Chapter 2
The Discovery of Pediatric Sleep Medicine

Oliviero Bruni and Raffaele Ferri

Abstract The aim of this chapter is to depict the discovery of sleep physiology in infants and the emergence of the discipline of pediatric sleep as relatively autonomous entity.

The gradual awareness regarding sleep disorders in infants and children begins in the nineteenth century when the first doctors and pediatricians begin to classify infants and children sleep disorders. The process that leads to the increasing understanding and knowledge of pediatric sleep disorders was not easy. Children's sleep has been neglected until the end of the last century with the main textbook of pediatrics reporting no chapters or only few paragraphs devoted to pediatric sleep.

It is interesting to note that the first observation that leads to the discovery of rapid eye movement (REM) sleep was made on neonates and infants, and the first study on the negative behavioral consequences of sleep apnea has been reported in children.

The story of the infants' and children's sleep behavior during the antiquity is briefly delineated, and subsequently the first recommendations on the sleep time duration are reported with surprisingly data.

This chapter also briefly lists the fundamental contribution of researchers from different countries and their role in the development of pediatric sleep medicine.

Finally, the history and the establishment of the scientific associations related to the pediatric sleep medicine are delineated.

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This historical overview has limitations, and some fundamental researchers that greatly contributed to the birth of pediatric sleep medicine as an independent field probably have been forgotten. However the last few years have acknowledged the growing interest on pediatric sleep, and different health providers (pediatric pulmonologists, otolaryngologists, neurologists, orthodontists, and psychologists) become interested in recognizing the negative consequence of sleep disorders for child health and development.

Keywords Sleep • Infant • Child • Adolescent • Development • Pediatric sleep associations

General Overview

Sleep medicine in adult as a scientific field begins in the 1950s and has greatly and speedily evolved over the past 60 years.

The appearance of pediatric and adolescent sleep medicine as an autonomous entity begins about 30 years ago related to several important researches in different clinical fields: obstructive sleep apnea and other sleep-related breathing disorders, sudden infant death syndrome (SIDS), insomnia, and narcolepsy. However, it was the gradual identification of the importance of sleep for several daytime dysfunctions like neurobehavioral problems, learning difficulties, growth failure, etc., which began to raise awareness on the importance of sleep in infancy and childhood development [1].

Beginning from the 1980s, there was a huge growth of pediatric and adolescent sleep medicine starting with two important publications. The first book for parents entitled *Solve Your Child's Sleep Problems* was written in 1985 by Richard Ferber [2] of the Boston Children's Hospital that for the first time described the behavioral treatment for pediatric insomnia and highlighted the developmental and behavioral aspects of pediatric sleep. Just 2 years later, Christian Guilleminault edited the book *Sleep and Its Disorders in Children* [3] that represented the reference for the pediatric sleep for clinicians and healthcare providers involved with infants and children. The contributions presented in that book provided the basis for the future development of a knowledge base for understanding normal and pathological sleep in infants and children.

The first comprehensive pediatric sleep textbook *Pediatric Sleep Medicine* was published by Sheldon, Spire, and Levy in 1992 [4], followed in 1995 by the reference book *Principles and Practice of Sleep Medicine in the Child* by Richard Ferber and Meir Kryger [5]; then the revised edition *Principles and Practice of Pediatric Sleep Medicine* by Sheldon, Ferber, and Kryger in 2005 [6]); and finally the second edition of this book published in 2014 [7].

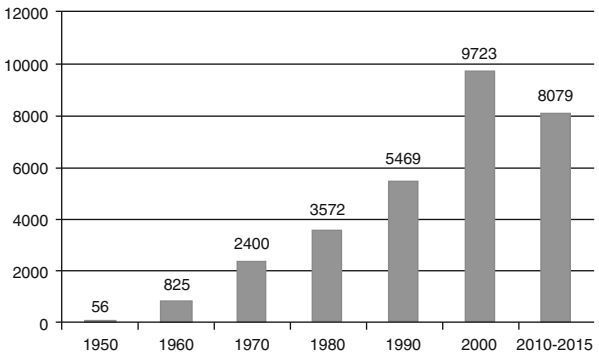

Fig. 2.1 Number of publications for each decade in PubMed with search word "sleep" limited to humans and all children (0–18 years)

Notwithstanding the awareness of the importance of sleep for development, pediatricians slowly begin to recognize the importance of sleep physiology and sleep structure to human development and behavior. Gradually, over the past decade, pediatric pulmonologists, otolaryngologists, neurologists, orthodontists, and psychologists have acknowledged the negative consequence of sleep disorders for child health and development and have integrated this into their clinical practice.

Although the growth of pediatric sleep medicine was tremendous, the classical pediatric textbooks almost ignored the topics of sleep disturbances with very few parts of the books dedicated to sleep disorders.

In 2002, the American Academy of Sleep Medicine (AASM) applied to the Accreditation Council on Graduate Medical Education (ACGME) for the establishment of sleep medicine training programs, and in 2003 sleep medicine was accepted as an independent medical specialty with a new multidisciplinary specialty examination in sleep medicine. In the first examination in 2007, considerations and disorders unique to childhood comprised 2 % of the first examination. Several efforts have been made to increase the presence of childhood sleep, and actually many schools of sleep medicine, hospitals, and academic clinics set up training programs, residencies, and fellowships in pediatric sleep medicine and recognized the peculiarity and uniqueness of sleep during human development [1].

This acknowledgment leads to a gradual and huge growth of scientific papers in pediatric sleep, with special emphasis on respiratory disturbances during sleep, as revealed by the amount of publications indexed on PubMed from the 1980s.

Figure 2.1 shows the number of publications that can be found in PubMed with the search word "sleep" limited to humans and all children (01–18 years). There was a steep increase in papers, especially in the last decade.

