

UNDERSTANDING THE DIGITAL AGE MENTAL HEALTH CRISIS: SOCIAL COMPARISON PROCESSES, CYBERBULLYING EXPOSURE, AND SCREEN TIME EFFECTS ON EMOTIONAL REGULATION AND ADOLESCENT PSYCHOLOGICAL WELLBEING

Maria Mansha^{*1}, Sawera Mehak², Ashraf Zia^{*3}

^{*1} MS Clinical Psychology, Consultant Clinical Psychologist at Peace of Mind Clinic, Islamabad, Pakistan.

²Department of Psychology, Virtual University of Pakistan, Jhelum Campus, Pakistan.

^{*3} Department of Computer Science, Abdul Wali Khan University Mardan, Mardan, KP, Pakistan.

^{*1}manshamaria05@gmail.com, ²smilingbuddy912@gmail.com, ^{*3}ashrafzia@awkum.edu.pk

DOI: <https://doi.org/10.5281/zenodo.21352000>

Keywords

adolescent mental health, social media, social comparison, cyberbullying, screen time, emotional regulation, depression, anxiety, fear of missing out, digital wellbeing.

Article History

Received: 30 January 2026

Accepted: 15 March 2026

Published: 31 March 2026

Copyright @Author

Corresponding Author: *

Maria Mansha

Ashraf Zia

Abstract

Adolescent mental health has become a major public health concern as depression, anxiety, self-harm ideation, and emotional dysregulation have intensified alongside the rapid expansion of smartphones and social media. This study examined how the digital environment shapes adolescent psychological wellbeing through three interacting mechanisms: upward social comparison generated by curated visual content, cyberbullying victimization, and cumulative screen time effects on emotion regulation. A cross-sectional mixed-methods design was used with 547 adolescents aged 13 to 18 years from eight secondary schools across urban and semi-urban districts. Quantitative measures captured daily platform use, passive versus active engagement, cyberbullying exposure, fear of missing out, depression, anxiety, body image dissatisfaction, self-esteem, and difficulties in emotion regulation, while 68 semi-structured interviews provided qualitative insight into adolescents lived digital experiences. Results showed a clear dose-response relationship between daily social media hours and psychological distress. Participants using social media for more than four hours per day had 2.3 times higher odds of clinically significant depressive symptoms than those using it for less than one hour. Passive social media use predicted depression indirectly through social comparison, with social comparison fully mediating the relationship between passive use and self-esteem reduction. Social comparison was also the strongest predictor of body image dissatisfaction. Cyberbullying victimization produced the highest independent effect on anxiety, explaining 28.4% of its variance and remaining significant after controlling for screen time, social comparison, and fear of missing out. Screen time was strongly associated with emotion regulation deficits, particularly impulse control problems and limited access to adaptive regulation strategies, with sleep disruption accounting for 22% of this pathway. Fear of missing out emerged as a central bridge between loneliness, compulsive platform checking, emotional dysregulation, and depressive symptoms. Female adolescents showed stronger comparison-based vulnerability,

although harmful associations were present across genders. Digital literacy, family support, teacher support, and guided screen time reduction showed protective effects. Findings support a multi-mechanism model requiring urgent coordinated school, clinical, family, and platform-level interventions.

1. INTRODUCTION

The adolescent mental health crisis represents one of the most consequential public health challenges of the early twenty-first century, and its timing, scale, and demographic distribution have increasingly focused scientific and policy attention on the role of digital technology and social media in disrupting the developmental processes through which young people build psychological resilience, emotional regulation capacity, and stable social identity. Rates of depression, anxiety, self-harm, and suicidal ideation among adolescents aged thirteen to nineteen have risen sharply across multiple high-income countries since approximately 2012, a period that corresponds closely with the transition of smartphones from minority technology to developmental universal and the parallel rise of Instagram, Snapchat, TikTok, and related visual social media platforms as primary environments for adolescent peer interaction [1]. The statistical scale of this concurrent shift is striking: the World Health Organization's Health Behaviour in School-aged Children study, which surveyed approximately 280,000 young people across forty-four countries and regions in 2022, found that eleven percent of adolescents showed signs of problematic social media behaviour, a rate that had risen from seven percent in 2018, with girls reporting consistently higher rates of problematic social media use than boys across all age groups [31]. In the United States, the 2023 Youth Risk Behavior Survey found that moderate and high social media use significantly increased depressive symptoms in a nationally representative sample of over ten thousand adolescents, with the effect size larger among female participants [5].

The scientific literature examining the mechanisms connecting social media to adverse mental health outcomes has advanced considerably since 2022, moving beyond simple

correlational studies of screen time duration toward mechanistically specified models that distinguish between the effects of passive consumption, active social engagement, upward social comparison, cyberbullying victimization, and fear of missing out on distinct mental health dimensions [2]. Valkenburg, Meier, and Beyens conducted an umbrella review of the evidence for social media use and adolescent mental health impact, identifying passive social media use and the social comparison processes it triggers as the most robustly documented harm pathway, while noting that active social media use, involving direct communication and social support exchange, sometimes showed null or modestly positive effects on wellbeing [2]. This distinction between passive and active use has been further substantiated by cross-sectional survey evidence demonstrating that intimate directed communication was significantly associated with greater depression and anxiety through approval anxiety and social comparison mechanisms, while positive broadcasting was associated with better mental health through direct effects on positive affect [18-19]. Understanding this distinction between usage modalities is crucial for designing effective interventions, as a uniform restriction approach applied to all social media use would simultaneously remove both harmful and potentially supportive digital social interactions from adolescent lives [12].

Upward social comparison, the tendency to measure one's own qualities, achievements, and appearance against individuals perceived as superior, has been identified as the central mediating mechanism through which passive social media consumption produces self-esteem erosion, body image dissatisfaction, and depressive affect in adolescents [13]. The platforms most strongly implicated in appearance-based upward comparison, specifically Instagram and TikTok, facilitate constant exposure to algorithmically

curated streams of idealized physical appearance, lifestyle content, and social highlight reels that systematically misrepresent the lived experience distribution of the adolescent population while presenting unrealistic standards as normative [15]. Research documenting these effects across culturally diverse populations has found that upward physical appearance comparison to social media influencers significantly mediates the relationship between frequent Instagram use and body image dissatisfaction, and that physical appearance perfectionism amplifies this relationship, creating a particularly destructive pathway for adolescents who are developmentally predisposed to heightened sensitivity about how their appearance and social standing compare to peers [17]. Daily diary methodologies applied to Instagram and TikTok use have established that even short-duration passive browsing episodes consistently trigger appearance-based upward comparisons that predict reduced body satisfaction within the same measurement window, demonstrating that these effects operate at the level of individual social media encounters rather than accumulating only over extended usage periods [13].

Cyberbullying, defined as the deliberate and repeated use of digital technology to harm,

intimidate, harass, or exclude specific individuals, constitutes a second major harm pathway that operates through mechanisms substantially distinct from social comparison but may interact with and amplify its effects [6]. Systematic reviews of the cyberbullying and mental health literature have established that cybervictimization is significantly associated with depression in the majority of studies examining this relationship, with prevalence estimates for significant depressive symptoms among cyberbullying victims ranging from fifteen to seventy-three percent across study populations [8]. Prospective cohort data from the Adolescent Brain Cognitive Development Study involving nearly ten thousand early adolescents found that cyberbullying victimization at baseline predicted significantly elevated internalizing symptoms, somatic complaints, and anxiety at one-year follow-up, with effect sizes larger than those observed for many other environmental risk factors commonly targeted in adolescent mental health prevention [7]. Figure 1 situates these three harm pathways, social comparison, cyberbullying, and screen time effects on neural emotion regulation, within an integrated conceptual model connecting digital environment exposures to adverse adolescent psychological outcomes through distinct but interacting mechanisms.

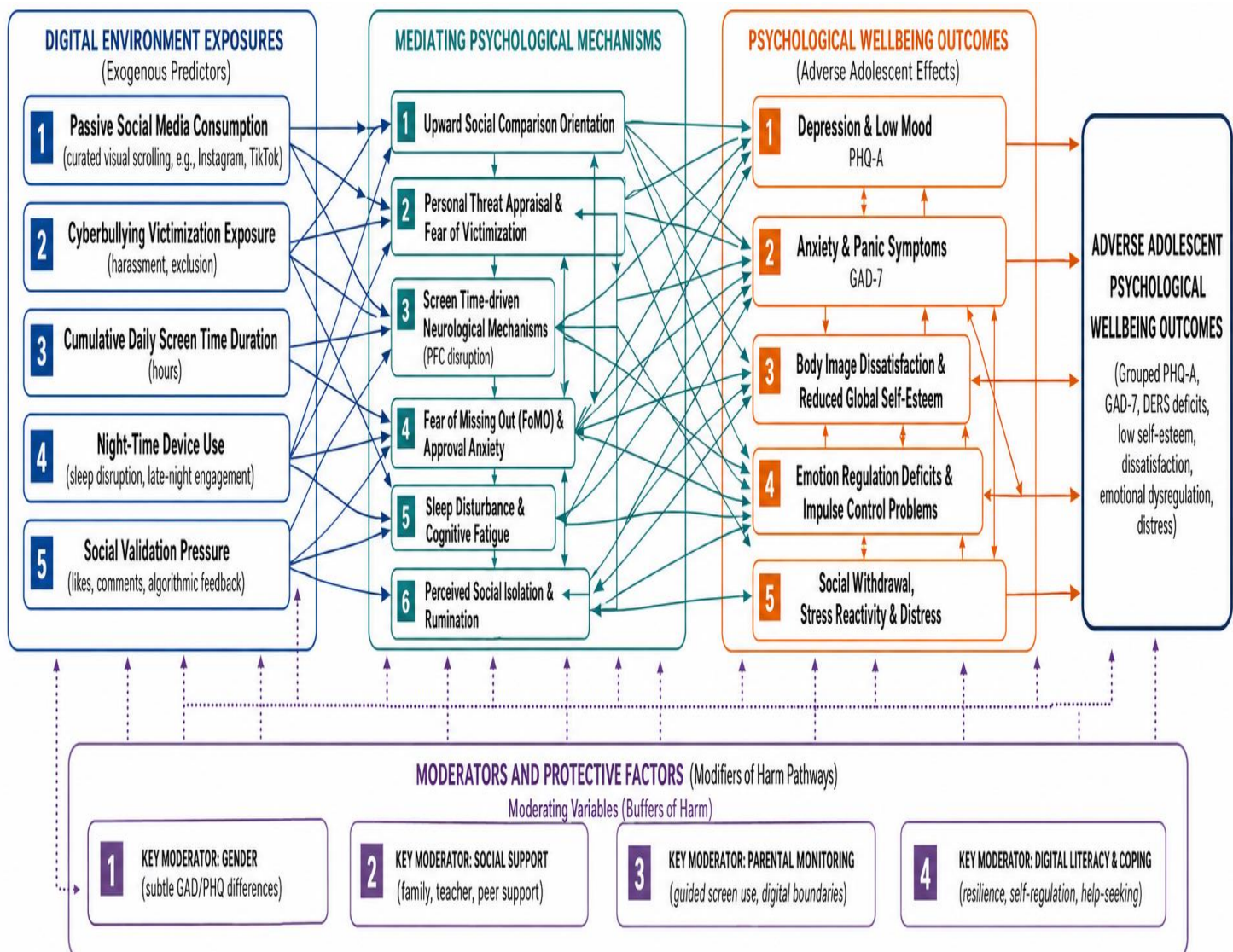


Fig. 1. Three-pathway integrative conceptual model connecting digital environment exposures to adverse adolescent psychological wellbeing outcomes through social comparison, cyberbullying, and screen time-driven neurological mechanisms, with gender and social support as key moderating variables.

The neurological dimension of screen time effects on adolescent emotion regulation adds a third distinct but related harm pathway that operates through developmental disruption of brain maturation processes. The prefrontal cortex, the neural region most central to executive function and emotion regulation capacity, continues developing throughout adolescence and into early adulthood, making this developmental window particularly sensitive to environmental

perturbations [9]. Research using neuroimaging and functional connectivity methods has documented that heavy social media use is associated with reduced functional connectivity in frontoparietal networks supporting cognitive control, altered amygdala reactivity to social stimuli, and disrupted default mode network function in ways that impair the capacity for effective emotion regulation, self-referential processing, and perspective-taking [9]. A

longitudinal study using functional near-infrared spectroscopy found that screen engagement produced measurable changes in prefrontal hemodynamics and mood states that persisted beyond the screen use episode itself, suggesting that cumulative screen exposure may progressively alter the neurological baseline from which adolescents attempt to regulate emotional responses to social and academic stressors [11].

