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Review Article

The Effects of Physical Activity on Body Composition, Lipid Profile, Leptin, and Adiponectin Levels in Women: A Systematic Review Study

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Abstract

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Activity and mobility have always been integral parts of human life. In this review article, the required data was collected by searching scientific search engines and using keywords such as sports training, leptin, adiponectin, and women. A comprehensive conclusion of the reviewed studies is also presented. Resistance training (RT) as a non-pharmacological method play an effective role in improving individuals' health by reducing the levels of cardiovascular risk factors. However, The increase in these indicators is due to exercise and shows the favorable result of exercising compared to not exercising. It exposes human body to cardiovascular diseases. Highly intensive interval training can improve aerobic power, anaerobic capacity, body composition, fat percentage, weight, waist-to-hip ratio, and BMI in overweight and obese women. Aerobic and nano-curcumin training can be effective in lowering the inflammatory status in overweight and obese women and also lead to weight loss by decreasing inflammatory factors. Regular RT reduces the potential risk of cardiovascular diseases by improving leptin and adiponectin levels; hence, it can be used as an effective non-pharmacological treatment to prevent these diseases. RT is an effective way to decrease cardiovascular risk factors and plays an effective role in promoting health. Intense intermittent exercise can be effective in preventing some obesity-related diseases. Endurance exercise can improve body composition and play an effective role in preventing overweight and obesity diseases. Aerobic and RT reduce leptin levels and anxiety in overweight and obese adolescent girls.

1. Introduction

Movement is a part of human life. In today's industrialized and civilized societies where human movement is becoming increasingly limited, physical education and physical activities have been of concern. Today's human-machine life has made individuals stay away from the activity, and their lack of movement has removed the vitality and freshness from their body, thereby replacing it with a dangerous factor, called obesity.

The prevalence of overweight and obesity is increasing rapidly in developing countries such as industrialized countries [1].

By 2030, the number of overweight and obese people is estimated to be 1.35 billion and 573 million worldwide, respectively. Obesity is associated with health risks such as type 2 diabetes, hypertension, coronary heart diseases, liver diseases, and cancer [2]. The harmful effects of obesity are due to



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changes in physiological function caused by the accumulation of the adipose tissue. Although the FDA has approved several treatment options for obesity management, these approaches are costly and have destructive side effects, including psychiatric symptoms. Accordingly, developing functional food as a safe and effective anti-obesity strategy seems essential [3].

Physiological and metabolic changes caused by the increased adipose tissue and changes in the body's energy balance lead to some chronic diseases such as cardiovascular diseases, atherosclerosis, metabolic syndrome, and type 2 diabetes. Although one of the main ways to control weight is to limit calorie intake by diet, studies have revealed that exercises reducing fat mass and increasing cardiorespiratory fitness are involved in preventing the accumulation of fat mass and enhancing lean mass [4].

Leptin is a protein hormone with a helical structure similar to cytokines, which is mainly produced by subcutaneous fat donor cells in a constant pulsed manner with a peak secretion at night. Leptin is synthesized and released and is partially related to the size of the adipose tissue. Accordingly, a considerable correlation has been observed between leptin and body fat content in most human samples. By stimulating the sympathetic nervous system, leptin increases fat oxidation and exotherm, thereby reducing the adipose tissue volume and inhibiting leptin production. This mechanism is disrupted in obese people. In other words, the central nervous system does not respond well to the amount of plasma leptin, an indicator of adipose tissue, and the obese have high circulating leptin levels. Meanwhile, the effect of exercise and interventions such as supplementation has attracted the attention of many researchers. Weight loss seems to have a significant effect on plasma adiponectin increase; however, the mechanisms regulating plasma adiponectin levels by changes in body weight are

still unknown [4].

Adiponectin is one of the most abundant hormones secreted by adipose tissue, which, unlike other adipokines such as leptin and ghrelin, is reduced in obesity. This hormone is critical in regulating energy to maintain homeostasis, fat metabolism, and carbohydrates and is responsible for insulin sensitivity [5].

Adiponectin is one of the main adipose tissue hormones regulating many biological activities, and its concentration, unlike other adipocytokines, decreases obesity, diabetes, serum levels, coronary artery diseases, and hypertension. Body adipocyte, body mass index, cardiovascular diseases, insulin resistance, and dyslipidemia, adiponectin play a critical role in counteracting diet-induced insulin resistance and lowering blood glucose levels [6].