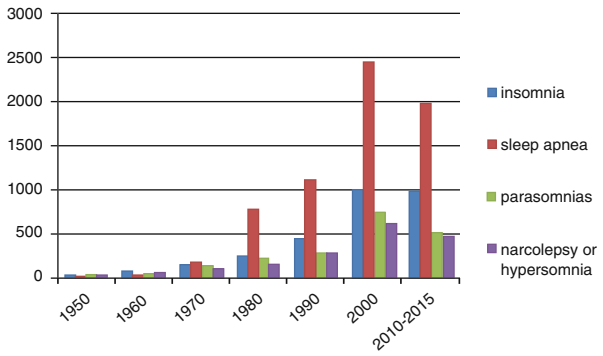

Fig. 2.2 Number of publications for each decade in PubMed search on the major sleep disorders of childhood limited to humans and all children (0–18 years)

In Fig. 2.2 the total number of publications on the major groups of sleep disturbances of childhood is reported based on PubMed search with the different words for each disorder limited to humans and all children (01–18 years).

As reported above, over the past 30 years, there has also been an increasing awareness of pediatric pulmonologists and pediatric otolaryngologists on the role of respiratory sleep disturbances in their clinical work, with an increasing understanding of the importance of a comprehensive knowledge of sleep medicine, since without a global view of the different physiological parameters during sleep it is extremely difficult to perform a correct diagnosis and a therapeutic decision.

Paralleling this consciousness, there was an increase of pediatric sleep centers in the USA and in Europe, and more and more countries are building up their own sleep centers. The need for specialized sleep laboratories is mandatory for the clear differences in sleep physiology and disturbances between adults and infants or children.

Besides the sleep medicine field, sleep research in childhood has been greatly developed by psychologists especially related to the neurobehavioral and psychosocial consequences of sleep disorders, with population studies on the effect of disturbed sleep on mental and physical health.

The changes in the society and especially the advent of the new technologies have had a great impact on sleep and could have been an addictive role in the progressive decrease of sleep duration in the modern societies.

In the following paragraphs, we will describe how pediatric sleep medicine evolved beginning from the description of the studies on infant and child sleep that helped the discovery of rapid eye movement (REM) sleep and of the efforts of the researchers for defining the different sleep structures in newborns, infants, and children. In the second part, we will review the clinical picture, analyzing studies on insomnia, parasomnias, respiratory disturbances, narcolepsy, disorders of movements during sleep, and sudden infant death syndrome (SIDS). The third part will illustrate the fascinating stories of sleep researchers that made this process possible and that built the history of pediatric sleep medicine. The final section will be devoted to the description of the birth of different pediatric sleep associations.

Infant's Eyes and the Discovery of REM Sleep

In 1926, during the Russian Academy of Sciences congress, the pediatricians Denisova and Figurin presented the results of their first formal pediatric sleep research showing that, several times during sleep, infants presented episodes, lasting for 10–15 min every half an hour, during which respiration and pulse became irregular and fast and small muscles presented numerous twitches. This periodic instability of physiological functions was present in healthy children, and the authors concluded that "normal sleep is not a state of rest" [8].

As reported by William Dement, this research inspired Kleitman and ultimately led to his decision to observe eye motility during sleep [9]:

> Kleitman had become very interested in what he termed the "basic rest-activity cycle". Being able to read Russian, he was aware of the report of Denisova and Figurin (1926) which described an impressively regular respiratory cycle in infants with a period of 50 minutes . He hypothesized that this short term periodicity ensured that a newborn infant would have frequent opportunities to respond to the stimulus of hunger pangs by waking up and crying, and would therefore get adequate nutrition…
>
> …All of this suggested to Kleitman that eye motility could be the most sensitive measure of the basic rest-activity cycle and also be more representative of changing brain activity, i.e. changing depth of sleep. He then assigned graduate student, Eugene Aserinsky, to observe eye and body motility in infants.

However, the first description that eye movements occur in sleep was reported by de Toni (1933) describing slow rolling eye movements at the onset of sleep which appeared to decrease as sleep continued and presumably deepened [10]. This observation precedes the landmark study that suggested that rapid eye movements represented a "lightening" of sleep and might indicate dreaming, due to the close association with irregular respiration and an increase in heart rate [11].

Before the discovery of REM sleep in 1953, between 1949 and 1952, Aserinsky observed that sleeping infants exhibited a recurring "motility cycle manifested by ocular and gross bodily activity" paralleling the observation of Denisova and Figurin in 1926.

Aserinsky described "periods of motility" (writhing or twitching of the eyelids) and "periods of no motility." The average duration of the periods of quiescence was about 23 min and of the entire motility cycle was approximately 50–60 min. This observation led Aserinsky and Kleitman to look for a similar phenomenon in adults and they discovered REM sleep.

After the description of REM sleep, the French school of Dreyfus-Brisac and Monod [12, 13] begins to study neonates and infants' sleep. Since infants can be easily studied during daytime, Dreyfus-Brisac and Monod attempted to define the specific sleep electroencephalographic (EEG) patterns of infants. N. Monod, invited to the USA by Parmelee, introduced neonatal polygraphic recording to the latter's laboratory and highlighted the need of a full polygraphic investigation including the recording of eye movements, respiration rate, and the electromyogram in addition to the ECG.

At the same time, sleep researchers in Prague described the development of sleep in infancy showing that "quiet" sleep (QS) (regular breathing with frequency of 30/min, closed eyes without movements, disappearance of body movements, spindles, and slow waves in EEG) alternated with "active" sleep (AS) (irregular respiration, eyes alternatively closed, half-open, or there were movements of bulbus oculi, increased frequency of body movements) in about 50–60 min intervals. These authors stated that the most striking changes took place in the first 12 weeks of life [14].

