

Research article

Anthropometric Changes Following a Six-Week Contextualized Exercise Training Program Among Overweight College Students: A Single-Group Pretest–Posttest Study

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Abstract: Overweight in college students is associated with adverse anthropometric profiles and health risks. This investigation examined anthropometric changes following a six-week contextualized exercise training program. A single-group pretest-posttest design involved 52 participants, 27 male and 25 female students. Body mass index (BMI) and waist circumference were assessed before and after participation. Because difference scores departed from normality, Wilcoxon signed-rank tests with Holm adjustment were applied. Sex-based analyses were exploratory. Median BMI decreased from 26.60 to 26.00 kg/m², with a median change of –0.70 kg/m² ($W = 18.00$; Holm-adjusted $p < .001$). Median waist circumference decreased from 85.00 to 81.00 cm, with a median change of –3.00 cm ($W = 0.00$; Holm-adjusted $p < .001$). Exploratory analysis suggested different BMI-change distributions by sex, but not waist-circumference change. Estimated body-fat percentage was excluded because posttest values could not be verified. Recorded BMI and waist circumference were lower after participation. However, the uncontrolled design, unavailable measurement-reliability and intervention-fidelity data, and unmonitored behavioral influences prevent causal attribution. Controlled studies with verified measurements and implementation monitoring are required.

Keywords: Contextualized exercise training, body mass index, waist circumference, overweight college students, anthropometric change

1. Introduction

Physical inactivity and excess adiposity remain major public-health concerns because of their associations with non-communicable diseases, impaired physical functioning, and premature mortality. Despite the established benefits of regular physical activity, substantial proportions of adults and young people continue to fall below recommended activity levels [1], [2]. The transition to higher education may increase this concern because college students commonly experience changes in academic workload, eating habits, sleep patterns, transportation, and recreational activities. These changes may encourage sedentary behavior, reduce daily energy expenditure, and contribute to gradual weight gain [3], [4]. Consequently, overweight during the college years should not be regarded solely as a concern related to physical appearance. Ra-

ther, it represents an early and modifiable health condition associated with excess adiposity, reduced physical fitness, metabolic abnormalities, and future cardiovascular risk [5], [6]. This concern is particularly relevant in Philippine higher education, where students may encounter behavioral and institutional barriers to regular physical activity. Filipino university students reported reductions in physical activity and changes in sedentary behavior during the COVID-19 community quarantine [7]. Similarly, college students in Manila identified insufficient time, energy, motivation, and resources as common barriers to physical activity [8]. Although tertiary physical education and campus wellness programs provide opportunities to encourage active lifestyles, their implementation may be affected by academic schedules, facility availability, instructional resources, and differences in students' physical capacities and exercise preferences [9], [10]. General exercise recommendations may therefore have limited practical application when they are not adapted to the conditions in which students study and participate in campus activities.

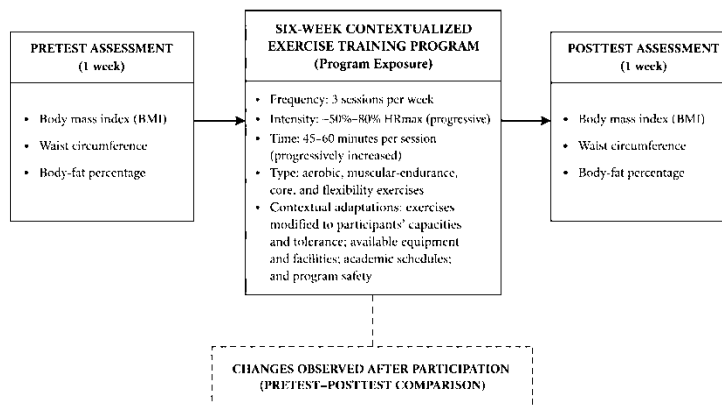
Structured exercise is an established component of overweight and obesity management because it may increase energy expenditure, improve cardiorespiratory and muscular fitness, enhance insulin sensitivity, and contribute to the management of total and central adiposity [11]–[13]. Exercise interventions involving university students with overweight or obesity have generally reported improvements in at least one anthropometric, fitness, or health-related outcome. However, the magnitude and consistency of the reported changes vary across studies [14]. A recent meta-analysis involving college students with obesity reported pooled improvements in body mass index (BMI), waist circumference, and hip circumference, whereas changes in body-fat percentage were less consistent [15]. These findings indicate that anthropometric indicators represent related but distinct dimensions of health and may not change to the same extent or within the same period. BMI provides a practical measure of body mass relative to height, but it does not distinguish fat mass from lean tissue or identify the anatomical distribution of body fat. Body-fat percentage provides an estimate of relative adiposity, although its precision depends on the measurement method, assessor technique, prediction equation, and assessment conditions. In contrast, waist circumference reflects central body size and is commonly used as a surrogate indicator of abdominal adiposity and cardiometabolic risk [11], [16]. Waist circumference is not, however, a direct measure of visceral adipose tissue. Its measurement may be influenced by anatomical-site identification, tape placement, respiration, hydration, abdominal distension, clothing, and assessor consistency.

