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RESEARCH

An Examination of Impulsivity and Metacognitions in Adolescents with Body-Focused Repetitive Behavior Disorders

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Abstract
Trichotillomania (TTM), skin-picking disorder (SPD), and nail-biting (NB) are classified as Body-Focused Repetitive Disorders (BFRBDs), which share characteristics with both obsessive-compulsive and impulse control disorders. This study aimed to compare impulsivity, metacognitions, and clinical characteristics across BFRBDs. Ninety adolescents (aged 10–18 years) with BFRBDs and 40 healthy controls (HC) completed the Revised Children's Anxiety and Depression Scale-Child Version (RCADS-CV), the Metacognitions Questionnaire for Children and Adolescents (MCQ-CA), the Barratt Impulsiveness Scale-Brief (BIS-Brief), and the Pediatric Quality of Life Inventory (PedsQL). Symptom severity was assessed using disorder-specific measures. There were no significant age differences between the BFRBDs and HC groups. However, within the BFRBDs subgroups, adolescents with TTM and SPD were significantly older than those with NB ($p = .028$). Notably, despite being younger, the NB group exhibited the longest duration of BFRBDs symptoms ($p < .001$). The TTM group showed higher MCQ-CA total, positive beliefs about worry, and cognitive monitoring. In contrast, the SPD group had higher poor self-regulation scores (all $p < .05$). Symptom severity across BFRBDs was negatively associated with PedsQL total scores and positively associated with MCQ-CA total and RCADS-CV total scores (all $p < .05$). These findings suggest that while metacognitions are more prominent in TTM, impulsivity plays a greater role in SPD. Understanding the distinct contributions of impulsivity and metacognitions in BFRBDs may facilitate the development of targeted treatment approaches tailored to each behavior.

Keywords Body focused repetitive behavior disorders · Impulsivity · Metacognition · Trichotillomania · Skin picking disorder · Nail biting

Introduction

Body-focused repetitive behaviors (BFRBs) are a highly heterogeneous group of habitual grooming behaviors that include hair pulling, skin picking, nail biting, lip /cheek biting, knuckle cracking, and teeth grinding. These behaviors are classified as Body-Focused Repetitive Behavior Disorders (BFRBDs) when significantly impair physical and psychosocial functioning [1, 2]. Trichotillomania (TTM) and skin picking disorder (SPD) are the most extensively studied in the spectrum of BFRBDs. TTM is characterized by recurrent hair pulling behavior that leads to noticeable hair loss without an underlying dermatological condition. Similarly, SPD involves persistent and excessive picking, scratching, or excoriation of the skin, often resulting in tissue damage [3]. Compared to TTM and SPD, nail biting (NB) has been less studied in psychiatric literature, even

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though it is highly prevalent, particularly in children and adolescents [4, 5]. NB manifests in a broad spectrum, ranging from mild habitual behaviors with minimal impact to more severe forms that cause significant damage to the nails and gingival structures. In cases of high symptom severity, referred to as pathological NB, significant psychosocial distress and impaired daily functioning are commonly observed [6, 7].

Trichotillomania and SPD have historically been categorized as impulse control disorders in the DSM. However, with the publication of the DSM-5, they were reclassified under the obsessive-compulsive and related disorders (OCRD) Sect [8]. This reclassification was primarily based on the recognition of shared features between compulsions of obsessive-compulsive disorder (OCD) and BFRBDs, such as repetitive and ritualistic behaviors triggered by negative internal states, abnormalities in the frontostriatal circuit, and shared vulnerability genes [9]. On the other hand, BFRBDs lack the cognitive processes typically observed in OCD, such as thought-action fusion, an inflated sense of responsibility, and thought control, and are often associated with a pleasurable nature and an irresistible urge that precedes the behavior [2, 9, 10]. In addition, BFRBDs have been found to co-occur with impulse control disorders frequently [11] and to respond favorably to addiction-based treatment interventions [2]. These findings have contributed to a growing body of research examining the role of impulsivity in the BFRBDs. Some authors have even proposed that BFRBDs should be conceptualized within an "impulsive-compulsive spectrum" beyond traditional classification frameworks [12].

Although there is no universally accepted definition, impulsivity is conceptualized from a neurobiological perspective as a deficit in top-down inhibitory control, resulting in increased novelty seeking, disadvantageous decision-making tendency, inattention, and impaired behavioral, emotional, and/or cognitive control [13]. Studies investigating the relationship between TTM and impulsivity using both self-report scales and behavioral tasks particularly assess impaired response inhibition, also referred to as motor impulsivity. However, findings have been inconsistent [14–17]. In contrast, motor and cognitive impulsivity (characterized by a tendency to make disadvantageous decisions, delay discounting, and poor self-regulation) have been more consistently associated with SPD than with TTM [18–20]. However, despite these findings, the role of impulsivity in NB remains underexplored, with existing evidence being both limited and inconsistent [21, 22].

Metacognition is a higher-order cognitive function enabling individuals to observe, evaluate, and regulate their cognitive processes [23]. According to Wells and Matthews' Self-Regulatory Executive Functions (S-REF) model, self-regulation plays a key role in developing and maintaining psychological well-being. In this context, maladaptive metacognitive beliefs can lead to more frequent use of ineffective coping strategies, such as rumination, hypervigilant attention to threat, and thought suppression. Over time, these patterns may impair self-regulation and lead to psychological distress [24]. Cartwright-Hatton and Wells defined metacognition across five distinct dimensions: positive beliefs, cognitive confidence, negative beliefs about worry (*uncontrollability and danger*), cognitive self-consciousness (closely related to cognitive monitoring), and need for control [25]. In the context of OCD, maladaptive metacognitive beliefs, particularly thought-action fusion and the need to control thoughts, contribute to the development and persistence of compulsions. Individuals with OCD often misinterpret intrusive thoughts as dangerous and uncontrollable, leading to increased distress and subsequent engagement in compulsive rituals as a means of neutralization. This cycle reinforces the belief that compulsions are necessary to prevent harm, further entrenching maladaptive metacognitive patterns [24]. Although many studies have examined the role of metacognitive beliefs in OCD symptoms, increased cognitive self-consciousness and the need to control thoughts, in particular, have been consistently associated with symptom severity [23, 26, 27]. Similarly, due to the repetitive and compulsive nature of BFRBDs, maladaptive metacognitive beliefs are thought to contribute to the onset and maintenance of these behaviors. However, research on the metacognitive underpinnings of compulsive behaviors in BFRBDs remains highly limited. One study examining patients with TTM and SPD found that beliefs about 'uncontrollability and danger' and the 'need to control thoughts' were significantly higher in both patient groups compared with healthy controls [28]. To the best of our knowledge, no study has specifically explored this issue in adolescents with BFRBDs, highlighting the need for further research on the metacognitive mechanisms underlying these behaviors.

