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# The Digital Epidemic Hijacking Sleep: Why Late-night Screens are a Clinical and Public-health Problem

**Momin Kashif***

**Professor, Department of Community Medicine, Parbhani Medical College & RP Hospital & Research Institute, Parbhani, Maharashtra**

***Corresponding Author:***
**Momin Kashif, Professor, Department of Community Medicine, Parbhani Medical College & RP Hospital & Research Institute, Parbhani, Maharashtra**
**E-MAIL: editor.pimr@gmail.com**



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## ABSTRACT

Smartphone use in bed is often perceived as a harmless lifestyle choice. However, emerging evidence indicates otherwise. Night time exposure to short-wavelength ('blue') light and engagement-driven content disrupts the body's circadian systems, fragments sleep architecture, and maintains cognitive arousal at a time when the brain should be winding down. [1–5] This editorial summarises current evidence on mechanisms, the Indian burden, and practical responses.

## MECHANISMS: CIRCADIAN DISRUPTION AND SLEEP ARCHITECTURE

Evening exposure to short-wavelength light (peak sensitivity ~460–480 nm) activates melanopsin-containing retinal ganglion cells, delaying circadian phase and suppressing the nocturnal rise of melatonin. [3, 6–8] In a controlled lab study with polysomnography and hormone testing, 90 minutes of evening smartphone reading without a blue-light filter reduced slow-wave sleep in the first quarter of the night and blunted the evening rise of melatonin; using a blue-light filter lessened but did not eliminate these effects. [9] Optical measurements from typical smartphones quantify the dose. In a dark room, social-messaging screens on typical smartphones deliver about 41–51 biolux of circadian light, which translate to roughly 7–11% melatonin suppression. Under brighter indoor lighting, the same phone use can reach ~59–105 biolux, with ~15–36% predicted suppression. [10, 11] These findings corroborate clinical experiences. Individuals may fall asleep after evening screen use yet wake unrefreshed because early-night slow-wave sleep, which is central to memory consolidation and physiological restoration, is diminished and the normal evening melatonin rise is blunted. [1, 9, 12]

## REINFORCEMENT LOOPS: WHY STOPPING IS HARD

Physiology explains only part of the problem. Modern social platforms and streaming interfaces deliberately maximise "time-on-platform" using uncertain, variable rewards (unpredictable new posts/likes), personalised ranking, infinite scroll, autoplay, and push notifications. Variable and intermittent rewards reliably sustain behaviour and increase persistence akin to drug addiction. [13, 14]

At the neural level, social feedback (e.g., "likes") engages ventral striatal reward circuits; converging neuroimaging evidence links stronger reward responsivity with greater social-media engagement and with features of problematic use. [15–17]

Specific interface choices remove natural stopping cues and prolong sessions. Infinite scroll and autoplay keep the reward stream continuous, reducing the likelihood of disengagement. Recent HCI and policy work characterises these as hyper-engaging design patterns that predictably extend screen time [18, 19]. From a regulatory perspective, such "addictive designs" are increasingly discussed under the umbrella of dark patterns, with calls to treat hyper-engaging interfaces as unfair commercial practices because they manipulate user behaviour at scale. [20]

In short, the combination of variable rewards and engagement-maximising interface patterns utilizes the same reinforcement principles that underlie addiction-like persistence. This design logic helps explain why many users find it difficult to stop especially when reward cues remain salient late in the evening.

## THE INDIAN BURDEN: A WIDE, DEEP, AND YOUNG PROBLEM

Smartphone use is strongly linked to sleep problems among Indian adolescents and young adults. In a large,

state-representative survey from the UDAYA study (Uttar Pradesh and Bihar), greater smartphone screen time was associated with higher odds of insomnia symptoms and short sleep, with a clear dose–response trend. [21] Evidence in students who are heavy users shows a similar picture. In medical and nursing students, smartphone addiction or prolonged daily use consistently correlates with poorer Pittsburgh Sleep Quality Index (PSQI) scores and higher odds of "poor sleeper" status [22–24]. These data indicate that, for younger Indians, late-evening and high-volume smartphone use is a measurable driver of sleep burden rather than a benign habit [21–24].

Among adults, Indian data that include objective sleep measures reinforce the concern. A multicentre study from AIIMS-New Delhi and PGIMER-Chandigarh (n=566) found higher mobile-phone use associated with worse PSQI scores where, in a polysomnography subsample, greater use was linked to altered sleep architecture (shorter latency to N2 and N3), consistent with dysregulated sleep quality despite similar total sleep time. [25] Taken together, current Indian evidence supports targeted counselling to reduce pre-bed smartphone exposure across the life course.

## FROM EVIDENCE TO PRACTICE: WHAT HELPS

We cannot stop smartphone use, but we can modify the behaviour. For that, both digital and face-to-face behavioural interventions work. A recent systematic review shows that app- or web-based sleep programmes for students and young adults improve sleep quality and reduce insomnia severity, complementing clinician-delivered care and expanding access [26]. This makes digital CBT-I a practical first line in crowded OPDs and campus settings.

Counselling should be mechanism-aligned. It should include to avoid the last hour before bed free of bright, blue-rich screens emphasizing that evening smartphone use blunts melatonin and reduces early-night slow-wave sleep, while blue-light filters offer only partial protection. [9–11] Individual should be warned about content design of apps as autoplay and binge-style viewing increase pre-sleep cognitive arousal and delay sleep onset. [5]

Clinical pathways should include brief screening for problematic use, especially when patients present with insomnia, fatigue, or mood symptoms. Meta-analytic evidence links problematic internet/smartphone use with substantially higher odds of sleep problems, beyond total screen time alone. [27] Indian data in adolescents, students, and adults support targeted counselling to limit pre-bed use and to restructure evening routines. [21–25] Clinicians can thus view bedtime screen use as exposure to a modifiable environmental and behavioural risk, rather than a personal shortcoming. Health systems can incorporate routine inquiries about evening device habits into sleep histories; universities and employers can integrate sleep-health literacy and healthy smartphone use for students and staff, and promote textbook reading and paper-based study particularly in the evening rather than relying only on computers and slide-based presentations. The regulators can scrutinise autoplay defaults and other engagement-optimising features from a public-health perspective.

Together, digital CBT-I at scale, last-hour screen hygiene, screening for problematic use, and design-level changes form a practical toolkit to reduce sleep burden linked to evening smartphone behaviour.

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