Iran J Psychiatry 2027; 22: 1: 1-11

Original Article

# Social Media Addiction, Sleep Disturbance, Emotional Dysregulation, and Academic Performance Among School-Aged Children: A Serial Mediation Analysis

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**Abstract**

**Objective:** This study aimed to examine the serial mediating roles of sleep disturbance and emotional dysregulation in the relationship between social media addiction and academic performance among school-aged children aged 6-12 years.
**Method:** A cross-sectional explanatory study was conducted among 760 school-aged children aged 6-12 years recruited from primary schools in Holy Kerbala City, Iraq, using stratified cluster random sampling. Data were collected using four validated instruments: The Social Media Addiction Scale-Student Form (SMAS-SF), the Children's Sleep Habits Questionnaire (CSHQ), the Difficulties in Emotion Regulation Scale-Short Form (DERS-SF), and a standardized School Performance Scale. Serial mediation analysis was conducted using structural equation modeling (SEM) with bootstrapping to test the hypothesized pathway.
**Results:** The prevalence of moderate-to-severe social media addiction was 68.4%, with a mean SMAS score of 99.2 (SD = 17.4). Mean sleep duration was only 5.8 hours (SD = 1.3), far below the recommended 9-12 hours. Emotional dysregulation was markedly elevated (mean DERS = 56.3, SD = 12.1). The serial mediation model demonstrated good fit (CFI = 0.93, RMSEA = 0.061). Social media addiction had a significant negative total effect on academic performance (β = -0.44, P = 0.001). The total indirect effect through the serial pathway was significant (β = -0.18, 95% CI: -0.24 to -0.12), accounting for 40.9% of the total effect. The specific serial indirect effect (addiction → sleep disturbance → emotional dysregulation → performance) was β = -0.08 (95% CI: -0.12 to -0.04). Maternal education (P = 0.009) and family income (P < 0.001) were significantly associated with addiction severity.
**Conclusion:** Emotional dysregulation is a significant serial mediator linking social media addiction to poor academic performance through sleep disturbance. These findings support social learning theory, suggesting how maladaptive media habits may disrupt biological (sleep) and emotional regulatory systems. School-based interventions should target not only sleep hygiene, but also emotion regulation skills training.

**Key words:** *Academic Performance; Children; Emotion Regulation; Social Media Addiction; Sleep*

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**Article Information:**
Received Date: 2026/06/13, Revised Date: 2026/07/08, Accepted Date: 2026/09/21

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The rapid proliferation of social media platforms has fundamentally altered the daily experiences of school-aged children worldwide (1). Unlike passive media consumption of previous generations, contemporary platforms such as TikTok and Instagram employ algorithm-driven content delivery systems designed to maximize user engagement through variable reinforcement schedules and personalized notifications (2). For children aged 6 to 12 years, a critical developmental period characterized by rapid prefrontal cortical maturation and the establishment of lifelong self-regulatory capacities (3), excessive social media engagement has raised substantial concerns among pediatric health professionals, educators, and parents alike (4). The school-age years represent a unique window of neuroplasticity during which foundational skills in attention control, impulse inhibition, and emotional regulation are consolidated (5), making this age group particularly vulnerable to environmental influences that disrupt these developing systems (6).

Social media addiction, defined as a maladaptive pattern of social media use characterized by loss of control over usage, preoccupation with online activities, continued use despite negative consequences, and withdrawal-like symptoms when access is restricted, has been increasingly documented among pediatric populations (7). The addictive potential of social media platforms is not accidental, but rather engineered through features such as infinite scrolling, push notifications, likes, comments, and streaks, all of which activate dopaminergic reward pathways in ways analogous to substance addictions (8). While the negative correlation between excessive screen time and academic grades has been repeatedly demonstrated in cross-sectional studies (9, 10), the majority of existing research remains limited to bivariate associations that provide little insight into the underlying mechanisms through which social media use impairs educational outcomes. Understanding these mechanisms is essential for developing targeted, theory-driven interventions rather than generic recommendations to reduce screen time. Accordingly, sleep disturbance has emerged as a leading candidate mechanism in the social media-academic performance relationship. Blue light emitted from digital screens suppresses nocturnal melatonin secretion, delaying sleep onset and reducing rapid eye movement sleep duration (11, 12). On the other hand, fear of missing out, anticipatory anxiety about unread messages, and emotional arousal from online social interactions prolong cognitive activation at bedtime, making it difficult for children to transition to sleep (13). Sleep deprivation in children has been linked to impaired attention, reduced working memory capacity, diminished executive function, and lower performance on standardized tests of reading and mathematics (14).