Previous studies in the literature have various limitations. A significant limitation is that they have predominantly included patients with TTM or SPD. In addition, the lack of a healthy control group (generally) and the heterogeneity of the samples in terms of age are important confounding factors in these studies. Therefore, the primary aim of this study is to conduct separate comparisons of TTM, SPD, and NB considering impulsivity, metacognitions, and clinical measures of BFRBDs (duration of the BFRBDs, comorbid symptoms of anxiety and depression, and quality of life). Its secondary aim is to assess the relationships between the severity of BFRBDs and impulsivity, metacognitions, and the clinical measures of BFRBDs.

Our main hypotheses in this study are: (1) Adolescents with BFRBDs would have higher levels of impulsivity. (2) Adolescents with SPD would exhibit elevated levels of impulsivity in both the motor and cognitive domains. In contrast, those with TTM and NB are expected to exhibit a more heterogeneous impulsivity pattern without any single subtype predominating. (3) Adolescents with BFRBDs would exhibit elevated levels of dysfunctional metacognitive beliefs, particularly in the domains of "negative beliefs about worry" and "cognitive monitoring". (4) The symptom severity of BFRDs would be positively correlated with impulsivity, metacognitions, and comorbid anxiety and depression symptoms.

Materials and Methods

Participants and Procedure

Ninety adolescents with BFRBDs admitted to the child and adolescent psychiatry and/or dermatology and venereology outpatient clinic of the . Research and Training Hospital were recruited between February and September 2024. Our BFRBDs sample consisted of 90 adolescents with 30 TTM, 30 SPD, and 30 NB. Since NB does not have a distinct diagnostic category, the criteria for pathological NB were established based on previous studies [29, 30]. Accordingly, pathological NB was defined as nail-biting behavior persisting for at least three months, occurring at least three days per week, and a score of nine or higher on the Modified Scale for Nail Biting, a modified version of the Massachusetts General Hospital Hairpulling Scale (MGH-HPS). The cut-off value for this scale was determined based on the threshold established in the Turkish validity and reliability study of the MGH-HPS [31]. To ensure diagnostic clarity, each participant was assigned to a single diagnostic group, meaning individuals with TTM, SPD, or NB did not have co-occurring BFRBDs.

Inclusion criteria for the BFRBDs group were as follows: (1) age between 10 and 18 years, (2) meeting DSM-5 criteria for TTM or SPD or the diagnostic criteria for pathological NB as established in our study, (3) no lifetime psychotropic medication use, (4) absence of an underlying dermatological, neurological or genetic condition associated with BFRBDs, (5) willingness to participate in the study and complete data on all relevant measurements. The exclusion criteria for the BFRBDs group were having a diagnosis of any chronic medical condition or one of the following psychiatric disorders: attention deficit hyperactivity disorder (ADHD), OCD, autism spectrum disorders, intellectual disability, bipolar disorder, psychotic disorders, alcohol/substance-related disorders, and language disorders. No psychiatric disorders other than those listed above were used as exclusion criteria. Patients with comorbid major depressive disorder (MDD) and anxiety disorders were not excluded from the study because of their high comorbidity rates with BFRBDs [32, 33]. During the initial eligibility assessment for the BFRBDs group, twenty adolescents were subsequently excluded from the study. Specifically, four individuals had sub-threshold symptoms, and five individuals were taking psychotropic medication. At the same time, to mitigate the potential influence of ADHD and OCD on impulsivity and metacognitions [34], nine adolescents with ADHD and two adolescents with OCD were excluded from the initial cohort.

The control group consisted of age- and gender-matched adolescents without any psychiatric disorders from the General Pediatric Clinic who had been admitted for minor acute conditions such as common cold, stomach ache, and so forth. They were screened via semi-structured clinical psychiatric interviews to ensure that they did not meet the diagnostic criteria for any psychiatric disorders. Following the semi-structured interviews, 12 adolescents with current psychiatric disorders were excluded from the study. Finally, 90 adolescents with BFRBDs (77 female, 13 male) and 40 matched healthy controls (36 female, 4 male) were included.

The study was approved by XXX University Medical Ethics Committee for Clinical Studies (January 15, 2024/No: 275-275-07). Comprehensive verbal information was provided about the methodology, schedule, what would be expected of the participants, potential benefits/risks, and confidentiality of the data. Written informed consent was obtained from all of the adolescents and their parents.

Measures

Demographic characteristics such as age, gender, psychiatric history of the adolescents and their parents, and clinical features (type and duration of the BFRBDs) were recorded by the researchers.

The Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version DSM-V, known as ***K-SADS-PL***, is a semi-structured interview designed to detect current and lifetime psychopathologies in children and adolescents [35]. The reliability and validity of the Turkish version of the K-SADS-PL have been demonstrated [36]. The K-SADS-PL was administered to adolescents and their parents by a certified child and adolescent psychiatrist, who was also the primary responsible researcher and first author of the study, to establish DSM-5-based diagnoses of TTM and SPD, identify comorbid psychiatric disorders in the BFRBDs group, and confirm the absence of psychiatric diagnoses in the healthy control group.

The Revised Children's Anxiety and Depression Scale-Child Version (RCADS-CV) is a 47-item self-report scale that assesses dimensions of anxiety and depressive disorders in children and adolescents [37]. The RCADS-CV consists of six subscales: social phobia (SP), generalized anxiety disorder (GAD), separation anxiety disorder (SAD), panic disorder (PD), OCD, and MDD. Each item is rated on a scale of 0 to 3, resulting in total scores ranging from 0 to 141. The raw subscales' scores were used to calculate the T-scores, which were considered clinically significant if they were greater than 65. The validity and reliability study in the Turkish sample was conducted by Görmez et al. [38]. All participants completed the RCADS-CV.

The Massachusetts General Hospital Hairpulling Scale (MGH-HPS) is a 7-item self-report scale that assesses the severity of TTM over the past seven days [39]. It has a single-dimensional structure. Each item is rated on a scale from 0 to 4, resulting in total scores ranging from 0 to 28, with higher scores indicating greater severity. A cut-off score of ≥ 9, as established in the Turkish validation study by Pirdogan Aydın et al. [39], was used to determine clinical significance. The MGH-HPS has demonstrated adequate psychometric properties in the Turkish sample [31]. In this study, Cronbach's alpha was 0.834. The scale was used to assess the severity of TTM and was completed by adolescents.

The Yale-Brown Obsessive Compulsive Scale Modified for Neurotic Excoriation (NE-YBOCS) is a clinician-administered scale that was first adapted by Arnold et al. from the original Yale-Brown Obsessive Compulsive Scale (Y-BOCS) [40, 41]. The NE-YBOCS consists of 10 items in three subscales: impulse (five items), behavior (three items), and control (two items). The total score is derived from the sum of 10 items, with no reverse coding of items. NE-YBOCS is a valid and reliable psychometric instrument for Turkish samples [42]. It was used to assess the severity of the SPD in this study, which the researchers rated.

