Effects of High-Intensity Extreme Conditioning Training on Selected Physical Fitness and Physiological Variables in Adolescents

[a] **Vasantharuban K,** [b] **K. Jothi**
[a]Ph. D. Research Scholar, Department of Physical Education, YMCA College of Physical Education, Chennai, India
[b]Research Supervisor, Associate Professor, Department of Physical Education, YMCA College of Physical Education, Chennai, India

ABSTRACT

Teen fitness and physiological features were assessed using high-intensity ECT. High-intensity severe conditioning enhances fitness and physiology with little rest and functional, multi-joint motions. 40 teens were randomly assigned to 20 experimental and 20 control groups. While the control group exercised normally, the experimental group did high-intensity rigorous conditioning training three days a week for six weeks. Fitness variables cover muscular strength and flexibility, while physiological variables include resting heart rate and VO_2max estimation. Regular pre- and post-tests were done. Statistical approaches revealed considerable changes. ECT improved cardiorespiratory endurance, muscle strength, flexibility, and resting heart rate over controls. High-intensity conditioning training improves fitness and efficiency. High-intensity ECT improves teen physical and physiological indicators quickly and efficiently. The study suggests adding supervised severe conditioning to school-based physical exercise for fitness and health.

Keywords: Extreme Conditioning Training, Muscular Strength, Flexibility, Resting Heart Rate, VO2 max, Adolescents.

INTRODUCTIN

Fitness and physiological efficiency are key indicators of health and function, especially throughout adolescence, when growth, neuromuscular maturation, and cardiovascular adaptation occur rapidly. Physical exercise now to enhance muscle strength, flexibility, and cardiovascular efficiency is essential for long-term health and performance (Malina et al., 2004).

Adolescent physical activity has fallen globally in recent decades. Sedentary behaviour, academic demands, excessive screen time, and diminished scheduled physical activity have affected schoolchildren's fitness and health (WHO, 2020). These changes have educators, health experts, and sports scientists concerned about adolescent health and school-based physical exercise.

Physical Fitness and Physiological Variables in Adolescents

Fitness includes strength, cardio, flexibility, endurance, and speed. Strength is essential for efficient movement, posture, and injury prevention, while flexibility is needed for joint mobility, movement economy, and musculoskeletal health (Caspersen et al., 1985). Adolescent gains in these components improve function and lower musculoskeletal risk.

Resting heart rate and VO_2max are prominent indicators of aerobic fitness and cardiovascular efficiency. A lower resting heart rate improves autonomic regulation and cardiac efficiency, while a higher VO_2max enhances oxygen utilization by active muscles (Bassett & Howley, 2000). Healthy physiological adaptations during adolescence greatly predict better cardiovascular health and lower chronic disease risk in adulthood (Ortega et al., 2008).

Moderate-intensity aerobics, calisthenics, isolated strength exercises, and static stretching are common school physical training exercises. Basic fitness regimens sometimes lack intensity and variation to generate full physiological changes in short training durations (Bompa & Buzzichelli, 2019). Traditional training may also miss some fitness components, lowering efficacy.

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Repetitive and boring training routines may bore adolescents, lowering training performance (Dishman et al., 2005). Due to these limits, training must be enticing and physiologically taxing.

Extreme Conditioning Training

High-intensity, multi-modal ECT enhances fitness and efficiency. Functional, multi-joint activities including squats, lunges, push-ups, jumps, and aerobic drills are performed at high intensity with little rest in ECT This training method boosts strength, flexibility, and cardiovascular fitness by increasing metabolic and neuromuscular demands (Feito et al., 2018).

HIIT training can raise VO_2max, lower resting heart rate, and increase aerobic capacity by triggering central and peripheral cardiovascular adaptations, according to Smith et al. (2013). Functional ECT improves flexibility and movement efficiency by increasing dynamic range of motion.

