KMAN PUBLISHING INSTITUTE
Journal Website

Article history:
Received 26 September 2025
Revised 26 November 2025
Accepted 07 December 2025
Published online 10 January 2026

Journal of Adolescent and Youth Psychological Studies

Volume 7, Issue 1, pp 1-10

E-ISSN: 2981-2526

Deep Learning Prediction of Emotional Dysregulation in Adolescents Based on Social Media Use Patterns, Sleep Quality, and Parental Attachment Styles

Arman. Hovhannisyan[1], Daniela. Restrepo[2*], Nino. Tsiklauri[3]

[1] Department of Cognitive Psychology, Yerevan State University, Yerevan, Armenia
[2] Department of Social Psychology, Universidad de Antioquia, Medellín, Colombia
[3] Department of Clinical Psychology, Tbilisi State University, Tbilisi, Georgia

*** Corresponding author email address**: daniela.restrepo@udea.edu.co

A r t i c l e I n f o

Article type:
Original Research

How to cite this article:
Hovhannisyan, A., Restrepo, D., & Tsiklauri, N. (2026). Deep Learning Prediction of Emotional Dysregulation in Adolescents Based on Social Media Use Patterns, Sleep Quality, and Parental Attachment Styles. *Journal of Adolescent and Youth Psychological Studies, 7*(1), 1-10. http://dx.doi.org/10.61838/kman.jayps.4988

A B S T R A C T

Objective: The objective of this study was to develop and validate a deep learning model for predicting emotional dysregulation in Colombian adolescents using social media use patterns, sleep quality, and parental attachment styles.

Methods and Materials: This quantitative, cross-sectional predictive study was conducted among 842 adolescents aged 13–18 years from secondary schools in Bogotá, Medellín, and Cali, Colombia. Participants completed standardized measures of emotional dysregulation, sleep quality, and parental attachment, and objective social media usage metadata were collected via smartphone monitoring over a 14-day period. Data were preprocessed and analyzed using a hybrid convolutional neural network–long short-term memory (CNN–LSTM) architecture. Model performance was evaluated using mean absolute error, root mean square error, coefficient of determination, area under the receiver operating characteristic curve, and classification accuracy. Explainable artificial intelligence techniques were applied to determine the relative importance of predictors.

Findings: The deep learning model demonstrated high predictive performance ($R^2 = .79$; RMSE = 5.37; AUC = .91; classification accuracy = 87.6%). Emotional dysregulation was significantly associated with social media use ($r = .58$, $p < .001$), sleep quality ($r = .62$, $p < .001$), and parental attachment ($r = -.55$, $p < .001$). Feature importance analysis identified sleep quality (32.4%), nocturnal screen exposure (21.8%), emotional dependency on social media (18.6%), parental attachment security (15.3%), and daily social media duration (11.9%) as the most influential predictors.

Conclusion: The findings indicate that emotional dysregulation in adolescence is strongly shaped by the interaction of digital behavior, sleep processes, and attachment relationships, and that deep learning models offer a powerful tool for early identification of adolescents at elevated emotional risk.

Keywords: *adolescent mental health; emotional dysregulation; deep learning; social media use; sleep quality; parental attachment; predictive modeling*

1. Introduction

Adolescence represents a critical developmental stage characterized by rapid neurobiological maturation, expanding social networks, and heightened emotional sensitivity. During this period, the capacity for emotional regulation plays a central role in shaping mental health trajectories, interpersonal functioning, academic success, and long-term psychosocial adjustment. Emotional dysregulation, defined as persistent difficulties in monitoring, evaluating, and modulating emotional responses in accordance with situational demands, has been identified as a core transdiagnostic vulnerability factor underlying a wide spectrum of adolescent psychopathology, including mood disorders, anxiety disorders, impulsivity, self-injurious behavior, and interpersonal dysfunction (Carvalho et al., 2023; Herdaetha et al., 2025; Hong et al., 2024). Understanding the mechanisms that contribute to emotional dysregulation during adolescence is therefore of paramount importance for prevention, early identification, and intervention.

Contemporary adolescence unfolds within a profoundly altered social ecology shaped by ubiquitous digital technologies and constant connectivity. Social media platforms have become deeply embedded in adolescents' daily routines, identity development, peer interactions, and emotional lives. While digital communication offers opportunities for social connection and self-expression, growing evidence indicates that excessive and dysregulated social media engagement is associated with increased emotional instability, depressive symptoms, anxiety, impulsivity, sleep disturbance, and impaired self-regulation (Khalaf et al., 2023; Marano et al., 2025; Tan & Fauzi, 2024; Yuan, 2025). Neurodevelopmental research suggests that the adolescent brain, still undergoing maturation of executive control networks and emotion regulation systems, may be particularly vulnerable to the cognitive and emotional demands imposed by continuous online stimulation (Yuan, 2025). These vulnerabilities are further amplified when digital behaviors disrupt sleep patterns and undermine fundamental biological rhythms essential for emotional homeostasis.

