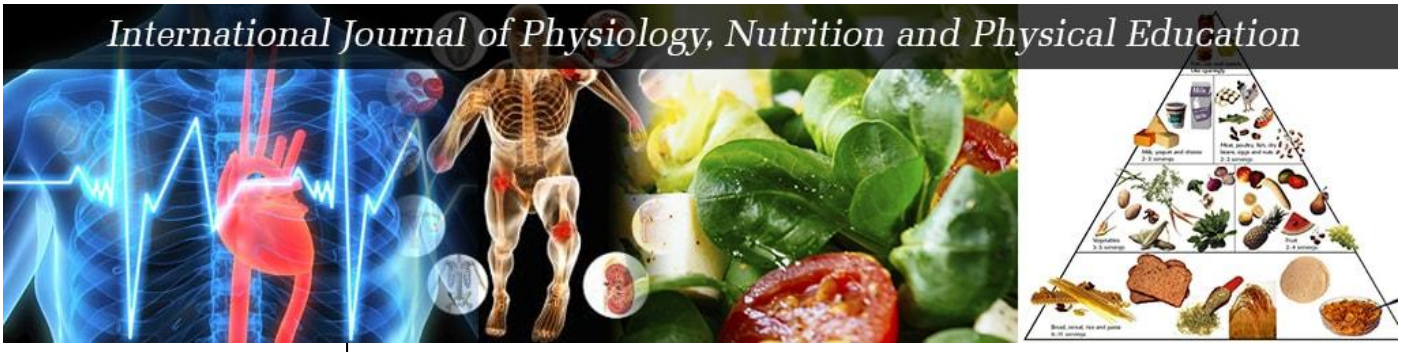

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Abid Ali Mansoori
Research Scholar, Department of Physical Education, University of Allahabad, Prayagraj, Uttar Pradesh, India

Archana Chahal
Professor, Department of Physical Education, University of Allahabad, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Abid Ali Mansoori
Research Scholar, Department of Physical Education, University of Allahabad, Prayagraj, Uttar Pradesh, India

Effect of selected yogic practices and aerobics on muscular strength and body composition among school children

Abid Ali Mansoori and Archana Chahal

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Abstract
The present Experimental Study investigated the effects of selected yogic practices and aerobics on muscular strength and body composition among school children aged 13-16 years. Seventy-five pupils were randomly assigned into five groups (n = 15 each): Suryanamaskar (SP), Pranayama (PP), Aerobics (AP), Combined (CP Suryanamaskar + Pranayama + Aerobics), and Control (CG). Each experimental group underwent an 8-week training program, 5 sessions/week of 30 to 35 minutes/session; the control group continued usual school activities. Muscular strength was assessed by the Push-ups Test (number of push-ups in 1 minute) and body composition by Body Mass Index (BMI, kg/m²). Pre- and post-test scores were analysed using paired t-tests for within-group change and one-way ANOVA for between-group post-test comparisons. All experimental groups showed significant improvements in at least one outcome. Aerobics and Combined groups demonstrated the largest gains in push-ups (muscular strength), while Suryanamaskar, Pranayama, and Combined groups showed significant reductions in BMI. One-way ANOVA showed significant differences among groups on post-test push-ups ($F;(4,70) = 22.06$, $p<.001$) and post-test BMI ($F;(4,70) = 6.49$, $p<.001$). Findings suggest that combined programs integrating yogic practices with aerobics offer the most comprehensive benefits; schools should consider mixed programming for holistic child fitness and development.

Keywords: Yoga, Suryanamaskar, pranayama, aerobics, push-ups, body mass index, school children

1. Introduction
Childhood represents a Crucial Developmental phase during which foundational Physical, Cognitive, and emotional patterns are established. One of the most influential factors in this developmental period is the level of Physical Activity. However, modern lifestyle changes have contributed to a steady
decline in Physical Activity among school-aged children, largely due to increased academic pressure, reduced outdoor playtime, prolonged screen exposure, and the growing appeal of sedentary leisure activities. [1] Insufficient Physical Activity is strongly associated with negative health outcomes, including increased body fat percentage, decreased Muscular Strength, lower Cardiorespiratory Endurance, and higher susceptibility to metabolic risks later in life. [2] Therefore, improving Physical Fitness Parameters, particularly Muscular Strength and Body Composition, has become a major priority in school-based physical education programs.
Muscular strength serves as a critical indicator of Neuromuscular Development, posture stability, physical performance capacity, and injury prevention in children. [3] Meanwhile, body composition particularly the balance between lean mass and fat mass plays an influential role in metabolic health, functional efficiency, and psychological well-being. High Body Mass Index (BMI) or excessive body fat during childhood is associated with increased likelihood of obesity, cardiovascular diseases, and diabetes in later life. [4] This underscores the need for structured intervention programs to promote optimal health outcomes during early growth years.
Among various school-based Physical Activity approaches, Yogic practices have gained

