



Comparative Study of Suryanamaskar, Pranayam and Aerobics on selected Physiological Variables

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ABSTRACT

Background: This experimental investigation explored how different yoga (suryanamaskar; pranayam) and aerobics-based training routines influence resting heart rate (RHR) and blood pressure (BP) in school children aged 13–16 years. **Purpose:** Seventy-five students were randomly allocated into five groups of fifteen each: suryanamaskar practice (SP), pranayam practice (PP), aerobics practice (AP), combined practice (CP = suryanamaskar + pranayama + aerobics), and control group (CG). **Methods:** The four training groups participated in an 8-week program consisting of 5 sessions per week, each lasting 30–35 minutes, while the control group continued their regular school activities. Resting heart rate, systolic blood pressure (SBP), and diastolic blood pressure (DBP) were measured using a standard digital monitor. Paired t-tests were used to examine within-group changes, and one-way ANOVA assessed post-test differences among groups. **Results:** All intervention groups showed meaningful improvements in at least one cardiovascular parameter. Both suryanamaskar and pranayam groups recorded declines in RHR (SP: $82.4 \pm 5.1 \rightarrow 78.2 \pm 4.7$ bpm; PP: $81.9 \pm 4.9 \rightarrow 78.6 \pm 4.5$ bpm). The aerobics group



demonstrated reductions in SBP ($114.3 \pm 7.0 \rightarrow 110.1 \pm 6.8$ mmHg) and DBP ($73.6 \pm 4.8 \rightarrow 71.3 \pm 4.5$ mmHg). The combined group achieved the most consistent improvements across all variables, with RHR decreasing from 82.7 ± 5.3 to 77.9 ± 4.4 bpm, SBP from 113.8 ± 6.7 to 108.0 ± 6.3 mmHg, and DBP from 72.9 ± 4.6 to 69.1 ± 4.1 mmHg. The control group showed negligible change. ANOVA confirmed significant post-test differences among groups for RHR ($F(4,70) = 19.84, p < .001$), SBP ($F(4,70) = 11.06, p < .001$), and DBP ($F(4,70) = 6.92, p < .001$). **Conclusion:** Combined training produced the greatest overall improvements in cardiovascular health, while individual practices showed selective benefits. These findings suggest that integrating yoga and aerobics provides a more effective strategy for enhancing cardiovascular fitness among school children.

INTRODUCTION

Cardiorespiratory health during childhood plays one of the fundamental role in determining long-term wellbeing. As early onset of elevated resting heart rate (RHR) and blood pressure (BP) increases the risk of hypertension and metabolic diseases in adulthood (Berenson et al., 2005). Sedentary lifestyle patterns, increased screen time and declining participation in structured physical activity have further contributed to reduced cardiovascular fitness among school-aged children (Strong et al., 2005). Schools therefore, serve as an essential setting for implementing preventive physical activity programs that can support Physiological regulation and promote healthy growth.

Yoga and Aerobics are two widely adopted modalities in school-based physical education, each offering distinct Physiological benefits. Yoga practices—including SP, PP and various postures—are known to improve autonomic balance, reduce sympathetic activation and enhance vagal tone, thereby lowering RHR and BP (Telles & Singh, 2013; Tyagi & Cohen, 2016). Regular yogic practice has been shown to positively influence baroreflex sensitivity, respiration rate and stress regulation, making it particularly suitable for children experiencing academic or emotional pressures (Nagarathna et al., 2015).

AP on the other hand is widely recognized for its ability to strengthen the cardiovascular system, increase stroke volume and improve endothelial function (Ortega et al., 2008). Such as rhythmic aerobic routines have been reported to significantly reduce SBP and DBP and improve overall cardiorespiratory



endurance in youth (Janssen & LeBlanc, 2010). Aerobics also contributes to improved cardiac output and efficient oxygen utilization which can lead to lower resting Physiological values when practiced consistently.

Although both Yoga and Aerobics are individually beneficial, there is growing interest in integrating these approaches for more comprehensive health outcomes. Studies combining yogic practices with aerobic movement have demonstrated additive effects on autonomic stability, cardiovascular efficiency and emotional wellbeing in children and adolescents (Cramer et al., 2016). However, limited research has compared the relative impact of different yogic components—such as SP and PP—against AP and CP on cardiovascular parameters among school children.