Sleep quality constitutes one of the most robust physiological foundations of emotional regulation. Adolescents experience natural circadian phase delays while simultaneously facing early school start times, academic pressures, and expanding digital engagement. As a result, chronic sleep deprivation and irregular sleep patterns have become widespread among youth populations. Empirical evidence consistently demonstrates that insufficient and poor-quality sleep is associated with heightened emotional reactivity, reduced frustration tolerance, impaired executive control, and increased susceptibility to mood disorders (Alvarado & Palmer, 2025; Kinsella & Chin, 2024; Xie & Feeney, 2024). Mechanistic models indicate that sleep disruption compromises prefrontal-limbic connectivity, thereby weakening top-down regulation of emotional responses and intensifying affective volatility (Kinsella & Chin, 2024; Xie & Feeney, 2024). Importantly, emerging research highlights that the relationship between sleep quality and emotional functioning is not merely linear but is dynamically intertwined with adolescents' social environments and attachment relationships (Alvarado & Palmer, 2025; Xie & Feeney, 2024).

Attachment theory provides a powerful framework for understanding the socioemotional foundations of regulation across development. Secure parental attachment fosters the internalization of adaptive emotion regulation strategies, while insecure attachment patterns are associated with heightened emotional reactivity, poor impulse control, maladaptive coping, and increased vulnerability to psychopathology (Chen, 2023; Ginalska & Cichopek, 2024; Hong et al., 2024; Salavou & Giannakopoulos, 2024). Longitudinal and neurobiological evidence demonstrates that early attachment experiences shape the development of regulatory neural circuits and stress response systems that remain influential throughout adolescence (Chen, 2023; Rogers et al., 2022). Adolescents with insecure attachment frequently exhibit difficulties in managing negative affect, resolving interpersonal stress, and sustaining emotional equilibrium, particularly in the context of peer conflict and romantic relationships (Bhau et al., 2025; Huang, 2025; Zhou, 2025).

Recent studies further indicate that parental attachment interacts with adolescents' engagement in digital environments. Adolescents with insecure attachment profiles are more likely to develop emotional dependency on online relationships, compulsive social media use, and heightened sensitivity to social feedback (Asniah, 2025; Berlianza & Pramono, 2025; Ricciardone et al., 2025). Such patterns may function as compensatory strategies for unmet relational needs but ultimately exacerbate emotional dysregulation and psychological vulnerability (Asniah, 2025; Berlianza & Pramono, 2025). Moreover, parental attachment influences adolescents' sleep quality through emotional security, daily routines, and the regulation of

JAYPS E-ISSN: 2981-2526

bedtime behaviors, further integrating relational and biological pathways of emotional functioning (Alvarado & Palmer, 2025; Hong et al., 2024).

The convergence of social media use, sleep quality, and parental attachment thus represents a complex, multidimensional system influencing adolescent emotional regulation. Traditional statistical approaches, while valuable, face limitations in modeling such nonlinear, high-dimensional interactions. Advances in artificial intelligence and deep learning offer transformative opportunities to capture these complex relationships and generate highly accurate predictive models of emotional dysregulation. Deep learning architectures, particularly hybrid convolutional and recurrent neural networks, have demonstrated exceptional capacity to integrate heterogeneous data sources, detect subtle behavioral patterns, and model temporal dependencies in psychological processes (Liao, 2025; Yuan, 2025; Zhou, 2025).

In the context of adolescent mental health, machine learning approaches enable the synthesis of self-report data, behavioral metrics, and physiological indicators to identify latent risk profiles with greater precision than conventional methods. Recent research has applied advanced computational techniques to examine digital behavior patterns, emotional expression, and relational dynamics, revealing predictive markers of psychological risk that were previously inaccessible (Marano et al., 2025; Ricciardone et al., 2025; Zhen & Tang, 2024). Importantly, explainable artificial intelligence techniques now permit transparent interpretation of model outputs, allowing researchers and clinicians to understand how specific factors such as sleep disruption, social media dependency, and attachment insecurity contribute to emotional dysregulation (Liao, 2025; Valenta et al., 2025).