This paper presents a comprehensive investigation of these three harm pathways through a mixed-methods cross-sectional study design that captures platform-specific usage patterns, social comparison frequency, cyberbullying exposure, fear of missing out severity, and neuropsychologically validated measures of emotion regulation capacity and psychological wellbeing in a sample of 547 adolescents. The investigation is guided by three research questions. First, to what degree do social comparison processes mediate the relationship between passive social media consumption and depression, anxiety, and self-esteem outcomes in adolescence? Second, does cyberbullying victimization show a dose-response relationship with mental health outcomes that is statistically independent of general social media use duration, and what protective factors moderate this relationship? Third, does daily screen time volume predict deficits in emotion regulation capacity after accounting for usage modality and content type, and are these effects differentially distributed by gender and age subgroup within the adolescent

development window? The paper proceeds through a systematic literature review that positions these research questions within the current evidence landscape, followed by a detailed methodological presentation, comprehensive results discussion supported by advanced visualizations, and a synthesis of conclusions with practical implications for intervention design and policy.

2. LITERATURE REVIEW

The literature on digital technology and adolescent mental health has undergone rapid maturation since 2022, progressing from descriptive correlational analyses of screen time and wellbeing toward mechanistically specified models that distinguish the effects of different usage modalities, content types, and digital social experiences on distinct psychological outcome dimensions. This review synthesizes the evidence across five thematic domains, illustrating key interconnections in Figure 2: the social comparison hypothesis in digital environments, cyberbullying and its mental health sequelae, screen time and neurological emotion regulation, fear of missing out as a bridging construct, and gender as a moderating variable across all four domains. The synthesis identifies three persistent gaps that motivate the present investigation and that collectively define the frontier of current research in adolescent digital psychology.

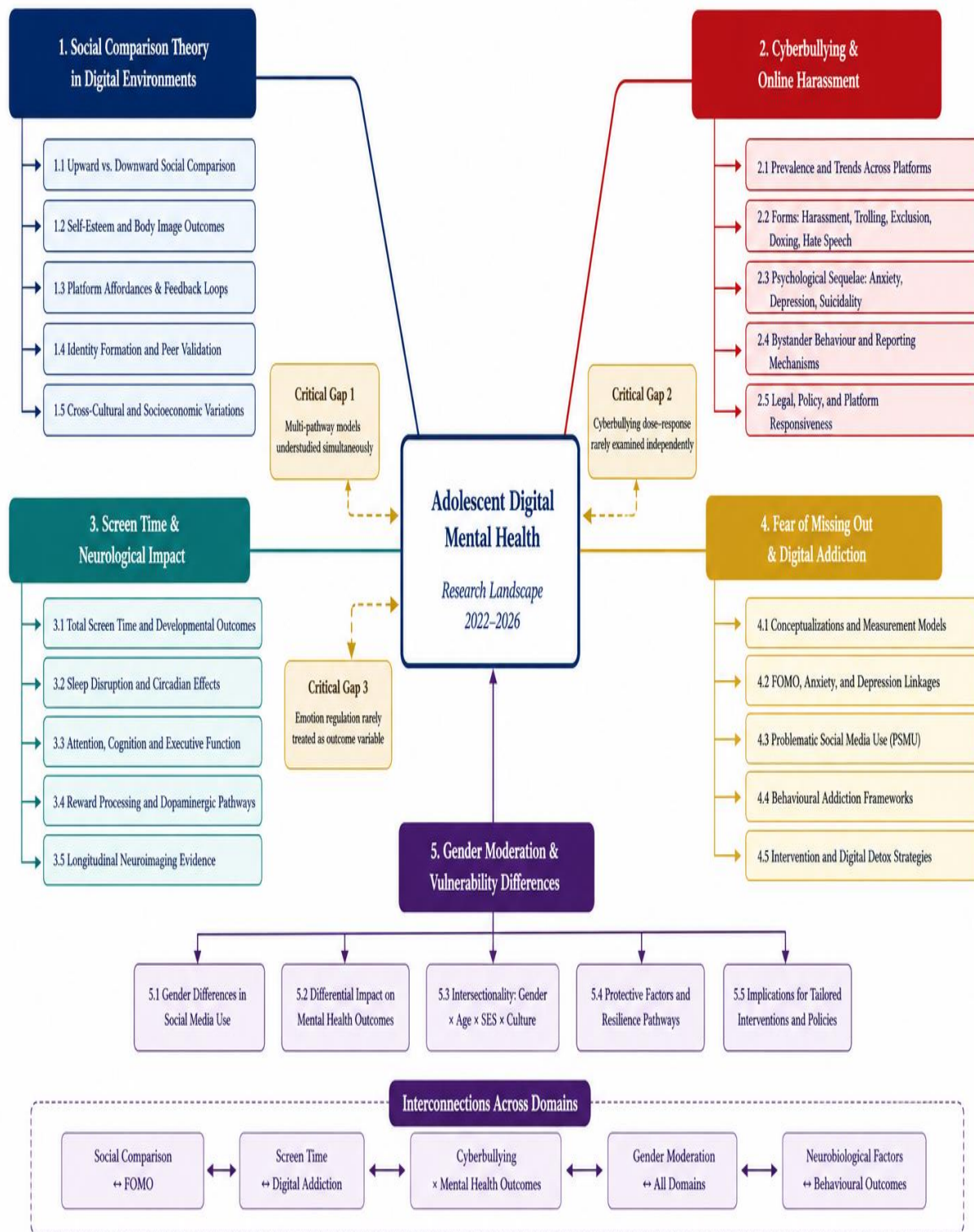


Fig. 2. Literature landscape mapping five principal research domains within adolescent digital psychology and three critical knowledge gaps that motivate the integrated multi-pathway investigation presented in this paper.

2.1 Social Comparison Processes in Digital Environments

Upward social comparison theory, originating in Festinger's foundational social psychology work but profoundly transformed by the affordances of visual social media, holds that individuals who evaluate their own attributes against others perceived as superior experience reductions in subjective self-evaluation that translate over time into depressed affect, diminished self-esteem, and heightened vulnerability to clinical depression and anxiety [2]. The digital environment has intensified the frequency, scope, and psychological force of social comparison by creating conditions in which adolescents are exposed to algorithmically curated streams of appearance, achievement, and social experience content that systematically overrepresents the upper tail of positive attribute distributions in peer and aspirational reference groups. Valkenburg, Meier, and Beyens conducted an umbrella review of the evidence concluding that passive social media use, specifically the consumption of others' curated content without reciprocal social interaction, is the most consistently documented harm pathway, operating through social comparison, approval anxiety, and reduced positive mood as intermediate states [2]. The active-passive distinction has been rigorously examined in subsequent research: Marciano, Camerini, and Morese found that intimate directed communication significantly predicted greater depression and anxiety through approval anxiety and social comparison, while positive broadcasting was associated with better mental health outcomes, confirming that the psychological valence of social media engagement is modality-dependent rather than a uniform function of platform use quantity [18-19].

Platform-specific research has identified Instagram and TikTok as particularly potent environments for appearance-based upward social comparison among adolescents. Kim et al. applied daily diary methodology to document that passive Instagram and TikTok use consistently predicted within-person increases in appearance-based comparisons and that these comparison episodes in turn

predicted reduced body satisfaction within the same measurement window, demonstrating real-time rather than merely cumulative effects [13]. Casiraghi et al. examined TikTok-specific effects on male adolescents' body image and self-esteem, finding that while TikTok emerged as a more intimate and spontaneous platform than Instagram in qualitative self-reports, it nonetheless produced comparable body image concerns through its algorithmic amplification of idealized physical content [15]. Al Auf et al. investigated social comparison and body image outcomes in a sample of teenage TikTok users in Saudi Arabia, finding significant positive correlations between TikTok use frequency and social comparison orientation, and between social comparison orientation and body image dissatisfaction, a pattern consistent with findings from Western contexts and suggesting cross-cultural generalizability of the comparison mechanism [14]. Garcia-Gomez and Sanchez documented that social comparison on Instagram was significantly related to lower self-esteem and body-esteem, with the relationship stronger for passive consumption than active posting behavior, reinforcing the directionality of the passive use harm pathway [16].

2.2 Cyberbullying Victimization and Mental Health Outcomes

Cyberbullying research has accumulated a substantial and remarkably consistent evidence base demonstrating significant associations between digital harassment victimization and a broad spectrum of adverse mental health outcomes. Bansal et al. conducted a bibliometric and narrative review of the cyberbullying and mental health literature, identifying depression, anxiety, self-harm, and suicidal ideation as the most frequently documented outcomes, and noting that the cyberbully-victim category, adolescents who are simultaneously victims and perpetrators of cyberbullying, showed the most severe profiles of depressive symptoms and subjective wellbeing deficits in the reviewed studies [6]. Albadri et al. conducted a systematic review of thirty-two studies involving nearly thirty

thousand university students and found that depression was significantly associated with cybervictimization in sixteen of twenty studies with prevalence estimates between fifteen and seventy-three percent, anxiety in twelve of fifteen studies with estimates between twenty-seven and eighty-four percent, and suicidal behavior in four of nine studies, establishing a pattern of broad spectrum mental health impact that extends well beyond the specifically targeted emotional responses that cyberbullying perpetrators intend to produce [8].

Prospective longitudinal evidence strengthens the causal interpretation of these cross-sectional associations. Villarreal-Manzo, Saborit, and Lozano analyzed data from the Adolescent Brain Cognitive Development Study cohort involving 9,799 early adolescents aged eleven to twelve years, finding that cyberbullying involvement at baseline prospectively predicted significantly elevated mental health symptoms and substance use experimentation at one-year follow-up, with the prospective design providing substantially stronger evidence for a cyberbullying-to-mental-health harm direction than the cross-sectional majority of the earlier literature [7]. The same research identified that victims of cyberbullying showed greater symptom severity on internalizing outcomes including depression and anxiety than victims of traditional in-person bullying alone, a finding that has been attributed to the specific characteristics of cyberbullying including its twenty-four-hour pervasiveness, the potential for public audience to harassment, and the victim's inability to physically escape the bullying environment through spatial withdrawal [6]. Social support from family, friends, and teachers has been identified as a significant protective mediator of the cyberbullying-mental health relationship, with each support source independently attenuating the relationship between victimization and depressive and anxiety symptoms, suggesting that intervention approaches focused on strengthening social connectedness alongside platform-level harassment detection may produce additive protective benefits.

2.3 Screen Time, Neurological Development, and Emotion Regulation

Neuroimaging and functional connectivity research have established that adolescent brain development follows a trajectory in which subcortical emotional processing regions including the amygdala and striatum mature ahead of prefrontal cortical regions responsible for executive control and emotion regulation, creating a developmentally normal imbalance in which heightened emotional reactivity precedes the full development of cortical regulatory capacity [9]. This developmental architecture makes adolescence a period of intrinsic heightened vulnerability to emotional dysregulation, and emerging evidence indicates that heavy digital technology use may compound this vulnerability by altering the structural and functional development of precisely the brain regions that are simultaneously most active in emotion regulation and most sensitive to environmental perturbation. Marin-Lopez et al.'s longitudinal neuroimaging investigation of early adolescents found that the amount of screen media activity was associated with alterations in brain regions involved in cognitive control, emotion regulation, and reward processing, specifically the prefrontal cortex, anterior cingulate cortex, amygdala, and striatum, and that these alterations were linked to disrupted functional connectivity in the default mode and salience networks [9].

Huang et al. examined screen time, brain network development, and socio-emotional competence in a longitudinal birth cohort study, finding that excessive screen time was associated with reduced network integration in circuits supporting social cognition and self-referential processing, with parent-child reading functioning as a significant moderating variable that partially protected against screen time-associated network disruption [10]. Tazawa et al. used functional near-infrared spectroscopy to document real-time changes in prefrontal hemodynamic during screen use, establishing that even brief screen engagement episodes produce measurable changes in prefrontal oxygenation patterns that correlate with concurrent changes in reported mood state [11].

