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Impulsivity in adolescent bipolar disorder

Gilbert KE, Kalmar JH, Womer FY, Markovich PJ, Pittman B, Nolen-Hoeksema S, Blumberg HP. Impulsivity in adolescent bipolar disorder.

Objective: Increased impulsivity has been shown to be a trait feature of adults with bipolar disorder (BD), yet impulsivity has received little study in adolescents with BD. Thus, it is unknown whether it is a trait feature that is present early in the course of the disorder. We tested the hypotheses that self-reported impulsiveness is increased in adolescents with BD, and that it is present during euthymia, supporting impulsiveness as an early trait feature of the disorder.
Methods: Impulsiveness was assessed in 23 adolescents with BD and 23 healthy comparison (HC) adolescents using the self-report measure of impulsivity, the Barratt Impulsiveness Scale (BIS), comprised by attentional, motor and non-planning subscale scores. Effects of subscale scores and associations of scores with mood state and course features were explored.
Results: Total and subscale BIS scores were significantly higher in adolescents with BD than HC adolescents. Total, attentional and motor subscale BIS scores were also significantly higher in the subset of adolescents with BD who were euthymic, compared to HC adolescents. Adolescents with BD with rapid-cycling and chronic mood symptoms had significantly higher total and motor subscale BIS scores than adolescents with BD without these course features.
Conclusion: These results suggest increased self-reported impulsiveness is a trait feature of adolescents with BD. Elevated impulsivity may be especially prominent in adolescents with rapid-cycling and chronic symptoms.

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Impulsivity is a prominent feature of bipolar disorder (BD) (1–3). Heightened impulsiveness is a characteristic feature of mania (3,4) and has also been associated with depressive episodes of BD (3,5). Using a self-report measure of trait impulsivity, the Barratt Impulsiveness Scale (BIS) (6), adults with BD show elevated impulsivity during both acute mania and depression as well as in euthymic periods (2,3,7–10). These findings support impulsivity as a trait feature of BD. Impulsivity is elevated in adults with rapid-cycling BD and suicidality, suggesting that impulsivity may be associated with poorer prognosis (11,12). Additionally, total and attentional impulsivity scores are related to an earlier age of onset in adult BD (12), suggesting that impulsivity may be a characteristic of BD presenting during adolescence. However, little work has focused on impulsivity in adolescent BD and thus, it is not clear whether impulsivity is a trait feature of the adolescent epoch.

To our knowledge, demonstration of trait impulsiveness across the attentional, motor and non-planning domains assessed by the BIS has not been reported previously in adolescents with BD. Increased impulsiveness in adolescents with BD is implicated by studies showing impaired response inhibition in tasks requiring inhibition of prepotent responses and adaptation of responses to changing reinforcement contingencies (13–16). Moreover, impulsiveness could contribute to deficits in adaptive set shifting and cognitive flexibility in BD, as shown in euthymic adolescents with BD and in adolescent BD without comorbid attention deficit hyperactivity disorder (ADHD) (13–16).

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We assessed self-reported trait impulsivity in adolescents with BD using the BIS (6). We hypothesised that adolescents with BD would show increased impulsiveness compared to healthy comparison (HC) adolescents, and that this increase would be present in euthymic, in addition to symptomatic, adolescents with BD. We also explored the relationship between impulsivity and clinical features of BD, including rapid-cycling, comorbidity with ADHD and suicidality.

Materials and methods

Subjects

Participants included adolescents aged 11–17 years, 23 with BD I [43.4% female, mean (M) age 14.7 years ± SD 1.32] and 23 HC adolescents (47.8% female, M = 14.2 ± 1.91). Adolescents with BD were recruited from the Yale School of Medicine medical centre and surrounding community; HC participants were recruited from the community. The presence or absence of DSM-IV Axis I disorders were confirmed by administration of the revised Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL) (17) to participants and a parent or guardian. Exclusion criteria included history of neurological disorders, loss of consciousness over 5 min and significant medical illness. Additionally, HC adolescents did not meet DSM-IV criteria (18) for an Axis I disorder, nor had a first degree relative with a history of psychiatric illness, as measured by the Family History Screen for Epidemiological Studies (19).

