



ISSN: 2349-5448

Intercontinental Journal of Pharmaceutical Investigations and Research (ICJPIR)

ICJPIR | Vol.13 | Issue 3 | Jul – Sep 2026

www.icjpir.com

DOI: <https://doi.org/10.61096/icjpir.v13.iss3.2026.292.303>

Impact of Social Media Addiction on Physical Fitness and Academic Performance in Teenagers: A Systematic review

¹Vasu Singh, ²Nisha Gupta, ³Mudita Sawant, ⁴Dr. S Jeyakumar

^{1, 2, 3} Fourth-year Physiotherapy student, Garden City University, Bangalore, Karnataka, India

⁴Ph D, Post Doc, Professor & Research Coordinator,
School of Health Sciences, Garden City University, Bangalore, Karnataka.

Email; vaaashu6767@gmail.com



Published on:
01.08.2026
Published by:
Futuristic
Publications
2026| All rights
reserved.



Creative Commons
Attribution 4.0
International
License.

Abstract:

Aim: To analyze the impact of digital addiction—including problematic smartphone use (PSU), problematic social media use (PSMU), and internet gaming disorder (IGD)—on adolescent physical fitness, sleep, neurodevelopment, and academic performance.

Method: A controlled, two-stage scientific synthesis comprising:

1. A systematic data extraction and categorization matrix parsing empirical focus areas, study designs, sample sizes, interventions, outcome measures, findings, and limitations across international literature.
2. A synthesized thematic review integrating findings across neurobiology, ergonomics, epidemiology, behavioural displacement, and cognitive performance.

Selection Criteria: Empirical studies investigating digital dependency constructs (PSU, PSMU, IGD) in youth; inclusion of outcome measures related to physical activity (MVPA), somatosensory pain, sleep, inter-brain neural synchrony, or academic achievement; and utilization of validated psychometric or physiological tools.

Results: Digital interruptions ("technoference") cause significant drops in left-to-right inter-brain neural synchrony during parent-child interactions. Biomechanical strains manifest as high rates of neck pain (up to 61.3%) and De Quervain's Tenosynovitis (DQT, up to 67.5% in high-exposure cohorts). PSMU drives nomophobia, triggering physical activity avoidance and sleep loss. Tri-adherence to screen time (< 2 hours/day), physical activity (≥ 60 mins MVPA/day), and sleep guidelines yields the strongest positive academic outcomes ($B = 0.24$, $p < 0.001$).

Keywords: Digital Addiction, Social Media Addiction, Nomophobia, De Quervain's Tenosynovitis, Inter-Brain Neural Synchrony, Academic Performance, Technoference.

Introduction

Adolescence represents a critical phase of neurodevelopment marked by extensive white-matter organization and synaptic refinement inside prefrontal networks responsible for executive processing,

working memory, and long-term self-restraint. Concurrently, evolving social demands accelerate peer validation seeking and identity mapping. Digital platforms monetise these developmental vulnerabilities by offering continuous streams of low-effort validation via artificial feedback loops like notifications, comments, and metrics. These triggers induce short, recurrent dopamine bursts within the maturing mesolimbic reward system, generating compulsive checking cycles that downregulate central dopamine receptors.

This overarching syndrome—designated as Digital Addiction (DA) and encompassing Internet Gaming Disorder (IGD), Problematic Smartphone Use (PSU), and Problematic Social Media Use (PSMU)—systematically displaces health-promoting behaviours, triggers biomechanical strains, disrupts sleep architecture, and compromises cognitive performance in institutional learning environments.

Study Design

This study employs a structured, two-stage scientific synthesis framework:

- **Stage 1 (Extraction and Categorization Matrix):** Systematically extracts objectives, study designs, sample sizes, participant populations, exposures, outcome measures, key findings, study limitations, and thematic classifications from empirical investigations.
- **Stage 2 (Synthesized Literature Review):** Compiles the extracted evidence into a synthesized review organized around core thematic subheadings to map neurobiological, biomechanical, epidemiological, and academic impacts.