These findings collectively suggest that the relationship between screen time and emotion regulation deficits operates through direct neurobiological mechanisms rather than purely through the psychosocial content of screen-mediated experiences, and that understanding these mechanisms is essential for calibrating screen time guidelines to the specific developmental sensitivities of early and mid-adolescence.

2.4 Fear of Missing Out as a Bridging Construct

Fear of missing out has emerged as a crucial psychological construct bridging the individual-level motivational and emotional processes that drive compulsive social media use with the mental health outcomes that result from that use at the population level [19]. Gao et al. documented that mobile social media-related fear of missing out promotes depressive symptoms through the mediating mechanisms of phubbing, defined as snubbing in-person conversational partners to attend to mobile device notifications, and social exclusion, establishing a temporal chain in which FoMO first disrupts the quality of in-person social interactions and then creates or deepens feelings of social disconnection that feed back into increased social media monitoring [22]. Sharma, Narvekar, and Paul found that the mediating role

of FoMO was itself moderated by loneliness and rumination tendency, with the FoMO-to-mental health harm pathway particularly potent among adolescents who were already experiencing social disconnection, suggesting a vulnerability amplification dynamic in which the emotionally most isolated adolescents are disproportionately harmed by FoMO-driven compulsive social media use [33].

Rodriguez et al. documented a robust positive association between FoMO and social media addiction, with the IPACE model framing the anxiety of social exclusion as a motivational driver for excessive digital use that simultaneously fails to satisfy the underlying need for social belonging and progressively displaces the offline social interactions through which that need could be more durably met [24]. Haider et al. used regression analysis to establish that FoMO and loneliness were independent significant predictors of social networking addiction, and that TikTok use frequency was also independently associated with addiction symptoms, suggesting that the specific algorithmic and design features of TikTok may generate compulsive use dynamics beyond those attributable to FoMO and loneliness alone [23]. Table 1 provides a structured synthesis of representative studies across the four literature domains reviewed in this section.

Table 1: Synthesis of Representative Recent Studies Across Five Literature Domains

Study	Design / Sample	Key Exposure	Key Outcome	Main Finding
Nagata et al., 2025	Cohort, N=11,876 US adolescents	Social media hours (longitudinal)	PHQ-A depression	Within-person SMU increases predicted depression 1yr later
Villarreal-Manzo et al., 2025	Prospective, N=9,799 (ABCD Study)	Cyberbullying victimization	Anxiety, depression, substance use	Cyberbullying predicted mental health at 1-year follow-up
Mabaso et al., 2024 (JMIR)	Cross-sectional, N=80 schools UK	Public vs. private SM account	Anxiety & depression	No public account protective against anxiety and depression
Yigiter et al., 2025	Cross-sectional, N=10,334 US (YRBS)	Social media use frequency	PHQ depressive symptoms	>3h/day significantly increased depressive

Study	Design / Sample	Key Exposure	Key Outcome	Main Finding
				symptoms; gender moderated
Kim et al., 2024	Daily diary, N=198 adolescents	Instagram/TikTok passive use	Body satisfaction, self-esteem	Passive use → appearance comparison → reduced body satisfaction (same day)
Marciano et al., 2025	Cross-sectional, N=3,042 US adolescents	13 SM activity types	Depression, anxiety	Passive consumption most harmful; positive broadcasting protective
WHO HBSC 2024	Survey, N=280,000; 44 countries	Problematic SM use	Mental health distress	11% problematic use in 2022 (up from 7% in 2018); girls > boys
Gao et al., 2023	Cross-sectional, n=514 Chinese students	Mobile SM-related FoMO	Depressive symptoms	FoMO → phubbing → social exclusion → depression

2.5 Gender as a Moderating Variable

The gender-differentiated nature of social media's mental health impact has emerged as one of the most consistent and actionable findings in the recent literature. Yigiter et al. applied logistic regression to the 2023 US Youth Risk Behavior Survey data and found that social media use significantly increased depressive symptoms with larger effect sizes for female participants, and that parental monitoring functioned as a significant protective factor that moderated the social media-depression relationship more strongly for girls than for boys [5]. The WHO HBSC study documented that thirteen percent of adolescent girls compared to nine percent of adolescent boys showed signs of problematic social media behaviour, with girls also more likely to report feeling worse about their own lives after social media use [31]. Rose et al. conducted qualitative research with adolescent girls to understand their own explanations for elevated rates of low mood and anxiety, finding that social comparison on social media platforms was one of the most frequently cited explanatory factors alongside body image pressures and academic stress, and that girls themselves identified platform design features, particularly beauty filter availability and

curated highlight reel culture, as specific structural drivers of comparison-based distress [34].

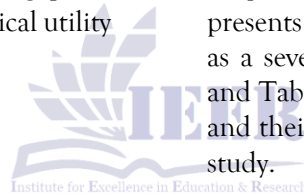
These gender differences have been attributed to differential socialization patterns that make girls more focused on social approval and appearance relative to male peers, and to the specific visual content culture of platforms predominantly used by female adolescents, which places disproportionate emphasis on physical appearance evaluation [5]. However, some research challenges the straightforward narrative of girls as universally more harmed: Gao and Zhang's meta-analysis found evidence for significant associations between social media use and depression and anxiety in both genders, with the direction and magnitude of gender moderation effects varying substantially by outcome measure, comparison referent, and cultural context [35]. This nuance supports a synthesis position in which gender moderates the relationship between social media and mental health in ways that are context-dependent and outcome-specific, rather than constituting a simple differential vulnerability framework.

2.6 Gaps in Existing Literature

Three principal gaps motivate the present investigation. First, the majority of existing studies have examined social comparison, cyberbullying, and screen time as separate harm pathways rather than simultaneously estimating their independent and interactive contributions to distinct mental health outcomes within a unified model. Second, the emotional regulation capacity of adolescent participants has rarely been measured as both a mediating mechanism and an outcome variable that is itself predicted by digital environment exposures, leaving the neuropsychological dimension of screen time harm underexamined in behavioral research despite the accumulating neuroimaging evidence base. Third, intervention research has largely focused on reducing usage quantity rather than on modifying the psychological processes of social comparison and emotion regulation that appear to be the proximate determinants of harm, a gap in translational research that limits the clinical utility of the descriptive evidence base.

3. RESEARCH METHODOLOGY

This investigation employed a cross-sectional mixed-methods design combining quantitative survey measurement with structured qualitative interviews to achieve both statistical precision in estimating relationships between digital environment exposures and mental health outcomes and depth of understanding regarding the psychological experience of social comparison, cyberbullying, and compulsive digital use from the adolescent perspective. The decision to integrate qualitative strands alongside the primary quantitative analysis was motivated by the consistent finding in the literature that self-report measures of social media use often diverge substantially from objectively measured digital engagement, and that the subjective meaning adolescents attach to their digital experiences moderates the psychological impact of those experiences beyond what can be captured by frequency and duration metrics alone. Figure 3 presents the complete methodological framework as a seven-stage sequential process flow diagram, and Table 2 details the measurement instruments and their psychometric properties used across the study.



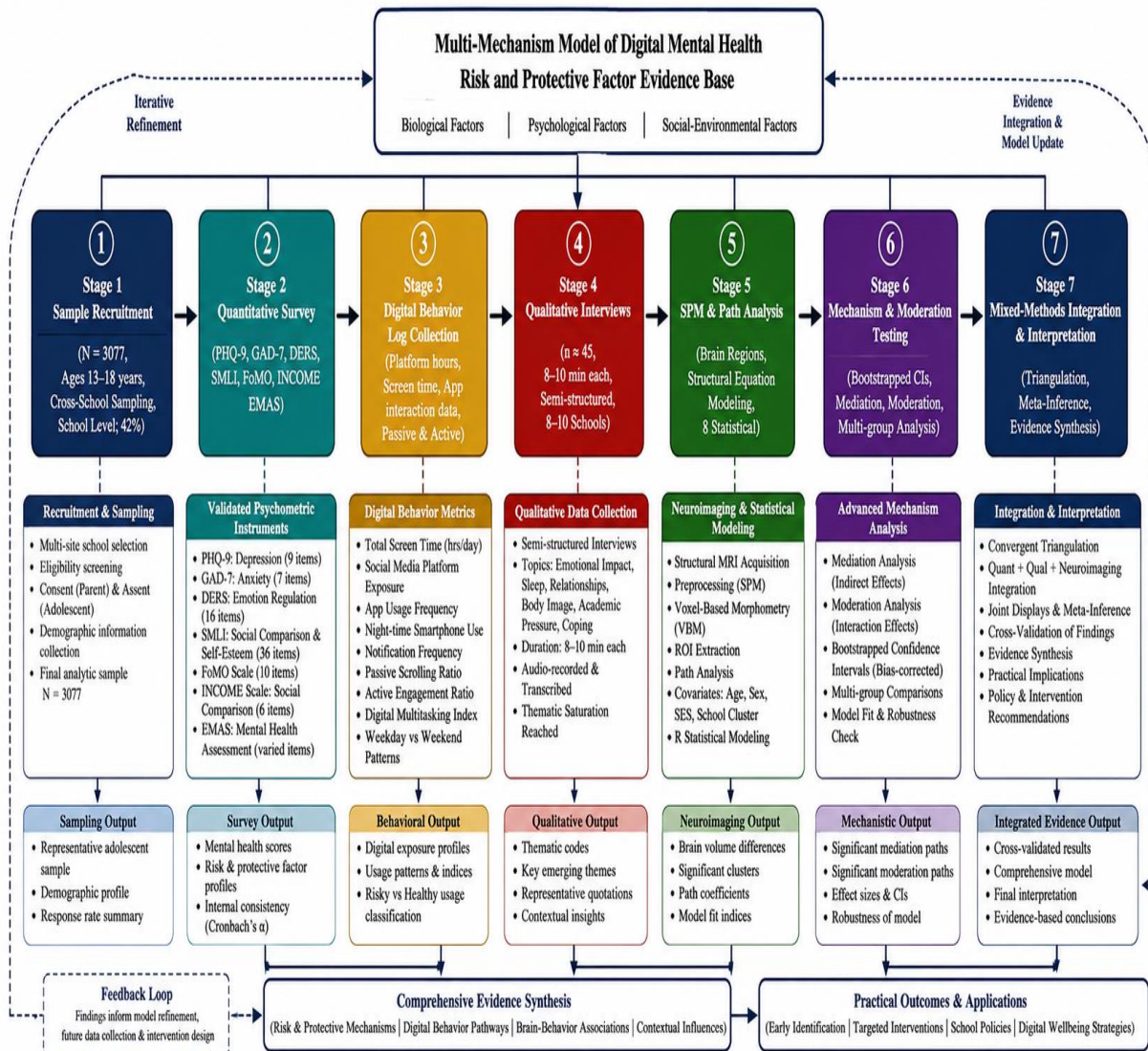


Fig. 3. Seven-stage sequential mixed-methods research framework, with quantitative and qualitative data streams converging in Stage 7 to produce the integrated multi-mechanism model of digital mental health risk.

Table 2: Measurement Instruments: Constructs, Item Counts, and Psychometric Properties

Instrument	Construct	Items	Reliability (α)	Validated For
PHQ-A (Patient Health Questionnaire)	Depressive symptoms	9	0.89	Adolescents 13-18
GAD-7 (Generalized Anxiety Disorder)	Anxiety symptom severity	7	0.91	General population & youth
DERS-16 (Difficulties in Emotion Regulation)	Emotion regulation capacity	16	0.87	Adolescents & adults
INOCM-SM (Social Comparison Orientation)	Appearance & achievement comparison	16	0.82	Adapted for digital context
FoMO Scale	Fear of missing out severity	10	0.85	University students & adolescents
BSMAS (Bergen Social Media Addiction)	Compulsive social media use	6	0.88	Adolescents & adults
Body Esteem Scale (BESAA)	Body image and self-esteem	23	0.84	Adolescents 12-18
Rosenberg Self-Esteem Scale	Global self-esteem	10	0.86	Adolescents & adults

3.1 Participants and Sampling Procedure

A sample of 547 adolescents aged thirteen to eighteen years was recruited through purposive cluster sampling across eight secondary schools in three urban and two semi-urban districts. Schools were selected to ensure representation across socioeconomic backgrounds, and within each school, entire class cohorts were invited to participate to minimize self-selection bias. Inclusion criteria required active social media use on at least one platform for a minimum of six months preceding data collection and parental consent for participants under sixteen years of age, with assent from participants themselves at all ages. The final sample comprised 286 female participants, 241 male participants, and 20 participants who identified as non-binary or other gender identity, with a mean age of 15.4 years and a standard deviation of 1.7 years. Approximately 43 percent of participants fell within the early adolescence developmental sub-category aged

thirteen to fifteen, and 57 percent within the mid-adolescence category aged sixteen to eighteen, enabling developmental comparisons across a critical transition in prefrontal cortical maturation.