At the time of assessment, 15 (65%) adolescents with BD were euthymic and 8 (35%) were in a current mood episode: 3 (16%) depressed, 2 (11%) manic and 3 (16%) in mixed states. Owing to the small number of participants in a mood episode, they were combined into a BD 'acute' subgroup for analyses. Six adolescents (26%) met criteria for rapid-cycling and five adolescents (22%) reported chronic mixed symptoms. These two groups were combined for analysis into a 'rapid-cycling' subgroup to compare adolescents who experience more time in clinically symptomatic states to the non-rapid-cycling BD subgroup who experience acute symptoms less frequently; secondary analyses also assessed the subgroup that met criteria for rapid-cycling separately from the chronic symptom subgroup. Current comorbidities in adolescents with BD included ADHD ($n = 7$, 30%), oppositional defiant disorder ($n = 3$, 13%), anxiety disorders ($n = 3$, 13%: separation anxiety disorder $n = 1$, generalised anxiety disorder and post-traumatic stress disorder $n = 1$ and specific phobia $n = 1$), substance abuse ($n = 1$, 4%) and enuresis ($n = 1$, 4%). Psychotropic medications prescribed to adolescents with BD included atypical antipsychotics ($n = 15$, 65%), anticonvulsants ($n = 11$, 48%), lithium ($n = 6$, 26%), antidepressants ($n = 4$, 17%), stimulants ($n = 5$, 22%) and benzodiazepines ($n = 1$, 4%). Three (13%) adolescents with BD were unmedicated at assessment.

Prior to study, written informed consent from the parent/guardian and written assent from participants were obtained. The study was approved by the Yale School of Medicine Institutional Review Board.

Instruments

Current mood episode and history of suicidal behaviours were assessed using the K-SADS-PL (17). The Child Depression Rating Scale (CDRS) (20) and Young Mania Rating Scale (YMRS) (21) assessed current mood symptoms. To measure impulsivity, the BIS version 11a (22) was used. The total score on the BIS self-report measure of impulsivity is the sum of three subscale scores: attentional impulsivity (inability to focus or concentrate), motor impulsivity (acting on the spur of the moment) and non-planning impulsivity (lack of sense of future). Total BIS scores, as well as the three subscale scores, were calculated from the BIS-11a and prorated to BIS-11 scores (22,23).

Statistical analysis

Analyses were performed in SAS version 9.1 (SAS Institute, Cary, North Carolina, USA) using BIS total and subscale scores as dependent variables. Independent sample *t*-tests were performed to compare the HC group to the BD group. Analysis of variance (ANOVA) was used to further assess differences between the euthymic BD subgroup, acute BD subgroup and HC group, followed by Tukey's multiple comparison procedure testing all pair-wise differences. Age and sex were considered in the comparisons above using analysis of covariance, but were not significant and dropped for parsimony. Within the overall BD group, effects of clinical factors were assessed one at a time using independent sample *t*-tests, including the presence/absence of rapid-cycling/chronic symptoms, ADHD comorbidity, history of suicide gestures and medication (on/off for any psychotropic medication and individually for atypical antipsychotic, anticonvulsant, lithium, antidepressants and stimulant subclasses).

Results

There were no significant differences between the HC and BD groups, or across HC, BD euthymic

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Table 1. Demographic features and BIS scores

	HC ($n = 23$)	All BD ($n = 23$)	Euthymic BD ($n = 15$)	Acute BD ($n = 8$)
Age	14.2 (±1.91)	14.7 (±1.32)	14.5 (±1.41)	15.1 (±1.13)
Gender (% *F*)	48	43	45	50
BIS total	61.7 (8.59)	74.2 (11.07)***	72.7 (12.99)**	77.0 (5.86)***
BIS attentional	16.4 (4.58)	21.1 (4.21)***	20.9 (4.85)**	21.5 (2.88)**
BIS motor	19.4 (3.69)	24.0 (5.58)*	24.1 (6.71)*	23.9 (2.75)
BIS non-planning	25.4 (4.73)	29.2 (5.50)*	27.8 (6.17)	31.8 (2.71)**

No significant differences between euthymic BD and acute BD groups.
Values are group means (SE) unless otherwise indicated.
Significantly different from HC group: *$p < 0.05$; **$p < 0.01$ and ***$p < 0.001$.

and BD acute groups, in age [$t(44) = -1.08$, $p > 0.05$] or gender [$\chi^2(1) = 0.088$, $p > 0.05$]. BIS total and all subscale scores were significantly higher in the BD group compared to the HC group (Table 1).

Comparing the euthymic BD, acute mood BD and HC groups using ANOVA, significant effects of group for total BIS scores [$F(2,43) = 9.66$, $p < 0.001$] and all subscale scores [attentional: $F(2,43) = 8.37$, $p < 0.001$; motor: $F(2,43) = 5.35$, $p < 0.01$; non-planning: $F(2,43) = 4.81$, $p < 0.05$] were observed. Tukey's *post hoc* tests showed the euthymic BD subgroup and acute BD subgroup each displayed significantly higher total scores than the HC group on total and attentional subscale scores (Table 1). Significantly higher scores on the motor subscale were only found for the euthymic BD subgroup, compared to the HC group. Conversely, only the acute BD subgroup differed from the HC group on the non-planning subscale. No differences were observed between the two BD subgroups. Controlling for CDRS and YMRS scores in the models above did not affect results, nor did total BIS scores correlate with current manic ($r = 0.22$, $p > 0.05$) or depressive ($r = 0.28$, $p > 0.05$) symptoms.