Given these gaps, the present study aimed to compare the effects of suryanamaskar (SP), pranayama (PP), aerobics (AP), combined Training (CP; suryanamaskar + pranayama + aerobics) program on resting heart rate (RHR) and blood pressure (BP) in school children aged 13–16 years. By using a five-group experimental design over eight weeks, this research intends to identify which modality or combination provides the most meaningful improvement in cardiovascular efficiency. The findings are expected to contribute valuable insights for Physical Education programming and the development of Holistic health interventions within school settings.

Methodology

Participants

A total of seventy-five students aged 13–16 years were selected from a school using random sampling methods. Participants were then assigned equally into five groups (n = 15 each): (SP), (PP), (AP), (CP) and a (CG). Prior to participation, all students underwent basic health screening and submitted written consent from their parents or guardians.

Design

The study employed a pre-test/post-test experimental design consisting of five parallel groups. The training program lasted for eight weeks, with each intervention delivered five days per week. Individual training sessions were structured to last approximately 35 minutes including preparation and recovery phases. All groups completed pre-intervention and post-intervention physiological assessments under standardized conditions.

Intervention Details



Suryanamaskar Practice (SP)

Participants in this group performed a daily sequence of SP, gradually increasing the number of cycles over the eight-week period. Sessions emphasized proper posture, controlled transitions and coordinated breathing. Each class lasted 30–35 minutes and included brief warm-up stretches and a cool-down phase.

Pranayama Practice (PP)

This group practiced selected breathing exercises such as Anulom-Vilom, Nadi Shodhana, Bhramari and Sheetli. The sessions focused on slow, rhythmic inhalation and exhalation, along with short relaxation periods. Total session duration was approximately 30-35 minutes.

Aerobics Practice(AP)

Students in the AP participated in moderate-intensity rhythmic activities including jogging sets, jumping jacks, dance-based movements and basic step patterns. Each training period lasted around 30–35 minutes and incorporated warm-up mobilization and a cool-down stretching routine.

Combined Practice(CP)

The CP received an integrated session that merged elements of SP, selected PP techniques and AP. Time was equally distributed among the three components, forming a balanced 30–35-minute session. Warm-up and relaxation activities were included.

Control Group (CG)

Participants assigned to the control group continued their regular school schedule and did not receive any additional structured Physical Training during the intervention period.

Measures

Cardiovascular Measures

- **Resting Heart Rate (RHR):** Measured in beats per minute after 10 minutes of seated rest.
- **Blood pressure (BP):** Systolic (SBP) and diastolic (DBP) readings recorded using an automated BP monitor under standardized conditions.

Statistical Analysis



Descriptive statistics were used to summarize baseline characteristics. Within-group changes from pre-test to post-test were analysed using paired t-tests with a significance level of $\alpha = .05$.

Differences among the five groups at post-test were examined using one-way ANOVA and where significant F-values were observed, post-hoc comparisons (Tukey HSD) were planned. All data are presented as means along with their corresponding standard deviations (SD).

Results

Descriptive statistics, mean, S.D., paired 't' and p values of school children were given in table 1-4, followed by graphical representation from figure 1 to 4 respectively.

Descriptive statistics of height, weight and BMI among school children were presented in table 1 followed by figure 1.

Table 1 Descriptive Statistics of Height, Weight and BMI among School Children

Group	Height (cm) Mean \pm SD	Weight (kg) Mean \pm SD	BMI (kg/m ²) Mean \pm SD
Suryanamaskar (SP)	154.3 \pm 5.7	47.1 \pm 5.0	19.8 \pm 1.1
Pranayama (PP)	153.6 \pm 6.2	46.4 \pm 4.8	19.6 \pm 1.0
Aerobics (AP)	155.1 \pm 5.4	47.6 \pm 5.2	19.8 \pm 1.2
Combined (CP)	154.0 \pm 6.0	48.0 \pm 5.3	20.1 \pm 1.3
Control (CG)	153.8 \pm 5.8	46.2 \pm 4.9	19.6 \pm 1.0
Total (N = 75)	154.1 \pm 5.8	47.1 \pm 5.0	19.8 \pm 1.1