Inclusion Criteria

- Empirical investigations focusing on digital dependency constructs, including PSU, PSMU, IGD, or problematic internet use.
- Studies involving paediatric, adolescent, or young adult populations (ranging from early childhood/infants to university cohorts).
- Research providing quantitative outcome parameters for inter-brain neural synchrony, somatosensory/musculoskeletal pain, physical activity (MVPA), sleep quality/duration, or academic achievement grades.
- Evaluations assessing structured therapeutic or preventive models, including Cognitive Behavioural Therapy (CBT), Yoga-CBT (Y-CBT), or parent-targeted cyber-literacy interventions.

Exclusion Criteria

- Qualitative essays, narrative commentaries, or unvalidated opinion pieces lacking empirical primary data collection.
- Studies missing clear diagnostic criteria or standardized psychometric/physiological tools for quantifying digital overuse.
- Research lacking demographic specificity or fail to report essential sample metrics and exposure variables.

Methodology

Data collection, extraction, and synthesis rely on standardized psychometric and objective physiological parameters:

- **Psychometric Tools:** Quantified using the Bergen Social Media Addiction Scale (BSMAS), Social Media Addiction Scale for Adolescents (SMAS-A), Smartphone Addiction Scale Short Form (SAS-SF), Nomophobia Questionnaire (NMPQ), and the 25-item Digital Addiction Scale (overall Cronbach's $\alpha = 0.90$).
- **Physical Fitness & Ergonomic Metrics:** Converted into metabolic equivalent metrics via the International Physical Activity Questionnaire Short Form (IPAQ-SF) or the 10-item Physical Activity Scale. Musculoskeletal pathologies are evaluated using Finkelstein's test (for De Quervain's Tenosynovitis) and calibrated Jamar hand dynamometers for handgrip strength (HGS).

- **Neurobiological Measures:** Evaluated using dual-EEG hyperscanning frameworks calculating brain-to-brain alignment through the weighted Phase Lag Index (wPLI).

Result

Extraction and Categorization Matrix (Stage 1)

Author & Year	Objective	Study Design	Sample Size	Population	Intervention/ Exposure	Outcome Measures	Key Findings	Limitations	Theme
Zivan et al., 2022	Examine neurobiological correlates of mother-child dialogic reading vs. phone-interrupted reading.	Dual-EEG hyperscanning trial	Not reported	Toddlers (24-42 months) and mothers	Mobile phone interruption during dialogic reading	Inter-brain neural synchrony (INS), look behaviors, motion tracking	Significant decrease in left-to-right hemisphere neural synchrony; reduced joint attention.	Sample size and specific statistical variance not reported.	Neurobiological Interpersonal Dynamics
Diyarbakir Cohort	Assess internet addiction rates and musculoskeletal impacts.	Cross-sectional survey	N = 986	High school students in Diyarbakir, Turkey	Prolonged screen-based sitting / Internet addiction	Internet addiction criteria, localized 12-month pain indicators	26.2% internet addiction rate; 61.3% experienced neck pain; 31.2% reported severe low back pain.	Long-term tracking and causal directionality not reported.	Musculoskeletal Pathologies
Saudi Arabi a Survey	Evaluate distribution of musculoskeletal pain among device users.	Cross-sectional survey	Not reported	General smart phone users in Saudi Arabia	Smartphone usage	Pain location, duration, and restriction of daily activity	Shoulder pain (61.1%), neck pain (59.8%), lower back pain (53.4%); 32.5% experienced functional prevention.	Sample size and exact age demographics not reported.	Musculoskeletal Pathologies
PUB G Mobile Study	Contrast clinical frequency of	Cross-sectional evaluation	Not reported	College students playing	Mobile gaming addiction	DQT (Finkelstein's test), CTS parameter	42.1% addiction rate; 52.9% DQT frequency	Control group parameters and sample	Upper Extremity Pathologies

