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IMPACT OF EXCESSIVE SCREEN TIME ON NEURODEVELOPMENT, SLEEP, BEHAVIOR, AND ACADEMIC PERFORMANCE IN CHILDREN: AN INTEGRATIVE REVIEW WITH SPECIAL REFERENCE TO AYURVEDIC DINACHARYA AND SADVRITTA

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ABSTRACT

Background: Children today are growing up immersed in a pervasive digital ecosystem of televisions, smartphones, tablets, and interactive platforms. Concurrently, Ayurveda has for centuries prescribed structured daily conduct — Dinacharya (daily regimen), Ratricharya (night regimen), and Sadvritta (code of right conduct) — intended to protect sensory, digestive, and mental health across the lifespan. This review examines whether these classical behavioral frameworks offer a coherent, complementary lens on the well-documented harms of excessive childhood screen exposure. **Objective:** To critically synthesize contemporary evidence on the neurodevelopmental, sleep-related, behavioral, and academic consequences of excessive screen time in children, and to examine the Ayurvedic constructs of Dinacharya, Ratricharya, Nidra, and Sadvritta as a potential integrative framework for prevention and management. **Methods:** A narrative-integrative review was conducted using PubMed/MEDLINE, Scopus-indexed journals, Frontiers, JAMA Network, and the AYUSH Research Portal, supplemented by classical Ayurvedic textual content as represented in peer-reviewed secondary literature. English-language biomedical publications from 2018–2026 were prioritized, including the American Academy of Pediatrics' January 2026 policy update on children's digital media use. **Key Findings:** Excessive screen exposure is consistently associated with altered neurodevelopmental trajectories (reduced cortical thickness, altered connectivity), delayed language acquisition, disrupted sleep architecture via melatonin suppression and psychological arousal, elevated risk of ADHD-type and internalizing behavioral symptoms, lower academic achievement, and physical sequelae including digital eye strain, myopia progression, and reduced physical activity/obesity risk. Ayurvedic Dinacharya and Ratricharya prescribe structured wake-sleep timing, sensory hygiene, and physical activity that parallel several evidence-based screen-time mitigation strategies, while Sadvritta's emphasis on self-regulation, sense-organ discipline (Indriya Nigraha), and social conduct offers a values-based behavioral vocabulary for digital self-regulation. Emerging Ayurvedic clinical research on Medhya Rasayana herbs and structured non-pharmacological regimens for gadget-use disorders shows preliminary promise but remains limited by small trial sizes. **Conclusion:** Excessive childhood screen time carries substantial, well-replicated risks across multiple developmental domains. Ayurvedic Dinacharya and Sadvritta provide a historically grounded, culturally resonant behavioral framework that converges conceptually with modern sleep hygiene and self-regulation science, but their formal integration into pediatric screen-time management requires dedicated clinical evaluation rather than assumption of equivalence.

KEYWORDS: Screen time; children; neurodevelopment; sleep; behavior; academic performance; Dinacharya; Sadvritta; Ayurveda; Nidra.

1. INTRODUCTION

Digital devices have become a near-universal feature of childhood within little more than a decade. Televisions, smartphones, tablets, gaming consoles, and increasingly artificial-intelligence-enabled applications together form what the American Academy of Pediatrics now terms a child's "digital ecosystem" rather than a single, countable behavior.[1] This shift in framing reflects a broader recognition that children no longer interact with screens in isolated blocks of time; digital media is woven into learning, entertainment, socializing, and even emotional self-soothing from infancy onward.[1]

For much of the past decade, professional guidance centered on simple hourly limits: no screens before 18–24 months except video calling, and roughly one hour of high-quality programming daily for ages two to five.[2] In January 2026, however, the American Academy of Pediatrics released an updated policy statement, "Digital Ecosystems, Children, and Adolescents," moving away from rigid hour-based limits toward a framework emphasizing content quality, context of use, and whether screen use displaces essential health behaviors such as sleep, physical activity, and in-person interaction.[1,3] This evolution reflects growing evidence that the amount of screen time matters less, on its own, than what it replaces and how it is used.[3]

Despite this reframing, the accumulated evidence base linking heavy or poorly-contextualized screen exposure to adverse outcomes in neurodevelopment, sleep, behavior, and academic achievement remains substantial and continues to grow.[4,5] Ayurveda, the classical Indian system of life sciences, addresses an overlapping domain through its doctrine of daily conduct: Dinacharya (the daily regimen), Ratricharya (the night regimen), and Sadvritta (the code of right conduct for physical, mental, and social well-being).[6,7] These frameworks prescribe structured timing of waking and sleeping, sensory hygiene, physical activity, and disciplined control of the sense organs (Indriya) and mind (Manas), several centuries before the emergence of digital media, yet addressing physiological and behavioral territory strikingly relevant to it.

The rationale for bringing these two literatures into dialogue is threefold. First, both are concerned with the same vulnerable population and developmental window: children whose neurological, ocular, and behavioral systems are still maturing. Second, Ayurvedic Dinacharya and Ratricharya already encode specific, testable behavioral prescriptions — regular wake-sleep timing, structured physical activity, restraint before sleep — that parallel evidence-based screen-time mitigation strategies identified independently in modern pediatric research.[3,8] Third, Sadvritta's emphasis on Indriya Nigraha (sense-organ restraint) and mental discipline offers a values-based, culturally resonant vocabulary for self-regulation that may complement, without replacing, modern behavioral interventions for excessive gadget use.[9,10]

This review therefore aims to: (i) summarize current evidence on the neurodevelopmental, sleep, behavioral, academic, and physical consequences of excessive childhood screen time; (ii) present the Ayurvedic conception of Dinacharya, Ratricharya, Nidra, and Sadvritta as they pertain to child health; (iii) construct a comparative framework linking the two; and (iv) critically examine the plausibility, limitations, and translational potential of this integration, while treating the correlation as heuristic rather than as an established mechanistic equivalence.