A Modified Scale for Nail Biting is a modified version of the MGH-HPS assessing NB. A modified version of the MGH-HPS was used in this study due to the lack of standardized instruments for the assessment of NB. Modifications were made by replacing all references to 'hair pulling' with 'nail biting.' The cut-off value was set at a total score of at least 9, the same as for the MGH-HPS. Using a modified MGH-HPS to assess NB is consistent with previous research [30]. In this study, Cronbach's alpha was 0.862. It was administered to adolescents with pathological NB to assess symptom severity.

The Metacognitions Questionnaire for Children and Adolescents (MCQ-CA) is a 24-item, self-report measure that assesses multiple domains of the metacognitive process, including positive beliefs about worry, negative beliefs about worry, superstitions, punishment, and responsibility beliefs (SPR beliefs) and cognitive monitoring [25, 43]. Scoring ranges from 24 to 96, with each item rated on a scale from 1 to 4, with higher scoring indicating more metacognitive activity. The validity and reliability study in the Turkish sample was conducted by Irak [44]. All participants completed the MCQ-CA.

The Barratt Impulsiveness Scale-Brief (BIS-Brief) is a short version of the BIS-11, specifically designed to measure impulsivity in clinical and non-clinical samples [45, 46]. The BIS-Brief consists of 8 items in two subscales: poor self-regulation and impulsive behavior. Each item is rated on a scale from 1 to 4, including four reverse-coded items. The BIS-Brief is a valid and reliable psychometric instrument for the Turkish sample [47]. All participants completed the BIS-Brief.

The Pediatric Quality of Life Inventory (PedsQL), which Varni and his colleagues developed, is a 23-item self-report scale that assesses multiple quality of life domains, including general, physical, and psychosocial health [48]. The reliability and validity of the Turkish version of the PedsQL have been demonstrated [49]. All participants completed the PedsQL.

Statistical Analyses

In the present study, which compares four independent groups, power analyses were conducted based on findings from previous literature to determine the minimum required sample sizes for detecting statistically significant differences in two key outcome measures: the Metacognitions Questionnaire-30 (MCQ-30) total score and the Barratt Impulsiveness Scale – Adolescent Version (BIS-11-A) total score. A previous study comparing individuals with TTM, SPD, and healthy controls reported mean MCQ-30 scores of 74.9 (SD = 13.3), 72.9 (SD = 16.5), and 65.0 (SD = 13.9), respectively. Based on these data, the estimated effect size was calculated as Cohen's f = 0.29, corresponding to a medium effect [28]. Based on this estimate, a power analysis assuming an alpha level of 0.05 and a statistical power of 0.80 indicated that a minimum total sample size of 132 participants would be required for a four-group comparison, or approximately 33 participants per group, assuming equal allocation. Similarly, another study comparing individuals with BFRBDs and healthy controls reported a significant group difference on the BIS-11-A, with a reported effect size of Cohen's d = 0.66 [17]. This corresponds to a large effect size (Cohen's f = 0.47). Using this effect size, the power analysis for a four-group comparison yielded a minimum total sample size of 54 participants or approximately 14 participants per group. The larger of the two estimates was considered to ensure sufficient power for

detecting group differences on both the MCQ-30 and BIS-11-A. The planned sample in the current study includes four groups comprising 30 participants with TTM, 30 with SPD, 30 with NB, and 40 healthy controls, consistent with the recommended sample size for achieving sufficient statistical power. This target was achieved by consecutively including all eligible participants during the recruitment period until each group reached the planned number.

The Statistical Package for the Social Sciences (SPSS) version 26.0 was used to analyze the data. The normality of data distribution was assessed using Shapiro-Wilk statistics. As the continuous variables (age, duration of the BFRBDs, and RCADS-CV subscale scores) did not show a normal distribution between the TTM, SPD, pathological NB, and healthy control groups, the Kruskal-Wallis test was used, and for categorical variables (gender, family psychiatric history, and comorbid psychiatric diagnoses), the chi-squared tests (Pearson Chi-square or Fisher-Freeman-Halton Test) were used. ANCOVA was used to compare MCQ-CA, BIS-Brief, and PedsQL scores and their subscales between groups, with total depression and anxiety scores (RCADS-CV Total Internalizing Score) as covariates. Post-hoc pairwise comparisons were conducted for significant group differences, and Bonferroni correction was applied to adjust for multiple comparisons, ensuring robust statistical conclusions. Spearman's correlation tests were used to examine correlations between the symptom severity scores of the TTM, SPD, and pathological NB groups and factors such as duration of the BFRBDs, RCADS-CV total internalizing score, PedsQL total score, BIS-Brief total score, and MCQ-CA total score, all of which were hypothesized to influence symptom severity. In addition, the symptom severity scores were standardized and recalculated, resulting in a single composite variable representing the severity of the symptoms in the BFRBDs in the case group (TTM, SPD, and pathological NB). To explore disorder-specific and transdiagnostic patterns, we conducted correlation analyses separately for each BFRBDs subgroup and for the overall BFRBDs sample using a standardized composite score. This dual-level analytical approach allowed us to evaluate both within-disorder specificity and spectrum-level commonality, which aligns with current dimensional models of BFRBDs.

Results

Table 1 demonstrates the demographic and clinical characteristics of the BFRBDs and control groups. Although no significant group differences in terms of age and gender were found, the mean age of the TTM and SPD groups was significantly higher than that of pathological NB in the BFRBDs. The majority of participants were female (90%). No significant group differences were found between the TTM, SPD, and pathological NB on the total number of comorbid psychiatric diagnoses and family psychiatric history. Finally, the mean duration of the pathological NB symptoms was significantly longer than that of TTM and SPD in the BFRBDs group. The comorbid psychiatric diagnoses in the BFRBDs group are presented in Fig. 1.