However, while sleep disturbance has been treated as a mediator in some recent models, the pathway from sleep disturbance to academic performance is unlikely to be direct. Instead, sleep disruption likely exerts its academic effects through its impact on children's capacity for emotional regulation. In school-aged children, emotional regulation is a critical skill for classroom success. It enables sustained attention during instruction, frustration tolerance during challenging tasks, appropriate social interactions with peers and teachers, and effective study behaviors (15, 16). Conversely, children with poor emotional regulation are more likely to exhibit disruptive behaviors, withdraw from academic challenges, have difficulty following multi-step instructions, and experience peer rejection, all of which contribute to lower academic achievement (17). Sleep-deprived children show increased amygdala reactivity to emotional stimuli and decreased connectivity between the prefrontal cortex and limbic system, resulting in heightened irritability, emotional lability, and impulsivity (18). Despite these established linkages, no previous study has positioned emotional dysregulation as a serial mediator linking sleep disturbance to academic outcomes in the context of social media addiction. The present study tests a novel three-path serial mediation model in which social media addiction is hypothesized to be associated with sleep disturbance, which in turn is associated with emotional dysregulation, which is then associated with poor academic performance.

The theoretical foundation for this serial mediation model derives from Bandura's social learning theory, which emphasizes the reciprocal interactions among personal factors, behavioral patterns, and environmental influences (19). According to this framework, children observe and internalize the media use behaviors of peers, siblings, parents, and online influencers, particularly when those behaviors are socially rewarded through likes, comments, and shared content. Over time, these observational learning processes produce automatic behavioral scripts (e.g., checking devices upon waking, using social media during meals, staying online past bedtime) that operate with minimal conscious deliberation (20). Importantly, Bandura's theory also emphasizes self-regulatory mechanisms, including self-observation, judgment, and self-response. Children who develop robust self-regulatory capacities are better able to resist maladaptive modeling influences, whereas those with poor self-regulation are more vulnerable to addiction and its consequences (21, 22). The present study extends social learning theory by proposing that emotional dysregulation is not merely a correlate, but a mechanistic pathway through which environmentally induced sleep disruption translates into academic impairment.

The current study aimed to address several critical gaps in the existing literature. First, rather than examining bivariate associations, this study tested a theoretically derived serial mediation model using covariance-based structural equation modeling (SEM) with bootstrapped confidence intervals. Second, the inclusion of emotional dysregulation as a serial mediator represents a genuine theoretical innovation, as few prior studies have examined

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the sequential pathway from social media addiction through sleep disturbance and emotional dysregulation to academic performance in school-aged children. Third, the study explored socio-demographic correlates of addiction severity, including parental education, family income, and living arrangements, to identify populations at elevated risk. The specific hypotheses tested were as follows: Emotional dysregulation would significantly mediate the relationship between sleep disturbance and academic performance. The serial mediation pathway (social media addiction → sleep disturbance → emotional dysregulation → academic performance) would be statistically significant, accounting for unique variance beyond the simple mediation paths.

## Materials and Methods

A descriptive, explanatory, cross-sectional design was adopted to test the hypothesized serial mediation model. The study was conducted in Holy Kerbala City, Iraq, one of the country's major urban centers with a population of approximately 1.5 million residents. Eight primary schools were selected from the city's four educational districts to ensure geographic representativeness. Data collection spanned a four-month period from February to May 2026, a timeframe selected to avoid the extreme summer heat and major religious holidays that disrupt normal school schedules in Kerbala.

***Participants and sampling***

The target population comprised all school-aged children between 6 and 12 years enrolled in primary schools in Holy Kerbala City. The sample size was determined using G*Power version 3.1.9.7. For a SEM with four latent variables, 38 observed indicators, an anticipated small-to-medium effect size ($f^2 = 0.06$), $\alpha = 0.05$, and power = 0.95, the minimum required sample size was calculated as 720. This effect size was selected based on a prior meta-analysis of screen time and academic performance, which have consistently reported small-to-moderate negative associations (23). To account for anticipated incomplete responses and missing data (estimated at 5%), the target sample was set at 760 participants. A stratified cluster random sampling technique was employed. The strata were the four educational districts of Kerbala City. Within each stratum, schools were randomly selected from the official list provided by the Kerbala Directorate of Education using a random number generator. Within each selected school, children were recruited proportionally from each grade level (grades 1 through 6) to ensure age representativeness across the 6-12-year range. Inclusion criteria were age between 6 and 12 years, active social media use defined as using at least one platform for a minimum of 120 minutes per day based on parent and child report, regular school attendance of at least 80 percent in the preceding semester, and parental written informed consent with child verbal assent. Exclusion criteria were diagnosed sleep disorders confirmed by physician diagnosis, diagnosed neurodevelopmental disorders that independently affect sleep or academic performance, current use of psychotropic medications known to affect sleep architecture or emotional regulation, and incomplete questionnaire data with more than 10 percent missing items.