2. METHODOLOGY

This is a narrative-integrative review rather than a systematic review or meta-analysis; no formal quantitative synthesis or prospective registration was undertaken, consistent with the conceptual, cross-disciplinary scope of the subject matter.

2.1 Literature Search Strategy

Searches were conducted across PubMed/MEDLINE, Scopus-indexed journals, Frontiers, JAMA Network, ScienceDirect, and the AYUSH Research Portal. Search terms combined biomedical vocabulary ("screen time", "neurodevelopment", "sleep", "melatonin", "ADHD", "academic performance", "myopia", "language delay") with Ayurvedic terminology ("Dinacharya", "Ratricharya", "Sadvritta", "Nidra", "Indriya", "Medhya Rasayana"). English-language biomedical literature published between 2018 and 2026 was prioritized, including the AAP's January 2026 policy update; classical Ayurvedic textual content was drawn from peer-reviewed secondary literature citing the Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya.

2.2 Inclusion and Exclusion Criteria

Included: peer-reviewed systematic reviews, narrative reviews, randomized controlled trials, cohort studies, and policy statements addressing childhood screen time and its neurodevelopmental, sleep, behavioral, academic, or physical correlates; peer-reviewed Ayurvedic conceptual, clinical, or scoping reviews addressing Dinacharya, Ratricharya, Sadvritta, Nidra, or Medhya Rasayana.

Excluded: non-peer-reviewed promotional material, single case reports without broader corroboration, and duplicate reports of the same dataset.

Table 1: Literature Search Strategy.

Database	Representative Keywords Used	Domain Covered
PubMed / MEDLINE	screen time; neurodevelopment; ADHD; myopia	Modern pediatric and developmental science

Scopus-indexed journals	sleep; melatonin; academic performance	Sleep science and educational outcomes
JAMA Network / Frontiers	digital media; behavior; mental health	Policy and behavioral health
ScienceDirect	language delay; obesity; sedentary behavior	Developmental and metabolic outcomes
AYUSH Research Portal / indexed Ayurveda journals	Dinacharya; Sadvritta; Nidra; Medhya Rasayana	Ayurvedic conceptual and clinical literature

3. Screen Time in Modern Childhood: Definitions and Evolving Guidelines

"Screen time" is conventionally defined as any time spent viewing content on televisions, smartphones, tablets, computers, or gaming consoles, encompassing both passive consumption and interactive or educational use.[1] For a decade following its 2016 guidance, the American Academy of Pediatrics recommended a widely cited two-hour daily ceiling for recreational screen use in older children, alongside a strict no-screen rule under 18 months except for video calling and a one-hour limit for ages two to five.[2] The World Health Organization's guidelines on physical activity, sedentary behavior, and sleep for young children issued similar recommendations: no screen exposure under age two, and less than one hour daily for ages two to five.[2]

On January 20, 2026, the AAP's Council on Communications and Media released an updated policy statement, Digital Ecosystems, Children, and Adolescents, explicitly retiring the fixed hourly ceiling in favor of a framework built around three questions: whether content is high-quality and age-appropriate, whether use is interactive/co-viewed or passive and solitary, and whether screen use is displacing sleep, physical activity, or face-to-face interaction.[1,3] The policy further highlights that many digital platforms are commercially designed to maximize engagement through features such as autoplay, infinite scroll, and algorithmic content curation, which can work against, rather than support, healthy child development regardless of the specific hour count involved.[1] This shift does not diminish the evidence of harm associated with heavy, low-quality, or sleep-displacing screen use; rather, it reframes the operative question from "how many hours" to "what is being displaced, and how."

Table 2: Evolution of Screen Time Guidance for Children.

Parameter	2016–2025 Guidance	2026 AAP Framework
Under 18–24 months	No screens except video calling	Largely unchanged; video calling still exempted.[1]
Ages 2–5	≤1 hour/day of high-quality programming	~1 hour/day remains a reasonable starting point, but framed as guidance rather than a hard ceiling.[3]

School-age / adolescents	Family Media Use Plan; ~2 hours/day recreational (informal)	No fixed hourly limit; individualized family media plan built around quality, context, and displacement.[1,3]
Underlying question	"How many hours?"	"Is this content high-quality? Is it interactive or co-viewed? Is it displacing sleep, activity, or connection?".[3]

4. Impact on Neurodevelopment

A scoping review of neuroimaging studies in children aged 0–12 years found that higher screen exposure was associated, in most included studies, with reduced cortical thickness, lower gray- and white-matter integrity, decreased cerebellar volume, and altered connectivity within networks governing language, attention, executive function, and emotional regulation.[4] These neural differences correlated with poorer literacy and language skills, increased anxiety and depressive symptomatology, and greater behavioral difficulty, although some structured and interactive digital activities — particularly certain video games — were associated with improvements in working memory, spatial awareness, and fine motor performance, underscoring that screen media is not uniformly harmful and that content and interactivity moderate outcomes.[4]

A critical narrative review framed this as a genuinely "two-sided" picture: co-viewing and high-quality educational content can support development, whereas passive, non-educational, and solitary use is associated with unfavorable neurodevelopmental trajectories, arguing that outright elimination of screens is neither realistic nor, on the current evidence, uniformly necessary.[5] Consistent with this, a review focused on preschoolers found excessive screen time strongly associated with neurodevelopmental delay, with one 2022 study reporting that boys as young as one year with heavy screen exposure showed early signs consistent with autism-spectrum-associated presentations and language delay, while protective factors such as nearby green space and high-quality public broadcasting content were associated with reduced screen time and better outcomes.[11]