The analysis of comorbid psychiatric diagnoses among individuals with BFRBs reveals notable differences across TTM, pathological NB, and SPD (Fig. 1). MDD is the most prevalent comorbidity, particularly in the SPD group ($n=10$), followed by both the TTM and pathological NB groups ($n=7$ each). SP is also highly represented, with the highest occurrence in the SPD group ($n=9$), followed by TTM ($n=7$) and pathological NB ($n=6$). GAD is more frequently observed in the TTM group ($n=6$) compared to pathological NB ($n=3$) and SPD ($n=4$). PD shows similar prevalence across the groups, with a slightly higher occurrence in the NB group ($n=2$), while SAD and Persistent Depressive Disorder (PDD) or Dysthymia show equal distribution across all groups ($n=2$ for TTM and SPD, $n=1$ for pathological NB in SAD). Enuresis nocturna (EN) is more

Table 1 Groups' demographic and clinical characteristics

	TTM ($N=30$)	NB ($N=30$)	SPD ($N=30$)	HC ($N=40$)	KWH or χ^2	Significance (p)	Post-hoc differences
	M (SD) or n (%)	M (SD) or n (%)	M (SD) or n (%)	M (SD) or n (%)			
Age, *years*	15.43 (1.93)	14.03 (2.22)	15.42 (1.67)	14.54 (2.30)	9.098[1]	**0.028**	TTM = SPD > NB
Gender					1.795[2]	0.641	–
Boy	3 (10%)	6 (20%)	4 (13.3%)	4 (10%)			
Girl	27 (90%)	24 (24%)	26(86.7%)	36 (90%)			
Comorbid psychiatric diagnoses	22 (73.3%)	20 (66.7%)	21 (70.0%)	–	54.595[3]	**<0.001**	
Family psychiatric history	8 (26.7%)	7 (23.3%)	5 (16.7%)	3 (7.5%)	5.190[3]	0.167	
Duration of BFRBDs, *years*	2.46 (2.25)	4.40 (2.19)	1.91(1.71)	–	97.149[1]	**<0.001**	NB > TTM = SPD

Note. M: Mean, SD: Standard Deviation, TTM: Trichotillomania, NB: Nail Biting, SPD: Skin Picking Disorder, HC: Healthy Controls, BFRBDs: Body-Focused Repetitive Behavior Disorders. *[1]Kruskal-Wallis H [2]Fisher-Freeman-Halton Test [3]Pearson Chi-Square Test; Post-hoc pairwise comparisons were conducted for significant group differences, and Bonferroni correction was applied to adjust for multiple comparisons, ensuring robust statistical conclusions

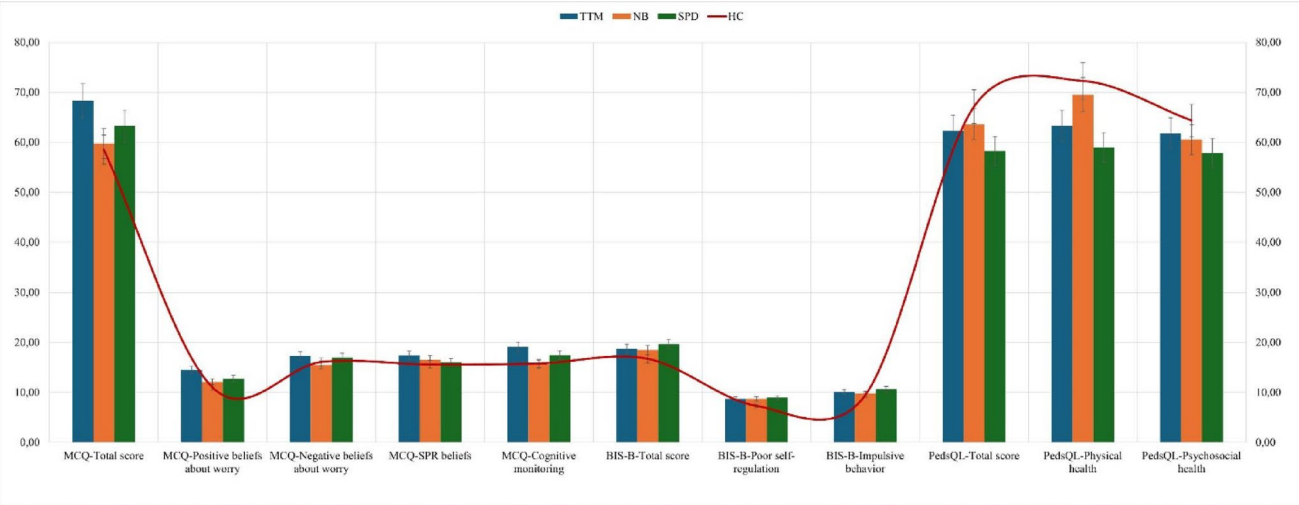

Fig. 1 Comorbid Psychiatry Diagnoses Among the BFRBDs Group. BFRBDs: Body- Focused Repetitive Behavior Disorders, TTM: Trichotillomania, NB: Nail Biting, SPD: Skin Picking Disorder, MDD: Major Depressive Disorder, SP: Social Phobia, GAD: Generalized Anxiety Disorder, PD: Panic Disorder, SAD: Separation Anxiety Disorder, PDD: Persistant Depressive Disorder, EN: Enuresis Nocturna

Table 2 Comparison of anxiety and depression scores between the BFRBDs and HC groups

		TTM ($N=30$)	NB ($N=30$)	SPD ($N=30$)	HC ($N=40$)	KWH	Significance (p)	Post-hoc differences
		M (SD)	M (SD)	M (SD)	M (SD)			
RCADS-CV	Total Internalizing	68.40 (12.15)	64.63 (13.37)	62.60 (12.31)	45.95 (8.68)	48.832	**<0.001**	TTM=NB=SPD>HC
	Total Anxiety	67.60 (12.51)	63.40 (12.78)	59.57 (12.60)	46.28 (8.49)	44.059	**<0.001**	TTM>HC NB>HC SPD>HC TTM>SPD
	SP	58.53 (11.14)	55.87 (11.88)	53.03 (12.64)	43.15 (10.12)	28.107	**<0.001**	TTM=NB=SPD>HC
	PD	66.80 (13.09)	63.90 (14.17)	60.87 (14.49)	51.33 (11.24)	25.747	**<0.001**	TTM=NB=SPD>HC
	MDD	68.23 (11.89)	64.03 (14.56)	67.77 (12.78)	45.45 (9.11)	51.609	**<0.001**	TTM=NB=SPD>HC
	SAD	63.13 (15.15)	61.60 (13.92)	57.93 (11.56)	52.28 (9.06)	11.021	**0.012**	TTM=NB>HC
	GAD	58.00 (10.44)	58.27 (11.14)	55.33 (9.82)	44.00 (8.58)	37.233	**<0.001**	TTM=NB=SPD>HC
	OCD	63.53 (12.96)	60.20 (10.97)	57.37 (12.81)	46.50 (8.67)	36.226	**<0.001**	TTM=NB=SPD>HC

M: Mean, SD: Standard Deviation, TTM: Trichotillomania, NB: Nail Biting, SPD: Skin Picking Disorder, HC: Healthy Controls, BFRBDs: Body-Focused Repetitive Behavior Disorders, RCADS-CV: Revised Children's Anxiety and Depression Scale Child Version, SP: Social Phobia, PD: Panic Disorder, MDD: Major Depressive Disorder, SAD: Separation Anxiety Disorder, GAD: Generalized Anxiety Disorder, OCD: Obsessive-Compulsive Disorder. *Statistical analyses were conducted using Kruskal-Wallis H test. Post-hoc pairwise comparisons were conducted for significant group differences, and Bonferroni correction was applied to adjust for multiple comparisons, ensuring robust statistical conclusions

prevalent in the TTM and pathological NB groups ($n=2$ each) compared to SPD ($n=1$). Less frequently diagnosed conditions such as agoraphobia, dissociative disorder, prolonged grief disorder, and specific phobia are sparsely distributed, appearing in only a few cases across the groups.