In the following years, Parmelee [15, 16] first showed two distinctive EEG patterns of sleep in infants called "active" sleep (AS) and "quiet" sleep (QS). QS is characterized by preserved chin EMG, few body movements, regular respiration and heart rate, and no eye movements; AS is characterized by rapid eye movements, frequent small face and limb movements, irregular respiration and heart rate, and the absence of or minimal chin EMG activity [17].

The same authors subsequently reported the changes of EEG in infants according to maturation related to conceptional age [18, 19] showing that QS in newborns at term is characterized by one of two EEG patterns: *tracé alternant* or high-voltage slow (HVS) activity:

> Tracé alternant is an EEG pattern in which 3–8 second bursts of moderate to high voltage 0.5–3.0 Hz slow waves intermixed with 2–4 Hz sharply contoured waveforms alternate with 4- to 8-second intervals of attenuated mixed frequency EEG activity; because this pattern alternates between activity and much less activity it is considered to be "discontinuous." In contrast, HVS consists of continuous moderately rhythmic 50–150 μV 0.5–4 Hz slow activity, without the bursting activity of the tracé alternant. HVS represents the more mature pattern of quiet sleep in infants.

Soon after the publication of the standards recommended by Rechtschaffen and Kales for the scoring of sleep stages in adults, it was clear that they were inappropriate for the scoring sleep stages in newborn infants. Therefore, a committee cochaired by Anders, Emde, and Parmelee worked on the definition of criteria for sleep scoring in infants that led to the publication of *A Manual for Standardized Techniques and Criteria for Scoring of States of Sleep and Wakefulness in Newborn Infants* in 1971 [20]. Afterward, Guilleminault and Souquet published a manual on the scoring of sleep and respiration during infancy [21].

In 1970, Dreyfus-Brisac [19] observed that active (REM) sleep could be identified in polygraphic tracings by 32 weeks of gestation because of the presence of frequent body movements, irregular respiration, and rapid eye movements while the eyes were closed.

In 1966 Roffwarg, Muzio, and Dement (1966) firstly described the ontogenesis of sleep states. They also tried to answer the question at what age do humans start having dreams. By observing infants, they confirmed the richness of their rapid eye movements; they therefore supposed that REM sleep was fundamental for the optimal development of the CNS. Roffwarg and colleagues found infants spent half of their total sleep time in REM sleep, leading to the theory that REM sleep must play an important role in the development and maturation of the immature brain [22].

Petre-Quadens in 1970 [23] described for the first time a decrease of REM sleep time and of rapid eye movements in mentally retarded subjects vs. normal children,

supporting the hypothesis of the importance of REM sleep for CNS development and learning. This and other observations led the researchers to investigate the relationships between REM sleep and cognition and memory for the next two decades.

Later on, a better definition of the evolution of different physiological parameters during sleep in infants was achieved by Curzi-Dascalova leading to the publication of a manual of methods for recordings and analyzing sleep-wakefulness states in preterm and full-term infants [24].

The difficulties of the definition of scoring rules for infants, children, and adolescents are mainly related to rapid and dynamic changes that occur during the first two decades of life and to the extreme interindividual variability. The comparison of polysomnographic variables needs serial longitudinal assessments linked to the normal progression of maturation, rather than a single polygraphic study at a single point in time [1].

Besides these difficulties, standards for evaluating sleep in older infants, toddlers, children, and preadolescents have been published in the new American Academy of Sleep Medicine (AASM) manual in 2007 [25] in which a specific pediatric task force was appointed. Not clearly in the manual, but in the associated papers published in the Journal of Clinical Sleep Medicine, a critical review and collection of data defined better the features of the sleep structure during development [26]. Finally, a German group headed by Dr. Sabine Scholle published three papers attempting to define the normative polysomnographic data during development [27–29].

The Gradual Discovery of Sleep Disorders in Infants and Children

There are very few reports on the infant and child's sleep in the antiquity. Aristotle's treatises on sleep and dreaming reported only that "Children sleep more than other people" and that "Very young children do not dream at all" or "Children begin to dream from ages 4 or 5" [30].

In the Roman era, the children were not allowed to get much sleep since it was believed that too much sleep decreased intelligence and stunted growth [31].

According to medieval beliefs about beds and sleeping, between 7 and 9 h of sleep were recommended, but this depended upon individual body types; with all people categorized according to the Galenic four humors, too much or too little sleep could cause dangerous imbalances and lead to illness. Nor did children require more sleep: one late fifteenth-century manual suggested 7 h was sufficient. This would roughly equate to summertime daylight hours, with an extra hour in the winter. In the mid-sixteenth century, physician Andrew Boorde was recommending two periods of sleep at night, with people rising briefly between them. Sleepers should lie first on one side and then on the other, in dry rooms to which snails, spiders, rats, and mice had no access [32].

During the Renaissance, children went to bed early, often before sunset. In boarding school, they slept two in a bed until the age of 14 when they were adults and slept alone. Poor children slept at home in the same bed with their siblings or parents. Children's beds were more like a hay pillow in a frame called a crib or they slept on hay mattresses on the floor. After the age of 7, children only slept with siblings of the same sex, a dog or two on cold nights. Even the aristocrat's children shared their bedrooms with their siblings and their servants. Sleeping alone was considered odd, lonely, and sad. Until the industrial era, sharing the bed with infants and children was the norm: families in the lower ranks routinely slept two, three, or more to a mattress, with overnight visitors included to generate welcome warmth and even brought farm animals within sleeping quarters at night. Besides protecting cows, sheep, and other livestock from predators and thieves, boarding with beasts allowed greater warmth, notwithstanding the "nastiness of their excrement" [33].

