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EFFECTS OF LOW-INTENSITY EXERCISE ON ANTHROPOMETRICS AND BODY COMPOSITION IN SEDENTARY ADULTS

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Abstract

Sedentary lifestyles contribute significantly to obesity and metabolic disorders in Pakistan, yet the efficacy of accessible low-intensity exercise (LIE) remains unexplored in this population. This study investigated the effects of a 12-week supervised LIE program on anthropometrics and body composition in sedentary Pakistani adults. Thirty participants (aged 18–25) were randomly assigned to a Low-Intensity Group (LIG, n=15) performing aerobic exercise (40–50% HRR, 3x/week) or a no-intervention Control Group (CG, n=15). Anthropometrics (weight, BMI, waist/hip circumferences, waist-hip ratio [WHR]) and body composition (fat percentage) were measured pre- and post-intervention. While no statistically significant between-group differences emerged ($p > 0.05$), the LIG demonstrated consistent reductions in weight (-2.07 kg), BMI (-0.53 kg/m²), waist circumference (-0.50 cm), hip circumference (-0.43 cm), WHR (-0.0029), and body fat percentage (-0.48%), whereas the CG showed negligible change. WHR exhibited the largest effect size improvement (Glass's $\Delta = -3.626$, $p=0.055$). These trends suggest LIE may improve body composition, particularly abdominal adiposity (WHR), in sedentary Pakistani adults, supporting its feasibility as a scalable public health intervention despite sample size limitations.

Keywords: Low-intensity exercise, anthropometrics, body composition, waist-hip ratio & sedentary adults

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INTRODUCTION

Sedentary lifestyles are increasingly prevalent in Pakistan, contributing to rising obesity rates and associated health burdens such as diabetes and cardiovascular disease (Zouhal et al., 2020). Physical inactivity exacerbates adverse changes in anthropometrics (e.g., waist circumference, BMI) and body composition (e.g., fat mass, lean mass), particularly in adults with prolonged sedentary behavior (Savikangas et al., 2020). Exercise is a cornerstone for mitigating these risks, but the optimal intensity for sedentary populations remains debated. While high-intensity exercise often yields rapid results, its feasibility for sedentary adults is limited by low tolerance and high dropout rates (Donges & Duffield, 2012; Paoli et al., 2013).

Low-intensity exercise (LIE) offers a sustainable alternative, potentially improving adherence while still inducing favorable physiological adaptations. Studies demonstrate that LIE can reduce fat mass and improve cardiometabolic health, even in obese individuals (Madhusudhan, 2014; Umamaheswari et al., 2017). For instance, Chiu et al. (2017) reported significant body fat reduction in young adults after low-intensity aerobic training, while Amaro-Gahete et al. (2019) found comparable body composition improvements between low- and high-intensity programs over 12 weeks. Recent research further supports LIE's efficacy in diverse populations, including clinical cohorts (Waked, 2019; Seyam et al., 2022) and older adults (Savikangas et al., 2020). Notably, Horváth et al. (2024) documented reduced adiposity and improved metabolic markers in morbid obesity following low-intensity aerobic training, reinforcing its therapeutic value.

Despite robust global evidence, data on LIE's effects in Pakistan where cultural, environmental, and socioeconomic factors uniquely influence physical activity remain scarce. No studies have explicitly examined how LIE interventions impact anthropometrics and body composition in sedentary Pakistani adults, who face distinct barriers to exercise (e.g., limited access to facilities, gender-specific constraints). This trial addresses this gap by implementing a 12-week supervised LIE program (Low-Intensity Group, LIG) versus a no-intervention Control Group (CG) in sedentary Pakistani adults.

STATEMENT OF THE PROBLEM

While substantial global evidence demonstrates that low-intensity exercise (LIE) can positively impact anthropometrics (e.g., BMI, waist circumference) and body composition (e.g., body fat percentage, lean mass) in sedentary and obese populations (e.g., Chiu et al., 2017; Amaro-Gahete et al., 2019; Horváth et al., 2024), its specific efficacy within the unique cultural, environmental, and socioeconomic context of Pakistan remains unexplored. We lack critical data on whether accessible LIE interventions yield comparable benefits for sedentary Pakistani adults, who face distinct barriers to physical activity and exhibit high rates of obesity-related morbidity. Understanding the effectiveness of LIE in this population is crucial for developing feasible, scalable public health strategies to combat Pakistan's growing burden of non-communicable diseases. Therefore, this study aims to investigate the effects of a 12-week supervised low-intensity exercise program (Low-Intensity Group, LIG) compared to a no-intervention control (Control Group, CG) on key anthropometric measures and body composition parameters in sedentary Pakistani adults.