The comparison of anxiety and depression scores between the BFRBDs (TTM, pathological NB, SPD) and HC groups revealed significant differences across all measured domains (Table 2). Total internalizing scores were highest in BFRBDs (TTM=68.40, NB=64.63, SPD=62.60) compared to HC ($p<.001$). Total anxiety scores were also elevated in BFRBDs, with TTM showing significantly higher scores than SPD ($p<.001$). SP scores were significantly higher for specific disorders in all BFRBD groups than in HC ($p<.001$). PD ($p<.001$), GAD ($p<.001$), and OCD ($p<.001$) also followed the same trend. MDD scores were notably higher in BFRBDs than HC ($p<.001$). Post-hoc analyses confirmed that all BFRBDs groups had significantly higher scores than HC for most variables. Notably, SAD scores were significantly higher in TTM and pathological NB groups than in HC ($p=.012$), but SPD did not differ significantly. Additionally, TTM had higher anxiety scores than SPD ($p<.001$), indicating a more severe anxiety profile.

The comparison of impulsivity, metacognition, and quality of life scores between the BFRBDs (TTM, pathological

NB, SPD) and HC groups revealed significant differences in several domains (Table 3; Fig. 2). For total metacognition scores, the TTM group (M = 72.63) scored significantly higher than both the pathological NB (M = 62.30) and HC (M = 52.20) groups ($p = .002$, $\eta^2 = 0.115$). Similarly, cognitive monitoring scores were significantly higher in TTM than pathological NB and HC ($p = .008$, $\eta^2 = 0.090$). Positive beliefs about worry were also significantly higher in TTM than in HC ($p = .034$, $\eta^2 = 0.067$), but no differences were observed in negative and SPR beliefs. Regarding impulsivity, poor self-regulation was significantly higher in the SPD group than in the HC ($p = .022$, $\eta^2 = 0.074$). However, no significant differences were found in total impulsivity or impulsive behavior scores. In quality of life (PedsQL), physical health scores were significantly lower in the SPD group than in HC ($p = .014$, $\eta^2 = 0.081$), while psychosocial health and total QoL scores did not show significant group differences.

The correlation analysis between self-report measurement scores, BFRBDs duration, and symptom severity revealed significant associations, particularly with symptom severity and internalizing symptoms (Table 4). Symptom severity (NE-YBOCS) showed strong negative correlations with quality of life (PedsQL, $\rho = -0.485$, $p = .007$, adjusted $p = .035$), indicating that greater symptom severity is linked to lower quality of life. It also correlated positively with internalizing symptoms (RCADS-CV, $\rho = 0.539$, $p = .002$, adjusted $p = .013$), suggesting that higher symptom severity is associated with increased anxiety and depression. The duration of BFRBDs was not significantly associated with symptom severity or impulsivity but had a weak positive correlation with metacognition (MCQ, $\rho = 0.256$, $p = .015$, adjusted $p = .049$). Impulsivity (BIS-Brief) was not significantly correlated with symptom severity, quality of life, or duration, indicating a weaker role in BFRBD persistence. However, metacognition (MCQ-CA) was significantly correlated with symptom severity ($\rho = 0.375$, $p = .041$, adjusted $p = .082$).

Discussion

This study is the first to compare TTM, SPD, and NB regarding impulsivity, metacognitions, and other BFRBD-related factors in children and adolescents. Our analysis of impulsivity in adolescents with BFRBDs compared to healthy controls supported our prediction of higher levels of impulsivity in the BFRBD group. Following pairwise comparisons, controlling for the effects of total anxiety and depression scores showed that poor self-regulation was significantly higher in the SPD group than in the controls. Consistent with our hypothesis, several studies have found that SPD is strongly associated with different aspects of impulsivity [50, 51]. Self-regulation involves the ability to control and direct one's thoughts, emotions, and behaviors towards a specific goal and is closely related to psychological constructs such as emotion regulation, behavioral control, and impulsivity. Individuals with poor self-regulation are more prone to impulsive decision-making, emotion regulation difficulties, and externalizing behaviors, particularly under conditions of heightened anxiety or stress [52, 53]. They often seek quick relief to manage distressing emotions, which may lead to maladaptive coping strategies over time. In the context of SPD, some authors have suggested that skin picking is an impulsive attempt to alleviate unpleasant negative emotional states, with the resulting sense of relief from skin picking reinforcing this behavior [54]. In addition, craving, which is often reported before a skin picking episode, is associated with reward expectation and may lead the individual to engage in behaviors that provide immediate relief [55]. In this process, the individual may choose a short-term reward despite potential long-term negative consequences, a phenomenon known as delayed discounting, another key component of cognitive impulsivity [21]. On the other hand, although the SPD group exhibited significantly higher levels of poor self-regulation, no significant correlation was found between impulsivity and symptom severity, particularly within this group. This finding is particularly interesting, given that several previous studies have demonstrated relationships between specific aspects of impulsivity and the severity of skin picking. One possible explanation for this discrepancy is that our study excluded comorbid disorders such as ADHD, OCD, and alcohol or substance use disorders, all of which are closely associated with impulsivity. While the negative impact of these comorbidities on symptom severity and clinical course is widely acknowledged, many existing studies have not statistically accounted for their potential confounding effect [56–58]. In addition, in the present study, impulsivity was assessed using a brief, culturally adapted instrument that has demonstrated validity in adolescent samples and captures two of its core dimensions. In contrast, previous research has often used more comprehensive tools to assess a broader range of impulsivity subcomponents, which may also contribute to this discrepancy [18, 20]. As impulsivity is a multidimensional and complex construct, these differences emphasize the importance of having culturally appropriate measurement tools that can capture its different aspects more thoroughly. Impulsive skin-picking behavior is frequently observed in individuals with SPD following episodes of intense negative emotion [54]. This observation supports the view that impulsivity in SPD may function as a state-dependent reaction to emotional distress rather than reflecting a stable personality trait. Therefore, relying solely

Table 3 Comparison of Impulsivity, metacognition and quality of life scores between the BFRBDs and HC groups

