

# Eating habits and psychopathology: translation, adaptation, reliability of the Nutrition Behavior Inventory to Portuguese and relation to psychopathology

*Hábitos alimentares e psicopatologia: tradução, adaptação, confiabilidade do Nutrition Behavior Inventory para o português e correlação com a psicopatologia*

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## ABSTRACT

**Objective:** *The Nutrition-Behavior Inventory (NBI) is a self-administered instrument that allows eating habits to be correlated with psychopathological symptoms. The objective was to translate and adapt the NBI to Portuguese, and test the Portuguese NBI's reliability. The second aim was to verify its sensitivity for identification of risk factors in terms of behavior/eating habits in children and adolescents.* **Methods:** *The NBI was translated, adapted, and back-translated. The Portuguese version of the NBI was then applied (N = 96; 9-12 years). In order to verify the internal consistency, Cronbach's alpha was used. The psychopathological indicators of the participants were accessed using the Child Behavior Checklist (CBCL). The mean CBCL scores were analyzed in relation to the NBI data (cutoff point:  $\geq 30$  with indicators, and  $< 30$  without).* **Results:** *Internal consistency was high (Cronbach's alpha = 0.89) for the NBI. The CBCL scores correlated significantly with NBI ( $> 30$ ) on the following: anxiety and depression ( $p = 0.041$ ), social difficulties ( $p = 0.028$ ), attention problems ( $p = 0.001$ ), aggressive behavior ( $p = 0.015$ ); ADHD ( $p < 0.001$ ), and conduct problems ( $p = 0.032$ ).* **Conclusion:** *The present results indicate that the NBI is a reliable instrument. The NBI can be useful for evaluating psychopathological symptoms related to the eating habits and behaviors of children and adolescents.*

## Keywords

Eating habits, psychopathology, children, mental health.

## RESUMO

**Objetivo:** *O Nutrition-Behavior Inventory (NBI) é um instrumento de autorrelato que permite que os hábitos alimentares sejam acessados e correlacionados com sintomas psicopatológicos. O objetivo foi traduzir, adaptar e testar a confiabilidade do NBI para o português. O segundo*

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objetivo foi verificar a sua sensibilidade para a identificação de fatores de risco em termos de comportamento/hábitos alimentares em crianças e adolescentes. **Métodos:** O NBI foi traduzido, adaptado e retrotraduzido. A versão em português do NBI foi então aplicada (N = 96; 9-12 anos). O instrumento foi analisado em relação à consistência interna por meio do índice alfa de Cronbach. Os indicadores psicopatológicos dos participantes foram acessados utilizando o *Child Behavior Checklist* (CBCL). Os escores médios do CBCL foram analisados em relação aos dados do NBI (ponto de corte:  $\geq 30$  com indicadores, e  $< 30$  sem). **Resultados:** A consistência interna foi alta (alfa de Cronbach = 0,89) para o NBI. As pontuações do CBCL foram associadas significativamente com NBI ( $> 30$ ) em relação aos indicadores: ansiedade e depressão ( $p = 0,041$ ), dificuldades sociais ( $p = 0,028$ ), problemas de atenção ( $p = 0,001$ ), comportamento agressivo ( $p = 0,015$ ), TDAH ( $p < 0,001$ ) e problemas de conduta ( $p = 0,032$ ). **Conclusão:** Os resultados indicam que o NBI é um instrumento confiável. O NBI pode ser útil para avaliar sintomas psicopatológicos relacionados com os hábitos alimentares e comportamentos de crianças e adolescentes.

### Palavras-chave

Hábitos alimentares, psicopatologia, crianças, saúde mental.

## INTRODUCTION

The etiology of mental disorders is complex and multifactorial, and more research is needed to decipher it. One of the most commonly accepted scientific hypotheses regarding the etiology of mental disorders is that there is a strong interaction between genetic predisposition and positive and/or negative environmental factors and that, therefore, interaction with the environment can affect the development of mental or physical health problems during a person's lifespan<sup>1</sup>.

The growing number of mental health problems has motivated scientists worldwide to study factors that provide protection from or increase vulnerability to the development of mental illness<sup>2</sup>. Furthermore, there is a need to find treatment approaches that are more effective than existing treatments, as well as to adopt a preventive posture.