Cross-cultural considerations further underscore the necessity of this research. Emotional regulation is shaped by sociocultural norms, family structures, and technological environments that vary across regions. Latin American adolescents, including those in Colombia, navigate unique combinations of collectivistic family values, socioeconomic disparities, and rapidly evolving digital ecosystems. While research on adolescent emotional regulation and digital behavior has expanded globally, substantial gaps remain regarding how these processes unfold within Latin American contexts and how they interact with culturally specific attachment patterns and family dynamics (Leal et al., 2023; Maya et al., 2023; Tuazzara, 2025). Psychometric research confirms the validity of attachment measures in adolescents with behavioral problems across diverse cultural settings, highlighting the relevance of attachment processes within Latin American populations (Leal et al., 2024a, 2024b; Maya et al., 2023).

Moreover, emerging clinical evidence indicates that dysregulated emotional processes in adolescence contribute to serious outcomes including impulsivity, self-injury, academic disengagement, and long-term psychiatric morbidity (Carvalho et al., 2023; Herdaetha et al., 2025; Rosharudin et al., 2023). These outcomes impose significant burdens on families, educational systems, and public health infrastructures. Identifying adolescents at elevated risk through early, precise prediction is therefore a critical priority.

Despite the growing literature on individual predictors of adolescent emotional dysregulation, few studies have integrated social media behavior, sleep quality, and parental attachment into a unified predictive framework using advanced deep learning methodologies. Even fewer have applied such approaches within Latin American populations. Addressing this gap offers substantial theoretical and practical benefits: theoretically, by advancing understanding of how biological, relational, and digital systems co-construct emotional regulation; practically, by informing data-driven screening, prevention, and intervention strategies.

In this context, the present study proposes an innovative computational model to predict emotional dysregulation among Colombian adolescents by integrating social media use patterns, sleep quality indicators, and parental attachment styles through a hybrid deep learning architecture. By combining psychological theory, developmental neuroscience, and artificial intelligence, this research aims to contribute both methodological advancement and clinically actionable insight to the field of adolescent mental health.

The aim of this study was to develop and validate a deep learning model for predicting emotional dysregulation in Colombian adolescents based on social media use patterns, sleep quality, and parental attachment styles.

2. Methods and Materials

2.1. Study Design and Participants

The present study employed a quantitative, predictive, cross-sectional design with a correlational framework to examine the capability of deep learning models to predict emotional dysregulation in adolescents based on social

JAYPS
E-ISSN: 2981-2526

media use patterns, sleep quality, and parental attachment styles. The target population consisted of adolescents enrolled in public and private secondary schools in three major urban regions of Colombia, including Bogotá, Medellín, and Cali. A multistage cluster sampling strategy was utilized to ensure adequate geographic and socioeconomic representation. Initially, schools were randomly selected from official registries of the Colombian Ministry of Education, followed by the random selection of classrooms within each school. All students aged 13 to 18 years who met the inclusion criteria were invited to participate. Inclusion criteria comprised enrollment in grades 7 through 11, regular access to a smartphone and at least one social media platform, and the ability to complete online questionnaires independently. Adolescents with diagnosed neurological disorders, severe cognitive impairments, or current psychiatric hospitalization were excluded from the study.

A total sample of 842 adolescents participated in the study, of whom 51.4% were female and 48.6% were male, with a mean age of 15.6 years (SD = 1.42). Prior to data collection, written informed consent was obtained from parents or legal guardians, and assent was obtained from all participating adolescents. Data were collected during the 2025 academic year through a secure online research platform administered within school computer laboratories under the supervision of trained research assistants.

2.2. *Measures*

Emotional dysregulation, the primary outcome variable, was measured using the Difficulties in Emotion Regulation Scale–Short Form (DERS-SF), a widely validated instrument for adolescent populations. The scale assesses six dimensions of emotional regulation difficulties, including nonacceptance of emotional responses, difficulties engaging in goal-directed behavior, impulse control difficulties, lack of emotional awareness, limited access to regulation strategies, and lack of emotional clarity. Responses were recorded on a five-point Likert scale, with higher scores indicating greater emotional dysregulation. The Spanish adaptation of the DERS-SF, previously validated in Colombian adolescents, demonstrated strong internal consistency in the present sample (Cronbach's $\alpha = .91$).

Social media use patterns were assessed using a composite measurement battery developed for this study, integrating behavioral frequency metrics and psychological engagement indicators. The instrument captured daily time spent on social media platforms, frequency of platform switching, nocturnal usage, compulsive checking behaviors, emotional dependency on social feedback, and exposure to emotionally charged content. Participants also consented to the passive collection of smartphone usage metadata through a custom mobile application that recorded objective indicators of application usage duration, number of unlocks, and nighttime screen exposure over a 14-day monitoring period.

Sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI), which measures subjective sleep quality across seven domains including sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Higher PSQI global scores indicate poorer sleep quality. The Spanish version of the PSQI demonstrated excellent reliability in the present sample (Cronbach's $\alpha = .88$).