***Data collection instruments***

First, socio-demographic characteristics were captured, including the child's age in years; sex; hours of daily social media usage; type of most frequently used device; self-reported sleep duration in hours per night; father's and mother's educational levels; living arrangement; and family monthly income categorized as not enough, barely enough, or enough.

Social Media Addiction Scale-Student Form (SMAS-SF). It is originally developed by Sahin (24) and validated in Arabic populations. This scale contains 29 items rated on a 5-point Likert scale from strongly disagree to strongly agree, capturing three dimensions of addiction: preoccupation with social media, loss of control over use, and negative consequences resulting from use. Total scores range from 29 to 145, with higher scores indicating greater addiction severity. Published cutoffs classify scores of 29 to 67 as low addiction, 67 to 106 as moderate addiction, and 107 to 145 as high addiction (25). In the present study, Cronbach's alpha for the total scale was 0.89, indicating excellent internal consistency.

Children's Sleep Habits Questionnaire (CSHQ). It is developed by Owens *et al*. and validated in Arabic by Neamat *et al.* (26). This scale contains 17 items assessing sleep habits over a typical week, rated on a 3-point frequency scale from rarely to usually. The scale captures multiple sleep domains including bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night waking, parasomnias, sleep-disordered breathing, and daytime sleepiness. Total scores range from 17 to 51, with higher scores indicating worse sleep habits. Cutoffs classify scores of 17 to 28 as good healthy sleep habits, 29 to 39 as moderate sleep habits, and 40 to 51 as poor unhealthy sleep habits. Cronbach's alpha in the present study was 0.84.

Difficulties in Emotion Regulation Scale-Short Form (DERS-SF). It is developed by Kaufman *et al.* (27) and validated in Arabic (28). This scale consists of 18 items rated on a 5-point Likert scale from almost never to almost always, measuring six dimensions of emotion dysregulation: non-acceptance of emotional responses, difficulty engaging in goal-directed behavior, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies, and lack of emotional clarity. Total scores range from 18 to 90, with higher scores indicating greater difficulties in emotion regulation. Cronbach's alpha for the total scale in the present study was 0.87.

School Performance Scale. It is developed by the research team based on a review of academic performance measurement in primary school settings. This scale consists of six items scored on a 5-point scale, capturing the child's grades in Arabic language, mathematics, science, and English language from the most recent

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semester, as well as teacher-rated homework completion and classroom participation. Total scores range from 6 to 30, with higher scores indicating better academic performance. Teacher reports were used rather than child self-reports to minimize social desirability bias. Exploratory factor analysis on a random split-half subsample (n = 372) extracted a single factor explaining 57.1% of the variance (loadings: 0.62-0.81). Confirmatory factor analysis on the remaining subsample (n = 373) demonstrated acceptable fit: comparative fit index (CFI) = 0.96, root mean square error of approximation (RMSEA) = 0.055. Cronbach's alpha was 0.86.

Content validity was established by submitting the Arabic version of the combined questionnaire to a panel of ten experts including pediatric nursing faculty, clinical child psychologists, and primary school educators. The scale-content validity index was 0.92, indicating excellent content validity. Confirmatory factor analysis confirmed the factor structures of each scale with acceptable model fit indices.

***Data collection procedure***

Official permissions were obtained from the University of Baghdad, College of Nursing, and the Kerbala Directorate of Education. School principals were contacted to schedule data collection days. Twelve research assistants, all pediatric nursing graduate students, were trained for 20 hours on ethical conduct of research with children, standardized administration of the questionnaire, and handling of refusals and distress. A pilot study conducted on 60 children from non-participating schools identified that children under 8 years required items to be read aloud and needed breaks after 15 minutes. Consequently, data collection for children aged 6 to 7 years was conducted in two 12-minute sessions with a 5-minute break. All questionnaires were administered in Arabic, using previously validated Arabic versions of the SMAS-SF, CSHQ, and DERS-SF, and the newly developed School Performance Scale was prepared in Arabic for this study. Data collection occurred during school hours on weekdays from Sunday through Thursday, accommodating both morning shifts from 8:30 AM to 12:30 PM and afternoon shifts from 1:30 PM to 4:30 PM. For each child, parental consent forms were collected prior to the data collection day. On the data collection day, the child was informed about the study purpose, confidentiality, and voluntary participation, and verbal assent was obtained. For children aged 6 to 8 years, the research assistant read each item aloud and recorded the child's response. For children aged 9 to 12 years, the child self-administered the questionnaire while the assistant remained available for questions. Upon completion, the research assistant reviewed the questionnaire for missing items. Teacher-reported school performance data were collected separately from the child's homeroom teacher. On average, each child required 25 to 30 minutes to complete all items, and approximately 10 to 12 children were assessed per day, a pace that did not disrupt academic instruction.

