Proceeding of ICSPHS 2026 Symposium: Critical Perspectives on Global Education and Psychological Development
DOI: 10.54254/2753-7048/2026.HT30126

# *The Relationship Between ADHD Symptoms and Internet Dependence among Adults: A Moderated Mediation Role of Emotion Regulation and Positive Childhood Experiences*

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***Abstract.*** Studies have shown that individuals with attention deficit hyperactivity disorder (ADHD) symptoms account for as much as 20% of the general population, and are closely related to adverse psychological outcomes such as depression, anxiety, and Internet dependence. Based on this, this study used a sample of 350 college students to explore the mediating role of emotion regulation strategies (cognitive reappraisal and expressive inhibition) in the relationship between ADHD symptoms and Internet dependence. Further, it tested the moderating role of positive childhood experiences (PCEs). Structural equation modeling results showed that among the two emotion regulation strategies (i.e., expressive inhibition and cognitive reappraisal), only expressive inhibition fully mediated the relationship between ADHD symptoms and network dependence. Positive childhood experience only regulates the pathway from ADHD to expression inhibition and its intermediary chain, and it is reinforcing at both high and low levels. The study revealed the characteristics of the emotional regulation mechanism of people with ADHD symptoms, and pointed out that positive childhood experiences may affect individuals' Internet dependence tendencies by strengthening restraint expression in specific cultural situations, providing a theoretical basis for future precise intervention.

***Keywords:*** ADHD Symptoms, Internet Dependence, Emotion Regulation, Positive Childhood Experiences

## 1. Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a prevalent neurodevelopmental condition whose core manifestations include inattention, hyperactivity, and impulsivity [1]. In fact, these characteristics—difficulty sustaining attention, excessive motor activity, or impulsive behavior—are not uncommon in the general population, especially among children and adolescents. A 2023 investigation of non-clinical adults found that approximately 20 % reported ADHD-like traits [2]. Meanwhile, the latest research indicates that in real life, there are indeed many individuals who exhibit similar traits but do not meet the clinical diagnostic threshold [3]. Nevertheless, sub-clinical attentional and impulsive difficulties are far from benign. Longitudinal evidence demonstrates that these symptoms predict later anxiety and depression and coalesce with low persistence and positive

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DOI: 10.54254/2753-7048/2026.HT30126

urgency, amplifying affective problems and fostering reliance on the internet. Carli [4] first documented a stable and significant association between inattention and internet dependency; Archi and Barrault [5] subsequently identified ADHD as an independent risk factor for depression, anxiety, and problematic internet use.

## 2. Literature review

### 2.1. The reciprocal relationship between internet dependency and ADHD

Internet dependency (ID) is defined as an intense and uncontrollable psychological–behavioral reliance on Internet use that produces clinically significant impairment in social, academic/occupational, or interpersonal functioning, accompanied by increased tolerance and withdrawal symptoms [6]. In individuals with ADHD symptoms, hypofunctioning of the prefrontal–striatal dopaminergic circuitry elevates reward threshold and weakens inhibitory control, rendering them hypersensitive to the immediate, variable, and high-magnitude reinforcers available online. To close the dopamine gap rapidly, they seek the powerful positive reinforcement provided by the Internet, thereby accelerating the development of ID [7]. Moreover, individuals with ADHD symptoms often exhibit emotion dysregulation; when confronted with stress, boredom, or real-life setbacks, they fail to deploy adaptive strategies such as cognitive reappraisal and instead adopt emotion-oriented and avoidant coping. Online content delivers instantaneous emotional stimulation or soothing, which further consolidates excessive Internet use and creates a vicious cycle [8]. Accordingly, we propose Hypothesis 1 that higher levels of ADHD traits will predict greater severity of Internet dependency.

### 2.2. The mediating role of emotion regulation

Emotion regulation (ER) refers to the entire process by which individuals influence the onset, experience, and expression of their emotions [9]. Two strategies frequently cited in the mental-health literature as prototypical examples are cognitive reappraisal (CR) and expressive suppression (ES). CR modifies emotional impact by reinterpreting the emotion-eliciting event before the response is fully activated, whereas ES is deployed after the response has emerged and consists of consciously inhibiting outward emotional signs [10].

