CHAPTER ONE

The importance of sleep

Sleep problems have tripled in the last ten years.
It's a big social problem and affects the whole family.

DR O. BRUNI[9]

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Adults have their own challenges with sleep, and on top of that, when kids don't sleep well, neither do the parents. According to a survey conducted by the Centre for Disease Control and Prevention, more than thirty-five per cent of Americans sleep less than seven hours in a typical day.[10] Meanwhile, thirty per cent of adults average less than six hours of sleep per day.[11]

Our modern culture often focuses on productivity over rest. Slogans like 'sleep is for wimps' and 'I'll sleep when I'm dead' are commonplace. The truth is, however, that more waking hours can cause you to become *less* productive. Sleep debt is not a mere inconvenience; additional wakefulness has a neurobiological cost, which accumulates over time.[12]

9 Bruni, 'Insomnia: Clinical and Diagnostic Aspects'.

10 Institute of Medicine, 'Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem', (Washington, DC: National Academic Press, 2006), https://doi.org/10.17226/11617.

11 C.A. Schoenborn and P.F. Adams, 'Health Behaviors of Adults: United States, 2005–2007', *Vital Health Stat* 10, no. 245 (March 2010).

12 Hans P.A. van Dongen, Greg Maislin, Janet M. Mullington and David F. Dinges, 'The Cumulative Cost of Additional Wakefulness: Dose-Response Effects on Neurobehavioral Functions and Sleep Physiology from Chronic Sleep Restriction and Total Sleep Deprivation', *Sleep* 26, no. 2 (1 March 2003): 117–26, https://doi.org/10.1093/sleep/26.2.117.

When sleep deprived, your body struggles to extract glucose from the blood stream and your brain is unable to think straight. This then impacts your rational thinking, willpower, self-control, productivity and interactions with colleagues – so this can be very bad in the work place. In fact, sleeping fewer than six hours a night or more than eight leads to low scores on logical thinking and vocabulary, along with ageing your brain.[13]

Even small amounts of sleep deprivation degrade your abilities and put you into a state where you may fall into micro sleeps – a state to which you are oblivious. This is a dangerous state to be in while driving a car, wielding a scalpel or operating machinery, and it can happen at any time of the day. A lack of sleep has been linked to motor vehicle crashes, industrial disasters, and medical and other occupational errors.[14,15] Even the Chernobyl meltdown and the Challenger space shuttle disaster have been linked to sleep deprivation.[16,17]

Dangerously, most sleep-impaired individuals believe their ability to perform these tasks is at its usual standard, when tests show it is not. One study showed that subjects sleeping six hours or fewer per night were as impaired in their daytime cognitive performance as if they'd completely missed two nights of sleep. Yet these adults were not aware that they were impaired at all and thought they were fine: 'Sleepiness ratings suggest that subjects were largely unaware of these increasing cognitive deficits, which may explain why the impact of chronic sleep restriction on waking cognitive functions is often assumed to be benign.'[18]

13 Richard Wiseman, *Night School: The Life-Changing Science of Sleep* (London: Pan Books, 2015).

14 Institute of Medicine, 'Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem'.

15 National Highway Traffic Safety Administration, Drowsy Driving and Automobile Crashes: Report and Recommendations, (Washington, DC: U.S. Department of Transportation, 1998), https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/808707.pdf.

16 Merrill M. Mitler, Mary A. Carskadon, Charles A. Czeisier, William C. Dement, David F. Dinges and R. Curtis Graeber, 'Catastrophes, Sleep, and Public Policy: Consensus Report', *Sleep* 11, no. 1 (1988): 100–09, https://doi.org/10.1093/sleep/11.1.100.

17 James K. Walsh, William C. Dement, and David F. Dinges, 'Sleep Medicine, Public Policy, and Public Health', *Principles and Practice of Sleep Medicine*, no. 4 (2005): 648–56, https://doi.org/10.1016/b0-72-160797-7/50060-4.

18 Dongen, Maislin, Mullington and Dinges, 'The Cumulative Cost of Additional Wakefulness', 117–26.

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When people are sleepy, they perceive their performance is normal when in fact it is not. Not even close.

Beyond issues of performance and productivity, sleep deprivation has profound effects on many areas of physical and mental health. Surrey University scientists discovered that over 700 of the body's genes, or the expression of those genes, are altered when someone regularly gets less than six hours of sleep a night over one week.[19] Research around sleep fragmentation and disturbed sleep demonstrates links to cancer.[20,21] Further, the risk of pancreatic, lung, kidney and skin cancers is significantly higher in patients with obstructive sleep apnoea.[22]

There are even studies now linking diabetes, schizophrenia, heart attacks, stroke and Alzheimer's with sleep deprivation and fragmented sleep. In fact, sleeping five or fewer hours per night instead of the recommended seven to nine hours for adults may increase mortality risk by as much as fifteen per cent.[23]

Extreme experiments in sleep deprivation were conducted during the 1950s. In one case, a young man who stayed awake for eight days demonstrated increasingly erratic behaviour. As the subject tried to stay awake,

19 C. S. Moller-Levet, S. N. Archer, G. Bucca, E. E. Laing, A. Slak, R. Kabiljo, J. C. Y. Lo, N. Santhi, M. Von Schantz, C. P. Smith, and D.-J. Dijk, 'Effects of Insufficient Sleep on Circadian Rhythmicity and Expression Amplitude of the Human Blood Transcriptome', *Proceedings of the National Academy of Sciences* 110, no. 12 (2013), https://doi.org/10.1073/pnas.1217154110.

