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The Effect of Impulsivity and Emotional Dysregulation on Trichotillomania in Bipolar Disorder: A Multidimensional Clinical Research

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Abstract

Objective: This study aimed to evaluate the effects of impulsivity and emotion dysregulation on trichotillomania (TTM) in adolescents with bipolar disorder (BD). We hypothesized that adolescents with comorbid BD and TTM would exhibit higher impulsivity, more severe emotion dysregulation, and a more complex clinical presentation compared to adolescents with BD alone and healthy controls.

Method: In this cross-sectional study, 120 adolescents aged 12-18 were assessed, comprising three groups: BD with a history of TTM (n=40), BD without TTM (n=40), and healthy controls (n=40). Participants were evaluated using standardized measures including the Barratt Impulsivity Scale (BIS-11), the Difficulties in Emotion Regulation Scale (DERS), the Young Mania Rating Scale (YMRS), and the Trichotillomania Global Severity Scale (TGSS).

Results: Both clinical groups (BD+TTM and BD-only) displayed significantly higher impulsivity than healthy controls, but there was no statistically significant difference between the two clinical groups in terms of impulsivity. However, a clear gradient was observed in emotion dysregulation; the BD+TTM group had the highest scores, followed by the BD-only group, with both being significantly higher than controls. Multiple regression analysis revealed that emotion dysregulation was the strongest predictor of TTM severity ($\beta = 0.0598$, $p < 0.001$). Furthermore, mania scores were significantly higher in the comorbid group and moderated the relationship between emotion dysregulation and impulsivity.

Conclusion: A history of TTM in adolescents with BD is a clinical indicator of profound emotion dysregulation rather than merely elevated impulsivity. These findings suggest that hair-pulling may function as a maladaptive coping mechanism for overwhelming emotional states. Therapeutic interventions should therefore prioritize targeting emotion regulation skills in this high-risk comorbid population.

INTRODUCTION

Trichotillomania (TTM) is a complex disorder characterized by the repetitive pulling out of one's own hair, resulting in significant functional impairment and psychosocial difficulties [1]. Classified under "Obsessive-Compulsive and Related Disorders" in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), TTM typically manifests or exacerbates during adolescence and often follows a chronic course [2]. Because adolescence is a pivotal developmental stage centered on identity formation, peer socialization, and academic achievement, the presence of TTM can profoundly damage an individual’s self-perception, leading to social isolation, stigmatization, and school failure [3, 4]. Phenomenologically, the behavior is often triggered by negative affective states—such as stress, anxiety, tension, or boredom—and is followed by a sense of relief; this cycle suggests that hair-pulling functions as a maladaptive mechanism for emotion regulation or coping.

While TTM has traditionally been categorized as an impulse control disorder, emerging empirical evidence indicates that this classification fails to capture the full complexity of the condition. In severe presentations, TTM often co-occurs with broader self-harm behaviors, suggesting it may serve as an entry point into more pervasive self-injurious patterns. This is particularly relevant for individuals with comorbid mood instability, where hair-pulling may act as a strategy to regulate affective tension rather than merely representing a failure of behavioral inhibition.

A critical clinical observation supporting this view is the treatment resistance often seen in TTM patients who possess overlapping bipolar features. These patients frequently fail to respond to first-line interventions, such as selective serotonin reuptake inhibitors (SSRIs) and habit reversal training (HRT). Conversely, such complex cases have demonstrated notable clinical improvement when treated with mood stabilizers. These specific therapeutic responses support the hypothesis that, in comorbid presentations, TTM symptoms are a reflection of dysregulated mood states

rather than isolated impulsivity. Consequently, the efficacy of mood stabilizers in this population likely stems from their ability to buffer emotional reactivity and promote affective stability. This evolving conceptualization necessitates a paradigm shift: TTM, particularly within the context of bipolar comorbidity, should be evaluated within the broader framework of mood regulation disorders.

Bipolar disorder (BD), a chronic mood disorder defined by manic, hypomanic, and depressive episodes, has a significant prevalence in the adolescent population [5, 6]. The potential intersection between TTM and BD is most evident in the shared domains of impulsivity and emotion dysregulation. In TTM, the inability to resist urges and the use of pulling to alleviate distress represents both impulsivity and maladaptive regulation. Similarly, BD is characterized by prominent impulsive behaviors—such as excessive spending, substance use, or risky sexual behavior—and intense emotional lability [7–10]. Furthermore, impairments in executive functions, such as planning and inhibition, are well-documented in both disorders.

These phenomenological overlaps suggest that a history of TTM in adolescents with BD may exacerbate existing deficits in impulsivity and emotion regulation, potentially worsening the clinical course of BD regarding episode severity, frequency, and treatment resistance. Despite these shared neurobiological and clinical mechanisms, there is a notable absence of systematic research examining how a history of TTM influences the clinical presentation of BD in adolescents.

To address this gap, this study aims to evaluate the specific effects of impulsivity levels and emotion regulation skills on TTM in adolescents with bipolar disorder. The primary hypothesis is that adolescents with BD and a history of TTM will exhibit significantly higher impulsivity, more severe emotion dysregulation, and a more complex clinical profile compared to both healthy controls and adolescents with BD alone. Additionally, the study seeks to determine if the prevalence and severity of TTM vary across different clinical presentations of the bipolar spectrum.

METHOD

This study is a cross-sectional, analytical, and quantitative study aiming to examine the effect of trichotillomania history on impulsivity and emotion regulation skills in adolescents with bipolar disorder (BD) and was conducted at xxxxx University Faculty of Medicine Hospital, Child and Adolescent Mental Health Outpatient Clinic. Within the scope of the study, a total of 120 participants, consisting of 80 adolescents (BD with a history of trichotillomania = 40; BD without a history of trichotillomania = 40) between the ages of 12–18, diagnosed with BD (Type I or Type II) according to DSM-5 criteria and who participated voluntarily, and 40 healthy control subjects without psychiatric diagnosis were evaluated. The sample size was calculated with G*Power 3.1 software according to 95% confidence level and 5% significance level, and 40 participants were included in each group considering possible sample loss. Participants were matched in terms of age and gender, and parental and adolescent consents were obtained in writing. Diagnostic evaluations were performed by experienced psychiatrists using the Kiddie Schedule for Affective Disorders and Schizophrenia - Present and Lifetime Version (K-SADS-PL, DSM-5 adaptation).

The Barratt Impulsivity Scale (BIS-11) [11, 12] the Emotion Regulation Difficulty Scale (DERS) [13, 14], the Beck Depression Inventory (BDI) [15, 16], the Hamilton Depression Rating Scale (HDRS) [17, 18], the Young Mania Rating Scale (YMRS) [19, 20], the Trichotillomania Global Severity Scale (TGSS) [21] and the Childhood Emotional Disorders and Schizophrenia Interview Schedule – Present and Lifetime Form (K-SADS-PL) [22, 23] were administered to the patients to assess their relevant traits. The assessments were carried out by trained psychiatrists in a structured two-stage process in a private environment free from distracting stimuli. The data were anonymized and stored in a secure digital environment accessible only by the research team, and the study was conducted with the approval of the University Medical Research Ethics Committee in accordance with the Declaration of Helsinki and Good Clinical Practice Guidelines (Approval Number 2025–5705). All statistical analyses were conducted using IBM SPSS Statistics for

