

Adolescent sleep

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Written by Ann Hagell

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WELCOME

AYPH's latest Research Update focuses on the neglected but important topic of adolescent sleep and sleep disorders. This summary presents the main messages and a selection of the resources identified. Topics covered by earlier updates include Long-term Conditions, Accidents and Injuries, Health Inequalities, Disability, Physical Activity, Alcohol & Substance Use, Teenage Pregnancy & Sexual Health, and Mental Health & Emotional Wellbeing. You can obtain the full version of this paper, along with copies of all our past and future updates, by joining AYPH (www.ayph.org.uk).

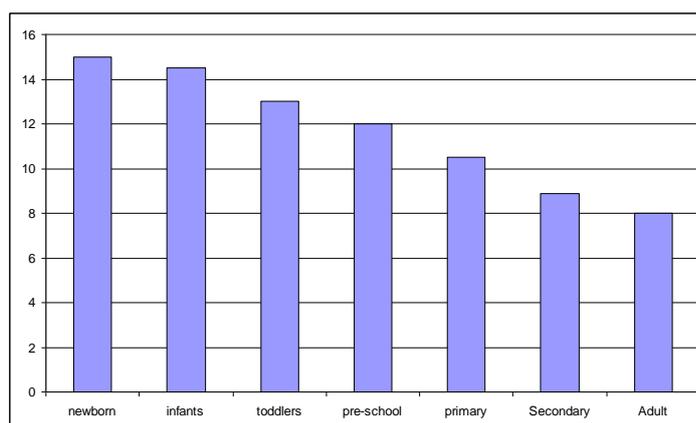
This paper is not based on a formal review of the literature, but presents an overview of the issues, and a useful selection of key, up-to-date findings on adolescent sleep, the links with health outcomes, and sleep disturbances.

WHAT DO WE KNOW ABOUT ADOLESCENT SLEEP AND WHY IS IT IMPORTANT?

Adolescent sleep is important because it might be both a cause and the result of health problems. However, it still remains a neglected topic in adolescent health research, partly because there are widespread misunderstandings about adolescents' needs for sleep. In fact, the sleep needs of teenagers are not very dissimilar to those of primary school aged children. They

remain higher than adult needs across the second decade of life; probably because sleep plays a big part in creating the environment for healthy brain development, and as research tells us, adolescent brains are still changing and refining across this age period.

Figure 1: Sleep needs across development



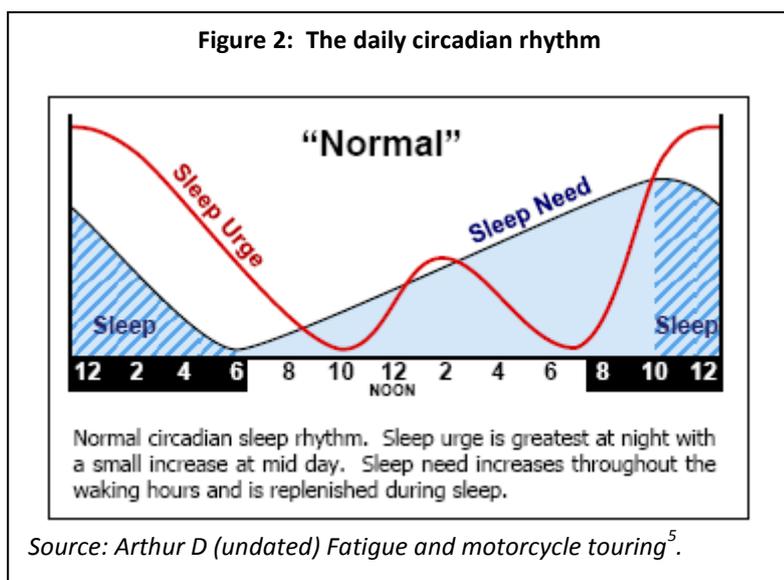
Source: National Sleep Foundation ¹

Figure 1 shows the 24 hour sleep need figures from birth to adulthood as recommended by the American National Sleep Foundation¹, but this figure for adolescents may be an underestimate; an early study by Carskadon and colleagues showed young people across the ages from 10-17 slept about nine hours and 20 minutes in laboratory conditions.²

The fact that young people sleep less than they did as younger children, and are inclined to stay up later than adults, is not the result of a need for less sleep, it is the result of what Carskadon called ‘..a perfect storm of biological, psychosocial and cultural forces’.³ Before looking at recent research and reports on the links with health, we begin with a very brief background on the biology of adolescent sleep.

