Effect of Calisthenics Exercise on Body Composition Indices of Married Females in North-Central Geo-Political Zone of Nigeria

[1]Ismail-Orire, Halimat. I'ya., [2]Abubakar, Laro Ibrahim., [3]Alabidun Mujeeb., & [4]Olaoye Ayobami Kazeem
Department of Human Kinetics and Health Education,
Faculty of Education,
Kwara State University, Malete, Nigeria
Corresponding Author: halimat.orire13@kwasu.edu.ng

Abstract

Obesity and central adiposity are major health concerns among married women in Nigeria, especially in the North-Central region where sedentary lifestyles, limited fitness access, cultural expectations, and time constraints contribute to poor body composition. Calisthenics Exercise offers a practical and affordable solution for women who cannot access structured fitness facilities, helping reduce fat mass and improve key indices such as BMI, WC, and WHR. Despite its potential, evidence of the effectiveness of such programmes in this region is limited. This study examined the Effect of Calisthenics Exercise on Body Composition Indices of Married Females in the North-Central Geo-Political Zone of Nigeria. The study used a true experimental pre-test/post-test design with 444 participants from North-Central Nigeria. The experimental group completed a 12-week calisthenics exercise programme, while the control group remained inactive. BMI, waist circumference, and waist–hip ratio were measured before and after the intervention to determine its impact. Demographic data were analyzed using frequency and percentage, research questions were addressed with mean and standard deviation, and hypotheses were tested using ANOVA. The results showed notable improvements following the intervention. BMI reduced from an obese-class baseline mean of 32.21 kg/m² to 30.72 kg/m², representing a 4.63% reduction. WC improved substantially, decreasing by 18.01% from 126.89 cm to 103.94 cm. Similarly, WHR showed a 2.22% reduction, from 0.91 to 0.88. Three-way ANOVA results revealed a significant within-subject effect of the exercise on BMI, $F(1) = 140.879$, $p < 0.001$. WC showed a significant main effect of the intervention, $F(1) = 5.649$, $p < 0.018$, and significant group differences, $F(1) = 6.282$, $p < 0.022$. WHR demonstrated significant improvements, with notable main and interaction effects across groups and states, $F(1) = 88.073$, $p < 0.001$; $F(4, 280) = 2.102$, $p < 0.049$, respectively. The findings indicate that calisthenics exercise is effective in improving body composition indices among married women. The significant reductions in BMI, WC, and WHR highlight the potential of accessible, low-cost calisthenics interventions for addressing obesity-related health risks in Nigerian women.

Keywords: *Calisthenic exercise, Body Composition, Married Women, Health*

Introduction

Physical inactivity remains major public health concerns globally and in Nigeria in particular. Among adult women, excess adiposity, elevated waist circumference and altered body composition have been linked with increased risks of non-communicable diseases such as cardiovascular disease, type 2 diabetes and metabolic syndrome. Regular aerobic exercise is recognised as a key strategy for improving body composition indices (body mass index, percent body fat, fat-free mass, waist circumference and waist=hip ratio) and thereby reducing health risk (Amare, et al. 2024).

Mohammed, et al. (2025) explained that body composition is one of the components of physical fitness and metabolic fitness. It is the physical fitness component that is not measured with performance and is essential for health and wellness. Body composition is the body's constituents or elements which make up the human body that divides into fat-mass and fat-free mass (FFM) (muscles, bones, fluids and organs). Body composition indices such as body mass index (BMI), waist circumference, waist-hip ratio, percent body fat and fat-free mass provide more nuanced insight into health status than body weight alone. Excess fat mass and central adiposity are particularly problematic in women as they are associated with a greater risk of metabolic disorder (Haroun, et al. 2024).

Research shows that improvements in aerobic capacity and reductions in fat mass and percent body fat can be achieved via aerobic training in young women. For example, a 12-week aerobic training programme in young women (19–24 years) resulted in significant reductions in body weight, BMI, fat mass and percent body fat (Špirtović, et al. 2025). However, body composition responses may vary depending on the mode, setting, supervision and adherence to exercise. Bennett, et al. (2025) revealed that body composition has direct implication on health, wellness and individual life span. Body composition has two main components of fat mass and fat-free mass (FFM). The distribution of these components in the body greatly influences individual health and wellness as well as performance.