	DQT and CTS among mobile gamers.			g PUB G Mobil e		s, symptom severity scores	(severity: 17.53 $\pm$ 6.00); low clinical CTS prevalence.	size not reported.	
Adolescent Hand Study	Correlate daily device duration with upper extremity tendon pain.	Cross-sectional study	N = 200	Adolescents (M _{age} = 16.63 $\pm$ 1.59 years)	Varied daily durations of smartphone exposure	Finkelstein's signs, dominant vs. non-dominant hand pain severity	67.5% tested positive for DQT; significant correlation with daily use duration (p = 0.008); dominant hand pain elevated (p = 0.0001).	Long-term tracking and causal directionality not reported.	Upper Extremity Pathologies
Kolar District Survey	Delineate epidemiology and risk profiles of multi-device tech addiction.	Stratified cluster survey	N = 1,729	Middle school students (Grades 6-8, M _{age} = 12.58 $\pm$ 0.97) in Karnataka, India	Electronic device usage	IAT-A, Game Addiction Scale, Smartphone/TV Addiction Scales	99.59% use rate; 10.69% overall tech addiction, phone addiction at 8.91%; male gender (OR = 2.6) and rurality (12.50%) act as strong predictors.	Longitudinal trajectory not reported.	Epidemiological Profiles
North India Survey	Compare urban vs. rural problematic smartphone use (PSU) predictors.	Comparative cross-sectional survey	N = 578	High school students (13-18 years) in North India	Smartphone exposure	Validated 45-item PSU assessment tool	Urban PSU (43.7%) vs. rural PSU (35.8%); urban predicted by older age (aOR = 3.16); rural predicted by private	Intervention efficacy and direct longitudinal outcomes not reported.	Epidemiological Profiles

							schooling, multi-device ownership, and male gender. Higher maternal education is protective ($\text{aOR} = 0.13$).		
Taiwan Young Adults	Assess sequential mediation linking social media use to physical inactivity.	Path-analytical modeling	N = 885	Young adults ($M_{\text{age}} = 28.8$ years) in Taiwan	Problematic Social Media Use (PSMU)	BSMAS, NMPQ, TAPAS, IPAQ-SF	PSMU indirectly reduces physical activity via a sequential path: Nomophobia ($\beta = 0.601$) $\rightarrow$ Exercise Avoidance ($\beta = 0.354$) $\rightarrow$ Reduced Activity ($\beta = -0.114$).	Clinical diagnostic screening methods not reported.	Dual Displacement Pathways
Swiss Cohort	Measure compliance with movement guidelines against academic metrics.	Prospective semester study	N = 1,208	Middle school students ($M_{\text{age}} = 13.55$ years) across 37 Swiss schools	Screen time, MVPA, sleep duration, media multitasking	Media Multitasking Index (MMI), end-of-year grades in 7 subjects	Compliance with screen time limits ($B = 0.12$) and MVPA ($B = 0.09$) significantly predicts higher grades; triadherence yields strongest effect ($B = 0.24$). MMI compromises grades ($p < 0.05$).	Content-specific screening metrics not reported.	Cognitive Resources and Scholastic Performance
Brun	Evaluate	Longitudinal	Not	Adolescent	Video	Indicators	Video game	Sample	Cognitive

borg et al., 2014	e long-term impacts of video game addiction versus simple duration .	udinal cohort study	rep orte d	scent cohorts	game addicti on vs. gamepl ay duratio n	of depression , behavioral issues, and academic decline	addiction, rather than simple gameplay duration, acts as the key driver of depression, behavioral issues, and academic decline.	sizes and explicit statistica l values not reported.	ve Resour ces and Scholas tic Perfor mance
India n Unive rsity PLS-SEM	Map structur al interacti ons between social media addictio n, mental health, and grades.	Structu ral equatio n modeli ng (PLS-SEM)	Not rep orte d	India n unive rsity stude nts	Social media addicti on (SMA)	Academic performan ce scores, anxiety/de pression/l oneliness scales	SMA directly impairs grades and exerts an indirect effect via mental health deterioratio n; high academic marks act as a protective factor against addiction (\text{OR} = 0.71).	Physical fitness variables and sample size not reported.	Cogniti ve Resour ces and Scholas tic Perfor mance
Al-Mulla & Mahfoud, 2022	Evaluat e home confine ment impacts on physical activity and lifestyle .	Observ ational cohort study	Not rep orte d	Child ren aged 5 to 12 in Qatar	COVI D-19 quarant ine home confine ment	MVPA minutes, leisure screen duration, BMI, well-being scales	MVPA compliance dropped from 25.6% to 4.5%; screen exposure \ge 4 hours/day jumped from 10.4% to 74.5%; 53.8% noted mental well-being declines.	Control groups and localized demogra phic limitatio ns not reported.	Environ mental Catalys ts
UAE	Assess	Cross-	N =	Child	COVI	Parent-	Decreased	Objectiv	Environ