Nutrition and eating habits are environmental factors that can have a substantial positive or negative influence on mental health<sup>3</sup>. Nutrition and eating behavior merit particular during childhood and adolescence when maturation and brain development are accelerated. Appropriate attention to diet and adequate consumption of nutrients can be vital to the proper development of neurobiological processes during this period<sup>4</sup>. Moreover, a child's dietary choices can have a strong impact on the way in which s/he learns, feels, and behaves<sup>5</sup>. The manifestation of early psychopathological symptoms of mental illness during adolescence, even when temporary, can be a harbinger of continued and even more serious mental health problems in adulthood<sup>6</sup>. Prevention measures should consider the timing of pediatric susceptibility and what environmental factors may "trigger" genetic predispositions to mental and behavioral disorders<sup>6</sup>.

A number of studies have demonstrated a relationship between diet and mental health, but few clearly delineated scientific studies have addressed this question in subjects that are in important developmental phases, such as late childhood and the start of adolescence<sup>7</sup>. During this period,

there are biological, psychological, and a social change that commonly gives rise to many behavioral changes.

Although it is clear that there is a relationship between diet and mental disorders, there is not yet a consensus among scientists as to whether food preferences and choices are causative or consequential factors of mental disorders<sup>8</sup>. Early diagnosis can help to prevent problems of increasing prevalence in the West, especially if diagnosis is followed by appropriate preventative and therapeutic measures, including improvements in the quality of dietary practices in order to reduce the social and personal impact of mental disorders and behavioral problems in young people<sup>9</sup>.

In 1980, Alexander Schauss developed the "Nutrition-Behavior Inventory" (NBI) for research examining the influence of diet on behavior. The NBI addresses behavioral, physical, and metabolic symptoms and their relationship to nutrition. It includes questions that enable evidence of habits involving high consumption of sugar, carbohydrates, and caffeine, as well as evidence of behaviors arising from metabolic and behavioral disorders, to be ascertained<sup>10</sup>. The NBI is an inventory with 52 questions, with each question addressing a particular symptom(s) of health, dietary habits, and behaviors. The form can be filled out with a pencil and takes 15~20 minutes. The higher the score (especially  $\geq 30$ ), the greater the probability that an individual has nutritional factors that affect their health and behavior<sup>10</sup>. The instrument can be applied in a self-reporting format with four answer choices, graded according to frequency as follows: "most of the time" (3 points); "often" (2 points); "rarely" (1 point); and "never" (0 points). Of the 52 questions on the NBI, 10 probe for evidence that a person may have a blood sugar disorder; responses to these questions may also indicate a high consumption of refined carbohydrates and caffeine<sup>10</sup>. At the moment, the NBI is the only instrument that allows for this type of analysis, as most scales used in studies examining the relationship between dietary habits and behaviors are specifically directed at identifying eating disorders,

such as anorexia, bulimia, and obesity. For example, the "Eating Attitude Test (EAT)"<sup>11</sup> is an instrument that reveals susceptibility toward the development of anorexia and bulimia nervosa in adults, whereas the "Children's Eating Attitude Test (ChEAT)"<sup>12</sup> evaluates symptoms of bulimia and a preoccupation with body weight in children and adolescents.

The first aim of the present work was to translate to Portuguese, adapt, and to test the reliability for the Brazilian population an instrument that is comparable to the English-language NBI in terms of being capable of flagging indicators of dietary behaviors or habits that may be related to mental disorders in people in late childhood and the start of adolescence. The second aim was to test the hypothesis that the NBI would be sufficiently sensitive to reveal associations between eating habit related risk factors and behavior in a group of children with psychopathologies relative to a healthy control group using the Child Behavior Checklist (CBCL)<sup>13</sup>. The CBCL is a broad spectrum inventory that documents behavioral and emotional problems and competencies in children 6 to 18 years of age<sup>13</sup>. The CBCL has been translated into over 80 languages and research has shown that it has great reliability and validity in clinical and non-clinical populations<sup>14-19</sup>. Furthermore, studies have also shown that the CBCL has good convergence with structured, interview-derived diagnostic categories<sup>20</sup>.

The long-term objective of this work is to provide a means for performing triage (that can be used not only in Brazil, but also in English speaking countries) for mental and/or behavioral problems during the critical period of development that occurs in late childhood and adolescence, thereby facilitating the administration of further preventative actions during this stage.