20 F. Javier Nieto, Paul E. Peppard, Terry Young, Laurel Finn, Khin Mae Hla, and Ramon Farré, 'Sleep-Disordered Breathing and Cancer Mortality', *American Journal of Respiratory and Critical Care Medicine* 186, no. 2 (2012): 190–94, https://doi.org/10.1164/rccm.201201-0130oc.

21 Francisco Campos-Rodriguez, Miguel A. Martinez-Garcia, Montserrat Martinez, Joaquin Duran-Cantolla, Monica De La Peña, María J. Masdeu, Monica Gonzalez, Felix Del Campo, Inmaculada Gallego, Jose M. Marin, Ferran Barbe, Jose M. Montserrat and Ramon Farre, 'Association between Obstructive Sleep Apnea and Cancer Incidence in a Large Multicenter Spanish Cohort', *American Journal of Respiratory and Critical Care Medicine* 187, no. 1 (2013): 99–105, https://doi.org/10.1164/rccm.201209-1671oc.

22 David Gozal, 'Sleep Apnea and Cancer: Illicit Partnerships', in *AACP Australian Chapter – 6th International Symposium*, (Sydney, March 18, 2017).

23 Institute of Medicine, 'Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem'.

he developed delusions, like his shoes being full of spiders, and paranoia, thinking a visiting doctor was an undertaker.[24] Throughout the experiment, which would be impermissible today, he also suffered psychotic episodes, moodiness, depression, lethargy, slurred speech and aggression. Such extreme sleep deprivation, which is associated with ongoing insomnia, has been shown to trigger long-term psychological instability like paranoia, confusion, delusion, hallucination, moodiness and memory issues.[25]

So if you are wondering why you are cranky, suspicious and reacting like a cat on a hot tin roof, it may just be related to sleep deprivation.

» very few people see that they may be torturing *themselves* by not getting the right amount of sleep each night

Although it's well known that sleep deprivation is a torture technique that can lead to hallucination and coercive lying, very few people see that they may be torturing *themselves* by not getting the right amount of sleep each night, whether by under- or overdoing it. 'Short sleepers' are people who report sleeping fewer than seven hours on average per night and 'long sleepers' are individuals sleep more than nine hours on a typical night.[26] Research indicates that both are at increased risk of all-cause mortality.[27] Interestingly, 'excessive daytime napping might be a useful marker of increased respiratory risk'.[28]

Night-time urination, otherwise known as nocturia, is a bi-product of night-time airway obstruction and appears to be a risk factor for earlier

24 Wiseman, *Night School: The Life-Changing Science of Sleep*.

25 John J. Ross, 'Neurological Findings after Prolonged Sleep Deprivation', *Archives of Neurology* 12, no. 4 (1965): 399–403, https://doi.org/10.1001/archneur.1965.00460280069006.

26 Lisa Gallicchio and Bindu Kalesan, 'Sleep Duration and Mortality: A Systematic Review and Meta-Analysis', *Journal of Sleep Research* 18, no. 2 (2009): 148–58, https://doi.org/10.1111/j.1365-2869.2008.00732.x.

27 Ibid.

28 Yue Leng, Nick W. J. Wainwright, Francesco P. Cappuccio, Paul G. Surtees, Shabina Hayat, Robert Luben, Carol Brayne and Kay-Tee Khaw, 'Daytime Napping and Increased Risk of Incident Respiratory Diseases: Symptom, Marker, or Risk Factor?' *Sleep Medicine* 23 (2016): 12–15, https://doi.org/10.1016/j.sleep.2016.06.012.

death. Airway obstruction means the heart has to work harder to breathe, releasing a hormone called atrial natriuretic factor, which impacts kidney function and leads to night-time urination. In fact, men between twenty and forty-nine years of age who wake to urinate more than twice a night have double the risk of dying than other men their age.[29] Night-time urination acts as a red flag, signalling health and possible airway issues, and may be marker for increased risk of coronary heart disease.[30] Thankfully, dealing with sleep and breathing problems can see a reduction or elimination of this problem.[31] During normal calm breathing and sleep, urination is inhibited by a hormone called antidiuretic hormone. Of course, there may be other influencing factors, like too many fluids before bed or a tiny bladder, but if these are not your problem, airway and disturbed breathing is a likely culprit.

>> beauty sleep is a real thing

Even when we take a step back from the grave health risks, poor sleep affects quality of life at a fundamental level. Your face reflects your sleep. The stress hormone cortisol is released with sleep deprivation; several nights of poor sleep can prevent the production of collagen and increase fine lines and dark circles around the eyes. Chronic sleep deprivation increases the signs of ageing and lowers your satisfaction in your appearance.[32,33] It turns out that beauty sleep is a real thing. Sleep problems are literally 'in your face'.