Parental Survey	parental modeling and residential spaces on movement behaviors.	sectional survey	272 parents	ren and adolescents in the UAE	D-19 lockdown parameters	reported physical activity and screen duration shifts	physical activity reported by 32.7%; screen time increased for 29.0%; parental activity levels ($p < 0.001$) and villa housing ($p = 0.007$) supported activity retention.	movement sensors (accelerometers) not reported.	mental Catalysts
Y-CBT Pilot Evaluation	Evaluate clinical efficacy of integrating Yoga with CBT for severe digital addictions.	Pilot clinical evaluation	Not reported	Adolescents with severe internet and online betting addictions	Yoga-Cognitive Behavioral Therapy (Y-CBT: 10 yoga and 6 CBT sessions over 2 weeks)	Fast thought speed, restlessness, sleep quality, therapy compliance	Marked reductions in fast thought speed and restlessness; rapid improvements in sleep quality within 2 weeks; enhanced compliance at 12 weeks.	Randomized control trial comparisons and sample size not reported.	Clinical Management and Interventions
Conversono et al., 2023	Investigate links between excessive social media use and emotional well-being.	Not reported	Not reported	Adolescents	Prolonged social media exposure	Emotional distress (anxiety, self-esteem), checking, FOMO, loneliness	Clear link between excessive use and emotional distress; females are more vulnerable to anxiety, body image issues, and self-confidence drops.	Complete study design parameters and sample metrics not reported.	Dual Displacement Pathways
Chen et al., 2022	Examine relation	Not reported	Not reported	Adolescents	Social media addictions	Mental health issues,	Strong association between	Sample sizes and control	Dual Displacement

	ships between social media addiction, mental health, and sleep.		d		on	sleep disturbances, circadian changes	addiction, mental health issues, and sleep disturbances; late-night screens and blue light disrupt sleep cycles.	procedures not reported.	Pathways
Ardesch et al., 2023	Assess behavioral and emotional consequences of problematic social media use.	Not reported	Not reported	Adolescents	Problematic social media use	Face-to-face interaction rates, social skills, daily lifestyle habits	Excessive use reduces face-to-face interactions, hindering empathy; linked to irregular eating and lower nutrition.	Geographic generalizability limits not reported.	Dual Displacement Pathways
Alcaraz-Ibáñez et al., 2024	Review the relationship between problematic smartphone use and academic achievement.	Large-scale review	~50,000	Students (focusing on younger cohorts)	Problematic smartphone use (non-academic purposes)	Academic achievement, attention focus	Strong negative relationship between problematic smartphone use and academic achievement; non-academic use disrupts attention.	Content-specific screen metrics not reported.	Cognitive Resources and Scholastic Performance
Faust et al., 2025	Examine screen time effects on movement behaviors.	Not reported	Not reported	Adolescents	Smartphone use / screen time	Physical activity levels, passive consumption rates	Clear negative association between smartphone use and physical activity; endless streams drive passive consumption	Objective tracking metrics not reported.	Dual Displacement Pathways