Parental attachment styles were measured using the Inventory of Parent and Peer Attachment–Revised (IPPA-R), specifically the parent attachment subscale. This instrument assesses perceived parental trust, communication quality, and alienation. Higher scores reflect more secure attachment representations. The IPPA-R exhibited strong internal consistency in the current study (Cronbach's $\alpha = .90$).

Demographic variables including age, gender, socioeconomic status, academic grade level, family structure, and urban versus suburban residence were collected using a standardized demographic questionnaire.

2.3. *Data Analysis*

Data preprocessing involved missing value imputation using multivariate imputation by chained equations, normalization of continuous variables via z-score standardization, and categorical variable encoding using one-hot techniques. Social media metadata were aggregated into behavioral features, including daily usage variability, nocturnal exposure index, and emotional reactivity coefficients derived from temporal interaction patterns.

The primary analytic framework employed deep learning architectures for predictive modeling. A hybrid neural network combining convolutional neural networks (CNN) and long short-term memory (LSTM) layers was constructed to model both static psychosocial features and temporal behavioral sequences. The dataset was randomly partitioned into training (70%), validation (15%), and test (15%) subsets. Model optimization was conducted using the Adam

JAYPS
E-ISSN: 2981-2526

optimizer with early stopping criteria based on validation loss. Model performance was evaluated using multiple metrics, including mean absolute error (MAE), root mean square error (RMSE), coefficient of determination (R^2), and area under the receiver operating characteristic curve (AUC) for high-risk emotional dysregulation classification.

To enhance model interpretability, Shapley Additive Explanations (SHAP) were applied to identify the relative contribution of social media usage, sleep quality indicators, and parental attachment dimensions to emotional dysregulation predictions. Traditional statistical analyses including Pearson correlations and hierarchical regression were conducted using SPSS 29 to validate machine learning findings and examine theoretical consistency.

All analyses were conducted using Python 3.11 with TensorFlow and PyTorch frameworks. Statistical significance for classical analyses was set at $p < .05$.

3. Findings and Results

The results section begins with a comprehensive descriptive analysis of the study variables and participant characteristics. Table 1 presents the demographic profile of the Colombian adolescent sample and the descriptive statistics for the primary study variables, providing the foundation for subsequent inferential and machine learning analyses.

Table 1

Demographic Characteristics and Descriptive Statistics of Study Variables (N = 842)

Variable	Category / Statistic	Value
Gender	Female	51.4%
	Male	48.6%
Age (years)	Mean (SD)	15.6 (1.42)
Residence	Urban	71.3%
	Suburban	28.7%
Socioeconomic Status	Low	32.5%
	Middle	45.8%
	High	21.7%
Daily Social Media Use (hours)	Mean (SD)	4.26 (1.38)
Nocturnal Screen Exposure (minutes/night)	Mean (SD)	64.7 (29.5)
Sleep Quality (PSQI global score)	Mean (SD)	8.14 (3.12)
Parental Attachment (IPPA-R)	Mean (SD)	92.6 (14.8)
Emotional Dysregulation (DERS-SF)	Mean (SD)	63.9 (16.2)

The sample demonstrated high engagement with social media platforms and suboptimal sleep quality, with PSQI scores exceeding the clinical cutoff for poor sleep. Emotional dysregulation levels were elevated across the sample, indicating substantial variability suitable for predictive modeling. Parental attachment scores reflected moderate security, with notable individual differences that supported its inclusion as a key predictor variable.

Table 2

Pearson Correlations Among Primary Study Variables

Variable	Social Media Use	Sleep Quality	Parental Attachment	Emotional Dysregulation
Social Media Use	1	.41**	−.29**	.58**
Sleep Quality	.41**	1	−.34**	.62**
Parental Attachment	−.29**	−.34**	1	−.55**
Emotional Dysregulation	.58**	.62**	−.55**	1

The correlational analysis revealed strong positive associations between emotional dysregulation and both social media use and poor sleep quality, and a strong negative association with parental attachment security. These relationships supported the hypothesized multivariate framework and justified the integration of these predictors into the deep learning model.

JAYPS
E-ISSN: 2981-2526

Table 3

Performance of Deep Learning Model on Test Dataset

Metric	Value
Mean Absolute Error (MAE)	4.12
Root Mean Square Error (RMSE)	5.37
R^2	.79
Area Under Curve (AUC)	.91
Classification Accuracy	87.6%
Precision	.88
Recall	.86
F1-Score	.87

The deep learning architecture demonstrated high predictive performance, explaining 79% of the variance in emotional dysregulation scores. Classification metrics further confirmed the model's robustness in identifying adolescents at elevated risk for emotional dysregulation.