These considerations are particularly important in short-duration studies, in which relatively small anthropometric changes may be difficult to distinguish from normal biological and measurement variability [15], [17]. Assessing BMI, waist circumference, and body-fat percentage together may consequently provide a more complete description of pretest–posttest anthropometric changes than using BMI alone. The outcomes observed during exercise programs may also depend on how the exercise dose is prescribed and progressed. The Frequency, Intensity, Time, and Type principle provides a systematic framework for structuring exercise according to participants' capacities and program objectives. Current recommendations encourage adults to accumulate at least 150 to 300 minutes of moderate-intensity aerobic activity per week, or an equivalent amount of vigorous activity, together with regular muscle-strengthening activities [1], [2]. Intervention duration, weekly frequency, session length, intensity, exercise modality, progression, and adherence may influence the extent and timing of anthropometric change [15], [18]. Combined training may be appropriate for college students with overweight because aerobic activity increases energy expenditure and develops cardiorespiratory capacity, while muscular-endurance activities may improve strength and help preserve lean tissue [12], [16]. Core and flexibility exercises may additionally support movement capacity, exercise tolerance, and safe participation. Previous investigations have examined interval training, continuous aerobic exercise, progressive running, Tai Chi, and technology-supported interventions among

university students with overweight or obesity [19]–[24]. Although these approaches have produced beneficial findings in some populations, they differ considerably in duration, intensity, supervision, required equipment, institutional setting, and participant characteristics. Some also require specialized resources or closely controlled facilities that may be difficult to reproduce in universities with limited equipment and space. Findings from a particular exercise modality or research environment therefore cannot automatically be generalized to every university population.

In the present study, contextualized exercise training refers to the local adaptation of a structured, progressive, FITT-based program to the participants' physical capacities and exercise tolerance, available equipment and campus facilities, academic schedules, and program-safety requirements. Contextualization was implemented through accessible and modifiable activities, including brisk walking, stationary cycling or elliptical exercise when available, chair squats, wall push-ups, step-ups, resistance-band rows, light dumbbell exercises, core exercises, and flexibility activities. Exercise alternatives and modifications were used to preserve the intended frequency, intensity, duration, and exercise type without requiring every participant to perform an identical activity or use specialized exercise facilities. This operational definition distinguishes contextualization from the general prescription of progressive combined training by emphasizing how the program was adapted and implemented within the participating university. Nevertheless, contextualization was not evaluated as an independent treatment component because the study did not include a non-contextualized exercise comparison group. The study therefore cannot determine whether contextualization provides greater anthropometric benefits than standard progressive combined training. Its contribution is instead centered on the local implementation of a resource-adapted FITT-based program and the description of anthropometric changes observed after participation. This framing directly addresses the reviewers' recommendation that the study's novelty be presented in terms of feasibility and local implementation rather than the superiority or effectiveness of contextualized exercise.

Self-Determination Theory provided an additional basis for designing and delivering the program. The theory proposes that participation in health-related behaviors may be supported by conditions that encourage autonomy, competence, and relatedness [28], [29]. In the present program, autonomy was supported by providing exercise alternatives appropriate to participants' physical capacities, preferences, and exercise tolerance. Competence was encouraged through attainable activities, gradual progression, guidance on exercise technique and intensity, and constructive feedback. Relatedness was supported through supervised and respectful group participation. However, autonomy, competence, relatedness, autonomous motivation, exercise enjoyment, and other psychological constructs were not directly measured. Self-Determination Theory therefore served only as an intervention-design rationale and was not tested as an explanatory, predictive, or mediation model. The study consequently does not assume that the need-supportive features improved motivation, adherence, participation, or anthropometric outcomes. This restricted theoretical role responds to the reviewers' concern that motivational and psychological mechanisms should not be inferred when the corresponding constructs were not assessed. Figure 1 presents the conceptual framework of the study. The framework shows the temporal sequence of the pretest assessment, participation in the six-week contextualized exercise training program, and posttest assessment. The program exposure was operationalized through three sessions per week, progressive intensity of approximately 50% to 80% of estimated maximum heart rate, an increase in session duration from 45 to 60 minutes, and combined aerobic, muscular-endurance, core, and flexibility exercises. BMI, waist circumference, and body-fat percentage were measured before and after participation. The framework illustrates the study procedures and the temporal order of measurement, rather than a confirmed causal pathway.



Note. The figure presents the temporal sequence of the pretest assessment, six-week program exposure, posttest assessment, and pretest–posttest comparison. The directional arrows indicate procedural sequence and do not represent a confirmed causal relationship. Because the study did not include a control or comparison group, changes observed after participation cannot be attributed exclusively to the exercise program.

Figure 1. Conceptual Framework of the Six-Week Contextualized Exercise Training Program

Despite the expanding literature on exercise among university students with overweight or obesity, evidence remains limited concerning short-duration, multimodal programs implemented in Philippine state universities using accessible activities and existing institutional resources. Previous investigations have frequently employed specialized equipment, highly controlled facilities, single exercise modalities, or technology-supported protocols that may not be readily transferable to institutions with different resource and scheduling conditions [21]–[24]. Evidence also remains inconclusive regarding whether six weeks is sufficient for concurrent changes to become evident in BMI, waist circumference, and estimated body-fat percentage [15], [18]. Examining these outcomes under ordinary university conditions may provide preliminary information regarding program implementation and estimates that can guide the design of longer and more rigorously controlled studies.

Accordingly, the present study examined changes in BMI, waist circumference, and body-fat percentage following participation in a six-week contextualized exercise training program among college students with overweight. The program consisted of three sessions per week, progressive exercise intensity from approximately 50%–60% to 70%–80% of estimated maximum heart rate, an increase in session duration from 45 to 60 minutes, and combined aerobic, muscular-endurance, core, and flexibility exercises. Specifically, the study determined whether the participants' posttest anthropometric measurements differed significantly from their corresponding pretest measurements.

Because the study employed a single-group pretest–posttest design, any differences between the two measurement periods are interpreted strictly as changes observed following participation and not as definitive effects caused by the exercise program. Without a control or comparison group, the observed changes cannot be distinguished from regression to the mean, measurement variability, measurement familiarization, dietary changes, sleep patterns, sedentary behavior, nonprogram physical activity, hydration status, health conditions, or other concurrent influences [30], [31]. These limitations are particularly relevant when interpreting a short-duration intervention and an anthropometric outcome such as waist circumference that may be affected by biological and measurement conditions. The study tested the following null hypotheses:

H0₁, there is no significant difference between pretest and posttest BMI;

H0₂, there is no significant difference between pretest and posttest waist circumference; and

H0₃, there is no significant difference between pretest and posttest body-fat percentage.

