


Physical Exercise Behaviors and Depressive Symptoms Among Elderly Chinese Women: Focus on Exercise Components

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Purpose: Several studies have investigated the association between physical exercise and depressive symptoms in the elderly population. However, the relationship between components of physical exercise such as frequency, intensity, duration, and depressive symptoms remains unclear. This study was conducted on elderly Chinese women to investigate the association between each component of physical exercise and depressive symptoms and to examine the association between physical exercise patterns and depressive symptoms.

Patients and Methods: A total of 1429 Chinese women aged ≥ 60 years were enrolled in this cross-sectional study and provided information on their exercise behaviors through a self-reported questionnaire. Depressive symptoms were assessed using the Zung Self-Rating Depression Scale. Multiple logistic regression analysis was used to estimate adjusted odds ratios (ORs) to measure the association between exercise behaviors and depression.

Results: High frequency, moderate intensity, long duration, and exercise habits were significantly associated with lower levels of depressive symptoms. Furthermore, participants with more than one optimal exercise behavior were more likely to have a lower risk of depressive symptoms. These associations were not changed after adjustment for confounding factors.

Conclusion: This study shows that exercise behaviors were significantly associated with the risk of developing depression. This finding suggests that keeping an optimal exercise behavior may be associated with a lower risk of depressive symptoms in elderly Chinese women.

Keywords: physical exercise, depressive symptoms, elderly women, cross-sectional study

Introduction

Depression is one of the most common mental disorders, affecting over 350 million people worldwide.¹ The incidence of depression has dramatically increased over the past decades.² Depressive symptoms not only affect one's quality of life but are also associated with several conditions such as cardiovascular disease,³ diabetes,⁴ acute coronary syndrome,⁵ and mortality among older adults.⁶ In China, 30% of men and 43% of women older than 45 years suffer from depressive symptoms.⁷ In addition, projections indicate that one-third of Chinese men and women aged ≥ 75 years suffer from depressive symptoms.⁸ China is the biggest developing country in the world because of its fast economic development in recent years. Economic growth has led to rapid population aging in the past decades. In 2017, there were 240.9 million people aged ≥ 60 years in China, accounting for 17.3% of the total

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Chinese population; this percentage is increasing.⁹ Projections indicate that there will be 487 million aged ≥ 60 years people, accounting for 34.9% of the whole Chinese population, by 2050.¹⁰ It is thus important to prevent or improve the occurrence of depressive symptoms in the elderly.

Physical activity and exercise have been associated with positive health outcomes such as a lower risk of cardiovascular disease, obesity, and mortality,¹¹ which are often correlated with depressive symptoms. Assessment of physical activity in some studies contained not only exercise but also job- and household-related activities. Although, studies have examined the relationship between physical activity and depression in the elderly, the link between different exercise components, such as frequency, duration, intensity, and history, and depressive symptoms is still unclear. Because of the confirmed inverse association between physical activity and the risk of depressive symptoms, we suggest that physical exercise components positively associated with higher physical activity (high frequency, long-duration exercise, and exercise habits) may also correlate with a lower risk of depressive symptoms. Considering that physical exercise is affected by several different components and that each component differentially influences depressive symptoms, we investigated the association of physical exercise components with depressive symptoms. It is noteworthy to mention that most studies on the association between physical activity and depressive symptoms focused on developed countries,^{12–15} and few studies were performed in countries like China with large rural populations. Limited data exist on the association of physical exercise behaviors with depressive symptoms among the elderly Chinese population, particularly for elderly Chinese women, although evidence suggests that women have a higher risk of depressive symptoms than men.¹⁶ Therefore, this study aimed to examine the association between different components of physical exercise and depressive symptoms among elderly Chinese women.

Methods

Participants

We did a cross-sectional study of Chinese women who underwent a bone health examination at the health management center of the Jiuhua area, Fengxian District, Shanghai. The study initially included 1722 women examined between April 2019 and May 2019 to. A face-to-face

survey was performed after the health examination in a separate room and participants received a gift after survey completion. All participants were informed about the purpose of the study, and written consent was obtained from participants following the examination, including an agreement to complete a questionnaire and authorizing anthropometric measurements. The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the Huaiyin Institute of Technology. A total of 1510 women from the initial 1722 participants (88%) agreed to take part in the study. The exclusion criteria for this study were being under the age of 60, taking antidepressants, receiving psychological therapy, having a physical disability, cognitive disorders, being hospitalized, or not completing the questionnaire. Based on these criteria, we excluded 81 participants and the final cohort consisted of 1429 women.