Research shows that individuals with ADHD symptoms rely on regulatory routes that differ sharply from those of non-ADHD peers. Preferring external cues, immediate feedback, and sensory-driven modulation, they show weak internal speech and delayed-gratification capacity, making it difficult to execute the “pause-and-reappraise” sequence before arousal peaks; consequently, their use of CR is markedly reduced [11]. To fill the social-adjustment gap left by scarce CR, many individuals with ADHD symptoms adopt ES as a compensatory tactic, suppressing visible emotion to meet situational demands [12]. ES, however, merely blocks emotional output without lowering subjective load; once suppression resources are depleted, the accumulated affect seeks a low-barrier, high-immediate-payoff outlet. Internet activities—anonymous, sensorily intense, and rich in instant feedback—become the most accessible alternative regulator.

CR is negatively associated with Internet dependency. it lowers addiction risk directly and indirectly by decreasing negative affect, such as depression and anxiety [13]. Conversely, ES is positively linked to Internet addiction; when individuals can no longer sustain suppression, they are prone to discharge pent-up emotion online, fostering dependency. Thus, ADHD symptoms impair ER and simultaneously intensify Internet use, while compromised ER further prolongs online time.

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The three constructs are intercorrelated, suggesting that ADHD traits may indirectly promote Internet dependency by weakening adaptive emotion regulation. We therefore propose Hypothesis 2 that emotion-regulation strategies mediate the relation between ADHD symptoms and Internet dependency, with both CR and ES serving as separate mediators.

### 2.3. The moderating role of positive childhood experiences

Previous studies have shown that positive childhood experiences can improve emotional regulation, depression, and anxiety levels while reducing mental health risks, building resilience, and promoting healthy personality development [14]. The absence or scarcity of positive childhood experiences increases the likelihood of emotional disorders, impulsivity, and eventual involvement in criminal behavior [15]. Relevant Childhood Positive Experiences (PCEs) refer to formative experiences that develop a sense of security, connection, and competence, such as stable relationships with caregivers, a safe environment, and opportunities for emotional development [16]. At the same time, relevant studies have shown that individuals with hyperactivity disorder (ADHD) with positive childhood experiences (PCEs) may have a significant difference in the development path of their emotion regulation (ER) ability from non-PCEs groups during their growth [17]. Childhood is a period when children gradually form basic cognition and shape more complex psychological functions. According to the HOPE framework proposed by Dr. Sege [18], there are four key types of PCE: cultivating relationships, safe and stable environments, meaningful social participation, and the development of emotional and social skills. According to the triple model proposed by Morris [19] According to the theory, parents influence children's emotional regulation in three ways: behavioral imitation, family emotional atmosphere, and emotion-related parenting behaviors. The "safe and stable environment" and "positive relationship cultivation" in PCEs provide high-frequency and visible opportunities for children's use of CR and ES to imitate behavior. The frequency of parents' own use of cognitive reappraisal and expression inhibition strategies will affect children's emotional regulation strategy preferences through "emotional socialization" behaviors (such as the way they respond to children's negative emotions), so that children will choose to internalize this emotional strategy in repeated observations and joint exercises, and promote the use of emotional regulation strategies Flexible use [20]. Individuals who grow up in a positive family atmosphere may acquire their parents' emotion regulation strategies in the long term, visualized as positive parenting behaviors. In the face of negative emotions, it is more inclined to use cognitive reevaluation strategies to reconstruct situational meanings, and under positive reinforcement, it can internalize the external scaffold (temporary and structured support provided by the external environment) into Self-efficacy, reducing dependence on the emotional regulation function of the Internet [21]. So that individuals can spontaneously use emotion regulation tools even in frustrating situations, instead of relying on the Internet to escape emotions, according to which hypothesis 3 Childhood positive experience (PCE) can be used as a moderating variable to regulate the above-mentioned intermediary chain.

### 2.4. Research hypotheses

Based on the theoretical and empirical evidence reviewed above, this study proposes three hypotheses to systematically examine the mechanistic links among ADHD symptoms, emotion-regulation strategies (CR and ES), PCEs and ID (Figure 1).H1. Higher levels of ADHD symptom related severity of ID. H2. Both CR and ES will independently mediate the relation between ADHD symptoms and ID. H3. PCEs will moderate the indirect effect described in H2.

