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Prevalence and Correlators of Anxiety and Depression in Premature Coronary Artery Disease

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Purpose: The present study assessed the correlation between anxiety and depression in young and middle-aged Chinese patients with coronary artery disease (CAD).

Patients and Methods: This study included 313 patients diagnosed with premature CAD at the Department of Cardiology between January and July 2023. The Zung Self-Rating Anxiety/Depression Scale (SAS/SDS) was used as a standardized scale to assess mental health symptoms. A binary logistic regression model (backward) was used to analyze the correlation between anxiety and depression in premature CAD.

Results: Anxiety was observed in 154 persons with a prevalence of 49.20%, with a median SAS score of 53.0 (52.00–54.00). Depression was observed in 91 patients, with a prevalence of 29.07%, with a median SDS score was 55.00 (54.00–57.00). A total of 63 (20.13%) patients had comorbid anxiety and depression. Multivariate logistic regression analysis revealed that anxiety was positively associated with severe coronary artery stenosis, systolic blood pressure (SBP), body mass index, and snoring. However, it is negatively associated with high-income levels. Depression was positively associated with age, severe coronary artery stenosis, and snoring. However, it was negatively associated with SBP. Comorbid anxiety and depression were positively associated with age, severe coronary artery stenosis, and snoring.

Conclusion: For the first time, we investigated the prevalence and correlators of anxiety and depression in premature CAD. Therefore, the correlators of emotional status should be routinely evaluated in both primary and specialized care services.

Keywords: Cardiovascular disease, premature coronary artery disease, anxiety, depression

Introduction

Coronary artery disease (CAD) has a significant global prevalence with 315 million reported cases.[1] CAD is one of the leading causes of disease-related suffering in developing nations. Three-fourths of the worldwide mortality from CAD occurs in countries with low to middle income.[2] In addition, mental health issues play a significant role in the disease burden worldwide. The first 17 World Mental Health Surveys conducted by the World Health Organization on global mental health revealed that mental illnesses were frequently found across 28 countries.[3] Over 300 million individuals across all age groups experience depression globally, and depression is projected to surpass other diseases as the primary cause of global disability by 2030.[4]

CAD serves as an intricate link between CAD and mental health problems. Studies have demonstrated that patients with CAD are more likely to experience mental health problems. However, individuals with mental health conditions

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appear to have a higher risk of developing CAD. In addition, shared biological processes may be connected to these two health conditions.[5] Psychiatric morbidities, including anxiety and depression, are prevalent in patients with CAD.[6] Moderate anxiety and depression symptoms have been reported in approximately 11% and 15% of patients diagnosed with CAD, respectively, increasing their risk of experiencing additional cardiovascular events.[7,8] Studies have reported that both anxiety and depression are associated with an increased risk of cardiovascular events, subsequent hospital readmission, and mortality from CAD.[6] A previous study reported that the prevalence of severe emotional reactions was observed in patients with CAD within the initial 4 months following acute myocardial infarction (AMI). Furthermore, there is a heightened risk of cardiac mortality among patients who experience depression after AMI.[9] The simultaneous presence of physical and psychiatric morbidities adversely influences the progression and prognosis of both conditions, contributing to an elevated overall burden.[10]

Although the incidence of cardiovascular events has been declining in older adults, the average age at CAD onset has been increasing in younger people.[11] A notable increase in the incidence of AMI among individuals aged between 35 and 54 years has been reported.[12] Therefore, it is important to focus more on the needs of younger populations. Similar to the elderly, most heart-related issues in young adults are caused by atherosclerosis, and they often have one or more of the usual risk factors for CAD.[13] There exists a high incidence of both anxiety and depression among young and middle-aged individuals.[14,15] In addition, identifying subclinical cardiac dysfunction provides both healthcare providers and patients with an opportunity for early action, which can help prevent the onset of symptomatic cardiovascular disease (CVD).[16]

Anxiety and depression are prevalent mental health challenges that young people face. These mental health issues can have a detrimental effect on their overall well-being and academic performance, ultimately influencing social interactions and diminishing their quality of life.[17] However, the association among anxiety, depression, and CAD in young and middle-aged patients has not yet been studied. This study aimed to fill this gap by assessing the correlation between anxiety and depression in young and middle-aged Chinese patients with CAD.

