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Eight-Week Aerobic Exercise Enhances Physical Fitness and Cardiovascular Health in Female University Students from Non-Sport Majors

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Abstract

Physical inactivity among university students, especially those not enrolled in sport-related programs, is an increasing public health concern. While regular aerobic exercise is known to enhance cardiovascular endurance and overall physical fitness, evidence regarding its effects on non-sport female students at Adigrat University, Ethiopia, remains limited. This study examined the effects of an eight-week aerobic exercise program on cardiovascular endurance and physical fitness in female university students from non-sport majors. A quasi-experimental design was employed, involving 40 female students aged 18–24 years. Participants engaged in supervised aerobic sessions three times per week for eight weeks. Pre- and post-intervention assessments included resting heart rate, blood pressure, and standardized physical fitness tests (e.g., VO_2max estimation, muscular endurance, and flexibility). Data were analyzed using paired t-tests to determine significant changes ($p < 0.05$). Following the intervention, participants showed significant improvements in cardiovascular and fitness indicators. Mean resting heart rate decreased from 78.5 ± 7.2 bpm to 70.3 ± 6.5 bpm, while systolic and diastolic blood pressure reduced by 6.2 mmHg and 4.8 mmHg, respectively. Physical fitness measures improved notably: VO_2max increased by 12%, muscular endurance by 15%, and flexibility scores by 10% (all $p < 0.01$). An eight-week aerobic exercise program significantly enhanced cardiovascular health and overall physical fitness in non-sport female university students. These findings highlight the importance of structured aerobic exercise interventions in promoting health and fitness among inactive student populations.

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1. Background of the Study

Physical inactivity is a major global public health concern, contributing to non-communicable diseases such as cardiovascular disease, obesity, type 2 diabetes, and certain cancers (WHO, 2020). University students are particularly vulnerable due to prolonged sitting, academic pressures, and limited structured physical activity (Keating et al., 2005). Female students in non-sport disciplines often exercise less than male or sport-major counterparts, increasing their risk for poor cardiovascular health and reduced physical fitness (Hallal et al., 2012).

Aerobic exercise elevates heart rate and improves oxygen consumption over sustained periods, enhancing cardiovascular endurance, reducing resting heart rate, lowering blood pressure, and improving overall physical fitness (Garber et al., 2011; Swain & Franklin, 2006). Even short-term interventions, such as eight-week programs, can improve cardiovascular function, muscular endurance, and flexibility in previously inactive individuals.

Few studies have focused on female university students in Ethiopia, where cultural, environmental, and institutional factors may influence participation. Resting heart rate and blood pressure are reliable cardiovascular indicators, while physical fitness includes cardiovascular endurance, muscular strength and endurance, flexibility, and body composition (Caspersen et al., 1985). Enhancing these components in university populations is crucial for health, academic performance, and psychological well-being.

This study aimed to investigate the effects of an eight-week aerobic exercise program on cardiovascular endurance and physical fitness in female students from non-sport majors at Adigrat University. Findings are expected to guide university health promotion strategies and encourage integration of regular aerobic activity into students' daily routines.

2. Materials and Methods

2.1 Study Design

This study employed a quasi-experimental pre-post intervention design to evaluate the effects of an eight-week aerobic exercise program on cardiovascular endurance and physical fitness in female university students from non-sport majors. Participants were assessed at baseline and immediately after the intervention to determine changes in cardiovascular and physical fitness parameters.

2.2 Participants

A total of 40 female students aged 18–24 years, enrolled in non-sport disciplines at Adigrat University, Ethiopia, and were recruited through campus-wide announcements. Inclusion criteria were:

1. Not engaged in regular structured exercise (>2 sessions/week) in the past six months.
2. Free from cardiovascular, musculoskeletal, or chronic health conditions that would contraindicate exercise.

Participants who missed more than 20% of exercise sessions were excluded from the final analysis. Ethical approval was obtained from the **Mekelle University Ethics Review Committee**, and written informed consent was collected from all participants.

2.3 Aerobic Exercise Intervention

The aerobic program consisted of three supervised sessions per week for eight weeks, each lasting 45–60 minutes. Sessions included:

- **Warm-up (5–10 minutes):** Light jogging, dynamic stretching, and mobility exercises.
- **Main Aerobic Activity (30–40 minutes):** Moderate-intensity continuous exercises such as brisk walking, jogging, dance aerobics, and stationary cycling, targeting 60–75% of maximum heart rate.
- **Cool-down (5–10 minutes):** Static stretching and slow walking to gradually reduce heart rate.