Windows, Version 28.0.1.1 (Armonk, NY: IBM Corp.), R software version 4.3.2 (R Core Team, 2023), and Python version 3.11.4 (Python Software Foundation, 2023). Descriptive statistics were calculated to summarize demographic and clinical characteristics. Normality of distribution was assessed via Shapiro–Wilk and Kolmogorov–Smirnov tests. For group comparisons, independent samples t-tests, one-way ANOVA, and where appropriate, non-parametric equivalents such as the Mann–Whitney U and Kruskal–Wallis tests (with Dunn's post-hoc correction) were employed. Correlation analyses were performed using Pearson's or Spearman's correlation coefficients depending on variable distribution. To identify significant predictors of trichotillomania severity, multiple linear regression analyses were conducted. In addition, hierarchical moderation models were used to test for interaction effects between clinical variables. Statistical significance was determined using a threshold of $P < .05$, and effect sizes were reported using Cohen's d for pairwise comparisons and η^2 (eta-squared) for ANOVA models. Multicollinearity was assessed using Variance Inflation Factor (VIF) values, and model assumptions were verified through residual diagnostics and Durbin–Watson tests. Cluster analysis was conducted using the K-means algorithm, and the Elbow Method alongside Silhouette Scores was employed to determine the optimal number of clusters. These unsupervised machine learning procedures were implemented in R (package: factoextra) and Python (library: scikit-learn v1.3.0). This analysis enabled the identification of six distinct clinical subgroups and supported individualized interpretations of psychopathological profiles.

RESULTS

Sample Characteristics

In the comparative analyses, no statistically significant difference was found between the three patient groups in terms of basic sociodemographic variables such as age, gender, place of residence, parental education level and family structure. T-test and ANOVA analyses revealed no significant difference between the groups in terms of these variables ($p > 0.05$).

Barratt Impulsivity Scale Results

In the assessments made on the Barratt Impulsivity Scale (BIS), the clinical groups (Bipolar Disorder with Trichotillomania and Bipolar Mood Disorder groups) showed significantly higher impulsivity scores compared to the control group (Fig. 1**)**. According to the results of the post-hoc Dunn's test, a statistically significant difference was found between the TTM + BPD group and the control group ($p < 0.001$). Similarly, a significant difference was observed between the BD group and the control group ($p < 0.001$). On the other hand, there was no significant difference between the TTM + BD group and the BD group in terms of impulsivity levels ($p \approx 0.081$). When descriptive statistics were analyzed, it was observed that the mean BIS scores of the TTM + BPD group were higher than the other groups.

Emotion Dysregulation Scale Findings

In the evaluations made on the Difficulties in Emotion Regulation Scale (DERS), significant differences were found between the three groups in terms of emotion regulation difficulties (Fig. 2). According to the results of the post-hoc Dunn test, statistically significant differences were observed between all groups. The difference between the TTM + BD group and the control group was especially statistically significant ($p < 0.001$). When the descriptive statistics were analyzed, it was determined that the TTM + BD group had the highest level of emotion dysregulation difficulty scores compared to the other groups; the BD group had an intermediate level and the control group had the lowest level.

Young Mania and Beck Depression Scores

The median mania score is notably elevated in the comorbid group, and the overall distribution is wider (Fig. 3). The p-value ($p < 0.001$) indicates that this difference is statistically significant. In contrast, the Beck Depression scores appear relatively similar between the two groups. While there is some variability, the median scores and distributional patterns do not differ substantially. The p-value ($p > 0.05$) confirms that the difference is not statistically significant.

Correlation Analysis

As a result of the correlation analyses conducted in the study, a very strong and positive correlation was found between TTM Global Scale scores and Difficulties in Emotion Regulation scores ($r = 0.76$, $p < 0.001$) (Fig. 4). In addition, there was a moderate positive correlation between TTM Global Scale scores and Beck Depression Scale scores ($r = 0.58$, $p < 0.001$). There was a positive correlation between Barratt Impulsivity Scale and Young Mania Scale ($r = 0.38$), a significant positive correlation between Difficulties in Emotion Regulation and Beck Depression scores ($r = 0.57$), and a negative correlation between Difficulties in Emotion Regulation and Young Mania scores ($r = -0.37$). In particular, the very high correlation between the TTM Global Scale score and the Emotion Dysregulation score ($r = 0.76$) suggests that these two scales assess similar psychopathological structures and is a remarkable findings.

Main Findings of the Regression Model

A multiple linear regression analysis was conducted to examine the independent contributions of four psychological variables—emotion dysregulation, impulsivity, depressive symptoms, and manic symptoms—to trichotillomania severity, as measured by the TTM Global Scale Score. The model was statistically significant and accounted for a moderate proportion of the total variance ($R^2 = 0.512$, $F(4, 115) = 30.12$, $p < 0.001$), indicating that the included predictors collectively explained approximately 51.2% of the variance in symptom severity. Among the predictors, Difficulties in Emotion Regulation (DERS) demonstrated the strongest statistical association with the outcome ($\beta = 0.0598$, $p < 0.001$). The Barratt Impulsivity Scale (BIS) score also showed a statistically significant effect ($\beta = 0.0109$, $p = 0.016$), albeit smaller in magnitude. In contrast, the Beck Depression Inventory (BDI) and Young Mania Rating Scale (YMRS) scores were not significant predictors ($\beta = 0.0156$, $p = 0.204$; $\beta = 0.0227$, $p = 0.355$, respectively). Variance inflation factors indicated moderate multicollinearity between DERS (VIF = 5.93) and BIS (VIF = 5.33), suggesting the presence of shared variance that does not exceed critical thresholds but warrants interpretive attention. The correlation between these two variables was $r = 0.462$. Notably, the current model's R^2 value (0.512) is lower than that observed in preliminary analyses ($R^2 = 0.941$), potentially reflecting differences in variable standardization, data preprocessing, or model specification. Despite this reduction, the final model retained statistical integrity and yielded stable coefficient estimates across predictors.

Moderating Role of Young Mania Variable

In this study, the possible moderating role of Young Mania score in the relationship between Emotion Regulation Score and Barratt Impulsivity Score was examined. The analysis revealed that the interaction term was statistically significant ($p < 0.001$), indicating that Young Mania significantly affected the relationship between these two variables. As Young Mania scores increased, the effect of the Emotion Regulation Score on the Barratt Score became stronger. This moderation effect was also observed in the interaction graph generated at three levels of Young Mania (low, medium, high), showing that the slope of the relationship increased with higher Young Mania levels (Fig. 5). For individuals with high Young Mania scores, the Barratt Impulsivity Score increased more rapidly with rising Emotion Regulation Scores, whereas this increase was more limited in individuals with low Young Mania scores.

In addition, the association between emotion regulation difficulties and TTM Global Scale scores was examined across different levels of Young Mania. At low levels of Young Mania, the slope of the relationship was 0.0630. In the moderate Young Mania group, the slope was 0.0548. At high levels of Young Mania, the slope increased to 0.1071, indicating a stronger positive association. These results indicate that Young Mania level moderates the strength of the relationship between emotion regulation difficulties and trichotillomania severity (Fig. 6).

Cluster Analysis

The optimal number of clusters was determined using Elbow and Silhouette methods (Fig. 7). Although the Silhouette score peaked at four clusters, the Elbow plot indicated a distinct inflection point at six; consequently, the six-cluster solution was selected to balance structural quality with superior clinical differentiation.