Biology of sleep: Sleep is believed to involve two independent but related processes⁴:

- **A daily ‘circadian’ rhythm**, coming from the brain’s ‘central clock’, a group of nerve cells in the brain called the suprachiasmatic nucleus (SCN), located in the hypothalamus. Working roughly on a 24 hour cycle, the SCN decides what time of day it is (on the basis of, for example, light) and then controls production of a hormone called melatonin, which induces sleepiness. Some indoor lighting does affect circadian rhythms, but it has to be very bright and of a certain wavelength (or colour); lights in the blue range are more important in this respect.



- **The sleep-wake pressure (homeostatic) system (sleep ‘urge’)**, reflecting the need for or pressure for sleep. The longer the person is awake, the more the system favours sleepiness. The longer they are asleep, the more it encourages wakefulness. Also note the small extra urge in the middle of the afternoon shown on the graph (Fig 2).⁵

During any given period of sleep there are two main types of sleep; Non-Rapid Eye Movement (NREM), and Rapid Eye Movement (REM), the latter thought to be when more vividly recalled dreams happen. Sleep also progresses through a series of different stages, during which different brain wave patterns are displayed (theta waves in the early, lighter stages; delta waves in the latter, deeper stages). Over the course of one night a number of cycles through the various different sleep types occur. Much of the function of these various aspects of sleep remains something of a mystery.

The full version of this paper includes a list of further reading; useful overviews, reviews, and editorials.

Key characteristics of adolescent sleep: What we do know is that adolescents tend to be ‘owls’ rather than ‘larks’, and as a result they tend to be sleepier than other age groups. Of course there will be individual differences that may range widely, but the key characteristics of usual adolescent sleep patterns include:

- The **circadian timing system** of adolescents tends to slow down through the process of puberty and lags behind that of the rest of the population.
- In addition, **the sleep pressure system** changes in a way that makes it easier to stay awake longer.
- As a result, **the classic pattern is of teenagers** who take longer to fall asleep at night and do not wake spontaneously in the morning. This pubertal ‘phase delay’, was only identified in the lab in the early 1990s. Interestingly, this pattern has also been found in adolescents of other species, so it presumably serves some kind of evolutionary purpose.
- In addition, pubertal and postpubertal adolescents show **different patterns of alertness** across the day.

The combination of societal pressure from early school and college starts, and social pressure from electronic communication devices, laptops and 24 hour entertainment cycles, work with this adolescent ‘owl’ tendency to create particular problems for today’s generation of young people. In particular, they sleep too little, and they are asked to be alert at inappropriate points in their circadian rhythms.

ADOLESCENT SLEEP DISORDERS

What are the key adolescent sleep disorders? Classification systems vary, but the following are the most commonly recorded:^{6,7} Sleep disorders normally need to be diagnosed by a paediatrician or sleep specialist. A referral to a sleep clinic may result.

- **Delayed Sleep Phase Syndrome (DSPS).** The most common of adolescent sleep disorders, this circadian rhythm disruption affects an estimated seven per cent of the adolescent population.⁸ People with DSPS tend not to sleep until 2-4am, wake very late in the day, feel tired until the evening, and there is a strong overlap with depression.
- **Night terrors:** Although more common in younger children, this can affect adolescents (around two per cent)⁹, including feelings of dread or terror, with episodes of waking bolt upright, eyes open, heart pounding, of which the child has no memory. Sometimes overlaps with post traumatic stress disorder (PTSD) and generalised anxiety disorder.
- **Sleep walking:** This is also more common in pre-pubescent children, prevalence peaking at around one in six at age 8-12 and usually outgrown without intervention.⁹
- **Sleep-onset anxiety:** Difficulty falling asleep because of excessive fears or worries.
- **Obstructive sleep apnea:** Obstructed air passages can lead to snoring and difficulty breathing during sleep. It affects around two per cent of children; figures for adolescents not given separately¹⁰.
- **Restless legs syndrome:** This is a persistent urge to move the legs with uncomfortable and unpleasant sensations, worse at night and accompanied by distress, and mood disturbance.
- **Narcolepsy:** This is a rare neurobiologically based genetic condition that may first appear in adolescence, including falling asleep suddenly and unexpectedly, and sleep onset-paralysis.