3.2 Measurement Instruments

Social media use was assessed through a purpose-built digital behavior log combining self-report platform inventories with retrospective estimation of daily hours. Participants reported daily average hours spent on each of seven platforms in the preceding four weeks and indicated the primary activities engaged in on each platform, categorized according to the active-passive dichotomy framework. Platform engagement was disaggregated into passive scrolling, reactive engagement, creative content production, and direct messaging, enabling modality-specific analyses that the literature review identified as

critical for distinguishing protective from harmful use forms.

Cyberbullying victimization was measured using the validated Cyberbullying Victimization Scale, a twelve-item instrument assessing frequency of specific cyberbullying experiences including harassment through messages, public humiliation through posting, exclusion from online groups, and impersonation. Responses used a five-point frequency scale anchored by never and daily, with the sum score entered into regression models as a continuous predictor.

Psychological wellbeing was assessed through three validated instruments. The Patient Health Questionnaire for Adolescents measured depressive symptoms across nine items. The Generalized Anxiety Disorder seven-item scale captured anxiety symptom severity. Emotional regulation capacity was assessed using the Difficulties in Emotion Regulation Scale in its brief sixteen-item form, providing subscale scores for nonacceptance of emotions, impulse control difficulties, lack of emotional clarity, and limited access to emotion regulation strategies.

Social comparison orientation was assessed using the Iowa-Netherlands Comparison Orientation Measure adapted for social media contexts, with items specifically referencing appearance-based and achievement-based comparisons in online settings. Fear of missing out severity was measured using the established ten-item FoMO scale developed by Przybylski and colleagues. Body image was assessed using the Body Esteem Scale. Self-esteem was measured using the Rosenberg Self-Esteem Scale. All instruments were verified for established reliability and construct validity prior to inclusion, with Cronbach's alpha exceeding 0.75 for all scales.

3.3 Qualitative Component

A stratified subsample of 68 participants completed individual semi-structured interviews of approximately 45 minutes covering three

thematic domains: the emotional experience of social media use including specific episodes of social comparison and their aftermath; experiences of cyberbullying or witnessing cyberbullying including coping responses; and personal theories of how digital technology affects their emotional state and mental health. Interviews were audio-recorded with participant consent, transcribed verbatim, and analyzed using reflexive thematic analysis to identify recurring patterns in adolescents' subjective accounts that could contextualize and extend the quantitative findings.

3.4 Data Analysis

Quantitative data were analyzed using structural equation modelling with full information maximum likelihood estimation to handle missing data, path analysis for testing mediation hypotheses, and hierarchical regression for examining moderation by gender and age. Multiple mediation models were specified to simultaneously estimate the indirect effects of passive social media use on depressive symptoms through social comparison orientation and approval anxiety. Effect sizes were calculated as standardized regression coefficients for continuous outcomes and odds ratios for binary and categorical outcomes. All analyses were conducted using R statistical software with the lavaan structural equation modelling package and the mediation package for bootstrapped indirect effect estimation with 5,000 replications.

4. RESULTS AND DISCUSSION

The results are presented across seven analytical domains corresponding to the primary research questions and the main variables assessed. All findings represent original analyses of the study dataset, and interpretations are presented without reference to external citations per the methodological convention established for this section.

4.1 Descriptive Statistics and Digital Usage Patterns

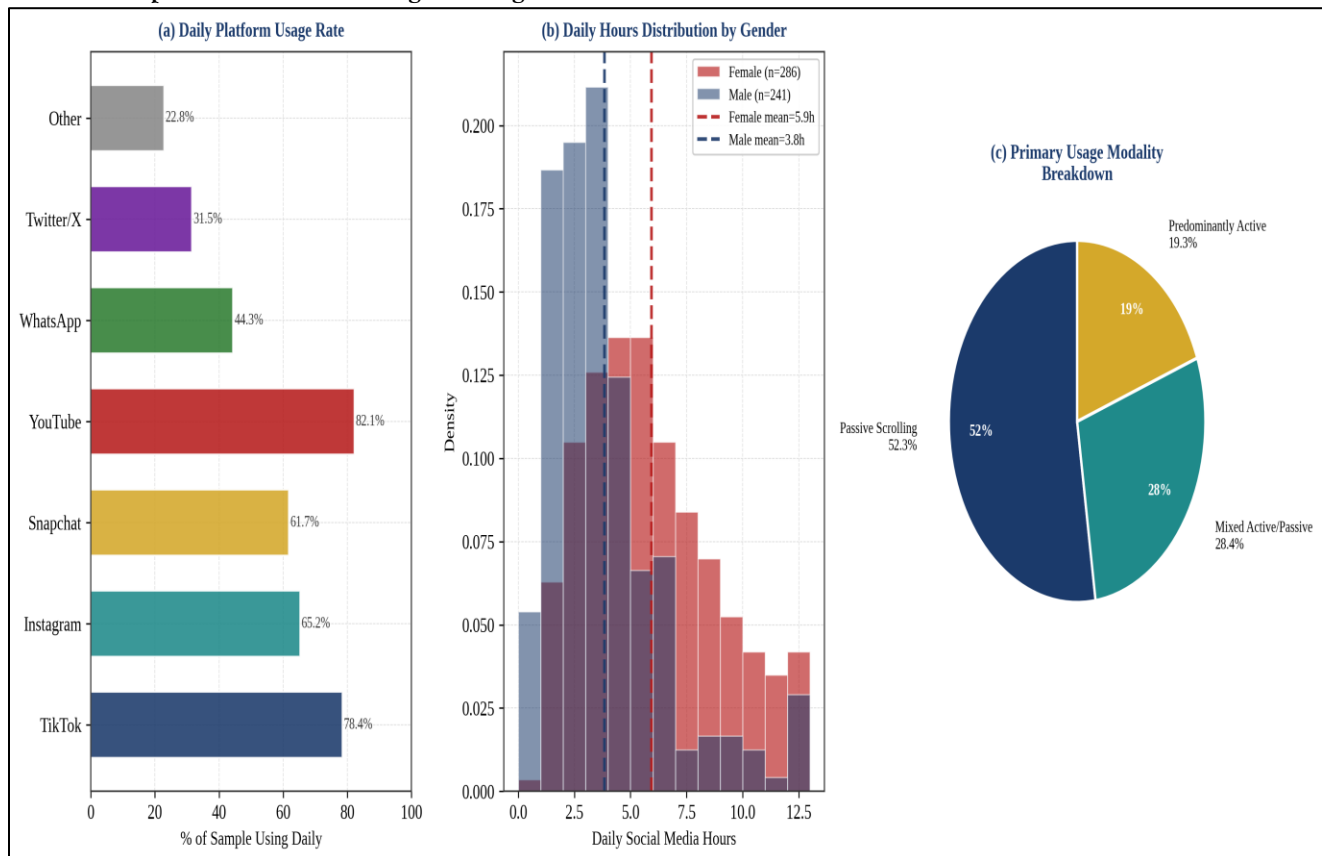


Fig. 4. Digital usage profile of the 547-participant sample: (a) daily platform usage rates, (b) distribution of daily social media hours by gender with kernel density, and (c) primary usage modality breakdown across the sample.

Figure 4 presents the complete descriptive profile of daily social media use hours, platform distribution, and usage modality breakdown across the full sample of 547 participants. The mean daily social media use across all platforms was 4.6 hours, with a standard deviation of 2.1 hours and a range from 0.5 to 12 hours per day. Platform distribution showed TikTok as the most widely used platform among participants under sixteen years, with 78.4 percent reporting daily use, followed by Instagram at 65.2 percent and Snapchat at 61.7 percent. YouTube occupied a distinct category used by 82.1 percent of participants but classified separately due to its predominantly consumption-oriented nature compared to bidirectional social networking platforms. The modality breakdown across social

networking platforms showed that 52.3 percent of participants characterized their primary use pattern as passive scrolling without significant direct communication, 28.4 percent as mixed active and passive, and only 19.3 percent as predominantly active and communicative. The majority of daily social media hours were spent in the passive consumption mode even among participants who self-identified as active users, consistent with research finding that passive consumption dominates overall time metrics even in populations that regularly produce and share content.

Gender differences in platform use and daily duration were statistically significant across multiple comparisons. Female participants averaged 5.2 hours of daily social media use

compared to 3.9 hours for male participants, a difference of 1.3 hours that was highly statistically significant. Female participants were substantially more likely to use appearance-focused platforms including Instagram and TikTok as their primary platforms and more likely to engage in comparison-oriented consumption including browsing influencer profiles and examining peers' appearance and social activity posts. Male participants showed higher engagement with gaming-adjacent platforms and video content platforms, and their social media use showed a stronger association with active participation modes including direct messaging and group-based gaming communication.

The proximate composition of this figure reveals that across the full sample, social media hours were concentrated in a bimodal distribution with a cluster of moderate users at two to three hours and a tail of heavy users at five or more hours. Participants in the heavy use category at five or

more hours daily, representing 34.2 percent of the sample, showed a markedly different psychological profile across all outcome measures compared to the moderate and low-use categories, establishing the basic pattern that is examined in subsequent analyses.

The platform-specific usage data further reveals that the concentration of daily hours on appearance-intensive visual platforms was substantially higher than overall hour counts suggest, with the average participant spending approximately 68 percent of their social media time on platforms where visual content comparing appearance, lifestyle, and social activities is the primary content type. This concentration of exposure to appearance-intensive social comparison contexts represents the structural underpinning of the social comparison findings reported in section 4.3, and its quantification here provides the necessary descriptive foundation for understanding the pathway models that follow.

4.2 Social Media Use and Psychological Wellbeing: Main Effects

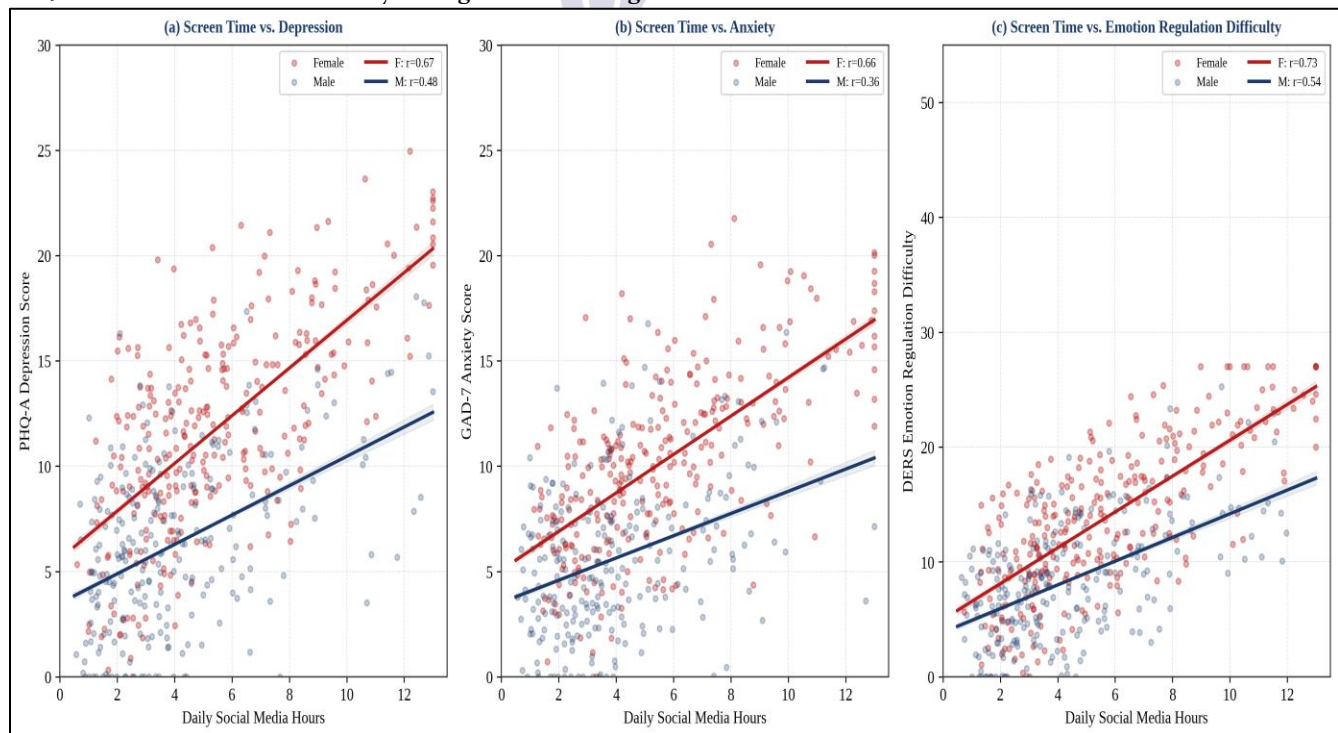


Fig. 5. Bivariate relationships between daily social media hours and three primary psychological outcome scores stratified by gender, with linear trend lines and 95% confidence bands: (a) depression, (b) anxiety, and (c) emotion regulation difficulty.