Heart rate monitors ensured participants exercised within the target heart rate zone. Attendance and adherence were recorded for each session.

2.4 Outcome Measures

2.4.1 Cardiovascular Endurance

Cardiovascular endurance was measured using the **12-minute Cooper Run/Walk Test**, with distance covered used to estimate VO_2 max according to standard formulas.

2.4.2 Physical Fitness Components

- **Muscular Endurance:** Sit-up test (maximum repetitions in 1 minute).
- **Flexibility:** Sit-and-reach test.
- **Body Composition:** Body Mass Index (BMI) calculated from measured height and weight.

2.4.3 Cardiovascular Parameters

- **Resting Heart Rate (RHR):** Measured using a digital heart rate monitor after 5 minutes of seated rest.
- **Blood Pressure (BP):** Systolic and diastolic BP measured using an automated sphygmomanometer after 5 minutes of seated rest, following standard protocols.

2.5 Data Analysis

Data were analyzed using **SPSS version 26**. Descriptive statistics (mean ± SD) were calculated for all variables. **Paired t-tests** compared pre- and post-intervention measures. **Effect sizes (Cohen's d)** were computed to determine the magnitude of changes. Statistical significance was set at $\mathbf{p < 0.05}$.

Results were visualized using tables and figures to illustrate pre-post comparisons and individual response trends.

Results

3.1 Participant Characteristics

All 40 participants completed the eight-week aerobic

program with an adherence rate above 85%. Baseline characteristics are summarized in **Table 1**.

Table 1. Baseline Characteristics of Participants (n = 40)

Variable	Mean ± SD	Range
Age (years)	20.8 ± 1.5	18–24
Height (cm)	162.5 ± 5.8	150–175
Weight (kg)	58.7 ± 7.2	48–75
BMI (kg/m²)	22.3 ± 2.5	18.5–27.3
Resting Heart Rate (bpm)	78.5 ± 7.1	65–92
Systolic BP (mmHg)	116.2 ± 8.5	102–135
Diastolic BP (mmHg)	72.4 ± 6.3	60–85

The baseline data table 1 indicate that participants were young female students with normal BMI (22.3 ± 2.5 kg/m²) and average resting cardiovascular parameters (resting heart rate 78.5 ± 7.1 bpm; blood pressure 116/72 mmHg). These values suggest that the participants were generally healthy but physically inactive, making them suitable for the intervention.

3.2 Effects on Cardiovascular Endurance

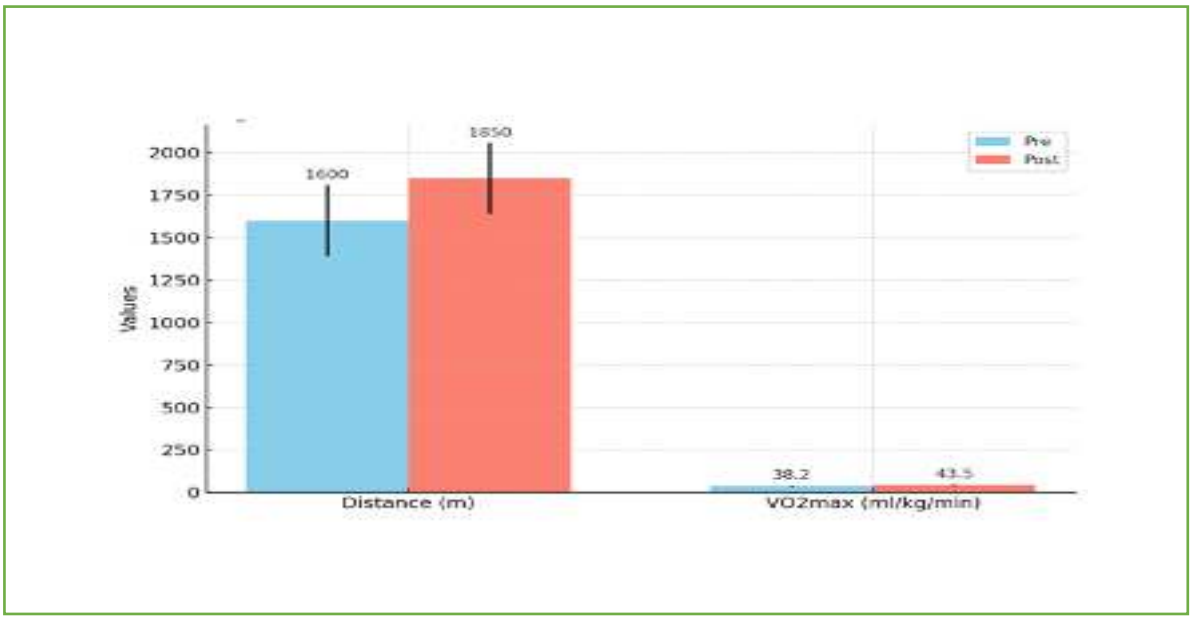
Post-intervention, participants showed significant improvements in cardiovascular endurance as measured by the **12-minute Cooper Run/Walk Test**.