LINKS WITH HEALTH

- **Accidents.** Contributing factors, particularly in road traffic accidents, include low nocturnal sleep time, poor quality sleep and self-assessed insufficient sleep¹¹, all characteristic of adolescents.
- **Fatigue and stress.** The association of fatigue and mood with sleep need and sleep loss has been reported to be more pronounced in younger (adolescent) subjects.¹²
- **Depression and anxiety.** Extensive links have been reported, particularly with certain types of anxiety – generalised anxiety, panic/agoraphobia and social anxiety.¹³
- **Behavioural difficulties** (attention and conduct). Sleep deprivation may lead to compromised alertness and neurobehavioural functioning, and thus may be linked to symptoms of ADHD.¹³
- **Risky health behaviour.** High school students have been shown to have elevated odds of engaging in, for example, smoking and substance use if they have insufficient sleep.¹⁴ There are very few studies on this kind of link, but if it is robustly replicated in other samples, it requires further attention.
- **Obesity.** A number of studies have pointed to a clear association between being overweight/obese and unmet sleep need. In a meta-analysis of published studies sleep deprivation was associated with an almost two fold increase in being obese in children.¹⁵

A school district in Kentucky, USA, moved its start time one hour later. Teenage car accidents in the district went down by 16 per cent, when the rest of the state showed a nine per cent rise.

What drives these links? We do not know yet, but possibilities include an impact on immune function, links with endocrine (hormone) and metabolic function, or shared lifestyle risks underlying both sleep and health outcomes.

ADOLESCENT SLEEP AND LONG-TERM CONDITIONS

Finally it is important to note the high overlap between long-term health conditions such as asthma, chronic kidney disease, juvenile arthritis, epilepsy and chronic pain conditions, and sleep problems. This is partly because of a higher rate of airway restriction in some conditions, side effects of medication, disruption to routines through hospitalisation, or effects of anxiety and stress. Studies suggest that around a half of patients with long-term, chronic conditions will show sleep disturbance.^{16,17} In a recent review, Lewandowski et al (2011) stress that poor sleep can exacerbate chronic conditions and must be considered

Half of patients with long-term chronic conditions will show sleep disturbance.

a critical part of the assessment and treatment.¹⁸ The links might be particularly through an impact on depressive symptoms.¹⁹

RECENT REPORTS

RCPCH (2009) Working party on sleep physiology and respiratory control disorders in childhood:

There are very few UK based reports on sleep that include a focus on adolescence. In this example, they are not treated separately from children as a whole, but the report does provide a series of recommendations about diagnosis and treatment, and the British Sleep Society UK Provider Directory.

RECENT RESEARCH

Adolescent sleep is a neglected research topic in the UK and, as always, there is the perennial problem of finding research material that focus directly on adolescents, not just on children and young people in general. This is a selection of those included in the full paper:

The effects of sleep restriction and extension on school-age children: What a difference an hour makes.

Sadeh A, Gruber R and Raviv A. (2003) *Child Development*. 74, 444-455

This widely cited study from Israel monitored the sleep of 77 children (9-12 years) for five nights. Manipulating their sleep led to significant neurobehavioural functioning differences, alertness, reaction time, fatigue, and sleep latency.

Meta-analysis of short sleep duration and obesity in children and adults.

Cuppuccio F, Taggart F, Kandala N-B, Currie A, Stranges S and Miller M (2008) *Sleep*, 31, 619-626

Results of a systematic search and combination of research results from 30 studies including over 600,000 participants, of whom 30,000 were children, undertaken by the University of Warwick Medical School in Coventry. Results showed a consistent increased risk of obesity for short sleepers.

Adolescent sleep, school start times and teen motor vehicle crashes

Danner F and Phillips B (2008) *Journal of clinical Sleep Medicine*, 4, 533-535

This study compared the sleep habits of students from a county-wide school district before and after a change in the school start times. Average hours of nightly sleep increased with the one hour delay in school start times, and average crash rates in the two years after the change dropped 16.5%.

The tired teen: A review of the assessment and management of the adolescent with sleepiness and fatigue

Findlay S (2008) *Paediatr Child Health* 13, 37-42

An approach to managing the fatigued teen is outlined, consisting of the following steps:

- Improving function through increased activity and fitness
- Focusing on stabilising school and social life, leaving employment and extracurricular activities aside
- Provision of clear advice on sleep hygiene
- Potential use of cognitive behavioural therapy

Earlier parental set bedtimes as a protective factor against depression and suicidal ideation.

Gangwisch J, Babiss L, Malaspina D, Turner B, Zammit G and Posner K (2010) *Sleep*, 33, 97-106

Drawing on nationally representative data, this study looked at the role of parent-set bedtimes in health outcomes for young people aged 12-17 years. For example, adolescents with parental set bedtimes of midnight or later were 24% more likely to suffer from depression.

