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Emotion Regulation in Individuals with ADHD: A Clinical Guide

Mahdavi Abed and Hejazi Elaheh

Abstract

Emotions play a vital and valuable role in human life because, in different ways, they affect people's behavior, thinking, and social interactions. Positive and negative emotions can both facilitate the process of progress and make the process difficult. Different people, especially those suffering from Attention-Deficit Hyperactivity Disorder (ADHD), resort to various strategies to regulate their emotions. Although several medicinal and psychotherapeutic methods have been introduced to help this spectrum of society, none of them have been able to solve psychosocial problems. Developmental studies and neuroimaging show that multiple cortical and subcortical regions in the brain regulate emotions, and with age, and effective psychotherapies, people's ability to do so improves. The present study examines issues, including ADHD, problems associated with emotion regulation in people with ADHD, emotion regulation strategies, parenting, and emotion regulation, and related neurological mechanisms, as well as offers some suggestions for the path forward in terms of clinical interventions.

Keywords: emotion regulation, ADHD, regulation strategies, neurocognitive mechanisms, self-regulation

1. Introduction

Attention-Deficit Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders, characterized by disruptive symptoms, comprising hyperactivity, impulsivity, and inattention. To diagnose this psychiatric disorder, these triple symptoms must be present in two or more contexts for at least 6 months and have impaired a person's average performance [1–3]. The disorder persists at various times into adulthood [4]. Other secondary symptoms associated with the disorder may include learning, emotional, and social problems [5] and co-occurrence with psychiatric disorders, comprising disruptive behavioral disorders, depression, and severe anxiety disorders [6]. The prevalence of this disorder is estimated to be between 3 and 7% among children and adolescents and 3–5% in adults [7–10], and the prevalence is 2 to 9 times higher in boys than in girls [1, 11, 12]. Various studies show that people with ADHD have heterogeneous neuropsychological profiles and suffer from significant problems with executive functions, emotion regulation, and

social interactions [13–20]. According to Garcia et al.'s [21] findings, between 50 and 70% of children with ADHD have a predicament in social interaction with their peers and cannot inhibit their problematic behaviors. Incompatible communication patterns in people with ADHD lead to social unacceptance by peers and gradually cause emotional and behavioral confusion. Although many therapeutic interventions have been used to reduce the main symptoms of this disorder, their social and emotional problems persist [22]. Recent scientific reports on ADHD suggest that emotion regulation may be a fundamental factor in the development and continuation of this disorder [23]. Emotional instability, sudden and severe anger, intense emotional responses, confusion at work, instability in interpersonal relationships, job and academic failure, alcohol abuse, and unusual responses to psychotherapy are among the significant problems faced by people with ADHD [24]. Given the adaptive value of emotions, it can be said that emotions affect people's cognitive systems and help improve social functions in line with environmental requests [16, 25]. People need several effective strategies in emotion regulation to adjust their emotions and adapt to social situations [17]. The critical questions of the present study are, given the vital place of emotion regulation, is the problem of emotion regulation in people with ADHD just an essential symptom of this psychiatric disorder or a separate issue? Which brain structures is the emotion regulation process associated with, and what areas of the brain are involved in neurological problems in people with ADHD? What strategies do people with ADHD use to regulate emotion? What tools are used to measure emotion regulation in different approaches? In this study, we are trying to answer the above questions so that professionals and therapists can provide more valuable services to help this spectrum of society.

2. Emotion regulation and ADHD

Belief in the ability to change our emotions has a long history and has been explained in fundamental theoretical and experimental research under various titles, such as psychological defense and coping style [25–27]. In the 1990s, emotion regulation (ER) emerged as a distinct field of research [28–31]. Emotion regulation is the ability to generate, maintain, decrease, and increase the intensity or abundance of emotion [32, 33]. Emotion regulation involves strategies that modulate and maintain an emotion and cope with tense situations [34, 35]. Emotion regulation is associated with transforming and modulating executive functions, including inhibition, planning, and working memory [36, 37]. Although emotion regulation is often conscious, it can occur implicitly and unconsciously [38, 39]. The processing and regulation of emotions are closely related to individual transformation. They are influenced by the behaviors of caregivers in early childhood, but in later years, it is facilitated by innate processes, social, interpersonal, and cultural factors, and neurological advances [40–44]. In the adult period, neurocognitive processes are developed through the widespread application of cognitive-behavioral strategies, including cognitive reassessment and problem-solving [42, 44]. Although not a new phenomenon for researchers, emotion regulation has been the focus of attention in people with ADHD [45–47]. Studies have shown that executive functions and emotion regulation are related [45, 46]. According to Bailey and Jones views [48], regulating emotions, cognitive processes, and social interactions occurs based on the components of the brain's executive functions, including working memory, inhibition, attention, and displacement, and becomes complex. Problems associated with emotion regulation appear