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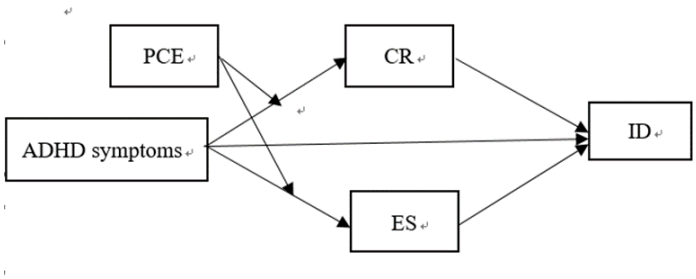


Figure 1. Hypothesis model

## 3. Methods

### 3.1. Participants

We used random-cluster sampling. A link to the online survey (Questionnaire Star) was distributed through WeChat to undergraduates in Hong Kong, Shanghai and adjacent cities. Inclusion criteria: age ≥ 18 and enrolment in a diploma- or degree-granting program. Four hundred students completed the questionnaire. Thirty-three were removed because completion time was < 300 s; fifteen failed all four attention-check items and two gave straight-line responses. The final sample comprised 350 valid cases (effective response rate = 87.5 %).

### 3.2. Measures

#### 3.2.1. Positive childhood experiences scale

We used the 10-item Positive Childhood Experiences scale developed by Narayan & Rivera [22] to assess supportive experiences before age 18. The scale covers three domains: self-awareness (1 item), supportive relationships (6 items) and positive, predictable life events (3 items). Each item is scored 0 (did not occur) or 1 (occurred); total scores range from 0 to 10, with higher values indicating more positive experiences. Previous research reported good reliability (Cronbach's α = 0.73), and Li [23] confirmed its validity in a Chinese sample. In the present study, Cronbach's α was 0.821.

#### 3.2.2. ADHD symptom scale

The Adult ADHD Self-Report Scale (ASRS) is an 18-item screening instrument for current ADHD symptoms and has been widely used internationally. It shows high concordance with clinical diagnoses [24]. Based on DSM-IV criteria, Part A (items 1–9) assesses inattention and Part B (items 10–18) hyperactivity/impulsivity. Items are rated 0 (never/rarely) to 4 (very often); total scores range from 0 to 72, with sub-scale totals of 0–36. A sub-scale score ≥ 17 indicates probable clinical symptoms. Previous studies reported Cronbach's α = 0.843; in this sample α = 0.83.

#### 3.2.3. Emotion-regulation strategies scale

The Emotion Regulation Questionnaire (ERQ) [25] measures the frequency of cognitive reappraisal (CR; 6 items) and expressive suppression (ES; 4 items). Items are rated 1 (strongly disagree) to 7 (strongly agree); total scores range from 10 to 70, with higher scores indicating more frequent use of the strategy. The Chinese version compiled by Wang [26] demonstrates good reliability and validity

DOI: 10.54254/2753-7048/2026.HT30126

(Cronbach's α = 0.85 for both sub-scales). In this study, Cronbach's α was 0.81 for CR and 0.79 for ES.

#### 3.2.4. Internet dependency scale

We used the 20-item Internet Addiction Scale developed by Young & Rodgers [27]. Items are rated 1 (completely disagree) to 6 (completely agree); the mean item score is computed, with higher values reflecting greater Internet dependency. Mean scores < 2.3 indicate normal use, 2.3–2.65 at-risk use, and ≥ 2.65 dependent use. The scale has shown excellent reliability (Cronbach's α = 0.93) and good validity in Chinese samples [28]. In this study Cronbach's α was 0.89.

### 3.3. Data analysis

All descriptive analyses were conducted with SPSS 22. Means and standard deviations are reported for every variable, and Pearson correlations among the observed variables are presented. Any demographic variable that correlates significantly with an outcome variable will be included as a covariate in subsequent analyses.A structural equation model (SEM) was estimated in JASP to test the hypothesized moderation model. Before examining the structural relations, a measurement model containing six latent factors—childhood adversity, positive childhood experiences, ADHD, internet dependence, cognitive reappraisal, and expressive suppression—was evaluated. After confirming a satisfactory fit of the measurement model and controlling for demographic variables, the hypothesized moderation model was tested. Model fit for both the measurement and structural models was assessed using the following criteria: Tucker–Lewis Index (TLI) and Comparative Fit Index (CFI) ≥ .90, Standardized Root Mean Square Residual (SRMR) and Root Mean Square Error of Approximation (RMSEA) ≤ .08 [29].

