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The Emotional Pathway to Addiction: A Dual-Path Mediation Model of Psychological Maltreatment and Social Media Dependence in Adolescents

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Received: 09 September 2025; Accepted: 13 February 2026; Published: 28 April 2026

ABSTRACT: Objectives: Social Media Dependence (SMD) has emerged as a growing public health concern among adolescents. Psychological Maltreatment (PM), characterized by denigration, intimidation, and emotional neglect, is considered an important familial risk factor for adolescents' emotional and behavioral problems. However, the psychological mechanisms linking PM to adolescent SMD remain insufficiently understood. This study aimed to examine the relationship between PM and SMD and to explore the mediating roles of Difficulty Describing Feelings (DDF), Depression (DP), and Anxiety (AN). **Methods:** A cross-sectional survey was conducted among 2243 Chinese adolescents. Descriptive statistics, correlation analyses, and mediation analyses were performed using SPSS, AMOS, and PROCESS while controlling for demographic variables including age, gender, grade, only-child status, and accommodation. **Results:** Correlation analysis indicated that PM was significantly and positively associated with SMD ($r = 0.218$), DDF ($r = 0.277$), DP ($r = 0.307$), and AN ($r = 0.307$) (all $p < 0.001$). SMD was also positively correlated with DDF ($r = 0.233$), DP ($r = 0.285$), and AN ($r = 0.293$). Mediation analysis revealed that PM had a significant indirect effect on SMD through DDF, DP, and AN (total indirect effect = 0.105, 95% Bootstrap CI [0.085, 0.127]), accounting for 48.17% of the total effect. Both independent mediation pathways (PM → DDF → SMD; PM → DP → SMD; PM → AN → SMD) and chained mediation pathways (PM → DDF → DP → SMD; PM → DDF → AN → SMD) were significant. **Conclusion:** PM is a significant risk factor for adolescent SMD. Emotional difficulties and negative affect play key mediating roles in this relationship. Interventions that enhance emotional expression abilities and reduce depressive and anxious symptoms may help mitigate the impact of PM on adolescents' SMD.

KEYWORDS: Psychological maltreatment; adolescents; social media dependence; difficulty describing feelings; depression; anxiety

1 Introduction

With the digital age emerging, social media has become a vital part of adolescents' daily lives. Extensive research has demonstrated that adolescents are prone to developing excessive dependence on social media. Additionally, Psychological Maltreatment (PM)—including verbal abuse, behavioral neglect, or emotional disregard—has been consistently associated with impairments in adolescents' psychological well-being and social adaptation [1–4].

However, several important gaps remain in the existing literature. First, prior research has largely focused on adult populations or has examined single psychological variables in isolation. Consequently, the psychological mechanisms through which PM influences adolescents' Social Media Dependence

(SMD) remain insufficiently understood. In particular, it is unclear how PM contributes to SMD through interconnected and progressive psychological processes.

Variables such as Difficulty Describing Feelings (DDF), Depression (DP), and Anxiety (AN) are likely to interact dynamically. However, they have rarely been examined within an integrated theoretical framework. Second, the extent to which these associations vary across cultural contexts has not been adequately explored, thereby limiting the generalizability of existing findings and constraining the development of culturally sensitive and context-specific intervention strategies.

To address these limitations, the present study proposes a chain mediation model to investigate whether and how PM sequentially influences adolescents' SMD through DDF, DP, and AN. By modeling these variables as a coherent psychological pathway, this study aims to provide a more nuanced understanding of the underlying mechanisms linking PM to problematic social media outcomes in adolescence. Ultimately, the findings are expected to offer evidence-based insights that can inform the design of targeted mental health interventions and educational practices tailored to adolescents.

2 Literature Review

2.1 Social Media Dependence (SMD)

In the academic literature, excessive or problematic use of social media has been conceptualized under various terms, including SMA, Problematic Social Media Use (PSMU), and Compulsive Social Media Use.

Although these constructs overlap in core features such as loss of control and negative life consequences, they differ in their theoretical emphases. For instance, the addiction framework typically adheres closely to established behavioral addiction criteria, including salience, tolerance, and withdrawal symptoms, whereas the notion of problematic use encompasses a broader range of psychosocial impairments without necessarily implying an addiction process. To enhance conceptual clarity and measurement precision, the present study adopts the term SMD. SMD is defined as a pattern of excessive engagement with social media platforms characterized by diminished control over usage behavior and an intense craving for online interaction, which in turn leads to significant social functioning impairments and/or psychological distress. This construct is operationalized using the Bergen Social Media Addiction Scale (BSMAS), which captures six core dimensions of addictive behavior: salience, mood modification, tolerance, withdrawal, conflict, and relapse [5,6]. Compared with the broader construct of Internet addiction, SMD specifically emphasizes excessive involvement in social networking platforms. Moreover, unlike PSMU, which primarily focuses on negative behavioral outcomes, the present definition places greater emphasis on the addictive process itself and its associated affective symptoms within a behavioral addiction framework. This conceptualization provides a clear and theoretically grounded measurement basis for examining the logical associations between PM and addictive social media behaviors among adolescents.

In recent years, adolescents and young adults have become the largest user group of social media platforms. The continuous and frequent use of social media by adolescents has increased significantly, with some developing excessive dependence on these platforms [1,7]. Moreover, previous meta-analytic evidence suggests that differences in classification methods and cultural contexts contributed to the variability in social media addiction prevalence across countries. Specifically, collectivist countries exhibited a prevalence rate of 31%, which was more than double that observed in individualist countries (14%) [8]. For Chinese adolescents, the intense academic pressure and insufficient emotional communication with parents may enhance their inclination to seek emotional solace through social media. Relevant research also indicates that TikTok is the most downloaded and fastest-growing social media platform globally and is widely used by adolescents [9]. However, the short-video format of TikTok, combined with its algorithm-driven content

recommendations that provide immediate rewards such as likes and comments, may reinforce adolescents' usage habits and increase the risk of dependence. In addition, a big-data cross-sectional study found that highly visual social media platforms may lead to mental health problems in adolescents [10]. Consequently, excessive social media use can result in dependence, which may also lead to negative impacts such as reduced cognitive flexibility [11], impaired sleep quality [12], and difficulties in emotional regulation [13]. In summary, adolescent SMD must be a key focus for attention.