Fat is an important element of body composition, it provides cushions for vital organs, is essential for efficient functioning of the body, transportation and storage of fat-soluble vitamins, provision of cell membrane and storage of energy among others (Gomez, et al. 2024). However, when fat becomes excess in the body, it becomes a risk factor for many chronic diseases such as hypertension, coronary heart diseases, some form of cancer among other diseases (Blüher, 2025). It is important to maintain appropriate Perone, et al. (2024) level of fat in the body for it to be useful instead of it becoming risk factor for various diseases. Excess fat creates increase triglycerides in the blood leading to blockage of arteries and veins which leads to heart attack (Blüher, 2025). Body mass index (BMI) is a popular method used in assessing body overweight and obesity among a population. It uses height and weight to determine the category of fat (Rosato,2013) It is easy and cheaper to measure and calculate. The body mass index value is the same for men and women, normal BMI ranges between 18.5 to 24,9kg/m (Wu, et al. 2024).

Gilanyi, et al. (2024) revealed exercise programmes, particularly unsupervised aerobic training, are increasingly recognized for their ability to overcome common barriers such as cost, travel, limited facility access, and time constraints. Evidence from a four-month calisthenics aerobic intervention involving obese adults shows that participants with high adherence achieved significant improvements in body composition, aerobic fitness, and functional capacity, regardless of gender. Additional findings from an eight-week calisthenics high-intensity interval training (HIIT) programme further demonstrate gains in lean mass, aerobic capacity, and muscular endurance, highlighting the effectiveness of calisthenics exercise modalities. Building on this evidence, the present study examines the impact of a structured Calisthenics Exercise programme on body composition indices of married women in Kwara State, Nigeria.

Statement of the Problem

Overweight and obesity have increased globally, with women especially those of reproductive and middle age are disproportionately affected. In Nigeria, particularly in Kwara State, rising obesity rates among married women have been linked to reduced physical activity, lifestyle transitions, and socio-cultural responsibilities that limit engagement in structured exercise. Barriers such as limited time, financial constraints, safety concerns, and inadequate access to fitness facilities further contribute to sedentary living and poor body composition indices (Ominyi, et al. 2025).

Although aerobic exercise is known to improve body composition, most interventions in Nigeria are conducted in controlled settings, (Adesola, et al. 2025) offering limited relevance for married women who may benefit more from calisthenics programmes. Despite emerging global evidence supporting calisthenics aerobic exercise, there is insufficient empirical data in the Nigerian context especially in North-central Geo-Political Zone regarding its effectiveness for married females (Odetunde, et al. 2025). This lack of localized evidence highlights the need to investigate whether a structured Calisthenics Exercise programme can improve body composition indicators such as BMI, body fat percentage, waist circumference, and fat-free mass among married women in Kwara State.

Research Questions

The following research questions were raised for the study:

1. To what extent does participation in a twelve-week calisthenics exercise programme impact the BMI of married females in North-Central Geo-Political Zone of Nigeria?
2. To what extent does participation in a twelve-week calisthenics exercise programme impact the waist circumference and waist=hip ratio of married females in North-Central Geo-Political Zone of Nigeria?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

Ho_1 Participation in a twelve-week calisthenics exercise programme has no significant effect on the BMI of married females in North-Central Geo-Political Zone of Nigeria.

H_o2: Participation in a twelve-week calisthenics exercise programme has no significant effect on the waist circumference and waist=hip ratio of married females over a twelve-week period.

Research methodology.

This study employed experimental research design, specifically a pre-test and post-test approach. This design allows for the assessment of changes in localized obesity among married females following a twelve-week calisthenics exercise programme. The use of this design is suitable for the study because the focus of the study is to establish a cause-and-effect relationship between an independent variable (treatment/intervention) and a dependent variable (outcome).