Weight loss seems to have a significant effect on increasing serum adiponectin. Although exercise cannot increase circulating adiponectin concentration, the mechanisms regulating plasma adiponectin are regulated by causing some changes in body weight are yet undetected. This is, while an essential part of weight loss programs is exercise. Exercise may affect fat cells and, therefore, serum adiponectin as many studies have revealed that many obese people may fail to participate in an aerobic activity due to orthopedic and cardiopulmonary limitations. Regular RT may be a promising treatment in this case. It increases adiponectin out of the retinal space and transfers it to the bloodstream by increasing blood flow and blood pressure, thereby increasing the concentration of plasma adiponectin. Improving blood flow to adipose tissue caused by RT also promotes hypoxia in the tissue and helps modifying the inflammatory condition. They are more responsive than RT [6].

On the other hand, medical experts recommend non-pharmacological methods such as exercise and physical activity to lose weight and prevent many diseases [3].



This study reviews the effects of different physical activities on body composition, lipid profile, leptin, and adiponectin levels in women.

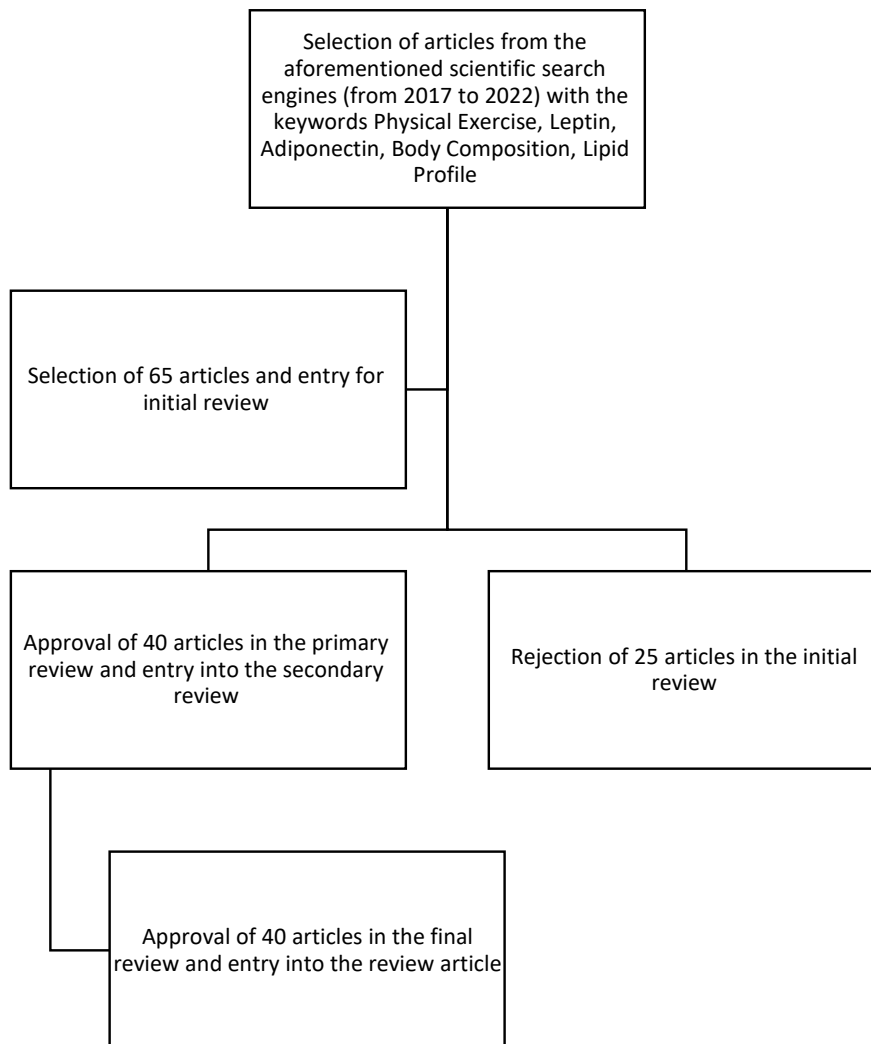
2. Methods

Considering the contradictory findings on the effects of resistance and endurance exercises on combined body composition, lipid profile, leptin, and adiponectin in women, in this review article, 40 relevant articles were selected from among 65 articles. on the studies addressed the effect of physical activity on body composition,

lipid profile, and leptin levels in women, and only recently-published articles in journals with an acceptable impact factor were included.