much earlier in children with ADHD compared to other children with typical neuro-developmental disorders [49]. In addition, the weaker the ability to regulate people's emotions, the greater the severity of the symptoms [50, 51]. Even though there is more evidence for children than adults in emotion regulation, the findings suggest that adults with ADHD use more incompatible emotion regulation strategies (such as suppression) [52, 53]. It should be noted that this finding has not been obtained by other researchers so far, and this lack of coordination can be caused by diagnostic tools or comorbidity of other disorders in adults [10, 20, 54–56]. The Shaw et al. [47] study of the overlap between ADHD and emotion regulation presented three models. In Model 1, emotion regulation and ADHD are wholly interconnected and intertwined. In other words, the inability to regulate emotion is the central core of ADHD symptoms. In this model, emotion regulation is the same as neurological disorders that underlie ADHD. Based on this model, it is valuable and necessary to teach emotion regulation strategies to help people with ADHD. In Model 2, emotion regulation and ADHD are separate and have different neurological and clinical etiologies. In Model 3, emotion regulation and ADHD are interconnected but completely independent. In this model, a moderate relationship between emotion regulation and ADHD is observed from early childhood to adulthood. The three models seem to gain a thorough understanding of the type of emotion regulation and ADHD association and address the genetic, neurological, and clinical characteristics pertaining to both of them. These three models also demonstrate the need for a hybrid pattern [51, 57–61].

3. Emotion regulation and parenting interactions

Parent-child interactions and emotional socialization may affect children's competence in the field of emotion regulation in a way that exacerbates children's ADHD symptoms, provides the basis for the development of these diseases, or disrupts the process of transferring self-regulatory skills [62]. However, coping with a child's negative emotions is essential for socialization and emotion regulation. Adopting unsupportive and inefficient strategies by parents aimed at controlling children's negative emotions may lead children to suppress negative emotions in later life. This repression is followed by cases such as negative emotional arousal and unregulated anxiety in people, and by internalizing negative emotions, emotional irregularities and less adapted behavioral responses are provided in the person [40, 63, 64]. Negative parental beliefs, conflicting family circumstances, and inefficient parenting styles are more common among families of children with ADHD than those of children without ADHD, and the educational style of these types of families causes behavioral problems and opposition of children with ADHD in the school context [65–67]. However, parental adaptation and social cohesion within families can act as a protective factor against behavioral problems in children with ADHD and improve their socialization process [68, 69]. The inability to regulate emotion during the early years of life may make the child susceptible to psychiatric disorders in subsequent periods of transformation. In line with mood characteristics in children with ADHD, the appearance of negative emotions in toddlers (frequent crying, inability to relieve themselves, or intolerance to failure) may be signs of impaired emotion regulation, perpetuating their behavioral problems and aggression in childhood and adolescence [70, 71]. As children grow older, they become more efficient in the field of emotion regulation through the development of brain executive functions and gradually learn to respond to life experiences in a socially acceptable and flexible

