

EFFECT OF AN 8-WEEK STEP AEROBIC PROGRAMME ON BODY MASS INDEX AND FLEXIBILITY OF OVERWEIGHT FEMALE STUDENTS IN ZARIA, NIGERIA

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ABSTRACT

The increasing prevalence of overweight and obesity among adolescents has become a global health concern, often leading to reduced physical fitness and flexibility. This study assessed the effect of an eight-week step aerobic programme on the body composition and flexibility of overweight female students in Zaria, Nigeria. A pre-test, post-test experimental research design was adopted, involving a purposive sample size of 18 overweight female students from Vital Years College, Grace Land, Zaria housing a population of 102 female students. The intervention consisted of step aerobic sessions held three times weekly on alternate days, following a progressive overload principle with intensities ranging from 50% to 80% of maximum heart rate. Data collection utilized a stadiometer and digital weight scale for Body Mass Index (BMI) calculation and a sit-and-reach box to measure flexibility. Statistical analysis was performed using descriptive statistics of mean, standard deviation, mean difference and the student t-test for dependent samples at a 0.05 alpha level of significance. Results indicated significant $P < 0.05$ improvements in all the physiological adaptations following the intervention. Specifically, the programme had a significant $p < 0.01$ effect on reducing BMI and a significant $p < 0.01$ improvement in participants' flexibility. Consequently, the null hypotheses stating that there is no significant effect of an eight-week step aerobic programme on the body composition and flexibility of overweight female students in Zaria were rejected. The study concludes that structured step aerobics is an effective school-based intervention for managing overweight status and improving body flexibility for physical performance among female students.

Keywords: step aerobics, body composition, flexibility, overweight, female students, BMI, secondary school.

Introduction

The rising prevalence of overweight and obesity among school-aged adolescents has become a significant global public health concern. Sedentary lifestyles, characterized by prolonged screen time and a decline in physical activity, have contributed to unfavourable changes in body composition and a reduction in physical fitness components like flexibility (Watts, *et.al.*, 2018). In Nigeria, particularly in urban areas, these trends are increasingly evident among female secondary school students, who often face unique socio-cultural barriers to engaging in regular outdoor sports or strenuous exercise (Kansra *et al.* 2021).

Body composition, specifically the ratio of fat mass to lean muscle mass, is a critical indicator of health. Excessive body fat in female adolescents is linked to various long-term risks, including cardiovascular diseases, metabolic syndrome, and musculoskeletal issues (García-Hermoso, *et.al.*, 2024). Furthermore, flexibility the ability of a joint or series of joints to move through an unrestricted, pain-free range of motion is often compromised in overweight individuals (Stoner, *et.al.*, 2016). Reduced flexibility can lead to poor posture, increased risk of injury, and decreased efficiency in performing daily tasks (Frontiers, 2025).

Physical education and structured exercise programs are essential interventions for managing body weight and improving physical health. Among various modalities, step aerobics has emerged as a popular and effective aerobic intervention (Visser, *et.al.*, 2019). It involves rhythmic movements performed on a raised platform (step), combining cardiovascular conditioning with lower-body strength and flexibility training. Step aerobics is particularly suitable for a school environment as it is space-efficient, can be performed indoors, and can be easily adapted to different fitness levels (Špirtović, *et.al.*, 2023).

Despite the known benefits of physical activity, many female students remain physically inactive, leading to an increase in overweight status and a decline in functional flexibility (Swift *et.al.*, 2018). While many studies have explored general aerobic exercises, there is limited empirical data specifically assessing how a structured, eight-week step aerobic programme affects the body composition and flexibility of overweight female students. In this specific geographical and demographic context, this study seeks to bridge that gap by evaluating the physiological adaptations resulting from eight-week step aerobic programme among female students.

Purpose of the Study

The primary purpose of this study is to assess the effect of an eight-week step aerobic programme on the body composition and flexibility of overweight female secondary school students in Zaria, Nigeria. Specifically, the study aims to:

1. Determine the changes in body composition (BMI) following the eight-week intervention.
2. Evaluate the improvement in flexibility (via the sit-and-reach test) after the eight-week intervention.
3. Compare the pre-test and post-test results to establish the level of adaptation.