[Insert Table 2 **here]**

As detailed in Table 2, six distinct phenotypes emerged. Cluster 1 (Low Symptom) exhibited minimal psychopathology, representing a resilient phenotype, whereas Cluster 0 (High Impulsivity) was characterized by elevated impulsivity and emotion dysregulation despite the absence of significant mood symptoms. Cluster 2 (Manic Features) showed a hyperarousal-dominant profile with sharply elevated mania scores. Cluster 3 (Mixed Mood) was defined by high scores in both depressive and manic domains, indicating emotional instability. Cluster 4 (Severe Depressive) was marked by severe depression and dysregulation with minimal mania, while Cluster 5 (High Impulsivity & Mixed Mood) displayed the highest impulsivity levels alongside co-occurring mood symptoms, representing the most high-risk clinical profile. The clinical validity of these subgroups was further supported by Trichotillomania (TTM) Global Scale scores (Fig. 8). Cluster 2 exhibited the highest mean TTM score (8.11), followed by the affectively burdened Clusters 5 and 3. Conversely, Cluster 1 reported no TTM symptoms, suggesting a strong dimensional link between the severity of affective dysregulation and hair-pulling behavior.

DISCUSSION

Group Differences in Impulsivity and Emotion Regulation

The present study investigated the differences in emotional dysregulation and impulsivity traits among patients diagnosed with trichotillomania comorbid with bipolar disorder, bipolar disorder, and controls. The primary finding of our study is that, although both clinical groups exhibited elevated levels of impulsivity in comparison with the control group, there was no statistically significant difference between the two clinical groups. Nevertheless, a substantial gradient was revealed by the scores of emotional dysregulation: the BD + TTM group demonstrated the highest level of disorder, followed by the BD group. The mean scores obtained by both of these groups were significantly higher than those of the control group. Interestingly, although the TTM + BD group exhibited numerically higher impulsivity scores than the BD-only group, the difference did not reach statistical significance ($p < 0.05$). This finding does not fully support our initial hypothesis that a comorbid history of trichotillomania would amplify trait impulsivity in youth with bipolar disorder.

Several plausible explanations can be considered. One possibility is a ceiling effect, where baseline impulsivity is already elevated in the BD group to a degree that leaves little statistical room for further differentiation. Alternatively, compensatory regulatory mechanisms or greater treatment exposure in the TTM + BD group (e.g., earlier mood stabilizer use due to more overt symptomatology) may have mitigated observable impulsivity. It is also worth considering that impulsivity, though present, may not be the primary trait that distinguishes the TTM + BD subgroup; rather, emotional dysregulation appears to play a more central and robust role, as confirmed by both the regression and moderation analyses. This pattern suggests that hair-pulling behaviors in BD youth may be more directly linked to emotional dyscontrol than to raw impulsive tendencies per se, a distinction with important therapeutic implications.

Correlation and Regression Analysis and Model Interpretation

Correlational analyses provided initial insights into the interrelationships among key clinical dimensions. The strongest association was observed between trichotillomania (TTM) severity and emotion dysregulation (r = 0.76), indicating a profound link between hair-pulling behavior and underlying affective instability. Moderate correlations were also noted between TTM severity, depressive symptoms, and impulsivity constructs. These findings support the hypothesis that emotion regulation difficulties represent a transdiagnostic vulnerability in adolescents with comorbid bipolar disorder and TTM, providing the empirical rationale for multivariate testing.

The subsequent regression analysis confirmed this hypothesis; the Difficulties in Emotion Regulation Scale (DERS) score emerged as the most robust predictor of TTM severity, underscoring the pivotal role of emotion dysregulation in the pathophysiology of hair-pulling. While impulsivity also showed a statistically significant association, its effect size was comparatively smaller. The final model demonstrated a moderate fit, explaining approximately 51.2% of the variance in TTM severity ($R^2 = 0.512$), a value achieved after refining the model to exclude outliers that initially yielded an inflated estimate. Multicollinearity diagnostics indicated moderate shared variance between DERS and impulsivity (VIFs 5.33–5.93), though values remained below critical thresholds. Notably, depression and mania scores did not significantly contribute to the regression model, reaffirming their limited predictive role in this context.

Collectively, these findings imply that TTM severity in bipolar youth is driven primarily by emotion dysregulation rather than pure impulsivity or mood states. In this context, hair-pulling functions not merely as an impulsive act, but as a maladaptive coping mechanism for overwhelming emotional tension. The behavioral sequence likely unfolds as follows: (1) an intense, poorly regulated emotional state; (2) an overwhelming urge to relieve internal distress; and (3) the 'impulsive' enactment of hair-pulling. Consequently, clinical interventions targeting impulsivity alone, without addressing these emotional triggers, are likely to be ineffective.

Pathways and Clinical Implications

Our findings expand upon existing literature regarding impulsivity and emotion regulation in trichotillomania (TTM) and bipolar disorder (BD). Although TTM is traditionally viewed as classic impulse control disorder [24] recent evidence highlights the critical role of emotion regulation deficits. A recent meta-analysis indicated a moderate association between TTM symptom severity and emotion regulation difficulties, with severe hair-pulling consistently linked to poorer regulatory abilities [25]. Aligning with this, our study identified emotion regulation deficits as the most distinguishing feature in adolescents with comorbid BD and TTM, suggesting that a history of TTM in this population signals pervasive affective dysregulation rather than merely heightened impulsivity.

While impaired impulse control is common to both disorders—evidenced by elevated trait impulsivity in TTM and persistent impulsivity in BD across mood states [26]—our results indicate that emotion regulation difficulties are central to the comorbid presentation. Although the BD + TTM group displayed the highest impulsivity scores, the difference was not statistically significant compared to the BD-only group. This pattern, alongside robust differences in emotion regulation, underscores affective dysregulation as the primary driver of symptom severity and clinical risk. Consequently, the comorbidity of BD and TTM reflects cumulative vulnerability, where impulse control deficits and emotional dysregulation interact to worsening instability. Clinically, interventions targeting emotion regulation skills should be prioritized for this dual-diagnosis population to address the core mechanisms underlying both hair-pulling and affective symptoms.

Transdiagnostic Psychopathology and Cluster Analysis

From a transdiagnostic perspective, the co-occurrence of trichotillomania history with bipolar disorder in adolescence illustrates how specific psychopathological processes cut across traditional diagnostic boundaries. Emotion

dysregulation (ED), in particular, is recognized as a transdiagnostic construct observed in numerous mental illnesses; disorders ranging from major depression and anxiety to borderline personality disorder and BD all demonstrate patterns of maladaptive emotion regulation that differ primarily in degree or expression [27]. Our findings support this view: the severe ED difficulties in the BD + TTM subgroup likely reflect an underlying dimension of emotional dyscontrol unique to no single diagnosis. Similarly, impulsivity—especially emotion-driven or "urgent" impulsivity—spans multiple disorders and contributes to a general psychopathology factor associated with poorer outcomes [28, 29]. The adolescents in our BD + TTM subgroup exemplify this overlap, manifesting impulse-control problems and emotional reactivity characteristic of both mood and compulsive disorders. In this way, their clinical profile resonates with emerging dimensional models, such as the Research Domain Criteria (RDoC), which emphasize traits like reward sensitivity, cognitive control, and affect regulation across diagnoses [30].

The findings of the six-cluster analysis reveal the heterogeneous nature of psychiatric disorders at the symptom level, showing that each cluster possesses distinct clinical characteristics and intervention needs:

Cluster 0: Represents a high-risk group for impulse-control disorders and addiction, reflecting high impulsivity and emotion dysregulation alongside extensive substance, alcohol, and tobacco use.

Cluster 1: Comprises individuals in remission or subclinical states, exhibiting low symptom levels across all scales and minimal risk behaviors.

Cluster 2: Located on the bipolar spectrum with prominent manic features, low depression, and common alcohol use, suggesting mania-associated risky behaviors.

Cluster 3: Resembles a mixed mood disorder with high levels of both depression and mania, with noteworthy suicide risk.

Cluster 4: Exhibits the highest emotion dysregulation and depression scores, carrying serious clinical alarms for suicide attempts and self-harm.