way [72]. As they enter adolescence, the process of emotion regulation appears more complex, so they also pay attention to the perspective of others in the field of emotional expression, adopt more adaptive strategies to deal with negative emotions (such as reassessing, gaining peer support or parenting, distracting attention, positive re-concentration, and so on...), use less repression, feel competent when others confirm their expression, interact with peers more desirably, and model as many successful and famous people as possible to mature [73–75]. Those who have experienced a restrictive parenting style in childhood may experience internal and external problems in adolescence, including poor self-control, inconsistency, breakdown of norms, intellectual rumination, destructive interactions, low resilience, and inefficient self-regulation [40, 72, 74, 76–79]. Subsequently, the occurrence of these multilateral problems by children and adolescents causes more severe reactions from parents, thus exacerbating their opposition and stubbornness [68, 80–84]. In addition, in the context of gender differences, boys may have fewer emotion regulation strategies, show more negative emotions than girls, and tend toward drug use or delinquent behavior. While girls may internalize symptoms and make them prone to depression in adolescence [1, 85, 86]. As described, emotional regulation skills develop during different developmental periods, especially childhood and adolescence, affect parental behaviors, and potentially protect or predispose people to problems. Therefore, parental education in the field of emotion regulation, healthy parenting, and ADHD-related behavior management can act as a shield against subsequent issues so that we do not witness unregulated emotions and comorbidity disorders.

4. Review of emotional regulation interventions

1. *Emotion regulation process model of Gross [87]*: James Gross is an emotion researcher who focuses on emotion regulation and develops the process model of emotion regulation. According to Gross, emotion regulation constitutes any effort to modify any emotional experience (positive and negative). It involves different processes such as: (1) selection of the situation, (2) modification of the situation, (3) attention to the situation, (4) change of thoughts regarding the situation, and (5) modulation of responses. The first four processes occur before an emotional reaction (antecedent-focused), and the last one, modulation of responses, is directly related to the emotional experience (response-focused). Antecedent-focused regulation occurs before the emotion is fully experienced or during the emotional experience, whereas response-focused regulation occurs after the emotion has wholly developed. Gross [88] believed that processes for regulating emotion can co-occur. An expanded model of Gross states that three valuation systems are involved in emotion regulation, distinguished by where they occur in the emotion regulation process. The first stage, identification, involves the detection of an emotion (perception), its evaluation as an experience that requires regulation (valuation), and a decision about whether regulation will begin (action). The second stage, selection, involves the identification of available emotion regulation strategies (perception), evaluation of whether specific strategies will be more or less successful depending on internal and external contextual factors (valuation), and making the choice to use a particular strategy (action). The third and final stage, implementation, involves translating a general emotion regulation strategy into specific behaviors that would be most

suitable for that specific situation (perception), evaluating the likely effectiveness or ineffectiveness of specific emotion regulation strategies (valuation), and choosing and implementing a specific emotion regulation strategy (action) [8, 16, 87, 89–91].

2. *Emotion regulation model of Allen et al. [92]*: In this model, which is based on eight principles, people are instructed to talk about positive emotions like happiness, pleasure, and love, as well as negative emotions like sadness, regret, and hatred, and to jot down any emotional state they experience and similar ones. This process is known as emotional labeling. Second, people are taught to identify and name emotions to distinguish between positive and negative emotions and to identify their psychological and physical effects. This is called emotional differentiation. Third, people are taught ways to increase positive experiences, including browsing, mental visualization of pleasant scenes, neglect of anxiety, cognitive consequences, etc. These are strategies for enhancing positive emotions. Self-regulation strategies, such as acceptance, positive re-concentration, positive re-planning, and evaluation, are also taught. These are techniques for managing emotions. Fourth, people are prepared to reduce their negative emotions by stopping mental eating, getting enough sleep, taking care of themselves, and correcting harmful thoughts. These are strategies for reducing negative emotions. Fifth, people either pay enough attention to their positive or negative emotions and accept them without judging the proper expression of emotion. This is known as emotional acceptance. Sixth, essential and notable points about how people are informed about the relationship between emotions and thoughts, how to reassess positive and negative emotions, pay attention to the consequences of each emotion, and express themselves healthily. This is known as emotional understanding. Seventh, it is taught theoretically and practically in changing negative emotions through action, unlike previously experienced emotions, such as fear, anxiety, anger, and stress. This is known as emotional change. Finally, there is a preliminary assessment of the goals' achievement level and a clear explanation of applying the skills gained in different environments, such as home and school [92, 93].