In the nineteenth century, there was an increasing interest for pediatric medicine, but the first books published devoted no chapters or even paragraphs to sleep. Child-rearing manuals did not deal with sleep as a problem, despite or perhaps because of extensive health advice in other categories. Sleep was not considered as a problem at that time probably because most activities went on during the night and there were much more possibilities to recover sleep during daytime than actually in modern societies. Surely, individual parents faced children with unusual sleep difficulties, but a sense of a larger category of issues did not emerge.

The reasons why people and doctors did not pay much attention to children's sleep can be different: (a) naps were common; (b) sleep patterns were less rigid; (c) many parents undoubtedly used opiates or alcohol to help the child sleep; and (d) the absence of much artificial light reduced nighttime stimulation and facilitated getting children off to bed.

From the late nineteenth century onward, there have been specific changes in sleeping arrangements with babies increasingly placed in cribs at a fairly young age, rather than rocked in cradles as their parents worked or relaxed. The infants and children had to learn to sleep alone as soon as possible.

Recurrent advices in health columns in popular journals dealt primarily with health precautions during sleep, rather than with sleep itself. There was a discussion of how much covering to place on the child, with concern both about overheating and underprotection; it is interesting to read that cold feet were to be avoided: "neglect of this has often resulted in a dangerous attack of croup, diphtheria, or fatal sore throat."

The first generic recommendations and guidelines about infant sleep and expectations with regard to "normal sleep" can be found in the medical books of the nineteenth century (e.g., "newborns don't sleep for more than 2 hours at a time," "children won't sleep through regularly until about 17 months," "by about six months of age, babies could get used to sleeping at specific times of the day and that mothers should not rush to comfort the baby immediately but should instead see if it resettles on its own).

Contrary to what is expected, the recourse to drug treatment was frequent: for children troubled in sleep, the easy access to and wide use of opiates surely reduced

the need for extensive expert comment on what to do to fight insomnia. At that time, however, there were recurrent warnings focused on the danger of opiates administered to children with fatal events [34].

Looking at the great debate on the adequate amount of sleep need for children, we could be really surprised in reading that in the nineteenth century, attitudes toward sleep involved surprisingly modest requirements of amount: (a) authorities urging early rising recommended going to bed by 10 pm, but then getting up as soon as the infant was compatible with not feeling sleepy or lethargic the next day; (b) infants, having slept uninterruptedly for 9 months in the womb, should sleep at least 12 h; (c) afternoon naps could be abandoned around 2 years of age; (d) by age 3, children should sleep no more than 12 h, and after this, sleep time should be shortened by 1 h per year; thus a 7-year-old should sleep 8 h and certainly no more than 9; (e) adolescents required less sleep still, and authorities explicitly discussing sleep sometimes advocated no more than 6–7 h for adults [35, 36].

With the advent of the industrial revolution, the artificial light, and the regulation of working and school hours, a disrupted night became a highly disturbing event. Social habits have dramatically changed, and obtaining a healthy night sleep was mandatory for optimal social and work functioning. At the same time, sleep has become more and more consolidated into one single bout per night, and also the possibility of ad hoc naps in children was limited by the new social and school rules.

At the end of nineteenth century, doctors noted the importance of sleep in building up "nerve force" in neurasthenic patients. Hypnotics were particularly recommended for sleepless patients, though drugs were often prescribed in the period as well, coming under more critical scrutiny by physicians only in the 1890s.

Problems of children's insomnia began to receive explicit attention, with recommendations of special feeding. The frequency and fervor of advice against using opiates for children increased; parents who assimilated this warning become more concerned about what other remedies to employ. The first tables with indications of sleep timing and duration begun to be published. The 1910 table, backed by the Bureau of Education, insisted on 13 h of sleep for children 5–6, 12 for those 6–8, 11 for those 10–12, 10 1/2 for those 12–14, 10 for those 14–16, and still 9 1/2 for those up to 18. These recommendations were strikingly different from the approach of the nineteenth century. A 1931 table called for 14–16 h for infants, 13–14 for toddlers, 12–13 still until 8 years of age, and on clown to 9 for 16-year-olds.

It was not until the 1920s that child-rearing manuals picked up the question of children's sleep and doctors dispensed sleep advice and recommend increasing amounts of sleep. Establishing a nighttime routine became important with rituals like daily bathing, story reading, toys, or night lights.

The importance of sleep and naps routine was greatly emphasized in the 1920s and 1930s. The American Medical Association highlighted the significance of a regular sleep schedule and even claimed that a "half-hour variation from this schedule … may induce masturbation, surreptitious reading in bed, restlessness, and inability to concentrate in school."

Children's sleep became a new kind of issue from around the 1920s. Nineteenth-century parents had undoubtedly worried about their charges' sleep, at least in particularly difficult cases.

After 1920, specific advice increased the amount of sleep held to be essential and the explicit scheduling required. Children had been sleeping for hundreds of thousands of years, with considerable apparent success. Why the new fuss, and new directives, early in this century?

An interesting paper tried to answer to these questions [34].

An important contributing factor was the increase of specialists in children that delivered the guidelines for the "correct behavior of infants and children" and were eager to export the findings of science to a parental audience. Further, the major improvements in infant health with the decrease of deaths in childbirth as well as the possibility of a novel arrangement for children's beds determined that infants were increasingly isolated from adults for sleep, placed in their own bedrooms, and early separated not only from parents but also from the nurse. This leads to a decrease of parental controls on infant's sleep behavior with the difficulty to interpret the nighttime behavior (crying, awakenings).

Due to the decrease of the use of opiates, parental concerns about children's sleep increased, and the opiates have been substituted by over-the-counter soporifics that had become the most widely prescribed of all drugs, as of today.