Domain-specific reviews reinforce this pattern. A study of children aged one to six years found that excessive screen exposure was associated with delayed fine motor, language, and social-skill acquisition, attributing this in part to the displacement of exploratory play and direct human interaction during a developmentally critical window.[12] A systematic review focused specifically on motor development found the evidence more heterogeneous, with studies varying in the strength and direction of association between screen exposure and gross/fine motor milestones, but noted that slowed motor development frequently co-occurred with delayed language, impaired social skills, disrupted sleep, and reduced physical activity, suggesting a clustering of risk rather than an isolated effect.[13] Language development has received particular attention: a systematic review found that toddlers introduced to smart media before 24 months, and those with more than two to four hours of daily exposure, showed reduced receptive and expressive vocabulary and higher rates of diagnosable speech delay, while co-viewing, educational app content, and later introduction of devices were associated with more favorable outcomes.[14] A separate scoping review similarly found that the majority of included studies reported a negative association between screen exposure duration and language development, most consistently among children under two years.[15] Notably, several studies found that parental screen use itself — not only the child's own exposure — independently predicted child language delay, implicating reduced parent-child verbal interaction as a key mediating pathway.[14,16]

Table 3: Screen Time and Neurodevelopmental Domains in Children.

Developmental Domain	Reported Association with Excessive Screen Time	Key Evidence
Brain structure/connectivity	Reduced cortical thickness, altered white-matter integrity, altered network connectivity	Neuroimaging scoping review, ages 0–12y.[4]
Language / speech	Delayed receptive/expressive vocabulary; higher rates of diagnosable speech delay, especially with exposure before 24 months	Systematic and scoping reviews.[14,15]
Fine motor and social skills	Delayed acquisition in children aged 1–6 years	Cohort-based review.[12]
Gross/fine motor milestones	Heterogeneous; frequently co-occurs with other delays	Systematic review.[13]
Executive function / attention	Reduced working memory and attentional control with heavy, passive use	Neuroimaging and preschool reviews.[4,11]
Structured/interactive digital use	Some positive associations with working memory, spatial skills, fine motor performance	Neuroimaging scoping review.[4]

5. Impact on Sleep

Three overlapping mechanisms are proposed to explain the well-documented association between screen use and disrupted childhood sleep: direct time displacement of sleep or sleep-promoting activity such as exercise; psychological and physiological arousal from engaging, emotionally stimulating, or social content; and circadian disruption via light-emitted melatonin suppression.[8] Regarding the last mechanism, blue-wavelength light emitted by self-illuminating screens is detected by intrinsically photosensitive retinal ganglion cells with peak sensitivity near 480 nm, suppressing pineal melatonin release and delaying circadian phase; a comprehensive review of pediatric evidence from 2020–2025 found that evening blue-light exposure measurably reduced REM sleep duration, increased REM fragmentation, prolonged sleep-onset latency, and impaired sleep efficiency, with the greatest disruption occurring when exposure fell between 21:00 and 22:30.[17]

Experimental work indicates that children may be more vulnerable to this effect than adults: in a controlled two-night study, melatonin suppression from blue-enriched white LED lighting was significantly greater in children than in adults at matched illuminance and color temperature, and children also reported significantly lower subjective sleepiness after blue-enriched exposure, consistent with a genuinely stronger circadian sensitivity in the pediatric population rather than merely a behavioral difference.[18] A related line of evidence in adolescents and young adults similarly links chronic evening blue-light exposure from devices to disrupted circadian timing, delayed sleep phase, and reduced sleep quality, compounding the pubertal tendency toward later intrinsic sleep timing and colliding with early school start times.[19] A crossover trial using partial blue-light-blocking glasses in schoolchildren aged 10–12 found that, although salivary melatonin levels were not significantly altered, blue-light blocking modestly advanced sleep onset and reduced daytime irritability and disruptive behavior, suggesting that behavioral and alertness pathways, not melatonin suppression alone, also mediate the sleep–behavior relationship.[20]

At the population level, a systematic review and meta-analysis of children under five years found consistent associations between higher screen time (particularly evening use) and shorter sleep duration, later bedtimes, and poorer sleep quality, with associations strongest for screen use occurring close to bedtime rather than screen use earlier in the day.[21] Taken together, this evidence supports a widely echoed practical recommendation: keeping bedrooms screen-free and stopping screen use at least one hour before bedtime, a recommendation now explicitly retained within the AAP's 2026 quality/context/displacement framework as one of its highest-confidence elements.[1]

Table 4: Mechanisms Linking Screen Time and Sleep Disruption in Children.

Mechanism	Physiological/Behavioral Basis	Evidence
Time displacement	Screen use directly substitutes for sleep or sleep-promoting activity	Narrative synthesis.[8]

	(exercise, wind-down routines)	
Psychological arousal	Engaging/emotionally stimulating content elevates cortisol/adrenaline, delaying sleep onset	Narrative synthesis.[8]
Melatonin suppression	Blue light (~480 nm) suppresses pineal melatonin via ipRGCs, delaying circadian phase	Comprehensive pediatric literature review 2020–2025.[17]; controlled LED exposure study.[18]
Heightened pediatric sensitivity	Children show greater melatonin suppression than adults at matched light exposure	Controlled two-night crossover study.[18]
REM sleep disruption	Reduced REM duration, increased fragmentation, prolonged sleep-onset latency	Comprehensive literature review.[17]
Behavioral/alertness pathway (independent of melatonin)	Blue-light blocking improved sleep phase and daytime irritability without altering melatonin	Randomized crossover trial, schoolchildren aged 10–12.[20]

6. Impact on Behavior and Mental Health

A systematic review of studies examining recreational screen time and attention-deficit/hyperactivity disorder found a consistent, if heterogeneous, association: higher electronic-screen exposure correlated with self-reported attention and hyperactivity problems, television and computer time during adolescence predicted ADHD symptoms measured years later at age 22, and a cross-sectional study from South India found that preschoolers with a clinical ADHD diagnosis were more likely to exceed recommended screen-time durations than unaffected peers.[22] The directionality of this relationship remains genuinely debated in the literature — heavier screen use may both contribute to, and be a behavioral consequence of, underlying attentional difficulty — a caveat this review preserves rather than resolves.