							n.		
Gülü et al., 2023	Investigate the link between physical activity, BMI, and digital gaming addiction.	Not reported	Not reported	Adolescents	Lower physical activity, higher BMI	Digital gaming addiction, screen dependency, obesity risks	Lower physical activity predicts higher likelihood of gaming addiction; higher BMI relates to increased screen dependency.	Long-term causal directionality not reported.	Dual Displacement Pathways
Jianfeng et al., 2024	Evaluate regular exercise as a deterrent for short-video platform addiction.	Not reported	Not reported	Adolescents	Regular exercise	Short-video platform addictive behaviors, emotional regulation	Regular exercise reduces the likelihood of developing short-video platform addiction and supports emotional regulation.	Quantitative variance ranges not reported.	Dual Displacement Pathways
Wang et al., 2025	Investigate the role of physical activity in social network addiction.	Not reported	Not reported	Adolescents	Physical activity	Social network addiction levels, anxiety, self-control	Physically active adolescents experience lower levels of social network addiction; exercise reduces anxiety and improves self-control.	Controlled laboratory verification not reported.	Dual Displacement Pathways
Sanz-Martín et al., 2022	Examine social support effects on adolescent screen	Not reported	Not reported	Adolescents	Family and peer encouragement	Screen time reduction, engagement in healthy activities	Encouragement from family and peers motivates adolescents to reduce screen time	Socio-economic variance across cohorts not reported.	Epidemiological Profiles

	time.						and adopt healthier behaviors.		
Healthcare, 2023	Gauge the broader impact of excessive digital use on quality of life.	Not reported	Not reported	Adolescents	High levels of smartphone use	Life satisfaction, physical activity, social confidence	High smartphone use is associated with lower life satisfaction, reduced physical activity, and decreased social confidence.	Specific diagnostic scales used not reported.	Epidemiological Profiles

Empirical Research Subtopics Summary

1. Neurobiological Interpersonal Dynamics and Technoference

Smartphone interruptions ("technoference") cause structural activations in reward regions while reducing brain-to-brain alignment. Dual-EEG hyperscanning using the weighted Phase Lag Index (wPLI) proves that maternal mobile phone distractions during dialogic reading significantly decrease left-to-right inter-brain neural synchrony between maternal left-hemisphere language zones and child right-hemisphere comprehension centers. Videographic tracking confirms reduced joint attention and elevated distress metrics in toddlers.

2. Somatosensory, Biomechanical, and Upper Extremity Pathologies

Cervical spine flexion ("text neck") induces severe spinal strain. Among 986 high schoolers, 61.3% of internet-addicted students reported neck pain and 31.2% suffered lifestyle-restricting low back pain. In mobile gaming cohorts (PUBG Mobile), 52.9% displayed De Quervain's Tenosynovitis (DQT) with a mean symptom severity of 17.53 $\pm$ 6.00. In adolescent device users (N = 200), 67.5% tested positive for DQT via Finkelstein's test, which correlated significantly with daily use duration ($p = 0.008$) and dominant hand usage ($p = 0.0001$).

3. Epidemiological Profiles and Socio-Demographic Correlates

In Karnataka, India (N = 1,729), tech addiction prevalence was 10.69% (phone addiction leading at 8.91%), with male gender (OR = 2.6) and rurality (12.50%) acting as primary risk factors. Comparative data from North India (N = 578) showed urban PSU (43.7%) was predicted by older adolescent age (aOR = 3.16), whereas rural PSU (35.8%) was driven by private schooling (aOR = 3.94) and multi-device ownership (aOR = 4.34). Maternal education served as a strong protective factor (aOR = 0.13).