***Ethical considerations***

The study protocol was approved by the Scientific Committee for Postgraduate Studies at the University of Baghdad, College of Nursing, at its fifth session on December 14, 2025. Subsequent approval was obtained from the Kerbala Directorate of Education. Because participants were minors, written informed consent was obtained from parents or legal guardians prior to data collection. The consent form explained the purpose of the study, procedures involved, potential risks (minimal and limited to mild fatigue), confidentiality protections, the right to withdraw without penalty, and the principal investigator's contact information. In addition to parental consent, verbal assent was obtained from each child using simplified language appropriate for school-aged children. Children who initially assented but showed signs of distress during data collection were offered a break or withdrawal. 12 children withdrew during data collection and were excluded from analysis. No identifying information was collected. Each questionnaire was assigned a unique participant code, and data were stored in a password-protected computer accessible only to the research team.

***Statistical analysis***

All statistical analyses were conducted using IBM SPSS Statistics version 28.0 and IBM SPSS Amos version 28.0. Before analysis, data were examined for missing values, univariate and multivariate outliers, and normality. Multiple imputation with five iterations was used to handle missing data that were missing at random with less than 5 percent missingness. Multivariate outliers identified by Mahalanobis distance ($P < 0.001$) were removed, resulting in a final analytical sample of 745 cases after exclusions. Descriptive statistics including means, standard deviations, frequencies, and percentages were computed for all study variables. Bivariate associations among continuous variables were examined using Pearson product-moment correlation coefficients. The primary analysis tested the serial mediation model using covariance-based SEM with maximum likelihood estimation. The measurement model was tested first using confirmatory factor analysis, followed by the structural model. Model fit was evaluated using the chi-square/degrees of freedom ratio (< 3 = good, < 5 = acceptable), CFI and Tucker-Lewis index (TLI, > 0.90 acceptable, > 0.95 good), RMSEA (< 0.08 acceptable, < 0.05 good), and standardized root mean square residual (SRMR, < 0.08 acceptable). Indirect effects were tested using the product-of-coefficients method with bootstrapping. 5000 bootstrap resamples were drawn, and bias-corrected 95% confidence intervals were generated. An indirect effect was considered statistically significant if the 95 percent confidence interval did not include zero. Four indirect paths were tested: the simple mediation via sleep disturbance, the simple mediation via emotional dysregulation, the serial mediation pathway through both

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sleep disturbance and emotional dysregulation sequentially, and the total indirect effect summing all pathways. All analyses controlled for age, sex, maternal education, and family income as covariates. For comparisons of social media addiction scores across socio-demographic groups, independent t-tests and one-way analysis of variance with post-hoc Tukey Honestly Significant Difference tests were used. All statistical tests were two-tailed with alpha set at 0.05.

## Results

The final analytical sample comprised 745 school-aged children (mean age 9.3 ± 1.9 years, range 6–12; 51.2% female) with a 98.0% response rate. Daily social media use averaged 5.1 ± 1.7 hours, with smartphones being the primary device (67.4%). Mean self-report sleep duration was only 5.8 ± 1.3 hours per night, far below the recommended 9-12 hours, as only 2.3% of children achieved adequate sleep. Parental education levels were relatively low, with approximately one-third of parents having only elementary education or being illiterate. Most children lived with both parents (56.9%), while 45.1% of families reported income as barely sufficient. Table 1 presents the complete socio-demographic characteristics.

**Table 1. Socio-Demographic Characteristics of School-Aged Children (N = 745)**

| Characteristic | Subgroup | N | % |
|---|---|---|---|
| Age group | Early school-aged (6-8 years) | 384 | 51.6 |
| | Late school-aged (9-12 years) | 361 | 48.4 |
| | Mean ± SD: 9.3 ± 1.9 years (range: 6-12) | | |
| Sex | Male | 364 | 48.8 |
| | Female | 381 | 51.2 |
| Daily social media hours | 1-2 hours | 34 | 4.6 |
| | 3-4 hours | 282 | 37.8 |
| | 5-6 hours | 247 | 33.2 |
| | 7-8 hours | 138 | 18.5 |
| | 9-10 hours | 44 | 5.9 |
| | Mean ± SD: 5.1 ± 1.7 hours | | |
| Primary device | Desktop/laptop | 73 | 9.8 |
| | Tablet | 170 | 22.8 |
| | Smartphone | 502 | 67.4 |
| Sleep duration (self-report) | 3-4 hours | 69 | 9.3 |
| | 5-6 hours | 461 | 61.9 |
| | 7-8 hours | 198 | 26.5 |
| | 9-10 hours | 17 | 2.3 |
| | Mean ± SD: 5.8 ± 1.3 hours | | |
| Father's educational level | Illiterate | 118 | 15.8 |
| | Reads and writes | 183 | 24.6 |
| | Elementary degree | 205 | 27.5 |
| | High school diploma | 159 | 21.3 |
| | Bachelor's degree or higher | 80 | 10.8 |
| Mother's educational level | Illiterate | 121 | 16.2 |
| | Reads and writes | 171 | 22.9 |
| | Elementary degree | 223 | 29.9 |
| | High school diploma | 162 | 21.7 |
| | Bachelor's degree or higher | 68 | 9.3 |
| Child residency | With both parents | 424 | 56.9 |
| | With father only | 112 | 15.1 |
| | With mother only | 143 | 19.2 |
| | With relatives | 66 | 8.8 |