## 4. Results

### 4.1. Descriptive statistics and correlation analysis (N = 350)

The final sample comprised 193 men (55.1 %) and 157 women (44.9 %). Seventy-nine percent held at least a bachelor's degree and 77.5 % were aged 18–25. Clinically significant ADHD symptoms were present in 71 participants (20.3 %); 104 (29.7 %) met the cut-off for Internet dependency; 34 individuals (9.7 %) met criteria for both conditions.

The means, standard deviations, and intercorrelations of all variables are reported in Table 1. Pearson correlations were computed among the five variables: positive childhood experiences, attention-deficit/hyperactivity disorder (ADHD) symptoms, internet dependence, cognitive reappraisal, and expressive suppression. Results showed that positive childhood experiences were significantly and positively correlated with cognitive reappraisal ($p < 0.01$), but negatively correlated with the other three outcome variables (i.e., expressive suppression, Internet dependency and ADHD symptoms) ($p < 0.01$). ADHD was significantly and positively correlated with both internet dependence and expressive suppression ($p < 0.01$).

DOI: 10.54254/2753-7048/2026.HT30126

Table 1. Correlation analysis

| variables | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1 | PCE | 1 | | | | |
| 2 | ADHD | -.369** | 1 | | | |
| 3 | CR | .679** | -.304** | 1 | | |
| 4 | ES | -.446** | .396** | -.335** | 1 | |
| 5 | ID | -.466** | .385** | -.324** | .841** | 1 |
| | M | 5.59 | 30.05 | 16.51 | 13.5 | 40.9 |
| | SD | 3.17 | 16.77 | 6.21 | 5.93 | 25.1 |

Note: p<0.05 * , p<0.01**

## 4.2. Structural equation model

The structural equation model was specified with ADHD symptoms as the independent variable, internet dependency (ID) as the dependent variable, expressive suppression (ES) and cognitive reappraisal (CR) as parallel mediators, and positive childhood experiences (PCE) as a moderator. Two primary pathways were examined: (1) indirect paths from ADHD symptoms to ID through ES and CR, and (2) direct paths from ES and CR to ID (see Figure 2). Fit indices indicated excellent model fit: TLI = .988, CFI = .997, RMSEA = .045, SRMR = .010.

The results indicate that ADHD symptoms have positively correlated with ES (beta =0.503, SE=0.029, P<0.001), only ES could have positively correlated with ID (beta=0.816, SE=0.150, P<0.001).

Of the two emotion-regulation strategies (i.e., ES and CR), only ES could be a full mediator affecting the pathway between ADHD symptoms and ID (effect = 0.615, SE = 0.103, p < 0.01, 95 % CI [0.412, 0.817]) (see Table 2), accounting for 95.2 % of the total effect.

PCEs moderated the link from ADHD symptoms to ES: ADHD symptoms positively predicted ES at both high and low PCE levels, with the effect remaining significant but slightly stronger when PCE was low (low PCE: b = 0.193, SE = 0.033, p < 0.001, 95 % CI [0.128, 0.258]; high PCE: b = 0.164, SE = 0.025, p < 0.001, 95 % CI [0.114, 0.223]) (see Table 2).

PCEs also moderated the sequence running from ADHD symptoms through ES to ID. The index of moderated mediation was significant at both levels of PCEs, indicating that the indirect effect was amplified under low PCE and remained robust under high PCEs (low PCEs: effect = 0.665, SE = 0.118, p < 0.01, 95 % CI [0.434, 0.896]; high PCEs: effect = 0.564, SE = 0.090, p < 0.001, 95 % CI [0.388, 0.740]) (see Table 2).

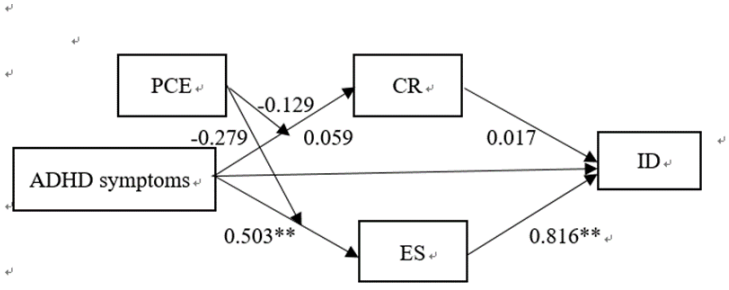


Figure 2. SEM model

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Table 2. Moderated mediation analysis results