The studies were selected by searching scientific search engines such as Pubmed, Sid Google Scholar, Springer, and Noormags. Inclusion criteria were containing the keywords of exercise, leptin, adiponectin, and women, and being published from 2017 to 2022. Articles containing no sufficient information were excluded. The method of collecting researches was with the topics and the relationship between exercise and

Chart 1. Flowchart of paper selection in present study



leptin and adiponectin levels in women .

3. Results

Qaidi et al. (2019) conducted a study on obese women with BMI ≥ 30 , BMI ≥ 40 , and without exercise. Eight weeks of nonlinear RT may improve fat metabolism to prevent overweight and obesity-related diseases such as heart diseases and diabetes in obese women. The reduction of leptin concentration by exercise is associated with changes in energy balance, improved insulin sensitivity, and changes in hormones associated with carbohydrate and fat metabolism. Considering the relationship between leptin concentration and changes in weight, obesity, and the fat tissue, the obtained results were primarily attributed to the capacity of exercise in reducing weight and body fat mass. However, the lack of a significant change in ghrelin needs to be investigated in the future by changing the duration of the study and having a strict dietary control. This is because the potential role of nutritional behaviors and a high-fat diet in increasing the secretion of ghrelin from its secreted tissues, especially the stomach and the beginning of the small intestine, has been reported several times. On the other hand, the use of spirulina supplement has no significant effect on any of the variables, and adding it to RT do not increase the effect of training. This may be caused by the insufficient dose, the duration of consumption and course, and the lack of strict diet control. However, since the present study is the first study addressing this issue, future research are recommended to control other effective variables such as the diet and include larger sample sizes to reach better findings [3]. Sazvar et al. (2020) compared the effect of five weeks of circuit RT with garlic supplementation on serum adiponectin levels of overweight women. Eight persons were assigned to each of the garlic supplement, placebo, resistance exercise, garlic, and exercise groups. The training groups had five weeks of RT three times

a week. All groups received 1000 mg of garlic supplement or placebo daily in two 500 mg doses for five weeks. Anthropometric indices and serum adiponectin levels were measured before and after the exercise program. After five weeks, resting serum adiponectin levels in the circular RT group with garlic supplementation increased compared to the other groups; however, the increase was not statistically significant. Moreover, weight loss in the Exercise group did not significantly differ from other groups (6).

Jamshidi et al. (2020) examined the effects of aerobic exercises and nano curcumin supplementation on body composition and serum amyloid A indices in overweight and obese women. The results showed that eight weeks of aerobic exercise, nano-curcumin supplementation, and the combined effect of exercise and nano-curcumin significantly decreased the serum amyloid A level, body weight, and body mass index. There was a significant change between the average of aerobic exercise and control as well as between exercise and nano curcumin supplement with the control; however, the waist-to-hip circumference ratio in the study group did not decrease significantly. Aerobic exercise and nano curcumin can reduce the inflammatory condition of patients by reducing inflammatory factors. [2].

Sajdi et al. (2018) investigated the effect of eight weeks of RT and a period without training on waist plasma values and the body composition of overweight and obese girls. The desired result in people is lost due to not practicing [7].

Javad et al. (2019) detected the effect of four weeks of HIIT training with ginseng supplementation on the aerobic, anaerobic, and body composition in overweight and obese women. According to the findings, intense intermittent exercise with ginseng supplements can improve aerobic capacity, anaerobic capacity, and body composition (fat percentage, weight, waist-to-hip ratio, and BMI) in overweight and



obese women [8].

Obesity is a major nutrition-health problem among adolescents in developed countries, which in addition to physical complications, can exert many psychological consequences, including increased anxiety. Sajdi et al. (2018) investigated the effect of a combination of aerobic and RT on leptin and cortisol in overweight and obese anxious adolescent girls. They concluded the significant effect of overweight and obesity on anxiety; however, no significant difference was observed in the cortisol level [1].

