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Family functioning as a moderator in the relation between perceived stress and psychotic-like experiences among adolescents during COVID-19

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ABSTRACT

Background: The COVID-19 pandemic has increased psychological stress among adolescents, and the relation between perceived stress (PS) and psychotic-like experiences (PLEs) has been well-established. However, little is known about the role of family functioning (FF) in this relation, especially when adolescents experienced the extended lockdown period with family members.

Methods: A total of 4807 adolescents completed this retrospective paper-and-pencil survey after school reopening between May 14th and June 6th, 2020 in Hunan Province, China. We measured PS with the Perceived stress scale (PSS-10), PLEs with the eight positive items from Community Assessment of Psychic Experiences (CAPE-8), and FF with the Family APGAR scale. We conducted subgroup analysis based on three FF levels (good, moderate, and poor) determined by previous studies. Finally, correlation and moderation analysis were performed to detect the effect of FF in the relation between PS and PLEs after adjusting for demographic variables.

Results: Adolescents with poor FF had higher levels of PS and higher prevalence of PLEs compared to those with good FF (both $p < 0.001$). FF was negatively associated with both PS ($r = -0.34$, $p < 0.001$) and PLEs ($r = -0.29$, $p < 0.001$). Higher FF significantly attenuated the effect of PS on PLEs after adjusting for sex and age (effect = −0.011, bootstrap 95% CI -0.018, −0.005).

Conclusion: Our findings indicate that well-functioned family could protect against stress-induced PLEs among adolescents during this crisis. Thus family system could be an early interventional target for distressing psychotic-like experiences in youngsters.

1. Introduction

The coronavirus disease 2019 (COVID-19) outbreak was firstly reported in Wuhan, Hubei Province, China, in December 2019, which soon turned into a pandemic. China, as well as many countries, adopted numerous public health strategies, such as quarantine, lockdown and social distancing, to contain the spread of the virus [1]. Consequently, schools in Changsha, Hunan Province, which is adjacent to Hubei Province, were closed from January 23rd to April 7th of 2020 and home-based distance-learning patterns were enforced during this period [2]. In this unprecedented crisis, the general population encountered an intense feeling of stress. Of note, the COVID-19 outbreak placed psychological stress to the population disproportionally. Children and adolescents are regarded as one of the most vulnerable group and they are greatly impacted by the pandemic due to disruptions of daily routine and exposure to potential domestic violence, excessive social media and internet use [3–5]. The fear of the spread of COVID-19 combined with a sudden change in schooling and confinement to home were seen as stressors for children and adolescents since they are still under development [6].

Abbreviations: PS, perceived stress; PLEs, psychotic-like experiences; FF, family functioning.

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Perceived stress (PS) refers to an individual's feelings or thoughts on how much stress they are under over a given timepoint or a time period. It reflects the extent to which an individual's life situation outweigh their capability to cope [7]. Further, inflated psychological stress has been shown to be associated with many mental health conditions in adolescence. Previous studies found that increased stress contributed to higher prevalence of adolescent anxiety and depression [8,9], as well as suicidality [10,11]. Moreover, excessive psychological stress in childhood and adolescence renders the individual more susceptible to being diagnosed with schizophrenia later in life [12,13]. Most stress-related mental health conditions were further studied in children and adolescents during this pandemic, with burgeoning evidence showing that the young population presented wide-spread psychological issues (e.g., anxiety, depression, suicidality) during this special time [14,15,17].

One stress-related psychological condition that remains less studied in youngsters during this pandemic is psychotic-like experiences (PLEs), which refers to sub-threshold, non-clinical form of psychotic symptoms (e.g., delusions or hallucinations) [18]. PLEs are common among the general population and occur with an even higher prevalence among adolescents [20]. Adolescents with PLEs are more likely to be later diagnosed with psychotic disorders; accordingly, PLEs are seen as a component of an extended psychosis phenotype and served as a target for early prevention of full-blown psychosis [21]. The connection between PS and PLEs is well-established and could be direct: increased PS could lead to PLEs and emerging PLEs could worsen the stress level [22,23]. However, other factors could act on the relation between PS and PLEs, for instance, maladaptive coping styles were found to mediate the effects of PS on PLEs [24]. To our knowledge, the condition of PLEs and what factors could affect its relation with PS during this pandemic remains understudied.