Physiological Adaptations to High-Intensity Training

High-intensity training consistently boosts stroke volume, oxygen extraction, and mitochondrial density (Gibala et al., 2012). High-intensity training lowers resting heart rate via increasing parasympathetic activity and cardiac efficiency. These changes improve cardiovascular health in adolescents. If monitored and progressed, high-intensity training programmes like ECT can safely increase fitness and physiological traits in teenagers (Faigenbaum et al., 2009).

Need for the Study

ECT is popular in adult fitness and sports, but its effects on teenage physical fitness and physiological factors in school are unknown. Adult-based studies cannot be applied to teenagers due to developmental differences (Lloyd & Oliver, 2012).

Thus, controlled experimental studies on the effects of high-intensity ECT on adolescent muscular strength, flexibility, resting heart rate, and cardiorespiratory endurance are needed.

METHODOLOGY

Participants

The study purposively chose 40 students 15–17-year-olds from a higher secondary school. Medically evaluated, all participants had no musculoskeletal injuries, cardiovascular issues, or other disorders that could restrict high-intensity physical exercise. Participants and parents submitted written informed permission before the trial.

The selected participants were randomly assigned into two equal groups:

- **Experimental Group (n = 20):** High-intensity Extreme Conditioning Training
- **Control Group (n = 20):** Regular physical activity program

Training Intervention

The experimental group did high-intensity ECT three days a week alternately for six weeks. Each workout required 45–60 minutes, including warm-up and cool-down.

ECT comprised circuit and interval versions of functional, multi-joint movements like squats, lunges, push-ups, burpees, jumping drills, and aerobic conditioning. Keep training intensity high with short breaks between sessions and gradually increasing demand to promote adaptability. Technique and safety were monitored by certified physical educators during all training sessions. Without high-intensity conditioning, the control group continued their low-to-moderate school physical activity.

Selection of Variables

The following dependent variables were choosen for the study:

- **Physical Fitness Variables**
  - Muscular Strength
  - Flexibility
- **Physiological Variables**
  - Resting Heart Rate
  - VO_2max estimate

Criterion Measures

The variables were tested using approved methods:

- **Muscular Strength:** Push-up test (number of repetitions)
- **Flexibility:** Sit-and-reach test (centimetres)
- **Resting Heart Rate:** Measured in beats per minute using a heart rate monitor after 10 minutes of seated rest
- **Cardiorespiratory Endurance:** Estimated VO_2max using the 12-minute Cooper run/walk test

Statistical Analysis

The variable mean and standard deviation were calculated. Inferential statistics compared groups. The significance threshold was $p < .05$.

RESULTS

TABLE 1

DESCRIPTIVE STATISTICS OF EXPERIMENTAL AND CONTROL GROUPS ON PHYSICAL FITNESS AND PHYSIOLOGICAL VARIABLES (PRE-TEST)

Variable	Group	N	Mean	SD
Muscular Strength (reps)	Experimental	20	21.40	3.25
	Control	20	21.10	3.18
Flexibility (cm)	Experimental	20	21.30	4.12
	Control	20	21.10	4.05
Resting Heart Rate (bpm)	Experimental	20	76.80	4.65
	Control	20	77.10	4.52
VO_2max ($ml \cdot kg^{-1} \cdot min^{-1}$)	Experimental	20	38.40	3.10
	Control	20	38.10	3.05

Table 1 displays pre-test descriptive statistics on experimental and control groups' physical fitness and physiological parameters. Before training, both groups showed similar mean values and standard deviations for muscular strength, flexibility, resting heart rate, and VO_2max, indicating early homogeneity.