3. *Meta-Thinking Training Program Based on Mental-Brain Simulation (MTMBS)*: This treatment protocol was developed by Mahdavi et al. [94] with an emphasis on cognitive and neuropsychological principles, including eight sessions focused on the present moment and self-awareness. The MTMBS protocol encourages individuals to change thoughts and mental images based on meta-thinking styles, principles of mental imagery, mental simulation methods, and Default Mode Network (DMN) suppression techniques. Adopting a third-person view of life, deep self-understanding, controlled and favorable reactions in challenging interactions and situations, selective decision-making in various aspects of life, responsibility in choices, considering the consequences of actions, and developing a future mindset are benefits of participating in this treatment protocol. In addition, MTMBS enables people to perform their tasks and experience a sense of self-efficacy. People are taught to use dialectical thinking patterns to clarify different aspects of a particular concept and to overcome contradictions. Also, repeat the way a behavior or action is performed in the future, associate thoughts, emotions, and behaviors, notice their positive aspects, change their own beliefs and mental tendencies, understand the details of a particular

hypothetical or actual event, visualize a positive pattern of self-fulfilling work, prepare to deal with future stressful or uncomfortable events, identify potential challenges and problems, and understand how to elevate them. Targeted exercises, such as confronting stimulating situations, identifying unpleasant emotional experiences in different tissues (home, school, or neighborhood), and replacing them with pleasant and adaptable emotions in simulated situations, help them visualize and improve their sense of self-efficacy and human action and manipulate their situation or emotions, relying on reassessment, rather than being passive. To reduce internal tension and inspire calm, they are taught to imagine a successful and ideal future with challenges in their minds and to simulate an efficient model of themselves to convert cognitions into actions. In addition, we ask the clients in a state of relaxation to imagine two boards in their minds (A/B). In the A-board, all the disruptive things in the past are written and drawn along with the images related to them. On the B-board, he is asked to write and draw all the positive changes that want to happen in the behavioral, emotional, cognitive, and social fields. Then, it is necessary to put away A-board in his mind so far that it disappears, leaving no trace of it. Nevertheless, it makes the B-board significant so that it encompasses the whole space of her mind, and she finds herself/himself trying to do it [94].

4. *Emotion regulation model of Gratz and Gunderson [95]*: This emotion regulation model aims to explain how people regulate their emotions and manage emotional distress. The underlying idea of the Gratz and Gunderson model is that regulation of emotion as a complex process involves cognitive, emotional, and behavioral dimensions. Their emotion regulation model consists of three fundamental components: (A) Reappraisal: This component is considered the first stage of the emotional regulation process. At this stage, individuals assess the environment and the stimuli they encounter, and based on this assessment, they determine how they react, (B) Emotion generation: At this stage, the emotional reactions of the person (fear, anger, or grief) that result from initial evaluation, personal experiences, past trauma, and cultural norms are activated, and (C) Emotion regulation: At this point, a person employs various strategies, including reappraisal, suppression, avoidance, rumination, etc., to manage or regulate the emotional response. People in the field of emotion regulation have significant individual differences from each other, including emotion regulation, emotional responsiveness, and emotional resilience. Studies have shown that the emotion regulation model can help develop psychological interventions to treat mood and anxiety disorders, developing educational protocols to enhance emotional intelligence in people of different age groups, and building health-oriented programs for employee well-being. In general, this emotion regulation model provides a comprehensive framework for understanding emotions and how to regulate them, allowing the development of more effective interventions and strategies to promote emotional health [95–98].
5. *Emotion regulation techniques of Leahy et al. [99]*: The designers of this model have introduced a cognitive-behavioral model of emotion regulation. According to this model, people use specific cognitive and behavioral strategies that can be adaptive or non-adaptive to regulate their emotions. The model consists of four very important components, including cognitive assessment, emotion production, emotion regulation, and emotion expression. In Cognitive Assessment,

individuals engage in cognitive interpretation of the situation and determination of the importance of emotion. In line with the views of Leahy and colleagues, individuals use specific cognitive frameworks, including cognitive biases, to evaluate situational events. At the stage of emotion generation, people produce emotion in response to cognitive assessments, and this process is influenced by a variety of factors, such as past experiences, personality traits, and social learning. In the emotion regulation phase, people regulate emotion through cognitive-behavioral self-regulation strategies, such as avoidance, suppression, and reassessment. Finally, in the emotional expression section, people respond to the process of regulating various physical-behavioral reactions, such as crying, laughing, and extrusion. The theme of this model indicates that people use different ways to regulate their emotions, which can be consistent or inconsistent. For example, when a person uses avoidance or repression to regulate their emotion, it may lead to incompatible and undesirable consequences, for instance, increased anxiety or depression. In this model, therapists can use cognitive-behavioral techniques to help patients identify and challenge incompatible strategies and more effectively regulate their emotions [100].