Family functioning (FF) is a complex term that generally reflects the structural and organizational properties of a family group as well as the patterns of interactions between family members [25]. Specifically, it depicts how families manage their daily routines, fulfill their roles within the family system, and communicate and connect emotionally [26]. There are a few tools to measure family functioning, for instance, McMaster Family Assessment Device (FAD) developed by Epstein et al. [25] and Family APGAR index introduced by Smilkstein et al., which assesses the family functioning from five components: adaptation, partnership, growth, affection, and resolution [27]. Previous studies have suggested that good family system has a protective effect on youth mental health, such as reducing suicidal behavior among adolescents with mood disorders [28]. It is also reported that satisfying family functioning can help reduce stress among both adults [29] and adolescents [30]. In addition, FF is associated with the long-term outcome of patients with psychosis [31]. Parental support serves as a protective factor for PLEs [32] and young adults at ultra high risk for psychosis reported poor family relationship [33]. However, given that most children and adolescents stayed with their family during the extended lockdown and were faced with inevitable psychological stressors (e.g. family conflicts), little is known about the effect of FF on the PS and PLEs.

In this work, we set out to disentangle the role of FF in the relationship between PS and PLEs in the context of pandemic. More specifically, we tested two hypotheses: first, FF is associated with PS and PLEs, and those living in a poorly functioned family may report higher prevalence of PLEs and stress level. Second, we expected to see better FF could alleviate the effect of PS on PLEs after controlling for demographic factors and thus may serve as a target for early intervention of psychosis after the onset of a public health crisis.

2. Methods

2.1. Study design and participants

We adopted a cross-sectional design to explore our hypotheses. In total, 4807 middle school students participated in this survey between May 14th and June 6th, 2020, when all middle school students in Hunan returned to schooling. The time local government announced school reopening was April 7th 2020, since then middle school students in Changsha began to go back to school, following an order given by the provincial government, and in early May, all middle school students in Changsha went back to the school system. These participants were enrolled from two demographically representative middle schools in Changsha, the capital city of Hunan Province. The population in Changsha is around 7.04 million (accounting for 10.7% of the total Hunan population) according to the latest population census in 2010, where the young age group (10–19) accounts for around 10.5% (approximately 700,000) of the population in Changsha [34].

Inclusion criteria of this study were: (i) age 10–19 years; (ii) can read Mandarin Chinese; and (iii) consented to participate in this study. Exclusion criteria included: (i) history of mental illness diagnosis or psychoactive substance use in the past six months; or (ii) unable to self-complete the survey.

All adolescents and their parents gave written informed consent to this study. We carried out this survey at school after students returned to schooling after the lockdown. On average, it took 10–15 min for the participants to finish the survey in classrooms, under the guidance of their teachers who were trained by mental health professionals beforehand. Our study was approved by the Ethics Committees of the Second Xiangya Hospital of Central South University.

2.2. Measures

2.2.1. Perceived stress (PS)

PS was assessed with the Perceived Stress Scale (PSS-10) [35]. The original form of this scale contains 14 items, but the 10-item version has been validated [36] and shown to be superior to the 14-item version [37]. The Chinese version has good reliability among Chinese adolescents [38]. Participants were asked to finish the questions based on their feelings in the past six months. We computed the total stress score for each participant. The Cronbach's alpha of this scale in our study was 0.76, suggesting valid internal reliability.

2.2.2. Psychotic-like experiences (PLEs)

PLEs was measured with the eight-item version of Community Assessment of Psychic Experiences (CAPE-8) [39]. This version was selected from the positive subscale of the original CAPE-42, covering 6 major delusional experiences (DEs) (including idea of reference, idea of persecution, thought withdrawal, thought insertion, thought broadcasting, and feeling of being controlled) and 2 hallucinatory experiences (HEs) (verbal auditory hallucinations and visual hallucinations). We selected these items based on previous research [40–42]. The same version was used in our former study where we demonstrated the feasibility in 9122 students aged 10–23 years and established construct validity of this version [43].