Methods

Study Participants

A total of 333 patients were diagnosed with CAD at the Department of Cardiology between January and July 2023, 20 of whom declined to participate in the study. Ultimately, 313 patients were included in this study. The inclusion criteria for this study were as follows: (1) CAD patients, (2) men aged less than 55 years or women aged less than 65 years,[18] and (2) patients who consented to participate in the study and filled out the consent document. The exclusion criteria were as follows: (1) patients with missing data and 2) inability to participate in the questionnaire survey at baseline enrollment.

Data Collection and Definitions

The Zung Self-rating Anxiety/Depression Scale (SAS/SDS) questionnaire[19] has frequently been used as a standardized scale and has been demonstrated to have high reliability and accuracy.[20,21] Therefore, it was used in this study. All questionnaires were completed by the patients themselves, and the scores were summarized by the researcher to assess the severity of anxiety and depression. An SAS score of 50–59 was classified as mild anxiety, 60–69 as moderate anxiety, and ≥70 as severe anxiety. The SDS scores 53–62 as mild depression, 63–72 as moderate depression, and 73 or more as severe depression.

Blood was drawn early in the morning, following a period without eating, and injected into tubes filled with ethylene diamine tetraacetic acid (EDTA). The tests were conducted within 4 h after the samples were prepared at the Tangshan Gongren Hospital's clinical laboratory. Biochemical indices included fasting blood glucose (FBG), total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C) were evaluated.

Blood pressure (BP) was evaluated after a period of rest lasting at least 5 min for each participant. BP measurements were conducted on the left arm, with the results rounded to the closest 2 mmHg, using a mercury sphygmomanometer, following a consistent method. The mean of three readings obtained with a gap of at least 5 min was used for data analysis. If there was a difference > 5 mmHg between two of the three readings, a supplementary measurement was

performed. The diagnosis of hypertension was based on a self-reported history of hypertension, a mean blood pressure ≥ 140/90 mmHg on two measurements at the examination.[22] The diagnosis of diabetes mellitus was based on a self-reported history of diagnosed diabetes mellitus or an FBG ≥ 7.0 mmol/L or a random plasma glucose ≥ 11.1 mmol/L.[23] Severe coronary artery stenosis is diagnosed when percutaneous coronary angiography reveals ≥ 75% stenosis of any of the major coronary arteries.[24] A family history of CVD was defined as a history of CVD in a biological family member.

Smoking and alcohol consumption data were collected using questionnaires. Present smoking was categorized as the consumption of at least one cigarette daily for at least 1 year.

Alcohol consumption was defined as the consumption of alcoholic beverages for at least 1 year. A monthly per capita household income of ≥ 3000 Chinese yuan was defined as the high-income level and vice versa as the low-income level. Those with upper high school and higher levels of education were considered to have high levels of education, whereas the reverse was true for lower levels. Professional quality control personnel monitored these parameters to ensure accuracy.

Statistical Analysis

All analyses were performed using SAS version 9.4 (SAS Institute; Cary, NC, USA). Baseline characteristics are expressed as the mean ± standard deviation or as frequencies and percentages. Differences in count data between groups were compared using the chi-square test. The normal distribution of quantitative variables was tested. For variables with a normal distribution, mean and standard deviation were used, whereas for variables whose distribution differed significantly from the normal distribution, median and interquartile range were used. Measurement information was compared using the *t*-test or Kruskal–Wallis test. A binary logistic regression model (backward) was used to analyze the correlation between anxiety and depression in premature CAD. Differences were considered statistically significant at $P < 0.05$.

Results

Characteristics of the Study Population

The characteristics of 313 patients are presented in Table 1. Anxiety occurred in 154 persons with a prevalence of 49.20%; the mean age was 55.2 ± 5.6 years and the median SAS score was 53.0 (52.00–54.00). Of those diagnosed with anxiety, 146 (46.65%) were mildly anxious, 8 (2.56%) were moderately anxious, and none were severely anxious. Depression occurred in 91 persons with a mean age of 56.2 ± 6.0 years, prevalence of depression was 29.07% and the median SDS score was 55.00 (54.00–57.00). Of those diagnosed with depression, 91 were mildly depressed and none were moderately or severely depressed. A total of 63 (20.13%) patients had comorbid anxiety and depression.