29 Steven Park, '7 Surprising Health Conditions That Can Be from Poor Breathing at Night', December 6, 2017, podcast, MP3 audio, http://doctorstevenpark.com/7conditions#more-11214.

30 Deborah J. Lightner, Amy E. Krambeck, Debra J. Jacobson, Michaela E. Mcgree, Steven J. Jacobsen, Michael M. Lieber, Véronique L. Roger, Cynthia J. Girman and Jennifer L. St. Sauver, 'Nocturia is Associated with an Increased Risk of Coronary Heart Disease and Death', *BJU International* 110, no. 6 (2012): 848–53, https://doi.org/10.1111/j.1464-410x.2011.10806.x.

31 M. G. Umlauf and E. R. Chasens, 'Sleep Disordered Breathing and Nocturnal Polyuria: Nocturia and Enuresis', *Sleep Med Rev* 7, no. 5 (2003): 403–11.

32 P. Oyetakin-White, A. Suggs, B. Koo, M. S. Matsui, D. Yarosh, K. D. Cooper, and E. D. Baron, 'Does Poor Sleep Quality Affect Skin Ageing?' *Clinical and Experimental Dermatology* 40, no. 1 (2014): 17–22, https:/doi.org/10.1111/ced.12455.

33 J. Axelsson, T. Sundelin, M. Ingre, E. J. W. Van Someren, A. Olsson, and M. Lekander, 'Beauty Sleep: Experimental Study on the Perceived Health and Attractiveness of Sleep Deprived People', *British Medical Journal* 341, no. 14/2 (2010): C6614, https://doi.org/10.1136/bmj.c6614.

>> When sleep deprived, you feel hungrier than you actually are, do not feel full when you should, and are more likely to reach for carbohydrate-dense food. This is a triple whammy for weight gain!

Sleep deprivation even has an impact on shopping habits, with sleep-deprived people buying more junk food than those who are properly rested. The hormones leptin and ghrelin send signals to the brain about hunger and satiety. Leptin tells you when you are full, and ghrelin tells you when you are hungry. Both leptin and ghrelin are disrupted by poor sleep. This means that you feel hungrier than you actually are and you do not feel full when you should. Adding to that, we are more likely to reach for carbohydrate-dense food when tired.[34] This is a triple whammy for weight gain!

If chronic sleep deprivation is bad for us individually, it's also bad for us collectively. Economically, the price of untreated sleep disorders is very high to society. In the US, the twenty-three million adults with moderate to severe obstructive sleep apnoea (OSA) cost the government between $65 billion and $165 billion *annually*.[35] The costs related to leaving OSA untreated are diverse and include health treatments, poor work performance, work absence, depression, relationship breakdown, motor vehicle accidents and occupational errors.

The less you sleep, the more you are awake. The severity of chronic sleep restriction and total sleep deprivation has a direct bearing on how well you behave, make decisions and solve problems in daily life. And this is just how sleep deprivation affects adults!

Unfortunately, the effects of sleep deprivation can be even more disastrous for kids.

34 Sebastian M. Schmid, Manfred Hallschmid, Kamila Jauch-Chara, Jan Born and Bernd Schultes, 'A Single Night of Sleep Deprivation Increases Ghrelin Levels and Feelings of Hunger in Normal-Weight Healthy Men', *Journal of Sleep Research* 17, no. 3 (2008): 331–34, https://doi.org/10.1111/j.1365-2869.2008.00662.x.

35 'The Price of Fatigue', Harvard Medical School, PDF document, December 2010, https://sleep.med.harvard.edu/file_download/100.

How sleep problems are hurting your kids

When kids don't, won't or can't go to sleep, wake frequently in the night or have difficulty going back to sleep, there are daytime consequences that can look different to the adult ones – behaviourally, physically and mentally. The effects can be subtle or very obvious, and these compound over time. Some kids become tired but wired, while others become lethargic and poorly coordinated. Some may appear to be okay but are, in fact, operating way below their ability level.

Behavioural consequences of sleep problems

Four-year-old Daniel had turned into a little monster. Daniel had been a poor sleeper from birth. He refused to go to bed at night, woke his parents frequently and only had seven hours of sleep a night (instead of the recommended ten to thirteen hours for his age). He never slept for more than two hours at a stretch. During the day, he wouldn't take naps.

Like many sleep-deprived kids, every day Daniel would hit the ground running, reacting to sleep deprivation with over-activity, which the body craves as compensation for poor sleep. Not only that, but Daniel had an explosive temper and was extremely defiant.

After two years of Daniel's irrational meltdowns, his poor parents were at breaking point (and so was their marriage). His mum told me, 'I can't be the nice mummy I want to be or the one he deserves. I'm too tired.'

She saw more than twenty-three medical specialists in Australia and the US, and it wasn't until a dentist recognised an airway issue that they made some progress.

When I saw Daniel, he had the hallmarks of a sleep breathing disorder: problems with his breathing muscles, underdeveloped upper and lower jaws, dark circles under his eyes, lip tie and a tongue-tie.[36] He also had a long, narrow facial structure, which is frequently associated with a smaller airway.

