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Original Research

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The Effect of Exercise training Performed to Musical Metronome Rhythm on Body Composition and Local Fat burning

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Abstract

Purpose: Rhythmic auditory cues (e.g., metronome or music beat) may enhance exercise synchrony and potentially influence body composition adaptations. This study examined whether resistance training performed in synchrony with a musical metronome rhythm improves body composition outcomes in adult women. **Method:** In a two-group pretest–posttest intervention, 30 adult women were allocated to a rhythm-synchronised resistance training group (music/metronome cue) (n = 15) or a control resistance training group (n = 15). Both groups completed the same 12-week supervised resistance-training programme; the intervention group performed movements synchronised to an approximate metronome rhythm (~128 beats per minute). Body weight, BMI, body fat percentage, fat mass, and lean body mass were assessed before and after the intervention. Data were analysed using group × time comparisons (with baseline-adjusted analyses where appropriate), alongside effect sizes and confidence intervals. **Results:** Body fat percentage decreased significantly in the rhythm-synchronised (music) group (30.17 ± 1.34 to 29.10 ± 1.39), whereas the control group showed an increase over time (30.76 ± 2.55 to 31.54 ± 2.63). Body weight and BMI showed no meaningful changes between groups across the intervention period. Changes in lean body mass did not differ significantly between groups. **Conclusion:** Synchronising resistance training with a metronome-based rhythmic cue may promote a more favourable change in body fat percentage compared with the same training performed without rhythmic cues in adult women. Further studies with larger samples and tighter control of confounding factors are recommended to confirm and generalise these findings.

Keywords: Body composition, Local fat burning, Resistance training, Exercise music, Metronome, Women's exercise.

Introduction

Physical inactivity and increasing prevalence of obesity in recent decades particularly among adult women have become major public health concerns. Body composition and fat distribution, especially in the abdominal region, are important indicators of metabolic health and physical appearance. The accumulation of fat in these areas increases the risk of cardiovascular and metabolic diseases. Fat distribution is influenced by genetic, hormonal, and sex-related factors. Combined aerobic- resistance training is known to reduce total body fat, although there is insufficient evidence supporting true spot reduction and fat loss generally occurs systemically (Paoli et al., 2021)(Stallknecht et al., 2007)(Yıldızer et al., 2024)(Merawati et al., 2023).
Some studies have suggested the possibility of stimulating localized lipolysis through increased blood flow to specific muscles during exercise. However, inactivity, excessive caloric intake, insulin resistance, visceral fat accumulation, and chronic inflammation worsen metabolic status and elevate the risk of type 2 diabetes and cardiovascular disease. Regular exercise is one of the most effective non-pharmacological interventions for improving body composition and metabolic health. Even online exercise programs have been shown to enhance muscular strength, body composition, and perceived physical ability (Yıldızer et al., 2024)(Stallknecht et al., 2007)(Makiel et al., 2023).
In optimizing exercise programs, using rhythmic music or metronome-synchronized beats can increase motivation, improve subjective workout experience, and help maintain consistency during high-intensity interval training (HIIT). Music may synchronize heart rate and breathing with exercise rhythm. Aerobic exercise, resistance training, and rhythmic activities such as dance are known to improve body composition and metabolic parameters, even if they performed through online videos. Combined aerobic- resistance training, compared with aerobic training only, has greater effects on reducing inflammation, improving body composition, and enhancing lipid profiles (Buchanan

& Marsh, 2002; Karageorghis et al., 2025; Makiel et al., 2023; Merawati et al., 2023; Sakairi et al., 2025; Van Dyck et al., 2015a).

Recent findings indicate that incorporating music into exercise not only increases enjoyment but may also influence physiological responses. Among stroke patients, rhythm and timing training with a musical metronome combined with physical exercise improved upper-limb function, daily activities, and quality of life. Similarly, group-based resistance training accompanied by music and augmented feedback increased motivation, repetition count, and positive affect toward exercise. However, excessive or inappropriate use of music for mood regulation- especially in individuals with overweight- may impair self-regulation and lead to more sedentary behaviors, resulting in negative long-term metabolic consequences (Ginström et al., 2025; Miras-Moreno et al., 2025; Yu et al., 2017).