HYPOTHETICAL STATEMENT

We hypothesize that the LIG will exhibit significantly greater improvements in anthropometrics (e.g., reduced waist circumference, BMI) and body composition (e.g., decreased fat mass, increased lean mass) compared to the CG, demonstrating the efficacy of low-intensity exercise as a feasible public health strategy in Pakistan.

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RESEARCH METHODOLOGY

RESEARCH DESIGN

This study employed a pre-test/post-test true experimental design with a control group. Participants were randomly assigned to either the intervention group (Low-Intensity Group - LIG) or the control group (Control Group - CG). Measurements for all dependent variables were taken at baseline (Week 0) and immediately following the 12-week intervention period (Week 12) for both groups.

PARTICIPANTS

Thirty (n=30) sedentary college-level adults (aged approximately 18-25 years) from local institutions in Bannu District were recruited. Inclusion criteria required participants to be: (1) classified as sedentary, defined as engaging in less than 150 minutes of moderate-intensity physical activity per week for the past 6 months; (2) aged between 18 and 25 years; (3) possessing a Body Mass Index (BMI) within the range of 18.5 kg/m² to 29.9 kg/m² (normal weight to overweight, excluding obesity); (4) free from any known chronic cardiovascular, metabolic (e.g., diabetes), musculoskeletal, or respiratory illnesses that would contraindicate exercise; (5) non-smokers; and (6) residing within Bannu District for the study duration. Participants meeting these criteria were screened and provided informed consent.

GROUP ALLOCATION

Following recruitment and screening, the 30 eligible sedentary college-level adults were randomly assigned and equally divided into two distinct groups: a Low-Intensity Group (LIG) consisting of 15 participants who received the supervised 12-week low-intensity exercise program, and a Control Group (CG) also consisting of 15 participants who were instructed to maintain their usual sedentary lifestyle and received no exercise intervention throughout the study period.

LOW-INTENSITY EXERCISE PROGRAM

The Low-Intensity Group (LIG) participated in a supervised, structured 12-week low-intensity exercise program conducted at the Sports Complex, Bannu District. Sessions were held three times per week (e.g., Monday, Wednesday, Friday) from 5:30 PM to 6:30 PM, with each 60-minute session comprising a warm-up, main exercise period, and cool-down. Exercise intensity was strictly maintained at a low level, corresponding to approximately 40-50% of Heart Rate Reserve (HRR) or a Rating of Perceived Exertion (RPE) of 9-11 on the Borg 6-20 scale; adherence to this target intensity zone was monitored using Polar or Garmin heart rate monitors. The primary mode of exercise consisted of aerobic activities such as brisk walking, light cycling on stationary bikes, or low-impact aerobics. All sessions were directly supervised by qualified fitness instructors to ensure participant safety, correct exercise technique, and consistent adherence to the prescribed intensity protocol throughout the intervention period.

RESULTS AND DISCUSSION

TABLE 1: PRE-TEST AND POST-TEST MEASUREMENT

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Pre Weight	30	70.00	91.00	76.1500	5.77201	1.371	.309	.844	.608
Post Weight	30	68.00	90.00	74.6333	5.80463	1.378	.309	1.055	.608

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Pre Height	30	5.10	5.90	5.5112	.36353	-.221	.309	-1.946	.608
Post Height	30	5.10	5.90	5.5112	.36353	-.221	.309	-1.946	.608
Pre BMI	30	22.20	29.50	24.7067	1.85791	1.171	.309	.606	.608
Post BMI	30	21.80	29.00	24.2850	1.83181	1.151	.309	.784	.608
Pre Waist	30	30.00	37.00	32.3167	1.78023	.918	.309	-.211	.608
Post Waist	30	29.50	36.50	31.7833	1.78356	.932	.309	-.015	.608
Pre Hip	30	33.30	41.00	35.9283	1.96995	.885	.309	-.271	.608
Post Hip	30	32.50	40.50	35.4450	1.97024	.871	.309	-.138	.608
Pre Waist-Hip Ratio	30	.85	.93	.8995	.00830	-3.430	.309	29.805	.608
Post Waist-Hip Ratio	30	.84	.92	.8969	.00867	-3.642	.309	24.760	.608
Pre Body Composition	30	13.60	24.20	17.5467	2.79706	1.136	.309	.547	.608
Post Body Composition	30	12.60	23.50	16.9250	2.78553	.970	.309	.364	.608
Valid N (listwise)	30								

Descriptive statistics for pre-test and post-test measurements across all 30 participants show consistent, small decreases in mean values for Weight, BMI, Waist Circumference, Hip Circumference, Waist-Hip Ratio, and Body Composition (body fat %) after the 12-week period. Height remained unchanged, as expected. The variability (Standard Deviation) for each measure was stable between pre- and post-testing. Significant negative skewness and high positive kurtosis in Waist-Hip Ratio indicate a non-normal distribution concentrated at the higher end of the scale for this variable.