Table 4

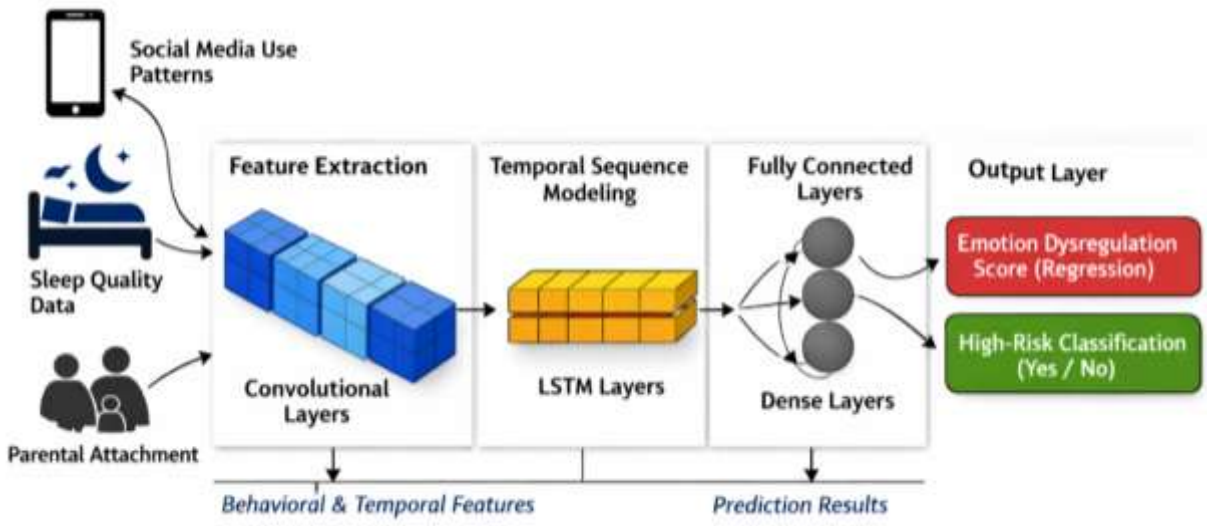
SHAP Feature Importance for Emotional Dysregulation Prediction

Predictor Feature	Relative Importance (%)
Sleep Quality Index	32.4
Nocturnal Screen Exposure	21.8
Emotional Dependency on Social Media	18.6
Parental Attachment Security	15.3
Daily Social Media Duration	11.9

The explainability analysis indicated that sleep quality emerged as the most influential predictor of emotional dysregulation, followed by nocturnal screen exposure and emotional dependency on social media. Parental attachment remained a substantial protective factor within the predictive model, highlighting its central role in adolescent emotional regulation.

Figure 1

Architecture of the Hybrid CNN–LSTM Deep Learning Model for Emotional Dysregulation Prediction



JAYPS
E-ISSN: 2981-2526

The integration of convolutional layers for feature extraction and LSTM layers for temporal pattern modeling enabled the network to capture both behavioral intensity and dynamic usage patterns, resulting in superior prediction accuracy and model stability.

4. Discussion

The present study sought to develop and validate a deep learning model for predicting emotional dysregulation in Colombian adolescents based on social media use patterns, sleep quality, and parental attachment styles. The findings provide strong empirical support for the proposed integrative framework and demonstrate that emotional dysregulation in adolescence is best understood as the emergent outcome of intertwined digital behaviors, biological regulation processes, and attachment-related relational dynamics. The high predictive accuracy of the hybrid CNN–LSTM model ($R^2 = .79$; AUC = .91) confirms the capacity of deep learning architectures to capture complex nonlinear relationships that traditional analytical methods cannot fully represent, thereby extending current knowledge in adolescent developmental psychopathology and computational mental health.

The strong positive associations between emotional dysregulation and both social media use and poor sleep quality align closely with existing literature. Prior research consistently documents that excessive social media engagement contributes to emotional instability, anxiety, depressive symptoms, and impaired self-regulatory capacity in adolescents and young adults (Khalaf et al., 2023; Marano et al., 2025; Tan & Fauzi, 2024; Yuan, 2025). The present findings extend this work by demonstrating that not only overall usage but also specific behavioral features—particularly nocturnal screen exposure and emotional dependency on social feedback—serve as highly influential predictors within a multivariate predictive model. This supports theoretical accounts that emphasize the role of continuous digital stimulation in overloading adolescent affective systems and undermining developing executive control networks (Yuan, 2025).