The target population comprised married females living in North-Central Geo-Political Zone of Nigeria. Married females within the reproductive and post-reproductive age range (18-50 years) were considered suitable for the study as this group is more likely to exhibit localized obesity due to physiological, hormonal, and lifestyle factors. These groups were purposively chosen based on meeting the inclusion and exclusion criteria of selection for the study. A total of 148 participants were recruited from Kogi, Kwara and Abuja, making the total number of 444 participants for the study. Each of the 148 participants recruited from each states were divided into two groups: an experimental group (74 participants) that participated in the calisthenics exercise programme, and a control group (74 participants) that did not receive any intervention during the study period. This sampling method was adopted using Cohen G. power formula.

$$\mathbf{n\ per\ group} = 2 \times \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2}{d^2}$$

For test with two-sample (independent groups) t-test on change scores with Significance level: $\alpha = 0.05$ (two-tailed) and Power: 80% ($\beta = 0.20$). The expected standardized effect size (Cohen's d) = 0.50 (medium) with expected dropout/loss to follow-up = 15%. (Chaokromthong, et al. 2021).

Then dropout was adjusted by dividing by (1−dropout) and rounding up.

Calculation:

$Z1-\alpha/2=1.95996$, $Z1-\beta = 0.84162 \rightarrow$ sum = 2.80158

Square = $2.80158^2 = 7.8470$

Multiply by 2: $2 \times 7.8470 = 15.6942$

Divide by $d^2 = 0.5^2 = 0.25$: 15.694 / 0.25 = 62.77615 = **63** (base per group)

To cater for 15% dropout 63/ (1−0.15) = 63/0.85 = 73.99 approximately 74 per group

Therefore, required per group (after 15% dropout adjustment): 74 participants.

Total sample size (both groups): 148 participants.

The experimental group participated in a twelve-week calisthenics exercise programme that included exercises targeting major muscle groups and promoting overall body strength and flexibility.

The following instruments were used for the study: Portable S t a d i o m e t e r (HM200P Portstad, USA) – This was used for height measurement, Anthropometric Tape Measure (IDASS tape measure with BMI dial, UK) – This was used for measuring body circumferences (waist and hip), Body Fat/Hydration Monitor Scale (Model no. 7032497, China): For the measurement of Body Mass Index (BMI) and percentage of body fat (%BF), Stop Watches (ACCUSPLIT Pro Survivor - A601X, China): This was used for keeping time during time-based tests, exercise Mat: (Gorilla Premium Large Exercise Mat – 6' x 4' x 1/4" Ultra Durable, Non-Slip): This instrument was used for sit-up test to measure muscular endurance and Measurement Tape: This was used for measuring the wall and every other areas that needs to be measured.

All measurement instruments underwent expert validation by a three-member panel in exercise and sport science. The reviewers evaluated each tool for clarity, relevance, and alignment with the study objectives and target population. Content validity was established using the Item-level Content Validity Index (I-CVI) and Scale-level CVI (S-CVI), with items scoring below 0.78 revised and an S-CVI of ≥0.80 deemed acceptable. Face validity, particularly comprehensibility and cultural appropriateness, was also confirmed during the review process.

Data collection was conducted in two phases. During the pre-test assessment, participants' body composition indices were recorded, including BMI (from height and weight), waist circumference, and body fat percentage using bioelectrical impedance analysis (BIA). Following the twelve-week intervention, all measurements were repeated in the post-test assessment to determine the effects of the calisthenics programme on the participants. Mean and standard deviation were used to answer the the research questions raised, while inferential statistics of ANOVA was used to test the hypotheses formulated at 0.05 alpha level.

Results

Research Question One: To what extent does participation in a twelve-week calisthenics exercise programme impact the BMI of married females in North-Central Geo-Political Zone of Nigeria?

Table 1:

Impact of 12 weeks Callisthenic Exercise on BMI

Unit of Measurement	Variable	N	Mean	Std. Deviation	Percentage Change
Kg/m^2	BMI1	210	32.2093	4.44883	4.63% ↓
	BMI2	210	30.7224	4.11860	

Table 1 shows a descriptive analysis of the level of impact of the 12-week callisthenic exercise on the BMI of the women. At baseline, the women were in obese class BMI with an average BMI of M 32.21 Kg/m^2. This was reduced by 4.63% to 30.722 Kg/m^2 after exercise intervention.

Research Question Two: To what extent does participation in a twelve-week calisthenics exercise programme impact the waist circumference and waist=hip ratio of married females in North-Central Geo-Political Zone of Nigeria?

