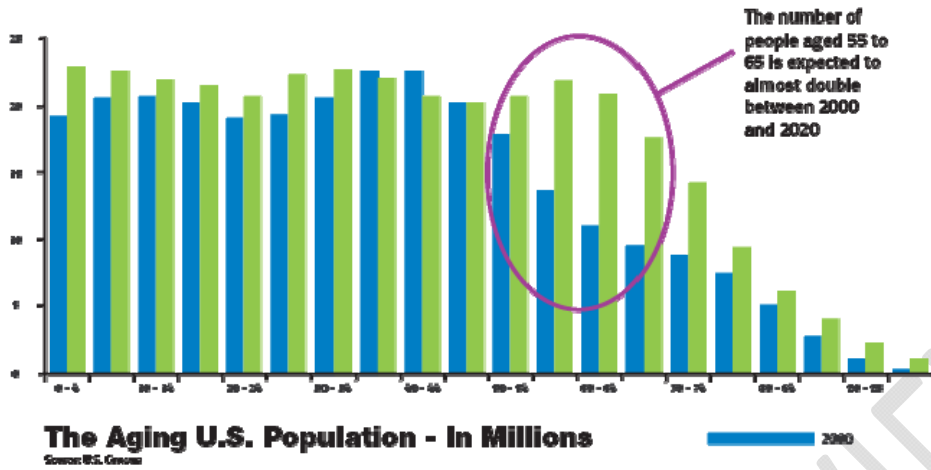
793 It is now realized that NFLE can present in a variety of forms [66], but a usual
794 variety is frequently misdiagnosed mainly because the complicated motor-
795 manifestations (eg kicking, hitting, rocking, thrashing, and cycling or scissor
796 movements of the legs) and vocalizations (from grunting,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

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

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

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

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



813

814

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

816

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

818



819

820

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

823

	Costs (millions \$)
Substances used for insomnia	
Prescription medications	809.92
Nonprescription medications	325.80
Alcohol	780.39
Melatonin	50.00
Total Cost of Substances	1,966.11
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
Total	11,960.70
Total direct costs	13,926.11

824

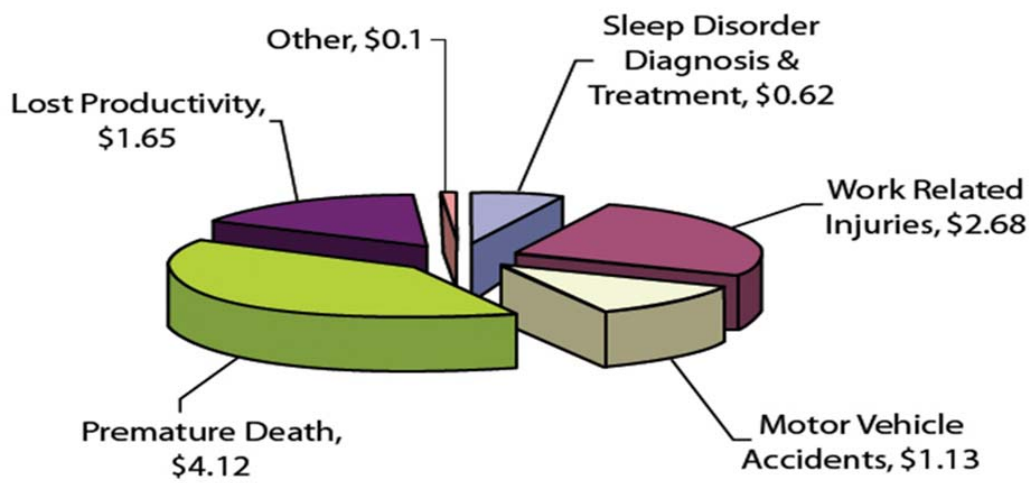
825

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

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

832

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



833

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

835 **Conclusion**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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