## METHOD

### Participants

This research was carried out in accordance with the Guidelines established by the Brazilian Ministry of Health's National Commission for Research Ethics, Resolution 196/96, and was approved by the Research Committee for Human Subjects. The present investigation was part of an ongoing longitudinal clinical assessment of behavioral, mood, and learning disorders conducted in our research institute. The assessment and diagnostic methods employed are described in detailed elsewhere<sup>21,22</sup>. The study included only children/adolescents between 9 and 12 years of age, of both sexes, who were students in schools belonging to the Municipal Education system of Curitiba, a southern city in Brazil, and who were sent for evaluation by a multi-professional team during the period between March 2007 and November

2009. To be included, the participants were required to have an intelligence quotient (IQ)  $\geq 70$  as determined by the third version of the Wechsler Intelligence Test (WISC-III)<sup>23</sup>.

Parents or guardians accompanying enrolled children provided written informed consent. Since the NBI only gives indicators of eating habit behavior associated with psychological problems, we tested the applicability of the NBI by comparing the results with results obtained from the CBCL, a well established (worldwide) inventory for evaluating psychopathology in children and adolescents<sup>14</sup>.

### Study procedures

The experimental strategy basically consisted of two steps: (1) "Translation, back-translation, and adaptation of the NBI" and (2) "Applicability of the NBI" utilizing results from the "Child Behavior Checklist" (CBCL).

### First step: translation, back-translation, and adaptation of the NBI

For the translation, adaptation, and validation of the NBI for the Brazilian population, the researchers sought the authorization of the original instrument's author in accordance with previously suggested guidelines<sup>24-26</sup>. Briefly, the original NBI was first translated to Portuguese by two independent professionals fluent in both the original and target languages; both versions were analyzed and synthesized. Subsequently, the synthesized version was back-translated to its original language and reviewed by an expert committee comprised of two clinical psychologists, a pediatric neurologist with an MD and a neuroscientist with a PhD. The Portuguese version of the NBI was then pretested on 20 respondents to probe for their understanding and acceptability of the test as well as for the emotional impact that the test makes. Small changes were necessary in order to adapt it to Brazilian culture. However, we avoided changing the essence of the questions as posed by the original author.

Participants who were able to read fluently responded the questionnaire by self-reporting. The evaluator – a psychology professional trained and directed to maintain neutrality while reading the instrument's questions – read the questions aloud for those who were not yet able to read fluently and helped them fill out the form in accordance with their answers.

In order to verify the internal consistency of the instrument's items, Cronbach's alpha was used. A construct can be indirectly validated with an internal base of consistency or no relation between the questions that make up part of the scale, indirectly leading to the conclusion that the scale is a valid construction<sup>27</sup>. The Cronbach's alpha coefficient is the simplest and best-known measure of internal consistency and is the primary approach used in constructing the validation of a scale. In general, a group of items that explore a common factor have a high Cronbach's alpha value.

The minimum acceptable value for the Cronbach's alpha coefficient is 0.70; alpha values between 0.80 and 0.90 are considered ideal<sup>28</sup>.

### Second step: applicability of the NBI (annex)

Based on their responses in the Portuguese-language version of the NBI, the subjects were separated into two groups, using a cutoff of 30 points<sup>10</sup>. The groups (< 30 and ≥ 30) were analyzed in relation to the scales for the "Child Behavior Checklist" (CBCL). This instrument, answered by the children's guardians, is used across the world, and has been validated in Brazil<sup>29</sup>, to measure psychopathological indicators and social and behavioral problems in subjects between 6 and 18 years old. The CBCL provides scales concerning overall problems and two scales of Internalizing and Externalizing problems of the following kind: depression, withdrawal, rule-breaking behavior, aggressiveness, social problems, and problems in thinking, attention, and somatization. In addition, the CBCL has a subscale based on the diagnostic criteria established by the Diagnostic and Statistical Manual of Mental Disorders (DSM), which gives indicators for affective, anxiety and somatic problems as well as indicators for the diagnosis of attention deficit/hyperactivity disorder, oppositional defiant disorder, and conduct problems<sup>29</sup>.

