

on, I have seen thousands of patients, many of whom have ‘slept their life away’ undiagnosed. Given that half of all people with the condition develop it before the age of 18, this is especially tragic for children, for whom every year is critical for development.

Yet narcolepsy’s cause is remarkably simple. It was discovered in 1999 by my team and that of Mashashi Yanagisawa through genetic studies in dogs and mice. In humans, research pinned it down to the loss of around 20,000 neurons in the brain’s hypothalamus containing hypocretin, a wakefulness-promoting protein. The next question is how they are lost. With data suggesting an autoimmune process following an influenza infection (in which the immune system confuses parts of the flu virus with hypocretin neurons), a full understanding of the condition might teach us much about autoimmunity in the brain. A more effective treatment will be available once hypocretin-stimulating compounds are developed that can penetrate the brain, which could happen in the next decade. These compounds help narcoleptics and many other people with unexplained sleepiness.

Nicholls drives home, too, how in denial we are about our need for sleep, and the prevalence of disorders preventing it. Sleep apnoea, which involves snoring and pauses in breathing, affects 10–20% of the population, most often men. Until the 1980s, it was largely unknown to physicians, although attested in fiction: a famous sufferer is Joe in Charles Dickens’ 1837 *The Pickwick Papers*. It took decades for mainstream medicine to recognize it as a frequent cause of high

blood pressure. Apnoea affects people with a narrow upper airway, often due to obesity; when they breathe in, the back of their throat collapses, disturbing sleep and reducing the oxygen they take in. The standard treatment is simple — supporting the airway during sleep with pressurized air — but many find it hard to tolerate. Nothing better is available.

Some harbour fears linked to sleep. As Nicholls notes, many people with insomnia (which affects 10% of people, most often women) are terrified by their lack of sleep, and try to force themselves into it. They might spend too long in bed, making their sleep worse by reducing their sleep debt too much. This causes a vicious circle. Their anxiety might be exacerbated by the barrage of media stories on the need to sleep for eight uninterrupted hours a night, or even by accounts of fatal familial insomnia. In that extremely rare condition, slumber is impossible because of lesions in the thalamus, the brain region that filters out sensory perceptions as we fall asleep. The most effective treatment for insomnia is a better understanding of sleep physiology, notably restricting sleep to increase sleep pressure and break the vicious circle.

Parasomnias occupy a chunk of the book — ‘almost normal’ disorders such as sleep walking, night terrors and sleep paralysis. These mixed states have definitive physiological explanations. Sleepwalking and night

**“We are in denial about our need for sleep, and the prevalence of disorders preventing it.”**

terrors, in which people, typically children, arise screaming while still asleep, come from non-REM sleep, when one part of the brain attempts to wake the person while the cortex is still asleep. Sleepwalkers can experience fatal falls, or even have unconscious sex, which can have medical and legal consequences. In REM sleep behaviour disorder — in which REM sleep paralysis does not work and patients enact their dream — people might attack their bed partner. Most go on to develop Parkinson’s disease. Research has only recently started to outline the neural underpinnings of these pathologies.

For all its strengths, Nicholls’s fascinating book leaves us wanting more. As *Sleepyhead* shows, sleep sciences are still in their infancy, and current research is mostly descriptive. Luckily — although Nicholls doesn’t cover this — the field is now poised to benefit from two scientific transformations. The first is genomics, which has cracked open the molecular basis of some objectively measurable traits or behaviours. The second is tools such as activity trackers, electroencephalography electrodes, devices to track movement caused by the heartbeat, and snoring recorders, which are making the objective tracking of our waking and sleeping lives vastly easier. ■

**Emmanuel Mignot** is the Craig Reynolds Professor of Sleep Medicine in the Department of Psychiatry and Behavioral Sciences at Stanford University in California and the Director of the Stanford Center for Sleep Sciences and Medicine.  
e-mail: [mignot@stanford.edu](mailto:mignot@stanford.edu)

## FILM

# Bollywood takes on menstrual stigma

**Subhra Priyadarshini** lauds a biopic of an inspired Indian sanitary-pad innovator.

Frugal innovation is a new norm in India, emerging sporadically in pockets of brilliance — from rural hamlets to technology labs. It has even spawned a word in Hindi: *jugaad*.

Thanks to *jugaad*, bioengineer Manu Prakash is flooding rural schools in India with his US\$1 ‘foldscope’, an origami-inspired microscope teaching science to tens of thousands of children. It is also in this spirit that, in 2000, school dropout Arunachalam Muruganantham created a do-it-yourself unit in Coimbatore, Tamil Nadu, to manufacture the world’s cheapest sanitary pads. Now, Muruganantham’s story hits the big screen in *Pad Man*, billed as the first feature-length film on menstrual hygiene.