2.2 The Relationship between Social Media Dependence (SMD) and Psychological Maltreatment (PM)

Adolescent SMD is closely related to emotional neglect and abuse. As reported by the World Health Organization, approximately 300 million children worldwide have experienced abuse, with nearly 50% of children aged 7–18 having suffered from PM [14]. PM is a well-documented adverse childhood experience. In the developmental and clinical literature, PM is broadly defined as caregiver behaviors that cause substantial psychological harm or impair a child's emotional or social development. PM typically encompasses both emotional abuse (e.g., verbal aggression, denigration, and humiliation) and emotional neglect (e.g., failure to attend to a child's emotional needs or to provide adequate warmth and support) [15–17]. The present study adopts this two-component conceptualization, as it captures the core relational deficiencies—abuse and neglect—that are particularly likely to prompt compensatory behaviors in online contexts during adolescence. Importantly, PM reflects a chronic and pervasive pattern of negative parent–child interactions in which caregivers consistently fail to meet children's basic emotional needs [18]. Consistent with Compensatory Internet Use Theory, this framework offers a critical explanatory lens. Adolescents exposed to PM are more likely to seek alternative means to compensate for unmet psychological needs, such as belongingness, self-esteem, and emotional regulation [19]. Social media platforms, with their affordances for social connection, immediate feedback (e.g., likes and comments), and emotion modulation, provide an especially accessible and reinforcing outlet for such compensatory processes. Under these conditions, social media use may gradually shift from a situational coping strategy to a habitual and maladaptive pattern, ultimately manifesting as excessive use and psychological dependence. This is demonstrated by studies identifying PM as a significant risk factor associated with SMD, as well as various psychological issues—including emotional dysregulation, mental health problems, and problematic behaviors—which exhibit both short- and long-term negative correlations [2–4]. A big-data cross-sectional study found that PM predicts adolescents' SMD tendency [20]. Additionally, a longitudinal study involving 1987 Chinese adolescents found that early emotional neglect not only significantly predicted their later levels of problematic smartphone use but also intensified their dependence on mobile social platforms by reducing school engagement, particularly among those with high sensation-seeking traits [21]. The sample characteristics of this study are consistent with those of the present research, providing important empirical support for the pathways through which emotional maltreatment affects adolescents' dependence on social media. Thus, based on compensatory theory and existing empirical evidence, this study hypothesizes,

Hypothesis 1: *PM is positively related to adolescents' SMD.*

2.3 The Mediating Role of Difficulty Describing Feelings (DDF) between Psychological Maltreatment (PM) and Social Media Dependence (SMD)

Adolescents who have experienced PM are at increased risk of developing DDF [22,23]. DDF is characterized by significant challenges in using language to describe one's own emotions [24,25]. The shattered assumptions theory provides a useful framework for explaining this association: chronic traumatic

psychological experiences undermine children's fundamental assumptions about safety, trust, and self-worth, thereby disrupting the development of a coherent emotional lexicon and impairing the capacity to identify and articulate internal emotional states [26,27]. Large-sample cross-sectional studies indicate that approximately 36% of adolescents experience DDF. These difficulties include an inability to express feelings using appropriate vocabulary and ambiguous or incoherent emotional expression, with prevalence rates of 34.3% in boys and 40.0% in girls. Research has identified PM as one of the strongest predictors of DDF [28]. A cross-sectional study identified a significant link between DDF and SMD among female adolescents [29]. Also, studies indicate that alexithymia can directly or indirectly predict SMD through metacognition [30], and DDF may be a strong risk factor for SMD [31]. Accordingly, from a theoretical standpoint, experiences of PM are likely to be accompanied by elevated levels of DDF. Such impairments in emotional awareness weaken adaptive emotion-processing capacities, which in turn are reflected in an increased reliance on online engagement as a strategy for managing emotional states. Thus, this study proposes,

Hypothesis 2: *DDF mediates the relationship between PM and adolescents' SMD.*

2.4 The Mediating Role of Anxiety (AN) and Depression (DP) between Psychological Maltreatment (PM) and Social Media Dependence (SMD)

A marked increase in AN and DP prevalence has been observed among the younger generation, linked to diverse stressors [32]. AN is typically regarded as a standard emotional reaction to actual or perceived threats [33]. DP, a prevalent mental disorder, manifests through symptoms such as persistent low mood, diminished interest in activities, fatigue, and disruptions in physiological and cognitive functions [34,35]. Both conditions constitute important manifestations of psychological distress. Globally, 34% of 10–19-year-olds are at risk of clinical DP [36]. Concurrently, a 52% rise in AN disorder incidence was observed among individuals aged 10–24 from 1990 to 2021 [37]. According to the latest data, approximately 22.34% of adolescents in China exhibit symptoms of AN [38,39], and these symptoms are on a significant rise among adolescents [40,41]. Studies have shown that AN and DP not only lead to decreased academic performance, reduced quality of life, and impaired sleep quality in adolescents but can also result in severe consequences, including death [42,43]. Psychological distress, such as AN and DP, has been found to predict SMD, with adolescents experiencing these conditions being at a higher risk of developing dependence on social media [44,45]. Additionally, the personalized content delivered by social media algorithms can exacerbate this issue. Adolescents with AN and DP may use social media as an escape from reality [46,47]. In addition, in line with the Affective Enhancement Hypothesis, the anonymity and convenience of the internet make adolescents with significant emotional distress (such as those with high levels of AN or DP) more likely to overuse social media, which may lead to dependence [48,49]. The present study cites this hypothesis primarily to illustrate how emotional states can mediate the relationship between PM and SMD, rather than implying the existence of a moderating effect. Moreover, AN and DP can impair adolescents' inhibitory control, thereby increasing their risk of SMD [50–52]. AN and DP in adolescents are also closely associated with PM. The shattered assumptions theory explains the impact of PM, proposing that the resultant trauma fractures one's worldview and self-perception, thereby triggering negative emotional and behavioral responses such as AN and DP [26,27]. Furthermore, PM can elevate neuroticism levels, increasing vulnerability to mental disorders and the likelihood of AN and DP in adolescence [53]. A study on Chinese adolescents found a strong positive link between emotional maltreatment and depressive symptoms ($r = 0.57, p < 0.001$) [54]. PM has also been identified as a distal risk factor for DP in later

adolescence [54,55]. A prospective longitudinal study indicated that individuals experiencing emotional abuse in childhood are at higher risk of developing AN and DP during adolescence [56]. Accordingly, PM can be conceptualized as a precursor to both DP and AN. Robust and well-established associations have been documented between PM and subsequent DP and AN. Both the shattered assumptions theory and the chronic stress model suggest that PM, as a severe and persistent interpersonal stressor, can dysregulate neurobiological stress-response systems (e.g., the HPA axis), thereby increasing vulnerability to DP and AN. In summary, this study hypothesizes,

Hypothesis 3: *AN and DP mediate the relationship between PM and adolescents' SMD.*

2.5 The Chain-Mediation Role of Difficulty Describing Feelings (DDF), Depression (DP), and Anxiety (AN) between Psychological Maltreatment (PM) and Social Media Dependence (SMD)

In the preceding sections, we preliminarily examined the association between PM and SMD and considered the potential roles of DDF, DP, and AN as mediators. However, from a theoretical perspective, a more refined sequential pathway appears more plausible. Specifically, DDF should not be regarded merely as an outcome of PM; rather, it represents a foundational psychological deficit that can further intensify emotional distress, including DP and AN. When adolescents experience persistent difficulties in identifying and articulating their emotions, negative affect is more likely to accumulate and escalate, ultimately manifesting as depressive or anxious symptoms. This process, in turn, increases the likelihood of SMD as a maladaptive coping strategy. Collectively, these dynamics support a chained mediation mechanism, whereby PM elevates DDF, which subsequently heightens DP and AN, forming a sequential and interlinked pathway linking PM to SMD.