		TTM (*N*=30)		NB (*N*=30)		SPD (*N*=30)		HC (*N*=40)		F	Sig-nifi-cance (*p*)	Partial eta squared	Post-hoc differences	Effect Size (η^2)
		M (SD)	Adjusted M (SE)	M (SD)	Adjusted M (SE)	M (SD)	Adjusted M (SE)	M (SD)	Adjusted M (SE)					
MCQ-CA	Total score	72.63 (9.56)	68.31 (1.86)	62.30 (10.60)	59.76 (1.78)	64.83 (12.03)	63.26 (1.76)	52.20 (11.32)	58.53 (1.80)	5.394	**0.002**	0.115	TTM > NB TTM > HC	0.115
	Positive beliefs about worry	15.20 (4.92)	14.52 (0.82)	12.50 (4.30)	12.10 (0.78)	13.00 (4.33)	12.75 (0.77)	10.03 (3.56)	11.01 (0.79)	2.975	**0.034**	0.067	TTM > HC	0.067
	Negative beliefs about worry	19.17 (4.67)	17.31 (0.72)	16.60 (4.55)	15.51 (0.69)	17.70 (4.15)	17.02 (0.68)	13.38 (4.12)	16.10 (0.70)	1.461	0.228	0.034	–	–
	SPR beliefs	18.63 (2.87)	17.38 (0.62)	17.23 (3.72)	16.50 (0.60)	16.47 (3.47)	16.01 (0.59)	13.78 (3.91)	15.61 (0.60)	1.365	0.257	0.032	–	–
	Cognitive monitoring	19.63 (5.74)	19.10 (0.81)	15.97 (3.68)	15.65 (0.77)	17.67 (3.39)	17.47 (0.76)	15.03 (3.60)	15.80 (0.78)	4.112	**0.008**	0.090	TTM > NB TTM > HC	0.090
BIS-B	Total score	19.10 (4.68)	18.75 (0.82)	18.70 (4.25)	18.49 (0.78)	19.77 (3.95)	19.64 (0.77)	16.22 (3.92)	16.74 (0.79)	2.142	0.098	0.049	–	–
	Poor self- regulation	8.70 (1.82)	8.71 (0.39)	8.70 (1.66)	8.71 (0.37)	8.93 (1.86)	8.94 (0.36)	7.35 (2.32)	7.33 (0.37)	3.322	**0.022**	0.074	SPD > HC	0.074
	Impulsive behavior	10.43 (3.59)	10.05 (0.58)	10.00 (3.19)	9.77 (0.55)	10.77 (2.74)	10.63 (0.54)	8.88 (2.44)	9.44 (0.56)	0.812	0.490	0.019	–	–
PEDSQL	Total score	55.09 (17.23)	62.31 (2.59)	59.39 (14.58)	63.63 (2.48)	55.62 (16.89)	58.25 (2.44)	77.70 (15.59)	67.13 (2.50)	2.097	0.104	0.048	–	–
	Physical health	57.11 (20.77)	63.26 (3.21)	65.94 (16.73)	69.54 (3.07)	56.77 (19.59)	59.00 (3.02)	81.27 (15.61)	72.28 (3.09)	3.677	**0.014**	0.081	HC > SPD	0.081
	Psychosocial health	54.01 (18.67)	61.81 (3.01)	55.89 (15.56)	60.50 (2.88)	55.01 (18.03)	57.85 (2.84)	75.79 (19.83)	64.38 (2.90)	0.878	0.455	0.021	–	–

M: Mean, SD: Standard Deviation, SE: Standard Error, TTM: Trichotillomania, NB: Nail Biting, SPD: Skin Picking Disorder, HC: Healthy Controls, RCADS-CV: Revised Children's Anxiety and Depression Scale Child Version, MCQ: The Metacognitions Questionnaire for Children and Adolescents, SPR beliefs: superstitious, punishment and responsibility beliefs, BIS- B: The Barratt Impulsiveness Scale-Brief, PedsQL: The Pediatric Quality of Life Inventory. *Statistical analyses were conducted using ANCOVA, with the RCADS-CV Total Internalizing Score included as a covariate to control for its potential confounding effects on group comparisons. Post-hoc pairwise comparisons were conducted for significant group differences, and Bonferroni correction was applied to adjust for multiple comparisons, ensuring robust statistical conclusions

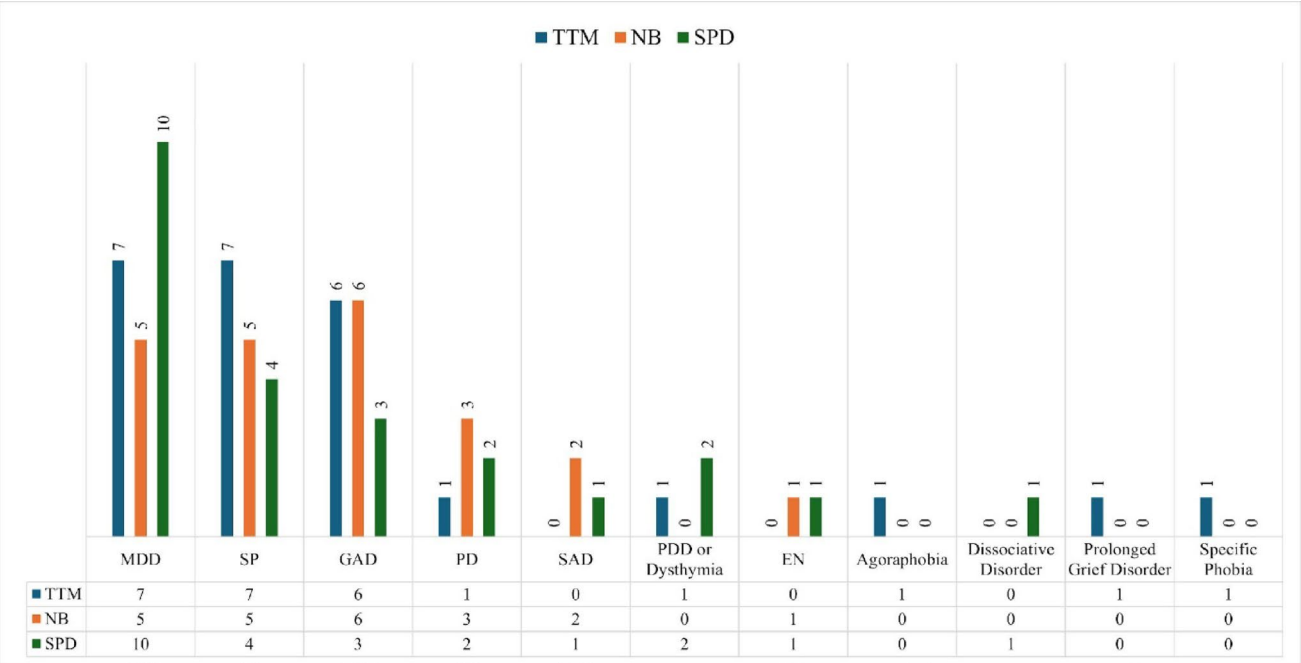

Fig. 2 Comparison of Adjusted Means for Metacognition, Impulsivity, and Quality of Life Scores Across BFRBDs and HC Groups. BFRBDs: Body- Focused Repetitive Behavior Disorders, PedsQL: The Pediatric Quality of Life Inventory, BIS- Brief: The Barratt Impulsiveness Scale-Brief, MCQ-CA: The Metacognitions Questionnaire for Children and Adolescents, HC: Healthy Controls