Sleep quality emerged as the most powerful predictor of emotional dysregulation, a finding that converges with extensive evidence highlighting sleep's central role in emotional homeostasis. Disrupted sleep compromises prefrontal-limbic connectivity and weakens top-down regulation of emotional responses, resulting in heightened emotional reactivity and reduced frustration tolerance (Kinsella & Chin, 2024; Xie & Feeney, 2024). The current study's SHAP analysis further revealed that nocturnal screen exposure significantly contributes to emotional dysregulation, offering computational confirmation of the mechanisms proposed by Kinsella and Chin, who identified digital behaviors as key disruptors of sleep architecture and circadian regulation in youth (Kinsella & Chin, 2024). These findings reinforce emerging models that conceptualize sleep not merely as a covariate but as a central regulatory system shaping adolescents' emotional and behavioral functioning (Alvarado & Palmer, 2025; Xie & Feeney, 2024).

Parental attachment demonstrated a substantial protective influence against emotional dysregulation, consistent with attachment theory and a wide body of developmental research. Secure attachment facilitates the internalization of adaptive emotion regulation strategies, whereas insecure attachment heightens vulnerability to emotional volatility, impulsivity, and maladaptive coping (Chen, 2023; Ginalska & Cichopek, 2024; Hong et al., 2024; Salavou & Giannakopoulos, 2024). The negative association between parental attachment and emotional dysregulation observed in this study aligns with neurodevelopmental evidence indicating that early attachment experiences shape the maturation of regulatory neural circuits and stress-response systems that remain influential throughout adolescence (Chen, 2023; Rogers et al., 2022). These findings further corroborate the results of Hong et al., who demonstrated that parental attachment significantly predicts emotional regulation capacity in high school students (Hong et al., 2024).

Importantly, the present results illuminate the interactive nature of attachment and digital behavior. Adolescents with lower attachment security exhibited higher emotional dependency on social media, consistent with prior work indicating that insecure attachment drives compensatory reliance on online relationships and heightened sensitivity to social feedback (Asniah, 2025; Berlianza & Pramono, 2025; Ricciardone et al., 2025). Such dependency patterns may temporarily alleviate relational distress but ultimately amplify emotional dysregulation by exposing adolescents to volatile peer evaluation and continuous emotional stimulation. These dynamics are particularly salient in adolescence, a developmental stage marked by heightened social sensitivity and identity formation (Bhau et al., 2025; Huang, 2025; Zhou, 2025).

The deep learning model's strong classification performance demonstrates the practical value of integrating psychological constructs with behavioral data. The hybrid CNN–LSTM architecture effectively captured both static

JAYPS Adolescent and Youth Psychological Studies E-ISSN: 2981-2526

psychosocial factors and temporal behavioral sequences, confirming recent theoretical arguments that adolescent emotional functioning must be modeled as a dynamic system rather than a set of isolated variables (Liao, 2025; Zhou, 2025). Moreover, the use of explainable artificial intelligence allowed for transparent interpretation of model outputs, supporting the growing emphasis on interpretability in clinical machine learning applications (Valenta et al., 2025). The identification of sleep quality, nocturnal screen exposure, emotional dependency, and attachment security as the most influential predictors provides clinicians and educators with clear targets for prevention and intervention.

Cultural context further strengthens the relevance of these findings. Latin American adolescents navigate distinctive combinations of family values, socioeconomic challenges, and rapidly expanding digital ecosystems. Prior research highlights that emotional regulation and attachment processes are shaped by sociocultural environments and family systems (Leal et al., 2023; Maya et al., 2023; Tuazzara, 2025). The current study extends this literature by demonstrating that the core mechanisms linking attachment, sleep, digital behavior, and emotional regulation operate robustly within Colombian adolescents, thereby enhancing the cross-cultural generalizability of contemporary developmental models.

5. Conclusion

Collectively, these findings support an integrative developmental model in which emotional dysregulation in adolescence emerges from the interaction of relational security, biological regulation systems, and digital behavior patterns. This model aligns with recent interdisciplinary perspectives emphasizing that adolescent mental health is shaped by overlapping neurobiological, social, and technological forces (Marano et al., 2025; Salavou & Giannakopoulos, 2024; Yuan, 2025). By operationalizing this framework within a deep learning architecture, the present study contributes a novel methodological approach and offers a powerful tool for early identification of emotional risk in youth populations.

6. Limitations & Suggestions

Several limitations should be considered when interpreting these findings. The cross-sectional design restricts causal inference, and longitudinal research is necessary to clarify the developmental trajectories linking attachment, sleep, digital behavior, and emotional dysregulation. The reliance on self-report measures for emotional and relational constructs introduces potential response biases, although the integration of objective smartphone usage data partially mitigates this concern. Additionally, the sample was limited to urban and suburban regions of Colombia, which may constrain generalizability to rural populations or other cultural contexts. Finally, although the deep learning model demonstrated strong performance, replication across independent samples is essential to confirm its robustness.