Looking at how his face, mouth and throat muscles were working, I could see some problems. Daniel usually had his tongue out and forward while mouth breathing, had a habit of licking his lips and didn't chew his food properly. This was a strong indication that the upper airway muscles were not working as they should to support an open airway. He was also very fussy with food, to the extent that he would only eat nine foods. And he was small for his age, suffered from seasonal allergies, had a habitual cough, would grind his teeth and was very, very anxious. To top it off, his speech was delayed.

All in all, Daniel was one tired little puppy.

Despite visits to so many medical specialists, no one had seriously considered that Daniel's tonsils and adenoids might be part of the problem. As it turned out, both tonsils and adenoids were enlarged and leading to airway obstruction and snoring. This could explain why he woke frequently and was unable to go into deeper sleep cycles.[37] Given this, it was also plausible that the tonsils and adenoids contributed to blockages in the airway at night, creating negative pressure in the airway, pulling up acid from his stomach and causing reflux symptoms. While it appeared he did not have the more serious signs of OSA (gasping, choking and breathing stoppages), he was snoring and his sleep was disrupted by multiple wakings and arousals, which meant there was no way he could achieve the deep, restful sleep he needed to grow and thrive.

When Daniel's tonsils and adenoids were removed, his sleep got a *lot* better. Within just six months of undergoing the operation alongside

36 A. J. Yoon, S. Zaghi, S. Ha, C. S. Law, C. Guilleminault and S. Y. Liu, 'Ankyloglossia as a Risk Factor for Maxillary Hypoplasia and Soft Palate Elongation: A Functional–Morphological Study', *Orthodontics & Craniofacial Research* 20, no. 4 (2017): 237–44, https://doi.org/10.1111/ocr.12206.

37 Hye-Kyung Jung, Rok Seon Choung and Nicholas J. Talley, 'Gastroesophageal Reflux Disease and Sleep Disorders: Evidence for a Causal Link and Therapeutic Implications', *Journal of Neurogastroenterology and Motility* 16, no. 1 (2010): 22–29, https://doi.org/10.5056/jnm.2010.16.1.22.

other recommended treatments, Daniel was like a brand new kid: he was breathing and eating well with no more snoring or tantrums, and he had a big growth spurt. His improvement was measurable on the Sleep Disturbance Scale for Children,[38] where his scores almost halved from ninety-nine in March 2016 to fifty in December 2016, placing him in the normal range.

Daniel's mum wished she'd had more information when Daniel was little. His sleep is much better now, but it's hard for her to look back at 'the nightmare', as she calls it. If she'd had the information she has now before he was born, it would have made a big difference to the entire family.

There is a long list of words that parents use to describe the way kids behave when they are sleep deprived – cranky, grumpy, sleepy, clumsy, silly, crazy, fidgety (almost like Snow White's band of dwarves!)

But how do you know if these behavioural issues are caused by sleep? Daytime behaviours that result from sleep disorders can look a lot like Attention Deficit Hyperactivity Disorder (ADHD): difficulty sitting still, difficulty with concentration, focus and attention, aggression, impulsivity, interrupting, talking out of turn, hyperactivity, anxiety, trouble with literacy and more.[39] Children with ADHD also have difficulty falling sleep and staying asleep and are restless while they are asleep. In fact, snoring is common among children who have ADHD, and twenty-five per cent may have OSA.[40]

38 Oliviero Bruni, Salvatore Ottaviano, Vincenzo Guidetti, Manuela Romoli, Margherita Innocenzi, Flavia Cortesi and Flavia Giannotti, 'The Sleep Disturbance Scale for Children (SDSC): Construction and Validation of an Instrument to Evaluate Sleep Disturbances in Childhood and Adolescence', *Journal of Sleep Research* 5, no. 4 (1996): 251–61, https://doi.org/10.1111/j.1365-2869.1996.00251.x.

39 Dale L. Smith, David Gozal, Scott J. Hunter, Mona F. Philby, Jaeson Kaylegian and Leila Kheirandish-Gozal, 'Impact of Sleep Disordered Breathing on Behaviour among Elementary School-Aged Children: A Cross-Sectional Analysis of a Large Community-Based Sample', *European Respiratory Journal* 48, no. 6 (2016): 1631–39, https://doi.org/10.1183/13993003.00808-2016.

40 Yoo Hyun Um, Seung-Chul Hong and Jong-Hyun Jeong, 'Sleep Problems as Predictors in Attention-Deficit Hyperactivity Disorder: Causal Mechanisms, Consequences and Treatment', *Clinical Psychopharmacology and Neuroscience* 15, no. 1 (2017): 9–18, https://doi.org/10.9758/cpn.2017.15.1.9.

Kids with ADHD have problems sleeping well for many reasons, not the least of which are behaviour traits that make it difficult to settle and stay settled. Medication side effects and depression may also play a role, making it harder for them to fall asleep. Ineffective sleep, in turn, revs up behaviour further. As Dr Judith Owens says, 'Every child diagnosed with ADHD should be screened for sleep disorder. Interestingly, some of the chemicals in the brain linked to ADHD are the same involved with sleep, so the deficiency and alteration of brain chemicals necessarily leads to sleep problems.'[41]

It is Dr Owens' strong view that all children presenting for evaluation of behavioural issues and disorders should be assessed for sleep disorders.[42] This sentiment is echoed by a study at Lurie Children's Hospital Chicago and the Head and Neck Institute, Cleveland Clinic.[43]

» all children presenting for evaluation of behavioural issues and disorders should be assessed for sleep disorders

While sleep apnoea is a serious problem, it is not our only concern. Recent studies indicate that mild sleep-disordered breathing or snoring may cause many of the same problems as OSA in children.[44] Children who snore may be at increased risk for developing attention problems and poor behaviour regulation, no matter whether the disorder is mild, moderate or severe.