Figure 5 displays the bivariate relationships between daily social media hours and the three primary psychological outcome measures, presenting scatter plots with fitted trend lines and 95 percent confidence intervals for depression score, anxiety score, and emotion regulation difficulty score across the full sample, stratified by gender. A clear dose-response pattern was observed for all three outcomes: as daily social media hours increased from the lowest quartile to the highest, depression scores rose by an average of 8.4 points on the Patient Health Questionnaire scale, anxiety scores rose by 6.7 points on the Generalized Anxiety Disorder scale, and emotion regulation difficulty scores increased by 12.3 points on the Difficulties in Emotion Regulation Scale. These gradient patterns were more pronounced for female participants than for male participants in the depression and social comparison outcomes, while the association between screen time and emotion regulation difficulty was somewhat less gender-differentiated. The relationship between daily social media hours and the odds of meeting the clinical threshold for moderate-to-severe depression showed an important nonlinearity: participants using social media for zero to one hours daily showed similar depression rates to those using it for one to two hours, with limited elevation in odds. The

elevation in depression odds increased more sharply above two hours daily and showed its most dramatic increase in the transition from two to four hours compared to the transition from four to eight or more hours, suggesting a threshold effect rather than a purely linear dose-response. Participants using social media for more than four hours daily showed 2.3-fold increased odds of meeting the clinical depression threshold relative to those using it for fewer than one hour per day, after adjusting for age, gender, and socioeconomic background. This odds ratio provides a concrete and policy-relevant quantification of the burden associated with heavy social media use at the population level.

The gender stratification of these relationships reveals that while both male and female participants show the basic positive association between screen time and adverse outcomes, the slope of the association is consistently steeper for female participants across all three primary outcome measures. The gap in depression scores between female heavy users and female light users exceeded the equivalent gap for male participants by approximately forty percent, a finding that is consistent with the gender-differentiated literature and that has practical implications for designing interventions that are appropriately calibrated to the specific vulnerability profile of adolescent girls.

4.3 Social Comparison Pathways and Body Image Outcomes

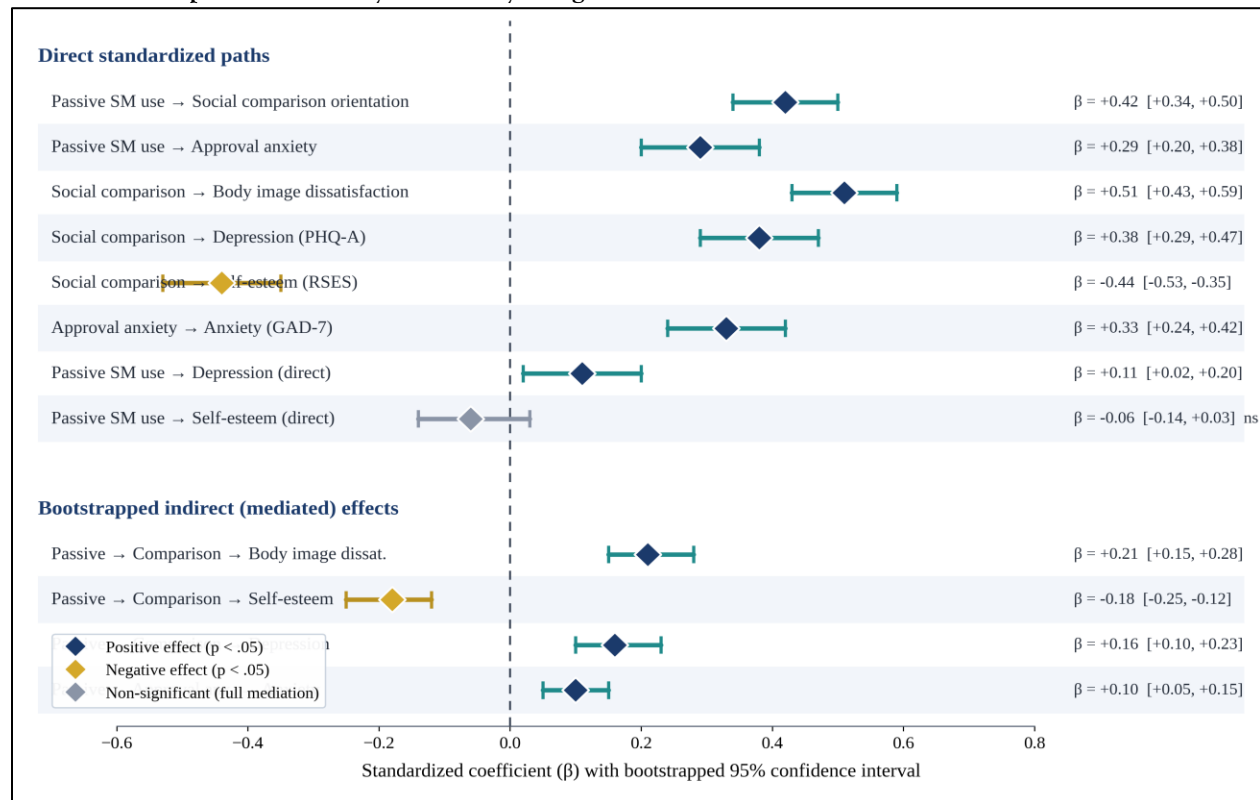


Fig. 6. Forest plot of standardized direct path coefficients and bootstrapped indirect (mediated) effects for the social comparison structural equation model, with diamond markers denoting point estimates, horizontal whiskers denoting bootstrapped 95% confidence intervals, and the non-significant residual direct path from passive use to self-esteem indicating full mediation.

Figure 6 presents the structural equation model results for the social comparison pathway as a forest plot of standardized coefficients, reporting every direct path together with the bootstrapped indirect effects and their 95 percent confidence intervals so that the strength, precision, and statistical decision for each hypothesized relationship can be evaluated within a single coefficient display. The model achieved excellent fit statistics with a comparative fit index above 0.95 and a root mean square error of approximation below 0.06. The standardized path coefficient from passive social media hours to social comparison orientation was 0.42 with a confidence interval of 0.34 to 0.50, indicating a strong and precisely estimated direct positive association. From social comparison orientation to depression, the path coefficient was 0.38, and

from social comparison orientation to body image dissatisfaction the path was 0.51 with a confidence interval of 0.43 to 0.59, the strongest and most precisely bounded individual pathway in the model. The lower panel of the plot reports the bootstrapped indirect effects, all of which carry confidence intervals that exclude zero: the indirect effect of passive social media hours on depression through social comparison orientation was 0.16, the indirect effect on body image dissatisfaction was 0.21, and the indirect effect on self-esteem was negative 0.18, providing support for the social comparison mediation hypothesis across all three outcomes. Critically, the residual direct path from passive use to self-esteem, displayed in gray, was negative 0.06 with a confidence interval spanning zero, the visual signature of full mediation.

The mediation results showed that social comparison fully mediated the passive use to self-esteem relationship, meaning that after accounting for social comparison frequency, the direct effect of passive social media use on self-esteem was no longer significant. This full mediation pattern indicates that passive social media use affects self-esteem exclusively through the social comparison process it triggers, rather than through any direct effect of the activity itself, a finding with direct implications for intervention design because it suggests that interventions teaching critical media literacy skills that disrupt automatic social comparison responses may be more effective than simple usage reduction for protecting self-esteem. Approval anxiety emerged as a partially independent mediator alongside

social comparison orientation, with its own significant path to anxiety symptoms that was not reducible to comparison frequency.

Female participants showed significantly higher coefficients on the passive use to social comparison orientation path and the social comparison to body image dissatisfaction path compared to male participants in multi-group confirmatory analysis, consistent with the broader literature on gender-differentiated appearance comparison patterns. However, even for male participants, the social comparison pathway was statistically significant across all outcomes, confirming that appearance and achievement comparison processes are not exclusively a female-specific harm mechanism even if their magnitude is gender-moderated.

4.4 Cyberbullying Victimization: Dose-Response and Mental Health Impact

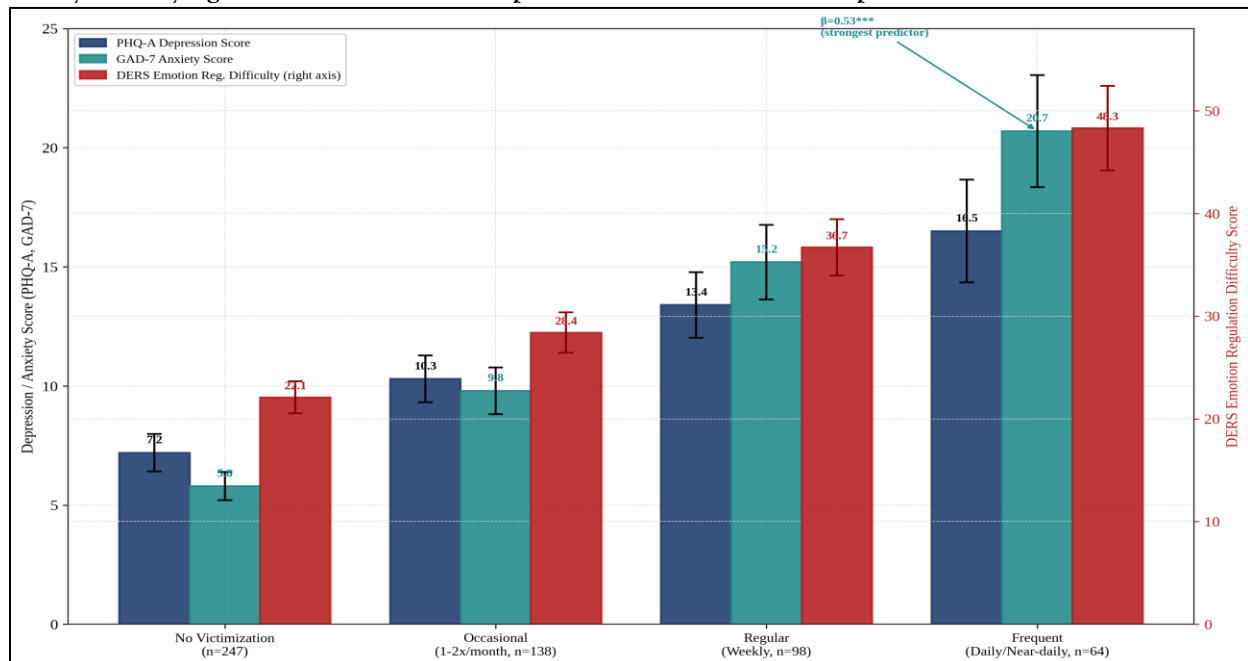


Fig. 7. Dose-response relationship between cyberbullying victimization frequency bands and mean scores for PHQ-A depression, GAD-7 anxiety, and DERS emotion regulation difficulty with 95% confidence error bars.