A review of the existing literature shows that although the separate effects of exercise and music are relatively well understood, studies that simultaneously examine the effect of structured exercise synchronized with a specific metronome rhythm on body composition, local fat reduction, and physiological markers in young non-athletic women are scarce or nearly absent. A knowledge gap also remains concerning the impact of specific rhythmic frequencies, such as 120 bpm, in this population particularly in women with overweight or low levels of physical activity.

Therefore, the present study aims to investigate the effect of a regular exercise program synchronized with a musical metronome on body composition and local fat reduction in young women. The central research question is whether synchronizing physical exercise with rhythmic auditory cues can lead to significant reductions in local fat, improvements in body composition indices, and enhancements in metabolic processes. Using a randomized controlled trial design and controlling for nutrition, exercise intensity, and music rhythm, this study seeks to clarify the potential role of combining music and exercise in enhancing the effectiveness of physical activity, promoting localized fat changes, facilitating metabolic processes, and improving overall body composition outcomes.

Methods

This quasi-experimental study employed a pretest–posttest design with two parallel groups. The target population comprised overweight adult women aged 25–35 years with a body mass index (BMI) of approximately 25–30 kg/m². Participants were recruited through a written call and voluntary enrolment. Prior to the intervention, all individuals received a full explanation of the study procedures, completed a general health screening questionnaire, and provided written informed consent. Participants with chronic diseases or those taking medication were excluded from the study.

After the initial screening, 30 eligible participants were randomly allocated to one of the two groups: resistance training with rhythmic music (n = 15) or the same resistance training performed without music (n = 15). To minimise the potential influence of dietary changes, participants completed a dietary recall questionnaire and were asked to maintain their usual eating habits throughout the study. They were also instructed to avoid any additional exercise or structured physical activity outside the research protocol during the 12-week intervention.

Both groups completed an identical resistance-training programme for 12 weeks, with three non-consecutive days per week (e.g., Saturday–Monday–Wednesday). Each session lasted 30 minutes and was performed at a moderate intensity corresponding to 60–70% of maximum heart rate (HRmax), equivalent to 12–14 on the Borg Rating of Perceived Exertion scale. The programme included 15 selected resistance exercises: squat, shoulder press, crunch, Bulgarian squat, push-up, V-sit, sumo squat, Swiss-ball triceps exercise, mountain climbers, deadlift, chest fly, sit-up, calf raise, seated row, and Russian twist. During the first six weeks, participants performed one set per exercise across two circuits (two rounds). During weeks 7–12, they completed two consecutive sets of 10–15 repetitions per exercise. Rest intervals were standardised at 30 seconds between sets and 60 seconds between exercises. All sessions were delivered in a controlled gym setting under the supervision of an experienced instructor.

The only difference between groups was the use of auditory rhythmic cues. In the music group, exercises were performed in synchrony with exercise music at a moderate tempo (approximately 128 beats per minute), delivered using a standardised rhythmic pattern to encourage movement–beat alignment. The control group performed the same protocol in silence. Anthropometric and body-composition measurements were collected 48 hours before the first training session and 48 hours after the final session.

Data were analysed using SPSS (version 26). Normality of distributions was examined with the Shapiro-Wilk test, and homogeneity of variances was assessed using Levene's test. To compare changes within and between groups across time, a two-way repeated-measures analysis of variance (group × time) was applied. Statistical significance was set at $p < 0.05$. Results are presented as mean ± standard deviation, and effect sizes were calculated using partial eta-squared (ηp^2) and interpreted according to Cohen's criteria.

Results

Baseline demographic and anthropometric characteristics are presented in Table 1. Participants in the music group (n = 15) and control group (n = 15) were comparable at baseline, with no statistically significant between-group differences in age, height, body weight, BMI, body fat percentage, fat mass, lean body mass, or waist-to-hip ratio (WHR). At baseline, mean age was 30.53 ± 1.11 years in the music group and 30.76 ± 1.28 years in the control group. Mean body weight was 67.04 ± 2.17 kg and 66.76 ± 3.05 kg in the music and control groups, respectively, and baseline BMI was 24.66 ± 0.95 kg/m² in the music group versus 25.37 ± 1.01 kg/m² in the control group (Table 1).