The use of small atrial fibrillation and aerobic exercise can affect obesity in many ways, including increasing the body metabolism. Baje et al. (2018) researched the effect of four weeks of aerobic training with and without small atrial fibrillation on the lipid profile and body composition of obese and overweight girls. Considering a significant decrease in body fat percentage and some anthropometric indicators in experimental groups, obese girls are recommended to use small supplements along with aerobic exercise to improve body composition [9].

In their study in 2017, Ghorbani et al. investigated the effect of intense intermittent exercise and black cumin consumption on liver enzymes, lipid profile, and blood sugar in obese and overweight women. It seems that intense intermittent exercise, along with the consumption of cumin, can effectively prevent some obesity-related diseases [10].

Segurian et al. (2020) compared the effect of high-intensity traditional RT on factors involved in fat metabolism among obese and overweight women. The intensity of exercise is an essential factor in the number of changes associated with fat metabolism and appetite control in obese individuals [5].

Tartibian et al. (2017) found out that a 12-week moderate-intensity aerobic exercise program produced significant changes in body composition,

lipid profile, and biochemical indices of obesity in overweight girls [11].

In a semi-experimental study, Safarpour et al. (2020) examined 45 obese and overweight women with a body mass index >25 kg/m² using a simple method. Spinning and stationary bike exercises can effectively prevent metabolic diseases by increasing the anti-inflammatory marker CTRP-3, which is involved in the metabolism of the body, the liver, and fat tissues [12].

Suri et al. (2020) reported no significant difference between the control and experimental groups regarding the changes in body composition, blood lipids, and levels of vascular adhesion molecules. It was also concluded that 10 weeks of combined training was not enough to reduce the level of 1VCAM and blood lipids, and more research is needed in this field [13].

Afshar et al. (2020) showed that fasting serum leptin levels significantly decreased in both groups after one month; however, the decrease was not significantly different between the two groups. Caffeine supplementation with combined exercise also increased resting energy expenditure (REE) and decreased leptin resistance index after one month. According to the findings, one month of combined aerobic-RT in both groups, especially due to the more significant reduction of the studied indicators in the caffeine group, maybe a risk factor To prevent further obesity in overweight girls [14].

Rad et al. (2018) findings showed that the percentage of fat, body mass index, and waist-to-hip ratio in the experimental group significantly decreased compared to the control group, while the fat-free mass and serum level of interleukin 10 did not change significantly. It was concluded that endurance exercise by improving body composition could play an essential role in preventing overweight- and obesity-related diseases. However, further studies are suggested to achieve the anti-inflammatory effects of this type



of exercise [15].

Maleki et al. (2020) claimed that in the RT + cinnamon consumption groups, RT and cinnamon supplementation significantly decreased leptin and adiponectin levels. However, no significant difference was observed between the effects of RT and cinnamon supplementation on leptin and adiponectin. Compared to RT and cinnamon supplementation alone, RT, along with cinnamon consumption, decreased leptin and increased adiponectin more significantly. Regular RT along with cinnamon supplementation reduces the potential risk of cardiovascular diseases by improving leptin and adiponectin levels and can be used as an effective non-pharmacological treatment to prevent these diseases [16].

According to Heydari et al. (2018), chamomile consumption, along with intermittent aerobic RT, can probably be effective in improving the body mass index and the fat percentage of overweight and obese women [17]. Alamdari et al. (2018) conducted a study entitled "Acute response and chronic adaptation of physiological and abstract indicators of appetite and body weight to aerobic activity in obese middle-aged and elderly women". Increased fasting hunger due to exercise prevents the expected weight loss from exercise; hence, eating low-calorie foods at least for breakfast is recommended. Moreover, considering the effect of an exercise session on increasing food satiety, it is recommended to postpone breakfast until after the exercise session [18].

In Joo et al.'s (2022) study, in addition to muscle strength and exercise capacity, 12 weeks of individual RT reduced serum leptin levels in proportion to body fat mass or visceral fat, suggesting that serum leptin levels might have been an alternative to exercise in rheumatoid arthritis [19].

Akta et al. (2022) found that when PCOS patients underwent HIIT training for 12 weeks, leptin and vespine levels did not change while

adiponectin levels increased. Serum insulin levels, TG, total cholesterol, and LDL-C decreased, and HDL-C levels increased [20].