For the scoring, we used software developed by Achenbach Assessment Data Manager (ADM)<sup>13</sup>, which converts raw scores into scores that are T-normalized for age and gender. The 98<sup>th</sup> percentile of the normative sample of T scores was 70 or greater and the subclinical (borderline) range for T scores was 65-70. For total Internalizing and Externalizing Problems, a T score in the range of 60-63 points is considered borderline and a T score above 63 points in the clinical range<sup>13</sup>.

### Data analyses

For the statistical analyses, Statistica-7.0 (StatiSoft® South America) software was used. Data were verified in relation to normality and descriptive analyses using Kolmogorov-Smirnov tests. The Levene test, one of the strongest and most robust tests in terms of deviations, was also used to verify the homogeneity of the variations. In cases where there was no homogeneity ( $p < 0.05$ ), Welch's Student's T-test (Test W/ Separate Variance Estimates in Statistica) was applied. The Student T-Test was used to examine relationships between the dependent variables (IQ, CBCL) and the independent NBI variable (NBI < 30 or NBI ≥ 30). Comparisons were considered significant when they had two-tailed values of  $p < 0.05$ .

## RESULTS

### Demographics

The demographic data are summarized in table 1. A total of 96 participants, 9 to 12 years of age, of both sexes (83 boys

and 13 girls), completed the inventory. Average age did not differ between the groups ( $p = 0.84$ ). The two groups were found to be similar with respect to potentially interfering factors, such as age and IQ. As the children were referred from the same local public schools, we could presume that there were not substantial socioeconomic differences in the groups studied.

**Table 1.** Demographic data for the study population

Parameter		NBI < 30 (N = 28)	NBI ≥ 30 (N = 68)	p
Sex	M (N = 83)	29% (N = 24)	71% (N = 59)	
	F (N = 13)	30.8% (N = 4)	69.2% (N = 9)	
Age	(years)	9.7 ± 1.2	9.8 ± 1.0	0.837
IQ Total	(WISC-III)	100.3 ± 20.7	99.3 ± 17.0	0.838

### Cultural and sample related adaptations

The cultural adaptation was tested in 20 participants. We found that after translation and back-translation, some questions needed to be adapted or withdrawn, as shown in table 2, to obtain the final version of the adapted questionnaire. An analysis performed to verify the internal consistency of the translated instrument yielded a Cronbach's alpha index value of 0.8896.

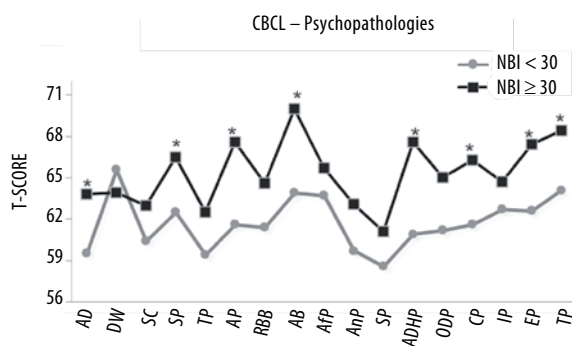
**Table 2.** Questions on the original NBI inventory that were changed during adaptation

Original question	Translation	Adaptation
23. I feel better after my first snack or meal of the day	23. Eu me sinto melhor depois do primeiro lanche ou refeição do dia [I feel better after my first snack or meal of the day]	23. Eu me sinto melhor depois do café da manhã [I feel better after breakfast]
26. I eat sweet things or drink caffeinated coffee, tea or cola	26. Eu como coisas doces ou bebidas cafeinadas como café, chá ou Coca-Cola [I eat sweet things or caffeinated drinks like coffee, tea or Coca-Cola]	26. Eu como doces ou bebo Coca-Cola, chá ou café frequentemente [I often eat sweets or drink Coca-Cola, tea or coffee]
31. I drink alcoholic beverages	31. Eu bebo bebidas com álcool [I drink alcoholic beverages]	Question removed*
36. I constantly worry about things	36. Eu constantemente me preocupo com as coisas [I constantly worry about things]	35. Eu estou sempre preocupado com alguma coisa [I am always worried about something]
48. I want to kill myself	48. Eu quero me matar [I want to kill myself]	47. Eu já pensei em me matar [I have thought about killing myself]
52. Do you smoke cigarettes?	52. Você fuma cigarros? [Do you smoke cigarettes?]	Question removed*

\* Questions removed since the study population were underage (9-12 years old).