The subgroups of BD adolescents with rapid-cycling/chronic symptoms had higher BIS total scores [$t(21) = 2.9$, $p < 0.05$], and motor subscale scores [$t(21) = -2.96$, $p < 0.05$], than adolescents with BD without these course features. Secondary analyses assessing adolescents with rapid-cycling and adolescents with chronic symptoms separately showed the rapid-cycling subgroup differed significantly from the HC group on both the total [$t(16) = -2.48$, $p < 0.05$] and motor subscale [$t(16) = -3.15$, $p < 0.05$] scores while differences between the chronic symptom subgroup and the HC group on total [$t(15) = -1.98$, $p = 0.06$] and motor subscale [$t(15) = -1.94$, $p = 0.07$] scores were at the trend level. No significant effects were detected for the presence or absence of ADHD comorbidity, history of suicidal behaviour or medication use (overall use or for subclass of medication).

Discussion

Impulsivity, as measured by the BIS, was significantly higher in adolescents with BD compared with HC adolescents. Consistent with findings in adult samples, (2,3,9,12), impulsivity was elevated within the euthymic subgroup of BD adolescents. This supports self-reported impulsiveness as a trait feature of BD that is present by adolescence. Additionally, previous reports show the attentional subscale to be associated with a more severe course of the disorder and an earlier age of onset (12). Similarly, in the current sample, the attentional subscale was the only subscale to show significant elevations in both the euthymic and acute mood subsamples compared with the HC adolescents. This is potentially consistent with reports of diminished performance on tasks requiring sustained attention and inhibition of inappropriate responses and deficits in prefrontal regions subserving impulse regulation reported in euthymic BD adolescents (13,15,16,24–28).

Neuroimaging studies of BD show structural and functional abnormalities in ventral prefrontal cortex (vPFC) neural systems that subserve impulse regulation (24–27), suggesting a neural difference that might mediate the increased impulsiveness of BD. Decreases in vPFC volume and deficits in vPFC engagement during tasks that require inhibition of prepotent responses have been reported in symptomatic and euthymic adults with BD (24,25). Preliminary evidence suggests these abnormalities emerge and progress during adolescence (25–27) and are associated with impaired behavioural inhibition (28).

Consistent with reported associations between more frequent episodes in adults with BD and elevated impulsivity (12), adolescents with BD with rapid-cycling and chronic symptoms showed elevated self-reported impulsivity, especially on the motor subscale, compared with BD adolescents with fewer episodes. We previously noted greater decreases in vPFC volume in adolescents and adults with BD with rapid-cycling, compared to those with BD without rapid-cycling (25), suggesting structural brain differences that may mediate the increased impulsivity in this population. Consistent with the findings, vPFC abnormalities in adolescents with BD have been linked to motor disinhibition (28). It is possible that greater abnormalities in the development of vPFC may lead to impulsivity and cycling phenotypic features of an adolescent subgroup with BD; however, it is also possible that episodes have neurotoxic effect in vPFC. Research to

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bridge the neurobiological findings, impulsivity and clinical course features of adolescents with BD is warranted.

Although increased suicidality has been associated with increased impulsivity in adults with BD (11,12), we did not detect this relationship in the adolescents. The additional diagnosis of ADHD also did not influence levels of impulsivity. ADHD not in conjunction with BD has been associated with increased BIS scores (29); however, our finding is consistent with reports of similar levels of difficulty in response inhibition in BD adolescents with and without comorbid ADHD (13,16). It should be noted though that the small subsample sizes in the subgroups with suicidality and comorbid ADHD may have reduced the ability to detect associations. Substance abuse is also associated with increased impulsivity in adult BD (1,8,11). However, this sample included only one adolescent who met criteria for a substance use disorder so associations could not be assessed. More sensitive measures of substance misuse may help to elucidate associations to substance use initiation and early misuse with impulsivity in adolescents with BD. Associations between total impulsivity and psychotropic medication status for any medication use and for use of subclasses of medications were not detected, although assessments may have been limited by small sample sizes.

To our knowledge, this is the first study to show trait impulsiveness in adolescents with BD using the BIS. Given the small sample size, the results should be considered preliminary. Future research should include larger samples and more systematic assessment of clinical features and medication. Future prospective studies of adolescents at risk for BD and assessment of structural brain differences associated with BIS scores will further aid in elucidating mechanisms underlying the development of impulsivity in the disorder.

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