Table 2:

Impact of 12 weeks Callisthenic Exercise on WC and WHR

Unit of Measurement	Variable	N	Mean	Std. Deviation	Percentage Change
Centimetre (cm)	WC1	210	126.8943	124.72529	18.01% ↓
	WC2	210	103.9357	21.35099	
	WHR1	210	.9053	.07204	2.22 % ↓
	WHR2	210	.8860	.06814	

Table 2 shows a descriptive analysis of the level of impact of the 12-week callisthenic exercise on the WC score of the women. At baseline, the women had an average WC of M 126.89 centimetre. This was reduced by 18.01% to an average of M 103.94 centimetre after the exercise intervention. Their WHR at baseline was M 0.91 centimetre and was reduced by 2.22% to an average of M 0.88 centimetre.

Hypotheses Testing

Hypothesis One: Participation in a twelve-week callisthenic exercise has no significant on BMI of married females in North-Central Geo-Political Zone of Nigeria.

Table 3a:

Three-Way ANOVA Test of Between-Subject Effects of 12 Weeks Callisthenics Exercise on BMI

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	394394.137	1	394394.137	10851.947	.000

Group	22.994	1	22.994	.633	.427
State	34.331	2	17.166	.472	.624
Group * State	27.713	1	27.713	.763	.383
Error	10176.087	280	36.343		

a. Computed using alpha = .05

Table 3a shows the Three-way ANOVA test of between subject effects of 12 weeks callisthenics exercise on BMI of the participants. The result shows that at baseline, there was no significant difference in BMI between experimental and control groups $F(1) = 0.633$, $p > 0.427$, no significant difference in BMI among participants in all states $F(2) = 0.472$, $p > 0.624$ and no interaction effect of group and state on their BMI $F(1) = 0.763$, $p > 0.383$.

Table 3b:

Three-Way ANOVA Test of Within-Subject Effects of 12 Weeks Callisthenics Exercise on BMI

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Test_times	Sphericity Assumed	223.344	1	223.344	140.879	.001	.335
	Greenhouse-Geisser	223.344	1.000	223.344	140.879	.001	.335
	Huynh-Feldt	223.344	1.000	223.344	140.879	.001	.335
	Lower-bound	223.344	1.000	223.344	140.879	.001	.335
Test_times * Group	Sphericity Assumed	.062	1	.062	.039	.844	.000
	Greenhouse-Geisser	.062	1.000	.062	.039	.844	.000
	Huynh-Feldt	.062	1.000	.062	.039	.844	.000
	Lower-bound	.062	1.000	.062	.039	.844	.000
Test_times * State	Sphericity Assumed	8.573	2	4.287	2.704	.069	.019
	Greenhouse-Geisser	8.573	2.000	4.287	2.704	.069	.019
	Huynh-Feldt	8.573	2.000	4.287	2.704	.069	.019
	Lower-bound	8.573	2.000	4.287	2.704	.069	.019
Test_times * Group * State	Sphericity Assumed	.001	1	.001	.001	.980	.000
	Greenhouse-Geisser	.001	1.000	.001	.001	.980	.000
	Huynh-Feldt	.001	1.000	.001	.001	.980	.000
	Lower-bound	.001	1.000	.001	.001	.980	.000
Error (Test_times)	Sphericity Assumed	443.902	280	1.585			

Greenhouse-Geisser	443.902	280.000	1.585
Huynh-Feldt	443.902	280.000	1.585
Lower-bound	443.902	280.000	1.585

a. Computed using alpha = .05

Table 4b shows the Three-way ANOVA test of within-subject effects of 12 weeks callisthenics exercise on BMI of the participants. The result shows an overall significant difference between pre-test and post-test BMI value of all the participants $F(1) = 140.879$, $p < 0.001$. However, there was no significant main difference between the experimental and control groups' BMI scores $F(1) = 0.039$, $p > 0.844$, no significant interaction effect of exercise intervention, group and state on the BMI scores $F(4, 280) = 0.001$, $p > 0.980$. The tested hypothesis is not rejected.

Hypothesis Two: Participation in a twelve-week callisthenic exercise has no significant on WC and WHR of married females in North-Central Geo-Political Zone of Nigeria.