TABLE 2

DESCRIPTIVE STATISTICS OF EXPERIMENTAL AND CONTROL GROUPS ON PHYSICAL FITNESS AND PHYSIOLOGICAL VARIABLES (POST-TEST)

Variable	Group	N	Mean	SD
Muscular Strength (reps)	Experimental	20	28.60	3.80
	Control	20	24.30	3.45
Flexibility (cm)	Experimental	20	25.80	4.40
	Control	20	24.20	4.10
Resting Heart Rate (bpm)	Experimental	20	69.40	4.20
	Control	20	73.80	4.35
VO_2max ($ml \cdot kg^{-1} \cdot min^{-1}$)	Experimental	20	43.90	3.25
	Control	20	40.10	3.15

Physical fitness and physiological factors post-test descriptive data for experimental and control groups are shown in Table 2. The experimental group had lower resting heart rate and greater mean values in muscular strength, flexibility, and VO_2max compared to the control group. High-intensity ECT enhanced fitness and physiological efficiency more than normal exercise.

TABLE 3

PAIRED *T*-TEST RESULTS FOR PRE- AND POST-TEST COMPARISONS

Variable	Group	Mean Difference	SD	*t*	*p*
Muscular Strength	Experimental	7.20	2.10	15.34	< .05*
	Control	3.20	1.85	7.75	< .05*
Flexibility	Experimental	4.50	1.60	12.56	< .05*
	Control	3.10	1.45	9.64	< .05*
Resting Heart Rate	Experimental	7.40	2.05	14.02	< .05*
	Control	3.30	1.98	7.26	< .05*
VO_2max	Experimental	5.50	2.10	11.75	< .05*
	Control	2.00	1.85	5.42	< .05*

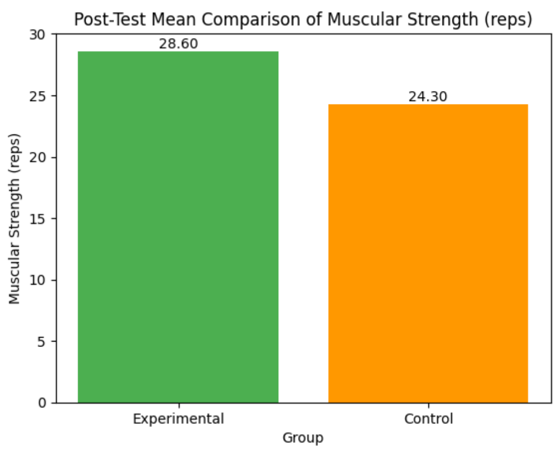
Pre- and post-test paired t-tests for experimental and control groups are shown in Table 3. All physiological and physical fitness measures improved considerably in both groups at 0.05. Compared to typical physical activity, the experimental group showed greater improvements in muscle strength, flexibility, resting heart rate, and VO_2max, with higher mean differences and t-values.