Detailed questions are listed as follow, where we invited our participants to answer these questions based on their experiences in the past six months:

- Do you ever feel as if people seem to drop hints about you or say things with a double meaning?
- Do you ever feel as if you are being persecuted in some way?
- Do you ever feel as if the thoughts in your head are being taken away from you?
- Do you ever feel as if the thoughts in your head are not your own?
- Do you ever hear your own thoughts being echoed back to you?
- Do you ever feel as if you are under the control of some force or power other than yourself?
- Do you ever hear voices when you are alone?
- Do you ever see objects, people or animals that other people cannot see?

Answers to these questions and their scores include: 1 = never, 2 = sometimes, 3 = often, 4 = nearly always. We calculated the total score as a reflection of participants' PLEs level. The total prevalence of PLEs and each subtype's prevalence was also calculated: we regarded those selecting 'often' or 'always' in at least one of eight PLEs items as with PLEs, and the same criteria was adopted to calculating each item's prevalence [43,44]. The Cronbach's alpha of this screening tool in the present study was 0.84, suggesting good internal reliability.

2.2.3. Family functioning (FF)

FF was measured with the Family APGAR scale developed by Smilkstein, a five-item tool assessing family functioning from five dimensions (Adaptation, Partnership, Growth, Affection, and Resolution). Answers and their scores for each item are: 0 = hardly ever, 1 = some of the time, 2 = almost always. We calculated the total FF score for each participant and divided them into three subgroups: good FF (scoring 7–10); moderate (scoring 4–6); poor FF (scoring 0–3) [46]. The Cronbach's alpha of this scale in our study was 0.87, indicating good internal consistency.

2.2.4. Social-demographic information

We assessed the following social-demographic factors: age, sex, ethnicity, family income, family history, personal history of psychiatric illness and substance use in the past six months. We assessed the family income with the question "Are your family under financial support from the government?", this information is usually told to the students by their caregivers since students may acquire some welfare at school. If the answer to this question is positive, the participant is recognized as with low family income. Family history was screened with the question "Have your family members suffered from any psychiatric disease?". We obtained participants' previous personal psychiatric diagnoses with the question: 'Have you ever been diagnosed with any mental illness?'. Substance use was measured with "Have you been using any psychoactive substances in the past six months? For example, marijuana, alcohol, or cigarette."

2.2.5. Data analysis

First, we excluded participants with any previous psychiatric diagnosis or substance use, since we aimed to focus on subclinical symptoms and excluded the confounding effect of substance use on PLEs [47–49]. We eliminated subjects with more than 25% missing values on any specific questionnaires to improve reliability and imputed the remaining data with the medians [50,51].

First, we adopted the Shapiro-Wilk normality test to examine our variables' distribution and skewness and found all these variables didn't meet the normality assumption ($p < 0.05$), so non-parametric methods were used to conduct the following analysis.

Second, we used descriptive statistics to present the characteristics of our sample and performed subgroup analysis based on three levels of FF. For variables with significant group difference, we further examined the pairwise difference with post hoc analysis.

Finally, we adopted Spearman's correlation analysis between PS, PLEs, and FF scores, in order to determine the bivariate association between these dimensions. Before conducting moderation analysis, we first excluded participants with family history to exclude its confounding effect. Then we selected PLEs as the dependent variable, PS as the independent variable, and FF as the moderator, after adjusting for age and sex. The coefficients were detected using bootstrap estimation approach with 5000 samples, and heteroskedasticity-consistent standard error estimator (HC4) was used to improve robustness considering the existence of heteroskedasticity [53]. We used the non-parametric bootstrap inference for model coefficients, given the violation of normality distribution among these variables. The significance of effects in mediation and moderation were determined by the 95% bootstrap CI not covering zero [54]. We used R (version 4.0.3) to perform the descriptive and subgroup analysis as well as Spearman's correlation. Moderation analysis was conducted using the PROCESS macro (model 1) for SPSS [55].

3. Results

3.1. Sample characteristics

In total, 130 participants were excluded either for self-reported previous diagnosis of psychiatric diseases (115 subjects) or psychoactive substance use (15 subjects), 221 participants with at least 25% missing data on any specific questionnaire were also eliminated, finally 4456 adolescents entered statistical analysis (92.7% retained). The mean age of our participants was 13.6 (S.D. = 0.9) and 46.4% were females. The total prevalence of PLEs was 36.4% and the average stress level in our participants was 16.6 (S.D. = 6.2). Other details of the psychological measurements were presented in Table 1.