Correlators of Anxiety and Depression in CAD Patients

Table 2 presents the correlations when anxiety was used as the dependent variable. Multivariate logistic regression analysis revealed that anxiety was positively associated with severe coronary artery stenosis (odds ratio [OR]: 2.258; 95% confidence interval [CI]: 1.315–3.878), systolic blood pressure (SBP; odds ratio [OR]: 1.024; 95% CI: 1.003–1.045), body mass index (BMI; OR, 1.104; 95% CI: 1.022–1.192), and snoring (OR: 3.513; 95% CI: 1.708–7.228), whereas it was negatively associated with high-income level (OR: 0.379, 95% CI: 0.220–0.654).

Table 3 presents the correlations when depression was used as the dependent variable. Multivariate logistic regression analysis revealed that depression was positively associated with age (odds ratio [OR]: 1.090; 95% CI: 1.043–1.139), severe coronary artery stenosis (OR: 1.947; 95% CI: 1.132–3.349), and snoring (OR: 2.647; 95% CI: 1.144–6.125), whereas it was negatively associated with SBP (OR: 0.970, 95% CI: 0.950–0.991).

Table 4 shows the correlations when comorbid anxiety and depression were the dependent variables. Multivariate logistic regression analysis revealed that comorbid anxiety and depression were positively associated with age (OR: 1.082; 95% CI: 1.020–1.147), severe coronary artery stenosis (OR: 3.898; 95% CI: 1.839–8.263), snoring (OR: 3.855; 95% CI: 1.397–10.637).

Table 1 Baseline Characteristics

Variables	Patients with Anxiety (n = 154)	Patients with Depression (n = 91)	Patients with Comorbid Anxiety and Depression (N=63)
SAS/SDS	53.0 (52.00–54.00)	55.00 (54.00–57.00)	54.00 (51.00–60.00)
Age, years	55.2 ± 5.6	56.2 ± 6.0	55.3 ± 5.7
Male, n (%)	49 (31.8)	25 (27.5)	20 (31.7)
Hypertension, n (%)	107 (69.5)	61 (67.0)	43 (68.3)
Diabetes, n (%)	104 (67.5)	57 (62.6)	40 (63.5)
CVD, n (%)	57 (37.0)	37 (40.7)	25 (39.7)
Severe coronary artery stenosis, n (%)	77 (50.0)	47 (51.7)	39 (61.9)
SBP, mmHg	133.7 ± 13.8	129.8 ± 16.5	131.5 ± 15.9
DBP, mmHg	81.99 ± 10.26	80.89 ± 9.87	80.4 ± 9.8
TC, mmol/L	4.57 ± 1.04	4.53 ± 1.18	4.5 ± 1.0
TG, mmol/L	1.68 (1.19–1.97)	1.69 (1.12–2.16)	1.5 (1.0–1.9)
LDL-C, mmol/L	2.78 ± 0.70	2.76 ± 0.78	2.7 ± 0.7
HDL-C, mmol/L	1.16 ± 0.32	1.14 ± 0.34	1.2 ± 0.3
FBG, mmol/L	5.04 (4.71–5.74)	5.18 (4.75–6.80)	5.6 ± 1.9
BMI, kg/m^2	27.27 ± 4.01	27.16 ± 3.81	27.1 ± 4.0
Current smokers, n (%)	46 (29.9)	20 (22.0)	16 (25.4)
Current drinkers n (%)	31 (20.1)	8 (8.8)	8 (12.7)
Snoring, n (%)	139 (90.3)	81 (89.0)	57 (90.5)
High income level, n (%)	57 (37.0)	35 (38.5)	26 (41.3)
High level of education, n (%)	56 (36.4)	40 (44.0)	31 (49.2)

Abbreviations: SAS, the self-assessment scale; SDS, the self-depression scale; SBP, systolic blood pressure; DBP, diastolic blood pressure; TC, total cholesterol; TG, triglycerides; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; FBG, fasting blood glucose; BMI, body mass index; CVD: cardiovascular disease.