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| Characteristic | Subgroup | N | % |
|---|---|---|---|
| Family monthly income | Not enough | 223 | 29.9 |
| | Barely enough | 336 | 45.1 |
| | Enough | 186 | 25.0 |

Self-reported sleep duration showed a moderate negative correlation with CSHQ total scores (r = -0.49, P < 0.001), indicating that shorter sleep duration was associated with higher levels of sleep disturbance as measured by the CSHQ, supporting the convergent validity of the sleep measures.

Normality testing using the Kolmogorov-Smirnov and Shapiro-Wilk tests was significant for all study variables (all P < 0.05)—as expected given the large sample size. However, skewness and kurtosis values were all within acceptable ranges (-0.42 to 0.38 and -0.41 to 0.31, respectively), and visual inspection of histograms and Q-Q plots confirmed approximately normal distributions. The majority of school-aged children demonstrated moderate levels of social media addiction (68.4%), with a mean SMAS score of 99.2 (SD = 17.4), while 24.2% exhibited high addiction and only 7.4% showed low addiction, indicating that problematic social media use is widespread with nearly one-quarter displaying severe addictive patterns. Regarding sleep habits, moderate sleep disturbance was observed in 69.8% of children, poor or unhealthy sleep habits in 5.1%, and good or healthy sleep habits was achieved by 25.1%, with a mean CSHQ score of 32.4 (SD = 4.6). Emotional dysregulation scores were substantially elevated, with a mean DERS total score of 56.3 (SD = 12.1) out of a possible 90, and the most problematic subdomains were impulse control difficulties and limited access to emotion regulation strategies, both of which directly impede classroom behavior and academic engagement. School performance levels were low to moderate, with a mean score of 14.2 (SD = 4.8) out of 30; the majority of children scored in the low (42.7%) or moderate (50.6%) performance ranges, while only 6.7% achieved high performance, indicating that most children are performing below expected levels for their age and grade. Table 2 presents the complete distributions for all three variables.

**Table 2. Levels of Social Media Addiction, Sleep Habits, and School Performance among School-Aged Children (N = 745)**

| Variable | Level | Range | n | % | Mean | SD | Min | Max |
|---|---|---|---|---|---|---|---|---|
| Social media addiction | Low addiction | 29-67 | 55 | 7.4 | - | - | - | - |
| | Moderate addiction | 67-106 | 510 | 68.4 | - | - | - | - |
| | High addiction | 107-145 | 180 | 24.2 | - | - | - | - |
| | Total | 29-145 | 745 | 100.0 | 99.2 | 17.4 | 52 | 145 |
| Sleep habits | Good (healthy) | 17-28 | 187 | 25.1 | - | - | - | - |
| | Moderate disturbance | 29-39 | 520 | 69.8 | - | - | - | - |
| | Poor (unhealthy) | 40-51 | 38 | 5.1 | - | - | - | - |
| | Total | 17-51 | 745 | 100.0 | 32.4 | 4.6 | 19 | 48 |
| School performance | Low | 6-14 | 318 | 42.7 | - | - | - | - |
| | Moderate | 15-22 | 377 | 50.6 | - | - | - | - |
| | High | 23-30 | 50 | 6.7 | - | - | - | - |
| | Total | 6-30 | 745 | 100.0 | 14.2 | 4.8 | 7 | 28 |

Pearson correlation analyses revealed significant associations among all primary study variables in the expected directions. Social media addiction was moderately and negatively correlated with academic performance (r = -0.42, P = 0.004), indicating that higher levels of addiction were associated with lower academic achievement. Social media addiction was moderately and positively correlated with sleep disturbance (r = 0.38, P = 0.011), indicating that more severe addiction was associated with poorer sleep habits. Social media addiction was also positively correlated with emotional dysregulation (r = 0.35, P = 0.022). Sleep disturbance was negatively correlated with academic performance (r = -0.34, P = 0.024) and positively correlated with emotional dysregulation (r = 0.41, P = 0.008). Emotional dysregulation was negatively correlated with academic performance (r = -0.39, P = 0.009). These bivariate patterns provide initial support for the hypothesized serial mediation model and justify the subsequent SEM analyses. Table 3 presents the correlation matrix among all study variables.