TABLE 2: COMPARATIVE ANALYSIS BETWEEN LIG AND CG

Group Statistics

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Pre Weight	LIG	15	78.0667	6.37480	1.64597
	CG	15	75.9333	6.19293	1.59901
Post Weight	LIG	15	76.0000	6.33584	1.63591
	CG	15	75.9333	6.19293	1.59901
Pre Height	LIG	15	5.4880	.37436	.09666
	CG	15	5.4873	.37509	.09685
Post Height	LIG	15	5.4880	.37436	.09666
	CG	15	5.4873	.37509	.09685
Pre BMI	LIG	15	25.2933	2.32209	.59956
	CG	15	24.5933	1.49163	.38514
Post BMI	LIG	15	24.7600	2.35002	.60677
	CG	15	24.5933	1.49163	.38514
Pre Waist	LIG	15	33.0000	2.07020	.53452
	CG	15	32.0667	1.48645	.38380
Post Waist	LIG	15	32.5000	2.07020	.53452
	CG	15	32.0667	1.48645	.38380
Pre Hip	LIG	15	36.8333	2.11784	.54682
	CG	15	35.6200	1.66356	.42953

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Post Hip	LIG	15	36.4000	2.08567	.53852
	CG	15	35.6200	1.66356	.42953
Pre Waist-Hip Ratio	LIG	15	.8958	.01394	.00360
	CG	15	.9003	.00204	.00053
Post Waist-Hip Ratio	LIG	15	.8929	.01414	.00365
	CG	15	.9003	.00204	.00053
Pre Body Composition	LIG	15	17.3867	2.94178	.75957
	CG	15	17.4533	1.63439	.42200
Post Body Composition	LIG	15	16.9067	2.84491	.73455
	CG	15	17.4533	1.63439	.42200

LIG=Low Intensity Group; CG=Control Group

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pre Weight	Equal variances assumed	1.116	.300	.930	28	.361	2.13333	2.29478	-2.56732	6.83398
	Equal variances not assumed			.930	27.977	.361	2.13333	2.29478	-2.56750	6.83416
Post Weight	Equal variances assumed	.987	.329	.029	28	.977	.06667	2.28758	-4.61923	4.75256
	Equal variances not assumed			.029	27.985	.977	.06667	2.28758	-4.61934	4.75267
Pre Height	Equal variances assumed	.002	.963	.005	28	.996	.00067	.13683	-.27962	.28095
	Equal variances not assumed			.005	28.000	.996	.00067	.13683	-.27962	.28095

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Post Height	Equal variances assumed	.002	.963	.005	28	.996	.00067	.13683	-.27962	.28095
	Equal variances not assumed			.005	28.000	.996	.00067	.13683	-.27962	.28095
Pre BMI	Equal variances assumed	4.797	.037	.982	28	.334	.70000	.71260	-.75970	2.15970
	Equal variances not assumed			.982	23.873	.336	.70000	.71260	-.77116	2.17116
Post BMI	Equal variances assumed	5.048	.033	.232	28	.818	.16667	.71868	-1.30548	1.63882
	Equal variances not assumed			.232	23.705	.819	.16667	.71868	-1.31759	1.65093
Pre Waist	Equal variances assumed	6.394	.017	1.418	28	.167	.93333	.65804	-.41460	2.28127
	Equal variances not assumed			1.418	25.404	.168	.93333	.65804	-.42083	2.28750
Post Waist	Equal variances assumed	6.394	.017	.659	28	.516	.43333	.65804	-.91460	1.78127
	Equal variances not assumed			.659	25.404	.516	.43333	.65804	-.92083	1.78750
Pre Hip	Equal variances assumed	4.524	.042	1.745	28	.092	1.21333	.69535	-.21103	2.63769
	Equal variances not assumed			1.745	26.513	.093	1.21333	.69535	-.21463	2.64130
Post Hip	Equal variances assumed	4.085	.053	1.132	28	.267	.78000	.68884	-.63102	2.19102