Internalizing symptoms show a similarly consistent, though not universal, pattern. Using National Survey of Children's Health data, one analysis found that daily screen time of four or more hours was consistently associated with anxiety, depression, and behavior/conduct problems in adjusted models, with physical activity and sleep disturbance identified as parallel mediating pathways through which screen exposure appeared to influence mental health.[23] A large longitudinal study of nine- and ten-year-olds by the University of California, San Francisco found that greater screen time predicted a higher likelihood of developing depressive and anxiety symptoms as children aged into early adolescence.[24] A systematic review of adolescent studies similarly found that overall screen exposure time was most consistently associated with poorer mental well-being, with social media use showing a distinct and independent association with depression risk, particularly in girls.[25] A longitudinal Canadian study of over 17,000 high-school students found that higher screen time predicted greater anxiety and depressive symptoms one year later, with the strength of association varying by screen type and sex.[26]

Population-based and neuroimaging studies extend this picture. One large population-based study found that high screen users were roughly twice as likely as low users to have received a diagnosis of, or needed treatment for, depression or anxiety.[27] Analysis of the Adolescent Brain Cognitive Development cohort found that adolescent screen time was associated with elevated risk of anxiety, depression, and substance use, potentially mediated by shared neurobiological reward and stress-regulation pathways undergoing rapid maturation during adolescence.[28] A related Yale-led analysis of the same cohort found that children with the highest screen media use were significantly more likely to exhibit internalizing problems — including depression, anxiety, and somatic complaints — two years later, with this association statistically mediated by measurable changes in brain development.[29] A Brazilian cross-sectional study similarly found a dose-dependent relationship between daily screen time and symptoms of depression, anxiety, and stress, with the highest exposure category (six or more hours daily) showing the strongest association.[30] A Swiss cohort study tracking adolescent media trajectories from ages 11 to 20 found that persistently high or increasing screen-time patterns were associated with poorer young-adult mental health and higher rates of substance use, delinquency, and aggression.[31]

Table 5: Screen Time and Behavioral / Mental Health Outcomes in Children and Adolescents.

Outcome	**Reported Association**	**Representative Evidence**
ADHD symptoms	Higher screen exposure correlates with attention/hyperactivity symptoms; bidirectionality plausible	Systematic review 2013–2023.[22]
Anxiety and depression	Dose-dependent association, strongest at ≥4–6 hours/day	NSCH analysis.[23]; Brazilian cross-sectional study.[30]
Longitudinal mental health risk	Higher screen time predicts later depressive/anxiety symptoms	UCSF cohort.[24]; COMPASS longitudinal study.[26]
Internalizing problems (brain-mediated)	High users show more internalizing symptoms 2 years later, mediated by brain development changes	ABCD cohort, Yale analysis.[29]
Substance use and conduct problems	Persistently high screen-time trajectories predict young-adult	Zurich cohort study.[31]

	substance use, delinquency, aggression	
Diagnosed depression/anxiety treatment need	High users ~2× more likely to have received diagnosis/treatment	Population-based study.[27]

7. Impact on Academic Performance

Evidence linking screen time to academic achievement spans early childhood through university. A Canadian cohort study examined standardized reading, writing, and math achievement in grades 3 and 6 and found associations between early television and digital-media exposure and subsequent academic outcomes, building on earlier evidence from the Quebec Longitudinal Study of Child Development in which each additional hour of television exposure at age two corresponded to measurable reductions in classroom engagement and fourth-grade mathematics proficiency.[32] A large Chinese study using the China Education Panel Survey of over 17,000 junior middle-school students found a statistically significant negative correlation between screen time and scores in Chinese, mathematics, and English, though the authors cautioned that findings from a high-academic-pressure cultural context may not generalize elsewhere.[33]

An Australian study of students in grades 5 through 12 attending a school with a bring-your-own-device policy found that sedentary screen behavior, sleep, and physical activity were each independently associated with academic performance recorded in school records, reinforcing the AAP's emphasis on displacement effects rather than screen time as an isolated variable.[34] A study among Indian school children similarly found that higher screen exposure was associated with poorer academic performance alongside greater anxiety and behavioral problems, though the authors noted that unmeasured factors such as intellectual ability, motivation, and parental educational attainment likely also contribute to academic outcomes and were not fully accounted for.[35] Notably, a prospective study among first-year medical students found that the purpose of screen use, rather than its total duration, best predicted examination performance: academic screen time correlated positively with marks, non-academic use correlated negatively, and total screen time alone showed no significant correlation — a finding consistent with the AAP's 2026 shift toward evaluating content and context rather than raw hours.[36] A 2026 cohort report tracking children from preschool found that each additional hour of daily early-childhood screen time was associated with an approximately 9–10% lower likelihood of reaching higher academic achievement levels in mathematics and reading years later.[37] Finally, a Japanese cohort study examining the joint effects of screen time and physical activity found that these two behaviors interacted, such that high screen time combined with low physical activity carried greater academic risk than either factor considered alone, underscoring the value of a displacement-based rather than purely time-based analytic framework.[38]

Table 6: Screen Time and Academic Performance: Representative Evidence.