The First Scientific Publications on Sleep in Infants and Children

A specific search in PubMed looking at the first scientific publications on pediatric sleep found some interesting papers that could give us a picture of how sleep in infants and children was considered in the first decades of the last century. In one of these papers, *Sleep Requirements of Children* published in the California State Journal of Medicine in 1921, there were recommendations for the amount of sleep for each age and several statements of common sense that would have been demonstrated scientifically several years later by the literature [37]:

> The Service commends the following precepts just issued by the London County Council: School children aged four years need twelve hours' sleep a day; aged five to seven, eleven to twelve hours; eight to eleven, ten to eleven hours; and twelve to fourteen, nine to ten hours.
>
> Children grow mainly while sleeping or resting; do you want yours to grow up stunted?
>
> Tired children learn badly and often drift to the bottom of the class; do you want yours to grow up stupid?
>
> When children go to bed late their sleep is often disturbed by dreams and they do not get complete rest; do you want yours to sleep badly and become nervous?
>
> Sufficient sleep draws a child onward and upward in school and in home life; insufficient sleep drags it backward and downward. Which way do you want your child to go?
>
> Tiresome children are often only tired children; test the truth of this.

> That a neighbor's child is sent to bed late is not a good reason for sending your child to bed late; two wrongs do not make a right. Going to bed late is a bad habit which may be difficult to cure; persevere till you succeed in curing it.

In a meeting of the British and Canadian Medical Associations, in 1931, Dr. Cameron categorized sleep disturbances as follows: (1) sleeplessness and continuous crying in young infants, (2) sleeplessness in older children, (3) night terrors, and (4) enuresis. He identified three causative factors for sleeplessness in infants: (a) pain (mainly colic or dyspepsia or aerophagy treated with chloral hydrate 10 min before each feed) or discomfort (nasal obstruction treated with few drops of adrenaline solution in the nostrils before the child is put to the breast), (b) inherited or constitutional neuropathy (which resembles the description of neonatal hyperexcitability), and (c) faulty management (which resembles the description of behavioral insomnia of childhood) [38].

Dr. Cameron affirmed that most infants who are sleepless and who cry constantly without any specific pain or discomfort do so because the management is faulty. Dr. Cameron also suggested practices to help crying infants, such as the primitive habit in all countries of putting the crying infant in the swaddling clothes and enveloped in the steady pressure of a light and porous shawl or putting him up against the mother's back (as in the African culture), so that he takes no part in the expression of her emotions, and divulging her thoughts from the child would lead the restless infant to soundly fall asleep. He finally expounded on a theory by which hypoglycemia or the presence of ketone bodies in the blood leads to enuresis, sleepwalking, and night terrors.

In a paper published in 1936 [39], the causes of disturbances of sleep in children had been classified as:

1. *Constitutional neuropathy* that included restless children who did not fall asleep easily and who were easily aroused by even trivial environmental stimuli; this was attributed to a calcium deficiency and treated with calcium.
2. *Sleep disturbances accompanying disease*: in infants painful conditions like otitis media, pain of colic and intestinal disturbances, hunger, teething, and eczema and in older children, renal colic, rheumatic fever, cardiomyopathies, and respiratory difficulties. Preferred treatments were narcotics (codeine very effective) and the barbiturates were given freely, especially when there was considerable restlessness.
3. *Faulty physical and mental hygiene*: disturbed sleep or failure to fall asleep may be due to uncomfortable or too much clothing or emotional disturbances. The author suggested that in infancy, faulty sleeping habits are easily established and difficult to overcome. Overstimulation, as represented by a too ambitious school program, too many extracurricular activities (dancing, music lessons, etc.), premature and untimely participation in social affairs and pleasures of the adult, unsuitable movies, and radio programs, is not conducive to restful sleep.
4. *Temperatures on the child*: the high temperature would determine a tremendous increase of the child's motor activity.

5. *Heavy meals*: a heavy meal at night is prone to cause not only excessive motor activity but terrifying dreams, crying out in sleep, and a constant turning in bed.

The famous pediatrician Benjamin Spock, in the late 1940s, made recommendations that have been greatly influential throughout the next several decades. The advices for getting the baby to sleep were "The cure is simple: Put the baby to bed at a reasonable hour. Say goodnight affectionately but firmly, walk out of the room, and don't go back…" [40].

In a following paper in pediatrics [41], Spock stated that chronic resistance to sleep in infancy is a behavior problem which was formerly rare but was becoming more frequent, and its frequency seems related to the trend toward self-regulation to babies and to confusion in how to apply this philosophy. The treatment of sleep problem in the baby less than 1 year of age with the crying out method showed that most of these babies would cry indignantly from 10 to 20 min the first night and perhaps 5–10 min the second night, but a great majority of them would be cured of sleep disturbance within two nights. Spock emphasized that this policy of letting the baby "cry it out" is recommended only for chronic resistance to sleep in the infant up to the age of 1 or 1.5 years.

In 1949, an interesting paper analyzed for the first time sleep disturbances in 100 children (5–14 years old) with primary behavior and emotional disorders at Rockland State Hospital, Children's Group. Sleep disorders were grouped into five categories:

- 1. Restlessness and minor disturbed states of sleep were found in 46 cases, divided into two subgroups: (a) restlessness such as rolling, rocking, tossing, and jerky movements and (b) talking, mumbling, crying, and swearing.
- 2. Nightmares were found in seven cases.
- 3. Night terrors in two cases.
- 4. Sleep walking in one case.
- 5. Enuresis in 26 cases.

The most frequent disorders were restlessness and minor disturbed states of sleep and enuresis that apparently occurred frequently in rejected children, while nightmares, night terrors, and sleep walking were relatively infrequent [42].