Future research should employ longitudinal designs to examine how the predictive relationships identified in this study evolve across adolescence and into early adulthood. Expanding the model to incorporate neurobiological markers, peer network data, and school environment variables may further enhance predictive precision. Cross-national studies are also warranted to explore cultural moderators of emotional dysregulation pathways. Finally, the integration of intervention data could enable the development of adaptive, real-time risk monitoring systems that respond dynamically to changes in adolescents' emotional and behavioral profiles.

The present findings underscore the importance of comprehensive, multi-level prevention strategies that address sleep hygiene, healthy digital behavior, and attachment-based family relationships. Schools and clinicians should incorporate digital literacy programs that promote balanced social media use and awareness of emotional dependency. Family-based interventions aimed at strengthening parental attachment security may serve as powerful protective mechanisms against emotional dysregulation. Sleep education initiatives targeting adolescents and caregivers should be prioritized to support emotional stability and overall mental health. The predictive model developed in this study offers a foundation for early screening tools that can guide timely and personalized interventions within educational and clinical settings.

Acknowledgments

We would like to express our appreciation and gratitude to all those who cooperated in carrying out this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

JAYPS Adolescent and Youth Psychological Studies
E-ISSN: 2981-2526

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

Authors' Contributions

All authors equally contributed to this article.

References

Alvarado, G., & Palmer, C. A. (2025). 0163 Sleep Quality and Social Interaction: The Moderating Role of Attachment Style. *Sleep*, *48*(Supplement_1), A74-A74. https://doi.org/10.1093/sleep/zsaf090.0163

Asniah, E. (2025). The Emotional Dependency of Adolescent Girls in Romantic Relationships: The Role of Father Nurturant. *Kne Social Sciences*, *10*(25), 258-271. https://doi.org/10.18502/kss.v10i25.19906

Berlianza, A., & Pramono, R. B. (2025). Kelekatan Orang Tua Dan Kecemasan Sosial Sebagai Faktor Penentu Kesepian Remaja Pengguna Media Sosial. *Riwayat Educational Journal of History and Humanities*, *8*(3), 3039-3050. https://doi.org/10.24815/jr.v8i3.47534

Bhau, S., Mahajan, V., Choudhary, S., & Tung, S. (2025). Exploring the Association Between Attachment and Bullying Among Adolescents Through Bowlbian Perspective. *International Journal of Innovative Science and Research Techno*, 2243-2252. https://doi.org/10.38124/ijisrt/25jul1500

Carvalho, C. B., Arroz, A. M. M., Martins, R., Costa, R., Cordeiro, F., & Cabral, J. (2023). "Help Me Control My Impulses!": Adolescent Impulsivity and Its Negative Individual, Family, Peer, and Community Explanatory Factors. *Journal of youth and adolescence*, *52*(12), 2545-2558. https://doi.org/10.1007/s10964-023-01837-z

Chen, Y. (2023). Impact of Attachment History on Development of Social Relationships Through Emotion Regulation. 209-217. https://doi.org/10.2991/978-2-494069-97-8_27

Ginalska, K., & Cichopek, A. (2024). Exploring Links Between Attachment and Mental Health. *Kwartalnik Naukowy Fides et Ratio*, *59*(3), 73-83. https://doi.org/10.34766/fer.v59i3.1299

Herdaetha, A., Matius Dimas Reza Dana, I., & Suwito, J. (2025). Factors Influence Non-Suicidal Self-Injury Behavior Among Young Adults. *Iseth*, 909-915. https://doi.org/10.23917/iseth.5481

Hong, S. L. T., Asatsa, S., & Mutisya, S. (2024). Parental Attachment and Emotional Regulation Among High School Students in Kikuyu Sub County, Kenya. *International Journal of Research and Innovation in Social Science*, *VIII*(IX), 450-458. https://doi.org/10.47772/ijriss.2024.809040

Huang, K. H. (2025). Attachment Style Interactions and Their Influence on Adolescent Relationship Information. *Interdisciplinary Humanities and Communication Studies*, *1*(5). https://doi.org/10.61173/1nvcc125

Khalaf, A. M., Alubied, A. A., Khalaf, A., & Rifaey, A. A. (2023). The Impact of Social Media on the Mental Health of Adolescents and Young Adults: A Systematic Review. *Cureus*. https://doi.org/10.7759/cureus.42990

Kinsella, J. E., & Chin, B. (2024). Mechanisms Linking Social Media Use and Sleep in Emerging Adults in the United States. *Behavioral Sciences*, *14*(9), 794. https://doi.org/10.3390/bs14090794

Leal, M., Adan, M., Heilman, K. J., & Cockcroft, K. (2023). Cardiac Regulation, Attachment Style, and Frustration Tolerance in Children With Disruptive Mood Dysregulation Disorder. https://doi.org/10.31234/osf.io/5j3g2