Study Population	Key Finding	Source
Canadian schoolchildren, grades 3 & 6	Early television/digital exposure associated with standardized achievement test outcomes	Cohort study.[32]
Chinese junior middle-school students (n=17,150)	Significant negative correlation between screen time and Chinese/math/English scores	CEPS-based study.[33]
Australian students, grades 5–12	Sleep, physical activity, and sedentary screen behavior each independently predicted academic performance	Cross-sectional survey.[34]
Indian school children	Higher screen time associated with poorer academic performance, anxiety, and behavioral problems	Cross-sectional study.[35]
Phase 1 MBBS students	Academic-purpose screen time positively correlated with marks; non-academic use negatively correlated; total time uncorrelated	Prospective observational study.[36]
Preschool cohort followed longitudinally	Each additional hour of early screen time associated with ~9–10% lower odds of high academic achievement later	Longitudinal cohort report.[37]
Japanese children aged 7–10	Joint (interactive) effect of screen time and physical activity on academic performance	Longitudinal study.[38]

8. Impact on Physical Health: Vision and Weight

Prolonged near-focus screen viewing has been linked to both acute digital eye strain and longer-term myopia progression. A comprehensive review of digital eye strain found a pre-pandemic prevalence of 5–65% among screen users, rising to an estimated 50–60% among children during pandemic-era remote learning, with symptoms including ocular discomfort, dryness, blurred vision, headache, and, in a subset of cases, new-onset esotropia and vergence abnormalities.[39] A PRISMA-guided review of pediatric media-device use and vision disorders similarly identified pre-myopia, myopia progression, digital eye strain, and acute acquired comitant esotropia as time-related consequences of incorrect or excessive device use in children.[40] Recent clinical data reported that children using smartphones more than four hours daily showed a mean annual myopic progression of 0.66 ± 0.27 diopters, with each additional hour of daily screen time associated with a 21% higher likelihood of developing myopia.[41] A broader review situated these ocular findings within a wider pattern of sedentary, screen-based childhood behavior that simultaneously reduces outdoor time (itself independently protective against myopia), physical activity, and mental well-being.[42]

Regarding weight and physical activity, a systematic review and dose-response meta-analysis of adolescent studies found that the highest screen-time category carried 1.27-fold higher odds of overweight or obesity compared with lower-exposure groups, without a clear linear dose-response gradient.[43] An earlier meta-analysis of pediatric studies found that screen time of two or more hours daily was associated with a 1.67-fold increased odds of overweight/obesity compared with under two hours.[44] A Community Guide systematic review of behavioral interventions found that programs reducing recreational sedentary screen time among children achieved reductions of roughly 26 minutes per day on average, accompanied by a 2.3 percentage-point reduction in obesity prevalence and improvements in physical activity and diet, providing reassuring evidence that this pathway is modifiable through structured intervention.[45] A broader systematic review of physical activity and sedentary behavior trends among youth aged 7–18 confirmed a decades-long decline in moderate-to-vigorous physical activity paralleling rising sedentary and screen time, describing physical inactivity as an emerging global pediatric public-health concern in its own right.[46]

Table 7: Screen Time and Physical Health Correlates: Vision and Weight.

Domain	Finding	Evidence
Digital eye strain	Prevalence rose to 50–60% among children during pandemic-era remote learning; symptoms include dryness, headache, esotropia	Comprehensive review.[39]; pediatric PRISMA review.[40]
Myopia progression	>4 hours/day smartphone use associated with 0.66D annual progression; each added hour raises myopia odds ~21%	Clinical analysis.[41]
Reduced outdoor time	Screen-based sedentary behavior displaces outdoor time, itself independently protective against myopia	Narrative review.[42]
Overweight/obesity (adolescents)	Highest screen-time category: 1.27× higher odds of overweight/obesity	Dose-response meta-analysis, 44 studies.[43]
Overweight/obesity (children, ≥2h/day)	1.67× higher odds versus <2 hours/day	Meta-analysis, 16 studies.[44]
Modifiability via intervention	Structured behavioral programs reduced screen time ~26 min/day and obesity prevalence 2.3 percentage points	Community Guide systematic review.[45]

9. Ayurvedic Framework: Dinacharya, Ratricharya, and Sadvritta

9.1 Dinacharya: The Daily Regimen

Dinacharya, derived from Dina (day) and Charya (conduct), refers to the structured sequence of daily practices prescribed in Ayurveda for the preservation of health in the healthy and the management of disease in the afflicted.[47] Classical elements include rising during Brahma Muhurta (the pre-dawn hours), oral and tongue hygiene, Abhyanga (oil massage), Snana (bathing), Vyayama (structured physical exercise), and Ahara (regular, wholesome meal timing).[6] A systems-biology analysis of these practices situates Dinacharya as a form of "quaternary prevention" — a whole-system approach that synchronizes bodily rhythms with the environment and social routine, reducing exposure to risk factors for lifestyle-related non-communicable disease before pathology develops.[48] Central to Dinacharya is Vyayama, structured daily physical exertion, which the same analysis identifies as scientifically well-supported for its cardiometabolic and mood-regulating benefits, directly paralleling the modern recommendation to displace sedentary screen time with physical activity.[48]