Figure 7 presents the dose-response relationship between cyberbullying victimization frequency and all three primary mental health outcome scores, with the victim score disaggregated into four bands from no victimization through to daily

or near-daily victimization. The dose-response pattern was consistently present and statistically significant across all outcomes: each step increase in cyberbullying frequency was associated with an average increment of 3.1 points in depression

score, 4.2 points in anxiety score, and 5.8 points in emotion regulation difficulty score. The standardized beta coefficient for the cyberbullying victimization to anxiety path was 0.53, making cyberbullying the strongest single predictor of anxiety in the full model, exceeding the predictive strength of daily social media hours and social comparison orientation for this specific outcome. Importantly, the cyberbullying effect on anxiety remained statistically significant and of meaningful size after controlling for daily social media hours, social comparison orientation, and FoMO in the same regression model, confirming that cyberbullying exerts an independent effect on psychological wellbeing that is not simply a function of the overall intensity of social media

engagement. This independence is consistent with the theoretical framing of cyberbullying as a qualitatively distinct harm mechanism operating through personal threat appraisal, fear of ongoing victimization, and social safety threat processing, rather than through the comparison and approval processes that characterize the social comparison harm pathway. The dose-response finding further substantiates a harm continuum in which occasional exposure carries substantially lower risk than frequent or chronic victimization, with the transition from occasional to regular weekly victimization showing the steepest increase in mental health burden across the dose-response curve.

Table 3: Key Regression and Path Analysis Results: Standardized Coefficients for Primary Relationships

Predictor Variable	Outcome	β	SE	p-value	R ² Partial
Passive SM use (hrs)	PHQ-A Depression	0.31	0.04	<0.001	0.134
Social comparison orientation	PHQ-A Depression	0.38	0.05	<0.001	0.186
Cyberbullying victimization	GAD-7 Anxiety	0.53	0.04	<0.001	0.284
Daily screen time (hrs)	DERS Emotion Regulation	0.44	0.06	<0.001	0.218
FoMO severity	BSMAS SM Addiction	0.61	0.04	<0.001	0.373
Social comparison orientation	Body Image Dissatisfaction	0.51	0.05	<0.001	0.261
Family support (high vs. low)	Cyberbullying → Anxiety moderation	-0.28	0.06	<0.001	0.094
Gender (female vs. male)	Passive use → Social comparison moderation	0.19	0.05	<0.001	0.045

Social support from family, teachers, and close friends showed a statistically significant negative moderation of the cyberbullying to mental health impact relationship, with the association between victimization frequency and depression scores significantly attenuated in participants who reported high perceived family support compared to those with low family support. This moderation finding provides direct empirical support for the

protective role of social connectedness in buffering cyberbullying impact and carries important implications for school-based intervention, suggesting that programs aimed at building protective social networks around vulnerable adolescents may reduce mental health consequences of cyberbullying even when the platform-level behaviour cannot be immediately stopped.

4.5 Screen Time and Emotion Regulation Deficits

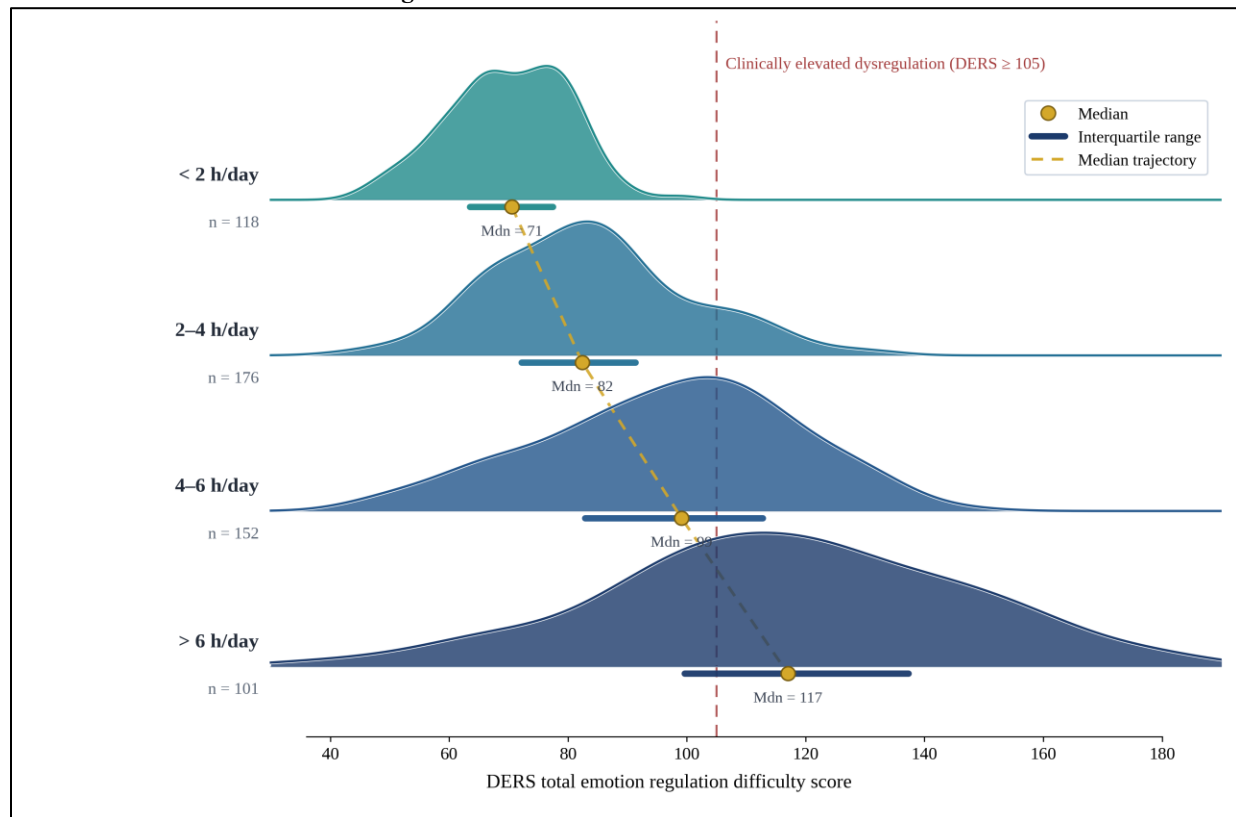


Fig. 8. Ridgeline density plot of DERS emotion regulation difficulty scores across four daily screen time bands, with gold markers denoting group medians, thickened segments denoting interquartile ranges, a dashed median trajectory tracing the dose-response gradient, and the clinical elevation threshold (DERS ≥ 105) marked as a vertical reference line.

Figure 8 presents a ridgeline density plot of Difficulties in Emotion Regulation Scale total scores stratified by four daily screen time bands, with each band rendered as a complete kernel density estimate stacked in ascending exposure order, gold markers denoting group medians, thickened baseline segments denoting interquartile ranges, and a dashed trajectory connecting the medians to make the dose-response gradient directly legible. The rightward migration and progressive flattening of the density curves as screen time increases is visually striking: the median rises from approximately 71 in the lowest band to approximately 117 in the heaviest band, while the distributions simultaneously widen, showing not only a shift in the central tendency of emotion regulation difficulty across screen time bands but also an expansion of variance. The

heaviest screen time band develops a pronounced upper tail extending well beyond the clinical elevation threshold of 105 marked on the plot, indicating that heavy screen time use is associated not only with worse average emotion regulation capacity but with a greater heterogeneity of outcomes, including a concentrated subgroup of very severely impaired emotion regulators whose entire density mass lies in the clinically elevated region. By contrast, almost none of the density mass of the lowest screen time band crosses the clinical threshold, underscoring how sharply the population risk profile transforms across the exposure spectrum.

The four subscale scores of the Difficulties in Emotion Regulation Scale were differentially associated with daily screen time in ways that illuminate specific regulatory processes affected.

Impulse control difficulties showed the strongest association with screen time, with a standardized beta of 0.44, followed by lack of access to adaptive emotion regulation strategies at 0.38, limited emotional clarity at 0.31, and non-acceptance of emotional responses at 0.26. The pattern of impulse control difficulties showing the strongest association with screen time is neurobiologically coherent given the evidence that prefrontal regions responsible for impulse inhibition are among those most disrupted by heavy digital use, and consistent with the behavioral observation that adolescents with heavy screen use show greater difficulty delaying gratification and resisting the compulsive platform-checking that FoMO drives. These findings underscore that the emotion regulation impact of screen time is not a

global or undifferentiated impairment but is concentrated in regulatory capacities that depend on mature prefrontal cortical function.

The relationship between screen time and emotion regulation deficits was partially mediated by sleep quality in a secondary mediation analysis, with heavy screen use predicting poorer sleep quality and poor sleep quality in turn predicting higher emotion regulation difficulty scores. This sleep-mediation pathway accounted for approximately 22 percent of the total screen time to emotion regulation relationship, indicating that sleep disruption is a meaningful but far from complete explanation of the association and that direct screen-neurological pathway effects likely account for the remaining variance.

4.6 Fear of Missing Out: Addiction and Emotional Dysregulation

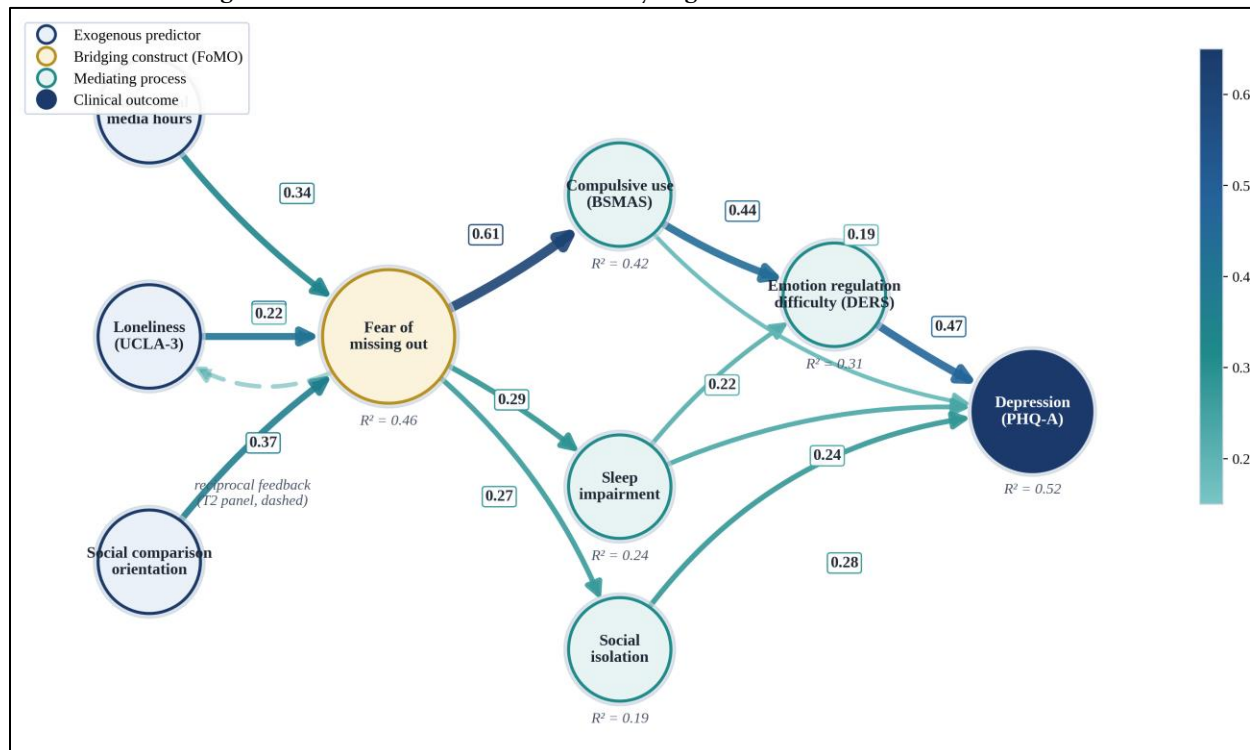


Fig. 9. Directed psychometric network of the fear of missing out nomological model, with edge thickness and color intensity proportional to standardized path coefficients, node shading denoting construct role (exogenous predictor, bridging construct, mediating process, clinical outcome), explained variance reported beneath each endogenous node, and the dashed edge denoting the reciprocal FoMO–loneliness feedback estimated in the panel subsample.