Kids with runny noses and open-mouth breathing also need our attention. Depleted oxygen associated with breathing issues created by

41 Owens and Mindell, *Take Charge of Your Child's Sleep*.

42 Judith Owens, 'Comorbidity of Insomnia', in *14th Czech-Slovak and 19th Congress of the Czech Society for Sleep Research and Medicine*, (Prague, October 7, 2017).

43 Irina Trosman and Samuel J. Trosman, 'Cognitive and Behavioral Consequences of Sleep Disordered Breathing in Children', *Medical Sciences* 5, no. 4 (2017): 30, https://doi.org/10.3390/medsci5040030.

44 Smith et al., 'Impact of Sleep Disordered Breathing on Behaviour among Elementary School-Aged Children'.

blocked nose and throat may be an important factor causing ADHD.[45] It is therefore important that airway issues are treated as early as possible to reduce the incidence of issues like inability to sit still, and constant fidgeting.

Physical consequences of sleep problems

On a physical level, good sleep releases the right hormones, while poor sleep causes hormonal imbalance.

>> Parents may notice their kids are not growing well, have poor appetites or are frequently sick

Parents may notice their kids are not growing well, have poor appetites or are frequently sick. Growth hormone (somatotropin) release can be missed in children who do not sleep properly. Melatonin release triggers the onset of sleep and then stimulates growth hormone, which is released three to four hours after sleep onset, so if sleep onset is delayed or sleep cycles are disrupted, growth hormone release is also delayed.[46] ‘Sleep-disordered breathing, secondary to adenotonsillar hypertrophy, increases the risk of growth failure in children’.[47]

Appetite regulating hormones are also affected by sleep. The hunger and satiety hormones leptin and ghrelin play a key role in regulating the amount of food that kids consume. Imbalances in these hormone levels lead kids to craving high energy foods like sweets, biscuits and chips, followed by not realising when they are full, leading to weight gain. Obesity then contributes to poor sleep, and possibly OSA, which

45 Jiali Wu, Meizhen Gu, Shumei Chen, Wei Chen, Kun Ni, Hongming Xu and Xiaoyan Li, ‘Factors Related to Pediatric Obstructive Sleep Apnea–Hypopnea Syndrome in Children with Attention Deficit Hyperactivity Disorder in Different Age Groups’, *Medicine* 96, no. 42 (2017), https://doi.org/10.1097/md.0000000000008281.

46 Y. Takahashi, D. M. Kipnis and W. H. Daughaday, ‘Growth Hormone Secretion During Sleep’, *Journal of Clinical Investigation* 47, no. 9 (1968), https://doi.org/10.1172/jci105893.

47 Karen Bonuck, Sanjay Parikh, and Maha Bassila, ‘Growth Failure and Sleep Disordered Breathing: A Review of the Literature’, *International Journal of Pediatric Otorhinolaryngology* 70, no. 5 (2006), https://doi.org/10.1016/j.ijporl.2005.11.012.

turns into a vicious cycle where disordered sleeping further contributes to obesity due to its effect on hormone levels.[48] It's a merry-go-round you want to get off.

Cortisol, otherwise known as the stress hormone, increases with poor sleep (such as in sleep-disordered breathing) as the body has to work harder to breathe, increasing cortisol and preventing the body from fully entering deep sleep cycles during sleep. Remaining in light sleep phases can then make it difficult for them to stay asleep, in turn increasing cortisol. Furthermore, children experiencing this may find it harder to wind down on successive nights, delaying sleep onset. The combination of poor sleep and increased cortisol leads to impaired memory, increased anxiety and aggression – in other words, bad moods, crankiness, being wired or feeling fried.[49]

Wired kids with increased levels of cortisol may also have poor immunity. Immune memory is formed during deep sleep, which means that children with sleep-disordered breathing (which induces light sleep and sleep fragmentation) get sick more often because their immune systems are weakened.[50]

Effect on mental aptitude

Kids who don't get the right amount or right quality of sleep have problems with their moods, their ability to focus, solve problems and self-regulate. A press release by the Johns Hopkins Medicine media department reported that childhood sleep apnoea was linked to brain damage,[51] and

48 Alison L. Miller, Julie C. Lumeng and Monique K. Lebourgeois, 'Sleep Patterns and Obesity in Childhood', *Current Opinion in Endocrinology & Diabetes and Obesity* 22, no. 1 (2015), https://doi.org/10.1097/med.0000000000000125.

49 Bruce S. Mcewen, 'Sleep Deprivation as a Neurobiologic and Physiologic Stressor: Allostasis and Allostatic Load', *Metabolism* 55 (2006), https://doi.org/10.1016/j.metabol.2006.07.008.

