

# Risk factor analysis and predictive model development for problematic internet gaming disorder occurrence

Andrian Fajar Kusumadewi<sup>1\*</sup>, Raihan Hananto<sup>2</sup>, Arrum Putri Amalia<sup>3</sup>, Muhammad Dicky Hertanto<sup>2</sup>, Hermanuaji Sihageng<sup>3</sup>, Muhammad Jordan Diandraputra<sup>2</sup>

<sup>1</sup>Department of Psychiatry, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Sleman, Indonesia; <sup>2</sup>General Practitioner, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Sleman, Indonesia; <sup>3</sup>Specialized Residency Training, Department of Psychiatry, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Sleman, Indonesia

## ABSTRACT

**Aim** To examine several aspects, such as sociodemographic, psychological, personality, and parenting characteristics, that may contribute to the occurrence of problematic internet gaming disorder (PIGD) in Yogyakarta, Indonesia. Additionally, the study intends to create a model that can accurately predict people who are at high risk of developing PIGD.

**Methods** A cross-sectional study was conducted on 350 participants aged 15-25 years in Yogyakarta. The data were gathered through the use of a questionnaire that consisted of demographic measures: the Internet Gaming Disorder Scale-Short Form (IGDS9-SF), the Depression Anxiety Stress Scale (DASS-21), the Big Five Inventory (BFI), and the Parenting Style Questionnaire. Multiple logistic regression was utilized for data analysis in order to identify relevant risk factors and construct a risk prediction model.

**Results** The study revealed that certain sociodemographic characteristics (male and student), psychological factors (depression, anxiety, and stress), personality traits (high neuroticism, low conscientiousness), and authoritarian parenting style were all significant predictors of the occurrence of PIGD. These characteristics led to the creation of the risk prediction model, which demonstrated strong performance with an area under the curve (AUC) of 0.85 (95% CI 0.80-0.90).

**Conclusion** Multifaceted issue and variety of risk factors influence PIGD. This study's risk prediction model can effectively identify individuals at a heightened risk of developing PIGD. This allows for early and targeted preventative and treatment interventions to be implemented.

**Keywords:** anxiety, depression, mental health, neuroticism, students

## INTRODUCTION

Problematic Internet Gaming Disorder (PIGD) is a growing concern in the digital age affecting mental health and various aspects of an individual's life (1,2). PIGD is classified as a mental disorder in the ICD-11 by the WHO and is characterized by a consistent, repetitive, and uncontrollable pattern of gaming (3). It has gained worldwide attention, particularly in the countries with extensive internet connectivity, such as Indonesia, where the prevalence is 2.03% (4). Those with PIGD face physical health issues, such as sleep abnormalities, obesity, and eye problems, as well as psychological problems such as depression, anxiety, and social disengagement (5,6). In severe cases, PIGD can lead to aggressive and suicidal behaviour (7,8).

Studies have shown multiple risk variables that can heighten an individual's vulnerability to PIGD (9,10). Males are a

significant risk factor for PIGD, as they tend to dedicate more time to competitive online games compared to women. Factors such as young age, student status, and low education level also increase susceptibility to PIGD (11). Psychological risk factors in patients with PIGD include symptoms of depression, anxiety, stress, low self-esteem, and challenges in emotional control. Personal traits like high neuroticism and poor conscientiousness are identified as risk factors for PIGD (12,13). People with elevated levels of neuroticism are more prone to experiencing stress, worry, and depression, which can heighten their vulnerability to developing PIGD (14).

Creating PIGD risk prediction models is crucial for identifying individuals who are at a heightened risk of acquiring this condition. Identifying individuals with high susceptibility allows for the prompt and accurate implementation of proactive measures, preventing the progression of PIGD into a more severe issue. Risk prediction models can enhance the ability of mental health practitioners to make well-informed therapeutic decisions, including the determination of the appropriate type and level of intervention required. In Indonesia, PIGD is a growing concern, particularly among adolescents and young

\*Corresponding author: Andrian Fajar Kusumadewi  
Phone: +62 821 9504 7689  
E-mail: andrian.fajar.kusumadewi@gmail.com  
ORCID: <https://orcid.org/0000-0001-6610-2470>

individuals. Yogyakarta, a hub for education and culture, has a significant number of people in this age demographics.