Research Questions

- i. What is the mean difference between an eight-week step aerobic programme on the body composition of overweight female secondary school students in Zaria?
- ii. What is the effect of an eight-week step aerobic programme on the flexibility of overweight female secondary school students in Zaria?

Hypotheses

- a. There is no significant effect of an eight-week step aerobic programme on the body composition of overweight female students in Zaria.

- b. There is no significant effect of an eight-week step aerobic programme on the flexibility of overweight female students in Zaria.

Methodology

The researchers employed a pre-test and post-test experimental design; Baseline measurements of body composition and flexibility were taken before the intervention. The eight-week step aerobic programme was administered. The same measurements were taken after the eight weeks. 8 weeks Step-aerobic programme on three alternate days a week was conducted involving overweight female students of Vital Years College, Grace Land, Zaria. A purposive sampling technique was used to select participants. Students were screened using Body Mass Index (BMI), only those with a BMI falling within the "overweight" category for their age/sex (85th to 95th percentile) were invited to participate. Twenty (20) female overweight students whose BMI range between 85th to 95th percentile used as sample for this study however, 'Two participants withdrew from the study, one due to illness and one for personal reasons, leaving a final sample of eighteen (18) for analysis. Body composition and flexibility measurements were taken at baseline and after 8 weeks of step-aerobic. Sit-and-Reach was used to measure the Flexibility of the lower back and hamstring muscles. The Body Mass Index (BMI) was used as an index of body composition, a digital Weighing Scale and Stadiometer were used to determine weight and height of participants to determine the BMI of participants. Talk test was used to monitor the intensity of the training programme. The descriptive statistics of means and standard deviation were used to analyse the physical characteristics of participants. The Student t-test for dependent sample was used to find significant differences between Pre and post test data of the variables. Decision to reject or retain the null hypotheses was at 0.05 alpha level.

Instrumentation

To ensure the result of this study is scientifically valid, the following standardized tools were used:

- i. Stadiometer and Digital Scale: To measure height (m) and weight (kg) for BMI calculation: BMI was calculated by dividing weight by the square of height (in meters). After measuring the height and weight of the participants in that sequence, the body mass index was determined and documented in both the pre-test and post-test
- ii. Sit-and-Reach Box: To measure the Flexibility of the lower back and hamstring muscles: To start the test, the subject sits barefoot on the floor in front of the flexibility box with his legs stretched forward. The knees should be straight and stretched and the distance between the feet should be 10 cm. The soles of the feet should also be flat and the heels should stick to the box. To perform the test, the hands are brought straight forward, and then the subject bends forward and pushes the box forward as far as possible with the tips of the index fingers. The subject has the right to bend and straighten his body a maximum of 4 times, and in the last time, he must hold his position at the maximum stretch for 1 to 2 seconds. The subject's score is the farthest point that was obtained in the last time of elongation in centimeters.
- iii. MP3 player used for music

The Intervention Programme (Step Aerobic)

A step aerobic programme is a high-intensity, low-impact rhythmic exercise performed using a raised platform. It combines cardiovascular conditioning with muscle endurance and coordination training (Kennedy-Armbruster & Yoke, 2014). Step aerobics programme was conducted as follows:

The central feature was a rectangular platform, typically between 23 cm-25cm high. The height could be adjusted using "risers" to increase or decrease the intensity of the workout. Higher steps require more energy expenditure and greater muscle activation.

Core Movements and Patterns of Step-aerobics

The exercise consists of choreographed stepping patterns synchronized to upbeat music of 120–135 BPM. Basic Step was stepping up with one foot, up with the other down in a V-Step that is, stepping wide onto the corners of the step and back to the centre with a repeater knee, stepping up and lifting the opposite knee multiple times before stepping down (Adamu & Mohammed, 2020).