## Analyses of the NBI with respect to CBCL psychopathological indicators

The averages obtained in the analyses of the subscales of the CBCL were compared between the groups, according to their NBI scores (NBI < 30 and NBI ≥ 30) to verify the statistical difference for each subscale. Figure 1 summarizes the results obtained for the two groups, participants with an NBI < 30 *versus* those with an NBI ≥ 30 points. These analyses indicate that significant correlations were detected by the CBCL for the problems of: anxiety and depression ( $p = 0.041$ ); social difficulties ( $p = 0.028$ ); attention problems ( $p = 0.001$ ); aggressive behavior ( $p = 0.015$ ); ADHD ( $p < 0.001$ ); and conduct problems ( $p = 0.032$ ); as well as for the externalizing problems ( $p = 0.03$ ); and total problems ( $p = 0.017$ ).



NBI: "Nutritional Behavior Inventory"; CBCL: "Child Behavior Checklist"; AD: anxiety/depression; DW: depression/withdrawal; SC: somatic complaints; SP: social problems; TP: thought problems; AP: attention problems; RRB: rule-breaking behaviors; AB: aggressive behaviors; AfP: affective problems; AnP: anxiety problems; SP: somatic problems; ADHP: attention deficit/hyperactivity problems; ODP: oppositional defiance problems; CP: conduct problems; IP: internalizing problems; EP: externalizing problems; TP: total problems. \* ( $p < 0.05$ ).

**Figure 1.** Graph comparing the NBI scores and the average T scores of the CBCL.

## DISCUSSION

The present results indicate that the Portuguese version of the NBI is a reliable instrument. Furthermore, a comparison of the NBI results with data obtained with the CBCL – a widely used instrument with excellent psychometric properties and convergence between structured interview-derived diagnoses – demonstrated that the NBI can also be useful for assessing psychopathological symptoms related to the eating habits and behavior of children and adolescents. Participants with high NBI scores also presented indicators of mood, attentional, and behavioral problems in the CBCL. There is a general consensus that the incidence rate of psychiatric disorders in children and adolescents has risen over the last few decades. Although the reasons for this increase remain speculative, some important research has focused

on possible causes and preventions for these disorders. The first aim of the present work was to translate and validate the NBI for Portuguese language speakers, and the second aim was to analyze whether factors such as eating behaviors and habits could be associated with psychopathology during late childhood and early adolescence. The goal was to find simple ways to identify symptoms and factors that negatively contribute to the mental health of this population or cause it to deteriorate. The NBI is a paper and pencil questionnaire that provides a straightforward analyzable inventory that can be applied in triage clinical settings or even at schools.

## Cultural adaptations and adaptations in relation to the sample

After the translation and back-translation of the original NBI, some questions needed to be withdrawn or adapted in light of the equivalence of construction comparison. Specifically, questions about smoking (an open question) and alcohol use (question 31) were removed from the study. We observed discomfort and resistance to these questions during the pilot application of the first questionnaire related to the age range (9-12 years) of the study's participants. The questions were removed in order to facilitate the participants' adherence. The cultural adaptations proposed did not imply changes to the main content of the questions; we confirmed this by observing comparisons between the back-translation and the original instrument, so as to identify the equivalence of construction. However, for those wishing to investigate issues related to alcohol and tobacco use in adults, the omitted questions may be left in the NBI.

The NBI was analyzed for internal consistency using Cronbach's alpha index<sup>27</sup>, which assesses the reliability of a test in situations in which the researcher is not able to do other interviews with the individual, but which require an appropriate estimate of the average degree of error. In general, scales with an alpha value lower than 0.70 should be avoided. The alpha value for our translated, adapted NBI was 0.8896, and there were no questions outside the expected average, indicating that the instrument had good internal consistency, in accordance with what we expected for its validation.