Changes in body composition outcomes before and after the 12-week intervention are summarised in Table 2 and illustrated in Figures 1–4. For body weight, both groups remained essentially stable over time. The music group changed from 67.04 ± 2.17 kg to 67.13 ± 2.36 kg, while the control group changed from 66.76 ± 3.05 kg to 67.12 ± 3.09 kg (Table 2). Consistent with this pattern, BMI also remained largely unchanged in the music group (24.66 ± 0.95 to 24.67 ± 1.04 kg/m²), with only a small increase in the control group (25.37 ± 1.01 to 25.51 ± 1.12 kg/m²). The group × time interaction for body weight was not statistically significant ($p = 0.29$), indicating no differential weight change between groups.

With respect to adiposity-related outcomes, body fat percentage showed a clearly different pattern between groups. In the music group, body fat percentage decreased from 30.17 ± 1.34% to 29.10 ± 1.39% (−1.07 percentage points), whereas the control group increased from 30.76 ± 2.55% to 31.54 ± 2.63% (+0.78 percentage points) (Table 2). This between-group divergence over time was statistically significant (group × time interaction: $F(1,28) = 9.13$, $p < 0.01$), indicating a more favourable change in body fat percentage in the rhythm-synchronised (music) condition (Table 2 and Figure 1).

Fat mass followed a broadly similar direction of change, although the magnitude differed between groups. The music group showed a small decrease in fat mass from 20.41 ± 1.66 kg to 20.35 ± 1.71 kg (−0.06 kg), while the control group increased from 24.36 ± 1.61 kg to 24.87 ± 1.80 kg (+0.51 kg) (Table 2; Figure 2). Overall, these data indicate that adiposity outcomes moved in a more favourable direction in the music group compared with the control group over the intervention period.

Lean body mass did not differ significantly between groups across time. Lean body mass increased slightly in both groups (music: 25.93 ± 0.75 to 26.31 ± 0.86 kg; control: 25.10 ± 1.18 to 25.49 ± 1.23 kg), but the group × time interaction was not statistically significant ($F(1,28) = 1.32$, p = 0.27), suggesting no differential effect of rhythm-synchronised training on lean mass adaptations (Table 2 and Figure 3).

Finally, central adiposity assessed via WHR demonstrated a favourable change in the music group compared with the control group. WHR decreased in the music group from 0.81 ± 0.00 to 0.78 ± 0.01 (−0.03), whereas the control group showed a small increase from 0.83 ± 0.01 to 0.84 ± 0.01 (+0.01) (Table 2; Figure 4). The group × time interaction for WHR was statistically significant (p = 0.03), indicating a more favourable shift in central adiposity markers with rhythm-synchronised resistance training.

Table 1. Baseline Characteristics of Participants (Mean ± SD)

Variable	Music Group (n = 15)	Control Group (n = 15)
Age (years)	30.53 ± 1.11	30.76 ± 1.28
Height (cm)	166.06 ± 1.30	162.20 ± 1.93
Body weight (kg)	67.04 ± 2.17	66.76 ± 3.05
BMI (kg/m²)	24.66 ± 0.95	25.37 ± 1.01
Body fat (%)	30.17 ± 1.34	30.76 ± 2.55
Fat mass (kg)	20.41 ± 1.66	24.36 ± 1.61
Lean body mass (kg)	25.93 ± 0.75	25.10 ± 1.18
Waist-to-hip ratio	0.81 ± 0.00	0.83 ± 0.01

Table 2. Body Composition Outcomes Before and After the 12-Week Intervention (Mean ± SD)

Variable	Music Group Pre	Music Group Post	Control Group Pre	Control Group Post
Body weight (kg)	67.04 ± 2.17	67.13 ± 2.36	66.76 ± 3.05	67.12 ± 3.09
BMI (kg/m²)	24.66 ± 0.95	24.67 ± 1.04	25.37 ± 1.01	25.51 ± 1.12
Body fat (%)	30.17 ± 1.34	29.10 ± 1.39	30.76 ± 2.55	31.54 ± 2.63
Fat mass (kg)	20.41 ± 1.66	20.35 ± 1.71	24.36 ± 1.61	24.87 ± 1.80
Lean body mass (kg)	25.93 ± 0.75	26.31 ± 0.86	25.10 ± 1.18	25.49 ± 1.23
Waist-to-hip ratio	0.81 ± 0.00	0.78 ± 0.01	0.83 ± 0.01	0.84 ± 0.01