The ability to describe emotions accurately is crucial for adolescents. When adolescents are unable to articulate negative emotions precisely, these emotions tend to accumulate internally. Over time, the suppression of such emotions can exacerbate psychological burdens, leading to symptoms such as low mood, self-doubt, and helplessness, which are precursors to AN and DP [57]. Moreover, prolonged emotional suppression can erode psychological resilience and stress tolerance, making adolescents more sensitive and further intensifying AN and DP [58]. Regarding the association between DDF and DP/AN, emotion regulation theory posits that the identification and labeling of emotions constitute a critical starting point for adaptive emotional regulation. DDF reflects a disruption at this foundational stage and is commonly accompanied by reduced emotional clarity and the accumulation of psychological distress. When emotions cannot be effectively recognized or articulated, affective confusion and unresolved negative affect are more likely to intensify over time. This sustained emotional dysregulation is closely associated with the emergence of DP symptoms (e.g., helplessness and low mood) as well as AN symptoms (e.g., pervasive worry and heightened tension). Research has shown that when individuals have poor emotion description abilities, the effectiveness of emotion regulation strategies, including cognitive reappraisal, is impaired in alleviating AN and DP [59]. This may be because adolescents who are unable to accurately describe negative emotions are prone to accumulating emotional distress. Such chronic emotional suppression may induce symptoms of DP and AN. A cognitive-behavioral framework suggests that DDF predisposes individuals to DP and AN by causing misinterpretation of ambiguous emotional cues as threatening [60,61]. Neurotransmitters are crucial for emotion regulation, with alterations in serotonin and norepinephrine levels being closely tied to DP and AN [62–64]. Individuals with DDF may exhibit abnormal regulation of these neurotransmitters, which can affect the activity of brain regions associated with emotion processing

and exacerbate DP and AN [65]. Multiple studies have shown that DDF is closely related to symptoms of DP and AN and can positively predict these negative emotions [66,67]. In summary, this study hypothesizes,

Hypothesis 4: *DDF, AN, and DP have a chain-mediating effect between PM and SMD among adolescents.*

Integrated Pathway and Serial Mediation: This study proposes a comprehensive sequential framework to elucidate the mechanisms linking personality traits to behavioral outcomes. We argue that PM is inherently associated with compromised emotional articulation, manifesting as elevated DDF. This core deficit in emotional processing inhibits the functional regulation of affect, allowing negative emotions to consolidate into structured psychological distress, specifically DP and AN. Building upon the Affect Enhancement Hypothesis and the framework of inhibitory control deficits, we further posit that adolescents resort to social media as a maladaptive regulatory strategy to mitigate or evade this multi-layered distress. Consequently, the proposed model delineates a developmental trajectory that initiates with a personality predisposition (PM), progresses through cognitive-affective impairments (DDF) and clinical symptoms (DP/AN), and ultimately culminates in SMD as a behavioral coping response.

To summarize, the Compensatory Internet Use Model indicates that individuals experiencing continuous psychological stress or emotional distress tend to resort to online activities to alleviate negative emotions or compensate for the lack of real-life support [19]. From this perspective, the current study defines PM as the core stressor that triggers compensatory use motivation. DDF reflects the individual's barriers in transforming and expressing emotional experiences, making emotional distress harder to resolve in daily contexts. DP and AN are the primary negative emotional responses formed after PM and impeded emotional expression, further increasing the individual's emotional burden. SMD manifests as the individual's continuous online interaction to seek emotional relief and alternative support. Under this theoretical framework, the current study constructs a chained mediation model from PM through DDF and DP, and AN to SMD, providing a theoretical basis for subsequent path analysis. The specific chained mediation model is shown in Fig. 1.

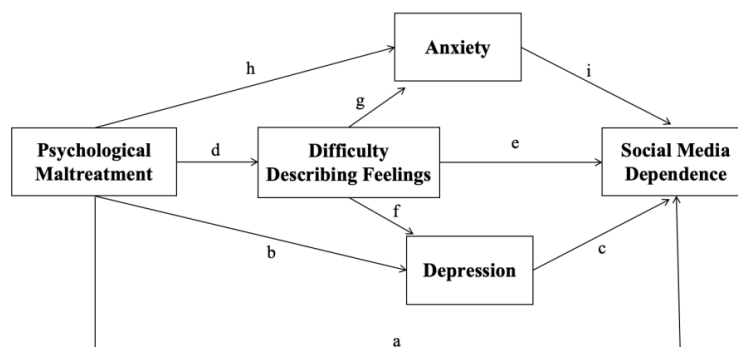


Figure 1: Hypothetical model diagram. Note: PM = Psychological Maltreatment; DDF = Difficulty Describing Feelings; AN = Anxiety; DP = Depression; SMD = Social Media Dependence. Hypothesis 1: PM → SMD (path a). Hypothesis 2: PM → DDF → SMD (paths d and e). Hypothesis 3: PM → AN → SMD (paths h and i); PM → DP → SMD (paths b and c). Hypothesis 4: PM → DDF → AN → SMD (paths d, g, and i); PM → DDF → DP → SMD (paths d, f, and c).

3 Methods

3.1 Participants

Conducted during the fall semester of 2024, this study examined a sample of Chinese adolescents using a cluster random sampling method. Schools were selected from three Chinese provinces—Hunan, Sichuan,

and Guangdong—ensuring balanced representation of urban and rural areas. Specifically, 3 primary schools, 8 junior high schools, and 10 senior high schools were randomly included, with questionnaires administered by class. Ethical approval was obtained from the Biomedical Ethics Committee of Jishou University (Approval No. JSDX-2024-0086). The study adhered to the principles of the Helsinki Declaration. Given that the majority of participants were minors, written informed consent was obtained from their parents or legal guardians prior to the survey. Specifically, information regarding the study's purpose and confidentiality was communicated to parents through school channels, and their consent was secured. Additionally, assent was obtained from the adolescent participants themselves; the first page of the questionnaire contained an informed consent form, and students were informed that their participation was voluntary and they could withdraw at any time. Only fully completed questionnaires were considered valid, and data from withdrawn participants were excluded. The survey was anonymous and designed to be completed within 20 min. In total, 2282 adolescents provided valid responses. After screening to exclude cases with excessively short response times and those showing obvious patterns of random answering, 2243 valid datasets were obtained.

Additionally, in determining the sample size, this study followed Kendall's rule. A fundamental rule in multivariate analysis requires a sample size 5–10 times the number of items to guarantee stable and reliable estimates [68]. Moreover, to enhance the scientific rigor and validity of the data, this study included an additional 20% in the sample size calculation to account for potential losses due to invalid questionnaires, incomplete returns, or errors in completion. Based on the formula for calculating the required sample size, $N = 10 \times \text{number of items} / (1 - 20\%)$. Accordingly, the minimum required sample size was determined to be 313. The actual survey yielded 2243 valid questionnaires, significantly exceeding the minimum requirement. Thus, the sample size is deemed adequate for mediation analysis. The sample comprised 1127 males and 1116 females. Geographically, 852 participants (38%) were from urban areas, while 1391 (62%) were from rural areas. Regarding family structure, 151 participants (6.7%) were only children, and 2092 (93.3%) had siblings. The sample comprised 81.8% boarders ($n = 1835$) and 18.2% day students ($n = 408$). By grade, 4.9% ($n = 111$) were in primary school, 38.5% ($n = 863$) in junior high, and 56.6% ($n = 1268$) in senior high.