In Tóth et al.'s (2022) study, HFD / APOB-100 mice showed cardiovascular sexual responses to MetS and ET. However, left ventricular gene expression, except for the leptin receptor and several genes associated with the stress response, was similar between the groups [21].

According to Olean-Oliveira et al. (2022), the menstrual cycle stage regulates Adipokine and lipoprotein responses after an HIIE session, which contributes to inflammatory conditions and highlights the importance of considering menstrual cycle stages in the exercise cycle [22].

Maddo et al. (2022) conducted a study on the relationship between weight gain, obesity-related adipokines, inflammation, and oxidative stress with cancer. Understanding the role of biological pathways associated with obesity and mediators in the pathogenesis and prognosis of endometrial malignancies may provide new perspectives on combination therapy strategies not being explored yet [23].

Babaei et al. (2022) Reported that a sedentary lifestyle caused fat to accumulate and secrete proinflammatory adipokines. However, regular exercise has several beneficial effects on metabolic and cognitive disorders. Although the underlying mechanisms of the beneficial effects of exercise on metabolism are not fully understood, changes in energy expenditure, fat accumulation, and circulating levels of myokines and adipokines may be important [24].

Ivona et al. (2022) considered adiponectin as a possible biomarker for metabolic syndrome in obese patients. Moreover, they found that adiponectin, LAR, insulin, and HOMA-IR levels did not change in physically active patients, while leptin levels decreased significantly in non-obese physically active individuals [25].

In Espinoza-Salinas et al.'s (2022) study, after



four weeks of intervention with cardiovascular training protocol, parasympathetic modulation increased in obese individuals, and inflammatory markers decreased [26].

In Semeraro et al.'s (2022) study, Mice in the exercise group that were fed a high-fat diet had lower levels of nitric oxide metabolites that oxidized high-density lipoprotein as cholesterol levels increased. According to their findings, the number of nitric oxide metabolites was inversely correlated with low-density oxidized lipoprotein cholesterol and homoarginine. Exercise significantly reduced inflammatory cytokines in mice fed a high-fat diet [27].

According to Iyengar et al. (2022), obesity-related dysfunction can contribute to cancer pathogenesis and treatment resistance through various mechanisms, including those mediated by insulin, leptin, adiponectin, proinflammatory mediators, and hormonal signaling pathways, especially in women [28].

According to Peng et al. (2021), the environmental resistance of leptin, especially leptin resistance in muscle, has recently received more attention, while its mechanism is unclear. Exercise is an effective way to reduce obesity, partially due to reduced leptin resistance [29].

Sajedi et al. (2021) concluded that aerobic

Table 1. Research on inflammatory factors

Type of exercise	Results(findings)	References
Nonlinear resistance training	Preventing overweight and obesity-related diseases	Ghaedi et al. (2019)
Circuit resistance training	Increased serum adiponectin level	Sazvar et al. (2020)
Aerobic exercises	Reduced inflammatory factors and decreased weight and obesity	Jamshidi Rad et al. (2020)
Resistance training	Decreased body composition index	Sajedi et al. (2018)
HIIT training	Improved aerobic capacity, anaerobic capacity, and body composition	Javad et al. (2019)
Aerobic training	Decreased body fat percentage and some anthropometric indicators	Bijeh et al. (2019)
Intense intermittent exercise	Preventing some obesity-related diseases	Ghorbani et al (2017)
Moderate-intensity aerobic exercise	Significant improvement in body composition, lipid profile, and biochemical indicators of obesity	Tartibian et al (2017)
Spinning and stationary bike exercises	Increased anti-inflammatory marker CTRP-3 and preventing metabolic diseases	Safarpour et al (2020)
Combined training	No decrease in VCAM 1 level and blood lipids	Suri et al. (2020)
Combined exercise	Increased resting energy expenditure (REE) and decreased leptin resistance index	Afshar et al. (2020)
Resistance training	Decreased leptin levels and increased adiponectin levels	Maleki et al. (2020)
Intermittent aerobic resistance training	Improved body mass index and fat percentage in the overweight and the obese	Heydari et al. (2019)
Aerobic activity	Increased fasting hunger caused by exercise and preventing expected weight loss caused by exercise	Alamdari et al (2018)
Individual resistance training	Decreased serum leptin and visceral fat levels	Joo YB et al. (2022)
HIIT training	Increased adiponectin level	Aktaş et al. (2022)
Cardiovascular training protocol	Decreased inflammatory markers	Espinoza et al (2022)
Aerobic exercise	decreased leptin and cortisol and increased serotonin levels	Sajedi et al. (2021)
Chronic exercise	Increased apelin and ghrelin levels and decreased leptin, irisin, and insulin levels	Dundar et al. (2021)



exercise combined with probiotics decreased leptin and cortisol and increased serotonin levels [30].