| | Path | | Effect value | P Value | Std Error | 95% confidence interval lower | upper |
|---|---|---|---|---|---|---|---|
| Direct effect | ADHD-ID | | 0.029 | 0.575 | 0.052 | -0.073 | 0.132 |
| Moderated effect | ADHD-CR-ID | | 0.002 | 0.664 | 0.004 | -0.005 | 0.008 |
| | ADHD-ES-ID | | 0.615 | <.001 | 0.103 | 0.412 | 0.817 |
| Moderation | ADHD*PCE->ES | Low | 0.193 | <.001 | 0.033 | 0.128 | 0.258 |
| | | High | 0.164 | <.001 | 0.025 | 0.114 | 0.223 |
| | ADHD*PCE->CR | Low | 0.029 | 0.371 | 0.032 | -0.033 | 0.093 |
| | | High | 0.015 | 0.543 | 0.025 | -0.035 | 0.063 |
| Moderated moderation | ADHD*PCE->ES->ID | High | 0.564 | <.001 | 0.090 | 0.388 | 0.740 |
| | | Low | 0.665 | <.001 | 0.118 | 0.434 | 0.896 |

## 5. Discussion

The present study examined whether positive childhood experiences (PCEs) moderate the ADHD–Internet dependency (ID) link and whether cognitive reappraisal (CR) and expressive suppression (ES) mediate that relation. Three findings emerged. First, higher levels of ADHD symptoms were positively related to ID. Second, only ES mediated the relationship between ADHD symptoms and ID. Third, PCEs moderated only the relationship between ADHD symptoms and the ES path and the subsequent indirect path.

The first finding 1 shows that ADHD symptoms were positively correlated with ID. Recent studies have pointed out that Internet content presents the characteristics of fragmentation, high rhythm, and instantaneous feedback. The rapid change of screen information allows individuals to obtain high-intensity stimulation in a short period of time without maintaining long-term concentration [30]. At the same time, the problems of high arousal and distraction among young people with ADHD symptoms make them more keen to pursue instant rewards and continuous information updates. The real-time reinforcement mechanism adopted by online games perfectly fits the characteristics of people with ADHD symptoms and meets their needs. Therefore, it is easier for them to adapt to the instantaneously changing network mechanism, and they can enter the online world more devotedly. In the long run, this continuous instant feedback will further weaken the individual's continuous attention ability, making it difficult to obtain in reality. Concentration and satisfaction are instantly and repeatedly cashed out on the screen, eventually leading to out-of-control network use [31].

The second finding 2 indicates that within the proposed model, only the indirect effect of ES was significant, whereas the indirect effect of CR did not reach significance, meaning that no mediating

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role of CR between ADHD and ID was detected. This outcome is inconsistent with Hypothesis H2 and contradicts conclusions drawn from several previous studies using ADHD child samples [32].Emotion regulation is a control process that consumes limited cognitive resources such as attention, working memory, and executive function [33]. The two strategies (CR and ES) have significant differences in the demand for cognitive resources. As a pre-conditioning strategy, CR must call working memory and executive functions before the emotional response is formed, and carry out multi-step "reinterpretation" of the meaning of the event, which consumes a lot of resources; However, ES belongs to response regulation, which only uses cognitive resources to control explicit expressions and body movements after emotions have been generated, with a single step and a low resource load. The group with ADHD symptoms happens to have defects such as small working memory capacity and weak executive function, and the cognitive resources available for call are more cramped [34]. Relevant studies have shown that in resource-constrained situations, ES with concise steps is more feasible, and the moderating effect of CR may be limited.

Another study also supported that individuals with ADHD symptoms are more likely to employ ES strategies [35], based on their psychological systems. This study explained that ES and CR depend on different psychological systems. For example, CR mainly uses working memory and language-semantic networks to reconstruct emotions, while ES controls explicit behavior through the motor-inhibitory system [36]. Due to the limitation of prefrontal lobe function in ADHD, the individual's language-semantic processing ability is insufficient, which leads to the hindrance of CR's psychological function. The operating system of ES is relatively independent of the prefrontal executive control system and is retained better in ADHD, so it is not significantly affected [37].

Therefore, based on these two theories, people with ADHD symptoms may find it more difficult than ordinary people to complete the executive operations required for reassessment, and are more likely to rely on the "low-resource" strategy of expressive suppression [38].