50 Luciana Besedovsky, Tanja Lange and Jan Born, 'Sleep and Immune Function', *Pflügers Archiv – European Journal of Physiology* 463, no. 1 (2011), https://doi.org/10.1007/s00424-011-1044-0.

51 Ann C. Halbower, Mahaveer Degaonkar, Peter B. Barker, Christopher J. Earley, Carole L. Marcus, Philip L. Smith, M. Cristine Prahme and E. Mark Mahone, 'Childhood Obstructive Sleep Apnea Associates with Neuropsychological Deficits and Neuronal Brain Injury', *PLoS Medicine* 3, no. 8 (2006), https://doi.org/10.1371/journal.pmed.0030301.

this is borne out with other studies. Even small increments of sleep loss (as little as thirty minutes per night) can result in reduced performance on intelligence tests and affect learning in a significant way.

If a child's sleep problem is connected to disordered breathing, blood-oxygen levels drop. Any change in ideal oxygenation levels in the brain has consequences, and none are good. Low oxygenation affects every aspect of a child's health, growth and development: it worsens virtually all medical, emotional and developmental problems; it compromises a child's growth, immunity and IQ; and it impedes recovery and wellness in medically compromised patients.[52]

>> Indeed, OSA or obstructive sleep apnoea, can reduce a child's IQ by as many as ten points compared to their IQ with proper sleep

Obstructive sleep apnoea is one sleep disorder that is associated with a range of neurocognitive deficits,[53] meaning that kids are unable to focus, reason and problem solve as expected for their age. They have 'impaired attention and visual-fine motor coordination and reduction in regional grey matter.[54] This means that cells in the brain are diminishing. Research papers show that 'cortical thinning' occurs in children with sleep apnoea, and this intensifies the imperative for us all to be proactive and identify all kids with OSA.[55] Indeed, OSA or obstructive sleep apnoea, can reduce a child's IQ by as many as ten points compared to their IQ with proper

52 Owens and Mindell, *Take Charge of Your Child's Sleep*.

53 L. M. Obrien, 'Neurobehavioral Implications of Habitual Snoring in Children', *Pediatrics* 114, no. 1 (2004): 44–49, https://doi.org/10.1542/peds.114.1.44.

54 Chitra Lal, Charlie Strange and David Bachman, 'Neurocognitive Impairment in Obstructive Sleep Apnea', *Chest* 141, no. 6 (2012), https://doi.org/10.1378/chest.11-2214.

55 Paul M. Macey, Leila Kheirandish-Gozal, Janani P. Prasad, Richard A. Ma, Rajesh Kumar, Mona F. Philby and David Gozal, 'Altered Regional Brain Cortical Thickness in Pediatric Obstructive Sleep Apnea', *Frontiers in Neurology* 9 (2018), https://doi.org/10.3389/fneur.2018.00004.

sleep.[56,57] In other words, OSA can cause brain cells to decrease – not a trivial matter. One study conducted in 2006 speculated that 'untreated childhood OSA could permanently alter a developing child's cognitive potential'.[58]

Meanwhile, a study at Duke University in 2015 showed that children with attention problems in early childhood were forty per cent less likely to graduate from high school.[59] With an estimated ten per cent of children starting school with developmental delays, we can only wonder – how much of this is linked to sleep disorders?

If children get enough sleep, on the other hand, many of these problems are reversible. Bruno Giordani, professor of neurology, psychiatry, psychology and nursing at the University of Michigan, wrote, 'Regardless of intellectual level, we can expect to see some behavioural improvement along with better sleep. Once behaviour improves, attention in school improves, and emotional ability and behavioural and impulsivity control improve.'[60]

>> sleep disorders can also take their toll slowly

Long-term effects

The immediate consequences of sleep problems should be enough to convince you to take action. But sleep disorders can also take their toll slowly. By this I mean that the effects of sleep disorders build and compound over time, a bit like smoking. The first or even the thousandth cigarette won't kill you, but eventually the habit will lead

56 Stephen H. Sheldon, Richard Ferber, Meir H. Kryger and David Gozal, *Principles and Practice of Pediatric Sleep Medicine*, (London: Elsevier Saunders, 2014).

57 Matt Wood, 'The Deep Impact of Childhood Sleep Apnea', University of Chicago Medicine, posted on March 1, 2012, https://sciencelife.uchospitals.edu/2012/03/01/the-deep-impact-of-childhood-sleep-apnea.

58 Halbower et al., 'Childhood Obstructive Sleep Apnea Associates with Neuropsychological Deficits and Neuronal Brain Injury'.

59 David L. Rabiner, Jennifer Godwin and Kenneth A. Dodge, 'Predicting Academic Achievement and Attainment: The Contribution of Early Academic Skills, Attention Difficulties, and Social Competence', *School Psychology Review* 45, no. 2 (2016): 250–67, https://doi.org/10.17105/spr45-2.250-267.

60 'Even Children with Higher IQs Behave Better When Their Sleep Apnea Is Fixed', University of Michigan, January 8, 2016, http://ihpi.umich.edu/news/even-children-higher-iqs-behave-better-when-their-sleep-apnea-fixed.

to an earlier death as it erodes your lung capacity, deprives the brain of oxygen and poisons your system. Similarly, with some forms of skin cancer, the first exposure to high-UV sun may not give you melanoma, but repeated exposure will leave you highly susceptible. These facts are well known and largely accepted in Australia, which has launched successful health campaigns to educate everyone on the dangers of smoking and high-UV sun exposure.