2. Materials and Methods

2.1 Research Design

This study employed a quantitative single-group pretest–posttest design to examine anthropometric changes among college students with overweight following participation in a six-week contextualized exercise training program. All 52 participants belonged to one group and underwent the same assessment procedures before and after the program. Body mass index (BMI), waist circumference, and body-fat percentage were measured at both time points. Because repeated measurements were obtained from the same individuals, each participant served as their own reference, and the matched pretest and posttest values were examined using paired-samples analysis. The primary analytical focus was the pretest–posttest change in the complete sample of 52 participants. Sex-stratified analyses were treated as exploratory secondary analyses and were not used to conclude that changes differed between male and female participants. A direct sex-by-time interaction would be required to test whether the magnitude of change varied significantly by sex. This distinction resolves the inconsistency identified by the reviewers between the complete-sample analysis described in the Methods and the separate within-sex analyses presented in the original Results. The design established the temporal sequence between baseline assessment, program participation, and posttest assessment, but it did not permit causal inference. Because no control or comparison group was included, the findings were interpreted strictly as changes observed following participation, rather than evidence of program effectiveness. The observed changes could not be separated from regression to the mean, measurement variability or familiarization, dietary intake, sleep patterns, sedentary behavior, nonprogram physical activity, hydration status, and other concurrent influences that were not continuously monitored or controlled. Measurement-related influences were particularly relevant to waist circumference, including tape placement, respiration, hydration, abdominal distension, clothing, assessment timing, and assessor technique. Therefore, any statistically significant change in waist circumference was not interpreted as direct evidence of reduced visceral adipose tissue or as a change caused exclusively by the program. The design also did not isolate contextualization as a separate intervention component because no non-contextualized exercise group was included. Consequently, the study could not determine whether contextual adaptation provided benefits beyond standard progressive combined training. Instead, the design documented the implementation of a resource-adapted FITT-based program within the participating university and generated preliminary anthropometric estimates for future controlled studies. Self-Determination Theory likewise served only as a rationale for program design and delivery because autonomy, competence, relatedness, motivation, and enjoyment were not directly measured or tested as explanatory mechanisms.

2.2 Participants

The study included 52 college students with overweight who completed the pretest assessment, the six-week contextualized exercise training program, and the posttest assessment. Participants were selected through purposive sampling based on the study's eligibility requirements. To qualify, participants had to be currently enrolled at the participating university, have a baseline body mass index (BMI) of at least 25.0 kg/m², obtain medical clearance for the prescribed exercise activities, be available throughout the six-week program, and provide written informed consent. All participants belonged to a single intervention group and underwent the same assessment and program procedures.

The sample consisted of 27 male participants (51.9%) and 25 female participants (48.1%), with a mean age of 19.87 years (SD = 1.42). At baseline, the participants had a mean height of 167.00 cm (SD = 6.51), body weight of 76.30 kg (SD = 8.18), BMI of 28.02 kg/m² (SD = 2.91), waist circumference of 87.74 cm (SD = 8.65), and body-fat percentage of 27.12% (SD = 6.15), as presented in Table 1. The complete sample of 52 participants constituted the primary analytical group. Sex-stratified analyses were treated as exploratory secondary analyses because the smaller subgroup sizes reduced statistical precision. Separate within-sex statistical results were not interpreted as evidence that anthropometric changes differed between male and female participants, as such a conclusion would require a direct sex-by-time interaction analysis. No a priori sample-size calculation was documented for the completed study. Therefore, the nonsignificant findings for BMI and body-fat percentage were interpreted cautiously and were not considered evidence of no change. A sensitivity power analysis based on the final primary analysis may be reported separately to indicate the minimum effect size detectable with the available sample.

Table 1. Demographic and Baseline Anthropometric Characteristics of the Participants

Factor	Attribute	Frequency	Percent (%)	Mean	Standard Deviation
Age	Years	52	100.0	19.87	1.42
Height	Centimeters	52	100.0	167.00	6.51
Baseline weight	Kilograms	52	100.0	76.30	8.18
Baseline body mass index	kg/m ²	52	100.0	28.02	2.91
Baseline waist circumference	Centimeters	52	100.0	87.74	8.65
Baseline body-fat percentage	Percentage	52	100.0	27.12	6.15
Sex	Male	27	51.9	—	—
	Female	25	48.1	—	—
Total		52	100.0	—	—

Note. BMI = body mass index; SD = standard deviation. Sex-stratified sample sizes were 27 male and 25 female participants. The sex-stratified analyses were exploratory and were not used to infer differences in anthropometric change between the two subgroups.

2.3 Research Instruments

Standardized anthropometric instruments were used to assess body weight, height, waist circumference, and estimated body-fat percentage at the pretest and posttest. The same types of equipment, participant instructions, anatomical procedures, and assessment sequence were applied at both measurement periods. The available participant-level dataset contained pretest and posttest fields for body weight, height, body mass index, waist circumference, skinfold measurements, and estimated body-fat percentage for 52 participants. Body weight was measured using a calibrated digital weighing scale and recorded to the nearest 0.1 kg. Participants were assessed without footwear and while wearing light clothing. Height was measured using a calibrated stadiometer and recorded to the nearest 0.1 cm, with participants standing upright according to standardized positioning procedures. Body mass index was calculated by dividing body weight in kilograms by height in meters squared. Waist circumference was measured to the nearest 0.1 cm using a flexible, nonelastic measuring tape. With the participant standing upright and the abdomen relaxed, the tape was positioned horizontally at the midpoint between the lowest palpable rib and the upper border of the iliac crest. The measurement was obtained at the end of normal expiration without compressing the skin. The study protocol specified that two readings were obtained and averaged. When the first two readings differed by more than 1.0 cm, a third reading was taken, and the mean of the two closest readings was recorded. The same anatomical landmark and measurement procedure were intended to be used during the pretest