3.2 Measurement Tools

3.2.1 Psychological Maltreatment (PM)

In this study, PM was assessed using the emotional abuse and neglect subscales of the Chinese version of the Childhood Trauma Questionnaire (CTQ), originally developed by Bernstein et al. and translated by Zhao et al. [69]. These subscales, revised by Fu and Yao [70], were specifically selected to measure PM among middle school students, as they align with our definition of PM, which includes emotional abuse and neglect as core components. This approach comprehensively reflects the active (e.g., belittling, humiliating) and neglectful (e.g., ignored emotional needs) characteristics of adolescents' psychological harm. Each of the emotional abuse and neglect subscales contains five items. The original subscales demonstrated internal consistency reliability coefficients of 0.76 and 0.69, respectively, indicating good reliability and thus suitability for assessing PM in adolescents. The scale employs a Likert 5-point rating method, ranging from 1 (never) to 5 (always), with the scoring method in this study consistent with the original scale. Some items are reverse-scored to minimize acquiescence bias. The full scale (10–50 points, higher scores indicating greater PM severity) showed good internal consistency ($\alpha = 0.823$), with subscale coefficients of 0.786 and 0.854, respectively.

3.2.2 Difficulty Describing Feelings (DDF)

In this study, adolescents' DDF was assessed using the DDF subscale of the Toronto Alexithymia Scale (TAS-20), originally developed by Bagby et al. [71], and subsequently adapted into Chinese by Zhu et al. [72]. During the adaptation process, certain wording was culturally adjusted to better fit the expression habits of the Chinese population, and it has been validated in adolescent samples. Previous research has reported good internal consistency for the Chinese version of the DDF subscale among Chinese adolescents, with a Cronbach's α of 0.747 [73]. The subscale comprises five items and employs a Likert 5-point rating scale ranging from 1 (strongly disagree) to 5 (strongly agree), consistent with the original scale. Some items are reverse-scored to minimize acquiescence bias. The scale score ranges from 5 to 25, with higher scores indicating greater difficulty in describing emotions. In this study, the Cronbach's α for this scale was 0.734, indicating good internal consistency. Additionally, to ensure that adolescents understood the items, a pilot test was conducted before the formal administration, and the results showed that all items were accurately understood by the adolescent participants. The Chinese version of the DDF subscale used in this study has been widely used in psychological research among Chinese adolescents [74,75].

3.2.3 Depression (DP)

The Patient Health Questionnaire-2 (PHQ-2) is a two-item instrument that assesses the frequency of depressive symptoms over the preceding two-week period using a 4-point Likert scale ranging from 0 (not at all) to 3 (nearly every day) [76]. The instrument's two items evaluate core depressive dimensions—low mood and anhedonia—each scored 0–3 based on symptom frequency, with total scores ranging from 0–6. Higher aggregate scores reflect more severe depressive symptomatology, consistent with the original scale's scoring protocol [77]. Given the large sample size and cross-regional nature of the present survey ($n = 2243$), the PHQ-2 was selected to reduce respondent burden and improve data collection efficiency while maintaining adequate screening sensitivity. Previous studies have demonstrated that the PHQ-2 shows strong correlations with the PHQ-9 and acceptable reliability and validity in Chinese adolescent populations, supporting its suitability for large-scale epidemiological research [78]. In the current study, the PHQ-2 demonstrated acceptable internal consistency (Cronbach's $\alpha = 0.711$).

3.2.4 Anxiety (AN)

Anxiety symptoms were assessed using the Generalized Anxiety Disorder Scale (GAD-2), a brief self-report screening tool measuring the frequency of anxiety symptoms over the past two weeks [79]. The scale consists of two items rated on a 4-point Likert scale (0 = not at all to 3 = nearly every day), yielding total scores ranging from 0 to 6, with higher scores indicating greater anxiety symptom severity. Considering the practical demands of a large-sample, multi-site survey, the GAD-2 was employed due to its efficiency, strong screening performance, and minimal respondent burden. Prior research has confirmed that the GAD-2 demonstrates high concordance with the full GAD-7 scale and has been validated in Chinese adolescent samples, making it appropriate for large-scale population-based studies [80,81]. In this study, the GAD-2 showed good internal consistency (Cronbach's $\alpha = 0.811$).

3.2.5 Social Media Dependence (SMD)

In this study, we used the Bergen Social Media Addiction Scale (BSMAS) to assess adolescents' SMD [82]. The BSMAS uses a 5-point Likert scale ranging from 1 (rarely) to 5 (very often), consistent with the original scale. The BSMAS comprises six items with total scores ranging from 6 to 30, where higher scores reflect more severe SMD. In this study, the scale demonstrated good internal consistency (Cronbach's $\alpha = 0.804$).

3.3 Covariates

In constructing the research model, this study controlled for key sociodemographic variables that may influence adolescents' SMD and PM, including gender, family structure, only child status, and boarding status. Research has shown that females are generally more dependent on social media than males [83]. Additionally, family structure and parent-child relationships are important factors affecting adolescents' emotional adaptation; insufficient family support can significantly increase the risk of DP and loneliness [84]. Moreover, studies from China suggest that only children may be more sensitive to AN and DP [85]. Furthermore, boarding conditions may impact adolescents' mental health. For example, parental separation has been associated with increased AN and DP in adolescents [86]. The intensity of boarding school management may also affect students' social interactions and emotional regulation, thereby influencing their psychological state [87]. In terms of social media accessibility, boarding students may have more opportunities to access the internet during specific times (such as weekends), while day students may have more stable internet access at home [88]. Based on the above evidence, this study included gender (1 = boy, 2 = girl), age, grade level, boarding status (1 = boarding, 2 = day student), residential area (1 = urban, 2 = rural), and only child status (1 = only child, 2 = non-only child) as control variables to ensure more robust model estimates [89,90].

3.4 Statistical Analysis

In this study, statistical analyses were performed using SPSS 27.0 software (IBM Corp., Armonk, NY, USA). Prior to hypothesis testing, the psychometric properties of the measurement instruments were evaluated using composite reliability (CR) and average variance extracted (AVE). This step was undertaken to establish the internal consistency and convergent validity of the measurement model. The results indicated that the CR values for all constructs exceeded the recommended threshold of 0.70, and all AVE values were greater than 0.50, demonstrating satisfactory reliability and validity in accordance with widely accepted statistical criteria in the literature. A common method bias test was initially performed to assess potential significant bias. If the bias value was below 40%, the study was deemed free from significant common method bias [91]. Descriptive statistics and correlation analyses were subsequently conducted on the demographic characteristics and core variables. To ensure analytical accuracy, all continuous variables were standardized using Z-score standardization (i.e., each variable was transformed by subtracting its mean and dividing by its standard deviation) prior to correlation analyses. To test the hypotheses, the relationship between PM and adolescents' SMD was examined, and the chained mediation effects of DDF, DP, and AN were analyzed using the PROCESS plugin (Model 81) in SPSS [92]. The selection of the SPSS PROCESS macro (Model 81) is conceptually and methodologically appropriate for this study. Model 81 possesses the unique capacity to simultaneously evaluate multiple parallel mediators while concurrently accounting for sequential (serial) pathways (e.g., the trajectory from DDF to DP/AN). This dual functionality is essential for testing the complex chain mediation framework theorized in our research. Unlike simpler models, Model 81 allows for a rigorous empirical examination of the interrelated mechanisms—moving from personality traits to cognitive-affective deficits and subsequent psychological distress—thereby ensuring that the indirect effects are estimated with high precision and theoretical alignment. During mediation analysis, demographic covariates (age, gender, boarding status) were controlled in all paths ($X \rightarrow M$ and $M \rightarrow Y$) using PROCESS Model 81, with $\alpha = 0.05$. Structural equation modeling in AMOS 29 (IBM Corp., Armonk, NY, USA) assessed model fit using indices including χ^2/df , GFI (Goodness-of-Fit Index), AGFI (Adjusted Goodness-of-Fit Index), CFI (Comparative Fit Index), TLI (Tucker-Lewis Index), and RMSEA