Table 2 Multivariate Logistic Regression Analysis of Anxiety in Patients with CAD

Variables	β	SE	Wald X^2	P	OR (95% CI)
Severe coronary artery stenosis	0.814	0.276	8.710	0.003	2.258 (1.315–3.878)
SBP	0.024	0.010	5.180	0.023	1.024 (1.003–1.045)
BMI	0.099	0.039	6.387	0.012	1.104 (1.022–1.192)
Snoring	1.257	0.368	11.654	0.001	3.513 (1.708–7.228)
High income level	−0.970	0.278	12.130	0.001	0.379 (0.220–0.654)

Abbreviations: SBP, systolic blood pressure; BMI, body mass index.

Table 3 Multivariate Logistic Regression Analysis of Depression in Patients with CAD

Variables	β	SE	Wald X^2	*P*	OR (95% CI)
Age	0.086	0.023	14.574	<0.001	1.090 (1.043–1.139)
Severe coronary artery stenosis	0.667	0.277	5.804	0.016	1.947 (1.132–3.349)
SBP	−0.030	0.011	8.112	0.004	0.970 (0.950–0.991)
Snoring	0.973	0.428	5.169	0.023	2.647 (1.144–6.125)

Abbreviation: SBP, systolic blood pressure.

Table 4 Multivariate Logistic Regression Analysis of the Comorbid Anxiety and Depression in Patients with CAD

Variable	β	SE	Wald X^2	*P*	OR (95% CI)
Age	0.079	0.030	6.921	0.009	1.082 (1.020–1.147)
Severe coronary artery stenosis	1.360	0.383	12.592	<0.001	3.898 (1.839–8.263)
Snoring	1.349	0.518	6.790	0.009	3.855 (1.397–10.637)

ROC Curves for Anxiety and Depression

The model for anxiety had an accuracy of 0.701, a sensitivity of 0.720, a specificity of 0.681, and an AUC of 0.793 (Figure 1A). The model for depression had an accuracy of 0.760, a sensitivity of 0.333, a specificity of 0.932, and an AUC of 0.751 (Figure 1B). The model for anxiety and depression comorbidities had an accuracy of 0.749, a sensitivity of 0.574, a specificity of 0.839, and an AUC of 0.846 (Figure 1C).

Discussion

Several studies have investigated the risk factors for the development of anxiety, depression, and CVD[25,26] and the relationship between anxiety, depression, and the incidence of CVD.[27,28] For the first time, we investigated the prevalence and correlators of anxiety and depression in patients with premature CAD.

First, our results indicated that CAD severity was positively associated with anxiety, depression, comorbid anxiety, and depression in premature CAD. Ekici et al conducted a study involving 225 patients who underwent elective coronary angiography and focused on the association between anxiety, depression, and CAD severity. The patients were categorized into three groups according to CAD severity. Anxiety and depression were assessed using the Hospital

