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EFFECT OF HOME-BASED AEROBIC EXERCISE ON BODY COMPOSITION INDICES OF MARRIED FEMALES IN NORTH-CENTRALNIGERIA

By

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Abstract

Obesity and central adiposity are major health concerns among married women in Nigeria, North-Central region is not without exceptions of sedentary lifestyles, limited fitness access, cultural expectations, and time constraints contribute to poor body composition. Home-based aerobic 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 Body Max Index, Waist Circumference, and Waist Hip Ratio. Despite its potential, evidence of the effectiveness of such programmes in this region is limited. This study examined the Effect of Home-Based Aerobic 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 home-based exercise programme, while the control group continued with their daily activity. 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 home-based 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 home-based interventions for addressing obesity-related health risks in Nigerian women. This implies that Calisthenic exercise improves the reduction

of localised obesity, improve cardiovascular health and lipid profile of the participants. The study, therefore, recommended advocacy for married females in North-Central participation in calisthenic exercise for optimal healthy

Keywords: Home-based 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

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). Maintaining an appropriate level of body fat is essential for the body to perform its normal physiological functions rather than allowing excess fat to become a risk factor for various diseases. When body fat accumulates excessively, it increases triglyceride levels in the blood, which may lead to the blockage of arteries and veins and consequently increase the risk of heart attack (Perone et al., 2024; Blüher, 2025).

To determine whether body fat is within a healthy range, Body Mass Index (BMI) is commonly used as a simple and reliable indicator for assessing overweight and obesity within a population. BMI is calculated using an individual's height and weight to estimate the level of body fatness (Rosato, 2013). The method is widely adopted because it is easy to measure, inexpensive, and practical for large population studies. BMI values are interpreted the same way for both men and women, with a normal range of 18.5 to 24.9 kg/m² (Wu et al., 2024).

Given the health risks associated with excessive body fat and the importance of maintaining a healthy BMI, various lifestyle and physical activity interventions have been recommended to manage body weight and improve body composition. In this regard, Gilanyi et al. (2024) revealed that home-based exercise programmes, particularly unsupervised aerobic training, are increasingly recognized for their ability to overcome common barriers such as cost, travel, limited access to facilities, and time constraints. Evidence from a four-month home-based aerobic intervention involving obese adults showed that participants with high adherence achieved significant improvements in body composition, aerobic fitness, and functional capacity regardless of gender. Similarly, findings from an eight-week home-based high-intensity interval training (HIIT) programme demonstrated improvements in lean body mass, aerobic capacity, and muscular endurance, highlighting the effectiveness of home-based exercise modalities in improving body composition and overall physical fitness. Building on this evidence, the present study examines the impact of a structured home-based aerobic 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, which may not be suitable for married women who could benefit more from flexible home-based programmes (Adesola et al., 2025). Despite increasing global evidence supporting home-based aerobic exercise, there is still limited empirical data in Nigeria particularly in the North-Central geopolitical zone on its effectiveness among married women (Odetunde et al., 2025).

This lack of localized evidence highlights the need to investigate whether a structured home-based aerobic 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. Towhatextentdoesparticipationinatwelve-weekcalisthenicsexerciseprogramme impact the BMI of married females in North-Central Geo-Political Zone of Nigeria?

2. Towhatextentdoesparticipationinatwelve-weekcalisthenicsexerciseprogramme 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 to guide the study:

Ho_1Participation 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.

Ho_2 Participation in a12-weekcalisthenicsexercise programme has no significant effect on the waist circumference (WC) and waist hip ratio (WHR) of married females over a 12-week period.

Research Methods

This study employed a true 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 home-based 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 285 participants were recruited for the study. The sample size was determined using G*Power software with a medium effect size (f = 0.25), an alpha level of 0.05, statistical power of 0.80, and six groups (three experimental and three control), which yielded a minimum sample of 240. To account for possible attrition, the sample was increased by 15%, resulting in 285 participants.