6. *Reinforcement learning perspective*: The reinforcement learning perspective-based emotion regulation model is a dynamic decision-making process involving learning and adaptation. This model includes essential factors, including the emotional state of the individual (intensity, duration, and value of emotion), constructive action (emotion regulation strategies), reward (positive and negative consequences of emotion regulation strategies), and value (determination of the amount of value assigned to emotional state and consequences of emotion regulation). In this model, the learner adjusts his emotions through trial and error, associates some emotion regulation strategies with specific outcomes, and adjusts his behavior accordingly. In addition, things like a person's long-term goals, emotion modulation practices, reward performance, learning speed, exploratory learning, and benefiting from experiences help a person to perform the emotion regulation process more efficiently [101, 102]. Relying on this emotion regulation model, we can better understand how people learn the self-regulation process and adapt over time. In this approach, which emphasizes the development and validation of computational models of selective behavior, people continuously make choices based on predictions they make about the value of stimuli or "good for me–bad for me" actions. Value predictions depend on rewards or punishments that are considered guiding behavior in the future. Based on this approach, calculations that determine and execute the actions of the emotion regulator may occur consciously or unconsciously. Therefore, the discrepancy between the predicted emotional state and the actual emotion can be considered a predictive error, showing that the regulatory action has not achieved its expected result [103]. When emotion moves away from the emotional state of the goal, there is a negative prediction error. When emotion exceeds the emotional state of the goal, there is a positive prediction error. The reinforcement learning approach distinguishes between two types of decision control: model-free and model-based. Although model-free control has low flexibility, it is very efficient because its response to environmental events occurs in a limited set of potential stimuli and responses, and behavior is driven purely by predictive errors experienced. While model-based control is characterized by systematic decision-making and dynamic computing, it is less computationally

efficient than model-free control. In addition, using model-based control does not require new experiences to build a model, meaning that individuals can use their existing knowledge and understanding of the environment to regulate their emotions. Most people combine model-free control and model-based control to regulate emotions, but one may prevail and gain more weight than the other, or both may go parallel [101–103].

In general, these patterns provide a comprehensive framework of interventions that emphasize teaching cognitive, behavioral, and neurological aspects.

5. Neurocognitive mechanisms of emotion regulation

On the neurological level, the emotions engage the subcortical regions (amygdala, ventricular striatum, and periorbital gray) and the cortex (anterior insula and dorsal anterior cingulate) [103–106]. As you know, several strategies can regulate emotions. However, imaging studies have shown that the most widely used strategy is reappraisal, in which a person actively seeks to adjust purposefully the way of thinking about the meaning of a stimulus or emotional position [90, 107, 108]. Based on the findings of behavioral studies and neuroimaging, emotion regulation comprises two distinct types: explicit and implicit [107]. Explicit emotion regulation requires conscious effort and active monitoring and is associated with a level of insight and awareness (such as reappraisal) [109, 110]. At an unconscious and subcortical level, the implicit adjustment is triggered automatically by the stimulus itself without conscious supervision [107]. Regulating “explicit” emotions involves several brain regions, including the dorsolateral prefrontal cortex (dlPFC), ventrolateral prefrontal cortex (vlPFC), supplementary motor area (SMA), pre-supplementary motor area, and placental cortex. According to Etkin et al. [103], the regulation of “implicit” emotions involves the ventricular anterior cingulate cortex (vACC) and the ventromedial prefrontal cortex (vmPFC). Studies in recent years have shown that reassessment is compelling in organizing responses in systems associated with emotional response, especially the amygdala (reacting to the presence and encoding of emotion-related stimuli), insula (responding according to the reward value of stimuli), and the abdominal striatum (representing information about physical states associated with emotional responses) [107, 111, 112]. Reappraisal through a network of different brain regions including the ventrolateral prefrontal cortex (vlPFC), posterior medial prefrontal cortex (pmPFC), dorsolateral prefrontal cortex (dlPFC), posterior parietal cortex (PPC), and anterior cingulate cortex (ACC) that modulate cognitive functions affect areas related to emotion regulation [107, 109, 111–113]. Neurological research on emotion regulation suggests that the control areas of the forehead of the brain (dorsolateral prefrontal cortex and ventrolateral prefrontal cortex) have a slower rate of transformation than the areas of emotional response (amygdala and ventral striatum) and peak in adolescence and appear to be a convincing response to mood instability and excessive emotional responsiveness in this age group [114–116]. Adverse environmental events as a stressor can affect a person’s ability to regulate emotions. Although moderate stress levels improve the learning process through increased alertness and attention, severe stress (exam anxiety) and chronic stress (poverty) can cause irreparable damage to a person’s cognitive abilities [117–119]. Kim et al. [117] found that adults who experienced childhood poverty were more likely than adults who grew up in favorable economic conditions to experience chronic stress exposure impacting