9.2 Ratricharya and the Structure of the Evening

Ratricharya, the night regimen, addresses conduct in the hours preceding sleep, including moderation of the evening meal, appropriate timing of Nidra (sleep), and avoidance of activities and stimulation that disturb the transition to rest.[7] Classical Kaumarabhritya and Swasthavritta literature groups Dinacharya, Ratricharya, seasonal Ritucharya, and Sadvritta together as an integrated set of rules whose combined observance is held to prevent disease and preserve optimal health across the lifespan.[7,49]

9.3 Sadvritta: The Code of Right Conduct

Sadvritta — from Sad (good) and Vritta (conduct or habit) — is the Ayurvedic code of personal and social behavior intended to protect mental, physical, and spiritual well-being and to cultivate mastery over the sense organs (Indriya).[50] A recent review classifies Sadvritta into five domains: Vyavaharika (ethical conduct), Samajika (social conduct), Manasika (mental conduct), Dharmika (moral conduct), and Sharirika (physical conduct), and draws explicit parallels between these classical categories and contemporary psychological constructs including self-control, prosocial behavior, gratitude, and compassion, each supported by modern empirical psychology.[9] Charaka Samhita's Sutrasthana prescribes specific behavioral rules — moderation in speech, restraint of anger and unnecessary worry, respect in social conduct, and disciplined control over sensory indulgence — explicitly framed as necessary "if we want to control the sense organs and to obtain perfect health".[49,51] This last emphasis, Indriya Nigraha or restraint of the sense organs, is of direct relevance to excessive screen engagement, which by its visual, auditory, and often socially rewarding nature represents a paradigmatic modern challenge to sensory self-regulation.

Table 8: Dinacharya, Ratricharya, and Sadvritta: Classical Components and Modern Relevance.

Component	Classical Elements	Relevance to Childhood Screen-Time Management
Dinacharya (daily regimen)	Early rising, oral hygiene, Abhyanga, Snana, Vyayama, regular Ahara timing	Structured routine and mandatory physical activity directly displace sedentary screen time.[6,48]
Ratricharya (night regimen)	Moderate evening meal, timed Nidra, avoidance of over-stimulation before sleep	Parallels modern sleep-hygiene advice to stop screen use before bedtime.[7]
Ritucharya (seasonal regimen)	Adjustment of diet/conduct to season	Encourages outdoor, nature-synchronized activity over year-round indoor screen use.[7]
Sadvritta (code of conduct)	Vyavaharika, Samajika, Manasika, Dharmika, Sharirika conduct; Indriya Nigraha (sense-organ restraint)	Provides a values-based vocabulary for self-regulation of visual/auditory media engagement.[9,49,51]

10. Nidra in Ayurveda: Classical Sleep Physiology and Screen-Displaced Sleep

Nidra (sleep) is regarded in Ayurveda as one of the three sub-pillars of life (Trayopasthambha), alongside diet and Brahmacharya, essential for both physical and mental well-being.[52] Acharya Charaka describes sleep as arising when the mind (Manas) and soul (Atma) become fatigued and the sense organs (Indriyas) withdraw from their respective objects (Vishaya) — a description that maps loosely onto the modern understanding of sleep onset as a state of reduced sensory processing and cortical disengagement.[52,53] Classical texts attribute multiple restorative functions to adequate Nidra, including happiness (Sukhakara), nourishment (Pushtikara), physical strength (Balyakara), cognitive enhancement (Jnanakara), and sustaining life itself (Jeevanakara).[54]

Ayurvedic nosology further classifies sleep into physiological sleep (Swabhavika Nidra), pathological sleep arising from Doshic imbalance (for example, Kapha-dominant or Tamas-driven sleep), and sleep induced by external or pharmacological causes, while explicitly linking insomnia (Nidranasha) to aggravated Vata, manifesting with symptoms such as muscle wasting and disturbed breathing.[55] A conceptual review correlating Nidra with modern lifestyle disorders notes that disturbed or irregular sleep, termed Nidra Vaishamya, is associated in classical descriptions with the same downstream consequences increasingly documented in sleep-deprivation research — impaired cognitive performance, reduced attention, diminished intellectual capacity, and heightened risk of metabolic and cardiovascular disturbance.[53,56] A further review distinguishes Vidhi-Sevita Nidra (sleep practiced according to prescribed timing and rules) from Avidhi-Sevita Nidra (irregular or improperly timed sleep), arguing that adherence to a regular Nidra Vidhi — a fixed, appropriately timed sleep schedule — is itself a primary determinant of health independent of total sleep duration.[57]

This classical emphasis on regularity and appropriate timing, rather than duration alone, converges closely with the modern mechanistic evidence reviewed in Section 5: screen-related sleep disruption operates substantially through delayed and irregular sleep timing (via melatonin suppression and psychological arousal) rather than through reduced sleep duration alone.[17,21] Ratricharya's prescription of a calm, unstimulating pre-sleep period and a consistent Nidra Vidhi thus anticipates, in classical vocabulary, the specific behavioral recommendation — screen-free time before bed, consistent sleep timing — that modern chronobiology now supports through direct measurement of melatonin and REM sleep architecture.

Table 9: Ayurvedic Nidra Concepts and Modern Sleep-Science Correlates.