Safety and Form

To prevent injury, especially in a school-based setting, certain technical "cues" adopted from, American Council on Exercise, (2018) were applied, the participants were guided to ensure that, the entire sole of the foot was placed on the step to avoid Achilles tendon strain, keeping the back straight, chest up, and shoulders relaxed and then stepping down softly to minimize impact on the joints.

Training Programme

This programme was designed to follow a progressive overload principle, gradually increasing the intensity and complexity of the routines to ensure physical adaptation in body composition and flexibility.

Stage 1. Warm-up (10 Minutes): was to increase core temperature and prepare joints for the stepping activity. The warm up includes activities such as marching in place, shoulder rolls, and dynamic stretches like leg swings, torso twists.

Stage 2. Main Step Aerobic Phase (30–40 Minutes) at weeks 1-2: participants focused on the "Basic Step" and "V-Step." Keep the platform at 4 inches. At weeks 3-5: participants were introduced to "Knee Lifts" and "Hamstring Curls" while stepping. The platform was Increase from 4 to 6 inches for those comfortable. At weeks 6-8: the programme was incorporated with "Power Moves" of light hops onto the step and lateral movements to engage the inner/outer thighs and improve hip mobility.

Stage 3. Flexibility & Cool-down (10–15 Minutes) Static Stretching: the participants holds each stretch for 20 – 30 seconds. The target muscles were the Hamstrings: the participants Sited forward fold (similar to the sit-and-reach test position). Step-edge stretch (dropping the heel off the back of the step). Lunges with the back knee down and Cat-cow stretches or child's pose were involved. Summary of the training schedule is shown in the table 1 below:

Table 1. Training Schedule

Week	Intensity (% of Max HR)	Duration	Focus Areas
1–2	50% – 60%	30 mins	Basic stepping techniques, posture, and rhythmic coordinat ion.
3–4	60% – 70%	40 mins	Increasing step height (risers) and adding arm movements to boost caloric burn.
5–7	70% – 80%	50 mins	High-intensity intervals, complex choreography (L-steps, repeaters), and extended cool-downs for flexibility.
8	65% – 70%	45 mins	Consolidating gains and preparing for post-test measurements.

Physiological Benefits of the core movement of Step-aerobics

According to Sadaqa, (2023) the following are the physiological merits derived from participating in step-aerobic core movements:

Cardiovascular Health: By maintaining a target heart rate for 30-60 minutes, it strengthens the heart and lungs, making it highly effective for burning calories and improving body composition.

Lower Body Toning: Constant stepping targets the glutes, hamstrings, quadriceps, and calves.

Flexibility: Because the movements require a full range of motion at the hip, knee, and ankle joints, consistent practice leads to improved joint mobility and muscle elasticity.

Coordination: The rhythmic nature of the choreography improves neuromuscular timing and balance (Sadaqa, 2023).

Result

Eighteen (18) overweight female students participated in the step aerobics training for duration of 8 weeks. The Training was conducted on three alternate days per week. Information on the physical characteristics (age, and BMI) of the subjects used in this study is presented in the table below.

Table 2. Physical Characteristics of Participants before intervention

Variable	Mean	SD	SE
Age (yrs)	18.89	1.08	0.25
BMI (kg/m ²)	27.68	1.02	0.24

Note: N = 18

Table 2 showed that the mean age of the participants was 18.89±1.08 years and BMI of 27.69±1.02kg/m². An observation of the BMI classification revealed that the participants were overweight (25.00 -29.99kg/m²). Standard Deviation indicates that most participants' scores are clustered closely around the mean, this shows the group is relatively uniform in their physical characteristics. The low standard error suggests that the sample mean is a reliable estimate of the average BMI and age for the larger population from which these participants were drawn.

Table: 3. Analysis of Mean difference of BMI of participants Before and After step aerobic training

Variable	Mean after	Mean before	Mean difference
BMI (kg/m ²)	25.71	27.68	-1.97

Note: N = 18

Answering Research Questions

1. What is the Mean difference of BMI of participants Before and After the step aerobics training?

Table 3 revealed that, there was a mean difference of -1.97 kg/ m² between the mean BMI of 25.71 kg/m² and mean BMI of 27.68 kg/ m², the negative sign indicates a significant reduction of -1.97 kg/ m² in the body composition of the participants.