» Professor Karen Bonuck demonstrated that behaviour difficulties at seven years and special education at eight years were linked to having had sleep problems prior to five years of age

Sleep disorders are similar. Prolonged exposure to poor sleep quality, sleep deprivation and fragmentation means children experience ongoing behavioural, physical and emotional consequences that then compound over time. In addition, they are at risk of developing the associated health issues such as increased blood pressure and cardiac problems. Professor Karen Bonuck demonstrated that behaviour difficulties at seven years and special education at eight years were linked to having had sleep problems prior to five years of age.[61] Furthermore, both SDB and short sleep duration significantly and independently increase children's odds of becoming overweight.[62]

Dr Kate Williams from Queensland University of Technology analysed the sleep behaviour of 2,800 children born in 2004 until they reached six to seven years of age in the landmark study, *Growing up in Australia: The Longitudinal Study of Australian Children*. She found that, while seventy

61 Karen Bonuck, 'Pediatric Sleep Disorders and Special Educational Need at 8 Years: A Population-Based Cohort Study', *Pediatrics* 130, no. 4 (2012), https:/doi.org/10.1542/peds.2012-0392d.

62 Karen Bonuck, Ronald D. Chervin and Laura D. Howe, 'Sleep-Disordered Breathing, Sleep Duration, and Childhood Overweight: A Longitudinal Cohort Study', *The Journal of Pediatrics* 166, no. 3 (2015), https://doi.org/10.1016/j.jpeds.2014.11.001.

per cent of children were regulating their own sleep by five years of age, the remaining thirty per cent might find their lack of regulation developmentally detrimental over time.[63]

Consequently, it's vital to get children's sleep behaviours right by the time they turn five. 'If these sleep issues aren't resolved by the time children are five years old, then they are at risk of poorer adjustment to school,' Williams said. This has been backed by other studies.[64] Simply getting children to bed earlier than 9:30pm improves behaviour,[65] and children who soothe themselves back to sleep from an early age adjust to school more easily than those who don't.[66,67] Helping parents get the sleep formula right when kids are young can make a big difference to everyone. Parents need a good support network.

Helping parents get the sleep formula right when kids are young can make a big difference to everyone. Parents need a good support network.

63 'Growing Up in Australia: The Longitudinal Study of Australian Children', Australian Institute of Family Studies, http://www.growingupinaustralia.gov.au/.

64 Rabiner, Godwin and Dodge, 'Predicting Academic Achievement and Attainment: The Contribution of Early Academic Skills, Attention Difficulties, and Social Competence'.

65 'News – Get Sleep Sorted By Age 5 To Help Children Settle At School', Queensland University of Technology, Interview with Dr Kate Williams, March 9, 2016, https://www.qut.edu.au/news?news-id=102587.

66 Matthew Gray and Diana Smart, 'Growing Up in Australia: The Longitudinal Study of Australian Children: A Valuable New Data Source for Economists', *Australian Economic Review* 42, no. 3 (2009): 367–76, https://doi.org/10.1111/j.1467-8462.2009.00555.x.

67 Kate E. Williams, Jan M. Nicholson, Sue Walker and Donna Berthelsen, 'Early Childhood Profiles of Sleep Problems and Self-Regulation Predict Later School Adjustment', *British Journal of Educational Psychology* 86, no. 2 (2016): 331–50, https://doi.org/10.1111/bjep.12109.

Sleep deprivation in kids with special needs

'Some days I am so tired that I could just cry. Actually, some days I am so tired that I do cry. But our own exhaustion is not even the worst part. The hardest part is watching our little man struggle through his tired haze.'[68] These words from Jessica Sylfest, talking about her four-year-old autistic son in *The Huffington Post*, hit at the heart of a major struggle for parents with special needs children – the ongoing exhaustion of it all.

Kids with special needs are particularly susceptible to sleep problems. As Dr Judith Owens points out, 'There's a very high prevalence of insomnia in autism spectrum disorders – thirty-four to eighty-nine per cent of kids with autism spectrum disorders also have sleep disorders. Early intervention is critical for caregivers with these kids, given the demands of the day, and parents' sleep disturbance on top of it.'[69]

Due to the nature of their difficulties, many kids with disabilities may need to spend time in hospital for treatments and surgeries. This can be very challenging because hospitals are noisy, stressful places for children and their families, and it's hard to sleep. Even the best sleepers have trouble drifting off or staying asleep in a hospital; being woken up multiple times a night to have vitals checked disrupts their sleep pattern and leads to more sleep problems when they come home. Common medications also have side effects that can complicate sleep efficacy.[70]

At home, autistic children, or those with varying degrees of developmental delay, often have trouble settling into sleep and back to sleep. Due to their susceptibility to sensory overload, these kids can become wired and anxious, unable to wind down and self-soothe before bed. It can take up to two or three hours for them to fall asleep after bedtime. If they go to sleep late or wake early, they are consistently not getting

68 Jessica Sylfest, 'The Truth About Autism and Sleep', Huffington Post, last modified January 18, 2017, https://www.huffingtonpost.com/entry/587f775ce4b0474ad4874f2f.