In Cipryan et al.'s (2021) study, in healthy young people, consuming a VLCHF diet during regular exercise over 12 weeks produced favorable changes in body weight and fat mass with beneficial changes in serum adiponectin and leptin concentrations [31].

Dundar et al. (2021) found that after eight weeks of chronic exercise, apelin and ghrelin levels increased; however, leptin, irisin, and insulin levels decreased. Decreased leptin and irisin levels are consistent with reduced lipid levels caused by chronic exercise [32].

Ismail et al. (2021) should that a 12-week aerobic exercise could significantly decrease leptin and liver enzymes in overweight non-diabetic HCV men. Decreased serum leptin levels after chronic exercise may be justified by glycogen depletion, glycolysis inhibition, and increased glucose utilization [33].

Tehfe et al. (2021) in their systematic review reported an inverse relationship between exercise and leptin. However, more research is needed to address the different effects of physical activity on leptin and define a more precise relationship between the risk of bias and the characteristics of studies in this field [34].

According to Gao et al. (2021), children with lower leptin levels exercised more effectively and spend more time on their meals. They also reported that leptin was closely related to diet and exercise habits [35].

Kharazi et al. (2021) documented that voluntary exercise reduced sperm abnormalities by improving the HPG axis and kisspeptin / leptin signaling in mice with type 2 diabetes [36].

In Kao et al.'s (2021) study, in both high-intensity short-term and low-intensity long-term exercise, the adiponectin/leptin ratio significantly increased only among normal-weight participants

with the false intervention [37].

In the study of Al-Kashif et al. (2021), the amount of change before and after biochemical variables (hormone leptin) in obese women shows the positive role of exercise program in improving leptin in obese women [38].

Table 1 shows a summary of studies on inflammatory factors.

4. Discussion

Nonlinear RT improves fat metabolism to prevent overweight and obesity-related diseases such as heart diseases and diabetes in obese women. As a non-pharmacological method, RT plays an effective role in improving individuals' health status by decreasing cardiovascular risk factors. However, the increase of these indicators caused by lack of training reflect the loss of the desired training results.

Endurance exercise improve body composition; hence, they play a critical role in preventing overweight- and obesity-related diseases. However, further studies are required to achieve the anti-inflammatory effects of this type of exercise. Endurance sports can effectively reduce the inflammatory condition of overweight and obese women and cause weight loss by decreasing inflammatory factors.

Spinning and stationary bike exercises can effectively prevent metabolic diseases by increasing the anti-inflammatory marker CTRP-3, which is involved in the metabolism of the body, the liver, and the fat tissue.

5. Conclusion

Aerobic and RT reduce leptin levels and anxiety in overweight and obese adolescent girls. Regular RT reduces the potential risk of cardiovascular diseases by improving leptin and adiponectin levels. It can also be used as an effective non-drug treatment to prevent these diseases.

Periodic intense exercise can be effective



in preventing some obesity-related diseases. Moderate-intensity aerobic exercise produces remarkable changes in body composition, fat distribution, and the biochemical indices of obesity in overweight girls.

Intermittent resistance and aerobic exercises can probably improve the body mass index and the fat percentage in overweight and obese women. Vigorous intermittent exercise can improve aerobic, anaerobic, and body composition (percentage fat, weight, waist-to-hip ratio, and BMI) in overweight and obese women. Combined resistance aerobic training prevents obesity risk factors in overweight girls. Exercise is an important and influential factor in changing the factors associated with fat metabolism and appetite control in obese people; however, further research is recommended to reach consistent findings in the future.

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Conflict of interests

The authors have no conflicts of interest with individuals or organizations.

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