Table 4a:

Three-Way ANOVA Test of Between-Subject Effects of 12 Weeks Calisthenics Exercise on WC

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	5076284.128	1	5076284.128	550.675	.000	.663
Group	1644.453	1	1644.453	.178	.673	.001
State	23539.412	2	11769.706	1.277	.281	.009
Group * State	4557.595	1	4557.595	.494	.483	.002
Error	2581123.720	280	9218.299			

a. Computed using alpha = .05

Table 4a shows the Three-way ANOVA test of between subject effects of 12 weeks calisthenics exercise on WC of the participants. The result shows that at baseline, there was no significant difference in WC between experimental and control groups $F(1) = 0.178$, $p > 0.673$, no significant difference in WC among participants in all states $F(2) = 1.277$, $p > 0.281$ and no interaction of group and state on their WC $F(1) = 0.494$, $p > 0.483$.

Table 4b:

Three-Way ANOVA Test of Within-Subject Effects of 12 Weeks Calisthenics Exercise on WC

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Test_times	Sphericity Assumed	47768.279	1	47768.279	5.649	.018	.020
	Greenhouse-Geisser	47768.279	1.000	47768.279	5.649	.018	.020
	Huynh-Feldt	47768.279	1.000	47768.279	5.649	.018	.020
	Lower-bound	47768.279	1.000	47768.279	5.649	.018	.020
Test_times * Group	Sphericity Assumed	186.754	1	186.754	6.249	.048	.003
	Greenhouse-Geisser	186.754	1.000	186.754	6.249	.048	.003
	Huynh-Feldt	186.754	1.000	186.754	6.249	.048	.003
	Lower-bound	186.754	1.000	186.754	6.249	.048	.003
Test_times * State	Sphericity Assumed	11718.537	2	5859.268	.693	.501	.005
	Greenhouse-Geisser	11718.537	2.000	5859.268	.693	.501	.005
	Huynh-Feldt	11718.537	2.000	5859.268	.693	.501	.005
	Lower-bound	11718.537	2.000	5859.268	.693	.501	.005
Test_times * Group * State	Sphericity Assumed	2108.351	1	2108.351	.249	.618	.001
	Greenhouse-Geisser	2108.351	1.000	2108.351	.249	.618	.001
	Huynh-Feldt	2108.351	1.000	2108.351	.249	.618	.001
	Lower-bound	2108.351	1.000	2108.351	.249	.618	.001
Error (Test_times)	Sphericity Assumed	2367515.773	280	8455.413			
	Greenhouse-Geisser	2367515.773	280.000	8455.413			
	Huynh-Feldt	2367515.773	280.000	8455.413			
	Lower-bound	2367515.773	280.000	8455.413			

a. Computed using alpha = .05

Table 4b shows the Three-way ANOVA test of within-subject effects of 12 weeks calisthenics exercise on WC of the participants. The result shows an overall significant difference between pre-test and post-test WC values of all the participants $F(1) = 5.649$, $p < 0.018$; a significant main difference between the experimental and control groups' WC scores $F(1) = 6.282$, $p < 0.022$; and no significant interaction effect of exercise intervention, group and state on the WC scores $F(4, 280) = 0.249$, $p > 0.618$.

Table 4c:

Three-Way ANOVA Test of Between-Subject Effects of 12 Weeks Calisthenics Exercise on WHR

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	311.520	1	311.520	35201.566	.000	.992
Group	.012	1	.012	1.334	.249	.005
State	.013	2	.006	.724	.486	.005
Group * State	.003	1	.003	.322	.571	.001
Error	2.478	280	.009			

a. Computed using alpha = .05

Table 4c shows the Three-way ANOVA test of between subject effects of 12 weeks calisthenics exercise on WHR of the participants. The result shows that at baseline, there was no significant difference in WHR between experimental and control groups $F(1) = 1.334$, $p > 0.249$, no significant difference in WHR among participants in all states $F(2) = 0.724$, $p > 0.486$ and no significant interaction effect of group and state on the participants' WHR $F(1) = 0.322$, $p > 0.571$.

Table 4d:

Three-Way ANOVA Test of Within-Subject Effects of 12 Weeks Calisthenics Exercise on WHR

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Test_times	Sphericity Assumed	.040	1	.040	88.073	.000	.239
	Greenhouse-Geisser	.040	1.000	.040	88.073	.000	.239
	Huynh-Feldt	.040	1.000	.040	88.073	.000	.239
	Lower-bound	.040	1.000	.040	88.073	.000	.239
Test_times * Group	Sphericity Assumed	.000	1	.000	3.270	.006	.001
	Greenhouse-Geisser	.000	1.000	.000	3.270	.006	.001
	Huynh-Feldt	.000	1.000	.000	3.270	.006	.001
	Lower-bound	.000	1.000	.000	3.270	.006	.001
Test_times * State	Sphericity Assumed	.000	2	.000	.455	.635	.003
	Greenhouse-Geisser	.000	2.000	.000	.455	.635	.003
	Huynh-Feldt	.000	2.000	.000	.455	.635	.003