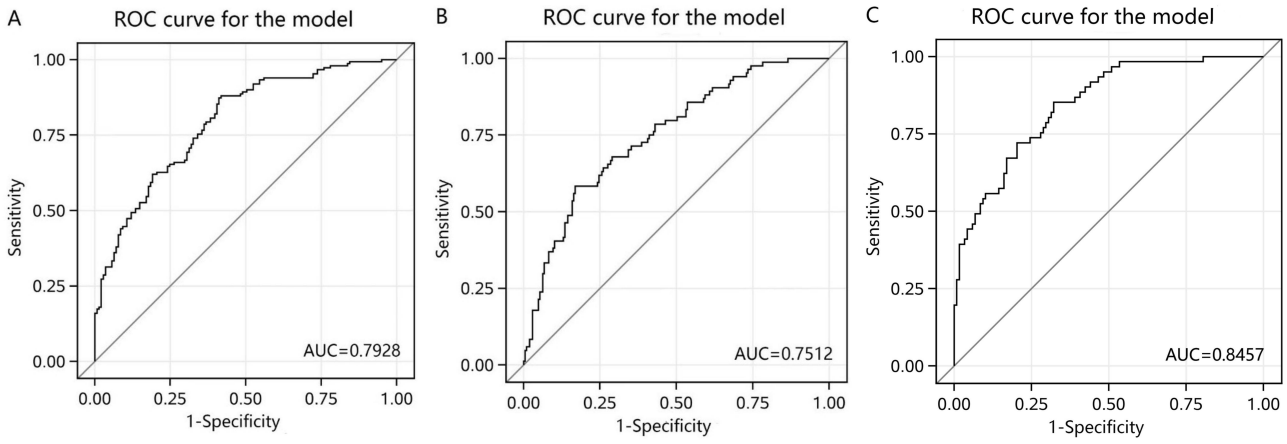

Figure 1 Receiver operating characteristic (ROC) curve for binary logistic model (**A**) (anxiety), (**B**) (depression), (**C**) comorbid anxiety and depression.

Anxiety and Depression Scale (HADS). These findings revealed a significant positive correlation between HADS scores and CAD severity.[29] Furthermore, Das et al studied 54 patients with CAD. The findings revealed that anxiety and depression scores, as measured by the HADS, were significantly higher in patients with triple-vessel disease than in those with double- or single-vessel disease.[30]

Second, our results indicated that SBP is positively associated with anxiety and negatively associated with depression in patients with premature CAD. Studies have explored the relationship between anxiety, depression, and blood pressure, yielding varied results. Certain studies have indicated a correlation between anxiety and hypertension, suggesting that individuals experiencing anxiety are at a greater risk of developing hypertension than those who do not experience anxiety.[31] Bacon et al conducted a study involving 197 non-hypertensive participants for 1 year. The findings indicated that the presence of an anxiety disorder was linked to a fourfold increase in the likelihood of developing hypertension (OR: 4.14, 95% CI: 1.18–14.56).[32] Ginty et al conducted a 5-year study involving 455 participants. The findings indicated that both depression (OR: 1.13, 95% CI: 1.05–1.21) and anxiety scores (OR: 1.11, 95% CI: 1.05–1.18) were linked to the subsequent development of hypertension.[33] Conversely, certain researchers have contested the influence of anxiety symptoms on the onset of hypertension. For example, Shinn et al demonstrated no correlation between depression or anxiety and variations in blood pressure over a 4-year follow-up period.[34] However, no study has specifically investigated the relationship among anxiety, depression, and blood pressure in patients with premature CAD.

Third, our results indicated that BMI was positively associated with anxiety. Gross et al examined the connections between symptoms of anxiety, depression, and risk factors for CVD in a young population. A total of 202 participants, aged between 8 and 18 years, were assessed in this cross-sectional study. These findings demonstrated that depression is linked to the levels of high-density lipoprotein cholesterol, triglycerides, and the metabolic syndrome cluster score.[35] Vogelzangs et al conducted a study involving individuals with either a current or remitted DSM-IV depressive or anxiety disorder ($N = 2315$) and healthy controls ($N = 492$). The findings revealed that individuals suffering from current anxiety disorders exhibited approximately a three-fold higher prevalence of coronary heart disease (OR for anxiety = 2.70, 95% CI = 1.31–5.56; OR for comorbid anxiety and depression = 3.54, 95% CI = 1.79–6.98). Additionally, patients with cardiovascular disease had a significantly higher BMI than those without cardiovascular conditions (25.4 vs 28.6, $P < 0.001$).[36]

Furthermore, our results indicated that snoring was positively associated with anxiety, depression, comorbid anxiety, and depression. Obstructive sleep apnea syndrome (OSAS) is a prevalent sleep disorder characterized by the recurrent obstruction of the upper airways. The primary symptoms of OSAS include episodes of respiratory cessation, accompanied by loud snoring.[37] Snoring caused by obstruction may indicate the presence of sleep-related breathing disorders, such as OSAS; however, it is important to note that not every individual who snores is diagnosed with OSAS.[38] Regarding the association between snoring and mental disorders, Jeong et al conducted a study involving 8530 Korean adolescents focusing on the examination of snoring frequency and depressive symptoms using questionnaires. The findings of this study revealed a positive correlation between the frequency of snoring and depressive symptoms.[39] Rezaeitalab et al performed a cross-sectional study involving 178 adult participants diagnosed with OSAS. The findings revealed that 53.9% of participants exhibited varying levels of anxiety, and 46.1% showed signs of depressive symptoms. Furthermore, their results indicated a correlation between the severity of OSAS and the prevalence of anxiety, with 66.7% of patients experiencing anxiety classified as having severe OSAS.[37]