Ayurvedic Concept	Classical Description	Modern Correlate
Nidra as Trayopasthambha	One of three pillars of life alongside diet and Brahmacharya	Sleep as a core biological need essential to development.[52]
Sleep onset via Indriya withdrawal	Sleep occurs when mind/soul tire and senses withdraw from objects	Reduced sensory processing and cortical disengagement at sleep onset.[52,53]
Nidra Vaishamya (disturbed sleep)	Associated with impaired cognition, attention, intellectual capacity	Documented cognitive and metabolic consequences of pediatric sleep disruption.[56]
Nidranasha (Vata-driven insomnia)	Muscle wasting, disturbed breathing, mental disturbance	Chronic sleep-onset difficulty and psychological arousal from screen content.[8,55]
Vidhi-Sevita Nidra (regulated sleep)	Emphasis on fixed, appropriately timed sleep over duration alone	Circadian regularity and consistent bedtime as protective factors.[21,57]

11. Medhya Rasayana and Non-Pharmacological Ayurvedic Approaches to Gadget Overuse

Medhya Rasayana refers to a class of rejuvenative Ayurvedic herbs classically indicated for enhancing Medha — comprising Dhee (intellect), Dhriti (mental control), and Smriti (memory) — and is increasingly examined for behavioral and cognitive disorders in children.[10,58] A recent Ayurvedic review of pediatric behavioral problems, including attention-deficit/hyperactivity disorder, oppositional defiant disorder, and anxiety-related behavior, frames these conditions as arising from imbalance among the mental Gunas (Sattva, Rajas, Tamas), impaired Manasika Bala, and depletion of Ojas, and summarizes modern pharmacological evidence supporting several classical Medhya herbs: Bacopa monnieri (Brahmi) for memory, executive function, and anxiety reduction including in pediatric ADHD populations; Centella asiatica (Mandukaparni) for neuroprotective and anxiolytic effects via cholinergic modulation; Convolvulus pluricaulis (Shankhapushpi) for cognitive performance; and Withania somnifera (Ashwagandha) for lowering stress-hormone levels.[58] An independent pharmacological update similarly catalogs the nootropic evidence base for these and related Medhya herbs, noting generally favorable preclinical and early clinical safety and efficacy signals, while emphasizing the need for further standardization.[59]

Direct clinical evidence in children is emerging but still limited in scale. A Prakriti-based, double-blind randomized controlled trial comparing Bacopa monnieri and Centella asiatica in 180 healthy boys aged 8–10 years found highly significant improvements in total memory score, multiple memory subtests, and IQ in the Bacopa (Brahmi) group, with the Centella (Mandukaparni) group also showing significant gains on most subtests, suggesting genuine, measurable cognitive benefit rather than a purely theoretical claim.[60] A separate controlled study of school-going children found that Medhya Rasayana administration improved short-term memory more than a yogic-practice-only intervention, attributing part of the effect to modulation of dopaminergic, serotonergic, and noradrenergic pathways implicated in learning and memory consolidation.[61] Most directly relevant to this review, a registered randomized controlled trial protocol is evaluating Medhya Rasayana (pharmacological), non-pharmacological Ayurvedic intervention, and cognitive behavioral therapy as three parallel arms for managing gadget addiction in children, explicitly grounding its non-pharmacological arm in Sadvritta Palana (adherence to Sadvritta) and Dhyana (meditation) as means of increasing Sattva Guna and reducing Raja and Tama Guna, the classical substrate the protocol holds responsible for impulsive, addictive engagement with digital devices.[10] A broader review of Medhya Rasayana in pediatric developmental disabilities similarly supports their use as adjunctive, generally well-tolerated cognitive support, though again calls for larger, better-standardized trials.[62]

Table 10: Medhya Rasayana and Related Ayurvedic Interventions: Classical Indication and Modern Evidence.

Herb / Intervention	Classical Indication	Modern Evidence
Bacopa monnieri (Brahmi)	Medhya — enhances Smriti (memory) and Dhee (intellect)	RCT in 180 boys: significant memory and IQ improvement.[60]; supportive pediatric ADHD data.[58]
Centella asiatica (Mandukaparni)	Medhya — neuroprotective, calming	Significant memory-subtest improvement in RCT.[60]; anxiolytic evidence via cholinergic modulation.[58]
Convolvulus pluricaulis (Shankhapushpi)	Medhya — cognitive enhancer	Preclinical/clinical support for cognitive performance.[58,59]
Withania somnifera (Ashwagandha)	Balya/Rasayana — stress and strength	Lowers stress-hormone levels; supports emotional regulation.[58]
Sadvritta Palana + Dhyana (non-pharmacological arm)	Increases Sattva Guna; reduces Raja/Tama Guna held to underlie impulsive gadget use	Active RCT protocol for gadget addiction in children (results pending).[10]

12. Integrative Correlation: Dinacharya and Sadvritta as a Digital-Wellness Framework

Read alongside one another, the modern evidence base and the Ayurvedic framework converge on a small number of shared operative principles rather than on any single unifying mechanism. Modern behavioral interventions that successfully reduce childhood screen time and its harms tend to work not by prohibition but by structuring the day: fixed routines, protected physical-activity time, parental co-engagement, and specific, non-negotiable screen-free windows around meals and bedtime.[45,63,64] This is structurally similar to what Dinacharya and Ratricharya already prescribe — a fixed daily architecture of waking, activity, eating, and sleeping — independent of any specific claim about digital media, since these regimens predate it.[6,48]

A cluster-randomized trial of a digital parental health-education intervention ("Stop and Play") delivered via structured messaging to mothers of preschoolers in Malaysia significantly improved maternal screen-time knowledge, self-efficacy, and child screen-time outcomes, illustrating that caregiver-directed behavioral education, rather than child-directed restriction alone, is an effective lever.[63] A multicomponent Indian trial protocol ("PLUMS") targeting children aged two to five similarly combines caregiver information/education/communication materials with motivational interviewing and substitute play activities, explicitly measuring sleep duration, behavior, and physical activity as secondary outcomes alongside screen time itself.[65] A systematic review of randomized controlled trials for reducing preschool screen time found that parent-focused programs were generally more successful than child-focused or purely informational approaches, and that interventions addressing the broader daily and family routine outperformed those targeting screen time in isolation.[64] Each of these evidence-based intervention designs — caregiver engagement, routine restructuring, substitute activity, and protected pre-sleep time — has a direct classical analogue within Dinacharya, Ratricharya, and Sadvritta, even though the correspondence is structural rather than mechanistically identical.