Table 4 Correlation analysis between self-report measurement scores, duration of the BFRBDs, and symptom severity of the BFRBDs

		MGH-HPS	A Modified Scale for Nail Biting	NE-YBOCS	Symptom severity of BFRBDs
PedsQL Total Score	Spearman's correlation coefficient	−0.378	**−0.447**	**−0.485**	**−0.377**
	p / Adjusted p (FDR)	0.040 / 0.082	**0.013 / 0.049**	**0.007 / 0.035**	**< 0.001 / 0.010**
	N	30	**30**	**30**	**90**
Duration of the BFRBDs	Spearman's correlation coefficient	0.232	0.136	−0.181	0.201
	p / Adjusted p (FDR)	0.218 / 0.311	0.472 / 0.555	0.338 / 0.422	0.058 / 0.105
	N	30	30	30	90
BIS- Brief Total Score	Spearman's correlation coefficient	0.237	−0.089	0.049	0.010
	p / Adjusted p (FDR)	0.207 / 0.311	0.638 / 0.709	0.796 / 0.838	0.924 / 0.924
	N	30	30	30	90
MCQ-CA Total Score	Spearman's correlation coefficient	0.185	0.269	0.375	**0.256**
	p / Adjusted p (FDR)	0.327 / 0.422	0.151 / 0.252	0.041 / 0.082	**0.015 / 0.049**
	N	30	30	30	**90**
RCADS- CV Total Internalizing Score	Spearman's correlation coefficient	0.397	**0.433**	**0.539**	**0.438**
	p / Adjusted p (FDR)	0.030 / 0.075	**0.017 / 0.049**	**0.002 / 0.013**	**< 0.001 / 0.010**
	N	30	**30**	**30**	**90**

Note. MGH-HPS: Massachusetts General Hospital Hairpulling Scale, NE-YBOCS: The Yale-Brown Obsessive Compulsive Scale Modified for Neurotic Excoriation, BFRBDs: Body- Focused Repetitive Behavior Disorders, PedsQL: The Pediatric Quality of Life Inventory, BIS- Brief: The Barratt Impulsiveness Scale-Brief, MCQ-CA: The Metacognitions Questionnaire for Children and Adolescents, RCADS-CV: Revised Children's Anxiety and Depression Scale Child Version, FDR: False Discovery Rate. *Spearman's correlation tests were conducted to assess relationships between self-report scores, duration of BFRBDs, and symptom severity. FDR correction using the Benjamini-Hochberg method was applied to control for multiple comparisons. The table presents both original and FDR-adjusted p-values, ensuring statistical reliability

on self-report instruments may overlook this situational dimension, potentially contributing to inconsistent findings. Future studies should integrate behavioral tasks with multidimensional self-report instruments to provide a more comprehensive understanding of the role of impulsivity in SPD. Our findings highlight several important implications. Future research should investigate the role of impulsivity in SPD using more standardized and objective methods to provide a deeper understanding of its neuropsychological underpinnings. In addition, targeted interventions to

improve self-regulation skills may help reduce impulsive behaviors in patients with SPD. Finally, given the consistent relationship between impulsivity and SPD, its classification within the psychiatric diagnostic systems warrants further investigation.

Pairwise comparisons—controlling for the effects of the total internalizing score—revealed that cognitive monitoring and the total metacognition score were significantly higher in the TTM group than in the pathological NB group and healthy controls. Although not hypothesized a priori, positive beliefs about worry were also significantly higher in the TTM group compared to controls, as group differences were primarily anticipated in the negative metacognitive domain. Cognitive monitoring is a critical cognitive phenotype that enables the flexible adjustment of goal-directed behavior in response to situational demands through the continuous monitoring of errors and external feedback. However, its excessive activation may lead to maladaptive compensatory responses —such as compulsions in OCD—particularly in situations where no behavioral adjustment is required [59]. Many studies have shown that excessive cognitive monitoring is consistently associated with OCD, and some authors have even proposed that it may represent a potential neurocognitive endophenotype of OCD [60]. However, to our knowledge, only one study has specifically investigated this cognitive phenotype in adults with TTM. Contrary to our finding, that study reported a decrease in response monitoring in the TTM group compared to healthy controls. The authors emphasized that TTM exhibits more impulsive characteristics than OCD, suggesting that TTM should be considered a separate phenomenon from OCD [61]. One possible explanation for this difference is that our study assessed trait-level maladaptive cognitive monitoring using a self-report instrument, whereas the previous study employed a performance-based behavioral task to measure state-level cognitive monitoring. In addition, the inclusion of adolescents in our sample and the control of almost all comorbid psychiatric conditions may also have contributed to the discrepancy in findings. In the context of TTM, increased cognitive monitoring may reflect the ongoing monitoring of internal triggers (e.g., anxiety, emotional distress, itching) before a hair-pulling episode, efforts to control urges or thoughts related to hair-pulling, and self-evaluative processes following the behavior.

In addition to cognitive monitoring, adolescents with TTM also showed higher positive beliefs about worry. As no previous studies have evaluated these beliefs in adolescents with TTM, this study provides the first data on this topic. Positive beliefs about worry, usually associated with GAD, refer to metacognitive beliefs that regard worry as useful, necessary, or functional [62, 63]. According to the behavioral-cognitive-metacognitive model of OCD, individuals can interpret negative automatic thoughts, such as "I am losing control" or "I cannot get this thought out of my mind," as abnormal or dangerous. This interpretation reflects the development of negative metacognitive beliefs, which can lead to using thought control strategies or engaging in compulsive behaviors. Positive beliefs about worry may also be critical in perpetuating this cycle. When individuals consider worrying a protective and necessary response to manage emotional distress, it can become reinforced and maintained as a favored coping mechanism, thereby perpetuating the obsessive-compulsive cycle [64]. In the context of TTM, individuals often describe hair-pulling behavior as a coping mechanism that temporarily alleviates intense anxiety or emotional distress [65, 66]. This suggests that hair pulling may serve a self-regulatory function in managing internal emotional states rather than simply reflecting an impulsive behavior. Although no studies have directly examined the role of positive beliefs about worry in TTM, recent phenomenological and qualitative findings indicate that some individuals who use hair pulling to relieve internal tension perceive worry—albeit indirectly—as a functional tool for emotional regulation. This raises the theoretical possibility that the perceived regulatory effect of hair pulling may contribute to heightened attention to internal cues over time and may be associated with the development of metacognitive beliefs that view worry as purposeful. Nevertheless, this remains a conceptual inference within the framework of the current study, highlighting the need for future empirical research to explore this potential relationship. Our findings suggest that dysfunctional metacognitive beliefs, particularly those related to cognitive monitoring and positive beliefs about worry, may play an important role in the onset and maintenance of TTM. Considering the potential role of maladaptive metacognitive beliefs in TTM, large-sample longitudinal studies may contribute to a better understanding of the clinical significance of these beliefs. At the same time, metacognitive-based interventions, including the restructuring of positive beliefs about worry and the ability to evaluate thoughts as 'mental acts,' may be considered as a potential therapeutic approach for TTM. Ultimately, although TTM has some impulsive characteristics, these findings may support a conceptualization of TTM within the OCD spectrum, particularly in terms of its relationship with metacognitive processes.