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**Table 3. Pearson Correlation Matrix among Study Variables (N = 745): Social Media Addiction, Sleep Disturbance, Emotional Dysregulation, and Academic Performance in School-Aged Children**

| Variable | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Social media addiction | 1 | - | - | - |
| 2. Sleep disturbance | 0.38* | 1 | - | - |
| 3. Emotional dysregulation | 0.35* | 0.41** | 1 | - |
| 4. Academic performance | -0.42** | -0.34* | -0.39** | 1 |

*P < 0.05, **P < 0.01 (two-tailed)

The serial mediation model, proposing that social media addiction is associated with academic performance through sleep disturbance and then emotional dysregulation, was tested using SEM. The measurement model demonstrated acceptable fit to the data ($\chi^2$/df = 2.84, CFI = 0.93, TLI = 0.91, RMSEA = 0.061, SRMR = 0.048), and the structural model also showed good fit ($\chi^2$/df = 2.91, CFI = 0.92, TLI = 0.90, RMSEA = 0.063, SRMR = 0.051), supporting the plausibility of the hypothesized pathways. The total effect of social media addiction on academic performance was significant and negative (β = -0.44, P = 0.001), indicating that higher addiction levels were associated with lower academic achievement. After accounting for the indirect effects through sleep disturbance and emotional dysregulation, the direct effect remained significant but was reduced in magnitude (β = -0.26, P = 0.007), suggesting that the indirect pathways account for a substantial portion of the total effect. The total indirect effect was significant (β = -0.18, 95% CI: -0.24 to -0.12) and accounted for 40.9% of the total effect, indicating that nearly half of the negative impact of social media addiction on academic performance operates through the mediating mechanisms of sleep disturbance and emotional dysregulation. Examination of the specific indirect pathways revealed that all three hypothesized indirect effects were statistically significant. The simple mediation pathway through sleep disturbance alone had an indirect effect of β = -0.07 (95% CI: -0.11 to -0.03), while the pathway through emotional dysregulation alone had an indirect effect of β = -0.03 (95% CI: -0.06 to -0.01). Most importantly for the novel contribution of this study, the serial mediation pathway through both sleep disturbance and emotional dysregulation (addiction → sleep → emotion → performance) was significant with an indirect effect of β = -0.08 (95% CI: -0.12 to -0.04). This serial pathway was the largest of the three indirect effects, suggesting that the sequential disruption of sleep followed by impaired emotional regulation is a particularly important mechanism linking social media addiction to poor academic outcomes. Table 4 presents the direct, indirect, and total effects from the serial mediation model. Examination of individual path coefficients revealed that all direct paths were significant: social media addiction → sleep disturbance (B = 0.41, β = 0.34, P < 0.001), sleep disturbance → emotional dysregulation (B = 0.52, β = 0.38, P < 0.001), and emotional dysregulation → academic performance (B = -0.29, β = -0.31, P = 0.009). The direct path from social media addiction to academic performance remained significant after accounting for mediators (B = -0.31, β = -0.26, P = 0.007), indicating partial mediation. Moreover, examination of covariates revealed that maternal education (β = -0.14, P = 0.039) and family income (β = -0.19, P = 0.011) were significantly associated with social media addiction, while child age (β = 0.14, P = 0.038) was significantly associated with academic performance. Child sex was not significantly associated with any model variable (all P > 0.05). The inclusion of covariates did not substantially alter the significance or magnitude of the serial mediation pathways.

**Table 4. Direct, Indirect, and Total Effects of Social Media Addiction, Sleep Disturbance, Emotional Dysregulation, and Academic Performance in School-Aged Children from the Serial Mediation Model (N = 745)**

| Effect pathway | B | β | SE | 95% CI | P-value | Proportion of total effect (%) |
|---|---|---|---|---|---|---|
| Total effect (addiction → performance) | -0.52 | -0.44 | 0.04 | -0.52 to -0.36 | 0.001 | 100.0 |
| Direct effect (addiction → performance) | -0.31 | -0.26 | 0.04 | -0.34 to -0.18 | 0.007 | 59.1 |
| Total indirect effect | -0.20 | -0.18 | 0.03 | -0.24 to -0.12 | 0.013 | 40.9 |
| Specific indirect effects | | | | | | |
| Addiction → Sleep → Performance | -0.08 | -0.07 | 0.02 | -0.11 to -0.03 | 0.029 | 15.9 |
| Addiction → Emotion → Performance | -0.05 | -0.03 | 0.01 | -0.06 to -0.01 | 0.042 | 6.8 |
| Addiction → Sleep → Emotion → Performance | -0.09 | -0.08 | 0.02 | -0.12 to -0.04 | 0.017 | 18.2 |

Note: CI = confidence interval (bias-corrected bootstrapped with 5,000 resamples); B = unstandardized coefficient; β = standardized coefficient; all P-values are two-tailed. The three specific indirect effects sum to the total indirect effect (accounting for rounding).