and posttest. These procedures are documented consistently in the submitted and supporting manuscripts. Skinfold thickness was assessed using a calibrated Lange Skinfold Caliper manufactured by Beta Technology, Santa Cruz, California, USA. The supporting protocol describes a sex-specific three-site assessment conducted on the right side of the body, using the chest, abdomen, and thigh sites for male participants and the triceps, suprailiac region, and thigh sites for female participants. The protocol states that two readings were obtained at each site and that a third reading was taken when the first two readings differed by more than 2 mm. The mean of the two closest readings was recorded to the nearest 0.5 mm. Body density was intended to be estimated using the applicable sex-specific Jackson–Pollock three-site equation and converted to estimated body-fat percentage using the Siri equation. However, the available participant-level spreadsheet contains only two columns for skinfold sites and does not identify the anatomical location represented by each column. It also contains identical pretest and posttest skinfold values and estimated body-fat percentages. Therefore, the electronic dataset does not independently verify the three-site protocol or the reported posttest body-fat values. The original anthropometric assessment forms and body-fat calculation records should be consulted before the three-site protocol and pretest–posttest body-fat results are retained in the final manuscript. Before anthropometric assessment, participants were instructed to wear light clothing, maintain normal hydration, avoid alcohol and strenuous physical activity for 24 hours, and avoid heavy meals immediately before testing. The supporting protocol additionally indicates that participants were instructed to empty their bladder and avoid caffeine before assessment. These additional preparations should be retained in the manuscript only if the original six-week assessment records confirm that they were followed. Instruments were inspected and calibrated before use. Completed assessment forms were reviewed for missing or inconsistent entries, and pretest and posttest records were matched using participant study codes. Although consistent procedures and participant instructions were used to improve measurement consistency, these quality-control procedures do not constitute numerical evidence of intra-rater reliability or measurement precision. A standardized intervention-monitoring form was also used to document attendance, session duration, prescribed intensity, achieved heart-rate exposure when recorded, workload progression, exercise modifications, missed sessions, exercise tolerance, protocol deviations, and adverse events. The supporting documents contain blank templates for recording these variables but do not provide completed participant-level summaries. Actual attendance, achieved intensity, modifications, and adverse-event results should therefore be reported only after completed monitoring records have been retrieved and verified. The prescribed exercise dose should not be presented as equivalent to the exercise dose actually received.

2.3 Data Gathering Procedure

Before data collection, ethical approval was obtained from the Adamson University Ethics Review Committee under Protocol No. 2026-048-EDU-04. Permission to conduct the study was subsequently obtained from the appropriate authorities of the participating university. Recruitment, participant assessment, intervention implementation, and data management were conducted according to the approved protocol and applicable confidentiality and data-protection requirements. Eligible college students were recruited through purposive sampling based on the established inclusion criteria. Before enrollment, prospective participants received an explanation of the study's purpose, procedures, duration, potential risks and benefits, confidentiality safeguards, and voluntary nature. Written informed consent and medical clearance were obtained before any anthropometric assessment or exercise activity. Each participant was assigned a study code to match pretest and posttest records without including direct personal identifiers in the analytical dataset. During the pretest, trained assessors measured body weight, height, waist circumference, and skinfold thickness using the standardized instruments and procedures described in the Research Instruments section. BMI

was calculated from measured body weight and height, while estimated body-fat percentage was derived from the recorded skinfold measurements. The same types of instruments, anatomical landmarks, participant instructions, and measurement sequence were applied to all participants. Participants were instructed to wear light clothing, maintain their usual hydration, avoid alcohol and strenuous exercise for 24 hours, and avoid a heavy meal immediately before assessment. The instruments were inspected and calibrated before use. Waist circumference was measured at the midpoint between the lowest palpable rib and the upper border of the iliac crest after normal expiration. The protocol specified that two readings were obtained and that a third reading was taken when the first two differed by more than 1.0 cm. The mean of the two closest readings was recorded. Following the pretest assessment, all participants entered the same six-week contextualized exercise training program. The prescribed program consisted of three supervised sessions per week, providing a maximum of 18 scheduled sessions. Exercise intensity progressed from approximately 50%–60% to 70%–80% of estimated maximum heart rate, while session duration increased from 45 to 60 minutes. The program combined aerobic, muscular-endurance, core, and flexibility activities. Exercise alternatives and workload modifications were permitted according to participants' physical capacities, exercise tolerance, safety considerations, available equipment, campus facilities, and academic schedules. These modifications were intended to preserve the target exercise component and prescribed FITT structure rather than change the overall objectives of the program. The prescribed weekly progression is presented in Table 3.

Table 2. The Six-Week Contextualized Exercise Training Program

Week	Frequency	Intensity	Time	Exercise Activities	Implementation Focus
1	3 sessions/ week	Light to moderate, 50%–60% HRmax	45 min/ session	Brisk walking, chair squats, wall push-ups, seated knee lifts, and flexibility exercises	Familiarization with the program, correct exercise technique, and joint safety
2	3 sessions/ week	Moderate, 55%–65% HRmax	50 min/ session	Inclined walking or stationary cycling, chair squats, resistance-band rows, bird-dog exercises, and flexibility exercises	Gradual workload progression and development of movement confidence
3	3 sessions/ week	Moderate, 60%–70% HRmax	55 min/ session	Moderate-paced stationary cycling, chair squats, dumbbell presses, glute bridges, and flexibility exercises	Improvement of muscular endurance, posture, and balance
4	3 sessions/ week	Moderate to vigorous, 65%–75% HRmax	60 min/ session	Brisk walking or elliptical exercise, step-ups, resistance-band rows, bird-dog exercises, and flexibility exercises	Increased training demand while monitoring fatigue and exercise tolerance
5	3 sessions/ week	Vigorous, 70%–75% HRmax	60 min/ session	Brisk walking or cycling, chair squats, dumbbell presses, step-ups, glute bridges, and flexibility exercises	Greater emphasis on muscular endurance and progressive overload
6	3 sessions/ week	Vigorous, 70%–80% HRmax	60 min/ session	Brisk walking or elliptical exercise and a whole-body circuit consisting of chair squats, wall push-ups, dumbbell presses, resistance-band rows, step-ups, bird-dog exercises, glute bridges, and flexibility exercises	Peak training phase and completion of the pre