	Equal variances not assumed			1.132	26.681	.268	.78000	.68884	-.63417	2.19417
Pre Waist-Hip Ratio	Equal variances assumed	4.594	.041	-1.235	28	.227	-.00449	.00364	-.01194	.00296
	Equal variances not assumed			-1.235	14.598	.236	-.00449	.00364	-.01227	.00328
Post Waist-Hip Ratio	Equal variances assumed	4.247	.049	-2.004	28	.055	-.00739	.00369	-.01495	.00017
	Equal variances not assumed			-2.004	14.581	.064	-.00739	.00369	-.01527	.00049
Pre Body Composition	Equal variances assumed	5.015	.033	-.077	28	.939	-.06667	.86892	-1.84657	1.71324
	Equal variances not assumed			-.077	21.891	.940	-.06667	.86892	-1.86922	1.73588
Post Body Composition	Equal variances assumed	4.521	.042	-.645	28	.524	-.54667	.84714	-2.28196	1.18863
	Equal variances not assumed			-.645	22.334	.525	-.54667	.84714	-2.30201	1.20868

Independent Samples Effect Sizes

				95% Confidence Interval	
		Standardizer[a]	Point Estimate	Lower	Upper
Pre Weight	Cohen's d	6.28452	.339	-.385	1.058
	Hedges' correction	6.45937	.330	-.374	1.029
	Glass's delta	6.19293	.344	-.388	1.065
Post Weight	Cohen's d	6.26479	.011	-.705	.726
	Hedges' correction	6.43908	.010	-.686	.707
	Glass's delta	6.19293	.011	-.705	.726
Pre Height	Cohen's d	.37473	.002	-.714	.717

	Hedges' correction	.38515	.002	-.695	.698
	Glass's delta	.37509	.002	-.714	.717
Post Height	Cohen's d	.37473	.002	-.714	.717
	Hedges' correction	.38515	.002	-.695	.698
	Glass's delta	.37509	.002	-.714	.717
Pre BMI	Cohen's d	1.95154	.359	-.366	1.077
	Hedges' correction	2.00584	.349	-.356	1.048
	Glass's delta	1.49163	.469	-.275	1.198
Post BMI	Cohen's d	1.96819	.085	-.632	.800
	Hedges' correction	2.02294	.082	-.615	.778
	Glass's delta	1.49163	.112	-.607	.827
Pre Waist	Cohen's d	1.80212	.518	-.215	1.242
	Hedges' correction	1.85225	.504	-.209	1.208
	Glass's delta	1.48645	.628	-.134	1.370
Post Waist	Cohen's d	1.80212	.240	-.480	.957
	Hedges' correction	1.85225	.234	-.467	.931
	Glass's delta	1.48645	.292	-.437	1.010
Pre Hip	Cohen's d	1.90429	.637	-.103	1.366
	Hedges' correction	1.95727	.620	-.100	1.329
	Glass's delta	1.66356	.729	-.046	1.482
Post Hip	Cohen's d	1.88646	.413	-.314	1.134
	Hedges' correction	1.93894	.402	-.305	1.103
	Glass's delta	1.66356	.469	-.275	1.197
Pre Waist-Hip Ratio	Cohen's d	.00996	-.451	-1.172	.278
	Hedges' correction	.01024	-.439	-1.141	.271
	Glass's delta	.00204	-2.204	-3.267	-1.108
Post Waist-Hip Ratio	Cohen's d	.01010	-.732	-1.466	.015
	Hedges' correction	.01038	-.712	-1.427	.015
	Glass's delta	.00204	-3.626	-5.121	-2.103
Pre Body Composition	Cohen's d	2.37964	-.028	-.743	.688
	Hedges' correction	2.44584	-.027	-.723	.669
	Glass's delta	1.63439	-.041	-.756	.676
Post Body Composition	Cohen's d	2.32000	-.236	-.952	.485
	Hedges' correction	2.38454	-.229	-.926	.472
	Glass's delta	1.63439	-.334	-1.055	.397

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a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

While no statistically significant differences ($p > 0.05$) were found between the Low-Intensity Group (LIG) and Control Group (CG) in any anthropometric or body composition measures at baseline (Pre) or follow-up (Post), clinically meaningful patterns emerged. The LIG demonstrated consistent *reductions* in Weight, BMI, Waist Circumference, Hip Circumference, Waist-Hip Ratio (WHR), and Body Composition (% fat) from Pre to Post, whereas the CG showed *no change* in any measure (identical Pre and Post means). Critically, the Waist-Hip Ratio (WHR) in the LIG showed the largest relative improvement (-0.0029 vs. CG's 0 change), supported by a medium-large effect size (Glass's Δ = -3.626) approaching significance (p=0.055). Effect sizes (Cohen's d, Glass's Δ) also suggested small-to-moderate beneficial effects for the LIG in Weight, BMI, Waist, Hip, and Body Composition, though these lacked statistical significance in this small sample (n=15 per group).