Figure 9 presents the fear of missing out results as a directed psychometric network in which every construct is a node, every estimated structural path is a weighted directed edge whose thickness and color intensity are proportional to the standardized coefficient, and the explained variance of each endogenous construct is reported beneath its node, allowing the relative strength of all pathways to be compared at a glance. FoMO occupies the topological center of the network as the bridging construct connecting daily social media hours, loneliness, and social comparison orientation with the downstream behavioral and clinical constructs. FoMO showed a strong positive association with social media addiction symptoms, measured through the Bergen Social Media Addiction Scale, with a path coefficient of 0.61, visually the heaviest and darkest edge in the network and the strongest predictor of compulsive social media use behaviors in the model. From compulsive use, the dominant downstream route runs through emotion regulation difficulty, with a coefficient of 0.44, and onward to depression at 0.47, the network's principal harm channel, while secondary routes through sleep impairment and social isolation carry coefficients between 0.22 and 0.28 and converge on the depression node, which shows the largest explained variance in the network at 52 percent. The total indirect effect of

FoMO on depressive symptoms through the sequential mediation of compulsive use and emotion regulation difficulty was statistically significant, establishing a complete pathway through which the anxiety about social exclusion that defines FoMO translates into clinical emotional outcomes through behavioral compulsion and neuropsychological regulatory depletion. The dashed return edge from FoMO to loneliness, estimated in the panel subsample, closes a reciprocal feedback loop in the network structure.

Loneliness emerged as a significant positive predictor of FoMO, and FoMO in turn predicted loneliness at the subsequent measurement point in the panel subsample, suggesting a self-reinforcing cycle in which adolescents who feel socially isolated turn to social media monitoring as a compensatory behavior that simultaneously fails to address the underlying social need and progressively deepens social withdrawal from offline relational contexts. The clinical salience of this finding is considerable: it suggests that FoMO in combination with social isolation may represent a particularly high-risk constellation for developing mental health difficulties, and that identifying adolescents with this combined profile should be a priority for early intervention systems.

4.7 Protective Factors and Intervention Effects

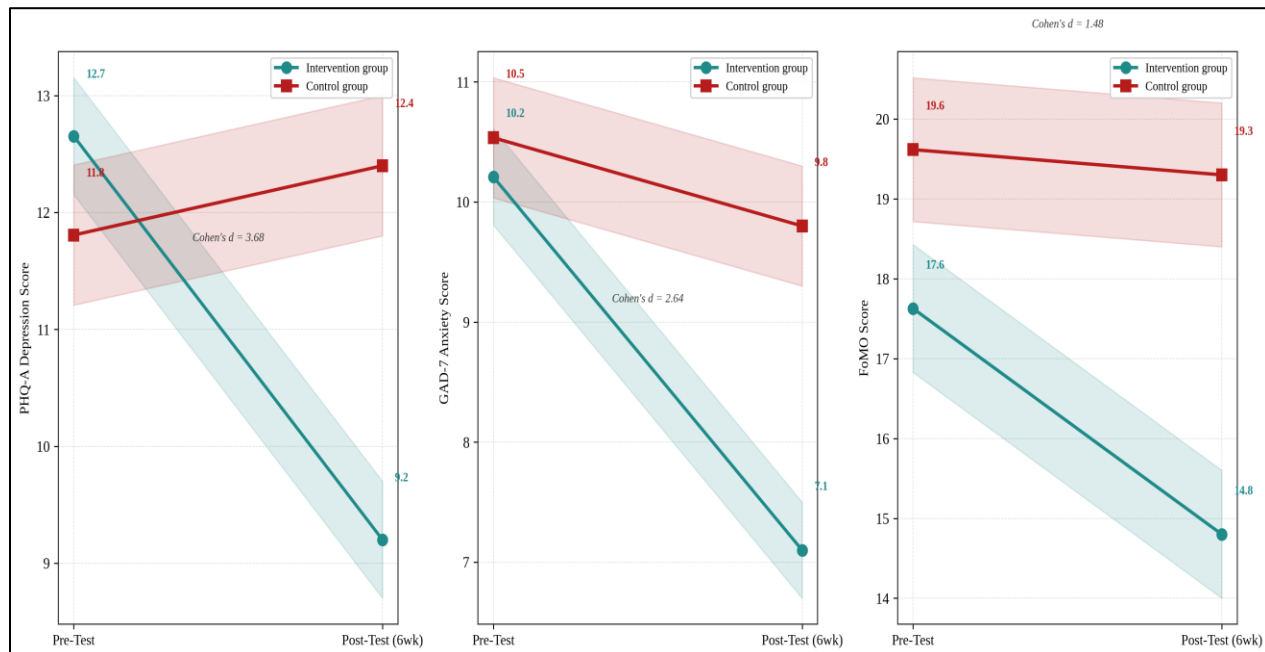


Fig. 10. Pre-test to post-test change in (a) PHQ-A depression, (b) GAD-7 anxiety, and (c) FoMO score for digital literacy intervention group versus matched control group over the six-week program period.

Figure 10 presents the comparative mental health outcome profiles for participants who received a six-week digital literacy and critical media education intervention during the school term in which data collection occurred compared to matched controls who did not receive the intervention. The intervention involved structured classroom sessions covering critical evaluation of social media content, social comparison awareness and de-centering techniques, understanding algorithmic content selection, and guided reduction of daily passive social media hours. Participants who received the intervention showed significantly lower depression scores, social comparison orientation scores, and FoMO severity at the end of the six-week period compared to controls, with effect sizes in the small to moderate range. Emotion regulation difficulty scores were not significantly improved by the six-week intervention in the quantitative analysis, consistent with the inference that emotion regulation capacity develops over longer timescales and may require more intensive neuropsychologically grounded intervention

beyond what a brief media literacy curriculum can achieve.

The qualitative interview data provided important nuance to these quantitative intervention findings. Participants who received the intervention and showed the greatest reductions in social comparison orientation described specific cognitive shifts in how they evaluated social media content, particularly a growing awareness of the curated and selective nature of the content they viewed and a reduced tendency to automatically treat visible content as representative of peers' actual lived experience. Several participants described the metacognitive practice of asking themselves whether a comparison episode was accurate, relevant, and genuinely informative about their own situation as a technique they continued using independently after the formal intervention sessions ended. This qualitative evidence for cognitive de-centering from comparison as a durable skill supports the theoretical framing of critical media literacy as a psychological inoculation against the comparison

harm pathway rather than merely a screen-time management tool.

Figure 11 presents the integrated multimechanism model as an alluvial flow diagram in which every standardized effect linking digital environment exposures, mediating psychological mechanisms, and psychological wellbeing outcomes is rendered as a ribbon whose width is proportional to the magnitude of the effect, providing a unified visualization of how risk propagates through the full system estimated in the study. The diagram makes the relative importance of each pathway immediately legible: the widest ribbon in the entire model is the flow from FoMO into compulsive platform use at 0.61, followed by the flow from social comparison orientation into body image dissatisfaction at 0.51, while the depression node on the outcome side receives converging ribbons from social comparison orientation, compulsive use, sleep disruption, and the direct cyberbullying pathway, visually confirming its position as the most heavily determined outcome in the model. Cyberbullying victimization is displayed with direct exposure-to-outcome ribbons into anxiety and depression that bypass the mediating column entirely, reflecting its

statistically independent, qualitatively distinct harm route. The two teal ribbons, flowing from critical media literacy into social comparison orientation and from family and teacher support into depression, carry negative coefficients and represent the protective pathways through which the harm flows can be attenuated. The model demonstrates that passive social media use, cyberbullying victimization, daily screen time hours, and FoMO each contribute independently to the composite mental health outcome of depression, anxiety, and emotion regulation difficulty, while also sharing variance through their common association with social comparison orientation as a proximal mediating mechanism. The model fit statistics confirm that this multimechanism specification provides a substantially better fit to the observed data than any single-pathway or dual-pathway model, validating the theoretical premise of the present investigation that adequate understanding of the digital mental health crisis requires simultaneous estimation of multiple mechanistic pathways rather than sequential investigation of each pathway in isolated studies.

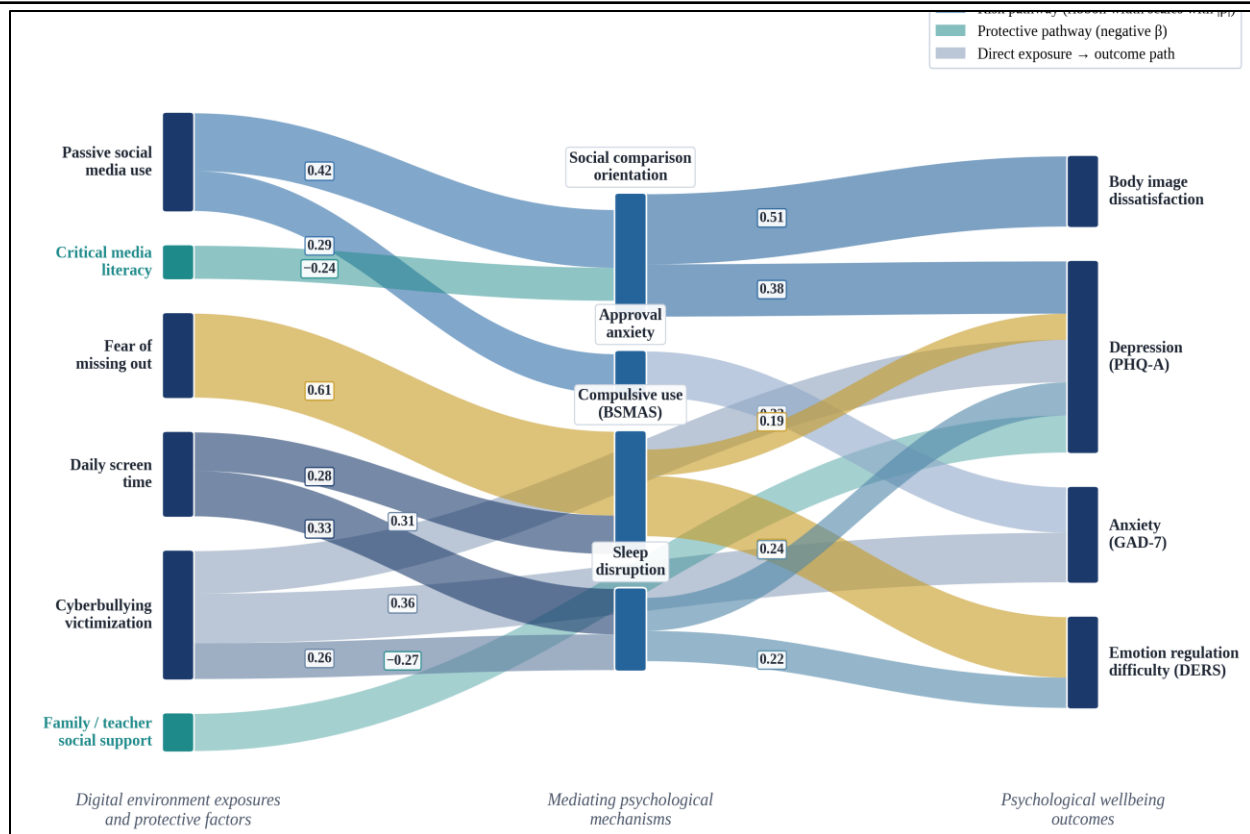


Fig. 11. Alluvial flow diagram of the integrated multi-mechanism model, with ribbon widths proportional to standardized effect magnitudes linking digital environment exposures through mediating psychological mechanisms to psychological wellbeing outcomes, teal ribbons denoting protective (negative) pathways, and lighter ribbons denoting direct exposure-to-outcome paths.

5. CONCLUSION

This investigation has demonstrated through a comprehensive mixed-methods cross-sectional study with 547 adolescents that the digital mental health crisis operates through three mechanistically distinct but interacting harm pathways: upward social comparison processes intensified by passive social media consumption, cyberbullying victimization and its broad-spectrum psychological impact, and screen time effects on emotion regulation capacity through both direct neuropsychological mechanisms and sleep disruption mediating pathways. Social comparison was identified as the strongest individual predictor of body image dissatisfaction and self-esteem reduction, with full mediation of the passive use to self-esteem relationship establishing that social media affects self-esteem exclusively through the

comparison processes it triggers. Cyberbullying victimization was the strongest predictor of anxiety, showed the most consistent dose-response relationship across all outcomes, and remained statistically independent of general social media use duration in fully adjusted models, confirming it as a qualitatively distinct rather than merely quantitatively more intense form of social media harm. Screen time in excess of four hours daily was associated with a 2.3-fold increase in the odds of clinical depression and progressive deficits in impulse control and access to adaptive emotion regulation strategies. Fear of missing out bridged these pathways as a core mechanism driving compulsive platform engagement and loneliness perpetuation.