The aim of this study was to thoroughly examine many aspects, such as sociodemographic, psychological, personality, and parenting, that may contribute to the occurrence of PIGD in the population of Yogyakarta, Indonesia. In addition, this study tried to create a risk prediction model that can accurately identify individuals who are at a heightened risk of developing PIGD using the aforementioned risk variables. It is expected that this approach will greatly aid in the prevention and treatment of PIGD in Indonesia, particularly in the city of Yogyakarta.

## PATIENTS AND METHODS

### Study design and participants

This study employed an analytical observational design utilizing a cross-sectional method. This approach enables the collection of data over a specific period to examine the correlation between risk variables and the occurrence of problematic internet gaming disorder (PIGD) in the population of Yogyakarta, Indonesia. The research will focus on people at the age between 15 and 25 who reside in the city of Yogyakarta. The research sample comprised 350 respondents who were picked at random from the target audience.

The inclusion criteria include individuals aged 15–25 residing in Yogyakarta City who are willing to participate in the research and can provide an informed consent. The exclusion criteria were individuals with serious mental health disorders such as schizophrenia or bipolar disorder, as well as those with major cognitive disabilities.

Prior to completing the questionnaire, participants were given details regarding research goals, methods of data collection, and their rights as research subjects. Prior to commencing the questionnaire, all respondents were provided with an informed consent. It is critical to ensure that respondents understand the research objective and are willing to engage in it on their own accord.

This study has obtained approval from the Medical and Health Research Ethics Committee of Universitas Gadjah Mada, Sleman, Indonesia (Ref. No. KE/FK/0490/EC/2023).

### Methods

The process of gathering data was conducted online using a survey platform. The selection of this strategy was based on multiple factors, which include: efficiency - online data collection surpasses traditional approaches like face-to-face interviews or paper questionnaires in terms of effectiveness and productivity; extensive reach - online survey platforms enable targeting of respondents from diverse geographical places and social demographics; anonymity - respondents may experience a greater sense of ease while responding to sensitive questions by remaining anonymous using an online survey platform. Participants were enlisted using social media and online forums in Yogyakarta City. The study selected social media as a recruiting technique due to its widespread usage among adolescents and young adults, the specific demographic group it targets. Online communities are utilized to engage with individuals who have a common interest in games.

The data were gathered through the utilization of a questionnaire comprising five distinct sections: sociodemographic data, Internet Gaming Disorder Scale-Short Form (IGDS9-SF) (15), Depression Anxiety Stress Scale (DASS-21) (16), Big Five Inventory (BFI) (17), and Parenting Style Questionnaire (PSQ)(18).

Internet Gaming Disorder Scale-Short Form (IGDS9-SF) (15) is a reliable and valid instrument used to measure the severity of problematic internet gaming in individuals. Nine items in the IGDS9-SF evaluate PIGD symptoms based on the diagnostic criteria outlined in ICD-11. Participants were instructed to assess the frequency of their symptoms over the past year using a 5-point Likert scale (0 = never, 4 = very often). The respondents were classified as having PIGD if their IGDS9-SF total score was 5 or more and as not having PIGD if their score was less than 5.

Depression Anxiety Stress Scale (DASS-21) (16) is an assessment for the severity of depression, anxiety, and stress that were experienced by participants. The DASS-21 comprises 21 items, categorised into three subscales: depression (consisting of 7 items), anxiety (consisting of 7 items), and stress (consisting of 7 items). Participants were requested to assess the frequency of their symptoms throughout the previous week using a 4-point Likert scale (0=never, 3=practically frequently). The aggregate score of each subscale was utilized to assess the intensity of psychological symptoms in survey participants.

Big Five Inventory (BFI) (17) measures five primary aspects of an individual's personality: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. A 5-point Likert scale, with 1 point indicating severe disagreement and 5 indicating strong agreement, assesses 44 items in the BFI. The aggregate score for each dimension is utilized to assess the level of the respondent's personality.

Parenting Style Questionnaire (PSQ) (18) serves as a tool to evaluate the parenting styles individuals experienced during their childhood and adolescence. Three subscales, authoritarian, permissive, and authoritative, categorize the 62 items in the PSQ. Participants were requested to evaluate the frequency with which their parents exhibited specific behaviours using a 5-point Likert scale (1=infrequently, 5=frequently). The cumulative score for each subscale is utilized to gauge the degree of parenting style encountered by the respondent.