Table 11: Correlation Between Evidence-Based Screen-Time Interventions and Ayurvedic Dinacharya/Sadvritta Principles.

Modern Evidence-Based Principle	Ayurvedic Correlate	Nature of Correspondence
Fixed daily structure / consistent routine	Dinacharya (daily regimen)	Both replace ad hoc, reactive scheduling with a fixed architecture of waking, activity, meals, and sleep.[6,48]
Screen-free period before bedtime	Ratricharya (night regimen); Vidhi-Sevita Nidra	Both prescribe a calm, unstimulating pre-sleep window and consistent sleep timing.[7,57]
Displacement with physical activity	Vyayama within Dinacharya	Both treat structured physical exertion as the primary substitute for sedentary screen time.[45,48]
Caregiver co-engagement and modeling	Sadvritta's social (Samajika) and family-oriented conduct norms	Both position adult behavior and relational engagement, not child restriction alone, as central.[9,63]
Self-regulation / impulse control training	Sadvritta's Manasika conduct; Indriya Nigraha	Both frame excessive engagement as a self-regulation deficit addressable through practiced discipline, not only external limits.[9,10]
Non-pharmacological behavioral therapy	Sadvritta Palana + Dhyana (meditation)	Both are being tested as active interventions for problematic gadget/media use, though Ayurvedic arm is still pre-trial-completion.[10,64]

13. DISCUSSION

The principal strength of reading modern screen-time science alongside Dinacharya and Sadvritta is practical rather than mechanistic: both traditions converge, independently, on structured routine, protected sleep timing, physical activity, and caregiver engagement as the most defensible levers for reducing harm, which lends the Ayurvedic framework genuine contemporary relevance as a behavioral and motivational vocabulary rather than as an alternative causal explanation for the neurobiological findings reviewed in Sections 4 through 8.[1,48] Sadvritta's explicit focus on Indriya Nigraha and mental discipline (Manasika Sadvritta) also offers language for self-regulation that may resonate with families and clinicians working within Ayurveda-informed health systems, complementing rather than substituting for evidence-based behavioral therapy.[9,10]

Several limitations temper this integration. First, the modern literature itself remains heterogeneous: associations between screen time and outcomes such as ADHD, obesity, and academic performance are frequently modest in size, vary by study design and population, and are complicated by reverse causation (for example, children with attentional or emotional difficulties may be given more screen time by caregivers as a coping strategy, rather than screen time solely causing those difficulties).[5,22] Most underlying data are observational, self-reported, and susceptible to recall and social-desirability bias, and few studies adequately separate passive from interactive or educational screen use, a distinction the 2026 AAP framework itself identifies as central.[1,36] Second, the Ayurvedic clinical evidence specific to gadget overuse remains genuinely preliminary: the most directly relevant trial, evaluating Medhya Rasayana and Sadvritta-based intervention for gadget addiction, is a registered protocol with results not yet fully reported at the time of this review, and existing Medhya Rasayana trials in children, while methodologically encouraging, involve modest sample sizes and short follow-up.[10,60]

Third, and most importantly, Dinacharya, Ratricharya, and Sadvritta are prescriptive behavioral and ethical frameworks developed centuries before digital media existed; their correspondence with modern screen-time mitigation strategies is a structural analogy — both independently favor routine, restraint, and protected sleep — rather than evidence that classical Ayurvedic physiology specifically anticipated or explains the neurobiological mechanisms (cortical connectivity changes, melatonin suppression, dopaminergic reward pathways) documented in the modern literature. Presenting the correspondence as more than a heuristic risks either overstating the specificity of classical texts or understating the genuine neurobiological complexity of contemporary findings. Clinically, this argues for a complementary rather than substitutive model: families and clinicians can reasonably draw on Dinacharya and Sadvritta as a culturally resonant, values-based motivational structure for implementing routine, screen-free windows, and physical activity, while relying on the modern evidence base — not classical texts — for specific claims about mechanism, dose, and risk, and while treating Medhya Rasayana and other pharmacological Ayurvedic interventions as adjuncts requiring the same standard of clinical evidence expected of any pediatric therapeutic.[59,62]

14. CONCLUSION

Excessive childhood screen time is associated, across a substantial and largely convergent body of evidence, with altered neurodevelopmental trajectories, disrupted sleep architecture, elevated risk of attentional and internalizing behavioral symptoms, reduced academic performance, and physical sequelae including digital eye strain, myopia progression, and obesity risk. The 2026 shift in American Academy of Pediatrics guidance — from fixed hourly limits toward a framework of content quality, context, and displacement — reflects a maturing recognition that what screen time replaces matters as much as how much of it occurs. Ayurveda's Dinacharya, Ratricharya, and Sadvritta, though conceived long before digital media, independently converge on the same practical levers: structured daily routine, protected and consistently timed sleep, mandatory physical activity, caregiver engagement, and disciplined restraint of sensory indulgence. This convergence makes these classical frameworks a plausible, culturally grounded complement to modern screen-time management, but their formal clinical integration — particularly for pharmacological interventions such as Medhya Rasayana — requires the same standard of rigorous, adequately powered clinical evaluation applied to any pediatric intervention, rather than an assumption of equivalence between classical constructs and modern neurobiological mechanisms.

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