Cluster 5: Defines a subgroup requiring special intervention for major depressive disorder, characterized by high depression, moderate impulsivity, and frequent self-harm.

These clusters offer a framework for guiding individualized treatment planning. For instance, Clusters 4 and 5, which exhibit pronounced dysregulation and depression with self-harm risks, may require intensive psychosocial interventions and close pharmacological monitoring. Cluster 0 could be prioritized for interventions targeting impulse control and addiction rehabilitation. Meanwhile, Clusters 2 and 3 reflect mood instability—Cluster 2 aligning with manic symptoms and Cluster 3 with mixed states—warranting mood-stabilizing strategies and longitudinal follow-up. Conversely, Cluster 1 may benefit most from preventive strategies rather than intensive intervention.

Beyond treatment planning, these clusters are valuable for risk stratification and prognosis. Cluster 1 may be associated with favorable functional outcomes, whereas Clusters 2, 4, and 5 suggest more complex, chronic clinical courses. Integrating these symptom-based groupings with biological correlates (e.g., genetic or neuroimaging markers) could enhance their translational validity. Future studies monitoring cluster stability could further define their utility in precision psychiatry.

In summary, this transdiagnostic approach offers a promising avenue for developing flexible, patient-centered intervention models that extend beyond categorical diagnoses [31]. Cluster-analytic studies in pediatric BD have previously demonstrated that heterogeneous profiles can be distilled into meaningful subgroups, such as distinguishing "dysregulated/defiant" phenotypes from "classic presentation" phenotypes [31]. Analogously, the BD subgroup with TTM

history in our study may represent a distinct cluster defined by poor emotion regulation and impulsive-compulsive behavior. Identifying such subgroups points to a convergence of BD with obsessive-compulsive/impulse-control spectrum pathology, facilitating personalized interventions through data-driven methods.

The Role of Mania as a Catalyst for Behavioral Impulsivity

The moderation analysis provides critical insight into the interplay of symptoms, revealing that the severity of manic symptoms—as indexed by the Young Mania Rating Scale (YMRS)—significantly moderates the relationship between difficulties in emotion regulation (DERS) and impulsivity. While the link between DERS and impulsivity is weak at low YMRS scores, it becomes markedly stronger as mania increases; this interaction is visualized in Fig. 3, which depicts the steepest slope for the high-mania group. A comparable moderation effect was observed for TTM severity, where the association between DERS and TTM Global Scale scores was significantly amplified at high YMRS levels.

These findings suggest that mania functions as a neurobiological accelerator of behavioral disinhibition, altering the brain's operating state to heighten latent vulnerabilities rather than merely adding distinct symptoms. Manic states are characterized by increased arousal, heightened reward sensitivity, cognitive racing, and impaired prefrontal executive control. An individual may possess a core, trait-level deficit in emotion regulation (high DERS); however, during euthymic or depressive phases, residual executive control may keep compulsive behaviors subclinical. The onset of a hypomanic or manic episode disrupts this top-down control, increases motivational drive, and amplifies sensitivity to internal tension. Consequently, the pre-existing vulnerability to emotion dysregulation goes unchecked, precipitating a surge in impulsive behaviors and compulsive acts such as hair-pulling. This mechanistic account elucidates clinical observations regarding the fluctuation of TTM symptoms with mood episodes and explains why mood stabilizers often attenuate hair-pulling in patients with comorbid BD and TTM.

Clinical Implications and Early Intervention

The strong association between trichotillomania (TTM) history and emotion dysregulation in adolescents with Bipolar Disorder (BD) serves as a crucial clinical "red flag." This phenotype signals a higher risk for impulsive behaviors, self-injury, and substance use, necessitating early identification and intensive monitoring. Our findings indicate that emotional dyscontrol correlates strongly with global illness severity ($r = 0.76$), suggesting that emotion regulation is a viable marker of illness burden. Early interventions targeting these deficits—particularly family-focused and transdiagnostic approaches—are essential. Capitalizing on the adolescent developmental window through family psychoeducation and support can strengthen emotion-regulation networks and prevent the entrenchment of maladaptive coping strategies.

Therapeutic Treatment Targets

Addressing the overlapping features of BD and TTM requires a multi-modal approach prioritizing emotion regulation and impulse control. Interventions derived from Dialectical Behavior Therapy (DBT) are particularly effective in helping patients manage intense affect and resist urges. In parallel, Habit Reversal Training (HRT), recognized as the first-line behavioral treatment for TTM, should be integrated to target specific hair-pulling behaviors. Furthermore, family-focused interventions such as Child- and Family-Focused CBT play a vital role in managing dysregulated behavior profiles and improving crisis problem-solving. These psychotherapeutic strategies should be complemented by pharmacotherapy, which aims to address mood instability and support the broader work on behavioral control.

Importance of Subgroups

This study demonstrates the utility of cluster-based analysis in capturing the heterogeneity of pediatric BD. By identifying TTM history as a distinguishing feature, we effectively isolated a "dysregulated subgroup" with severe

impairment. Recognizing this specific phenotype allows for more stratified research and personalized clinical interventions compared to traditional diagnostic categories alone.

Limitations

Several limitations should be noted. The cross-sectional design precludes causal inferences between TTM history and dysregulation. The relatively small sample size (n = 40 per group) limits statistical power, particularly for subgroup analyses. High correlations between certain scales (e.g., emotion regulation and TTM severity) suggest potential measurement overlap. Additionally, the conceptual debate regarding TTM as impulsive versus compulsive may limit generalizability. Future research should utilize longitudinal designs and neuroimaging to clarify these associations.

Conclusion

A history of trichotillomania in adolescents with BD is not merely a comorbidity but a marker of profound emotion regulation deficits and impulse-control dysregulation. Early identification allows clinicians to implement targeted treatments—specifically DBT, HRT, and family-focused therapies—that hone emotion regulation skills. Delineating such high-risk subgroups is essential for advancing personalized medicine in youth mental health.

Declarations

Funding: No external funding was received for this study.

Conflict of Interest: The authors declare that they have no conflicts of interest.

Clinical Trial Number: Not applicable.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy and ethical restrictions related to sensitive clinical information.

Consent to Participate: Informed consent was obtained from all individual participants included in the study.

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Tables

Table.1: Multiple Linear Regression Model Predicting TTM Global Scale Score

Variable	β (Standardized)	p-value	VIF
Emotion Regulation (DERS)	0.0598	< 0.001	5.93
Impulsivity (Barratt Impulsiveness)	0.0109	0.016	5.33
Depression (Beck Depression Inventory)	0.0156	0.204	2.78
Mania (Young Mania Rating Scale)	0.0227	0.355	3.01
Model R^2	0.512		
F(4, 115)	30.12	< 0.001	
Max Correlation (DERS–BIS)	r = 0.462		

Note: Summary of the multiple linear regression model predicting trichotillomania severity (TTM Global Scale Score) in adolescents with bipolar disorder. The model includes four psychological predictors: emotion dysregulation (DERS), impulsivity (BIS), depressive symptoms (BDI), and manic symptoms (YMRS). Standardized beta coefficients (β), significance levels (p-values), and Variance Inflation Factor (VIF) values are reported for each predictor. The model accounted for 51.2% of the total variance in TTM severity and was statistically significant ($F(4,115) = 30.12$, $p < 0.001$). Moderate multicollinearity was observed between DERS and BIS predictors (VIF > 5), but all values remained within acceptable thresholds (VIF < 10).

Table 2. Psychometric Profiles and Clinical Interpretations of Identified Clusters.