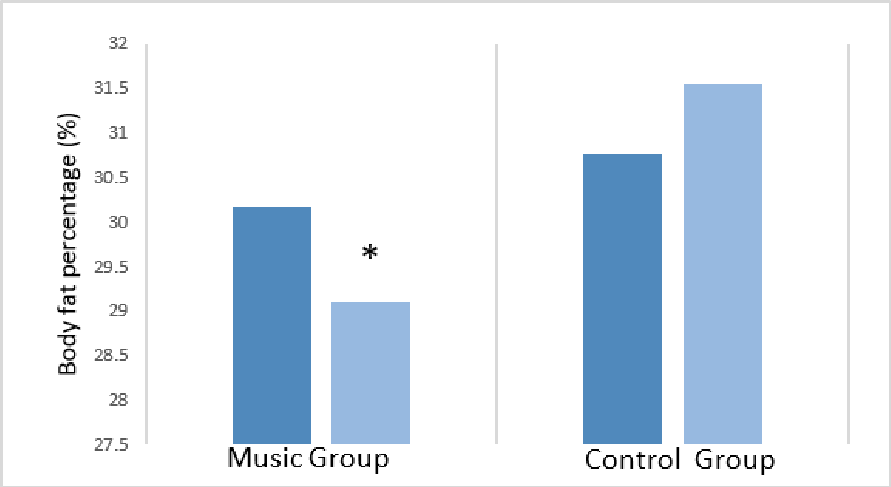

Figure 1: Mean±SD body fat percentage before and after the intervention. The (*) symbol indicates a statistically significant difference ($p < 0.05$).

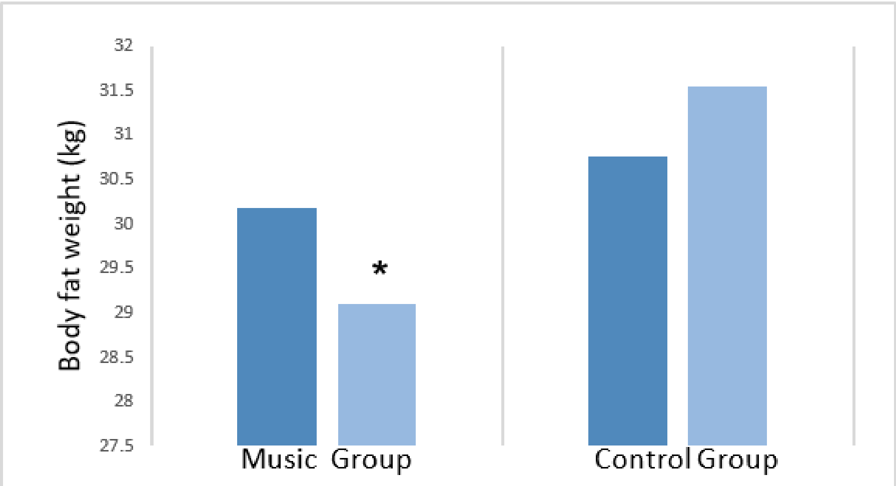

Figure 2: Mean ±SD fat weight before and after the intervention

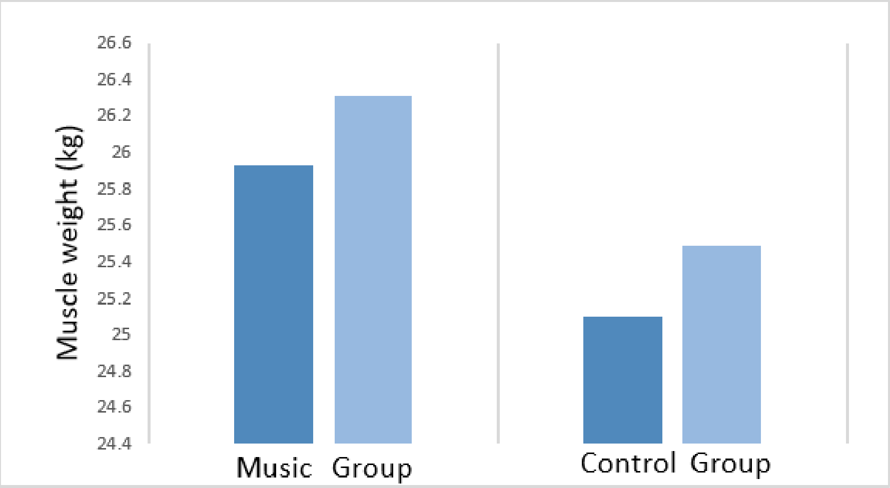

Figure 3: Mean ±SD lean body mass before and after the intervention. The (*) symbol indicates a statistically significant difference ($p < 0.05$).