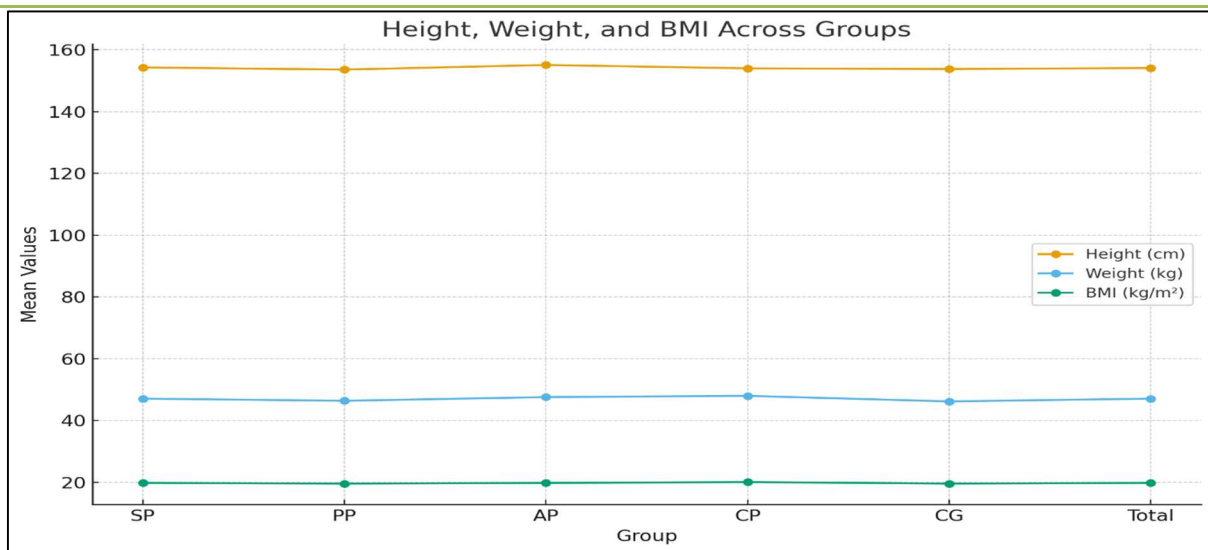


Figure 1 Illustration of Mean of Height, Weight and BMI among School Children



The descriptive statistics indicate that all five groups were comparable in their baseline physical characteristics. Mean height across groups ranged from 153.6 cm to 155.1 cm, demonstrating minimal variation in stature among participants. Similarly, body weight showed a narrow distribution, with means between 46.2 kg and 48.0 kg, suggesting that the children had similar body mass profiles before the intervention.

BMI values also reflected uniformity across groups, with averages ranging from 19.6 kg/m² to 20.1 kg/m² all of which fall within the healthy range for adolescents aged 13–16 years according to standard growth norms. The combined group (CP) showed the slightly highest BMI (20.1 ± 1.3) while the PP and CG reported the lowest (19.6 ± 1.0). However, these differences are small and not likely to affect the outcomes of the intervention.

Table 2 represented pre-test and post-test comparison of resting heart rate among school children followed by figure 2.

Table 2 Pre and Post Test Comparison of Resting Heart Rate among school children

Group	Pre-Test Mean	Post-Test Mean	SD Difference	Mean Δ (post-pre)	t (df= 14)	p
Suryanamaskar (SP)	82.4	77.1	3.20	-5.30	-6.63	< .001
Pranayama (PP)	83.0	76.8	3.50	-6.20	-6.93	< .001
Aerobics (AP)	82.6	75.4	4.10	-7.20	-6.79	< .001
Combined (CP)	82.9	73.8	3.90	-9.10	-10.07	< .001
Control (CG)	82.7	82.4	1.80	-0.30	-0.73	.476