Cluster	Impulsivity	Emotion Dysregulation	Depression	Mania	Clinical Profile	Interpretation	Complaints of the patient group at the first visit to the outpatient clinic
Cluster 0	High (58.29)	High (68.29)	Low (7.65)	Low (3.12)	High Impulsivity Group	Elevated impulsivity and emotion dysregulation; minimal mood symptoms	Impulsivity-based behavioral problems Anger control difficulties Antisocial behavior patterns Risky decision-making and alcohol use tendencies
Cluster 1	Low (33.42)	Low (43.10)	Low (1.88)	Low (0.33)	Low Symptom Group	The healthiest group; low scores on all symptom domains	Routine psychoeducation or developmental counseling
Cluster 2	Low (40.60)	Low (52.00)	Low (7.27)	High (12.53)	Manic Feature Group	Predominantly manic symptoms; other domains are relatively mild	Outbursts, agitation and hyperactivity-like symptoms Decreased need for sleep Excessive assertiveness in social situations Remarkable behavioral activation
Cluster 3	Low (39.75)	Low (48.75)	High (27.75)	High (9.25)	Mixed Mood Group	Prominent symptoms of both depression and mania	Rapid emotional changes (depression + mania) Irritability and tantrums Problems in family, friendship and school relationships High risk of suicide
Cluster 4	High (68.56)	Very High (165.00)	High (24.56)	Low (0.00)	Severe Depressive Group	Extremely impaired emotion regulation; marked depressive symptoms	Symptoms of severe depression (anhedonia, withdrawal) Significant impairment in

							functionality Social withdrawal High risk of suicide
Cluster 5	Very High (94.85)	Moderate (76.54)	High (16.92)	High (13.15)	High Impulsivity & Mixed Mood	Highest impulsivity; co-occurrence of depression and mania	Severe agitation and emotional dysregulation Suicidal behavior or attempt Impulsive actions at crisis level Mixed mood episodes

Note: This table presents the descriptive characteristics of the six empirically derived clusters based on scores of impulsivity (BIS), emotion dysregulation (DERS), depression (BDI), and mania (YMRS). Each cluster reflects a distinct clinical configuration, allowing for nuanced subgroup identification beyond diagnostic categories. Cluster labels and interpretations were assigned based on dominant symptom dimensions and their combinations. The final column summarizes the most frequently reported presenting complaints among individuals in each group at initial outpatient visits, providing translational insight into how these latent profiles manifest clinically. This classification supports the development of tailored psychiatric interventions aligned with symptom-based needs rather than broad diagnostic categories alone.

Figures

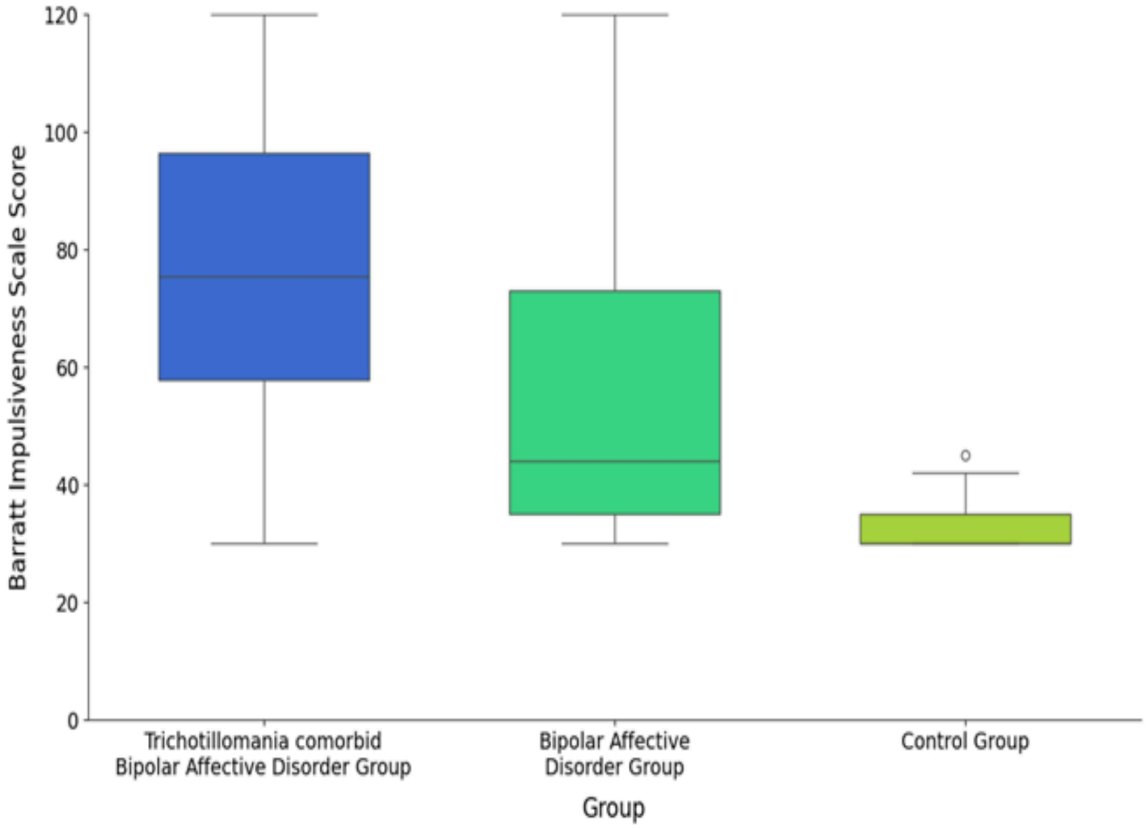


Figure 1

Comparison of Barratt Impulsiveness Scale Scores Between Groups

Boxplot visualization of BIS total scores across three study groups: (1) individuals with bipolar affective disorder comorbid with trichotillomania, (2) individuals with bipolar affective disorder only, and (3) healthy controls. The TTM+BD group demonstrated the highest levels and widest range of impulsivity, followed by the BD-only group. The control group showed markedly lower and more narrowly distributed impulsivity scores. These distributions reflect a clinical gradient of impulsivity severity across diagnostic categories.