Physical Exercise Assessment

Physical exercise behaviors were evaluated using a four-question self-reported questionnaire.

1. Frequency: “During the last month, how many days did you exercise per week?” The response options were “never,” “1–5 days,” and “ > 6 days.” 2. Intensity: “What is the usual intensity of your exercise?” Response options were “Low intensity: breathing and heart rate does not change significantly and is not challenging to perform;” “Intermediate intensity: slightly faster breathing and heart rate with minimal sweating;” and “High intensity: rapid breathing, faster heart rate, and profuse sweating.” 3. Duration: “How long do you usually exercise?” Response options were “ < 30 minutes,” “30 minutes–1 hour,” “1–2 hours,” and “ > 2 hours.” Responses of “ < 30 minutes” and “30 minutes to 1 hour” were combined as “ < 1 hour” for analysis. 4. History: “How long have you been exercising?” Response options were “ < 6 months,” “6 months–1 year,” “1–3 years,” “3–5 years,” and “ > 5 years.” For the analysis, we divided responses into three categories: < 1 year, 1–3 years, and > 3 years. The test score reliability coefficient was 0.95 using Cronbach’s alpha.

Depressive Symptom Assessment

Depressive symptoms were assessed using the Zung’s Self-Rating Depression Scale (SDS), a self-administered questionnaire of 20 items designed to screen the severity of depressive symptoms.¹⁷ All items are scored from one to four points depending on the frequency of the listed

problems. The overall result is a sum of the 20 scores; values range from 20 to 80 with higher values indicating increased severity of symptoms. We used a cutoff value of 40 to define depression and a second cutoff value of 45 for sensitivity analyses. These cutoff values are widely used in epidemiological studies to diagnose depressive symptoms.¹⁸ Reliability and validity of the SDS in Chinese populations have been demonstrated.¹⁹ The test score reliability coefficient for SDS was 0.79 using Cronbach's alpha.

Assessment of Confounding Factors

We measured participants' weight and height to calculate their body mass index (BMI). Blood pressure was measured on the upper left arm with an automatic sphygmomanometer (KENTARO HBP-9021J, Japan). A second measurement was taken if the value of the first measurement indicated hypertension (systolic blood pressure ≥ 140 mmHg, diastolic blood pressure ≥ 90 mmHg, or the use of an anti-hypertensive drug). Information on age, former occupation, smoking and drinking habits, household income, living condition, and educational level were obtained from the questionnaire. Former occupation was divided into white-collar and blue-collar worker. Tobacco smoking was categorized as smoking, former smoker, and non-smoker. Alcohol drinking was divided into drinking every day, drinking occasionally, and non-drinker. Household income was divided into three categories: $\leq 50,000$ Yuan (low income), 50,001–70,000 (middle income) and $>70,000$ (high income). Educational level was divided into $<$ high school diploma and \geq high school. These confounding factors were considered because they have direct or indirect effects on exercise behaviors or depressive symptoms and have been examined in previous studies.^{20,21}

Statistical Analyses

We tested the univariate relationships between our demographic and lifestyle variables with depression and exercise behaviors using *t*-test for continuous variables and the chi-square test for categorical variables. Logistic regression was used to estimate crude and adjusted odds ratios (ORs) for the association between exercise behaviors and depression. Depressive symptoms were used as the dependent variable with exercise behaviors as the independent variable. The adjusted model included the nine confounding factors. Significance of differences within exercise variables was assessed using the Bonferroni test. To

estimate cumulative effects of the different exercise measures we created an a posteriori variable reflecting the number (one to four) of "optimal" exercise behaviors based on the level of each question with the strongest OR for lower depressive symptoms. A *p* values < 0.05 were considered statistically significant. All analyses were conducted using SPSS[®] 24.0 (IBM Corporation, Armonk NY, USA) for Windows[®].