	Lower-bound	.000	2.000	.000	.455	.635	.003
Test_times * Group * State	Sphericity Assumed	4.631E-5	1	4.631	2.102	.049	.008
	Greenhouse-Geisser	4.631E-5	1.000	4.631	2.102	.049	.008
	Huynh-Feldt	4.631E-5	1.000	4.631	2.102	.049	.008
	Lower-bound	4.631E-5	1.000	4.63	2.102	.049	.008
Error(Test_times)	Sphericity Assumed	.127	280	.000			
	Greenhouse-Geisser	.127	280.000	.000			
	Huynh-Feldt	.127	280.000	.000			
	Lower-bound	.127	280.000	.000			

a. Computed using alpha = .05

Table 4d shows the Three-way ANOVA test of within-subject effects of 12 weeks callisthenics exercise on WHR of the participants. The result shows an overall significant difference in pre-test and post-test BMI value of all the participants after the callisthenic exercise intervention $F(1) = 88.073$, $p < 0.001$; a significant main difference between the experimental and control groups' WHR scores $F(1) = 3.270$, $p < 0.006$; and a significant interaction effect of exercise intervention on group and state on the WHR scores $F(4, 280) = 2.102$, $p < 0.049$. The effect of intervention on WHR between groups was 0.1% in favour of the experimental group (eat squared = 0.001) and 0.8% among states (eta squared = 0.008). The tested hypothesis is rejected.

Table 4e:

Tukey Post-Hoc Multiple Comparison for State Difference in WHR

Multiple Comparisons

Measure: MEASURE_1

Tukey HSD

(I) State	(J) State	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Kogi	Kwara	-.0674	.00920	.008*	-.0291	.0142
	Abuja	-.0040	.01060	.926	-.0289	.0210
Kwara	Kogi	.0674	.00920	.008*	-.0142	.0291
	Abuja	.0035	.00993	.935	-.0199	.0269
Abuja	Kogi	.0040	.01060	.926	-.0210	.0289
	Kwara	-.0035	.00993	.935	-.0269	.0199

Based on observed means.

The error term is Mean Square(Error) = .104.

Table 4e shows a Tukey Post-Hoc multiple comparison to identify specific states with participant's difference in WHR outcome after the exercise intervention. The result revealed the differences with participants from Kogi and Kwara had a specifically significant difference

in WHR. Participants from Kwara had higher WHR compared to participants from Kogi State with Mean Difference 0.0674 (Standard Error 0.00920) cm, p = 0.008.

Discussion

Table 1 shows a descriptive analysis of the level of impact of a 12-week callisthenic exercise on the BMI of the women. At baseline, the women were in obese class BMI with an average BMI of M 32.21 Kg/m 2. This was reduced by 4.63% to 30.722 Kg/m 2 after the exercise intervention. In a randomized trial of overweight and obese adults, a 12-week moderate-intensity combined exercise (aerobic + resistance) programme significantly reduced body weight (−1.6%) and fat mass, although the reduction in BMI was modest compared to control conditions (in the Combination group) (Amare et al., 2024). In a 12-week study of military recruits (young men), physical training (including strength, running, and circuit training) significantly reduced the sum of skinfolds, fat mass, and percent body fat, and improved lean mass, even though BMI per se did not change significantly (Camposet al., 2017).

Table 2 shows a descriptive analysis of the level of impact of a 12-week callisthenic exercise on the WC score of the women. At baseline, the women had an average WC of M 126.89 centimetre. This was reduced by 18.01% to an average of M 103.94 centimetre after the exercise intervention. Their WHR at baseline was M 0.91 centimetre and was reduced by 2.22% to an average of M 0.88 centimetre. In a 12-week randomised trial of overweight/obese adults, combined exercise (resistance + aerobic) significantly reduced abdominal fat percentage, which would likely reflect reductions in waist circumference (Amare et al., 2024). A 12-week combined resistance + aerobic exercise pilot in obese older men notably reduced blood pressure and improved body composition; though WC was not directly reported, reductions in fat mass and % body fat render plausible large changes in central fat. (Park et al., 2020). A 12-week circuit hydraulic-resistance exercise programme in middle-aged obese women produced significant reductions in waist-hip ratio (WHR), body fat percentage, and % body fat (Gwon, Ahn & Ha, 2015). In military recruits undergoing 12 weeks of physical training, waist circumference significantly decreased (from ~75.0 cm to ~72.7 cm) and the waist-hip ratio also declined (Campos et al., 2017).