2.3 Data Analysis

Data were analyzed using IBM SPSS Statistics version 25. Before analysis, participant records were checked for missing values, duplicate entries, implausible measurements, and inconsistencies between the electronic dataset, assessment forms, and statistical output. Pretest and posttest observations were matched using participant study codes. The number of participants with complete paired observations was reported separately for each anthropometric outcome. Participant characteristics were summarized using frequencies and percentages for categorical variables and means and standard deviations for continuous variables. Pretest and posttest values for body mass index (BMI), waist circumference, and estimated body-fat percentage were reported as mean $\pm$ standard deviation. Mean change was calculated as the posttest value minus the pretest value; therefore, negative values indicated reductions. The primary analyses examined pretest-to-posttest anthropometric changes in the complete sample of 52 participants. Paired-samples *t*-tests were used to assess changes in BMI, waist circumference, and estimated body-fat percentage because the same participants were measured at both time points. For each outcome, the results were reported using the number of complete pairs, pretest and posttest means and standard deviations, mean change, 95% confidence interval for the mean change, *t*-statistic, degrees of freedom, exact two-tailed *p*-value, and Cohen's *d_z* as the paired-samples effect size. Cohen's *d_z* was calculated by dividing the mean paired difference by the standard deviation of the paired differences. Before conducting the paired-samples tests, the distributions of the individual pretest-to-posttest difference scores were examined for influential outliers and substantial departures from normality using graphical and statistical procedures. When an outcome showed a serious violation of the paired-samples *t*-test assumptions, the Wilcoxon signed-rank test was considered as a sensitivity analysis. Results of any nonparametric sensitivity analysis were reported separately and were not substituted selectively based on statistical significance. Because three primary anthropometric outcomes were evaluated, the Holm procedure was applied to control the familywise error rate. The three raw *p*-values from the complete-sample analyses were ranked from smallest to largest and compared sequentially with Holm-adjusted significance thresholds. Both raw and Holm-adjusted *p*-values were reported. Statistical conclusions regarding the primary outcomes were based on the Holm-adjusted values, while effect sizes and 95% confidence intervals were considered when evaluating the direction, magnitude, and precision of the observed changes. Analyses stratified by sex were treated as exploratory secondary analyses, rather than prespecified primary analyses. Separate paired-samples tests were conducted descriptively for the 27 male and 25 female participants only when complete and verified outcome data were available. These within-sex analyses were not used to conclude that anthropometric changes differed between male and female participants. A statistically significant change in one subgroup and a nonsignificant change in another subgroup does not establish a difference between subgroups. If sex-related differences were examined, a direct sex-by-time interaction was required and was reported separately as an exploratory analysis. This approach resolves the inconsistency between the original Methods, which identified the complete sample as the primary analytical group, and the original Results, which reported only separate within-sex tests. No valid *a priori* sample-size calculation was documented for the completed six-week study. Therefore, a sensitivity power analysis was used to characterize the statistical sensitivity of the available sample rather than to retrospectively justify its adequacy. The sensitivity analysis was based on the complete-sample paired design, the final number of analyzable paired observations, a two-tailed significance level of .05, and statistical power of .80. The minimum detectable paired effect was reported as Cohen's *d_z*. Because the subgroup analyses involved only 27 male and 25 female participants, their estimates were considered less precise than those obtained from the complete sample. Nonsignificant findings were not interpreted as evidence that no anthropometric change occurred. The primary analysis followed a complete-pair approach for each outcome. Participants with either a missing pretest or missing posttest value for a

particular outcome were excluded only from the paired analysis of that outcome. Missing anthropometric values were not replaced through single-value imputation. The amount and pattern of missing data, including the number of complete pairs for each outcome, were reported transparently. No intention-to-treat analysis or multiple imputation was claimed unless these procedures were supported by the original statistical records. Waist-circumference findings were interpreted with particular caution. The available electronic dataset retained only the final waist value for each measurement period and did not contain the separate repeated readings required to calculate intra-rater reliability, technical error of measurement, or smallest detectable change. Statistical significance was therefore not interpreted as evidence that the observed change exceeded measurement error, represented confirmed visceral-fat loss, or was caused exclusively by the exercise program. Estimated body-fat percentage was included in the final inferential analysis only after the posttest values, skinfold sites, and calculation method had been verified against the original assessment and calculation records. The available spreadsheet contained two unidentified skinfold-site columns and duplicated the pretest skinfold and body-fat entries in the posttest fields. If these discrepancies could not be resolved using original source records, body-fat percentage was excluded from confirmatory inferential analysis and reported as unverified. Attendance, actual session duration, achieved heart-rate exposure, exercise modifications, missed sessions, and adverse events were summarized using frequencies, percentages, means, standard deviations, or ranges when completed monitoring records were available. These variables were treated as descriptive indicators of intervention fidelity and safety. The prescribed frequency, duration, and intensity were not substituted for actual participant-level exposure. When completed monitoring records were unavailable, this information was identified as missing rather than estimated. All statistical tests were two-tailed. The nominal significance level was set at $\alpha = .05$, with Holm adjustment applied to the three primary anthropometric endpoints. Statistical significance was interpreted together with effect sizes, confidence intervals, measurement limitations, data completeness, and the single-group design. Accordingly, pretest-to-posttest differences were described as changes observed following participation and not as definitive causal effects of the exercise program.