Results

Characteristics of participants are shown in Table 1. After exclusions, 1429 participants were included in the analysis. The mean age of participants was 69.2 ± 7.09 years. The percentage of participants with depression was 42.0% for SDS ≥ 40 and 24.6% for SDS ≥ 45 . Participants with depression were more likely to be older and have higher BMI. The proportions of women who had been blue-collar workers, with low household income, or a high educational level scored higher in the depression category. In contrast, participants who were non-smokers, non-drinkers, or had higher household incomes were more likely to have a lower incidence of depressive symptoms.

Crude and adjusted OR from logistic regression models for the relationship between exercise frequency (days/week) and depressive symptoms are shown in Table 2. In adjusted models, when compared with the no exercise category (reference), the OR (95% CIs) of participants in the categories exercise 1–5 times per week and exercise ≥ 6 days per week were 0.94 (0.67, 1.32) and 0.37 (0.29, 0.48) for SDS cut-off ≥ 40 , and 1.14 (0.78, 1.67) and 0.31 (0.23, 0.43) for SDS cut-off ≥ 45 respectively.

Table 3 reports the association between exercise behaviors and depression, specifically among the 833 participants who reported any exercise. In these women, longer exercise duration was significantly associated with a reduced risk of depression. The OR (95% CIs) relative to the exercise ≤ 1 hour/day group (reference) for the categories, 1–2 hours/day, and >2 hours/day were 0.45 (0.32, 0.62) and 0.40 (0.21, 0.75) for SDS cut-off ≥ 40 , and 0.35 (0.23, 0.54) and 0.25 (0.09, 0.65) for SDS cut-off ≥ 45 respectively. The association between exercise intensity and depressive symptoms was not linear. The adjusted OR (95% CIs) of moderate exercise intensity was 0.38 (0.26, 0.54) which was significantly lower than 1 (reference) for low intensity, and 1.03 (0.62, 1.71) for high exercise intensity for SDS cut-off ≥ 40 . This association was the same for SDS cut-off ≥ 45 . The adjusted OR (95% CIs) of 1–3 years exercise history was 0.51 (0.30, 0.85)

Table 1 Participant Characteristics According to Depressive Symptoms in 1429 Elderly Women

	Non Depressive Symptoms	Depressive Symptoms	p value ^a
	n = 829	n = 600	
Age	68.4 (7.1) ^b	70.3 (7.0)	< 0.001
BMI	24.1 (2.9)	24.4 (3.2)	0.03
Former occupation (n; %)			
White color	160 (67.8)	76 (32.2)	< 0.01
Blue color	669 (56.1)	524 (43.9)	
Smoking (n; %)			
Smoker	6 (40.0)	9 (60.0)	< 0.001
Former smoker	0 (0)	16 (100.0)	
Non-smoker	823 (58.9)	575 (41.1)	
Alcohol drinking (n; %)			
Drinking everyday	0 (0)	16 (100.0)	< 0.001
Drinking occasionally	49 (69.0)	22 (31.0)	
Non-drinker	780 (58.1)	562 (41.9)	
Household Income (n; %)			
Low	261 (50.6)	255 (49.4)	< 0.001
Middle	272 (62.2)	165 (37.8)	
High	296 (62.2)	180 (37.8)	
Living along (n; %)			
Yes	64 (55.2)	52 (44.8)	0.56
No	765 (58.3)	548 (41.7)	
Educational level (n; %)			
≥ High school	162 (52.3)	148 (47.7)	0.02
< High school	667 (59.6)	452 (40.4)	
Hypertension (n; %)			
Yes	501 (59.8)	337 (40.2)	0.12
No	328 (55.5)	263 (44.5)	
Diabetes (n; %)			
Yes	134 (52.3)	122 (47.7)	0.05
No	695 (59.2)	478 (40.8)	

Notes: ^aObtained using t-test for continuous variables and χ^2 analysis for variables of proportion. ^bMean (SD) for all continuous variables.

and > 3 years exercise history was 0.59 (0.37, 0.94) for SDS cut-off ≥ 40 compared to the < 1 year exercise history category (reference). This association was the same for SDS cut-off ≥ 45 .

Tables 2 and 3 shows that the odds of depressive symptoms were lowest with ≥ 6 days exercise frequency, >2 hours exercise duration, intermediate exercise intensity and >3 years of exercise. Thus, we defined these exercise behaviors as optimal exercise behaviors. Regardless of

SDS cutoff, women with more than one optimal exercise behavior had significantly lower odds of depressive symptoms (Figure 1).