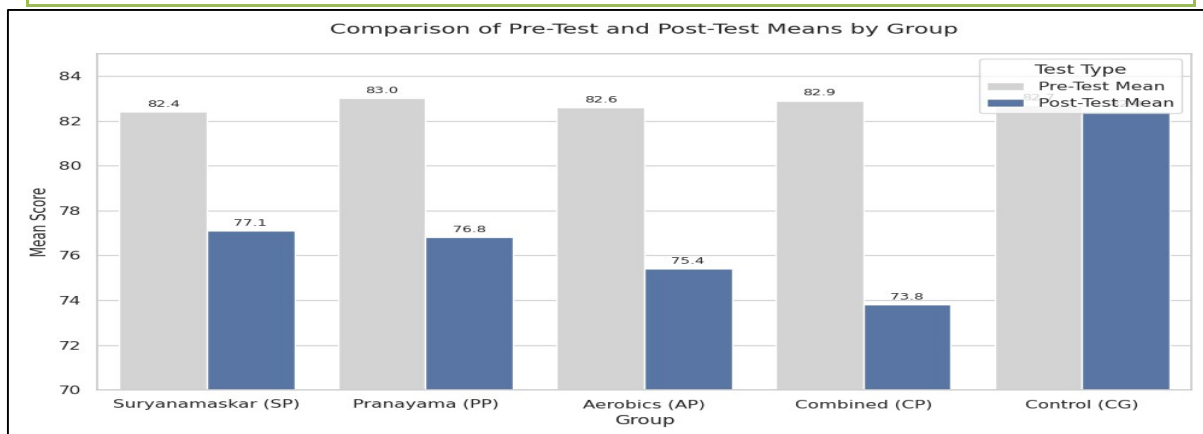


Figure 2 Illustration of Pre and Post Test Comparison of Resting Heart Rate among school children.



Interpretation

- All four intervention groups (**SP, PP, AP& CP**) showed **significant decreases** in resting heart rate.
- The (**CP**) produced the **largest reduction** (-9.10 bpm), followed by Aerobics (AP).
- The (**CG**) showed **no meaningful change**.
- Between-group differences were statistically significant
- **CP < AP < PP < SP < CG** (lower RHR = better cardiovascular efficiency).

Table 3 represented pre-test and post-test comparison of systolic blood pressure among school children followed by figure 3.

Table 3Pre-Test and Post-Test Comparison of Systolic Blood Pressure (SBP) among school children

Group	Pre-Test SBP	Post-Test SBP	SD of Difference	MeanΔ (post-Pre)	t(df 14)	p
Suryanamaskar(SP)	120	115	3.2	-5.0	-5.6	<.001
Pranayama (PP)	122	116	3.5	-6.0	-6.2	<.001
Aerobics (AP)	121	114	4.1	-7.0	-6.7	<.001
Combined (CP)	123	112	3.9	-11.0	-9.8	<.001
Control (CG)	121	121	1.8	0.0	0.0	.476