Sleep behaviors are potentially alterable risk factors for mental disorders and CAD. However, the relationship between different sleep behaviors and common mental disorders in individuals with CAD is not fully understood. In a study conducted by Cao et al, 18,776 participants with a history of CVD were analyzed using data from the UK Biobank. A composite score reflecting healthy sleep was developed incorporating five specific sleep behaviors: chronotype, sleep duration, insomnia, snoring, and excessive daytime sleepiness. Over a median follow-up period of 11.8 years, 965 cases of depression and 812 cases of anxiety were recorded. The adjusted hazard ratios (HRs) for participants exhibiting a healthy sleep pattern, in comparison to those with a poor sleep pattern, were found to be 0.45 (95% CI: 0.35–0.57) for depression and 0.77 (95% CI: 0.58–1.03) for anxiety. This indicates a significant association between sleep patterns and a reduced risk of depression among individuals with CVD.[40]

Furthermore, our results indicated that a high-income level is negatively associated with anxiety in patients with premature CAD. Sareen et al conducted a study involving 34,653 non-institutionalized adults and assessed them at two intervals spaced 3 years apart. The findings indicated that a decline in household income over these two periods was linked to a heightened risk of developing mood, anxiety, or substance use disorder.[41] Vine et al performed a cross-sectional analysis of data from 498 young adolescents and revealed a negative correlation between household income and scores related to physical symptoms, separation, and panic anxiety.[42]

Finally, our results indicated that age was positively associated with depression, comorbid anxiety, and depression. Previous research has demonstrated that younger individuals tend to experience higher levels of anxiety and depression than their older counterparts do. Anxiety disorders are most frequently observed in individuals aged 25–44 years.[43] Major depressive disorder (MDD) is a widespread mental health condition that can manifest at any age throughout an individual's life. Nevertheless, the period of greatest risk for onset typically occurs from mid-to-late adolescence through the early 40s.[44] Schaakxs et al conducted a study involving 2981 individuals aged 18–88 years, all of whom were diagnosed with MDD at the outset and underwent a valid clinical assessment after 2 years. The main focus of this study was the progression of MDD over a 2-year period. Findings indicated that the trajectory of MDD deteriorated progressively with increasing age, with individuals aged 70 years and above experiencing the most severe outcomes in comparison to the reference group of participants aged 18 to 29 years.[45] Sisay et al conducted a study of 370 patients with cardiovascular diseases. The findings indicated that patients aged > 60 years exhibited the highest prevalence of depression among all the age groups. Specifically, individuals in the age group exceeding 60 years were 1.16 times (CI: 0.57–2.32) more likely to experience depression compared to those aged 18 to 24 years.[46]

Our study had several limitations. First, the size of the study population was relatively small; a larger cohort would enhance the statistical power of the findings. The challenge of confounding variables is a persistent issue in observational studies; however, we performed statistical adjustments for a wide array of potential confounders. Despite these adjustments, unmeasured factors may have influenced our results. Second, the interplay between mental disorders and CAD complicates the determination of causality as this cross-sectional study did not allow us to establish a sequence of these conditions. Observational data inherently limit the ability to ascertain causality and direction. Third, the assessment of anxiety and depression was based on questionnaire responses regarding symptoms rather than formal diagnoses made by psychiatrists for major depressive and anxiety disorders. Finally, the specific age range of the participants may have restricted the generalizability of the conclusions.

Conclusion

In summary, we examined the prevalence and correlators of anxiety and depression of anxiety and depression in individuals with premature CAD. Consequently, it is essential to assess the factors that influence emotional well-being during routine evaluations in both primary and specialized healthcare settings.

Data Sharing Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethics Approval and Informed Consent

This study was approved by Tangshan Gongren Hospital ethics committee (GRYY-LL-KJ2021-K6). All patients signed an informed consent. The authors confirmed that the guidelines outlined in the Declaration of Helsinki were followed.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically

reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The author(s) report no conflicts of interest in this work.

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