3. Results

3.1 Distribution of the Pretest-to-Posttest Difference Scores

Shapiro-Wilk tests were applied to the individual pretest-to-posttest difference scores. Statistically significant departures from normality were found for BMI, $W = 0.810$, $p < .001$, and waist circumference, $W = 0.822$, $p < .001$. Therefore, two-tailed Wilcoxon signed-rank tests were used for the primary analyses. Table 3 indicates that non-parametric procedures were appropriate. The normality findings do not test whether the outcomes changed; they establish the analytical method used to evaluate those changes.

Table 3. Pretest–Posttest Differences in Body Mass Index

Outcome	Shapiro-Wilk W	p-value	Assessment
BMI	0.810	< .001	Evidence of departure from normality
Waist circumference	0.822	< .001	Evidence of departure from normality

Note: Normality was evaluated using difference scores calculated as posttest minus pretest. BMI = body mass index.

3.2 Primary Complete-Sample Anthropometric Analysis

As shown in Table 5, median BMI decreased from 26.60 kg/m² at pretest to 26.00 kg/m² at posttest. The median individual change was -0.70 kg/m². The Wilcoxon signed-rank test indicated a statistically significant difference, $W = 18.00$, unadjusted $p = 9.64 \times 10^{-10}$, with a rank-biserial correlation of -0.974 . Median waist circumference decreased from 85.00 cm to 81.00 cm. The median individual change was -3.00 cm. This difference was also statistically significant, $W = 0.00$, unadjusted $p = 4.19 \times 10^{-10}$, with a

rank-biserial correlation of -1.000 . One participant had no recorded waist-circumference change, while all participants with nonzero differences had lower posttest measurements. For descriptive comparability, mean BMI decreased from 27.89 kg/m^2 ($SD = 2.79$) to 26.98 kg/m^2 ($SD = 2.67$), while mean waist circumference decreased from 86.15 cm ($SD = 8.48$) to 82.67 cm ($SD = 8.81$). These means are supplementary descriptive statistics because the inferential conclusions were based on Wilcoxon signed-rank tests. The findings indicate downward shifts in the recorded BMI and waist-circumference distributions between the two assessment periods. Because the study lacked a control or comparison group, these differences represent changes observed following participation and do not establish that the program caused the changes.

Table 4. Primary Pretest-to-Posttest Anthropometric Changes in the Complete Sample

Outcome	<i>n</i>	Pretest median (IQR)	Posttest median (IQR)	Median change (IQR)	Wilcoxon <i>W</i>	Unadjusted <i>p</i>	Rank-biserial correlation
BMI, kg/m^2	52	26.60 (25.90–29.03)	26.00 (25.28–27.48)	-0.70 (-1.10 to -0.40)	18.00	9.64×10^{-10}	-0.974
Waist circumference, cm	52	85.00 (79.75–93.00)	81.00 (77.00–90.00)	-3.00 (-4.00 to -2.00)	0.00	4.19×10^{-10}	-1.000

Note: Note. Change was calculated as posttest minus pretest; negative values indicate reductions. *W* represents the smaller signed-rank sum. BMI = body mass index; IQR = interquartile range.

3.3 Multiplicity-Adjusted Primary Findings

The Holm procedure was applied to the two valid analyzable outcomes. As presented in Table 5, the Holm-adjusted *p*-values were 9.64×10^{-10} for BMI and 8.38×10^{-10} for waist circumference. Both differences remained statistically significant after controlling the familywise error rate. Table 6 confirms that the findings for BMI and waist circumference were not attributable to testing these two outcomes without multiplicity control. However, reducing the outcome family from three planned endpoints to two analyzable endpoints represents a deviation from the original analysis plan and does not provide evidence concerning body-fat percentage.

Table 5. Holm-Adjusted Results for the Final Analyzable Primary Outcomes

Outcome	Wilcoxon <i>W</i>	Unadjusted <i>p</i>	Holm-adjusted <i>p</i>	Decision
BMI, kg/m^2	18.00	9.64×10^{-10}	9.64×10^{-10}	Statistically significant
Waist circumference, cm	0.00	4.19×10^{-10}	8.38×10^{-10}	Statistically significant

Note: Estimated body-fat percentage was excluded because the retained posttest values and skinfold protocol could not be verified.

3.4 Exploratory Sex-Stratified Anthropometric Analyses

Exploratory analyses showed statistically significant reductions in BMI and waist circumference within both sex subgroups. Median BMI change was -0.90 kg/m^2 among male participants and -0.40 kg/m^2 among female participants. Median waist-circumference change was -3.00 cm in both subgroups. These within-subgroup findings describe changes over time but do not, by themselves, demonstrate that the magnitude of change differed by sex.

Table 6. Exploratory Sex-Stratified Anthropometric Changes

Outcome	Subgroup	<i>n</i>	Pretest median (IQR)	Posttest median (IQR)	Median change (IQR)	Wilcoxon <i>W</i>	<i>p</i> -value
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BMI, kg/m ²	Male	27	27.20 (26.35–30.45)	26.00 (25.50–28.10)	–0.90 (–1.10 to –0.70)	3.50	< .001
BMI, kg/m ²	Female	25	26.40 (25.80–27.20)	25.70 (25.20–26.80)	–0.40 (–0.80 to –0.30)	4.00	< .001
Waist circumference, cm	Male	27	90.00 (82.50–93.50)	84.00 (79.00–91.00)	–3.00 (–4.00 to –2.00)	0.00	< .001
Waist circumference, cm	Female	25	81.00 (79.00–89.00)	78.00 (76.00–85.00)	–3.00 (–4.00 to –2.00)	0.00	< .001

3.5 Exploratory Comparison of Anthropometric Changes by Sex

Direct comparisons of participant-level change scores were conducted using Mann-Whitney *U* tests. The distribution of BMI change differed between the subgroups, $U = 195.50$, $p = .009$, with a larger median reduction among male participants. This finding should be considered hypothesis-generating because the analysis was exploratory, used relatively small subgroups, and was not included in the multiplicity-adjusted primary family. Waist-circumference change did not differ by sex, $U = 329.50$, $p = .889$. Both subgroups had the same median change and interquartile range. Thus, the retained data did not provide evidence of a sex-related difference in waist-circumference change.