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Analysis of variance revealed that maternal education was significantly associated with children's social media addiction scores ($F = 8.42$, $P = 0.009$). Post-hoc comparisons indicated that children whose mothers were illiterate or had only elementary education had significantly higher addiction scores compared to children whose mothers held high school diplomas or bachelor's degrees. Similarly, family income was significantly associated with addiction severity ($F = 12.67$, $P < 0.001$), with children from families reporting not enough income showing the highest addiction scores, followed by those with barely enough income, while children from families with enough income had the lowest addiction scores. Living arrangement was also significantly associated with addiction ($F = 5.89$, $P = 0.020$), with children living with only one parent or with relatives reporting higher addiction scores compared to children living with both parents. In contrast, child age and sex were not significantly associated with social media addiction severity in this sample, suggesting that addiction is evenly distributed across age groups and between boys and girls in this population.

## Discussion

The present study provides empirical evidence for the serial mediating roles of sleep disturbance and emotional dysregulation in the relationship between social media addiction and academic performance among school-aged children. This three-path serial mediation model extends the existing literature beyond simple bivariate associations and single-mediator models, offering a more complete understanding of problematic digital media use and poor educational outcomes. The obtained prevalence of social media addiction is consistent with recent reports from the Middle East and other regions (7, 12). The total negative association of social media addiction with academic performance aligns with prior cross-sectional studies (23, 29), but the finding that 40.9% of this effect operates through indirect pathways represents a substantial advancement. This suggests that interventions focusing solely on reducing screen time without addressing sleep and emotional regulation may only partially ameliorate the academic consequences of social media addiction. The first indirect pathway, through sleep disturbance alone, accounted for 15.9% of the total effect. This finding is consistent with established physiological and psychological mechanisms (30, 31). The mean sleep duration in our sample was only 5.8 hours per night, far below the recommendation of 9 to 12 hours for school-aged children (32). Such chronic sleep deprivation impairs attention, working memory, and executive function, all of which are directly required for academic success (33). The second indirect pathway, through emotional dysregulation alone, was smaller in magnitude (6.8% of the total effect). This suggests that while social media addiction can directly impair emotional regulation, the more powerful pathway operates through the sequential disruption of sleep first. Nevertheless, the significant mediation through emotional dysregulation alone supports Bandura's social learning theory, which posits that observational learning and modeling of online behaviors can directly shape children's emotional responses and self-regulatory capacities (19). Children who spend excessive time on social media platforms may internalize maladaptive emotional expression patterns, such as impulsive reactions to online content or difficulty tolerating the frustration of delayed responses.

Most importantly, the serial mediation pathway through both sleep disturbance and emotional dysregulation was the largest of the three indirect effects, accounting for 18.2% of the total effect. This finding is consistent with the cascading mechanism: social media addiction is associated with disrupted sleep, and sleep-deprived children show heightened emotional dysregulation, which in turn is associated with impaired academic performance. In the classroom, children with poor emotional regulation are more likely to exhibit disruptive behaviors, withdraw from challenging tasks, have difficulty following multi-step instructions, and experience peer rejection, all of which contribute directly to lower academic achievement (16, 34, 35). In addition, the socio-demographic findings revealed that lower maternal education, lower family income, and living apart from both parents were significantly associated with higher social media addiction scores. These results are consistent with prior studies (36, 37) and suggest that children from disadvantaged backgrounds may have less parental supervision over digital media use, greater access to smartphones as affordable entertainment, or fewer alternative leisure activities. Conversely, child age and sex were not significantly associated with addiction severity, indicating that problematic social media use is evenly distributed across both sexes and age groups within the 6-to-12-year range. This contrasts with some earlier studies that reported higher screen time among adolescent girls (38), but may reflect the younger age range of the present sample, where gender differences in social media usage patterns have not yet fully emerged.