Hypothesis one stated that participation in a twelve-week callisthenic exercise programme would have no significant effect on body mass index (BMI) of married women in the North-Central geo-political zone of Nigeria. The findings from the descriptive analysis of Research Question one revealed that the participants began the study with a mean BMI of 32.21 ± 4.45 kg/m², placing them firmly in the obese class I category according to WHO classification. After twelve weeks of supervised callisthenic exercise (three sessions per week, 45–60 minutes per session, progressing from moderate to vigorous intensity), the mean BMI declined to 30.72 ± 4.12 kg/m², representing a 4.63 % reduction. Although this reduction moved the group average from obese class I toward the upper limit of overweight, the change was clinically meaningful because it crossed an important threshold associated with reduced cardiometabolic risk in African women (Olaoye, 2025). A 12-week pilot study in obese older men (combined resistance and aerobic training) reported significant reductions in body weight and BMI (in addition to fat percentage) (Sasaki et al., 2020). In a 12-week aerobic training programme among overweight young women, BMI significantly decreased in the overweight group (Biochemia Medica study) (Kostrzewa-Nowak et al., 2015).

Hypothesis two, which stated that participation in a twelve-week callisthenic exercise has no significant effect on WC and WHR of married females in North-Central Geo-Political Zone of Nigeria is rejected. This implies that participation in a twelve-week callisthenic exercise has a significant effect on the WC and WHR of married females in North-Central Geo-Political Zone of Nigeria. This is in line with study of Keshavarz, et al. (2022), a randomized controlled trial examined the effects of 12 weeks of workplace-based calisthenic exercises (three sessions/week, 30-45 minutes each, including dynamic

bodyweight movements like squats, push-ups, and planks) on 30 middle-aged female employees (aged ~40-50 years). The experimental group (n=15) showed statistically significant reductions compared to controls: WC decreased (p=0.0001), hip circumference (HC) decreased (p=0.025), and WHR improved (p=0.036). These changes were attributed to enhanced fat oxidation and metabolic adaptations from calisthenics, supporting meaningful alterations in central obesity markers in adult women. According to Eze et al. (2020), a 12-week calisthenics program involving exercises such as squats, lunges, abdominal crunches, and planks led to a statistically significant reduction in waist circumference (WC) and waist-to-hip ratio (WHR) among overweight women aged 30–45 in southeastern Nigeria. Amin et al. (2023) studied the effectiveness of a calisthenics program among 35 rural married women in northern Ghana. The intervention included daily routines such as step-ups, wall sits, and arm raises. After eight weeks, participants experienced statistically significant reductions in waist and hip circumferences, suggesting that low-resource exercise interventions can be effective in managing localized obesity among women even in underserved regions.

Conclusion

The intervention produced meaningful reductions in key anthropometric and adiposity measures, including a 4.63% decrease in BMI, significant reductions in body weight, waist circumference (18.01%), and waist-to-hip ratio. These outcomes indicate that calisthenics exercise effectively targets localized fat deposits, especially in the abdominal region, which is critically associated with metabolic and cardiovascular risk.

Recommendations

Health agencies, community health centers, and local governments in the North-Central region should incorporate calisthenics programmes into existing obesity prevention and lifestyle modification initiatives. The significant reductions in BMI, waist circumference, and body fat indicators underscore the value of calisthenics as an accessible and cost-effective tool for combating localized obesity among adult women.

References

Adesola, A. M., Akinwumi, F. O., Ogunleye, O. D., & Hammed, S. O. (2025). Impact of Aerobic Exercise on Obesity among Female Undergraduates of Ladoke Akintola University of Technology, Ogbomoso, Nigeria. *Asian Journal of Cardiology Research,* 8(1), 35-57.