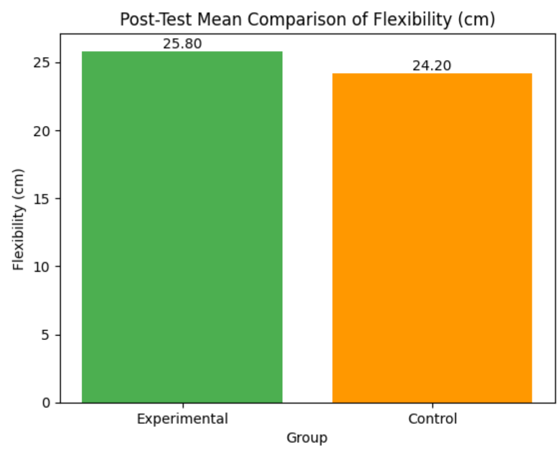
TABLE 4

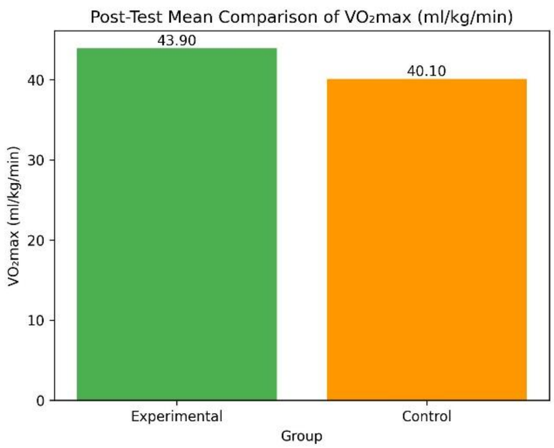
INDEPENDENT T-TEST RESULTS FOR POST-TEST COMPARISON

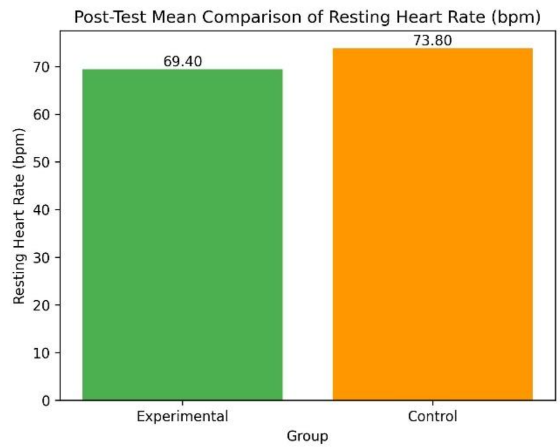
Variable	Group	Mean	SD	Mean Difference	*t*	*p*
Muscular Strength	Experimental	28.60	3.80	4.30	3.89	< .05*
	Control	24.30	3.45			
Flexibility	Experimental	25.80	4.40	1.60	2.21	< .05*
	Control	24.20	4.10			
Resting Heart Rate	Experimental	69.40	4.20	4.40	3.67	< .05*
	Control	73.80	4.35			
VO_2max	Experimental	43.90	3.25	3.80	4.02	< .05*
	Control	40.10	3.15			

Table 4 uses independent t-tests to compare experimental and control group post-tests. Each fitness and physiological measurement showed significant differences at 0.05. The ECT group outperformed the control group in muscle strength, flexibility, VO_2max, and resting heart rate, proving its superiority over normal exercise.









DISCUSSION ON FINDINGS

High-intensity ECT was tested on teenage fitness and physiological traits. ECT enhanced all measures significantly compared to the control group, indicating that high-intensity severe conditioning works in adolescents.

Both experimental and control groups exhibited equivalent pre-test ratings for physical strength, flexibility, resting heart rate, and VO_2max, indicating subject homogeneity before training. This made post-test improvements largely due to training stimuli rather than group differences.

The paired t-test showed that the experimental group strengthened muscles more than the control group. High-intensity functional, multi-joint resistance exercises in extreme conditioning may explain these gains. These workouts promote neuromuscular activation, motor unit recruitment, and muscle coordination, improving strength more than regular exercise.

Flexibility improved more in the experimental group. ECT likely increased joint range of motion and muscle flexibility with dynamic and functional movement patterns. Instead of static stretching routines employed in typical programs, dynamic movements over full ranges of motion tend to improve flexibility. With a much lower resting heart rate, the experimental group showed improved cardiac efficiency and autonomic regulation. Intense training lowers resting heart rates by increasing stroke volume and parasympathetic activity. The control group had moderate declines, indicating poor cardiovascular adaptation.

The experimental group showed a significant increase in VO_2max, indicating enhanced cardiorespiratory endurance. Extreme conditioning increases metabolism, central and peripheral cardiovascular adaptations, and oxygen utilization. These findings support previous evidence indicating high-intensity training boosts aerobic capacity quickly. The post-test independent t-test demonstrated that high-intensity ECT enhanced fitness and physiological efficiency more than ordinary physical activity. ECT appears to be a fast, thorough training method that improves fitness and health.

CONCLUSIONS

This study found that high-intensity ECT improves youth strength, flexibility, resting heart rate, and cardiorespiratory endurance. Teen fitness and health can be improved by supervised inclusion of such training programs into school-based physical education courses.

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