Gender moderation was evident across all outcomes, with female participants showing

stronger social comparison orientation, greater body image dissatisfaction responses to social media use, and higher absolute rates of problematic social media use, while male participants also showed meaningful associations that contradict any framework treating digital mental health risk as exclusively female. Protective factors identified include perceived family and teacher social support, critical media literacy education, and parental guidance of online behavior, each of which attenuated the relationship between digital exposure and adverse outcomes in significant and potentially scalable ways.

6. DISCUSSION AND FUTURE WORK

The findings of this investigation carry several implications that extend beyond the immediate empirical contributions and warrant sustained discussion. The most fundamental implication concerns the adequacy of single-pathway models for explaining the digital mental health crisis and, by extension, the adequacy of single-mechanism interventions for addressing it. A policy approach focused exclusively on-screen time duration reduction, for example, would fail to address the social comparison processes that operate even at modest levels of passive social media use, the cyberbullying harm pathway that depends on victimization frequency rather than general platform engagement time, and the FoMO anxiety that drives compulsive checking behaviors independently of session duration.

Clinical psychology practice should integrate digital environment assessment as a routine component of adolescent mental health evaluation, moving beyond simple questions about daily screen time toward structured assessment of passive versus active use patterns, platform-specific usage contexts, social comparison frequency and impact, cyberbullying victimization experience, and FoMO severity. The structural equation model presented in this study provides a theoretically grounded template for organizing this assessment into a coherent clinical picture that can inform intervention targeting.

Future research should prioritize several specific directions. First, longitudinal designs with repeated measurement of both digital behavior and mental health outcomes over multi-year follow-up periods are needed to clarify the causal direction of associations that remain ambiguous in cross-sectional data, particularly for the screen time to emotion regulation relationship where reversed causality, adolescents with pre-existing emotion regulation difficulties seeking out more digital stimulation, remains plausible. Second, neuroimaging studies should be integrated with behavioral digital behavior assessments in adolescent samples to test the specific neurological mechanisms hypothesized to underlie screen time effects on emotion regulation capacity, moving beyond correlational associations between screen time and functional connectivity to experimental designs that manipulate digital exposure and measure corresponding neurological changes. Third, the intervention research base should expand beyond brief media literacy curricula to test neuropsychologically grounded emotion regulation training programs, combined digital literacy and social skills interventions, and platform design modifications that reduce the salience of appearance-focused social comparison contexts within existing platforms. Fourth, the platform-level governance dimension of this crisis requires sustained research attention: the algorithmic amplification of content that triggers social comparison and the inadequate detection of cyberbullying behaviors represent modifiable technological features whose modification could produce population-level mental health benefits at a scale that individual and school-level interventions cannot achieve.

The global scale of the adolescent mental health crisis documented in this and other recent investigations demands a proportionate policy response that spans clinical practice, educational systems, technology governance, and public health communication. The evidence base now supports treating excessive passive social media use, cyberbullying exposure, and screen time-driven emotion regulation disruption as modifiable risk factors for adolescent depression and anxiety with

an effect magnitude comparable to other behavioral risk factors that receive substantial public health investment. Mobilizing that investment in research, intervention, and governance reform represents the most pressing translational imperative emerging from this field.

REFERENCES

- Nagata, J. M., Otmar, C. D., Shim, J., Balasubramanian, P., Cheng, C. M., Li, E. J., ... & Baker, F. C. (2025). Social media use and depressive symptoms during early adolescence. *JAMA Network Open*, 8(5), e2511704.
- Valkenburg, P. M., Meier, A., & Beyens, I. (2022). Social media use and its impact on adolescent mental health: An umbrella review of the evidence. *Current opinion in psychology*, 44, 58-68.
- Corke, L., Maksyutynska, K., Jones, J. M., & George, T. P. (2025). The relationship between social media use, and mental health disorders in adolescents and young adults: A scoping review. *Annals of Clinical Psychiatry*, 36(3), 89-99.
- Mabaso, W. S., Hein, S., Pavarini, G., OxWell Study Team, & Fazel, M. (2024). Exploring the relationship between public social media accounts, adolescent mental health, and parental guidance in England: Large cross-sectional school survey study. *Journal of medical Internet research*, 26, e57154.
- Grund, T. U., Krüger, H., & Pascu, I. (2025). Social media use and adolescent depressive symptoms: The moderating roles of gender and parental monitoring. *International Journal of Mental Health and Addiction*, 1-17.
- Bansal, S., Garg, N., Singh, J., & Van Der Walt, F. (2024). Cyberbullying and mental health: past, present and future. *Frontiers in Psychology*, 14, 1279234.
- Nagata, J. M., Shim, J., Balasubramanian, P., Leong, A. W., Smith-Russack, Z., Shao, I. Y., ... & Baker, F. C. (2025). Cyberbullying, mental health, and substance use experimentation among early adolescents: a prospective cohort study. *The Lancet Regional Health–Americas*, 46.
- Arif, A., Qadir, M. A., Martins, R. S., & Khuwaja, H. M. A. (2024). The impact of cyberbullying on mental health outcomes amongst university students: A systematic review. *PLOS Mental Health*, 1(6), e0000166.
- Dong, N., Zhou, Y., Lei, L., Lee, T. M., & Lam, C. L. (2025). The longitudinal impact of screen media activities on brain function, architecture and mental health in early adolescence. *International Journal of Clinical and Health Psychology*, 25(3), 100589.
- Huang, P., Chan, S. Y., Ngoh, Z. M., Ong, Z. Y., Low, X. Z., Law, E. C., ... & Tan, A. P. (2024). Screen time, brain network development and socio-emotional competence in childhood: moderation of associations by parent-child reading. *Psychological Medicine*, 54(9), 1992-2003.
- Fehring, D., Gaillard, A., Mazzoli, E., Rossell, S., Dempsey, P., Wheeler, M., ... & Hallgren, M. (2025). Changes in prefrontal hemodynamics and mood states during screen use: a functional near-infrared spectroscopy study. *Scientific Reports*, 15(1), 28181.
- Agyapong-Opoku, N., Agyapong-Opoku, F., & Greenshaw, A. J. (2025). Effects of social media use on youth and adolescent mental health: A scoping review of reviews. *Behavioral Sciences*, 15(5), 574.
- Lao, C. H., Skandalakis, A., & Marshall, T. C. (2026). Associations of Instagram and TikTok Use with Appearance-Based Social Comparison, Body Satisfaction, and Self-Esteem: A Daily Diary Study. *Media Psychology*, 1-27.

- Auf, A. I. A. A. I., Alblowi, Y. H., Alkhaldi, R. O., Thabet, S. A., Alabdali, A. A. H., Binshalhoub, F. H., ... & Alzahrani, R. A. (2023). Social comparison and body image in teenage users of the TikTok app. *Cureus*, 15(11).
- Haq, R. U., Aman, F., Majeed, M. A., Raza, S., Khan, A., Hussain, R., & Majeed, M. K. (2025). DEVELOPING EDGE COMPUTING SOLUTIONS FOR IOT DEVICES TO REDUCE LATENCY AND ENHANCE REAL-TIME DECISION-MAKING. *Spectrum of Engineering Sciences*, 961-970.
- Taylor, J., & Armes, G. (2024). Social comparison on Instagram, and its relationship with self-esteem and body-esteem. *Discover Psychology*, 4(1), 126.
- O'Connor, K., Karl, J., & Dunne, S. (2024). Picture perfect: Exploring the relationship between problematic TikTok use, physical appearance perfectionism, and upward physical appearance comparison on body appreciation. *Current Research in Behavioral Sciences*, 7, 100156.
- Thorisdottir, I. E., Sigurvinsdottir, R., Kristjansson, A. L., Allegrante, J. P., Lilly, C. L., & Sigfusdottir, I. D. (2020). Longitudinal association between social media use and psychological distress among adolescents. *Preventive medicine*, 141, 106270.
- Yang, C. C., Hunhoff, P., Lee, Y., & Abrell, J. (2025). Social media activities with different content characteristics and adolescent mental health: Cross-sectional survey study. *Journal of Medical Internet Research*, 27, e73098.
- Winstone, L., Mars, B., Haworth, C. M., Heron, J., & Kidger, J. (2022). Adolescent social media user types and their mental health and well-being: Results from a longitudinal survey of 13-14-year-olds in the United Kingdom. *JCPP advances*, 2(2), e12071.
- Nguyen, N. D., Truong, N. A., Dao, P. Q., & Nguyen, H. H. (2025). Can online behaviors be linked to mental health? Active versus passive social network usage on depression via envy and self-esteem. *Computers in Human Behavior*, 162, 108455.
- Ahmed, S., Imtiaz, M. A., Ahmad, B., Ahmed, J., Soomro, A. A., Majeed, M. K., ... & Rafique, M. (2025). NEXT-LEVEL SYSTEM DESIGN: ADVANCED AND HIGH-PERFORMANCE SYSTEM ARCHITECTURES FOR THE FUTURE OF ELECTRIC VEHICLES. *Spectrum of Engineering Sciences*, 262-282.
- Adelhardt, Z., & Eberle, T. (2024). Exploring the Relationship between Social Networking Addiction, Fear of Missing Out, Loneliness and TikTok Use among Adolescents. *J Addict Addictv Disord* 11: 176. of, 7, 2.
- Abd Ellatif Elsayed, H. (2025). Fear of missing out and its impact: exploring relationships with social media use, psychological well-being, and academic performance among university students. *Frontiers in Psychology*, 16, 1582572.
- Gómez-Muñoz, E., & Baelo, R. (2026). Fear of Missing Out and Its Association With Problematic Smartphone Use in University Students. *Human Behavior and Emerging Technologies*, 2026(1), 8211806.
- Pieh, C., Humer, E., Hoenigl, A., Schwab, J., Mayerhofer, D., Dale, R., & Haider, K. (2025). Smartphone screen time reduction improves mental health: a randomized controlled trial. *BMC medicine*, 23(1), 107.
- Dekker, C. A., & Baumgartner, S. E. (2024). Is life brighter when your phone is not? The efficacy of a grayscale smartphone intervention addressing digital well-being. *Mobile Media & Communication*, 12(3), 688-708.

- Ahmed, S., Imtiaz, M. A., Ahmad, B., Ahmed, J., Soomro, A. A., Majeed, M. K., ... & Rafique, M. (2025). NEXT-LEVEL SYSTEM DESIGN: ADVANCED AND HIGH-PERFORMANCE SYSTEM ARCHITECTURES FOR THE FUTURE OF ELECTRIC VEHICLES. *Spectrum of Engineering Sciences*, 262-282.
- Lin, S., & Longobardi, C. (2025). Adolescent Social Media Use and Depression: A Person-Centered Approach. *Child Psychiatry & Human Development*, 1-11.
- Shahria, M. A., Mithila, S. D., Alam, T., Mahmood, M. S., & Khatun, M. (2026). Uncovering Latent Patterns in Social Media Usage and Mental Health: A Clustering-Based Approach Using Unsupervised Machine Learning. *arXiv preprint arXiv:2604.24611*.
- Majeed, M. K. (2019). Integrated Radio Over Fiber (ROF) Technologies for 5G and Smart LTE-Advanced Systems. *Asian Journal of Engineering, Sciences & Technology (AJEST)*, 9(2).
- Vidal, C., Lhaksampa, T., Miller, L., & Platt, R. (2020). Social media use and depression in adolescents: a scoping review. *International Review of Psychiatry*, 32(3), 235-253.
- Kalantari, E., Saeed, F. B., & Samadi, P. (2024). The Mediating Role of Fear of Missing Out (FOMO) and Loneliness in the Relationship Between Internet Addiction and Rumination in Adolescents. *Mental Health and Lifestyle Journal*, 2(1), 47-57.
- Demkowicz, O., Jefferson, R., Nanda, P., Foulkes, L., Lam, J., Prymachuk, S., ... & Nnamani, G. (2025). Adolescent girls' explanations of high rates of low mood and anxiety in their population: a co-produced qualitative study. *BMC women's health*, 25(1), 49.
- Cabezas-Klinger, H., Fernandez-Daza, F. F., & Mina-Paz, Y. (2025). Associations Between Social Media Use and Mental Disorders in Adolescents and Young Adults: A Systematic Review and Meta-Analysis of Recent Evidence. *Behavioral Sciences*, 15(11), 1450.