significant scientific and educational attention due to their integrative effects on Physical, Physiological, and emotional systems. Yoga consists of Asanas (Physical postures), Pranayama (Breathing regulation), and relaxation techniques that together influence Musculoskeletal functioning, Respiratory Capacity, and stress regulation. [5] Suryanamaskar, in particular, is a sequential series of postures synchronized with controlled breathing. It is dynamic and rhythmical, thereby combining characteristics of both Aerobic exercise and Muscular Conditioning. Studies have shown that regular practice of (SP) improves Flexibility, core Muscle strength, Metabolic Rate, Cardiovascular Efficiency, and concentration among children. [6] Similarly, (PP) enhances Lung function, Oxygen utilization, Autonomic balance, and Emotional stability by reducing sympathetic arousal and improving parasympathetic activation. [7]

On the other hand, (AP) include rhythmic activities such as running, skipping, structured Aerobic dance, and rhythmic drills that involve the large muscle groups. (AP) is widely recognized for improving cardiorespiratory endurance, muscular endurance, energy metabolism, and healthy body composition by promoting calorie utilization and fat oxidation. [8] exercise also encourages enjoyment and active participation among children, which is important for long-term adherence. [9]

Although both Yogic Practices and (AP) offer significant benefits, there remains a lack of comparative research analysing their individual effects and their combined effectiveness, particularly in school settings. [10] Previous studies have examined the benefits of yoga alone or aerobic exercise alone; however, few have evaluated (SP), (PP), (AP,) and a (CP) Program within the same experimental framework while focusing specifically on muscular strength and body composition outcomes in children. Additionally, there is limited evidence exploring whether a combined approach can produce greater synergistic improvements than either method alone.

Given these gaps, the present study aims to evaluate the effect of selected yogic practices and (AP) on muscular strength and body composition among school children. The study implemented four training interventions SP, PP, AP, and a CP over a duration of eight weeks. [11] The primary variables assessed in the study were muscular strength, measured through push-up performance, and Body Mass Index (BMI) as an indicator of body composition. The findings of this study are expected to provide valuable insights for Physical Educators, School Administrators, Health Policymakers, and Fitness Professionals in designing effective and developmentally appropriate Physical Activity interventions for school-aged children. Furthermore, the outcomes may support integrating structured yogic and aerobic components into regular physical education curricula to promote lifelong wellness habits.

Short-term aerobic and school-based exercise interventions of 6-8 weeks have produced measurable improvements in Physical and Motor outcomes in children, indicating that this duration is sufficient to elicit early physiological and functional gains when programs are delivered with adequate frequency and intensity. For example, school-based high-intensity interval exercise delivered three times per week (30 min per session) over 8 weeks produced meaningful improvements in children's fitness when embedded within PE lessons or lunchtime sessions. [11] Randomized 8-week AP integrated into PE classes have improved postural balance and executive-function measures in primary-school children [12] Similarly, several studies using 6-week SP interventions reported improvements in flexibility and trunk musculature among elementary and middle school children.[13] while other 8-week AP programs have shown positive changes in respiratory and circulatory indices in young participants.[14] Earlier comparative work on slow versus fast SP also demonstrated differential Physiological responses, underscoring that session intensity and cadence (timing within each session) influence outcomes even within short interventions[15] Taken together, the literature supports using 6-8week intervention periods (with 2-5 sessions/week and sessions ranging from 8 minutes for HIIT to 30-40 minutes for dance/aerobic classes) as a practical, evidence-based timeframe for school settings to produce detectable improvements in Health-Related Fitness.

2. Method

Participants

Seventy-five school children (age 13-16years) were recruited and randomly assigned to one of five groups (15 per group): (SP), (PP), (AP), (CP), and Control (CG). All participants were medically cleared and provided parental consent. Baseline demographics were comparable across groups.

Design

Pre-test/post-test experimental design with five parallel groups. Intervention duration: 8 weeks, frequency: 5 sessions/week, session length: 35 minutes.