Table 7. Exploratory Sex-Stratified Anthropometric Changes

Outcome	Male median change (IQR)	Female median change (IQR)	Mann-Whitney <i>U</i>	<i>p</i> -value
BMI, kg/m ²	–0.90 (–1.10 to –0.70)	–0.40 (–0.80 to –0.30)	195.50	.009
Waist circumference, cm	–3.00 (–4.00 to –2.00)	–3.00 (–4.00 to –2.00)	329.50	.889

Note. These comparisons were secondary and exploratory. Negative values indicate lower posttest measurements.

3.7 Data and Measurement Limitations Affecting the Results

Estimated body-fat percentage was not analyzed because the posttest entries duplicated the pretest values and the documented skinfold procedure could not be verified. These duplicated values should not be interpreted as evidence that body-fat percentage remained unchanged. Formal intra-rater reliability, technical error of measurement, and smallest detectable change could not be calculated because the separate waist-circumference readings were not retained. The waist result may therefore have been influenced by tape placement, anatomical-landmark identification, respiration, hydration, abdominal distension, clothing, assessment timing, or assessor technique. The recorded waist reduction should not be interpreted as direct evidence of reduced visceral adipose tissue. Attendance, achieved intensity, actual session duration, exercise modifications, missed sessions, and adverse events could not be summarized because complete monitoring records were unavailable. The prescribed program therefore should not be interpreted as the exact exercise dose received by every participant, and neither full adherence nor the absence of adverse events can be confirmed.

4. Discussion

4.1 Anthropometric Changes

The reduction in BMI indicates that participants generally had lower body weight relative to height at posttest. This finding is broadly consistent with evidence that structured exercise may support weight management among individuals with overweight or obesity, although the magnitude of change varies according to exercise type, frequency, intensity, duration, and participant characteristics [5,11,13,18]. The progressive combination of aerobic and muscular-endurance activities may have increased physical activity and energy expenditure during the six-week period [10–12]. Nevertheless, energy expenditure, dietary intake, and physical activity outside the supervised sessions were not measured. These explanations should therefore be considered plausible interpretations rather than demonstrated mechanisms. BMI is a practical and widely used indicator of weight status, but it does not distinguish fat mass from fat-free mass or identify the anatomical distribution of body fat [11,12]. Consequently, the

recorded BMI reduction should be interpreted as a change in body weight relative to height rather than direct evidence of reduced adiposity. The inability to verify the body-fat data further limits conclusions regarding changes in body composition. Waist circumference also decreased between the pretest and posttest. This measure provides information about central body size that is not captured fully by BMI and is commonly used as a surrogate indicator of abdominal adiposity and cardiometabolic risk [5–7,11]. The concurrent reductions in BMI and waist circumference therefore present a consistent pattern across the two analyzable anthropometric outcomes. However, waist circumference is not a direct measure of visceral adipose tissue and should not be interpreted as confirmed visceral-fat loss. The waist-circumference finding requires additional caution because formal measurement-reliability estimates were unavailable. Waist measurements may be influenced by tape placement, anatomical-landmark identification, respiration, posture, hydration, abdominal distension, clothing, assessment timing, and assessor technique [11,12]. Because the separate readings were not retained, intra-rater reliability, technical error of measurement, and smallest detectable change could not be calculated. It was therefore not possible to establish whether the recorded reduction exceeded the expected measurement error. The large rank-biserial correlations indicate that the paired differences were strongly concentrated toward lower posttest values. These statistics describe the direction and consistency of the retained measurements, but they should not be interpreted as estimates of causal treatment effects. The unusually consistent waist-circumference changes should also be verified against the original assessment records before the dataset is considered final. Without a comparison group, the anthropometric changes cannot be separated from regression to the mean, measurement variability, dietary changes, sleep patterns, sedentary behavior, nonprogram physical activity, hydration, or other concurrent influences [29,30]. The findings consequently describe changes observed following participation rather than evidence of program effectiveness.

4.2 Exploratory Sex-Based Findings

BMI and waist circumference decreased within both sex subgroups. However, separate within-subgroup significance tests do not establish that the magnitude of change differed between the subgroups. Direct comparison of the individual change scores suggested a difference in the distribution of BMI change, with a larger median reduction among male participants. No corresponding difference was observed for waist circumference. The BMI finding should be regarded as hypothesis-generating because the analysis was exploratory, the subgroup sizes were relatively small, and the comparison was not included in the primary multiplicity-adjusted outcome family. The study also did not measure factors that could explain the observed difference, including attendance, achieved exercise intensity, diet, nonprogram physical activity, baseline body composition, and changes in lean tissue. It is therefore inappropriate to conclude that one subgroup responded better to the program. The absence of a sex-related difference in waist-circumference change indicates that the distributions of the recorded waist changes were comparable between the subgroups. Larger studies with prespecified subgroup hypotheses, sufficient statistical power, and direct interaction analyses are needed to determine whether anthropometric changes differ by sex [18,19].