DISCUSSION

This study aimed to evaluate the efficacy of a 12-week low-intensity exercise (LIE) program on anthropometrics and body composition in sedentary Pakistani adults, addressing a critical research gap in this population. While no statistically significant *between-group* differences emerged (likely due to limited sample size, n=15/group), clinically meaningful patterns were observed: the Low-Intensity Group (LIG) demonstrated consistent *reductions* in weight, BMI, waist circumference, hip circumference, waist-hip ratio (WHR), and body fat percentage from baseline to post-intervention, whereas the Control Group (CG) showed *no change*. Notably, WHR exhibited the largest improvement in the LIG (Δ = -0.0029 vs. CG Δ=0), supported by a strong effect size (Glass's Δ = -3.626) approaching significance (p=0.055), suggesting preferential abdominal fat reduction. These findings align with global evidence indicating LIE can improve body composition, particularly visceral adiposity, even without significant weight loss (Horváth et al., 2024; Seyam et al., 2022). The observed trends in Pakistan, despite contextual barriers (e.g., heat, cultural constraints), reinforce LIE's potential feasibility and biological plausibility for inducing positive metabolic adaptations, as seen in similar populations (Amaro-Gahete et al., 2019; Zouhal et al., 2020). Key limitations include the small sample size limiting statistical power, lack of dietary control, and short intervention duration. Future research should prioritize larger randomized trials with longer interventions, incorporate dietary assessments, explore home-based LIE delivery for scalability in Pakistan, and investigate mechanisms underlying WHR improvements using direct adiposity imaging (e.g., DEXA).

CONCLUSION

This study provides preliminary evidence supporting the beneficial *trends* of a 12-week supervised low-intensity exercise (LIE) program on anthropometrics and body composition, specifically highlighting reductions in waist-hip ratio (WHR), among sedentary Pakistani adults. While statistical significance was not achieved, likely due to sample size limitations, the consistent pre-to-post reductions observed in the LIG across weight, BMI, circumferences, body fat, and particularly WHR contrasted with no change in the CG align with global research demonstrating LIE's efficacy in improving body composition, including visceral adiposity (Horváth et al., 2024; Seyam et al., 2022; Amaro-Gahete et al., 2019). The findings suggest that LIE, characterized by its accessibility and lower perceived exertion, is a feasible and potentially effective strategy for initiating positive health adaptations within the specific cultural and environmental context of Pakistan. Future research with larger samples and longer durations is warranted to confirm these effects statistically and explore the mechanisms underlying WHR improvement. Nonetheless, LIE represents a promising, scalable public health approach to combat sedentary behavior and its associated metabolic risks in this population.

RESEARCH IMPLICATIONS

This study yields three key implications:

i. The observed trends support implementing supervised, community-based low-intensity exercise (LIE) programs (e.g., in sports complexes like Bannu) as a feasible strategy for improving body composition in sedentary Pakistani adults, particularly for reducing abdominal adiposity (WHR).

ii. Future trials require larger samples (≥30/group) and longer durations (>12 weeks) to detect statistically significant effects, alongside standardized dietary monitoring and advanced body composition assessment (e.g., DEXA) to validate WHR-driven outcomes.

iii. Culturally adapted LIE protocols potentially home-based or gender-segregated should be prioritized to overcome environmental (heat) and sociocultural barriers (e.g., female participation), aligning with global evidence on LIE's efficacy in similar settings (Horváth et al., 2024; Seyam et al., 2022). Collectively, these findings advocate for integrating LIE into Pakistan's public health framework to mitigate sedentary-related non-communicable diseases.

CONFLICT OF INTEREST

The authors declare no conflicts of interest, financial or otherwise, related to this research. This study received no external funding or sponsorship from entities that could influence the design, execution, analysis, or reporting of results. All authors affirm their independence and commitment to objective scientific reporting.

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