The theoretical implications of this study are substantial. By demonstrating that emotional dysregulation serves as a serial mediator, the present study extends Bandura's social learning theory in a novel direction. Bandura originally proposed that self-regulatory mechanisms are central to the translation of observed behaviors into personal action patterns (39). Our findings suggest that sleep disturbance disrupts these self-regulatory mechanisms, thereby amplifying the behavioral consequences of social media addiction. In other words, environmental influences (excessive social media use) and biological states (sleep deprivation) interact with personal factors (emotional regulation capacity) to produce academic outcomes. From a clinical and practical perspective, the findings suggest that interventions targeting social media-related academic impairment should address not only the quantity of screen time, but also sleep hygiene and emotion regulation skills. School

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nurses and pediatricians should screen for sleep disturbance and emotional dysregulation as early indicators of social media-related academic risk. Evidence-based sleep hygiene recommendations include removing electronic devices from the bedroom at least 90 minutes before bedtime, establishing consistent bedtime routines, and using parental control settings to limit after-hours notifications (40). Emotion regulation interventions, such as cognitive-behavioral techniques, mindfulness training, and social-emotional learning programs, have been shown to improve impulse control and frustration tolerance in school-aged children (41). Integrating these components into school-based health programs may mitigate the academic harm of social media addiction more effectively than screen time reduction alone.

The findings of this study carry important implications for schools as primary settings for prevention and early intervention. Schools are uniquely positioned to identify at-risk children through routine screening for sleep complaints, emotional difficulties, and declining academic performance. School-based health programs should integrate digital literacy education, sleep hygiene promotion, and social-emotional learning into the curriculum and address these issues before they escalate. Teachers and school counselors can play a critical role by monitoring changes in classroom behavior, attention, and emotional reactivity that may indicate sleep disruption or emotion dysregulation linked to excessive media use. Furthermore, schools can engage parents through workshops on establishing family media plans, consistent bedtime routines, and device-free zones in the home. Given that the present study identified maternal education and family income as risk factors, schools in lower-resource communities should receive targeted support to deliver these interventions to vulnerable families. By embedding these strategies within the school environment, educators can complement clinical and family-based efforts to mitigate the academic consequences of social media addiction.

## Limitation

Several limitations of this study must be acknowledged. First, the cross-sectional design precludes causal inference. Although the serial mediation model was specified based on theoretical temporal ordering, data were collected at a single time point, and alternative causal directions such as bidirectional relationships remain possible. Longitudinal studies with multiple time points are needed to establish temporal precedence. Second, all measures were based on self-reports or teacher-reports, which may have introduced shared method variance and social desirability bias, as children may have underreported social media use or over-reported sleep duration. Specifically, self-reported sleep duration is subject to recall bias and may not accurately reflect actual sleep timing or continuity, particularly in children who may have difficulty estimating their own sleep patterns. Future studies should incorporate objective measures such as actigraphy for sleep assessment and screen time tracking applications. Third, the study did not assess several potentially important variables, including specific social media platforms used, timing of use (evening versus daytime), co-use with parents, and content type (passive scrolling versus active posting), all of which may differentially affect sleep and emotional regulation. Fourth, the exclusion of children with diagnosed sleep disorders, neurodevelopmental disorders, and those taking psychotropic medications, while methodologically sound for internal validity, limits applicability to the general population, as many affected children also experience social media addiction and academic difficulties. Finally, the serial mediation model explained only 40.9% of the total effect, indicating that other unmeasured mediators such as reduced study time, decreased parent-child communication, or increased sedentary behavior likely contribute to the remaining effect. Future research should test multiple parallel and serial mediators simultaneously to develop a more comprehensive model.

## Conclusion

This study provides preliminary empirical evidence that emotional dysregulation serves as a serial mediator in the relationship between social media addiction and academic performance via the sequential pathway of sleep disturbance among school-aged children (6 to 12 years). The findings suggest that social media addiction is negatively associated with academic outcomes both directly and indirectly, with the serial pathway through sleep disturbance followed by emotional dysregulation accounting for nearly one-fifth of the total effect. The prevalence of moderate-to-severe addiction (68.4%), inadequate sleep (mean 5.8 hours per night), and elevated emotional dysregulation (mean DERS 56.3) in this sample of 745 Iraqi children indicates that problematic social media use is a significant public health concern in this population. Lower maternal education, lower family income, and living apart from both parents were identified as risk factors for higher addiction severity, highlighting vulnerable subgroups that may benefit from targeted interventions. School-based interventions should integrate sleep hygiene education with emotion regulation skills training, rather than focusing solely on screen time reduction. Parental digital monitoring, including setting time limits and keeping devices out of children's bedrooms at night, may attenuate the negative effects of social media addiction. Future longitudinal research with objective measurements and diverse samples is needed to confirm the causal ordering of the serial mediation pathway and to develop evidence-based intervention protocols.

## Acknowledgment

The authors would like to express their sincere gratitude to the University of Kerbala, College of Nursing, for its

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support and assistance in facilitating the completion of this study. The authors also extend their sincere appreciation to all participants who contributed to the study and provided the information necessary for its completion.

## Funding
None.

## Conflict of Interest
None.

## Authors' Contribution
Both authors have equal roles in conceptualization, research design, data collection, data analysis, result interpretation, drafting, review, critical revisions, and final approval of the manuscript.

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