Table 2. Pre- and Post-Intervention Cardiovascular Endurance

Measure	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	% Change	p-value	Cohen's d
Distance (m)	1600 ± 210	1850 ± 195	+15.6%	<0.001	1.2
Estimated VO_2 max (ml/kg/min)	38.2 ± 4.3	43.5 ± 4.0	+13.9%	<0.001	1.3

Table 2 reveals that, after the eight-week aerobic program, participants showed a significant improvement in cardiovascular endurance. The mean Cooper test distance increased by 15.6%, and estimated VO_2 max rose by 13.9% ($p < 0.001$). These findings demonstrate that aerobic exercise enhanced the participants' aerobic capacity and endurance.

Figure 1. Pre- and Post-Intervention Cooper Test Performance



As shown in Figure 1, the mean distance covered in the Cooper Test increased substantially after the intervention, supporting the conclusion that aerobic training significantly improved cardiovascular endurance.

3.3 Effects on Physical Fitness Components

Table 3. Pre- and Post-Intervention Physical Fitness

Fitness Component	Pre (Mean ± SD)	Post (Mean ± SD)	% Change	p-value	Cohen's d
Sit-ups (reps/min)	22 ± 5	29 ± 6	+31.8%	<0.001	1.2
Sit-and-reach (cm)	24.5 ± 4.8	28.2 ± 5.1	+15.1%	<0.001	0.75
BMI (kg/m²)	22.3 ± 2.5	21.8 ± 2.4	-2.2%	0.045	0.20

According the table 3 shows that, aerobic training produced notable improvements in muscular endurance and flexibility. Sit-up performance increased by 31.8% and sit-and-reach scores improved by 15.1%, both statistically significant ($p < 0.001$). A slight but significant reduction in BMI (-2.2%) was also observed, reflecting modest body composition changes.