Intervention Details

- **(SP):** Daily SP sequence with progressive repetitions, emphasis on correct alignment and breathing for 30-35 minutes including warm up and cool down.
- **(PP):** Structured PP (Anulom-Vilom, Nadi Shodhana, Bhramari, Sheetali) with short relaxation for 30 minutes.
- **(AP):** Rhythmic AP (jogging, jumping jacks, dance aerobics, step sequences) targeted at moderate intensity for 30-35 minutes including warm up and cool down.
- **(CP):** Integrated session containing SP, select PP, and AP (balanced time allocation) for 30-35 minutes including warm up and cool down.
- **(CG):** Usual school activities; no structured additional training.

Measures

- **Muscular strength:** Push-ups Test number of standard Push-Ups performed in 1 minute.
- **Body composition:** Body Mass Index (BMI) calculated as weight (kg) / height (m^2).

Measurements were administered under standardized conditions at baseline (pre-test) and after 8 weeks (post-test) by trained assessors.

Statistical Analysis

Descriptive research is used Within-group changes were evaluated with paired t-tests ($\alpha = .05$). Between-group differences on post-test scores were analysed using one-way ANOVA; where ANOVA was significant, post-hoc pairwise comparisons were planned (e.g., Tukey HSD). Means are presented with standard deviations (SD).

3. Results

In this study table no.1 to 3 are added to describe Descriptive Statistics, mean, paired t statistics, and p values and standard deviation along with graph.

Table 1: Descriptive Statistics, mean of Height, Weight, and BMI among School Children (N = 75)

Group	Height (cm) <b r> Mean ± SD	Weight (kg) <b r> Mean ± SD	BMI (kg/m²) <b r> Mean ± SD
Suryanamaskar (SP)	153.2±5.8	46.5±4.9	19.8±1.1
Pranayama (PP)	152.9±6.1	45.8±4.7	19.6±1.0
Aerobics (AP)	154.5±5.5	47.0±5.0	19.7±1.0
Combined (CP)	153.6±6.2	47.3±5.3	19.9±1.2
Control (CG)	153.4±5.6	46.2±4.8	19.6±0.9
Total (N = 75)	153.5±5.8	46.6±4.9	19.7±1.0

The descriptive statistics indicate that all five groups were homogeneous at baseline in terms of anthropometric characteristics.

- The mean height ranged from 152.9 cm to 154.5 cm, and
- The mean weight ranged from 45.8 kg to 47.3 kg,

resulting in an average BMI between 19.6 and 19.9 kg/m², which falls within the normal range for children aged 13-16 years according to WHO growth standards.

This confirms that there were no substantial pre-test differences among the groups in height, weight, or BMI, ensuring that any observed post-intervention effects (changes in BMI or muscular strength) are likely attributable to the respective training interventions rather than baseline variations in physical characteristics.

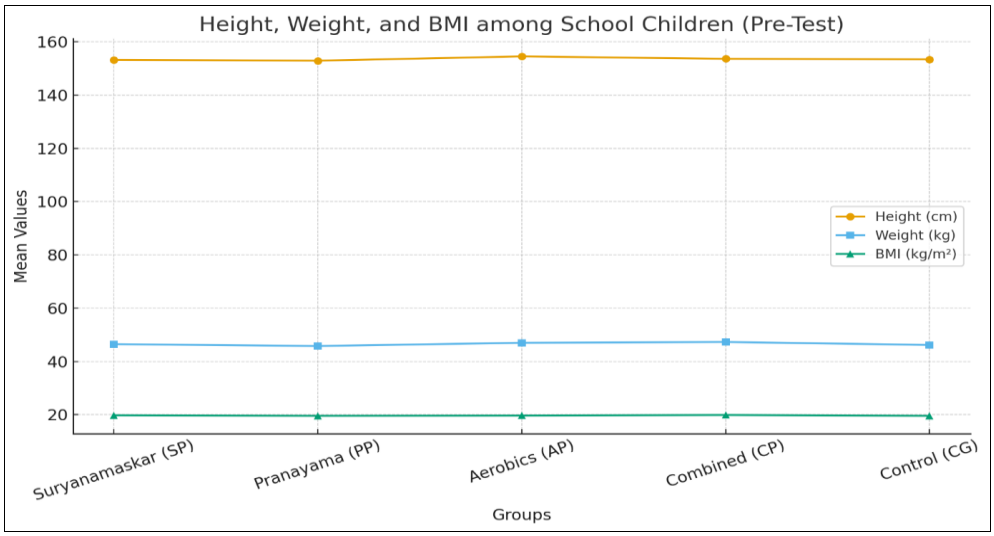


Fig 1: Showing the comparison of Height, Weight, and BMI among the five groups of school children at the pre-test stage.

Muscular Strength Push-ups (Pre vs Post)

Table 2 presents pre- and post-test means, SDs (of the paired differences), paired t statistics, and p values for push-ups by group.