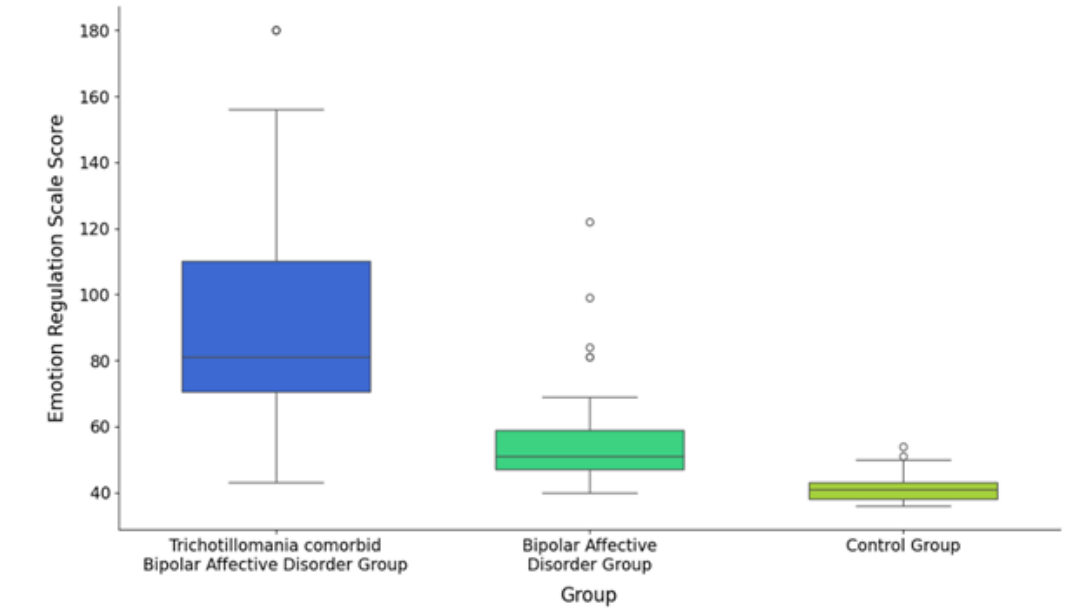


Figure 2

Comparison of Emotion Regulation Scale Scores Between Groups

This boxplot illustrates the distribution of scores on the Difficulties in Emotion Regulation Scale (DERS) across three groups: individuals with bipolar affective disorder comorbid with trichotillomania, individuals with bipolar affective disorder alone, and healthy controls. The comorbid TTM+BD group exhibited notably higher DERS scores, with a wider range and higher median compared to the other groups. The BD-only group showed intermediate scores, while the control group demonstrated the lowest and most tightly clustered emotion regulation difficulty levels. These patterns suggest a graded increase in emotion dysregulation severity aligned with clinical complexity.

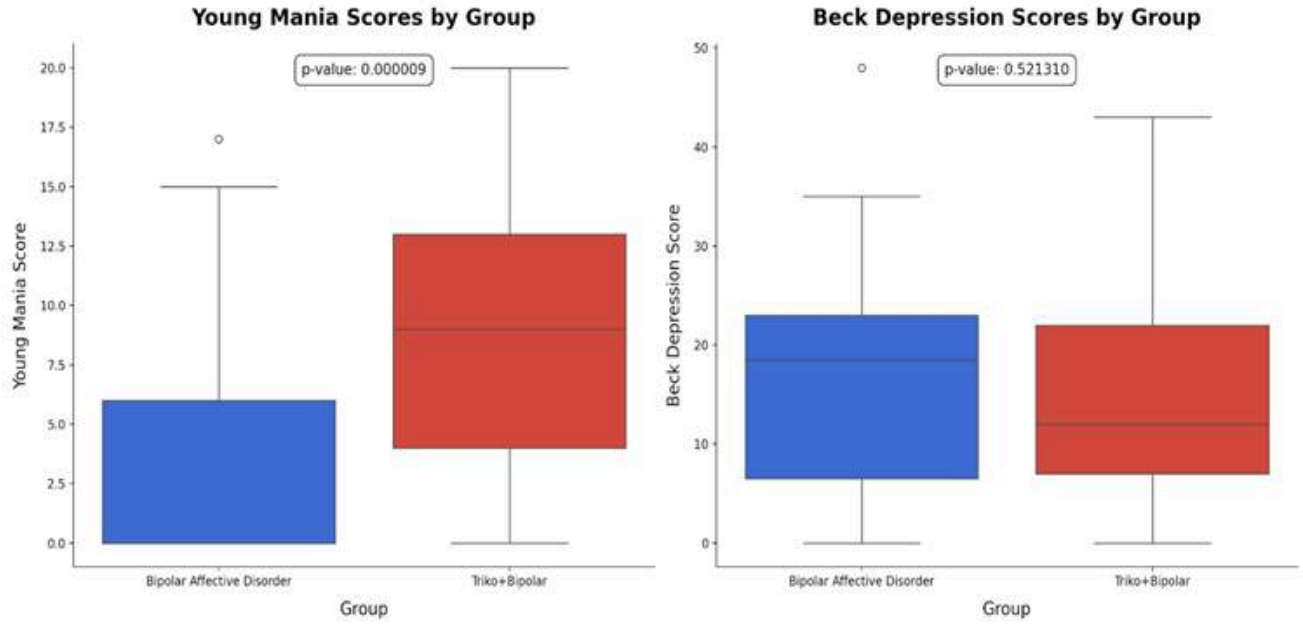


Figure 3

Comparison of Young Mania and Beck Depression Scores Between Groups

This figure presents side-by-side boxplots comparing two clinical scales between the BPD group and the TTM+BPD group. The left box plot illustrates that individuals in the TTM+BD group have significantly higher Young Mania scores compared to those in the Bipolar-only group.

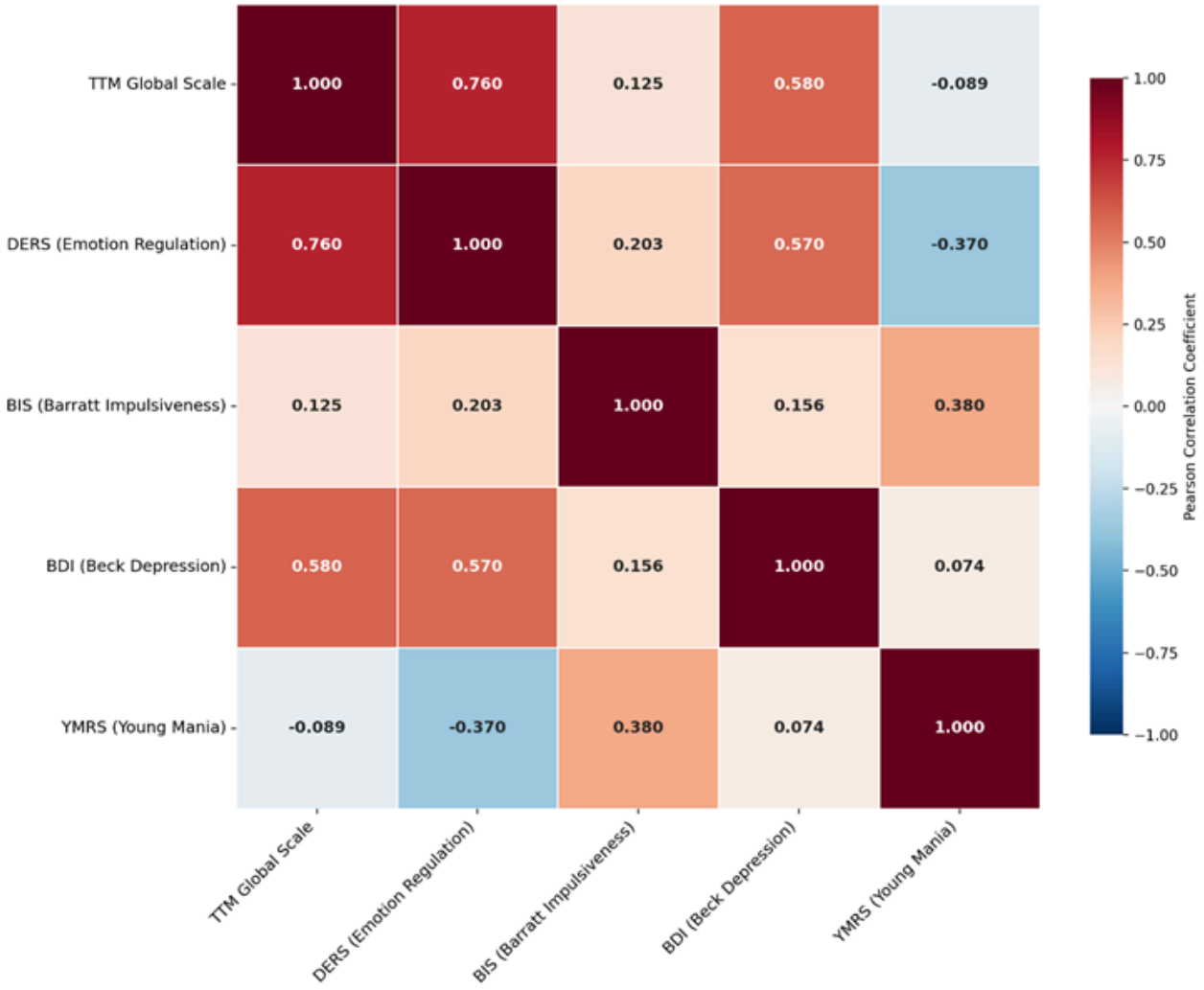


Figure 4

Moderating Role of Young Mania Variable

Moderation effect of Young Mania Level on the relationship between emotion dysregulation and impulsivity. The figure illustrates the interaction between Difficulties in Emotion Regulation scores (x-axis) and Barratt Impulsiveness Scale scores (y-axis) across three levels of manic symptoms: low (blue line), medium (green line), and high (red line), corresponding to mean-centered YMRS values of −1.21, 4.78, and 10.76 respectively. The steeper slope observed in the high mania group indicates that greater manic symptom severity strengthens the positive association between emotion dysregulation and impulsivity.