Table: 4. Analysis of Mean difference of Flexibility of participants Before and After step aerobics training

Variable	Mean after	Mean before	Mean difference
Sit and Reach (cm)	36.44	28.93	7.51

Note: N = 18

2. What is the Mean difference of seat and reach (flexibility) of participants before and after the step aerobics training?

Table 4. revealed that, there was a mean difference of 7.51 between the seat and reach mean of 36.44 cm and the seat and reach mean of 28.93 cm, indicating a significant increase of 7.51 cm in the flexibility of the participants.

Hypotheses Testing

Baseline measurements of body composition and flexibility were taken before the intervention, after which the eight-week step aerobic programme was administered, upon the completion of the eight weeks intervention, the same measurements were taken again to assess if there were adaptations.

Hypothesis 1: There is no significant effect of an eight-week step aerobic programme on the body composition of overweight female secondary school students in Zaria.

Table 5: Paired t-test analysis of the pre and post test score of BMI of the participants

Variable	Test Period	Mean	SD	DF	MD	t	P
BMI	Pre test	27.68	1.05	17	- 1.97	7.65	0.01
	Post test	25.71	0.81				

$N = 18, t(33) = 2.021 \quad p < 0.05$

The results on table 5 showed the paired t-test analysis of the pretest-post test scores of the BMI of the participants. An observation of the result in table 3 showed that 8 weeks of step aerobics had significant decrease on the BMI of the participants ($t = 7.65, p < 0.05$). Therefore, the null hypothesis which states that there is no significant effect of an eight-week step aerobic programme on the body composition of overweight female secondary school students in Zaria. was rejected.

Hypothesis 2: There is no significant effect of an eight-week step aerobic programme on the flexibility of overweight female secondary school students in Zaria.

Table 6: Paired t-test analysis of the pre and post test score of flexibility of the participants

Variable	Test Period	Mean	SD	DF	MD	t	P
Sit and Reach	Pre test	28.93	1.34	17	7.51	15.82	0.01
	Post test	36.44	1.83				

$N = 18, (t) = 15.82 \quad P < 0.05$

The results on table 6 revealed the paired t-test analysis of the pretest-posttest scores of the flexibility of the participants.

An observation of the results on table 6 showed that 8 weeks of step aerobics had significant increase in the flexibility of the participants ($t = 15.82, p < 0.05$). Therefore, the null hypothesis which states that, there is no significant effect of an eight-week step aerobic programme on the flexibility of overweight female secondary school students in Zaria was rejected.

To provide a comprehensive analysis of how the BMI reductions relate to the improved flexibility is shown by comparing the two datasets: Body mass index is an index of body composition. The mean BMI dropped from 27.68 kg/m² to 25.71 kg/ m², with a significant reduction of 1.97 kg/ m². Sit and Reach is an index of flexibility. The mean Sit and Reach score improved from 28.93 cm to 36.44 cm, with a significant increase of 7.51 cm. In sports science, a reduction in body mass (BMI)

often correlates with improved range of motion (flexibility), as there is less physical obstruction and improved muscle efficiency.

Statistical Summary

Table 7. Combines the key findings from BMI and flexibility data collections:

Variable	Pretest (Mean)	Post-test (Mean)	Mean Diff	p-value	Interpretation
BMI (kg/m ²)	27.68	25.71	-1.97	< 0.01	Significant Decrease
Seat and reach (cm)	28.93	36.44	+7.51	< 0.01	Significant Increase

Final Research Interpretation

The intervention was highly effective, as 100% of participants improved their flexibility scores, and 100% reduced their BMI. The group moved from a "Poor" flexibility rating to an "Average/Good" rating while simultaneously moving closer to a "Normal" BMI range.