### Statistical analysis

The process of data analysis was conducted in multiple stages. Descriptive analysis was used to provide a detailed account of participants' sociodemographic characteristics and the occurrence rate of PIGD within the research sample. The data were summarized using descriptive statistics, including frequency, percentage, mean, and standard deviation. Bivariate analysis was employed to investigate the correlation between each risk factor (sociodemographic, psychological, personality, and parenting) and the occurrence of PIGD. The  $\chi^2$  test was employed to examine the association between categorical data, while the t test was utilized to assess the relationship between continuous variables. Multiple logistic regression analysis was employed to find risk factors that autonomously predict the likelihood of PIGD while accounting for other risk factors. The multiple logistic regression model quantifies the impact of each risk

factor on the occurrence of PIGD, as indicated by the odds ratio (OR). The PIGD risk prediction model was created using the findings from a multivariate study. This approach integrates multiple high-risk indicators into a single equation to accurately determine the likelihood of an individual having PIGD. The risk score was calculated by multiplying the regression coefficient by 10 (on a scale of 10) and then dividing it by 8 (representing the number of factors included). The risk score quantifies the extent to which each predictor contributes to the elevation of PIGD risk, ranging from 0 to 10. As the risk score increases, the predictor has a stronger impact on raising the likelihood of PIGD. The performance of the risk prediction model was evaluated by calculating the area under the curve (AUC) of the receiver operating characteristic (ROC) curve. The AUC is a quantitative measure that assesses a model's capacity to distinguish between people who have PIGD and those who do not have PIGD. The AUC values vary between 0.5, indicating that the model performs no better than random guessing, and 1.0, indicating a perfect model.

## RESULTS

Table 1 shows the distribution of respondents' sociodemographic characteristics in this study. The data show that the majority of respondents were male, 230 (65.7%), aged between 18 and 21 years, 190 (54.3%), were students, 252 (72.0%), had a high school education level, 179 (51.4%), and came from families with middle economic status, 217 (62.9%).

**Table 1. Sociodemographic characteristics of 350 participants**

Characteristics	No (%) of participants
<b>Gender</b>	
Male	230 (65.7)
Female	120 (34.3)
<b>Age group (years)</b>	
15-17	85 (24.3)
18-21	190 (54.3)
22-25	75 (21.4)
<b>Status</b>	
Students	252 (72.0)
Workers	98 (28.0)
<b>Educational level</b>	
Junior high school	42 (12.0)
Senior high school	179 (51.4)
University/College	129 (36.9)
<b>Economic status</b>	
Low	52 (14.9)
Middle	217 (62.9)
High	81 (23.1)

The 18–21-year age group dominated the sample, 190 (54.3%), indicating that PIGD was a more common problem in young adults. However, the proportion of respondents with a tertiary education level of 129 (36.9%) was also quite large, indicating that PIGD can occur at various levels of education (Table 1).

The prevalence of PIGD among the study participants was 12.6% (44 participants). Out of the 350 participants, 44 (12.6%)

fulfilled the PIGD criteria by scoring 5 or higher on IGDS9-SF. This score indicates that the individual under assessment exhibits severe symptoms of PIGD and satisfies the diagnostic criteria specified in the ICD-11. The results of a bivariate analysis showed the relationship between several risk factors and the prevalence of PIGD in the studied population. Males exhibited a greater prevalence of PIGD, 35 (15.22%) compared to females, 9 (7.5%). The prevalence of PIGD was greater among students, 36 (14.29%) compared to non-students, 8 (8.16%). Respondents who had completed junior high school or less had a significantly higher occurrence of PIGD, 15 (35.71%) compared to respondents who had completed high school or more, 29 (9.42%). Participants who exhibited elevated levels of depression, anxiety, or stress demonstrated greater prevalence of PIGD than participants with lower symptom levels. Individuals with elevated levels of neuroticism had a higher incidence of PIGD, 25 (19.84%) than those with lower levels of neuroticism, 19 (8.48%). Participants with a low level of conscientiousness had a higher prevalence of PIGD, (16.67%) than those with a high level of conscientiousness, 16 (8.79%). An authoritarian parenting style exhibited a greater occurrence of PIGD, 22 (17.46%) in individuals compared to those not reared with such a style, 22 (9.82%) (Table 2).