Kleitman in a paper entitled "Mental hygiene of sleep in children" [43] described perfectly for the first time the features of behavioral insomnia of childhood stating that "the child is born with certain capacities for learning, including the ability to synchronize, with ease or difficulty, the primitive sleep-wakefulness cycle with diurnal periodicity in his physical and social environment. To establish good sleep habits in children it is necessary to cooperate with the natural tendency to develop a persistent 24-hour rhythm, reinforcing the latter by the customary methods of conditioning." Moreover, he acknowledged the individual variability for the need of sleep and warned about the recommendations on the amount of sleep needed for the infants and children. He affirmed that "the total time spent in sleep, out of each diurnal period, decreases with age, but not uniformly in all children nor in a particular child at different ages. Tables of hours of sleep provided as a guide to parents are misleading in that the figures suggested for all ages are arbitrarily high. Even if

more realistic, such figures could stand only for averages, which, by and large, are meaningless when the individual child is considered."

During the period 1950–1970, the literature on sleep problems in children increased steadily. Ronald Illingworth published several papers attempting to categorize sleep disturbances in infants and children [44, 45].

Concluding one paper on sleep problems in the first 3 years of age, he indicated the difficulties in treating sleep problems reporting that it is not sufficient to instruct on sleep hygiene rules or to give a drug and finally acknowledged the complexities of the treatment of sleep problems.

In the 1966 paper [45], Illingworth summarized the causes of sleep problems in children as follows:

1. Problems Related to Parents.
2. Habit Formation
3. The Child's Ego and Negativism
4. Sleep Needs.
5. Developmental Patterns.
6. The Child's Love for His Parents.
7. Causes of awakenings
8. Errors Concerning Bedtime
9. Other Emotional Factors
10 Unknown Causes

The treatment of sleep problems at that time was based on common sense and on the beliefs of a single pediatrician. Illingworth suggested that it is wrong to pick a child up at the first whimper but also that it is essential to go immediately to his room when a child wakens with a sudden scream because at these times it would be not only cruel but possibly dangerous not to go to him. He stated that drugs have little place in sleep problems and phenobarbital is useless with these children and suggests chloral hydrate given 0.5 h before bedtime as the best drug for this problem. Finally, he reported that, in some cases, unfortunately, the parents should accept the early morning awakenings as one of the penalties of having children.

In the 1950–1960s, different studies attempted to define the normative parameters of sleep in children as well as the frequency of sleep disturbances. A paper analyzed the frequency of night awakenings in 1957, finding a prevalence of 17 % at 6 months and 10 % at 12 months [46]. In a longitudinal study, Klackenberg in 1968 defined the sleep behavior of children up to 3 years of age [47].

The New Era of Pediatric Sleep: Contribution by Researchers from Different Countries

There is no doubt that pediatric sleep medicine received a strong initial input from European researchers 50 years ago. In France, Belgium, Italy, and Germany, researchers begun to publish on the early development of the sleep cycle, sleep EEG, and sleep behavior in infants [48].

The French group (Dreyfus-Brisac, Monod, Curzi-Dascalova) worked on the definition of the features of the sleep EEG and respiratory and cardiovascular parameters in newborns and infants. The studies by the Italian group of Salzarulo and Fagioli shed light on sleep organization and sleep states during development. The French researchers also contributed to the characterization of sleep apnea, parasomnias, and narcolepsy (Marie Jo Challamel) together with Sona Nevsimalova, from Prague (Czech Republic). In Belgium, André Kahn and his group (Patricia Franco and José Groswasser) made important advancements in clarifying the mechanisms of the sudden infant death syndrome (SIDS) and infant sleep apnea.

Thanks to André Kahn, in the 1990's a medial campaign was launched about infant's sleeping position ("back is best"), and therefore, the SIDS risk was greatly diminished.

In Germany, Prechtl described sleep patterns before and after birth, emphasizing the concept of "state"; other German groups made a big effort to characterize the features of sleep EEG during development (Schölle), as well as the characterization of infant sleep apnea (Poets). In the UK, Stores investigated mainly sleep in children with mental retardation; other sleep researchers were also involved in the research in pediatric sleep (Wiggs, Gringras, Hill, Fleming, and others).

Halasz from Hungary published several papers on the neurophysiology of sleep and on the relationship between sleep and epilepsy in children.

Another group of Italian researchers (Bergonzi, Gigli, and Ferri) started to explore sleep neuro- and psychophysiology in children with mental retardation, in an international collaboration with Grubar in France and Petre-Quadens in Belgium.

The first specific sleep questionnaires have been published in the last 1990s: the Sleep Disturbance Scale for Children by Oliviero Bruni [49], the Child Sleep Habits Questionnaire by Judith Owens [50], the Pediatric Sleep Questionnaire by Ronald Chervin [51], and several others.

In Italy, Oliviero Bruni and his group, in strict collaboration with Raffaele Ferri, made a great effort to advance the definition of sleep microstructure in children, characterizing the alterations of the cyclic alternating pattern in normal children and in those with neurodevelopmental disabilities. Giannotti and Cortesi explored the sleep habits in adolescents and the sleep problems in children with neurodevelopmental disabilities such as autism and epilepsy. In Sicily, Silvestri has contributed to the definition of sleep disorders in children with ADHD. Contributions on sleep apnea in children and on the treatment with orthodontic apparels have been reported by the group of Maria Pia Villa. In Spain an enthusiastic group of researchers gave a big contribution in the different fields of pediatric sleep. Among them, Rosa Peraita-Adrados, co-founder of the Iberian Association of Sleep Pathology and research fellow at the Stanford University, made contributions on infants' sleep and neurological disorders and was editor of a Book "Trastornos de Sueño en la Infancia" (1992), with an important dissemination in the Spanish speaking community worldwide. Eduard Estivill was a pioneer for treatment of pediatric insomnia; Teresa Sagales made contributions on epidemiology and pediatric neurology; Gonzalo Pin Arboledas as well as many other Spanish researchers on consensus documents for common pediatric sleep disorders.