A multistage sampling procedure was employed. Firstly, Kwara State, Kogi State, and the Federal Capital

Territory (FCT) Abuja were purposively selected from the North-Central zone based on accessibility, security, and prevalence of obesity among women. Secondly, the state capitals Ilorin, Lokoja, and Abuja were purposively selected due to their population diversity, infrastructure, and availability of community and recreational centers suitable for the intervention. Thirdly, major community centers within these capitals were selected to capture married women from diverse socio-economic backgrounds. Finally, eligible participants were screened using inclusion and exclusion criteria and selected through systematic random sampling, after which they were randomly assigned to either experimental groups, which received the 12-week calisthenics exercise intervention, or control groups, which received no intervention but continued with their normal daily routine and were monitored throughout the study.

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, AnthropometricTapeMeasure(IDASStapemeasurewithBMIdial,UK)–Thiswas used for measuring body circumferences (waist and hip), BodyFat/HydrationMonitorScale(Modelno.7032497,China):Forthemeasurementof Body Mass Index (BMI)and percentage of body fat (%BF), Stop Watches(ACCUSPLITProSurvivor-A601X,China):This was used for keeping time during time-based tests, exerciseMat:(GorillaPremiumLargeExerciseMat–6'x4'x1/4"UltraDurable, Non-Slip):This instrument was used forsit-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.

Standardized instruments were used for the measurements. Standardised instruments are also reliable. However, all the instruments were initially used for measurement in a pilot study to get the Researcher and Research Assistants familiarised with their functions and calibration. These instruments are: portable stadiometer (hm200p portstad, usa), anthropometric tape measure (idass tape measure with bmi dial, uk), body fat/hydration monitor scale (model no. 7032497, china), stop watches (accusplit pro survivor - a601x, china), digital hand dynamometer (gripx-b07strwcpj, usa), exercise mat: (gorilla premium large exercise mat – 6' x 4' x 1/4" ultra-durable, non-slip), measurement tape.

Data collection was conducted in two phases (pretest phase and posttest phase). 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.

Descriptive statistics (frequencies and percentages) were used to summarize respondents' demographics and general responses, mean and standard deviation were used to analyse all the research questions, Inferential statistics of Analysis of Variance (ANOVA) were employed to test the hypotheses at the 0.05 level of significance.

Results

Demographic Characteristics of Respondents

The demographic data for the study were analyzed and presented in Table 5 as Follows:

Table 1: Descriptive Analysis Demographic of demographic Characteristics

Variable	**Mean (M)**	**Standard Deviation (SD)**
Age in years	41.41	7.28
Variables	**Frequency**	**Percent**
State		
Kogi	90	31.6
Kwara	125	43.9
Abuja	70	24.6
Total	285	100.0
Marital Status		
Married	235	82.5
Widowed	32	11.2
Separated	18	6.3
Total	285	100.0
Number of Children		
None	8	2.8
1 – 3	223	78.3
4 – 6	52	18.2
7 or more	2	0.7
Total	285	100.0
Educational Level		
No formal education	11	3.9
Primary	16	5.6
Secondary	188	66.0
Tertiary	70	24.5
Total	285	100.0
Occupation		
Self-employed	118	41.4
Civil Service	77	27.0
Teaching	42	14.7
Health	19	6.7
Banking	7	2.5
Other	22	7.7
Total	285	100.0
Religion		
Islam	175	61.4
Christianity	110	38.6
Total	285	100.0

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Table 1reveals the study involved 285 married women from North Central Nigeria with an average age of 41.41 ± 7.28 years. Most participants were from Kwara State (43.9%), followed by Kogi State (31.6%) and Abuja (24.6%). The majority were married (82.5%), and most had between one and three children (78.3%). In terms of education, 66% had secondary education, while 24.5% had tertiary education. Most participants were self-employed (41.4%), with others working as civil servants (27%) or teachers (14.7%). Regarding religion, 61.4% were Muslims and 38.6% were Christians.

Answers to the Research Questions

Research Question One:

Table 2: 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 2 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:

Table 3: 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 3 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 4a: 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 4a 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 4b: 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 a12-week calisthenics exercise programme has no significant effecton thewaist circumference (WC) and waist hip ratio (WHR) of married females over a 12-week period.