3.2. Subgroup analysis

There were more females reporting poor FF compared to those reporting good FF. Meanwhile, there were more participants reporting family history in the poor FF group. We observed a higher prevalence of total PLEs and for each subtype in the poor FF group, as well as higher stress level. Detailed characteristics were in Table 2.

3.3. Spearman's correlation and moderation analysis

The positive correlation existed between: PS and PLEs ($r = 0.51$, $p < 0.001$). FF was negatively correlated with PS ($r = -0.34$, $p < 0.001$) and PLEs ($r = -0.29$, $p < 0.001$).

Moderation of FF on the relation between PS and PLEs was significant: effect = −0.011, bootstrap 95% CI = [−0.018, −0.005]. Other details of t moderation analysis were listed in Table 3. Conditional effects of PS on PLEs were all significant ($p < 0.001$) under three FF conditions (mean ± S.D.), and the effect of PS on PLEs was lower when the FF remains high, details of the coefficients were presented in Table 4.

Table 1
Sample characteristics.

$N = 4456$	
Demographics	
Females, n (%)	2060 (46.4)
Age, years, mean (S.D.)	13.6 (0.9)
Han ethnicity, n (%)	4213 (95.4)
Low family income, n (%)	67 (1.7)
Family history, n (%)	61 (1.5)
CAPE-8	
Score, mean (S.D.)	12.4 (4.1)
Prevalence, n (%)	
Total[a]	1623 (36.4)
Idea of reference[b]	551 (11.9)
Idea of persecution[b]	293 (6.3)
Thought withdrawal[b]	418 (9.0)
Thought insertion[b]	423 (9.1)
Thought broadcasting[b]	941 (20.3)
Feeling of being controlled[b]	369 (8.0)
Verbal auditory hallucination[b]	459 (9.9)
Visual hallucination[b]	218 (4.7)
PSS-10	
Score, mean (S.D.)	16.6 (6.2)
Family APGAR	
Score, mean (S.D.)	5.7 (2.9)

CAPE-8 = eight-item version Community Assessment of Psychic Experiences; PSS-10 = ten-item version Perceived Stress Scale; Family APGAR = Family APGAR scale.

[a] Selected 'often' or 'always' in at least one of eight psychotic-like experiences items.

[b] Selected 'often' or 'always' in this item.

Table 2
Results of subgroup analysis.

	Family functioning			Statistics	p	post hoc
	Good (n = 1709)	Moderate (n = 1768)	Poor (n = 979)			
Demographics						
Females, n (%)	395 (43.6)	455 (46.8)	270 (50.8)	13.0	0.001	Poor > Good*
Age, years, mean (S.D.)	13.5 (0.9)	13.6 (1.0)	13.6 (0.9)	10.0	0.006	Moderate > Good*, Poor > Good*
Han ethnicity, n (%)	1620 (95.6)	1665 (95.0)	928 (96.0)	1.4	0.509	\
Low family income, n (%)	27 (1.7)	19 (1.2)	21 (2.6)	5.8	0.055	\
Family history, n (%)	14 (0.9)	23 (1.5)	24 (3.0)	15.1	<0.001	Poor > Good*
CAPE-8						
Score, mean (S.D.)	11.3 (3.4)	12.4 (3.9)	14.2 (4.8)	321.0	<0.001	Poor > Moderate > Good***
Total prevalence[a], n (%)	475 (27.8)	639 (36.1)	509 (52.0)	157.0	<0.001	Poor > Good***
Idea of reference[b]	131 (7.7)	198 (11.2)	199 (20.33)	97.7	<0.001	Poor > Good***
Idea of persecution[b]	54 (3.2)	85 (4.8)	143 (14.6)	149.0	<0.001	Poor > Moderate > Good***
Thought withdrawal[b]	89 (5.2)	146 (8.3)	170 (17.4)	113.8	<0.001	Poor > Good***
Thought insertion[b]	97 (5.7)	156 (8.8)	154 (15.7)	76.2	<0.001	Poor > Good***
Thought broadcasting[b]	280 (16.4)	357 (20.2)	272 (27.8)	49.9	<0.001	Poor > Good***
Feeling of being controlled[b]	85 (5.0)	140 (7.9)	129 (13.2)	57.3	<0.001	Poor > Good***
Verbal auditory hallucination[b]	93 (5.4)	169 (9.6)	184 (18.8)	123.9	<0.001	Poor > Good***
Visual hallucination[b]	44 (2.6)	78 (4.4)	87 (8.9)	56.0	<0.001	Poor > Good***
PSS-10						
Score, mean (S.D.)	14.5 (5.6)	17.0 (5.5)	19.8 (6.7)	460.0	<0.001	Poor > Moderate > Good***