In Israel, following the input by Peretz Lavie, Avi Sadeh studied how to investigate sleep in infants objectively and less invading and developed the actigraph and characterized the algorithm for scoring actigraphic recordings in infants and children. Further, his studies on normative sleep data in children and on the relationships between sleep and academic achievement made a great advancement in the pediatric sleep field.

In the USA, Richard Ferber, from the Children's Hospital of Boston, was the first to publish a comprehensive book for treating behavioral insomnia in infants and children which had an enormous success, so that the acronym "ferberize the child" is currently used to indicate the application of the behavioral techniques to solve insomnia of infants and children.

At the University of California, Los Angeles, a child psychiatrist, Thomas Anders (coauthor of the manual for sleep scoring in infants together with Emde and Parmalee) focused his research on ontogenesis of sleep-wake states from infancy through early childhood and on sleep disorders in children with autism and other neurodevelopmental disorders. He classified infants as self-soothers or signalers, depending upon whether they cry following a nighttime awakening or whether they put themselves back to sleep without signaling to their parents.

Christian Guilleminault at Stanford University is the researcher who established the branch of sleep medicine in childhood; he can be considered as a pioneer of pediatric sleep medicine, and there is no branch of pediatric sleep medicine to which he has not contributed.

Mary Carskadon started her career at the Stanford University and, along with Dr. William Dement, she developed the Multiple Sleep Latency Test. Her research on adolescent sleep-wake behavior and consequences of insufficient sleep in adolescents raised public health issues and determined some changes in the public policy, such as a later school start time in secondary schools.

Another huge contributor to the field of pediatric sleep is David Gozal with fundamental researches in the last 20 years that have revolutionized the studies on sleep apnea in children. He studied, in particular, the relationships between respiratory sleep disorders and neurobehavioral, cardiovascular, and metabolic diseases and the mechanisms that mediate defense responses that lead to complications from low oxygen levels, disrupted sleep, and long-term health and developmental consequences of chronic sleep and breathing problems during childhood.

Carole Marcus' studies shed light on diagnosis and management of childhood OSAS and on the use of positive airway pressure therapy in children heading the publication of several clinical practice guidelines on OSAS.

In the field of insomnia in childhood, Judith Owens made significant contributions on the pharmacologic treatment of sleep disorders in children and on the interaction between sleep and ADHD, as well as on the impact of delaying school start time on adolescent sleep, mood, and behavior. Jodi Mindell, a clinical psychologist specializing in pediatric sleep medicine, has published many papers on the treatment of behavioral insomnia in childhood, on pharmacologic treatment of pediatric sleep disorders, on cultural issues impacting sleep, and on the cultural differences in sleep patterns and behaviors.

Ronald Chervin made several important contributions on neurological and behavioral effects of sleep disorders; his studies highlighted the importance of disrupted sleep and described an association between inattentive, hyperactive behavior and symptoms of two primary sleep disorders: OSAS and RLS.

In Canada, Brouillette, over the past 30 years, made major contributions to the understanding of childhood OSAS and other controls of breathing disorders; he also developed a specific scale to assess the clinical severity of OSAS and evaluated the utility of oximetry for the diagnosis of OSAS in children.

More recently, Gruber, from McGill University in Montreal, showed the importance of an adequate sleep duration for optimal functioning in children, demonstrating that even a small sleep deprivation has serious consequences for health and daytime functioning in normal and ADHD children.

Pediatric sleep researchers in Australia in the last years (Horne, Blunden, Matricciani, Olds, Lushington, Kennedy, Kohler, Gradisar, and others) have produced significant and important papers on the cardiovascular control during sleep in neonates and children, on the declining trend of sleep duration in children and adolescents, on cognitive functioning in normal children and in children and infants with sleep-disordered breathing, on the behavioral treatment of sleep disorders in children, and on the impact of technology in adolescents' sleep.

South America, Brazil, and Chile had several prolific researchers: in Chile, Peirano and Algarin conducted several studies on the effect of iron deficiency anemia on sleep in children; in Brazil, several researchers such as Tufik, Lahorgue-Nuñes, Lopes, and Alvés also made substantial contributions.

In Japan, Segawa, in collaboration with Nomura, after the discovery of dopamine-responsive dystonia, explored the body movements during sleep in infancy as indicators for the detection of normal or abnormal CNS development. At the same time, Okawa defined the disorders of the circadian rhythm in brain-damaged children, while other sleep researchers such as Kohyama, Komada, Kato, and many others continued to work in the pediatric sleep medicine field.

Many Asian countries are actually growing in the pediatric sleep medicine field, as acknowledged by the increasing number of publications especially from China, Hong Kong, Taiwan, Singapore, and Thailand, and probably new insights and new developments from other developing countries should be expected [48].

The Establishment of the Pediatric Sleep Associations

The rise of pediatric sleep medicine as a specific field was not an easy process. The marginal place in the sleep congresses in the 1970s was clear too strict for this emerging area, linked to the evidence that most of the adult sleep disorders begin in childhood or even in infancy with specific age-related clinical expressions. Therefore, it was immediately evident that a specific "pediatric sleep knowledge" would have been required in order to identify and treat correctly the different sleep

disorders of infants and children. Starting with small symposia or satellite meetings during the congresses of the main sleep adult societies like the European Sleep Research Society (ESRS) and the Associated Professional Sleep Societies (APSS), the exponential and huge growth of contributions by pediatric sleep researchers rise the exigency to develop independent pediatric sleep associations.