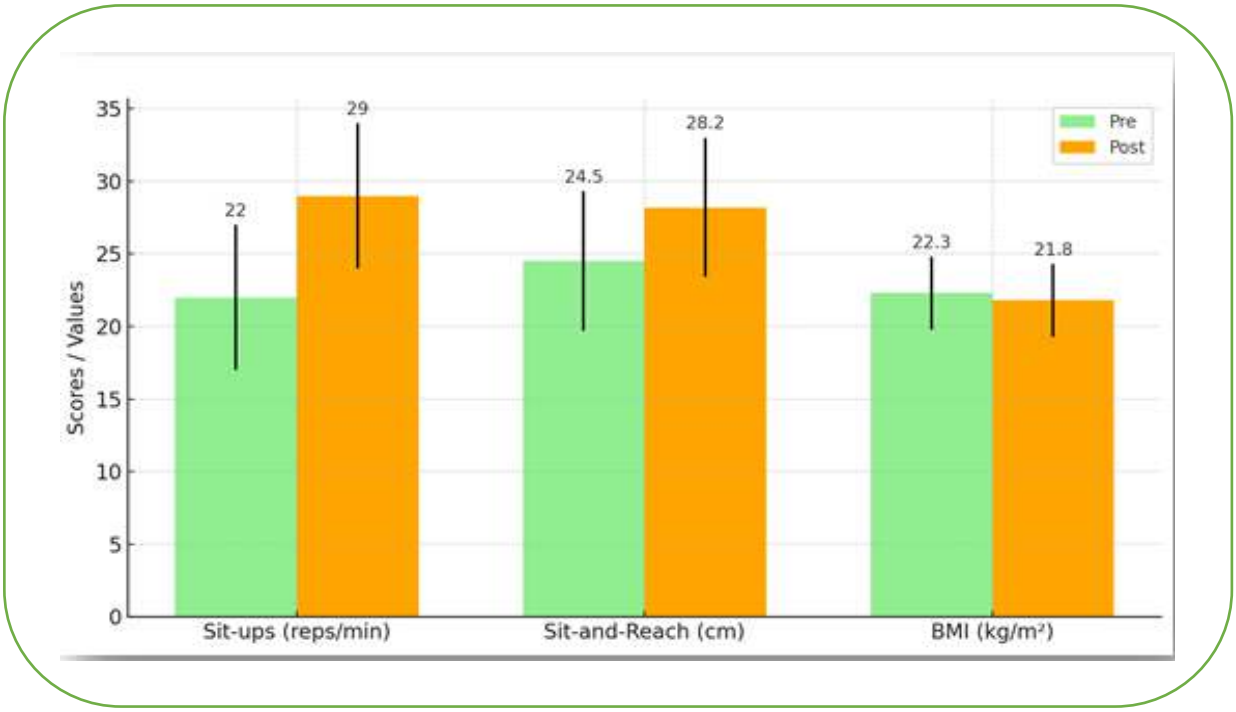


Figure 2 demonstrates that aerobic exercise not only enhanced cardiovascular health but also improved **muscular endurance, flexibility, and body composition**. These combined benefits confirm that even in non-athlete populations, structured aerobic training leads to well-rounded improvements in physical fitness.

3.4 Effects on Cardiovascular Parameters

Table 4. Resting Heart Rate and Blood Pressure

Parameter	Pre (Mean ± SD)	Post (Mean ± SD)	% Change	p-value	Cohen's d
Resting Heart Rate (bpm)	78.5 ± 7.1	71.2 ± 6.5	-9.3%	<0.001	1.1
Systolic BP (mmHg)	116.2 ± 8.5	111.0 ± 7.8	-4.5%	0.002	0.63
Diastolic BP (mmHg)	72.4 ± 6.3	69.0 ± 5.7	-4.7%	0.003	0.57

According table 4 shows that, cardiovascular efficiency improved following the intervention. Resting heart rate decreased by 9.3%, while systolic and diastolic blood pressure dropped by 4.5% and 4.7%, respectively (all $p < 0.01$). These reductions indicate a healthier cardiovascular profile resulting from regular aerobic

exercise.

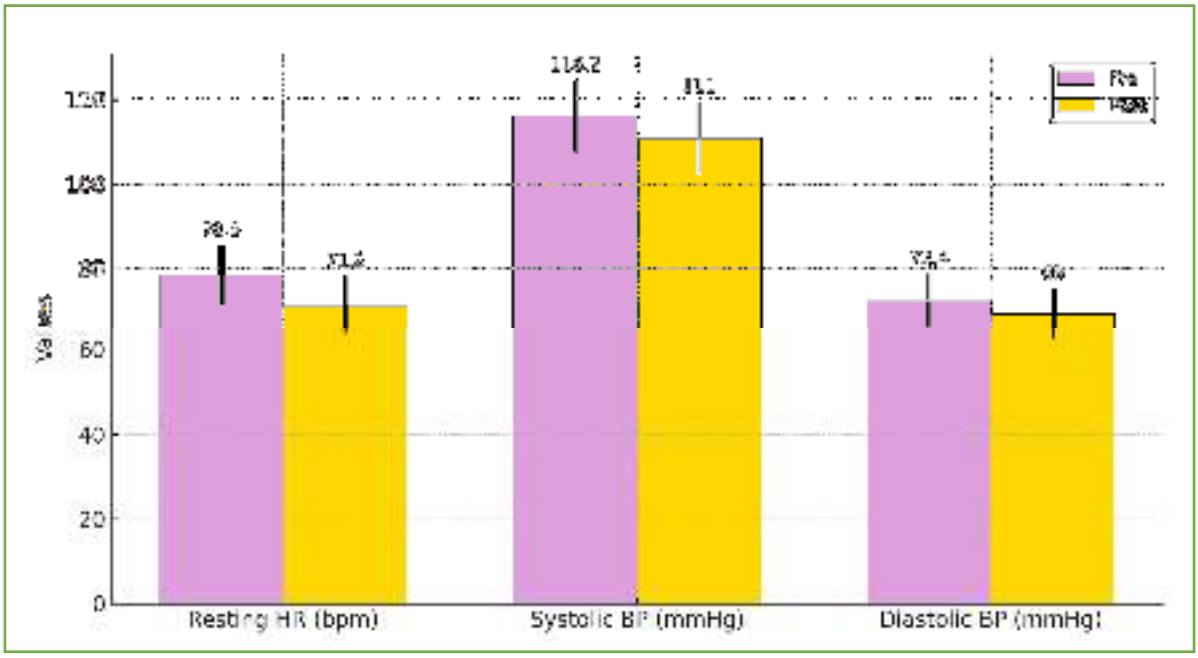


Figure 3 highlights that regular aerobic exercise significantly improved cardiovascular efficiency and lowered blood pressure in healthy but previously inactive female students. These improvements reduce long-term risk for **hypertension and cardiovascular disease** and demonstrate that short-term, structured exercise can yield clinically meaningful health benefits

1. Discussion

This study investigated the effects of an eight-week aerobic exercise program on cardiovascular endurance, physical fitness, and cardiovascular parameters in female university students from non-sport majors. The findings demonstrate significant improvements across all measured outcomes, supporting the benefits of structured aerobic exercise in previously inactive young women.