Discussion

In this study, we investigated the association between different components of physical exercise and depressive symptoms among elderly Chinese women. The results showed that higher exercise frequency, long exercise duration, moderate exercise intensity, exercise habits (over one year), and one or more “optimal” exercise behaviors were associated with a significantly lower risk of developing depressive symptoms. Our study expands previous findings on the associations of physical exercise and depressive symptoms.

Although our study assessed depressive symptoms differently, results are consistent with studies showing a prevalence of depressive symptoms of 43% in Chinese women aged 45 and over⁷ and 39.9% in Chinese men and women over 55 years of age.²² However, a cohort study in southern China reported a lower rate of depressive symptoms (10.2%) among 1999 women aged 65 and over.²³

Previous studies examined the association between physical activity and depressive symptoms in elderly Japanese adults²⁴ and Brazilian adults.²⁵ These studies linked higher leisure physical activity to lower depressive symptoms. Another work about elderly American women showed that moderate and vigorous exercise levels correlated with lower depression scores.²⁶ Although the participants in these studies are from different countries there is an identifiable pattern partially consistent with our findings. China has faced a dramatic change in the past three decades. The rapid urbanization process led to the migration of young adults to cities for work, leaving their parents behind. Thus, young adults nowadays cannot support their parents as much as they did in the past. In addition, convenient means of transportation result in people living more sedentary lifestyles. These are factors affecting depressive symptoms and physical activity in China but might not affect other countries (especially developed countries). According to literature, several studies have investigated the association between physical exercise and depressive symptoms among the older Chinese population. A cross-sectional study among 1604 urban residents aged 50 years or older found that a ≥ 3 times per week frequency of physical exercise was

Table 2 Adjusted Associations Between Exercise Frequency and Depressive Symptoms Among 1429 Elderly Women

	Exercise Frequency (Days/Week)			p for Trend ^a
	Never	1–5	≥ 6	
n.	596	206	627	
Depressive symptoms (SDS ≥ 40, n)	315	100	185	
Risk (%) ^b	52.9	48.5	29.5	
Crude	1	0.84 (0.61, 1.16) ^c	0.37 (0.30, 0.47)	< 0.001
Adjusted model ^d	1	0.94 (0.67, 1.32)	0.37 (0.29, 0.48)	< 0.001
Depressive symptoms (SDS ≥ 45, n)	199	65	88	
Risk (%) ^b	33.4	31.6	14.0	
Crude	1	0.92 (0.66, 1.29)	0.33 (0.25, 0.43)	< 0.001
Adjusted model ^d	1	1.14 (0.78, 1.67)	0.31 (0.23, 0.43)	< 0.001

Notes: ^aObtained by multiple logistic regression analysis. ^bRisk of depressive symptoms based on the SDS for each tertile. ^cValues represent odds ratios and parenthetical values represent 95% confidence intervals. (all such values). ^dAdjusted for age, BMI, drinking and smoking habits, physical activity, family income, former occupation, living status, educational level, hypertension, and diabetes.

associated with a lower prevalence of depression.¹⁴ However, in this study, physical exercise was only assessed by exercise frequency; exercise duration and intensity were not evaluated. A longitudinal study of 5949 Chinese residents aged 45 or older suggested that while higher levels of leisure time physical activity had mitigating effects on depressive symptoms, a high level of total physical activity was directly associated with elevated depressive symptoms.²⁷ Total physical activity includes physical activity during occupational work and housework. Individuals' mood when engaging in leisure sports is different from their mood during work. Most of participants in this previous study were working individuals. Thus, the association of physical activity with depressive symptoms could vary depending on whether the physical activity is purely a leisure activity or includes all forms of physical exercise. Furthermore, high leisure time physical activity was associated with reduced occurrence of new depressive symptoms in a longitudinal study of 2630 Chinese adults aged 53 and older.²⁸ In all these studies, age and sex were considered as confounding factors and none specifically reported associations in women. In addition, these studies did not extensively examine physical exercise components. However, Wang et al used a sex-stratified analysis to examine the association between depression and physical activity in 9118 Chinese adults, including 4681 women aged 45–74 years. In this study, lower frequency, short duration, and moderate physical activity were associated with a lower risk of depression in women.²⁹ This work is similar to the present study, but the findings are not fully

consistent with ours. This study showed a gender-related difference between physical exercise components and depressive symptoms and suggested considering gender for the design of study strategies. All participants in our study were over 60 years old and retired because the general retirement age in China is 55 for women. Therefore, the influence of work in the development of depressive symptoms was reduced in our study. The design of our study shows that the cohort used in this work is highly representative of the Chinese elderly population.