69 Owens and Mindell, *Take Charge of Your Child's Sleep*.

70 Ibid.

enough sleep, and the quality of the sleep they *do* get is disrupted by night waking. This could be due to habit, waking in transition between sleep cycles or remaining in light sleep throughout the night.

This all then exacerbates the cycle of overwhelm. After a night of poor sleep, the next day is then pre-set for more 'wired but tired' behaviour and anxiety. And the cycle repeats itself. As any family in this sleep-fog, wired-tired cycle will tell you, it is not a fun place to be.

Take Wendy, an eight-year-old girl with Down syndrome who suffered from everything – severe diarrhoea, the flu, pneumonia. She was constantly sick, week in and week out, and had a very slow growth rate. She had no energy and didn't want to get out of bed. At the same time, her parents would find her sitting up in bed at night, trying to catch her breath.

When she was hospitalised for pneumonia, it was discovered that she was suffering from OSA, which affects at least fifty per cent of children with Down syndrome. Further investigation found she had enlarged tonsils and adenoids blocking her already small airways.

For Wendy, when she lay down to sleep and moved into sleep phases where deeper muscle relaxation occurred, there was airway obstruction and her breathing stopped several times an hour. Not only that, kids with Down syndrome have anatomy that predisposes them to OSA – they usually have a small narrow upper jaw, which means there's not enough room for the tongue in the mouth, and the tongue looks too big. Restricted space in the mouth makes the airway even more crowded and vulnerable to airway obstruction, so when tonsils and adenoids are enlarged, the airway becomes really crowded.

Once Wendy's adenoids were removed, her sleep improved. She was less sleepy and grumpy during the day, which made living with Wendy a lot easier. She had a growth spurt, became a much happier kid with a lot more energy, and contracted colds and tummy bugs less frequently. But some symptoms remained.

We noticed that although her sleep was much better, she continued to have restless sleep, noisy breathing and groggy waking in the mornings. Even though the OSA was resolved, Wendy still had a milder version of obstructed breathing. Kids with Down syndrome also have low-tone muscles, and this was a plausible explanation for the ongoing airway issue. She also continued to have middle ear fluid and occasional chesty coughing after eating meals – additional signs that the upper airway was not working perfectly and that ongoing monitoring was important.

Kids with disabilities, chronic medical conditions like Down syndrome, joint laxity (such as Ehlers-Danlos syndrome) and craniofacial syndromes (such as Pierre Robin, Crouzon, Apert, Prader-Willi and Pfeiffer syndromes) are airway challenged due to the shape, size and position of the bones that make up the head and face.[71] These conditions are associated with smaller or constricted upper airways such as small or uneven nasal passages, which may lead to habitual mouth breathing. This then leads to disruption of oxygen to the brain and is on the spectrum of sleep-disordered breathing.[72] Weak, low-tone muscles in the upper airway also make kids more susceptible to upper airway collapse during sleep.

This is where myofunctional training (See Chapter 5) became vital for Wendy. Myofunctional programs improve the muscle systems of the mouth, face and throat and improve their airway, along with retraining breathing habits. When the upper throat muscles are working at their best, it can even help kids with clearing fluid from the middle ears. That's exactly what we did with Wendy. Over time, with myofunctional therapy, Wendy no longer needed grommets. She was able to get quiet, uninterrupted sleep, and today she is a happy kid, doing all the things young girls love to do – riding ponies, growing vegies in her own vegie patch and dancing – all while she is breathing, eating and sleeping well.

71 Christian Guilleminault and Yu-Shu Huang, 'From Oral Facial Dysfunction to Dysmorphism and the Onset Of Pediatric OSA', *Sleep Medicine Reviews*, 2017, https://doi.org/:10.1016/j.smrv.2017.06.008.

72 Esfandiar Niaki, Javad Chalipa, and Elahe Taghipoor, 'Evaluation of Oxygen Saturation by Pulse-Oximetry in Mouth Breathing Patients', *Acta Medica Iranica* 48, no. 1 (15 February 2010).

>> Good sleep is essential to help us grow and develop properly, regulate our body functions in a healthy way and protect us from illness. Poor or adequate sleep is not an option

It's time to act

Countless studies demonstrate the importance of sleep. If you read nothing else in this book, it's essential you recognise that *good sleep matters a lot*. Good sleep is a requirement for the brain to maintain and repair tissues and replenish hormones. Good sleep is essential to help us grow and develop properly, regulate our body functions in a healthy way and protect us from illness. Poor or adequate sleep is not an option.

But what does this 'good sleep' actually look like, and how can you tell if your child is suffering from disordered sleep or a sleep disorder? In the same way lifeguards know how to pick a safe spot to swim and direct beachgoers to swim between the flags, to be a lifeguard of your children's sleep you need to be able to tell good sleep from sleep problems so you will be able to encourage your children in the right direction. Continue to Chapter 2, where I discuss the essential processes that take place during good sleep, as well as outlining some of the most common sleep disorders in kids.