(Root Mean Square Error of Approximation). Mediation effect significance was tested via 5000 bootstrap replications, with bias-corrected 95% confidence intervals ensuring analytical robustness [93].

4 Results

4.1 Common Method Bias Test

To mitigate common method bias, this study implemented several procedural controls during data collection: (1) The questionnaire was administered anonymously, and participants were informed that there were no “correct answers” to reduce social desirability effects. (2) All scale items were presented in a random order to minimize systematic response patterns. (3) Some scales included reverse-scored items to reduce acquiescence bias. (4) Different variables were presented in separate blocks to avoid response biases caused by homologous information. To address potential common method bias, Harman’s single-factor test was performed through unrotated principal component analysis. Results revealed three factors with eigenvalues exceeding 1, collectively explaining 51.14% of the total variance. The first factor accounted for 22.09% of variance, remaining below the 40% threshold and indicating minimal concern for common method bias.

4.2 Correlation Analysis

As presented in Table 1, the correlation analysis revealed significant associations among all key variables. Specifically, PM was positively correlated with SMD, DDF, DP, and AN. Similarly, SMD showed positive correlations with DDF, DP, and AN. Furthermore, significant positive correlations were observed between the mediator variables (DDF, DP, and AN), which supports the feasibility of the proposed mediation models.

Table 1: Correlation analysis.

Variables	Mean	Standard Deviation	CR	AVE	1	2	3	4	5
1 SMD	13.26	5.038	0.85	0.50	-				
2 DDF	20.37	7.524	0.92	0.55	0.233***	-			
3 PM	13.51	3.820	0.83	0.51	0.218***	0.277***	-		
4 DP	2.11	1.556	0.70	0.54	0.285***	0.412***	0.307***	-	
5 AN	3.88	1.705	0.78	0.64	0.293***	0.392***	0.307***	0.682***	-

Note: *** $p < 0.001$. Abbreviations: CR = Composite Reliability; AVE = Average Variance Extracted; SMD = Social Media Dependence; DDF = Difficulty Describing Feelings; PM = Psychological Maltreatment; DP = Depression; AN = Anxiety.

4.3 Mediation Model Testing

The overall fit of the structural model was first assessed in this study. The results indicated the following fit indices: $\chi^2/df = 4.364$; CFI = 0.954, TLI = 0.903, IFI = 0.955, NFI = 0.944; GFI = 0.905, AGFI = 0.936. The RMSEA was 0.083, with a 90% confidence interval of [0.071, 0.095] and a p -value for close fit (PCLOSE) > 0.05; RMR (Root Mean Square Residual) = 0.044. Overall, model fit was evaluated using multiple complementary indices. Although the χ^2/df value exceeded the ideal threshold of 3, it remained within the acceptable range of <5 for complex structural models with a large sample size [94,95]. The RMSEA value, while slightly above the conventional cut-off of 0.08, should be interpreted in conjunction with the high incremental fit indices, all of which exceeded the recommended criterion of 0.90 (CFI, TLI, IFI > 0.90), suggesting a satisfactory match between the model and the data [95]. Furthermore, the 90% confidence interval for RMSEA was reported in accordance with established statistical conventions for

testing the close-fit hypothesis in structural equation modeling [96]. Taken together, these results indicate an acceptable and theoretically meaningful fit.

Based on Table 2 and Fig. 2, adding mediator variables to the demographic controls increased the explained variance of SMD from 4.9% to 12.2%. Path analysis showed that PM was significantly and positively associated with SMD (direct path $\beta = 0.112$ after mediation; total path $\beta = 0.218$). Furthermore, PM exhibited significant positive associations with DDF ($\beta = 0.275$), DP ($\beta = 0.207$), and AN ($\beta = 0.214$). In turn, DDF ($\beta = 0.099$), DP ($\beta = 0.113$), and AN ($\beta = 0.143$) were each positively linked to SMD. Additionally, DDF showed positive associations with both DP ($\beta = 0.351$) and AN ($\beta = 0.330$). These results support the significant mediating roles of DDF, DP, and AN in the relationship between PM and SMD among adolescents. The specific effect sizes for each pathway are provided in Table 3.

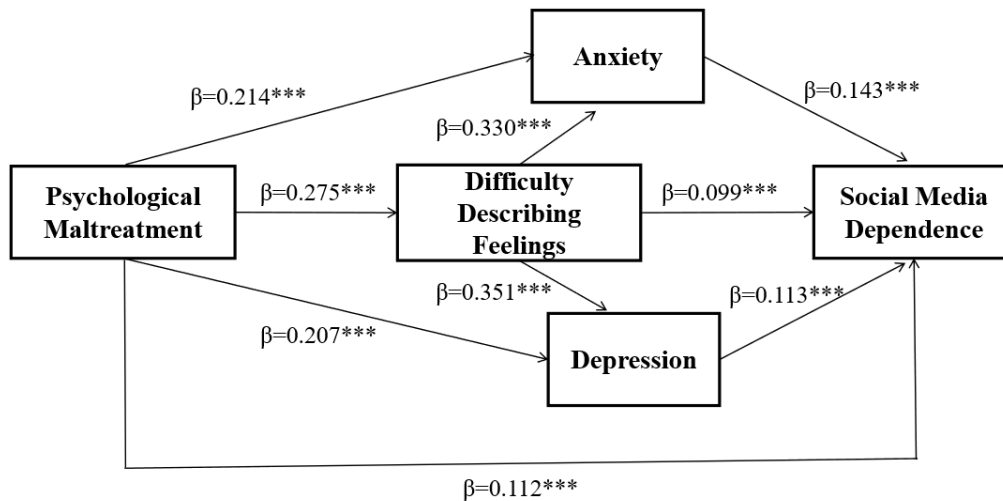


Figure 2: Diagram of the chain mediating model. Note: The figure displays the standardized path coefficients (β) and their significance levels ($***p < 0.001$).

Table 2: Mediation model test.