A motivational school-based intervention for adolescent sleep problems

Cain N, Gradisar M, Moseley L (2011) *Sleep Medicine*, 12, 246-51

Year 11 students in an Australian secondary school were subject to four 50-minute sleep education classes held weekly. Students in the intervention group increased their knowledge about sleep, and were more motivated to improve their sleep routines.

Poor sleep quality and emotion processing in adolescents

Soffer-Dudek N, Sadeh A, Dahl R, and Rosenblat-Stein S (2011) *Sleep*, 34, p1499-1508

The sleep of 94 ten year olds was assessed every year for three years (using actigraphy for seven nights). Elevated night awakenings and decreased sleep efficiency was associated with poorer performance in an emotional information processing task.

Prevalence of sleep disturbances in children and adolescents with chronic kidney disease.

Davis I, Greenbaum L, Gipson D, Sinha R, Matsuda-Abedini M, Emancipator J, Lane J, Hodgkins K, Nailescu C, Barletta G, Arora S, Mahan J and Rosen C (2012) *Pediatric Nephrol.* 27, 451-9

In this American clinic-based study, over half (53%) of 159 school-aged patients with chronic kidney disease had symptoms of a sleep disturbance. Sleep disturbances were in turn related to lower quality of life scores.

Davis et al – 53% of school-aged children with chronic kidney disease had symptoms of a sleep disturbance

EXAMPLES OF CURRENT UK INITIATIVES

Wilson SJ, Nutt DJ, Alford C et al (2011) British Association for Psychopharmacology consensus statement on evidence-based treatment of insomnia, parasomnias and circadian rhythm disorders. *Journal of Psychopharmacology*, 24(11) 1577-1600. Downloadable from http://www.bap.org.uk/pdfs/BAP_Sleep_Guidelines.pdf

Secondary school experiments: Unlike the USA, the UK has not systematically evaluated experiments to change the school start time, although three secondary schools in North Tyneside and Kent have tested a later start time of 10am and have reported anecdotal information on reductions in absence and persistent absenteeism.

REST – Resources for effective sleep treatment, e-learning package. www.restproject.org.uk
The REST project was funded by the Health Foundation to improve care for people with insomnia. An e-learning package is designed for health professionals working in primary care, but can also be used by others interested to learn more about insomnia and its management.
<http://elearning.restproject.org.uk/>

Sound Sleep Project (Scotland). A teaching pack and training day for education professionals throughout the UK, launched in 2011, aiming to raise awareness in schools of the importance of sleep for adolescent wellbeing. http://www.sleepscotland.org/teen_school_workshops.php.

National Attention Deficit Disorder Information and Support Service, 'Sleep seekers campaign', leaflet of advice about sleep for young people with ADD, where there is a high degree of overlap.
<http://www.addiss.co.uk/sleepseekersbooklet.pdf>

CONCLUSION

There is evidence to suggest that adolescent sleep is an important consideration in health outcomes. Intrinsic biological processes delay the onset of sleep and change sleep patterns, but society insists that young people burn the candle at both ends, and so the result is a generation of sleep deprived people.

AYPH is calling for more widespread acknowledgment that adolescent sleep is an important topic, and better understanding that adolescent sleep patterns are driven by biological changes, not rebellious attitudes. AYPH wants sleep to move up the UK research agenda, and for anyone in contact with young people to be aware of the health implications of poor sleep habits. Sleep should be part of the discussion about healthy living, particularly in this age group. It may have implications for a range of health outcomes and even for appetite and healthy eating.

Examples of useful resources (extended list in our full research update)

British Sleep Society, http://www.sleeping.org.uk/Paediatric_Sleep_Section.aspx

British Snoring and Sleep Apnoea Association: Information and advice, products, treatments and remedies concerning snoring. www.britishsnoring.co.uk

National Sleep Foundation: American website with information on sleep and sleep disorders. www.sleepfoundation.org

Narcolepsy Association UK (UKAN): Promotes the interests of people with narcolepsy and encourages better understanding of the illness. www.narcolepsy.org.uk

Sleep disorder clinics: <http://www.narcolepsy.org.uk/AboutNarcolepsy/Findyourlocalsleepcentre.aspx#.TG2mxdDs8c>

Sleep for Science: the E P Bradley Hospital Sleep Research Laboratory in Rhode Island, USA, directed by Professor Mary Carskadon's: <http://www.sleepforscience.org>. Useful resources and cutting edge research on young people.

Profiling your research and receiving future updates:

To receive copies of our full research updates you can become a member of AYPH by visiting our website at ayph.org.uk or email info@youngpeopleshealth.org.uk.

We currently produce research updates quarterly.

Summaries of all previous updates are available in the research section of our website.

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