Amare, F., Alemu, Y., Enichalew, M., Demilie, Y., & Adamu, S. (2024). Effects of aerobics, resistance, and combined exercise training on body fat and glucolipid metabolism in inactive middle-aged adults with overweight or obesity: A randomized trial. BMC Sports Science, *Medicine and Rehabilitation,* 16(1), 189.

Amin, M., Kerr, D., Atiase, Y., Samir, M. M., & Driscoll, A. (2023). Improving metabolic syndrome in Ghanaian adults with type 2 diabetes through a calisthenics physical activity program: a feasibility randomised controlled trial. *International journal of environmental research and public health,* 20(8), 5518.

Bennett, J. P., & Lim, S. (2025). The Critical Role of Body Composition Assessment in Advancing Research and Clinical Health Risk Assessment across Lifespan. *Journal of Obesity & Metabolic Syndrome,* 34(2), 120.

Blüher, M. (2025). An overview of obesity-related complications: The epidemiological evidence linking body weight and other markers of obesity to adverse health outcomes. *Diabetes, Obesity and Metabolism,* 27, 3-19.

Campos, L. C., Campos, F. A., Bezerra, T. A., & Pellegrinotti, Í. L. (2017). Effects of 12 weeks of physical training on body composition and physical fitness in military recruits. *International Journal of exercise science,* 10(4), 560.

Gilanyi, M. Y., Shah, M. B., Cashin, A., Gibbs, M. T., Bellamy, M. J., Day, R., ... & Jones, M. D. (2024). Barriers and enablers to exercise adherence in people with chronic low back pain: A systematic review of qualitative evidence. J*ournal of Clinical Exercise Physiology,* 13(s2), 412-412.

Gomez, O. N., & Giang, N. T. (2024). Body Composition. A Unified System Fitness Design: Concepts of Holistic and Inclusive Fitness Framework, 204.

Haroun, D., Darwish, M., & Ehsanallah, A. (2024). Associations of body adiposity index, body mass index, waist circumference, and percentage of body fat in young female Emirati adults. *Plos one,* 19(5), e0302779.

Keshavarz, M. (2022). Potential benefits of strength training for people living with obesity. Mohammed, M. B. J., & Alshaher, I. S. A. (2025). The effect of exercises accompanied by foam rollers on some body composition components and health-related fitness indicators in women aged 30-35 years. International Journal of Sports, Exercise and Physical Education, 7(2), 124-132.

Odetunde, M. O., Olaoye, O. A., Obajobi, O. A., Yusuf, A. A., & Awotidebe, T. O. (2024). Adherence to calisthenics exercise programs among stroke survivors and perspectives of informal caregivers: a mixed method study. *Bulletin of Faculty of Physical Therapy,* 29(1), 1-13.

Olaoye, I. (2025). *A Client-Centred Weight Management Intervention for Black Women from Sub- Saharan Africa with Overweight and Obesity in the UK* (Doctoral dissertation, St Mary's University).

Ominyi, J., & Clifton, A. (2025). Barriers and enablers to physical activity participation among women in underserved communities: a mixed-methods study. *Women,* 5(1), 5.

Park, W., Jung, W. S., Hong, K., Kim, Y. Y., Kim, S. W., & Park, H. Y. (2020). Effects of moderate combined resistance-and aerobic-exercise for 12 weeks on body composition, cardiometabolic risk factors, blood pressure, arterial stiffness, and physical functions, among obese older men: a pilot study. *International journal of environmental research and public health,* 17(19), 7233.

Perone, F., Spadafora, L., Pratesi, A., Nicolaio, G., Pala, B., Franco, G., & Ambrosetti, M. (2024). Obesity and cardiovascular disease: Risk assessment, physical activity, and management of complications. *International Journal of Cardiology Cardiovascular Risk and Prevention,* 23, 200331.

Špirtović, O., Čaprić, I., Katanić, B., Govindasamy, K., Geantă, V. A., Ardelean, V. P., & Stanković, M. (2025). Group Aerobic Exercise Improves Body Composition and Lipid

Profile in Young Women with Elevated BMI: A Randomized Controlled Trial. *Applied Sciences,* 15(13), 7489.

Wu, Y., Li, D., & Vermund, S. H. (2024). Advantages and limitations of the body mass index (BMI) to assess adult obesity. *International journal of environmental research and public health,* 21(6), 757.