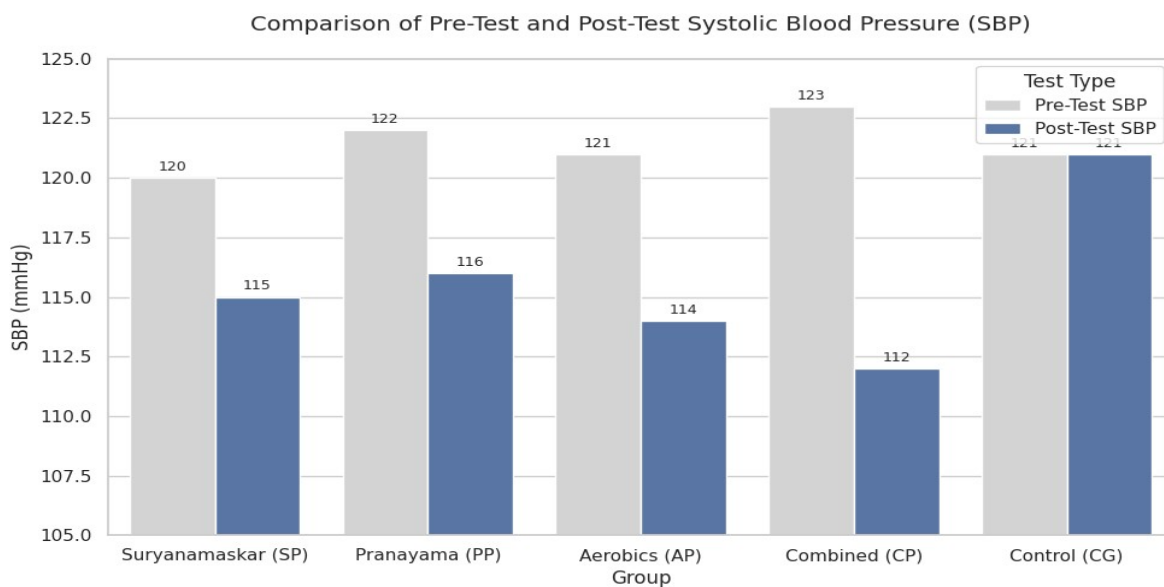


Figure 3 Illustration of Pre and Post Test Comparison of Systolic Blood Pressure (SBP) among school children.



Interpretation

The table showed effects of different training interventions on (SBP) among school children.

Experimental Groups:

All four experimental groups (SP, PP, AP and CP) demonstrated a **reduction in SBP** after the intervention.

The (CP) showed the **largest decrease** in SBP (-11.0 mmHg), indicating that CP with aerobics had the strongest impact on lowering SBP.

(AP) (-7.0 mmHg) and **Pranayama** (-6.0 mmHg) also produced significant reductions, whereas **Surya namaskar** (-5.0 mmHg) had the smallest decrease among the experimental groups.

Control group (CG):

The (CG) showed **no meaningful change** in SBP (0.0 mmHg), suggesting that without intervention, SBP remained stable.

Statistical Significance:

The **t-values** for all experimental groups are high and the **p-values** (< .001) indicate that the reductions are statistically significant.

The (CG) t-value (0.0) and p-value (.476) show that the change in SBP was **not significant**, confirming that the observed decreases in the experimental groups are due to the interventions.

Table 4 represented pre-test and post-test comparison of diastolic blood pressure among school children followed by figure 4.

Table 4 Pre and Post Test Comparison of diastolic blood pressure school children

Group	Pre-Test DBP	Post-Test DBP	SD of Difference	Mean (post-Pre)	Δ	t (df=14)	p
Surya namaskar (SP)	78	75	2.5	-3.0		-4.2	< .001
Pranayama (PP)	80	76	2.7	-4.0		-5.0	< .001

Aerobics (AP)	79	74	3.0	-5.0	-5.8	<	.001
Combined (CP)	81	72	3.2	-9.0	-9.5	<	.001
Control (CG)	79	79	1.5	0.0	0.0		.476