Leal, M., Adan, M., Heilman, K. J., & Cockcroft, K. (2024a). Autonomic Response and Attachment Style in Disruptive Mood Dysregulation Disorder. *South African Journal of Psychiatry*, *30*. https://doi.org/10.4102/sajpsychiatry.v30i0.2293

Leal, M., Adan, M., Heilman, K. J., & Cockcroft, K. (2024b). Autonomic Response and Attachment Style in Disruptive Mood Dysregulation Disorder. https://doi.org/10.22541/au.169056904.41867362/v2

Liao, J. M. (2025). Attachment Styles and Coping Efficiency: Navigating Academic Stress. *Lecture Notes in Education Psychology and Public Media*, *92*(1), 107-112. https://doi.org/10.54254/2753-7048/2025.22968

Marano, G., Lisci, F. M., Rossi, S., Marzo, E. M., Boggio, G., Brisi, C., Traversi, G., Mazza, O., Pola, R., Gaetani, E., & Mazza, M. (2025). Connected but at Risk: Social Media Exposure and Psychiatric and Psychological Outcomes in Youth. *Children*, *12*(10), 1322. https://doi.org/10.3390/children12101322

Maya, J., Arcos-Romero, A. I., & García, M. V. H. (2023). Psychometric Properties of the Inventory of Parents-Peer Attachment (IPPA) in Adolescents With Behavioural Problems. *Clínica y Salud*, *34*(3), 131-137. https://doi.org/10.5093/clysa2023a13

Ricciardone, S. M., Koehler, V. B., & Rutherford, M. D. (2025). Linguistic Markers of Faster Life History Strategies Among Teen Parents on Reddit: A Comparative Analysis. https://doi.org/10.21203/rs.3.rs-6306298/v1

Rogers, C. R., Chen, X., Kwon, S. J., McElwain, N. L., & Telzer, E. H. (2022). The Role of Early Attachment and Parental Presence in Adolescent Behavioral and Neurobiological Regulation. *Developmental Cognitive Neuroscience*, *53*, 101046. https://doi.org/10.1016/j.dcn.2021.101046

Rosharudin, N. A., Hoesni, S. M., Ali, M. M., & Khairuddin, K. F. (2023). Parenting Factors and Emotion Regulation Among Asian Adolescents: A Systematic Review. *International Journal of Academic Research in Business and Social Sciences*, *13*(11). https://doi.org/10.6007/ijarbss/v13-i11/19492

Salavou, V., & Giannakopoulos, G. (2024). Attachment in Adolescence: Old Patterns and New Challenges. https://doi.org/10.20944/preprints202409.1181.v1

Tan, C. N., & Fauzi, M. A. (2024). Unravelling Late Adolescents' Addiction to Social Media: A Unified Theory Perspective. *Global Knowledge Memory and Communication*. https://doi.org/10.1108/gkmc-02-2024-0099

Tuazzara, V. F. (2025). Peran Lingkungan Keluarga Dalam Pembentukan Perkembangan Sosioemosional. *Imajinasi*

JAYPS E-ISSN: 2981-2526

Jurnal Ilmu Pengetahuan Seni Dan Teknologi, *2*(4), 40-51. https://doi.org/10.62383/imajinasi.v2i4.1001

Valenta, S. T., Ventura, S., Garelli, S., Vicennati, V., Beneventi, M., Agostini, A., Pagotto, U., & Filippini, N. (2025). Exploring Attachment Dimensions in Individuals With Overweight or Obesity. *Behavioral Sciences*, *15*(3), 305. https://doi.org/10.3390/bs15030305

Xie, Y., & Feeney, B. C. (2024). A Narrative Review of Mechanisms Linking Romantic Relationship Experiences to Sleep Quality. *Sleep Advances*, *5*(1). https://doi.org/10.1093/sleepadvances/zpae049

Yuan, D. (2025). The Impact of Social Media on the Adolescent Brain: Cognitive, Emotional, and Societal Implications. *Journal of Education and Educational Research*, *16*(3), 51-57. https://doi.org/10.54097/03c3y333

Zhen, Z., & Tang, F. (2024). Impact of Mattering on Parental Attachment: Social Support Mediation and Self-Efficacy Moderation in Rural Chinese Children. *Evolutionary Studies in Imaginative Culture*, 1570-1579. https://doi.org/10.70082/esiculture.vi.1482

Zhou, Z. (2025). The Impact of Family of Origin on Romantic Relationships: A Psychological Perspective. *Lecture Notes in Education Psychology and Public Media*, *81*(1), 70-78. https://doi.org/10.54254/2753-7048/2025.20444

JAYPS Adolescent and Youth Psychological Studies
E-ISSN: 2981-2526