Multivariate analysis, namely logistic regression, about the risk factors linked to the occurrence of PIGD showed that males were 3.21 times more likely to experience PIGD than females ( $p < 0.001$ ) indicating that being male is a substantial risk factor for PIGD. Students were 2.15 times more likely to experience PIGD than non-students ( $p = 0.012$ ) suggesting that being a student is also a significant risk factor for PIGD. The presence of symptoms related to depression, anxiety, and stress was found to significantly elevate the likelihood of PIGD ( $p < 0.001$ ). For every one-point increase on the DASS-21 scale measuring symptoms of depression, anxiety, or stress, there was a corresponding 23% increase in the probability of developing PIGD for depression, an 18% increase for anxiety, and a 14% increase for stress. There was a significant correlation between high levels of neuroticism and a 12% higher risk of PIGD ( $p < 0.001$ ); this indicates that people with elevated degrees of neuroticism are more likely to have PIGD. There was a significant correlation between a high level of conscientiousness and a 12% decrease in the incidence of PIGD ( $p = 0.002$ ) indicating that a heightened level of conscientiousness provides protection against PIGD. Authoritarian parenting was found to have a significant correlation with an 87% higher incidence of PIGD ( $p = 0.011$ ) indicating that authoritarian parenting could be a key contributing factor to PIGD. This multivariate study reveals significant risk factors for PIGD, including male gender, student status, depressive symptoms, anxiety, stress, high neuroticism, low conscientiousness, and authoritarian parenting (Table 3).

With a risk score of 2, males have a twofold higher risk of PIGD compared to females. Students have a risk score of 1, indicating a marginally elevated risk of PIGD compared to individuals who are not students. The presence of depressive and anxiety symptoms poses a significant risk for PIGD development (with a score of 2). The risk score of stress symptoms is 1, suggesting that stress has a lower impact on PIGD risk

**Table 2. Bivariate analysis between risk factors and problematic internet gaming disorder (PIGD) occurrence**

Risk factor		Total No of participants	No (%) of PIGD	p
<b>Sociodemographic</b>				
<b>Gender</b>	Male	230	35 (15.22)	<0.001
	Female	120	9 (7.5)	
<b>Status</b>	Students	252	36 (14.29)	0.012
	Non-students	98	8 (8.16)	
<b>Educational level</b>	Low (Junior high school or below)	42	15 (35.71)	0.035
	High (Senior high school or college)	308	29 (9.42)	
<b>Psychiatric symptoms</b>				
Depressive symptoms	High	105	27 (25.71)	<0.001
	Low	245	17 (6.94)	
Anxiety symptoms	High	112	29 (25.89)	<0.001
	Low	238	15 (6.30)	
Stressful symptoms	High	98	26 (26.53)	<0.001
	Low	252	18 (7.14)	
<b>Personality</b>				
Neuroticism	High	126	25 (19.84)	<0.001
	Low	224	19 (8.48)	
Conscientiousness	Low	168	28 (16.67)	0.002
	High	182	16 (8.79)	
<b>Parenting style</b>				
Authoritarian	YES	126	22 (17.46)	0.005
	NO	224	22 (9.82)	

**Table 3. Multivariate analysis of problematic internet gaming disorder (PIGD) occurrence risk**

Risk factors	Regression coefficient	Odds ratio (OR)	95% Confidence interval (CI)	p
<b>Sociodemographic</b>				
Gender (Male)	1.78	3.21	1.85-5.56	<0.001
Status (Students)	1.23	2.15	1.18-3.91	0.012
<b>Psychiatric symptoms</b>				
Depression	0.78	1.23	1.15-1.32	<0.001
Anxiety	0.65	1.18	1.10-1.27	<0.001
Stress	0.58	1.14	1.07-1.22	<0.001
<b>Personality</b>				
Neuroticism	0.56	1.12	1.06-1.19	<0.001
conscientiousness	-0.68	0.88	0.81-0.96	0.002
<b>Parenting style</b>				
Authoritarian	1.34	1.87	1.15-3.04	0.011