Outcome Variables	Predictor Variables	β	SE	t	R^2	F
SMD	PM	0.218	0.021	10.534***	0.049	16.341***
DDF	PM	0.275	0.020	13.544***	0.080	27.734***
DP	PM	0.207	0.020	10.594***	0.213	75.534***
	DDF	0.351	0.020	17.937***		
AN	PM	0.214	0.020	10.843***	0.199	69.464***
	DDF	0.330	0.020	16.725***		
SMD	PM	0.112	0.021	5.278***	0.122	31.116***
	DDF	0.099	0.022	4.439***		
	DP	0.113	0.028	4.028***		
	AN	0.143	0.028	5.169***		

Note: $***p < 0.001$. Abbreviations: SE = Standard Error; SMD = Social Media Dependence; DDF = Difficulty Describing Feelings; PM = Psychological Maltreatment; DP = Depression; AN = Anxiety.

Table 3: Mediation model path analysis.

Intermediate Path	Effect Size	SE	Bootstrap 95% CI	Proportion of Mediating Effect
Total effect	0.218	0.021	0.177, 0.258	
Direct effect	0.112	0.021	0.071, 0.154	
Total indirect effect	0.105	0.011	0.085, 0.127	48.17%
PM → DDF → SMD	0.027	0.007	0.014, 0.041	12.39%
PM → DP → SMD	0.023	0.007	0.010, 0.038	10.55%
PM → AN → SMD	0.031	0.008	0.017, 0.047	14.22%
PM → DDF → DP → SMD	0.011	0.003	0.005, 0.017	5.05%
PM → DDF → AN → SMD	0.013	0.003	0.007, 0.020	5.96%

Abbreviations: SE = Standard Error; CI = Confidence Interval; SMD = Social Media Dependence; DDF = Difficulty Describing Feelings; PM = Psychological Maltreatment; DP = Depression; AN = Anxiety.

5 Discussion

5.1 The Relationship between Psychological Maltreatment (PM) and Adolescents' Social Media Dependence (SMD)

The results of this study indicate that Hypothesis 1 is supported, indicating that PM is significantly and positively correlated with adolescents' SMD. Compared with previous studies that have confirmed the positive correlation between emotional abuse and social media use, this study further focuses on the more specific type of maltreatment—PM—and concentrates on SMD, making the research more theoretically and empirically targeted [97]. Most prior studies have treated emotional abuse as a broad and undifferentiated form of maltreatment and have typically adopted general social media use as the outcome variable. Consequently, they have failed to adequately capture the strength and specificity of the association between particular maltreatment subtypes and SMD as a form of problematic behavior.

In contrast, the present study clearly delineates its core constructs by focusing on PM—a distinct subtype characterized by psychological harm and controlling behaviors—and SMD, which is defined as a compulsive pattern of social media use accompanied by functional impairment. This conceptual precision enhances the practical relevance of the findings and addresses two key limitations in the existing literature: the ambiguous classification of maltreatment types and the overly broad operationalization of outcome variables. As such, the present findings provide new evidence for the specific linkage between adverse experiences and adolescents' problematic digital behaviors.

By integrating theoretical mechanisms with a critical analysis of cultural context, the present results not only corroborate explanatory pathways that appear robust across cultures but also extend existing theories within the Chinese sociocultural setting. Previous research has consistently shown that adolescents exposed to PM are more likely to exhibit low self-esteem and deficits in offline social competence [98,99]. However, much of this evidence is derived from Western contexts and has rarely considered the potential moderating role of Eastern parenting practices. Within the authoritarian or highly controlling parenting styles prevalent in China, PM often manifests through humiliating verbal criticism (e.g., “you are useless” or “why are you so stupid”) [100]. This culturally specific expression of PM not only directly undermines adolescents' sense of self-worth but may also intensify reliance on online social interaction through a psychosocial pathway characterized by familial invalidation → self-doubt → withdrawal from offline social engagement.

Compared with offline interpersonal interactions, which are often perceived as high in pressure and low in immediate reward, social media platforms provide anonymity, controllability, and instant, quantifiable positive feedback (e.g., likes and comments). These features are particularly effective in meeting adolescents' unmet needs for recognition following self-esteem impairment. Moreover, the

dopamine-related pleasure elicited by such feedback may further reinforce and maintain SMD-related behaviors [101,102]. Taken together, these findings not only support the broadly applicable mechanism of self-esteem impairment–driven social compensation but also highlight its cultural specificity, demonstrating that the pathway linking PM to SMD is strongly shaped by sociocultural context.

5.2 The Mediating Role of Difficulty Describing Feelings (DDF)

The results of this study indicate that Hypothesis 2 is supported, indicating that DDF plays a mediating role between PM and SMD among adolescents. Additionally, the study found that adolescents' DDF is significantly positively correlated with PM and that DDF is significantly positively correlated with SMD, largely consistent with previous findings [103,104]. In addition, prior research has indicated that PM may impair emotional metacognition, thereby constraining individuals' ability to identify and articulate their own emotional experiences [105]. By refining the research boundaries, the present study advances and extends the existing literature in several important ways. Earlier studies have often treated maltreatment as a composite construct or have focused on alexithymia—a broad concept encompassing emotional expression difficulties—in relation to adolescents' behavioral problems [106]. In contrast, the present study introduces two key innovations. First, it isolates the unique effect of PM by excluding the influence of other maltreatment subtypes. Second, it explicitly adopts DDF as the mediating variable, rather than a global alexithymia construct, thereby more precisely elucidating the transmission pathway through which emotional processing deficits link PM to SMD. The internal logic of this mediating mechanism can be comprehensively explained through an integrative framework combining trauma theory, the social compensation hypothesis, and neurobiological evidence. From a trauma-theoretical perspective, PM constitutes a form of chronic psychological trauma that disrupts emotional perception and expression systems [107]. Neurobiological studies further suggest that such disruption may stem from abnormalities in neurotransmitter functioning or structural alterations in brain regions involved in emotion regulation [108,109]. Rather than merely reiterating these established conclusions, the present study extends prior work by linking emotional processing deficits to adolescents' digital behavioral choices. Specifically, DDF may hinder adolescents' ability to express emotions and obtain emotional support in offline contexts; according to the social compensation hypothesis [110], this deficit increases the likelihood that adolescents will turn to social media for alternative forms of emotional fulfillment. Moreover, neuroimaging evidence indicates that DDF is associated with functional abnormalities in the amygdala and prefrontal regions (including the dorsolateral and ventromedial prefrontal cortex) [111–113]. These brain areas play a critical role in inhibitory control, and their developmental status or functional efficiency is closely related to adolescents' capacity for self-regulation in social media use. When regulatory efficiency in these regions is compromised, individuals are more likely to experience difficulties controlling usage duration and to exhibit stronger dependence-related characteristics. By integrating multiple theoretical perspectives, this study moves beyond the limitations of single-framework approaches and provides a more comprehensive account of the mediating role of DDF. Importantly, this integrative analysis identifies enhancing emotional expression abilities as a concrete and theoretically grounded target for future intervention efforts aimed at reducing SMD among adolescents.