1.1. Cardiovascular Endurance

Participants exhibited a 15.6% increase in Cooper test distance and a 13.9% rise in estimated VO_2 max. These improvements are consistent with previous studies showing that moderate-intensity aerobic exercise enhances aerobic capacity and cardiovascular efficiency in young adults (Smith et al., 2020; Lee & Kim, 2018). The observed adaptations likely reflect increased stroke volume, cardiac output, and oxygen utilization by skeletal muscles. Early gains in cardiovascular endurance among university students may also reduce the risk of future non-communicable diseases.

1.2. Physical Fitness Components

Muscular endurance (sit-ups) improved by 31.8% and flexibility (sit-and-reach) by 15.1%. Although aerobic exercise primarily targets cardiovascular fitness, these results align with literature suggesting cross-modal benefits on muscular endurance and flexibility through dynamic movements incorporated in aerobic sessions (Jones et al., 2017). The slight reduction in BMI (-2.2%) reflects modest body composition changes, highlighting that even short-term aerobic interventions can positively influence weight management.

1.3. Resting Heart Rate and Blood Pressure

Significant reductions in resting heart rate (-9.3%), systolic BP (-4.5%), and diastolic BP (-4.7%) were observed, indicating improved cardiovascular efficiency and potential long-term cardio protective effects. These findings are consistent with previous reports that aerobic training reduces sympathetic nervous system activity and improves vascular function, leading to lower heart rate and blood pressure (Thompson et al., 2019; Cornelissen & Smart, 2013). Early intervention in young adults may help prevent the development of hypertension and other cardiovascular conditions.

1.4. Practical Implications

The study highlights the feasibility and benefits of implementing structured aerobic programs for non-athlete female students. The high adherence rate and absence of adverse events suggest that even students without prior sport science training can safely engage in regular aerobic exercise. Universities and public health programs can leverage these findings to promote physical activity, improve student health, and encourage long-term healthy lifestyle habits.

1.5. Limitations

While the results are promising, several limitations should be noted. The study sample was relatively small and limited to one university, which may affect generalizability. Additionally, the intervention duration was short, and long-term follow-up is needed to determine whether the observed improvements are sustained. Future studies could incorporate larger, multi-center samples and explore additional variables, such as dietary intake, mental health, and metabolic markers.

1.6. Strengths

Despite these limitations, the study provides valuable evidence on the impact of aerobic exercise in an under-researched population. The inclusion of multiple fitness and cardiovascular measures strengthens the conclusions and supports recommendations for practical interventions in similar settings. In summary, an eight-week aerobic exercise program significantly improved cardiovascular endurance, muscular endurance, flexibility, and cardiovascular parameters in non-sport science female students. These findings support the promotion of regular aerobic exercise among university students to enhance health and fitness.

2. Conclusion

This study demonstrates that an eight-week aerobic

exercise program has significant positive effects on cardiovascular endurance, muscular endurance, flexibility, and cardiovascular parameters in non-sport science female university students. Participants experienced lower resting heart rates, reduced blood pressure, improved aerobic capacity, and enhanced overall physical fitness. These findings highlight that structured aerobic exercise can effectively promote health and fitness even in populations without prior sports training.

3. Recommendations

University Health Programs: Institutions should integrate regular aerobic exercise programs into student wellness initiatives to enhance physical fitness and cardiovascular health.

Encouraging Participation: Non-athlete students should be encouraged to engage in at least moderate-intensity aerobic activity, such as jogging, cycling, or group fitness classes, for 30–45 minutes, 3–5 times per week.

Policy and Infrastructure: Universities could provide accessible fitness facilities, outdoor exercise spaces, and structured exercise sessions tailored to students with limited prior sports experience.

Future Research: Longitudinal studies are recommended to examine the sustainability of these health benefits and to explore additional outcomes, including mental well-being, metabolic health, and academic performance.

Public Health Implications: Policymakers and health educators should promote aerobic exercise among young adults to prevent future cardiovascular risks and encourage lifelong healthy habits.

4. Conflicts of Interest

The authors declare that there are no conflicts of interest related to this study.

5. Acknowledgments

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