In turn, people who tend to use ES to release negative emotions are more likely to delve into the Internet, which can be explained in two ways. First, when repressed emotions cannot be effectively processed, individuals may turn to the Internet for immediate comfort, thereby increasing the risk of Internet dependence [39]. Second, according to the principle of negative reinforcement, behaviors that can immediately reduce disgust are reinforced by repetition. ES constantly generate negative emotions, and online activities are repeatedly selected for their rapid relief effects, eventually internalizing into inertial coping styles, thus forming dependence [40]. As a result, those who regularly use ES are more likely to slide to alternative adjustments such as swiping, gaming, or social media, reinforcing the risk of web dependence. The difference is that a high CR means that individuals are more inclined to adopt positive cognitive reconstruction to regulate their emotions when faced with stress. Their negative emotions have not only not been suppressed but have been effectively alleviated.

Therefore, ES can serve as a mediator for the model, and people with ADHD symptoms will use ES more often to facilitate ID.

Finding 3 shows that PCEs moderated only the path running from ADHD to ES and the subsequent mediated pathway, amplifying the positive relation at both high and low levels, a pattern that offers partial support for Hypothesis H3 yet diverges from the usual expectation in that positive childhood experiences exerted a bidirectional amplification effect within the ADHD, ES and ID mediation chain.

With respect to the absence of a significant interaction between PCEs and CR, although CR correlates positively with PCE, reappraisal is a high-order executive function that requires real-time prefrontal inhibition and reconstruction of emotional input; simply providing external emotional

DOI: 10.54254/2753-7048/2026.HT30126

support cannot upgrade this capacity in adults with ADHD. Recent adult data further indicate that PCE reduce emotional dysregulation indirectly by “enhancing social support” (i.e., belonging, self-esteem, tangible aid) rather than by exerting any direct effect on the specific cognitive strategy of active reappraisal.

PCEs explain the positive regulation of the intermediary chain in two aspects. First, based on the Social masking effect [41], people with ADHD symptoms may tend to cover up their symptoms because they hope to better integrate into society and avoid stigma from others. Further, living in positive childhood environments (i.e, high support and high expectation of parents), these people may hope to integrate into society more; however, their concealment behavior could be strengthened. Then, the use of ES by individuals is reinforced. Therefore, the emotional impulses concealed by individuals cannot be released in real life, and the online world, as a more suitable place, will carry and release the accumulated emotions of individuals, thereby promoting the positive operation of the entire intermediary chain.

Second, from the perspective of culture, under the background of Chinese family upbringing, the positive expectation of harmony in a good family atmosphere will strengthen the norm of "peace is the most important" in Chinese culture [42]. In this atmosphere, the individual will consciously control and reduce the expression of negative emotions to promote family warmth. The empirical research based on social-emotional learning (SEL) by Yang Chuanli and Lin Lizhen [43] also pointed out that the high-care-high-control parenting of Chinese families will make children show more traits of situational adaptive inhibition rather than explicit expression in the process of communication, and the internalization of this behavior pattern enables the strategy of ES to be proficiently applied by ADHD individuals in a good family atmosphere, and automatically applied as inertial emotion regulation skills [44]. This is why PCE can positively regulate this intermediary chain in the study.

### 5.1. Limitations

Several limitations should be noted. The sample consisted entirely of university students and was relatively small, restricting generalisability. The cross-sectional design precludes causal inference, and sole reliance on self-report questionnaires risks common-method bias. Other uncontrolled variables (e.g., level of social support) may also have influenced the results. Future work should employ longitudinal designs to establish causal ordering, recruit more diverse populations, and complement questionnaires with behavioral tasks and clinical interviews to capture the true relations among constructs.

### 5.2. Conclusion

Taken together, this study delineates the complex interplay among ADHD traits, Internet dependency, cognitive reappraisal, expressive suppression, and positive childhood experiences. It reveals a distinctive emotion-regulation pattern in adults with ADHD who prefer expressive suppression over cognitive reappraisal. Within the Chinese cultural context, positive childhood experiences did not weaken this preference; instead, by reinforcing a “restrain expression” behavioral style, they enhanced suppression skill and channelled emotional discharge into cyberspace. Theoretically, the findings challenge the view that PCEs are uniformly protective and offer a new lens for understanding adult ADHD in specific cultural settings. Clinically, they urge practitioners to assess the actual function of suppression before promoting reappraisal, and to

DOI: 10.54254/2753-7048/2026.HT30126

flexibly supplement or replace strategies as needed, thereby achieving more precise and effective interventions.

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