5.3 The Mediating Role of Anxiety (AN) and Depression (DP)

Hypothesis 3 was supported, indicating that both AN and DP serve as mediators in the association between PM and adolescents' SMD, with a statistically significant difference observed between their mediating effects (AN: 14.22% > DP: 10.55%). This finding is consistent with previous evidence demonstrating

positive associations between PM and AN/DP, as well as between AN/DP and Internet-related addictive behaviors [114–117]. Importantly, by disentangling the differential mechanisms underlying these emotional disorders, the present study addresses a notable limitation in prior research that has tended to treat emotional disorders as a homogeneous mediating construct. The pathways through which PM contributes to AN and DP can be understood through an integrative framework combining neurobiological evidence, cognitive emotion regulation theory, and stress-response models. Neurobiological research suggests that PM may induce structural or functional alterations in key brain regions such as the hippocampus and prefrontal cortex [118,119], both of which are critically involved in emotion regulation. From a cognitive emotion regulation perspective, PM is closely associated with maladaptive regulatory strategies, including heightened emotional suppression and impaired attentional control [120,121]. At the biological level, stress-response models indicate that PM, as an early-life stressor, is frequently accompanied by dysregulation of the hypothalamic–pituitary–adrenal (HPA) axis, typically reflected in abnormal cortisol secretion [122], which has been robustly linked to elevated levels of AN and DP symptoms [123,124].

Rather than reiterating these established mechanisms, the present study integrates them into a developmental framework SMD formation among adolescents. According to compensatory Internet use theory [19,125], adolescents with elevated AN or DP often experience insufficient social support or limited emotion regulation capacity in offline contexts, prompting them to increasingly turn to social media for emotional relief. Moreover, both AN and DP are commonly accompanied by weakened inhibitory control [51], a psychological vulnerability that manifests behaviorally as difficulties in self-regulating social media use, thereby increasing the risk of SMD. More importantly, the observed difference—whereby the mediating effect of AN (14.22%) exceeded that of DP (10.55%)—offers a more fine-grained perspective on the relationship between emotional disorders and digital dependence. This discrepancy can be attributed to their distinct behavioral profiles. Adolescents with AN are typically characterized by sustained hypervigilance and heightened tension, making them more likely to use social media as a “temporary refuge” to alleviate concerns related to academic demands, interpersonal relationships, or family stress. Such coping patterns often involve frequent checking and compulsive engagement, thereby fostering high-intensity and habitual use. In contrast, adolescents with DP are more likely to exhibit withdrawal, low energy, and reduced behavioral activation; even when they seek emotional support online, their usage frequency and intensity tend to be lower than those of their anxious counterparts.

By differentiating these disorder-specific behavioral pathways, the present study moves beyond the overly generalized treatment of “emotional disorders” in prior research and highlights the distinct roles of AN and DP in the development of SMD. This nuanced understanding provides a stronger empirical foundation for designing targeted and precision-based intervention strategies aimed at reducing adolescents’ dependence on social media.

5.4 The Chain-Mediation Role of Difficulty Describing Feelings (DDF), Anxiety (AN) and Depression (DP)

The results confirm Hypothesis 4, demonstrating a significant chained mediation pathway where DDF and DP/AN sequentially link PM to SMD. Specifically, DDF showed significant positive correlations with both DP and AN in adolescents, aligning with established findings [67,126,127]. By incorporating adolescents’ neurodevelopmental characteristics, the present study further deepens understanding of the mechanisms underlying the formation of the chained pathway and addresses a key limitation of prior research—namely, the lack of a developmental perspective. The core logic linking DDF to DP/AN lies in its obstruction of emotion regulation and access to social support. Individuals with elevated DDF experience

difficulties in accurately identifying and expressing their own and others' emotions, which impairs both self-soothing capacities and the effective seeking of emotional support from others [128,129]. As a result, negative emotions are more likely to accumulate over time, ultimately precipitating symptoms of DP and AN.

Another important theoretical contribution of this study is the explicit integration of adolescents' neurodevelopmental features to explain why this pathway is particularly salient during adolescence. Adolescents undergo a distinctive developmental stage characterized by an imbalance between relatively early maturation of emotion-related brain regions and delayed development of regulatory control systems. Specifically, the amygdala—responsible for threat detection and emotional reactivity—tends to mature earlier, whereas the prefrontal cortex (including dorsolateral and ventromedial regions), which supports emotion regulation and cognitive control, develops more slowly [130–132]. This neurodevelopmental asymmetry renders adolescents less tolerant of deficits in emotional articulation and more vulnerable to emotion regulation failures, thereby amplifying the transmission effect from DDF to DP/AN.

From a theoretical perspective, this chained mediation model extends prior research by moving beyond single or parallel mediation frameworks that dominate the existing literature on PM and adolescent SMD. Most previous studies have examined isolated mediators—such as DP or AN—or tested multiple mediators in parallel, implicitly assuming that emotional processes operate independently. Such approaches, however, overlook the sequential and cumulative nature of emotional dysfunction following early adverse experiences. By explicitly modeling the pathway of $PM \rightarrow DDF \rightarrow DP/AN \rightarrow SMD$, the present study reveals a progressive emotional transmission process in which deficits in emotional articulation function as an upstream mechanism that precipitates subsequent internalizing symptoms, ultimately increasing vulnerability to maladaptive digital coping behaviors. This sequential structure clarifies not only whether emotional factors mediate the PM-SMD association, but also how and in what order these psychological processes unfold during adolescence.

Importantly, these findings refine and extend the Compensatory Internet Use Theory by deepening the conceptualization of “emotional regulation deficits.” Rather than treating emotional dysfunction as a single mediating construct, the present study conceptualizes it as a multi-stage transmission node along $PM \rightarrow DDF \rightarrow DP/AN \rightarrow SMD$, beginning with impaired emotional expression (DDF) and cascading into DP and AN. This chain-based perspective echoes the emotional processing chain framework, providing empirical support for the notion that early disruptions in emotional awareness and expression set off a downstream sequence of affective dysregulation that ultimately manifests in SMD. In this sense, the current study expands the application boundary of existing theories by integrating emotional processing deficits into a developmentally ordered mediation structure.

The identification of this chained mediation model also provides novel, mechanism-based implications for interventions targeting adolescents' SMD. The influence of PM on SMD does not operate directly; rather, it is transmitted sequentially through DDF and subsequently through DP/AN, ultimately culminating in dependence-related outcomes. Accordingly, effective intervention strategies should move beyond a sole focus on reducing social media use or alleviating a single emotional symptom. Instead, they should target key nodes along the chained pathway in a sequential manner: first, enhancing emotional description abilities to block the initial transmission of risk; second, alleviating DP and AN symptoms to disrupt the intermediate links; and ultimately, reducing vulnerability to SMD. This multi-target, stage-specific intervention framework is likely to be more precise and effective than single-focus approaches. Moreover, this chain-based framework advances existing mediation research in the field of adverse experiences and

digital dependence, offering a more comprehensive theoretical framework for understanding the complex developmental origins of adolescents' problematic digital behaviors.