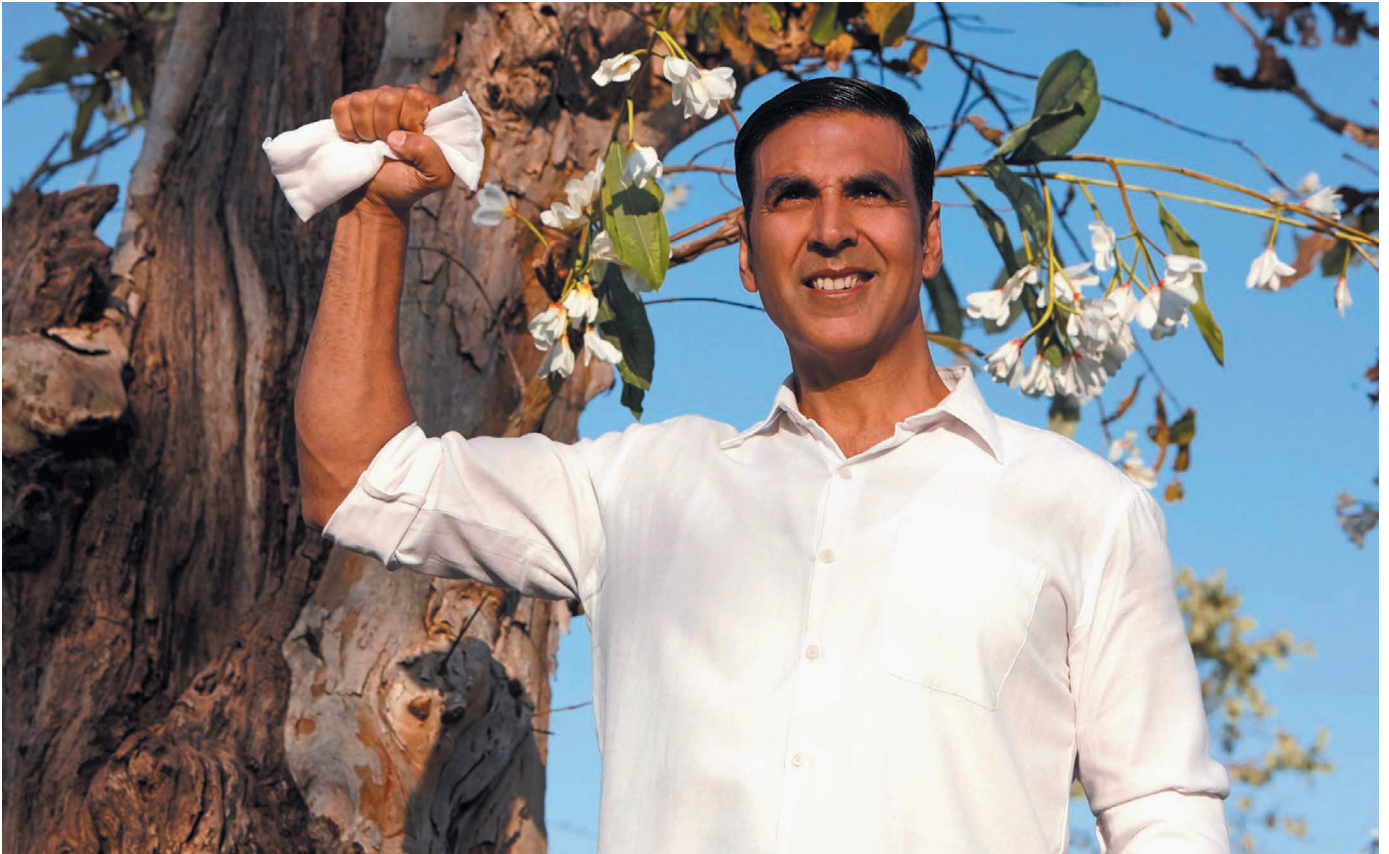
‘Period poverty’ is a health issue affecting women in countries across the globe. In Britain, 1 in 10 girls and women aged 14–21 cannot afford sanitary products, according to London-based charity Plan International UK. In India, according to a 2015–16 government health survey, just 58% of women aged 15–24 can afford to use a hygienic method of menstrual protection: 78% in urban areas and 48% in rural ones. And the average varies wildly between states — from 91% in Tamil Nadu to just 31% in Bihar. The rest resort to rags, leaves and even ash. This can result in serious health risks, such as toxic shock syndrome, and lead to absence from school or work.