While several of the previous studies reported results similar to ours, none were specifically designed to look at older Chinese women. In addition, none assessed the effect of exercise history, which may be an important modifier of the effect of exercise. Using two cutoff values for the SDS score also strengthens our results. The present study not only made up for the deficiencies of previous studies but also strengthened the evidence on the association between physical exercise components and depressive symptoms. Our findings are relevant for elderly women who would like to be more physically active or who already have exercise habits.

Physical exercise may decrease the prevalence of depressive symptoms because of its beneficial effects on the central nervous system. Previous studies showed that physical exercise increased levels of norepinephrine and serotonin in animal and human.^{30,31} Norepinephrine and serotonin are two central neurotransmitters, which can enhance neuronal survival, promote neural repair, and consequently improve mood and depressive

Table 3 Adjusted Associations Between Exercise Behaviors and Depressive Symptoms Among 833 Elderly Women

	Categories of Exercise Behaviors			p for Trend ^a
	Exercise Duration (Hours/Day)			
	≤ 1	1–2	> 2	
n.	374	391	68	
Depressive symptoms (SDS ≥ 40, n)	160	109	16	
Risk (%) ^b	42.8	27.9	23.5	
Crude	1	0.52 (0.38, 0.70) ^c	0.41 (0.23, 0.75)	< 0.001
Adjusted model ^d	1	0.45 (0.32, 0.62)	0.40 (0.21, 0.75)	< 0.001
Depressive symptoms (SDS ≥ 45, n)	99	48	6	
Risk (%) ^b	26.5	12.3	8.8	
Crude	1	0.39 (0.27, 0.57)	0.27 (0.11, 0.64)	< 0.001
Adjusted model ^d	1	0.35 (0.23, 0.54)	0.25 (0.09, 0.65)	< 0.001
	Exercise intensity (level)			
	Low	Intermediate	High	
n.	188	537	108	
Depressive symptoms (SDS ≥ 40, n)	83	147	55	
Risk (%) ^b	44.1	27.4	50.9	
Crude	1	0.48 (0.34, 0.67)	1.31 (0.82, 2.11)	0.94
Adjusted model ^d	1	0.38 (0.26, 0.54)	1.03 (0.62, 1.71)	0.24
Depressive symptoms (SDS ≥ 45, n)	46	71	36	
Risk (%) ^b	24.5	13.2	33.3	
Crude	1	0.47 (0.31, 0.71)	1.54 (0.92, 2.60)	0.48
Adjusted model ^d	1	0.31 (0.20, 0.50)	1.16 (0.65, 2.08)	0.73
	Exercise insistence (year)			
	< 1	1–3	>3	
n.	90	252	491	
Depressive symptoms (SDS ≥ 40, n)	39	86	160	
Risk (%) ^b	43.3	34.1	32.6	
Crude	1	0.68 (0.41, 1.11)	0.63 (0.40, 1.00)	0.08
Adjusted model ^d	1	0.51 (0.30, 0.85)	0.59 (0.37, 0.94)	0.16
Depressive symptoms (SDS ≥ 45, n)	30	45	78	
Risk (%) ^b	33.3	17.9	15.9	
Crude	1	0.44 (0.25, 0.75)	0.38 (0.23, 0.62)	< 0.01
Adjusted model ^d	1	0.27 (0.14, 0.50)	0.31 (0.18, 0.54)	< 0.01

Notes: ^aObtained by multiple logistic regression analysis. ^bRisk of depressive symptoms based on the SDS for each tertile. ^cValues represent odds ratios and parenthetical values represent 95% confidence intervals. (all such values). ^dAdjusted for age, BMI, drinking and smoking habits, physical activity, family income, former occupation, living status, educational level, hypertension, and diabetes.