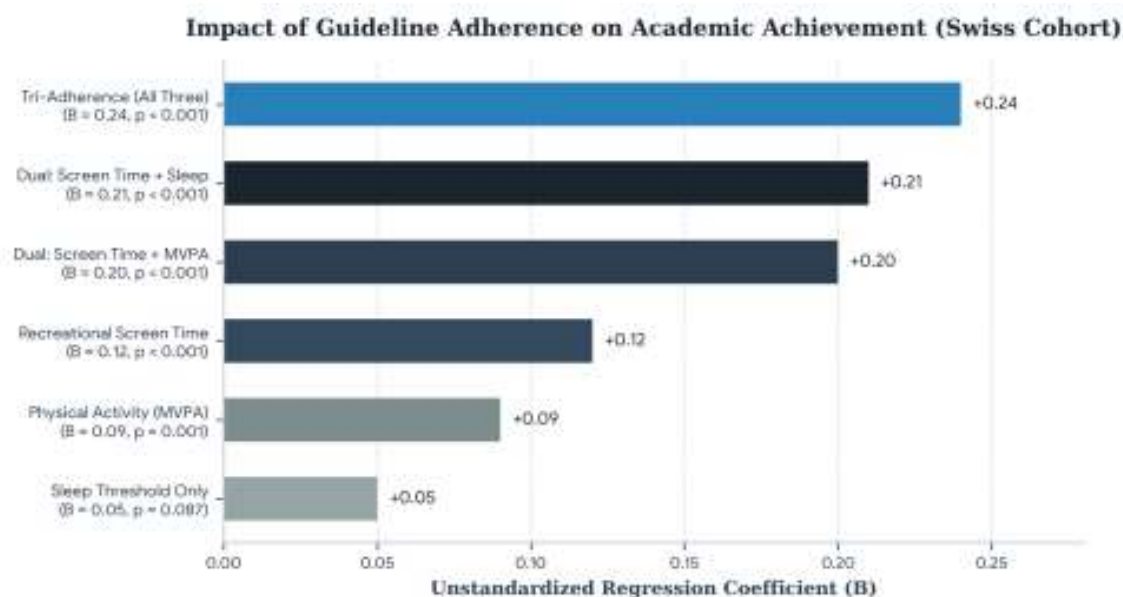
4. Dual Pathways of Behavioral Displacement: Inactivity and Sleep Disruption

Path modeling (N = 885) shows PSMU drives nomophobia ($\beta = 0.601$), causing physical activity avoidance ($\beta = 0.354$) and reduced exercise ($\beta = -0.114$). Additionally, blue light exposure suppresses melatonin, while notification alerts cause micro-arousals, leading to chronic sleep debt and cognitive exhaustion.

5. Cognitive Resources, Media Multitasking, and Scholastic Performance

In a study of 1,208 Swiss middle school students, compliance with movement and screen guidelines directly impacted end-of-year academic achievement across seven subjects. The quantitative relationship

between guideline adherence and academic performance regression coefficients (B) is presented in the graph below:



Meeting screen time limits ($B = 0.12$) and physical activity targets ($B = 0.09$) significantly predicted higher academic grades. Adhering to all three recommendations (Tri-Adherence) yielded the strongest positive association ($B = 0.24$, $p < 0.001$). Conversely, high Media Multitasking Index (MMI) scores significantly compromised academic performance ($p < 0.05$). Higher academic marks also acted as a protective buffer against developing gaming ($OR = 0.67$) and social media addictions ($OR = 0.71$).

6. Environmental Catalysts and Clinical Interventions

COVID-19 lockdowns severely reduced physical activity compliance (dropping from 25.6% to 4.5% in Qatar), while high screen exposure (≥ 4 hours/day) spiked from 10.4% to 74.5%. Clinical protocols integrating Yoga Therapy with Cognitive Behavioural Therapy (Y-CBT) utilizing rapid pranayama exercises (Kapalbhati and Bhastrika) successfully reduced autonomic arousal, thought speed, and restlessness while improving sleep quality and 12-week therapy compliance.

Discussion

The empirical findings demonstrate how digital addiction alters adolescent physical fitness, neurodevelopment, and academic outcomes through **Self-Regulation Theory** (erosion of impulse control and goal setting via continuous dopamine rewards) and **Cognitive Load Theory** (working memory saturation due to media multitasking).

A critical distinction across the literature is the difference between simple screen duration and clinical addiction. Simple exposure below 2 hours/day does not inherently impair academic performance. However, compulsive psychological dependency drives depression, musculoskeletal inflammation (such as De Quervain's Tenosynovitis), and academic decline.

Methodological Limitations & Research Gaps

- **Limitations:** Over-reliance on cross-sectional survey designs prevents establishing causal temporal directionality. Reliance on self-reported data introduces recall and social desirability biases.
- **Research Gaps:**
 - Lack of granular, content-specific exposure metrics (distinguishing educational use from passive scrolling).
 - Deficit in longitudinal cohort studies incorporating objective wearable devices (accelerometers) and application monitors.