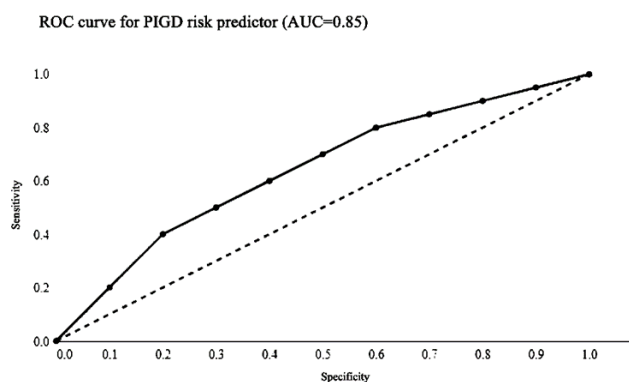
compared to other variables. Nevertheless, the impact remained statistically significant, suggesting that people with elevated levels of stress had a somewhat greater susceptibility to PIGD. The authoritarian parenting style, which involves rigorous control and a lack of emotional support, has a risk score of 2. This suggests that it increases the likelihood of PIGD. A risk score of 1 implies that neuroticism, which refers to the inclination to experience negative emotions like anxiety and depression, has a lesser impact on the risk of PIGD compared to other factors. Nevertheless, the impact continues to be statistically significant. The risk score of -1 suggests that being conscientious, which means being structured, responsible, and goal-oriented, has a protective effect against PIGD (Table 4).

The ROC (receiver operating characteristic) curve graph (Figure 1) illustrates the performance of the PIGD risk prediction model. The area under the ROC curve (AUC) was 0.85, indicating that the model performed well in differentiating between individuals with PIGD and individuals without PIGD.

Overall, the results of this internal validation indicate that the PIGD risk predictor score performs well and can be a useful tool in identifying individuals at high risk for PIGD.

**Table 4. Problematic Internet Gaming Disorder (PIGD) risk predictor score**

Predictors	Risk score*
Gender (male)	2
Status (students)	1
Depressive symptoms	2
Anxiety symptoms	2
Stress symptoms	1
Neuroticism	1
Conscientiousness	-1
Parenting style (authoritarian)	2



**Figure 1. Receiver operating characteristic (ROC) curve for problematic internet gaming disorder (PIGD) risk predictor.**

## DISCUSSION

The study reveals that male gender and student status are separate factors that can predict the likelihood of problematic internet gaming disorder (PIGD). Reportedly, males tend to engage in competitive online gaming and dedicate more time to gaming than females, with student status heightening the susceptibility due to the greater amount of leisure time and reduced obligations compared to employed individuals (19). Males are three times more likely to experience PIGD than females in our investigation. Competitive online gaming offers a platform for males to showcase their masculine identities, such as dominance, competition, and aggression, which may increase their gaming engagement and susceptibility to PIGD (20,21). Online gaming can also serve as a platform for social interaction, particularly among teenagers and young adults, which can foster feelings of inclusion and approval but also strengthen reliance on gaming and increase the risk of developing PIGD (22). Students also have certain traits that can heighten their susceptibility to encountering PIGD; they typically have greater leisure time compared to employed people, which can be occupied by online gaming (23). Students may also have fewer additional obligations, allowing them to spend more time engaging in gaming activities. Insufficient responsibility may also make students less aware of the negative consequences of excessive gaming. Students often succumb to the influence of their classmates when making decisions about entertainment and leisure time, leading to more time dedicated to gaming and increased vulnerability to PIGD (2).

Problematic internet gaming disorder is a condition where individuals with high level of depression, anxiety, and stress are more likely to experience symptoms such as gaming addiction. These symptoms can lead to maladaptive coping mechanisms, such as gaming as a temporary escape from difficulties (24,25). However, prolonged gaming can exacerbate these symptoms over time. Psychological problems can also hinder an individual's ability to regulate emotions and manage impulses, leading to feelings of despair, anxiety, restlessness, and apprehension (24,26). Stress can also hinder cognitive function and decision-making, especially regarding game usage (27). Furthermore, psychological problems can increase an individual's susceptibility to addiction, as these issues can alter brain activity, particularly in reward and motivation regions, increasing their vulnerability to gaming's addictive consequences (21).