Consistent with one of our hypotheses, comorbid anxiety and depression symptoms were positively and moderately correlated with the symptom severity of BFRBDs. Numerous studies have shown that the presence of comorbid psychiatric disorders increases symptom severity, reduces treatment response and compliance, and negatively impacts the clinical course [30, 67, 68]. In line with our expectations, a positive and statistically significant relationship

was also found between the symptom severity of BFRBDs and dysfunctional metacognitive beliefs. Notably, dysfunctional metacognitive beliefs were not significantly correlated with disorder-specific severity measures. One possible explanation for this finding is that, although the sample size determined by the power analysis was sufficient for group comparisons, detecting a statistically significant correlation, especially in subgroup analyses, may require a larger sample size. This is particularly relevant considering the nature of the hypotheses tested and the anticipated effect sizes. In contrast, the analysis using a composite symptom severity score across all BFRBD groups did reveal a significant correlation, likely due to the greater variability and increased statistical power provided by the aggregated data. In addition, dysfunctional metacognitive beliefs may reflect a cognitive predisposition (trait-like characteristic) or, more broadly, a transdiagnostic risk factor rather than serving as a direct correlate of symptom severity in subgroups. This perspective may also help to explain why no significant relationship was found between total metacognitive belief scores and symptom severity in the TTM group, despite certain domains—particularly cognitive monitoring and positive beliefs about worry—being significantly elevated. Finally, the significant clinical heterogeneity among BFRBDs subtypes may help explain the absence of significant relationships between dysfunctional metacognitive beliefs and disorder-specific symptom severity. A recent study showed that BFRBDs subtypes differ significantly in terms of age at symptom onset, behavioral functions, emotional and cognitive triggers, and the level of functional impairment [1]. This phenomenological dissociation suggests that dysfunctional metacognitive beliefs, as a transdiagnostic risk factor, may not be uniformly related to the specific symptom dynamics of each subtype.

Contrary to our expectations, no statistically significant correlation was found between impulsivity and the symptom severity of BFRBDs. The significant correlation between maladaptive metacognitive beliefs and symptom severity in individuals with BFRBDs may be due to the trait-level nature of these beliefs, which tend to represent stable and enduring aspects of one's cognitive style. In contrast, impulsivity may manifest in response to contextual or situational factors, such as stressful conditions. This suggests that impulsivity may reflect state-dependent behavioral patterns. Therefore, it is considered important to complement self-report instruments with behavioral tasks to provide a more comprehensive understanding of the potential role of these cognitive structures in BFRBDs. In addition, it is important to note that the validity and reliability of the measurement tools used to assess BFRBDs in our study have only been demonstrated in adult samples. The lack of psychometric data specific to the adolescent age group requires caution in interpreting the findings. Future research should focus on developing assessment tools with established validity and reliability specific to this age group, thereby contributing to more scientifically sound findings.

This study also found no significant differences in total anxiety and depression scores or psychiatric comorbidity rates between the TTM, SPD, and pathological NB groups. This finding contrasts with previous research, which has often associated TTM and SPD with higher rates of psychiatric comorbidity and greater psychosocial and physical impairment, while NB has been characterized as a more benign condition [1, 30, 33]. The inclusion of adolescents with pathological NB, which is clinically significant and associated with functional impairment, may have contributed to this result. The finding that pathological NB can negatively affect functionality to a similar extent as TTM and SPD highlights the need for clinicians to conduct a more comprehensive assessment of patients presenting with NB.

Strengths and Limitations

This study has several positive features. This is the first study to examine impulsivity and metacognitions in adolescents with BFRBDs. Unlike previous research, a more homogeneous group was created in terms of age and gender, and adolescents with pathological NB were also included in the study. This study also ensured that participants received a single diagnosis of BFRBD. Only drug-naive patients were included in this study, and patients with comorbid diagnoses of ADHD and OCD, which are strongly associated with impulsivity and metacognitions, were excluded. The potential impact of different variables on impulsivity and metacognitions was also controlled as much as possible, thereby increasing the reliability of the results.

Some limitations of the study may be considered. Although we used the most appropriate self-report scales that assess impulsivity and metacognitions from a transdiagnostic perspective and whose validity and reliability studies have been conducted in our cultural context, the self-report scales used in this study may have influenced the results due to the multidimensional and complex nature of impulsivity and metacognitions. In addition, although the self-report measurements used in this study to assess BFRBDs have been validated in adults, they have not been psychometrically validated in children and adolescents. Therefore, the reliability and validity of these measures in our sample may be limited. Another important limitation is the study's cross-sectional design, which precludes any inference about causal relationships between the variables. Additionally, the our sample's predominantly female composition may limit the generalizability of the findings. Despite increasing

statistical power and enabling dimensional comparisons, using a composite symptom severity score for all BFRBDs may have limited the ability to capture disorder-specific features. Although a sample size of 130 is sufficient to detect significant relationships even at moderate effect sizes, larger samples and longitudinal studies are needed to better understand the impulsive and compulsive underpinnings of BFRBDs.

Conclusions

The recent classification of TTM and SPD under OCRD in the DSM-V and the significant overlap of BFRBDs with impulse control disorders have highlighted the need for accurate placement of these behaviors along the impulsive-compulsive spectrum. While studies on the position of BFRBDs in this spectrum are limited in the adult population, there is a complete absence of such studies in children and adolescents. This study, therefore, holds significant potential. It compares three prominent BFRDs with each other and with a control group in terms of impulsivity, metacognitions, and other related factors. The results of this study indicate that maladaptive metacognitions are the more predominant feature of TTM, impulsivity is the more predominant feature of SPD, and NB should be clearly defined within this spectrum. Future longitudinal studies with larger samples elucidating the roles of impulsivity and metacognitions in pediatric BFRBDs will contribute to developing different treatment strategies tailored to each behavior, offering hope for improved patient outcomes.

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Declarations

Competing Interests The authors declare no competing interests.

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