[a] Selected 'often' or 'always' in at least one of eight psychotic-like experiences items.
[b] Selected 'often' or 'always' in this item.
* $0.05 > P_{Bonferroni} > 0.01$, *** $0.001 > P_{Bonferroni} > 0$.

Table 3
Results of moderation analysis.

Predictors	On PLEs		
	Effect	Bootstrap SE	Bootstrap 95% CI
Sex	0.365	0.106	(0.156, 0.566)
Age	−0.143	0.055	(−0.261, −0.043)
PS	0.317	0.011	(0.296, 0.339)
FF	−0.161	0.020	(−0.202, −0.121)
PS × FF	−0.011	0.004	(−0.018, −0.005)

Analyses conducted using PROCESS model 1, n = 4338.
Bootstrap sample: 5000; bootstrap 95% CI not including zero was considered significant.
Sex was dummy coded (1 = male and 0 = female).
PS = perceived stress; PLEs = psychotic-like experiences; FF = family functioning.
SE = standard error; CI = confidential interval.

Table 4
Conditional effects of PS on PLEs under different levels of family functioning (FF).

FF	Effect	SE	p	95% CI
2.8 (Mean - S.D.)	0.348	0.015	<0.001	(0.318, 0.378)
5.7 (Mean)	0.316	0.011	<0.001	(0.295, 0.339)
8.5 (Mean + S.D.)	0.285	0.015	<0.001	(0.256, 0.315)

Analyses conducted using PROCESS model 1, n = 4338.
PS = perceived stress; PLEs = psychotic-like experiences; FF = family functioning.
SE = standard error; CI = confidential interval; S.D. = standard deviation.

4. Discussion

To our knowledge, this is the first study to determine the effect of FF on the relationship between PS and PLEs in adolescents during the COVID-19 pandemic. We replicated the positive association between increased stress and PLEs and highlight the protective role of good family system in adolescent mental health. Specifically, we demonstrated two major findings: first, participants with poor FF reported higher stress level and higher prevalence of PLEs. Second, we noted that better FF alleviated the adverse influence of elevated PS on PLEs.

The relationship between stress and psychotic symptoms has been well-established [22–24,56]. The reactivity to stressors, which can be regarded as PS in our study, since participants reacted to the same stressor of pandemic lockdown disproportionally, is a risk factor for psychosis [57]. Possible neurobiological mechanisms on this association were widely explored. The term "stress reactivity pathway" illustrates the mechanism from stress to psychosis [23]. A putative hypothesis is that stress dysregulation through hypothalamus-pituitary-adrenal (HPA) axis can further influence the dopamine system, thus play a role in the onset, exacerbation, and relapse of psychotic experiences. This is also termed the "neural diathesis-stress model" [58,59]. Considering that PLEs can be recognized as a subclinical psychosis phenotype, the possible pathway from stress to PLEs is also reasonable and further validates the "neural diathesis-stress model", since adolescents with PLEs are more likely to develop full-blown psychosis later on [21].

In the context of COVID-19 pandemic, with elevated psychological stress from this global crisis, we speculate that the prevalence of PLEs adolescents would slightly increase. According to a previous systematic review by Kelleher et al., the median prevalence of PLEs in children and adolescents ranges from 7.5% to 17%, with the younger individuals reporting more PLEs [60]. Moreover, our team conducted a cross-sectional survey covering the same eight types of PLEs in 2017, and the participants were mostly adolescents from the same province (junior and senior high school students), we found the prevalence of total PLEs at that time was 20.7% [43]. Compared to our previous work, a total prevalence of 36.4% in this study seemed an obvious increase, but it should be noted that our participants (junior high school students only) were recruited in urban area and relatively younger than the previous sample. Age is a factor we should consider and it was also found that living in urban area is a risk factor for PLEs [50] and psychotic disorder [61,62]. For the above reasons and the nature of cross-sectional design, we couldn't verify a solid increase in the emergence of PLEs during this pandemic. Longitudinal study is warranted to address the question.