A previous study has shown biological plausibility between psychological symptoms and problematic internet gaming disorder (PIGD) (28). Neuroimaging studies have shown that individuals with PIGD exhibit alterations in brain structure and function similar to those observed in patients with other addictive illnesses, such as substance addiction (29,30). These alterations occur in brain regions associated with reward, motivation, and impulse regulation, which are also affected by depression, anxiety, and stress (26). Signs of depression, anxiety, and stress are significant factors that increase the chance of developing PIGD (24). Individuals who exhibit these signs may use gaming as a means of avoiding difficulties or managing their negative feelings. However, excessive gaming usage may exacerbate these symptoms and establish a relentless cycle that is difficult to break (31).

Neuroticism, one of the five main dimensions of personality in the BFI, is linked to more intense and frequent negative emotions, low self-esteem, and increased susceptibility to stress. In the context of PIGD, neuroticism may increase the risk through several mechanisms, such as using online gaming as a way to cope with negative emotions and stress, reinforcing gaming habits, and increasing the risk of PIGD (14). Conscientiousness, another personality dimension in the BFI, is linked to various behavioural problems, including substance abuse, impulsive behaviour, and poor academic performance (32). Low conscientiousness may increase the risk of PIGD through various mechanisms, such as difficulty controlling the urge to play games, less effective time management, and an attraction to activities that provide thrills or excitement, such as online games (33).

Authoritarian parenting is a significant risk factor for PIGD, as it involves rigorous control, high demands, one-way communication, and absence of emotional warmth (34). Children raised in authoritarian home contexts often experience elevated levels of psychological stress, lack effective coping mechanisms, and reduced intimacy and support from parents (35). Authoritarian parenting can significantly impact a child's brain development, particularly in the regions of the brain responsible for emotional regulation and stress handling (36). Neuroimaging studies have demonstrated that children who grow up in stressful home circumstances exhibit reduced grey matter volumes in the prefrontal cortex, which is responsible for executive processes such as decision-making, planning, and impulse control (37,38). Insufficient prefrontal cortex development can lead to difficulties in impulse management and emotion regulation (38), which are significant risk factors for PIGD.

This study's findings have significant implications for the prevention and treatment of PIGD. Initially, it is imperative to implement proactive measures at an early stage, focusing on people with elevated risk factors, such as students and those who have been brought up in authoritarian home settings. Possible interventions encompass providing education regarding the hazards of PIGD, fostering the growth of social and emotional competencies, delivering stress management instruction, and enhancing awareness. Furthermore, interventions should encompass a wide range of components, such as cognitive-behavioural therapy, social skills training, and family support. Interventions should be customized to meet the unique needs of each individual and consider their distinct risk factors.

This research is subject to constraints as the research sample does not adequately reflect the total Indonesian population. Fur-

ther investigation can be carried out using larger and more representative samples to enhance the applicability of the results.

In conclusion, this study presents empirical evidence that PIGD is a multifaceted issue that is affected by multiple risk factors. These risk factors include sociodemographic factors such as being male and student, psychological factors such as experiencing depressive symptoms, anxiety, and stress, and personality traits such as high neuroticism and low conscientiousness. Additionally, the study found that authoritarian parenting plays a significant role in predicting the occurrence of PIGD. This research creates a risk prediction model that serves as a valuable tool for identifying individuals at heightened risk of PIGD. This enables the early and targeted implementation of preventative and treatment strategies.

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## AUTHOR CONTRIBUTIONS

Conceptualization, A.F.K.; methodology, A.F.K. and R.H.; software, A.P.A. and M.D.H.; validation, A.F.K., R.H. and H.S.; formal analysis, A.P.A.; investigation, M.D.H.; resources, M.D.H. and M.J.D.; data curation, M.J.D.; writing—original draft preparation, A.F.K. and A.P.A.; writing—review and editing, M.D.H. and H.S.; visualization, M.J.D.; supervision, A.F.K.; project administration, M.J.D.; funding acquisition, A.F.K. All authors have read and agreed to the published version of the manuscript.

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## TRANSPARENCY DECLARATION

Conflict of interests: None to declare.

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