## Clinical implications and study limitations

The present study had some limitations. First, our sample was made up mainly of male participants. This gender imbalance was related to the characteristics of our center's line of research, as the students were referred to us from local schools<sup>21,22</sup>. In this population, teachers tend to recommend or refer students with externalizing symptoms, rather than those with internalizing symptoms, and research has shown<sup>30</sup> that boys tend to have more externalizing problems than girls. Second, since the NBI has not been translated to other languages (e.g., Spanish), we were unable

to compare our results with those of other translations and cultures. Nonetheless, our work may open new avenues of research in the area of eating habits and psychopathology in other countries. Third, we only analyzed the results of the NBI with respect to CBCL indicators, and not with the respective conclusive diagnoses of the disorders in the children. However, several studies have well documented that the CBCL has good convergence with structured psychiatric interview<sup>16,31-35</sup>. Fourth, because of the research characteristics of our center, we could only include children and adolescents in the sample. Thus, we do not know whether the NBI as translated would be useful for the adult population in Brazil. This indicates that further research validating our already translated NBI may be tested in an adult Brazilian population.

In spite of the limitations mentioned above, the results presented indicate that the NBI has sensitivity for identifying psychopathological symptoms related to the dietary habits of children and adolescents (Figure 1). It supports current data in the literature that suggests that emotional difficulties and problems are correlated with eating habits and consumption of so-called junk-food<sup>36,37</sup>. Furthermore, early studies showed that adolescents who together with their parents exhibited aggressive behavior had very high NBI scores<sup>10</sup>. The present study showed that pre-adolescents with social problems, aggressive behavior issues, and conduct problems also had NBI scores above the cut-off point of 30 (Figure 1). Certainly, additional studies are needed to extend our seminal findings.

In addition, studies suggest that children who eat more junk-food may have nutritional imbalances over the long-term, since these foods are normally rich in sugar and fat, and in many instances, contain additives, food coloring, and preservatives, and provide poor quality nutrition<sup>36</sup>. Consumption of junk-food has been shown to make adolescents more prone to hyperactivity and attention problems, as well as other emotional problems that are often comorbid with these conditions, such as behavioral disorders and social problems<sup>37</sup>. High consumption of caffeine and sugar, mainly in the form of soft drinks, has been associated with aggressive behavior, ADHD, social problems and somatic complaints<sup>38</sup>.

An unhealthy dietary regimen can also be considered a subjacent symptom of mental disorders<sup>39</sup>. In addition, changes in the reward circuit of the brain during puberty can also be related to depressive symptoms in adolescents. It is possible; however, that an increase in reward seeking behavior, at this point in development, may compensate for changes in affect<sup>40</sup>.

The continual search for foods that are very tasty, though being poor in nutritional value, uses neural paths of behavioral reinforcement, including the dopaminergic system, progressively degrading the equilibrium of the brain's reward circuit and thereby generating more consumption

and a compulsion for this type of food. This circumstance, termed "dietary dependence", is considered a mental health risk factor, especially during childhood and adolescence<sup>40</sup>.

Mood, anxiety disorders and substance abuse disorders are among the most studied, common, serious, and incapacitating disorders that arise during adolescence<sup>41</sup>. Moreover, the manifestation of these disorders during early adolescence is associated with subsequent development of serious forms of these diseases, and anxiety symptoms often precede mood disorders during childhood and adolescence<sup>40</sup>. Therefore, this issue in and of itself underscores why early diagnosis and detection of risk factors for mental health problems during these phases is crucial.

## CONCLUSION

The presently developed Portuguese-language NBI is the first instrument that allows for triage to evaluate emotional and behavioral problems and dietary habits related to behavioral and mood disorders in Portuguese speaking people. The presently reported analyses of its internal consistency after translation and adaptation when administered to Brazilian children and adolescents offer sufficient proof of its validation. Furthermore, our results suggest that there is a strong association between NBI findings and CBCL psychopathological indicators for several mental health problems, such as depression, anxiety, attention problems, aggressiveness, and conduct and social problems. The indicators for externalizing and total problems were also significant.

The results presented in this study suggest that poor diet may be associated with mental disorders and demonstrate that the NBI can be used for early identification of symptoms of emotional problems and behaviors and related dietary habits in an inexpensive, easy, and rapid manner. The NBI is easy to administer in walk-in clinics or by teachers in schools, thus facilitating the early identification of risk factors that contribute to mood or behavioral disorders. NBI findings can also serve as a basis for planning possible complementary actions and therapeutic interventions, such as modifying dietary habits or secondary prevention tactics. Such interventions can prevent problems from progressing or becoming chronic, which is important considering adolescents' vulnerability to mental illness.

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## DISCLOSURES

None to declare.

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