Discussion

The findings indicate a significant reduction in BMI with an increase in flexibility among female students during the post-intervention period. Recent studies of (Ojediran & Odunaiya, 2013, Špirtović *et.al.*, 2023, Lee, *et.al.*, 2025, Špirtović, *et.al.*, 2025, Frontiers, 2025, Jones, *et.al.* 2025 and Nikita, *et.al.* 2026), evaluating "aerobics" protocols (combining high-impact moves with rhythmic transitions) found that participants improved their body composition changes alongside flexibility scores. This is attributed to the multi-planar movements required in choreographed aerobic routines, indicating that participating in step-aerobics training significantly reduces body fat and increase body flexibility in overweight females. The findings show that the exercise training outlined in this research resulted in a ($p < 0.05$) significant decreases in BMI and and increased seat and reach (flexibility) indicating that engaging in step-aerobic exercise can facilitate favourable alterations in body composition without the need for calorie limitations. This outcome could be attributed to the elevated levels of free fatty acids (↑FFA) present in individuals with surplus adiposity, which can be readily utilized during physical activities.

The finding of a significant ($p < 0.05$) reduction in BMI in the present study is verified by several previous studies focusing on female populations. The results of this present study mirror the findings of Špirtović *et al.* (2023), who recorded a 2.5% reduction in BMI among young women. This suggests that the 8-week duration is a sufficient tipping point for observable metabolic changes. The significant drop in BMI aligns with Obembe and Akinbo (2019), who observed a mean reduction from 33.00 kg/m² to 29.45 kg/m². This supports the narrative that step aerobics is not just for general fitness but is a viable clinical intervention for weight management. The significant differences noted in the present study ($p < 0.05$) are further validated by Ojediran and Odunaiya (2013) and Adamu & Mohammed (2020), both of whom reported significant training effects on body mass index and visceral fat after 8 weeks of aerobic engagement.

The significant improvement observed in the present study on the sit and seach test is a recurring theme in aerobic training research, particularly for female students. 8-week results are consistent with Nikita *et al.* (2026), who found significant sit and reach improvements in as little as 6 weeks. This suggests that while flexibility gains begin early, they are sustained and potentially compounded by the 8-week mark. The significant improvement in your experimental group aligns perfectly with Ngwakwe *et al.* (2025), whose study of 80 female adolescents also showed mean flexibility improvements significantly higher than those of a control group ($p < 0.05$). Interestingly,

Jones et al. (2025) noted that flexibility is a motivator for women choosing this training. The present data provides the empirical proof that justifies this preference, showing that the choice to use step aerobics for flexibility is evidence-based.

Beyond simple measurements, the improvements recorded on body flexibility contribute to the improvement of female physical fitness and is in agreement to the study of in *Frontiers in Endocrinology* (2025) who suggests that the BMI changes observed may be linked to improved metabolic flexibility. This implies that participants' bodies have become better at switching between fuel sources (carbohydrates and fats) during and after exercise. The results align with studies ranging from adolescents (Ngwakwe et al. 2025) to middle-aged females (*Frontiers* 2025), it confirms that step aerobics is an effective intervention across the female lifespan.

The mechanisms that led to a reduction in the body mass were physical exercises (step-aerobics), increasing energy consumption, and with it, a reduction in body mass, which was not compensated by increased calorie intake Mitić & Gušić, (2018). The increase in body flexibility through activities like step aerobics is the result of several physiological and neuromuscular adaptations (McArdle *et.al* 2022). A study by Nikita et al., (2026) suggests that even short-term aerobic interventions can counteract the typical physical decline and stiffness associated with menopause.

Conclusion

This study reinforces the established consensus that an 8-week step aerobics intervention is a potent tool for improving the physical profile of female students. The statistical significance ($p < 0.05$) across both BMI and flexibility parameters places your research in direct agreement with contemporary studies, confirming that the intervention effectively addresses both body composition and musculoskeletal health.

Recommendation

Based on the findings of this study, the researchers recommended that:

- i. Physical Education teachers should incorporate step-aerobics activity in the Physical Education programme for school age females to improve their body composition.
- ii. Female students should regularly engage in step aerobics programme to increase the level of body flexibility.

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