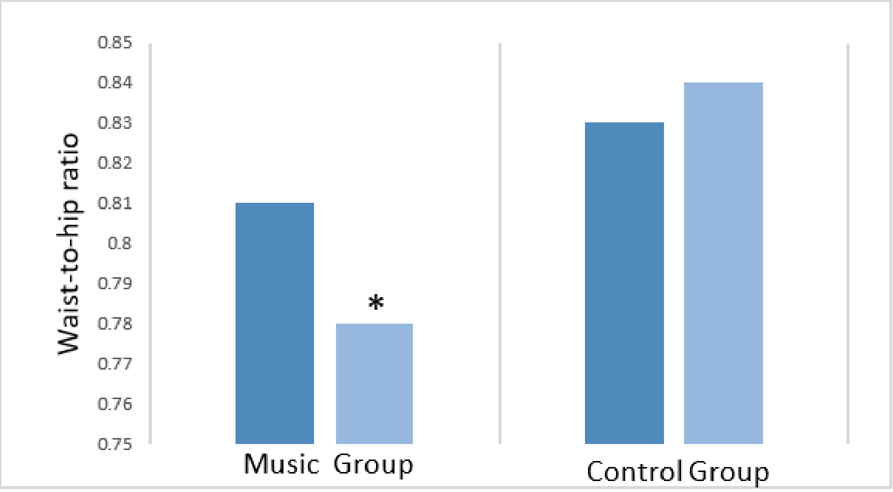

Figure 4: Mean±SD waist-to-hip ratio before and after the intervention. The (*) symbol indicates a statistically significant difference ($p < 0.05$).

Discussion

The present study indicates that adding metronome-synchronised music (128 bpm) to a standardised resistance-training programme in overweight young women produced greater improvements in overall adiposity and central body-composition markers than performing the same programme without music. Specifically, the music condition showed a clearer reduction in body fat percentage and a significant decrease in waist-to-hip ratio (WHR), whereas lean mass did not increase significantly relative to control. Taken together, these findings suggest that rhythmic auditory cueing may not merely enhance the exercise experience, but can also strengthen the body-composition benefits of a structured training programme in this population (Karageorghis et al., 2025).

From a physiological perspective, improvements in adiposity indices are consistent with the established role of exercise as a non-pharmacological strategy for improving metabolic health and cardiometabolic risk factors. Moderate-to-vigorous exercise interventions have been linked to favourable changes in metabolic biomarkers (including inflammatory mediators) and broader cardiometabolic profiles, which, over time support reductions in fat mass (Makiel et al., 2023; Merawati et al., 2023). Moreover, in overweight and obese individuals, resistance-based interventions are generally associated with meaningful benefits for body composition (fat mass reduction, preservation of lean mass, and strength gains), although the magnitude of lean-mass change depends on training variables such as load, volume, and modality (Binmahfoz et al., 2025; Liu et al., 2022). In our trial, the absence of a significant between-group difference in lean mass may therefore reflect the *moderate intensity, time-limited sessions, and circuit-style structure* of the protocol, which can be sufficient for fat-loss improvements but not always optimal for hypertrophy, especially when dietary protein intake and progressive overload are not tightly controlled (Liu et al., 2022).