neural activity, such as reduced activation of the lateral dorsal prefrontal cortex and lateral ventricular prefrontal cortex and increased amygdala activation. Experiencing more adversity in life is associated with a more fantastic neurological reaction to negative images in the amygdala and various activation patterns in the prefrontal cortex of the brain [120]. Some researchers believe positive emotions increase attention and concentration, accelerate learning, and empower memory [121]. For example, receiving positive feedback (getting rewarded for getting a grade in the exam) compared to negative feedback (being punished or rejected) can trigger a better emotional response and function and activate different neural circuits [122–124]. In addition, in the social regulation of emotions in children and adolescents, an adult caregiver can play an effective and decisive role in reducing emotional responses when there exist harmful stimuli, avoiding dangerous choices when deciding in sensitive situations, increasing activation in control areas including the ventrolateral prefrontal cortex and posterior medial prefrontal cortex, and reducing the activation of the ventral striatum and amygdala [125–127]. However, peers instead of adults may lead to impulsive decision-making and increased activation of the ventral striatum and ventrolateral prefrontal cortex [128, 129]. When children and adolescents are excluded from peers, increased activation of the anterior cingulate cortex and posterior medial prefrontal cortex is associated with symptoms of depressive disorder and social pain [128, 130].

6. Conclusion

The study attempted to present different approaches and models of emotion regulation. It was observed that, in some approaches, emotion regulation is emphasized as part of psychiatric disorders (such as ADHD and MDD (major depressive disorder)); in others, it is distinct and separate from disorders, and in other approaches, it is associated with disorders. The presentation of different patterns of intervention improving emotion regulation indicates a diversity of educational strategies on the one hand and brain-based intervention on the other. In a few studies, both aspects of emotion regulation have been considered. The present study showed that training and interventions when regulating emotion can help reduce psychological problems and improve the brain's executive functions. Accordingly, it seems that to reduce the adverse effects of ADHD, the use of a set of strategies can be more effective. According to existing research, emotion regulation affects people's mental health and quality of life. Although the ability to self-regulate emotions helps people achieve their goals in life with greater ease, any significant deficit in emotion regulation can make them vulnerable to psychosocial disorders. Parents and professionals can teach children and adolescents how to behave in exposure to positive and negative emotions, how to explain their emotional experiences in interaction with others, what strategies to use in response to complex situations to moderate emotions, play a more active role in various life situations, and express themselves more adaptable by being aware of the adverse consequences of negative emotions and the effectiveness of positive emotions. Since the human mind has very high flexibility and neuroplasticity in childhood and adolescence, educators and behavioral sciences professionals implement courses on self-reflective thinking, problem-solving, evidence-based decision-making, strengthening executive functions, coping with social damages, identification, secure attachment, socialization, and healthy resilience for parents, teachers, and students to take a practical step in prevention to remove the prevalence of this social-emotional disorder and its subsequent consequences at different levels of society and facilitate the flourishing of their talents.

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