Table 5a: Three-Way ANOVA Test of Between-Subject Effects of a 12 Week 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 5a shows the Three-way ANOVA test of between subject effects of a 12-week 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 5b: Three-Way ANOVA Test of Within-Subject Effects of a 12 Week 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
est_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
est_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
est_times * oup * 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
or(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 5b shows a three-way ANOVA was conducted to examine the effect of a 12-week calisthenics exercise programme on the waist circumference (WC) of the participants. The results revealed a significant difference between the pre-test and post-test WC values of the participants, F(1,280)=5.649,p=.018, F(1,280)=5.649,p=.018. There was also a significant main effect of group (experimental and control) on WC scores, F (1,280) =6.282, p=.022, F (1,280) =6.282,

p=.022. However, there was no significant interaction effect among exercise intervention, group, and state on WC scores, F (4,280) =0.249, p=.618, F (4,280) =0.249, p=.618. Therefore, the null hypothesis was NOT rejected.

Table 5c: Three-Way ANOVA Test of Between-Subject Effects of a 12 Week 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 5c shows the Three-way ANOVA test of between subject effects of a 12-week 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 5d: Three-Way ANOVA Test of Within-Subject Effects of a 12 Week 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 5d shows a three-way mixed ANOVA was conducted to examine the effect of a 12-week calisthenics exercise programme on the waist-hip ratio (WHR) of the participants. The results revealed a significant difference between the pre-test and post-test WHR values of the participants, F (1,280) =88.073, p<.001, F (1,280) =88.073, p<.001. There was also a significant main effect of group (experimental and control) on WHR scores, F (1,280) =3.270, p=.006,

F (1,280) =3.270, p=.006. Furthermore, a significant interaction effect of exercise intervention, group, and state on WHR scores was observed, F (4,280) =2.102,p=.049, F(4,280)=2.102,p=.049. The effect size of the intervention on WHR between groups was η^2 = .001 (0.1%), while the effect across states was η^2 = .008 (0.8%), indicating small effect sizes. Therefore, the null hypothesis is rejected.

Table 5e: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	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 5e 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 2 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 fatmass, 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 percentbody fat, and improved lean mass, even though BMI per se did not change significantly (Camposet 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) reportedsignificant 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 significantlydecreased in the overweight group (Biochemia Medica study) (Kostrzewa-Nowak et al., 2015).

Table 3 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 anaverage WC of M 126.89 centimetre. This was reduced by 18.01% to an average of M 103.94centimetre after the exercise intervention. Their WHR at baseline was M 0.91 centimetre andwas 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 inwaist circumference (Amare et al., 2024).A 12-week combined resistance + aerobic exercise pilot in obese older men notably reducedblood 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 womenproduced 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, waistcircumference significantly decreased (from ~75.0 cm to ~72.7 cm) and the waist-hip ratio alsodeclined (Campos et al., 2017).

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 for WHR and not rejected for WC. This implies that participation in a twelve-week callisthenic exercise has a significant effect on the WHRbut the effect was not significant for WC 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 home-based 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

Based on the findings of this study, the following recommendations are made:

1. 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, triglycerides, and body fat indicators underscore the value of calisthenics as an accessible and cost-effective tool for combating localized obesity among adult women.
2. Healthcare providers, including physicians, nurses, physiotherapists, exercise and sport scientists and public health educators should recommend calisthenics as part of non-pharmacological treatment for patients with obesity, hypertension, or dyslipidemia. The improvements in systolic and diastolic blood pressure, resting heart rate, and lipid profiles demonstrate that calisthenics can complement routine medical management of cardiometabolic disorders.

3. Fitness instructors, physical educators, and wellness coaches should incorporate structured calisthenics routines into exercise prescriptions for women. The observed improvements in adiposity, thigh girth, and skinfold thickness show that calisthenics effectively targets specific fat deposits and enhances muscle tone even without specialized equipment.
4. Given the culturally appropriate and equipment-free nature of calisthenics, community leaders, women's groups, and NGOs should promote home-based group sessions targeted at married women, who often face barriers related to childcare, domestic responsibilities, or limited time. Encouraging participation through peer groups or community clubs may enhance adherence.
5. State Ministries of Health and Women Affairs should develop policies that support low-cost physical activity interventions. The consistency of significant improvements across states indicates that the programme can be scaled regionally to reduce obesity prevalence and related cardiovascular risk factors among women.

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