**Pad Man**  
DIRECTOR:  
R. BALKI  
Columbia/Hope:  
2018.

*Pad Man* attempts to

open up this taboo topic for much-needed discussion through narrative sparked by melodrama and music. Like Shree Narayan Singh’s 2017 film *Toilet: Ek Prem Katha*, centred around the problem of open defecation, it has captured the imagination of a nation grappling with a massive burden of women’s health issues.

Directed by R. Balki, *Pad Man* has a starry cast. Muruganantham (renamed Lakshmikantham) is played by renowned Bollywood action-hero-turned-character-actor Akshay Kumar; the powerful theatre actor Radhika Apte plays his wife, Shanthi (called Gayatri). There is even a jingoistic cameo from superstar Amitabh Bachchan, who, playing himself, declaims: “India should not be seen as a country of one billion people. ▶



Akshay Kumar plays the lead in *Pad Man*, a fictionalized biopic of sanitary-pad innovator Arunachalam Muruganatham.

▶ India should be seen as a country of one billion minds.”

Muruganatham's is the inspiring story of an unconventional and tenderhearted man. In the early 1990s, he was an assistant in a hardware workshop. His wife's use of rags during menstruation concerned him, so he experimented with materials — first cotton, then cellulose fibre — to make a pad that wouldn't leak, in a process of reverse engineering. At first, when it came to testing his prototypes, “the only available victim was my wife”, Muruganatham said in a 2012 TED talk. In *Pad Man*, we see Lakshmikant perfecting the scientific steps of pulverizing cellulose fibres, compressing them, sealing the pad with non-woven fabric and sanitizing the whole with ultraviolet light. And it was all accomplished using four ingenious, makeshift machines that cost peanuts, compared to the giant assembly lines used by multinational companies.

At the cost of being ostracized for openly tackling a hidden issue, he worked doggedly on the pad's design. The biggest challenge was finding volunteers to test it. “Everyone thought I had gone mad,” he says. He finally realized that he could turn guinea pig himself. He wore a pad, and used a deflated football filled with goat's blood and fitted with a tube. It took him six years to isolate cellulose as the core adsorbing medium. That roller-coaster journey won him a

national innovation prize, a spot on *TIME* magazine's ‘100 most influential people’ list in 2014, and one of India's highest civilian awards, the Padma Shri, in 2016.

*Pad Man* makes Muruganatham's unusual journey relatable, although it often descends a little into preachiness. It falters, too, with a laboured first half, in which the risk to women's health is not clearly delineated, and the stigma associated with the subject of menstruation is signalled by bursts of “*Sharam!*” (shame) from the female actors. Endorsing Bollywood's unapologetic love affair with song and dance, the demure Gayatri suddenly breaks into an exaggerated, hip-swaying number to celebrate the puberty of a girl next door.

The rest of the film brings in the usual elements of a potboiler — a love angle, the rise and rise of the protagonist and Gayatri's forgive-and-feel-proud reconciliation. Bachchan delivers the applause-inducing line: “America has Superman, Spiderman and Batman. India has Pad Man!”

Over the past decade, Muruganatham has travelled across villages in India — first selling his sanitary pads, and then setting up self-sustaining pad-making units in

**“Period poverty is a health issue affecting women in countries across the globe.”**

collaboration with women's self-help groups and cooperatives. He has spawned close to 2,500 such centres, in India and a dozen other developing countries. His pads retail at a fraction of the cost of those from multinational brands.

Although *Pad Man* captures the essence of grass-roots innovation and benefits from true-to-life portrayals by a brilliant set of actors, the instructive overtone mars the narrative. If it wants to reach other countries affected by period poverty, the song-and-dance might be a dampener. The film is also currently an urban sensation. Reaching its target audience in India's rural hinterland might be difficult, given the taboo — unless Balki and team have a plan for that.

Meanwhile, a social movement is now associated with the film. Muruganatham has mentored a biologist, Maya Vishwakarma, who came home to rural Madhya Pradesh from California four years ago to spread menstrual-hygiene awareness. Vishwakarma has now received backing to distribute free pads to tribal women. Her mission has earned her the sobriquet Pad Woman. The buzz created by *Pad Man* might help her small non-profit organization to get international donors and become a national movement. ■

**Subhra Priyadarshini** is chief editor of Nature India.