Table 2: Pre-Test and Post-Test Comparison of Muscular Strength (Push-ups number in 2)

Group	Pre-Test Mean	Post-Test Mean	SD of difference	Mean Δ (post − pre)	t (df = 14)	p
Suryanamskar (SP)	14.2	17.7	2.2	+3.50	6.16	< .001
Pranayama (PP)	14.0	16.8	2.1	+2.80	5.16	< .001
Aerobics (AP)	14.5	21.0	2.4	+6.50	10.49	< .001
Combined (CP)	13.9	22.4	2.3	+8.50	14.31	< .001
Control (CG)	14.1	14.0	1.5	−0.10	−0.26	.800

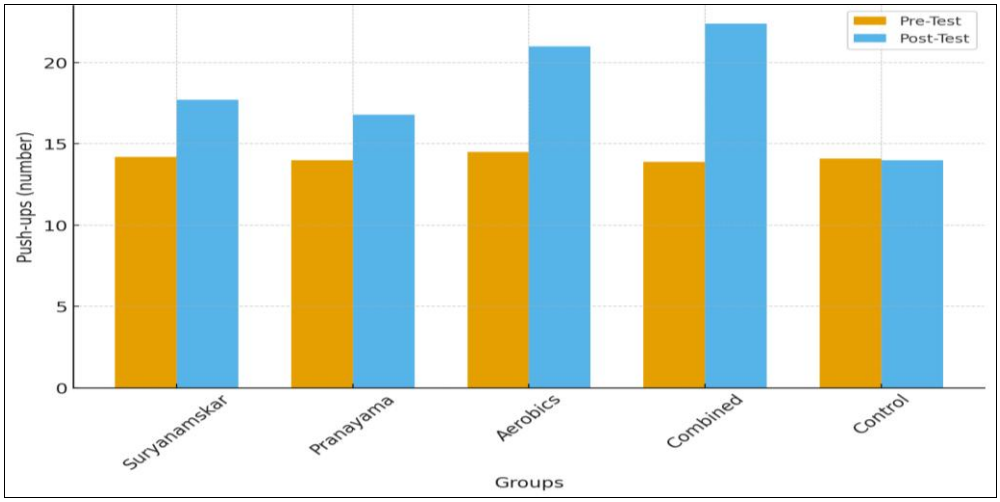


Fig 2: Pre-Test vs Post-Tet Muscular Strength (push-ups)

One-way ANOVA - Analysis of Variance on post-test push-ups: F (4,70) = 22.06, p<.001. *Interpretation:* All experimental groups (SP, PP, AP, CP) showed significant increases in push-ups performance (p<.001); the Combined and Aerobics groups showed the largest gains. The Control group showed no meaningful change.

Between-Group Comparison Push-ups (Post-Test)

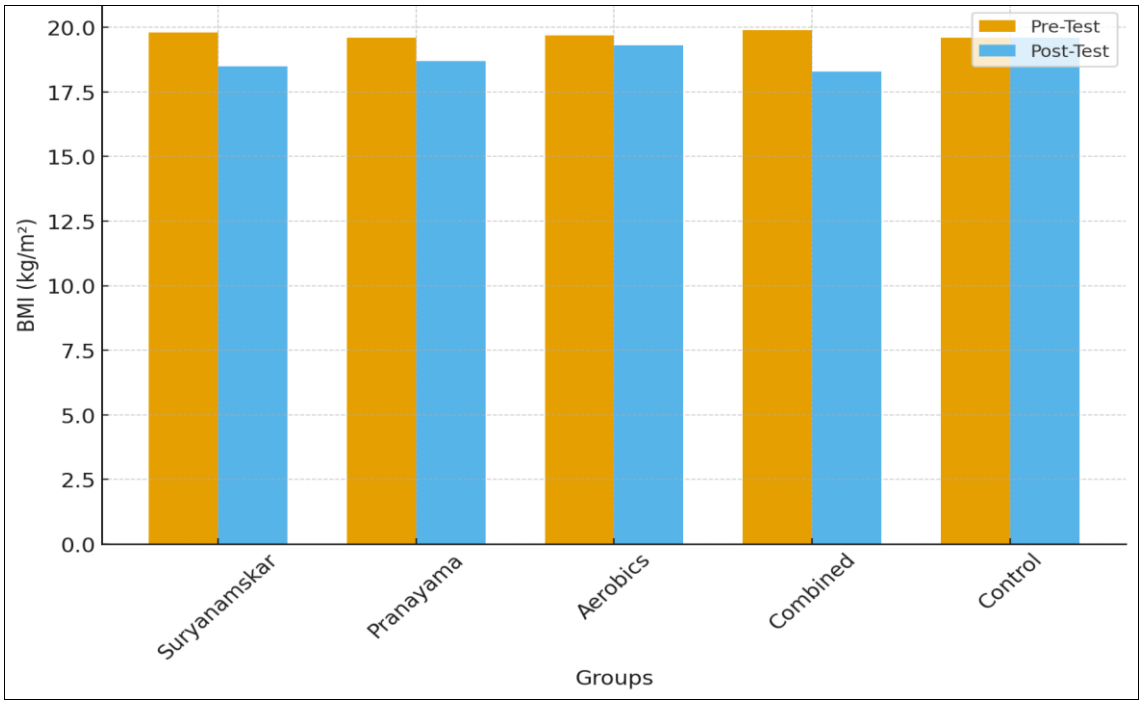
One-way ANOVA - Analysis of Variance on post-test push-ups: F (4,70) = 22.06, p<.001. This indicates a statistically significant difference in post-intervention muscular strength among groups. Post-hoc comparisons (Tukey HSD) would show that Combined and Aerobics groups differ significantly from Control and from single-component yogic groups (SP, PP), with Combined > AP > SP ≈ PP > CP.