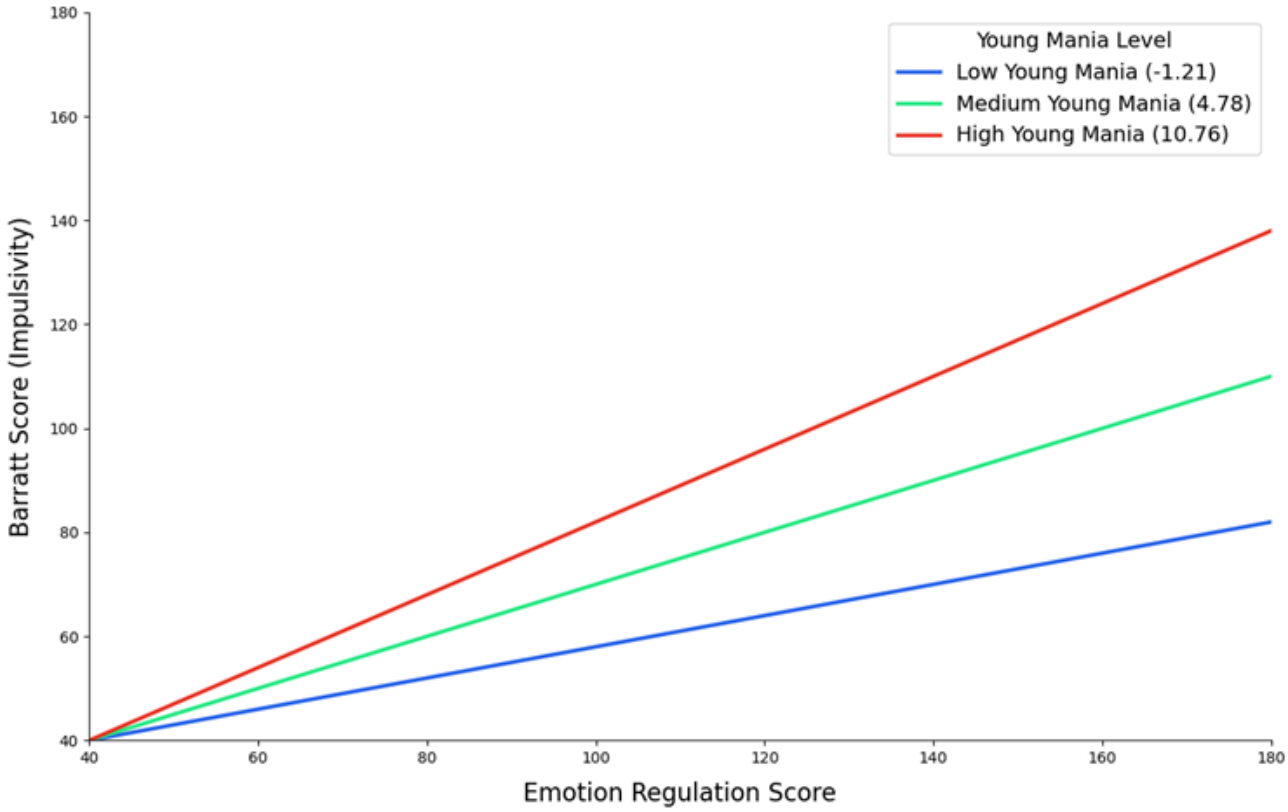


Figure 5

Moderating Effect of Young Mania on the Relationship Between Emotion Regulation and TTM Global Scale Scores

This figure illustrates the interaction effect of Young Mania levels (low, medium, high) on the relationship between Emotion Regulation Scale Scores and NIMH Scores. Separate regression lines are plotted for each group. The slope increases with higher levels of Young Mania, indicating variation in the strength of association across groups.

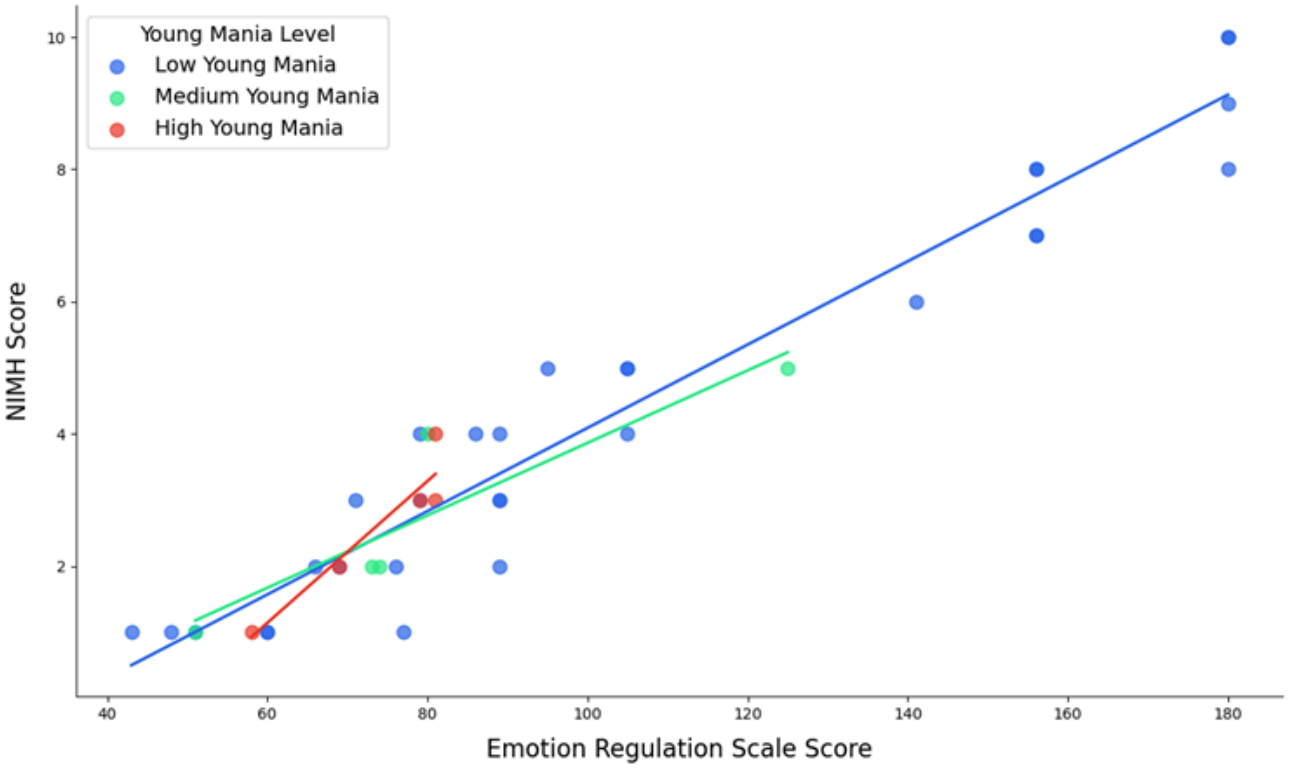


Figure 6

Elbow and Silhouette Method Plot for Determining Optimal Number of Clusters

The left panel illustrates the Elbow Method, showing the within-cluster sum of squares (WCSS) across different values of k (number of clusters). A noticeable inflection point occurs at k = 6, suggesting diminishing returns in model fit beyond this point. The right panel displays the Silhouette Method results, where the average silhouette score peaks at k = 4, indicating the highest internal consistency and cluster separation at that level. Despite the slightly lower silhouette score at k = 6, the six-cluster solution was selected for subsequent analyses due to its superior clinical interpretability and acceptable clustering quality.