A key interpretive question is why rhythmic music would preferentially enhance fat-loss and central adiposity markers. Contemporary evidence increasingly supports the idea that music can improve the *affective and perceptual* experience of exercise making training feel more pleasant, more sustainable, and in some cases more productive. For example, controlled work on HIIT indicates that music can meaningfully improve the perceived pleasantness of demanding sessions, which can be consequential for adherence and training quality over time. Broader syntheses also suggest that music can influence psycho-physiological responses around exercise performance (e.g., perceived exertion, affective state, and performance-related outcomes), supporting the plausibility of a pathway in which participants maintain more consistent rhythm, accumulate more effective work, or tolerate training better when rhythmic cues are present.(Delleli et al., 2023) In parallel, cadence- and rhythm-entrainment research shows that humans naturally align repetitive movement patterns with external auditory tempo, providing a mechanistic basis for improved movement regularity and potentially improved session quality when participants are intentionally synchronised to a beat.(Van Dyck et al., 2015b)

Our findings on WHR are also relevant to the long-standing debate about regional ("spot") reduction. The prevailing view is that fat loss is largely systemic; however, recent evidence suggests that region-specific changes can occur under certain conditions, depending on exercise selection, muscle recruitment patterns, and the nature of the training stimulus. Mixed endurance–strength circuit training has been examined explicitly in the context of "spot reduction," with some evidence of regional changes in fat thickness following targeted protocols.(Paoli et al., 2021) More directly, a recent randomised controlled trial reported outcomes consistent with the existence of spot-reduction effects in the trunk region under specific abdominal endurance conditions, reinforcing the possibility that *regional adaptations* may be detectable even when overall weight change is modest.(Brobakken et al., 2023) In the present study, WHR served as a practical marker of central adiposity, but it cannot distinguish visceral from subcutaneous abdominal fat. Therefore, the most defensible interpretation is that metronome-synchronised training improved a clinically relevant marker of central fat distribution, while the underlying anatomical compartment(s) of change remain to be confirmed with higher-resolution methods (e.g., DEXA, MRI).(Brobakken et al., 2023; Paoli et al., 2021) It is also important to interpret the “music advantage” with nuance. Not all engagement with music is beneficial: observational evidence suggests that using music primarily as a mood regulator in daily life can be associated with *unfavourable* health and fitness outcomes among overweight adults, implying that context, motivation, and behavioural patterns matter.(Ginström et al., 2025) In our design, music was employed as a structured rhythmic cue (metronomic tempo) embedded within supervised training, which likely differs substantially from passive or compensatory music use in everyday sedentary contexts. Additionally, emerging resistance-exercise research continues to investigate how music interacts with other performance supports (e.g., augmented feedback) and whether such combinations alter mechanical performance, highlighting that the performance consequences of music may depend on how it is implemented.(Miras-Moreno et al., 2025) Collectively, these considerations support the interpretation that purposeful, rhythm-matched music may be most beneficial when it functions as a training aid (entrainment and pacing), rather than solely as a background stimulus.

Despite the promising results, several methodological considerations should be acknowledged when interpreting the findings. The sample size was relatively small and limited to overweight young women, which may restrict generalisability to other age groups, men, or individuals with different training status. Central adiposity was inferred from anthropometric indices rather than direct imaging of regional fat compartments; therefore, the present data cannot determine whether changes primarily reflect subcutaneous versus visceral fat adaptations. In addition, dietary intake and non-protocol physical activity were monitored largely through self-report and instructions to maintain habitual behaviour, so residual confounding cannot be fully excluded. Finally, the intervention duration and the moderate-intensity circuit structure may have been insufficient to elicit pronounced between-group differences in lean mass. Future studies should employ larger samples, longer follow-up periods, objective monitoring of lifestyle factors, and more precise body-composition methods to clarify the mechanisms and robustness of rhythm-synchronised training effects.

Conclusion

In conclusion, synchronising resistance training with metronome-paced rhythmic music (128 bpm) was associated with more favourable changes in body fat percentage and a central adiposity marker (waist-to-hip ratio) than performing the same training without music in overweight young women. The intervention resulted in a significant reduction in total body fat percentage and a favourable change in WHR, whereas changes in lean body mass were not significantly different between groups. These findings suggest that rhythmic auditory cueing may be a practical and low-cost strategy to enhance selected outcomes of structured resistance-training programmes, particularly those related to adiposity indices. Incorporating tempo-matched music into supervised exercise may potentially support pacing and movement regularity and thereby contribute to improved fat-related outcomes. Further research using larger samples and more precise regional fat assessment is recommended to confirm these effects and clarify underlying mechanisms.

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Conflicts of Interest:

There are no conflicts of interest.

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