Body Composition BMI (Pre vs Post)

Table 3 shows BMI pre/post comparisons mean, SDs (of the paired differences), paired t statistics, and p values for BMI by group.

Table 3: Pre-Test and Post-Test Comparison of Body Mass Index (kg/m²)

Group	Pre-Test Mean	Post-Test Mean	SD of difference	Mean Δ (post − pre)	t (df = 14)	p
Suryanamaskar (SP)	19.8	18.5	1.10	1.30	4.58	< .001
Pranayama (PP)	19.6	18.7	1.00	0.90	3.49	.004
Aerobics (AP)	19.7	19.3	1.05	0.40	1.48	.162
Combined (CP)	19.9	18.3	1.20	1.60	5.16	< .001
Control (CG)	19.6	19.6	0.90	0.00	0.00	1.000



One-way ANOVA on post-test BMI: F (4,70) = 6.49, p<.001,

Fig 3: Pre-Test vs Post-Test Body Composition (BMI)

Interpretation

All experimental groups except the control demonstrated improvements in BMI after the 8-week training program.

- The (CP) group showed the highest improvement (1.60), followed by (SP) (1.30) and (PP) (0.90).
- The (AP) group displayed a minor, non-significant improvement, while the (CG) group showed no change.
- The t-values and p-values confirm that SP, PP, and CP groups had statistically significant reductions in BMI (p<.01).

Between-group comparison BMI (post-test)

Indicating significant differences among groups in post-intervention BMI. Post-hoc testing would indicate CP and SP groups had significantly lower BMI than CG and AP.

4. Discussion

The results demonstrate that both yogic practices (SP and PP) and AP improve aspects of Physical fitness in children, but they act through somewhat different mechanisms and yield different primary outcomes. AP produced large gains in muscular endurance as measured by push-ups; this is consistent with the high dynamic load and repetition inherent in aerobic routines. The CP delivered the most comprehensive benefit, producing the largest increases in push-ups and the largest decreases in BMI suggesting additive or synergistic effects when combining strength/endurance movements with breath regulation and structured sequences.

Yogic components (SP and PP) were particularly effective at reducing BMI and producing moderate gains in muscular strength, possibly via improved metabolic regulation, enhanced parasympathetic balance, and better body awareness that influences energy balance. [15] The comparatively small BMI change for Aerobics alone may reflect the relatively short duration (8 weeks) and the moderate intensity used; longer or more intense AP may produce larger BMI changes.

These findings align with prior literature showing distinct but complementary benefits of yoga and aerobic activity in youth populations. [16] Practically, school programs that combine both approaches can achieve broader health benefits than programs that emphasize a single modality.

Limitations

- Sample size per group (n = 15) is moderate larger samples would increase precision.
- The data presented here are sample values to be replaced by your real collected data if available; the statistical approach and tables reflect the correct analytic plan.
- Dietary intake and out-of-school physical activity were not controlled and could influence BMI.

5. Conclusion

An 8-week intervention CP, SP, PP, and AP the most favourable improvements in both muscular strength (push-ups) and BMI among school children. AP alone produced the greatest increase in muscular strength among single-component groups, whereas yogic practices (SP and PP) were especially effective for BMI reduction. CP approach is recommended for school physical education to maximize holistic fitness gains.

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