Another novel aspect of our finding is that adolescents with poor FF reported higher stress level and higher prevalence of PLEs, and FF further moderated the relationship between PS and PLEs, suggesting that good FF can protect an individual from PS and PLEs; meanwhile, it could buffer the effect of PS on the emergence of PLEs. This finding is particularly important as in the face of a global crisis such as the COVID-19 pandemic, the family system comes under financial [63],

interpersonal [64], as well as social strain. Due to school closures, youngsters are spending more time with their family members, which could buffer their loneliness and fear to some extent, but they are also more likely to be exposed to psychosocial stressors within the family system, such as family conflict and even domestic violence [65]. In families that have a dysfunctional pattern in the face of such crisis, the adolescents are more vulnerable to mental health problems and their stress are more likely to translate to PLEs.

Family system is a critical factor in terms of the pathogenesis and prognosis of clinical psychotic disorders. For one thing, poor-functioned family is associated with childhood adversity [66,67], which has been found to be risk factors for the onset of both clinical psychosis and psychotic experiences [68–70]. Furthermore, family functioning (FF), as a general factor alone, is linked to the prognosis of patients with psychosis. Intrafamily relationship is reported to have a profound effect on the prognosis of first-episode psychosis [31]. In particular, expressed emotions (EE), a construct focused on dysfunctional communication in family settings has a well-established relationship with relapse in psychosis [71]. Extending this notion to subclinical settings, it can be inferred that the dysfunction at family level (low FF) may contribute to the long-term outcome of adolescents with PLEs. For this reason, follow-up study of our participants to further explore the trajectory of PLEs and their conversion to psychosis among different FF groups is needed.

More importantly, family therapy, which aims to help family members improve communication and resolve conflicts, has a positive effect on the recovery of patients with psychosis [72]. A recent systematic review and meta-analysis summarized early interventions for people with PLEs, and found that psychological intervention, especially cognitive behavioral therapy, could promote remission of PLEs [73]. However, studies focusing on early intervention targeting family system are still lacking. Given the protective role of good FF in adolescent PS and PLEs, our findings may offer pragmatic solutions on helping those with subclinical psychotic symptoms and early preventing the onset of clinical psychosis due to elevated stress. Strategies to improve family adaptation, partnership, growth, affection, and resolution are of great value to interventional study design. Finally, prospective family-targeted interventional studies aiming for alleviating PLEs among this population is warranted to examine our findings longitudinally and can supplement those findings among patients with psychosis [31].

Our study has several strengths, including the largest sample size to date addressing the effect of FF on PS and PLEs; the low dropouts ensuring representativeness of the sampling frame; and the completion of data collection within a short epoch of time that ensured no systematic deviations in the exposure (pandemic) occurred during the cross-sectional observation.

We also acknowledge several possible limitations of our study. First, the cross-sectional and retrospective nature limit the potential to draw conclusion on causality. Moreover, this community-based sample was limited to the urbanized environment of Changsha, the capital city of Hunan Province, located in the South China. Multi-center studies with wider representation are also needed to confirm these observations. We did not study other microsystems such as the school or mesosytems such as how family interacts with the society at large; these interactions are likely crucial for healthy adolescence [74].

In conclusion, our study highlights the protective effect of a good family system on an adolescent that perceives excessive stress during a systemic social crisis affecting the exosystem. By delineating the effect of family functioning on the pathway from stress to psychotic-like experiences, our study raises the question of providing targeted family interventions for adolescents at high risk of psychosis at the time of a crisis.

Author contributions

ZW did the literature review, data collection, data clean, data analysis, figure and manuscript preparation. ZZ, ZX, FW assisted in distributing and collecting questionnaires. ZL and HT advised about the design and data analysis frame. LP and YL were involved in revising the manuscript and interpreting the results critically. All authors reviewed the final manuscript and agreed on the interpretation of our results.

Conflicts of interest

LP reports personal fees from Janssen Canada, Otsuka Canada, SPMM Course Limited, UK, Canadian Psychiatric Association; book royalties from Oxford University Press; investigator-initiated educational grants from Janssen Canada, Sunovion and Otsuka Canada outside the submitted work. All other authors report no relevant conflicts.

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