5.5 Discussion of Control Variables

The role of demographic covariates in the present model warrants careful consideration, as these factors provide important contextual grounding for interpreting the psychological associations among the core variables. The results indicate that gender, grade level, and boarding status are significantly associated with both DDF and SMD. Specifically, female adolescents exhibited higher levels of SMD, which may be attributable to their greater tendency to use digital platforms for relationship maintenance and social comparison [29]. In parallel, the higher prevalence of DDF observed among females may reflect gender-specific socialization pathways in emotional expression and may further interact with experiences of PM, thereby increasing vulnerability to downstream emotional difficulties. These findings align with prior evidence suggesting that gender differences in emotional processing and social media engagement are shaped by both sociocultural expectations and differential exposure to interpersonal stressors. In addition, the association between grade level and SMD likely captures the combined effects of increasing academic demands and greater access to digital devices as adolescents grow older. As academic pressure intensifies and autonomy over media use expands, adolescents may become more reliant on social media as a coping or avoidance strategy. Furthermore, the observed relationship between boarding status—defined as physical separation from primary family support systems—and SMD suggests that reduced face-to-face familial support may encourage adolescents to compensate by seeking emotional connection and social interaction through digital platforms. Importantly, by statistically controlling for these demographic variables, the present study demonstrates that the identified chained mediation mechanism (PM → DDF → DP/AN → SMD) remains highly robust and is not merely an artifact of demographic differences. This finding underscores that the association between PM and SMD extends beyond basic sociodemographic factors and that the proposed mediation pathway exhibits strong stability and generalizability across diverse demographic backgrounds. Consequently, the present results provide more reliable pathway estimates and contribute to a deeper understanding of the complex psychological mechanisms underlying adolescents' digital behavior problems.

5.6 Practical Implications

This study elucidates the complex relationship between PM and adolescent SMD by identifying the chained mediation pathway through DDF, DP, and AN. These findings extend current understanding of SMD etiology and reaffirm the profound impact of PM on adolescent mental health and behavioral outcomes. Moreover, by integrating PM, DDF, DP, AN, and SMD into a unified theoretical framework, this study systematically explores the subtle connections between adolescents' mental health and the online environment, thereby laying an empirical foundation for enhancing psychological resilience among adolescents and facilitating healthier adaptation to digital challenges. Based on the above results, comprehensive interventions for adolescents are urgently needed. At the family level, emotional communication training can be provided for parents to help reduce implicit PM, such as blame and belittlement, making the family a safe emotional base rather than a source of stress. At the school level, structured emotional expression courses can be incorporated into mental health education. Through activities such as emotional diaries and situational role-playing, students can transform unclear feelings into recognizable and regulatable emotional language, thereby reducing the likelihood of turning to social media for emotional numbing. At the policy level, it is recommended to establish an early screening

system for DP and AN in schools, integrated with joint assessments by teachers and parents, to identify high-risk students in a timely manner and provide targeted psychological support services. Only through the collaboration of families, schools, and policies can the vicious cycle of PM—emotional dysregulation—SMD be broken, allowing adolescents to maintain healthy online behavior in today's digital age.

5.7 Limitations and Future Research

This study elucidates the chained mediation mechanism between PM and adolescent SMD. However, several limitations should be acknowledged.

First, the cross-sectional design precludes definitive causal inferences regarding the directional relationships among variables. Future research should adopt longitudinal designs with repeated measurements to more clearly reveal the change processes of key psychological factors. Second, this study primarily relies on adolescents' self-reports, and the assessment of PM and emotional symptoms may be subject to subjective bias. Future studies could combine reports of parenting styles from parents and observations of social media use behavior from teachers or parents to enhance measurement objectivity. Additionally, this study focuses solely on PM and does not include other important factors that may affect adolescents' mental health, such as physical abuse, sexual abuse, or other adverse childhood experiences (ACEs). This focus may limit a comprehensive understanding of the mechanisms underlying SMD. Future research could incorporate a broader range of abuse and adversity indicators to more accurately construct risk models for adolescent dependence behaviors. Moreover, the PHQ-2 and GAD-2 used in this study are ultra-brief screening tools. Although convenient for surveys, their ability to capture symptom severity is limited, which may lead to an underestimation of DP and AN. Future studies should adopt more comprehensive assessment instruments, such as the PHQ-9 and GAD-7, to improve measurement precision. Finally, as the current sample was drawn from specific Chinese provinces, generalizability is limited. Future studies should recruit participants from more diverse geographic, cultural, and urban-rural contexts to strengthen external validity.

6 Conclusions

By constructing and empirically validating a chained mediation model, the present study elucidates the underlying psychological mechanism linking parental PM to adolescent SMD. The findings demonstrate that DDF, DP, and AN jointly constitute a coherent sequential mediation pathway within this association. This indicates that the impact of PM on adolescents' digital behavior does not occur directly; rather, it unfolds through a complex psychological process in which PM undermines emotional processing capacities, subsequently eliciting internalizing emotional symptoms that increase vulnerability to SMD. The central theoretical contribution of this study lies in its empirical confirmation of this chained pathway, which provides an integrative framework for understanding adolescent development in the digital era. Specifically, the model bridges a developmental risk perspective emphasizing the long-term consequences of early adversity with a motivational perspective highlighting the compensatory functions of online environments. In doing so, the findings suggest that adolescent SMD, in certain contexts, can be conceptualized as a maladaptive compensatory strategy driven by deficits in emotional functioning, rather than merely as a manifestation of poor self-control or a preference for entertainment. This perspective advances existing research by shifting the focus from surface-level behavioral descriptions to the underlying emotional and social-psychological processes that shape problematic digital engagement.

In summary, the present study underscores the central role of emotional health in linking adverse family environments to adolescents' digital behavior problems. The findings call for a reorientation

of intervention priorities for SMD rooted in PM, advocating that preventive and remedial efforts move beyond behavioral restriction toward early cultivation of emotional competencies and the strengthening of supportive relational contexts. By validating a theoretically grounded mechanism model, this study provides a critical empirical foundation for future theoretical refinement and for the development of more targeted and developmentally informed intervention strategies.

Acknowledgement: We extend our sincere gratitude to all individuals and institutions that provided assistance and support for this study. Special thanks go to Jishou University for providing academic support and research resources throughout the research process. We also express our appreciation to the volunteers who participated in the experiment; their cooperation was crucial in facilitating the data collection process.

Funding Statement: The authors received no specific funding for this study.

Author Contributions: Juyan Fang was responsible for drafting the initial manuscript and conducting in-depth discussions and analyses of the research results. She also provided significant suggestions for revising and improving the manuscript. Yang Liu primarily undertook the experimental operations and data processing tasks and assisted Juyan Fang in optimizing the research design. Xin Deng was in charge of the overall research design, while Mengting Pan was responsible for formulating the research plan. Guoqiang Chen participated in data collection and analysis. All authors collectively reviewed and revised the final manuscript to ensure its quality. All authors reviewed and approved the final version of the manuscript.

Availability of Data and Materials: The data and materials used in this study are properly stored and can be made available to relevant researchers upon reasonable request. Please contact us at ldyedu@foxmail.com for access. We commit to providing data support to other researchers, in compliance with relevant laws, regulations, and ethical requirements, to promote academic exchange and further research development.

Ethics Approval: Approved by the Biomedical Ethics Committee of Jishou University (Approval No: JSDX-2024-0086). Informed consent was obtained from all individual participants included in the study and their legal guardians. Privacy protection measures were strictly implemented throughout the research process.

Conflicts of Interest: The authors declare no conflicts of interest.

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