The European Pediatric Sleep Club

Pediatric sleep medicine in Europe started within the ESRS and paralleled the development of this society. In the late 1980s, a group of pediatricians, child neurologists, psychiatrists, and psychologists interested in sleep during development began to join in informal meetings during the early ESRS congresses. They were represented by most eminent sleep researchers that made the history of pediatric sleep medicine: Dreyfus-Brisac, Monod, Curzi-Dascalova, Dittrichova, Mirmiran, Prechtl, Salzarulo, Fagioli, and Kahn worked together to start the European research of infant sleep. Other researchers joined this initial group like Navelet, Challamel, Guilleminault, Vecchierini, Gaultier, Stores, Peraita-Adrados, Nevsimalova, Katz Salomon, Poets, and many other scientists. After the preliminary informal meetings, this group of scientists subsequently constituted the European Pediatric Sleep Club (EPSC) as a part of the ESRS, aimed at consolidating the area of pediatric sleep medicine, with the goal to bring together clinicians and researchers from different disciplines. The EPSC had its own meeting every year since the first one in 1991 in Paris and joins the ESRS Congress every 2 years.

The EPSC meetings were held in Paris (1991), Helsinki (1992), Prague (1993), Firenze (1994), Messina (1995), Brussels (1996), Lyon (1997), Madrid (1998), Dresden (1999), Istanbul (2000), Bled (2001), Reykjavik (2002), Rome (2003), and Prague (2004). Following the efforts by André Kahn, the International Pediatric Sleep Association (IPSA) blossomed in 2005 from the EPSC.

The Pediatric Sleep Medicine Conference

The inaugural Pediatric Sleep Medicine Conference was held in Amelia Island, Florida, in February 2005. The meeting was cofounded by Jodi Mindell and Judith Owens, with the objective of bringing together pediatric sleep experts from around the world to share sleep science. The meeting also sought to define priorities for basic and clinical research, patient care, and public policy for the emerging field of pediatric sleep medicine. The conferences included pediatricians, pulmonologists, psychologists, psychiatrists, and neurologists, as well as social workers and nurses. The meeting was held yearly until 2009, at which time it became a biannual meeting offset by biannual meetings of the IPSA. The meeting continues to be held in Amelia Island, Florida, and now includes courses on best practices in pediatric sleep medicine and pediatric polysomnography.

The International Pediatric Sleep Association

The story of IPSA is strictly linked to the EPSC, as mentioned above. The creation of this international association was the dream of André Kahn and was initiated in 2003 by his efforts and by his dedication to the field of pediatric sleep medicine. The author of this chapter has been involved in this project by Dr. Kahn and was honored to work with him. Unfortunately, shortly before his 61st birthday, André Kahn abruptly died on September 1, 2004, in Brussels, at the end of his usual karate training session. Despite his absence, but following his inspiration, during the last EPSC meeting in 2004 in Prague, it was decided to build up a new international association. It was not an easy step, since there were long debates about the nature of this association which was initially intended as a "clinically oriented" organization. Also there were other uncertainties about the lack of the strength and the power to build this association and several uncertainties about scientific and financial support.

However, the following year, during the World Association of Sleep Medicine (WASM) meeting in Berlin, the IPSA was founded on October 13, 2005, with the crucial contribution of Christian Guilleminault. The bylaws were created stating the mission of IPSA: (a) to promote basic and applied research in all areas of sleep in infants, children, and adolescents, (b) to provide topical information to the public about pediatric sleep, (c) to increase the knowledge of pediatric sleep problems and their consequences, (d) to promote teaching programs on pediatric sleep, (e) to hold scientific meetings, and (f) to provide information to the public about perspectives and applications of pediatric sleep research.

The first board was elected and appointed in 2007, with the aim to represent nearly all the countries in the world in which pediatric sleep medicine was pursued, for a 4-year term, consisting of Oliviero Bruni as president, Christian Guilleminault as vice-president, and Patricia Franco as secretary. The Board of Directors comprised Ronald Chervin, David Gozal, Avi Sadeh, Patricio Peirano, Magda Lahorgue-Nuñes, Rosemary Horne, and Daniel Ng.

In 2007, IPSA has been affiliated with the Elsevier's journal *Sleep Medicine*, an affiliate of the World Association of Sleep Medicine (WASM), and in 2009, it joined the Pediatric Sleep Medicine Conference.

From 2007 to 2009, IPSA meetings were held as part of the WASM congresses, but in 2010 the first independent IPSA congress was organized by Oliviero Bruni in Rome. The congress was a huge success in terms of participants and high scientific quality, with 203 abstracts, 64 symposia, 1 pediatric sleep course, 1 keynote lecture, and 34 countries represented worldwide.

After this successful meeting, it was decided to continue to have an IPSA meeting every 2 years in different parts of the world. The second IPSA meeting was held in Manchester (UK) in December 2012, and the third IPSA meeting was held in Porto Alegre (Brazil) in 2014. The next meetings will be in Taiwan in 2016 and in Lille (France) in 2018.

The IPSA congresses aim to lead to a substantial advancement of pediatric sleep medicine, collecting the most renowned international speakers and giving to all participants the opportunity to share knowledge in sleep medicine and research.

In 2012, with the help of Allan O'Bryan (WASM), the IPSA Foundation (a non-profit organization) has been created to raise funds from different sources, such as industries and pharmaceutical companies, in order to allow fund-raising for scientific and charity purposes.

Conclusions

The historical overviews always have limitations, and also this representation of the birth of pediatric sleep medicine as an independent field probably has forgotten to cite some fundamental researchers. The aim was to delineate the emergence of pediatric sleep depicting the progressive awareness on sleep of infants, children, and adolescents.

A huge amount of studies in the last decades have demonstrated that almost all sleep disorders have a negative impact on the child health.

The field of pediatric sleep medicine is currently growing in the different countries with huge possibilities of expansion. Innovative researches will highlight the role of sleep in brain plasticity and in integrating neural networks required for early brain development. Further, new studies will lead to a better knowledge of the development of sleep and of the effects of sleep disruption on behavioral disorders, problems of attention, and learning disabilities.

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