symptoms.^{32,33} In addition, moderate exercise can decrease the level of inflammatory markers.^{12,34} Since the symptomatology of depression includes behaviors that occur during chronic inflammatory stress,³⁵ we speculated that physical exercise might also improve depressive symptoms by reducing inflammation. Another study indicated that high aerobic fitness is associated with low depression score.³⁶ In our study,

the elderly woman performed aerobic exercise. Thus, participants who exercise regularly or for long durations could have higher aerobic fitness, which may consequently be associated with lower prevalence of depressive symptoms. In addition, people who exercise frequently and for extended periods outdoors are more exposed to sunlight. It has been proven that sun exposure is associated with fewer depressive symptoms.³⁷

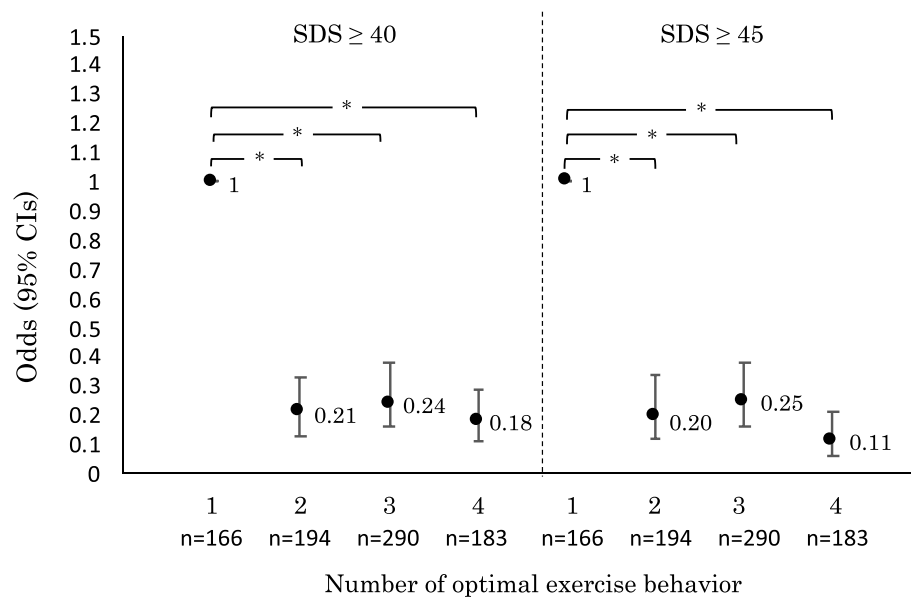


Figure 1 Adjusted odds ratio and 95% CIs of the association between number of optimal exercise behaviors and depressive symptoms. The results were adjusted for age, BMI, former occupation, smoking and drinking status, household income, living condition, educational level, hypertension, and diabetes. * $p < 0.001$.

We also considered that women who have exercise habits have an overall healthier lifestyle that correlated with a lower risk of depressive symptoms.

There are several limitations to our study. First, owing to the nature of cross-sectional studies, we cannot make conclusions about causality. Second, while we collected data on basic confounding factors, we cannot exclude the possibility that depressive symptoms are affected by other factors associated with physical exercise such as access to food and nutrition. Third, participants in this study were limited to women receiving a bone health examination; women who were taking antidepressants, receiving psychological therapy, or had a physical disability were excluded from the study. Thus, there might be a selection bias. Fourth, participants in the present study came only from one area in Shanghai, China, and might not be representative of the entire population. As mentioned before, given the dramatic changes China experienced in the past decades, the characteristics of elderly Chinese women may differ from elderly women in other countries. Fifth, physical activity other than deliberate exercise, such as physical activity during occupational work or housework, is not measured in the present study. This may be an influencing factor in the association between exercise behaviors and depressive symptoms. Finally, the use of a self-reported questionnaire for exercise behaviors may have introduced recall bias.

Conclusions

In conclusion, the present study found that physical exercise was associated with lower levels of depressive symptoms among elderly Chinese women and that this association was maximized through two or more optimal exercise behaviors. Our finding further strengthens the evidence on the association between physical exercise and mental health, and provides important evidence for women's mental health and implications for the field of preventive medicine and health education. In the future, the combination of exercise behaviors that is best for elderly women to improve depressive symptoms should be examined, and prospective studies or randomized trials should be conducted to confirm these findings and clarify causality.

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Disclosure

The authors report no conflicts and interest in this work.

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