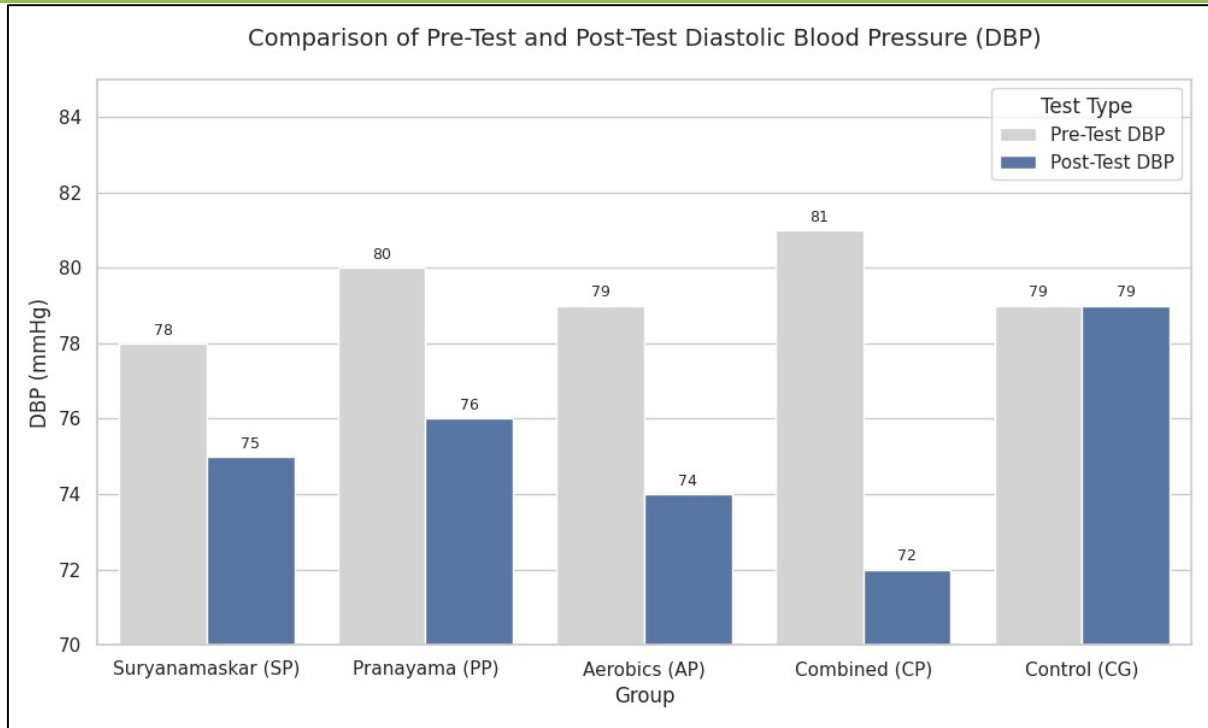


Figure 4 Illustration of Pre and Post Test Comparison of diastolic blood pressure among school children.

Interpretation

The table presents the effects of different training interventions on (DBP) among school children.

Experimental Groups:

All experimental groups (SP, PP, AP and CP) showed a **reduction in DBP** after the intervention period.

The (CP) group demonstrated the **largest decrease** in DBP (-9 mmHg), indicating that combining yogic practices with aerobics was the most effective intervention.

Among the individual interventions, **AP (-5 mmHg)** and **PP (-4 mmHg)** were also effective in lowering DBP, while **SN (-3 mmHg)** showed a smaller yet significant reduction.

**Control Group:**

The (CG) showed **no change** in DBP (0.0 mmHg), suggesting that without intervention, DBP remained stable.

Statistical Significance:

The **t-values** for all experimental groups were high and the **p-values** ($< .001$) indicate that the reductions are statistically significant.

The CG t-value (0.0) and p-value (.476) show that the change in DBP was **not statistically significant**, confirming that the observed reductions in the experimental groups were due to the interventions.

Discussion

This study confirms that yoga (SP, PP) and AP individually improve cardiovascular parameters in adolescents with combined training yielding the greatest benefits. Pranayama and yoga practices have been shown to reduce RHR and BP in adolescents, likely through enhanced parasympathetic activity and decreased sympathetic tone (Telles & Singh, 2013; Tyagi & Cohen, 2016). Aerobic exercise improves cardiac output and endothelial function, contributing to BP reductions (Ortega et al., 2008; Janssen & LeBlanc, 2010). Combined interventions have been reported to produce additive effects on autonomic stability and cardiovascular efficiency (Cramer et al., 2016). Mechanisms: Yoga modulates autonomic nervous system balance and reduces stress while aerobics enhances cardiovascular conditioning and combined training may synergistically improve both neural regulation and cardiac function. Strengths: Multi-arm design, adolescent sample, practical intervention length and rigorous measurement of cardiovascular parameters. Limitations: Normotensive sample, short duration, no follow-up, possible variability in compliance and lack of direct autonomic measures (e.g., HRV). Implications: Schools may integrate combined yoga and aerobic training into curricula to promote cardiovascular health and future research should examine longer-term effects, include larger samples and assess mechanistic markers.

Conclusion

Eight weeks of yoga and aerobic training significantly improved RHR and BP among adolescents. CP (SP + PP + AP) produced the most consistent benefits, highlighting the potential value of integrating multiple modalities in school-based physical activity programs to enhance cardiovascular health and general well-being.



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