4.3. Contextualization and Theoretical Interpretation

The program was contextualized by adapting exercise activities, workloads, and schedules according to participant capacity, exercise tolerance, safety considerations, available equipment, campus facilities, and academic schedules. Tailored physical-activity interventions may help address individual and environmental barriers to participation, particularly in settings where time, facilities, and exercise resources are limited [17–21]. The use of accessible exercises also demonstrates how a progressive FITT-based program may be implemented under ordinary university conditions [12]. The

study did not include a non-contextualized structured-exercise group. Therefore, the recorded changes cannot be attributed specifically to contextualization. They may reflect the combined influence of structured exercise, progressive workload, supervision, exercise content, participant expectations, and contextual adaptations. The study consequently documents the implementation of a resource-adapted program but does not establish that contextualization provides greater benefits than standard progressive exercise. Self-Determination Theory informed selected delivery features, including exercise alternatives, progressive tasks, feedback, and supervised group participation. These features are conceptually related to autonomy, competence, and relatedness, which may support sustained participation in physical activity [22,23]. However, these psychological constructs were not evaluated using verified participant-level longitudinal data. The available questionnaire contained only aggregate tallies and did not establish administration timing, individual scores, subscale reliability, or relationships with anthropometric outcomes. The study therefore cannot conclude that the program increased autonomy, competence, relatedness, motivation, enjoyment, or adherence. Self-Determination Theory should be treated as an intervention-design rationale rather than a tested explanatory or mediation model.

4.4. Data and Implementation Limitations

Estimated body-fat percentage was excluded because the retained posttest skinfold and body-fat entries duplicated the corresponding pretest values. The electronic dataset also contained only two unidentified skinfold-site columns, which was inconsistent with the documented three-site procedure. These discrepancies represent a data-verification problem and should not be interpreted as evidence that body-fat percentage remained unchanged. The absence of a verified body-fat outcome prevents the study from determining whether the BMI and waist-circumference changes were accompanied by changes in total or regional adiposity. BMI, waist circumference, and body-fat percentage represent related but distinct constructs and should not be treated as interchangeable measurements [11,12]. Complete intervention-monitoring records were also unavailable. Attendance, heart-rate exposure, actual session duration, exercise modifications, missed sessions, and adverse events could not be quantified. The prescribed program should therefore not be assumed to represent the exercise dose received by every participant. The available documentation establishes that the program was implemented, but it does not provide sufficient evidence to evaluate adherence, implementation fidelity, feasibility, or safety. Other limitations include purposive sampling from one university, lack of a comparison group, unavailable waist-measurement reliability estimates, unmonitored behavioral factors, and relatively small exploratory subgroups. These limitations restrict causal interpretation, statistical precision, and generalizability.

4.5. Implications and Future Research

The findings provide preliminary evidence that recorded BMI and waist circumference changed during the implementation of a six-week resource-adapted exercise program. Future studies should include a contextualized exercise condition, a standardized structured-exercise condition, and an appropriate comparison group. This design would help distinguish changes associated with structured exercise from any additional contribution of contextual adaptation. Future research should preserve all repeated anthropometric readings, document assessor identity, standardize assessment timing and participant preparation, and calculate intra-rater reliability, technical error of measurement, and smallest detectable change. Clearly defined body-composition procedures or more precise assessment methods should also be used [11,12]. Intervention fidelity should be documented through attendance, actual session duration, achieved heart rate or perceived exertion, exercise progression, modifications, missed sessions, and adverse events. Diet, sleep, sedentary behavior, and nonprogram activity

should also be monitored because these factors may influence anthropometric outcomes independently of supervised exercise [29,30]. Larger samples and prespecified interaction analyses are needed to examine possible sex-related differences.

5. Conclusions

Recorded BMI and waist circumference were significantly lower at posttest than at pretest among the 52 college students who participated in the six-week contextualized exercise training program. Both differences remained statistically significant after Holm adjustment for the final analyzable outcome family. Exploratory analyses showed reductions within both sex subgroups. A direct comparison suggested a possible sex-related difference in BMI change, but not in waist-circumference change. Because the subgroup analyses were exploratory, the BMI finding should be considered hypothesis-generating rather than confirmatory. These findings provide preliminary evidence of anthropometric changes during the period in which the resource-adapted program was implemented. However, the single-group pretest-posttest design does not establish that the exercise program caused the observed changes. The findings may also have been influenced by measurement variability, regression to the mean, dietary changes, sleep, sedentary behavior, nonprogram physical activity, hydration, and other concurrent factors. Estimated body-fat percentage could not be evaluated because the retained posttest values and skinfold-assessment procedure could not be verified. Formal waist-measurement reliability, intervention fidelity, achieved exercise dose, and adverse-event data were also unavailable. Consequently, the waist-circumference reduction should not be interpreted as confirmed visceral-fat loss, and the study cannot establish the program's adherence, feasibility, safety, or actual exercise exposure. The findings also do not demonstrate that contextualization provides benefits beyond standard progressive exercise or that Self-Determination Theory-related mechanisms influenced the outcomes. Future controlled studies should include an appropriate comparison group, verified body-composition assessment, standardized measurement-reliability procedures, behavioral monitoring, and complete intervention-fidelity and safety reporting.

Supplementary Materials: The supplementary files include the prescribed six-week exercise protocol (Table S1), session-delivery and modification procedures (Table S2), blank monitoring and adverse-event templates (Table S3), the de-identified dataset for the analyzable BMI and waist-circumference outcomes (Table S4), statistical outputs (Table S5), and authorized de-identified assessment forms (File S1). Unverified body-fat data and unavailable fidelity, reliability, and safety summaries are excluded. All personally identifiable, consent, medical-clearance, and medical-record information is withheld to protect participant confidentiality.

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Informed Consent Statement: Informed consent was obtained from all participants involved in the study. Before enrollment, participants received information regarding the study's purpose, procedures, duration, potential risks and benefits, confidentiality safeguards, and voluntary nature. Written informed consent was obtained before any study-specific assessment or intervention procedure was conducted.

Data Availability Statement: The de-identified data supporting the findings of this study are available from the corresponding author upon reasonable request. The dataset is not publicly available because it contains participant-level anthropometric information that is subject to institutional ethical approval, informed consent conditions, and privacy protections. Access may be granted for legitimate academic purposes following approval by the corresponding author and the relevant institutional authority, subject to an appropriate data-use agreement.

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