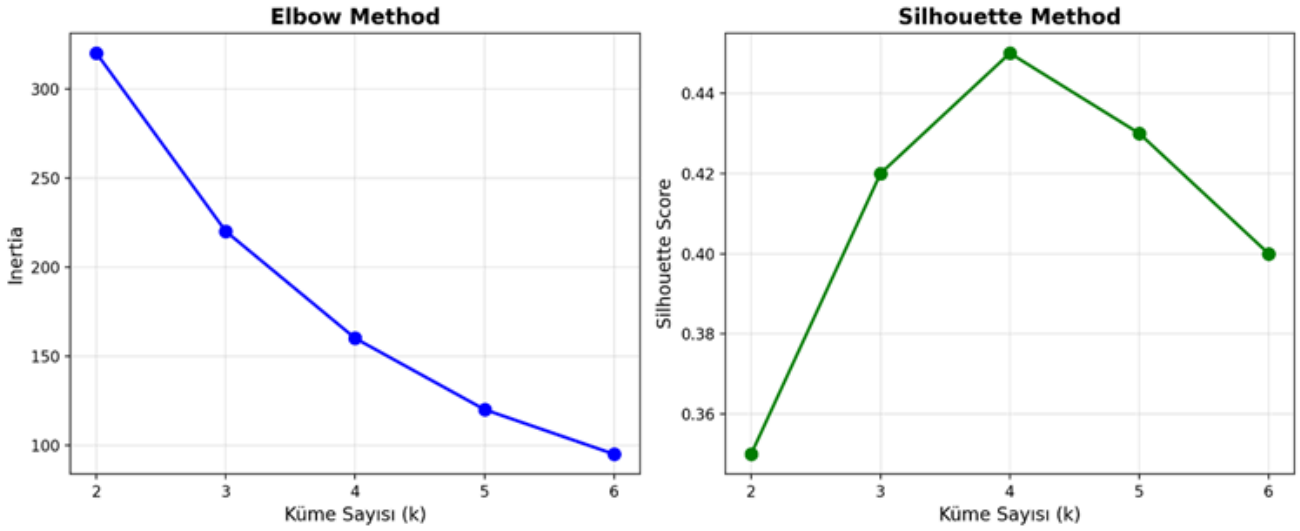


Figure 7

Correlation matrix depicting the associations among psychometric variables *TTM Global Scale, DERS (Difficulties in Emotion Regulation Scale), BIS (Barratt Impulsiveness Scale), BDI (Beck Depression Inventory), and YMRS (Young Mania Rating Scale). Warmer colors represent positive correlations, while cooler tones indicate negative associations. Notably, a strong positive correlation was observed between TTM severity and emotion dysregulation (r = 0.76), while emotion dysregulation and manic symptoms were moderately inversely correlated (r = -0.37). All values are Pearson's r coefficients.*

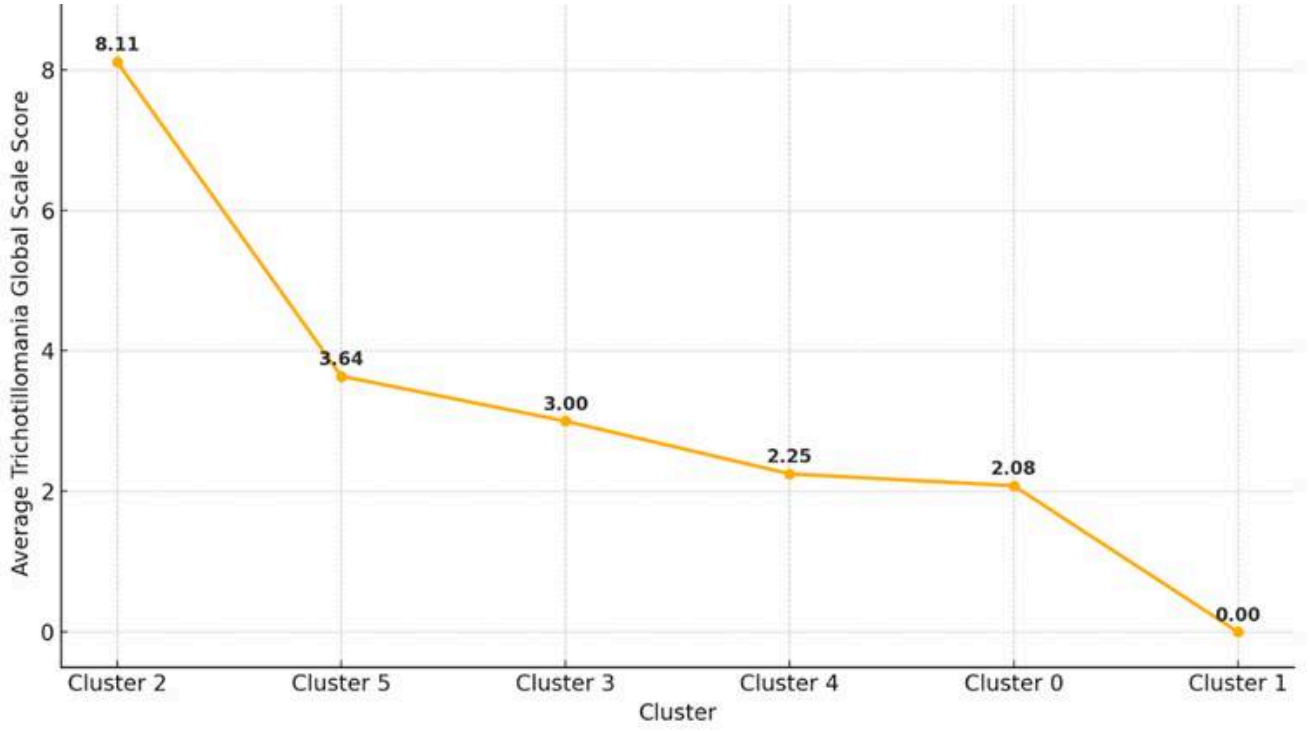


Figure 8

Mean Trichotillomania Global Scale Scores Across Identified Clusters

The line plot displays the average TTM Global Scale scores for each of the six clusters identified through unsupervised clustering analysis. A clear gradient is observed across clusters, with Cluster 2 exhibiting the highest mean TTM severity (M = 8.11), followed by Clusters 5, 3, 4, and 0. Cluster 1 reported a mean score of 0, indicating the absence of clinically relevant hair-pulling behaviors in that group. These differences highlight the heterogeneity in trichotillomania severity across subgroups and underscore the value of data-driven clustering in identifying latent symptom profiles within the clinical population