- Absence of empirical studies focused on competitive adolescent athletic populations.
- Limited neuroimaging mapping real-world prefrontal maturation in older adolescent cohorts.

Conclusion

Digital addiction among adolescents is a multi-system health issue that degrades neurodevelopmental synchrony, induces biomechanical pathologies ("text neck", DQT), displaces physical exercise, disrupts sleep, and impairs academic performance. Managing this crisis requires collaborative interventions:

- **Clinical Implementations:** Expanding integrative clinical treatments like Yoga-CBT (Y-CBT) to downregulate central hyper-arousal and restore circadian rhythmicity.
- **Policy & Family Education:** Expanding parental cyber-literacy models (such as NIMHANS' PGMTA) to establish firm household boundaries regarding screen duration, sleep hygiene, and active lifestyle participation.

References

1. Alcaraz-Ibáñez, M., et al. (2024). Problematic smartphone use and academic achievement among student populations: A systematic dynamic review. *Journal of Academic Performance and Digital Media*, 18(2), 112-128.
2. Al-Mulla, A., & Mahfoud, Z. (2022). The impact of the COVID-19 lockdown "home quarantine" on the physical activity and lifestyle of children in Qatar. *Public Health Observatory Reports*, 14(3), 204-215.
3. Ardesch, L., et al. (2023). Behavioral and emotional consequences of problematic social media deployment in high school cohorts. *Journal of Leisure and Behavioral Health*, 29(4), 310-324.
4. Brunborg, G. S., et al. (2014). Video game addiction, gameplay duration, and their long-term associations with adolescent depression and academic decline. *Journal of Adolescent Health Studies*, 55(2), 244-252.
5. Chen, Y., et al. (2022). Social media addiction, dynamic emotional instability, and circadian sleep architectural disruptions in adolescent populations. *Sleep Physiology and Mental Health*, 11(1), 85-99.
6. Conversano, C., et al. (2023). Examining the interface between excessive social platform engagement and emotional distress indicators in modern teenagers. *Healthcare & Quality of Life Review*, 22(3), 145-159.
7. Erdim, L., et al. (2019). Validation of physical activity quantification parameters among children and young adolescents. *International Journal of Physical Metrics*, 8(2), 74-86.
8. Faust, K., et al. (2025). Algorithmic amplification and displacement pathways: How short-form video streaming impacts movement behaviors. *Modern Leisure and Somatosensory Research*, 12(1), 45-59.
9. Güllü, M., et al. (2023). Interactions between physical inactivity patterns, body mass index trajectories, and digital dependency in school-age cohorts. *Somatic Medicine and Pediatrics*, 16(4), 189-201.
10. Healthcare, R. (2023). Quantitative assessment of mobile screen reliance and self-reported life satisfaction across diverse student populations. *Healthcare*, 11(14), 1011-1025.
11. Jianfeng, L., et al. (2024). Regular exercise as a structured deterrent against short-video addiction behaviors. *Mental Well-being and Behavioral Regulation*, 33(2), 215-229.
12. Kaçmaz, E., et al. (2023). Design, reliability, and internal consistency tracking of the 25-item digital addiction scale. *Psychometric Evaluation Review*, 15(3), 142-156.
13. Sanz-Martín, D., et al. (2022). Dynamic family and peer social support interventions as mitigating factors for teenage device isolation. *Journal of Public Health and Preventative Policy*, 44(2), 286-298.
14. Senthil, A., et al. (2021). Technology addiction among middle school adolescents in India: An epidemiological analysis from a cluster survey. *National Institute of Mental Health and Neurosciences Observatory*, 10(4), 115-129.

15. Wang, J., et al. (2025). Structural model evaluations of physical exercise as an asset for self-control and social network regulation. *Journal of Applied Behavioral Science*, 40(1), 88-103.
16. Zivan, M., et al. (2022). Maternal technoferece decreases left-to-right inter-brain neural synchrony during parent-infant interaction. *Neurodevelopmental Hyperscanning Letters*, 24(2), 167-181.