MATERIALS AND METHODS
MATERIAL AND METHODS

This study was conducted on 200 healthy young sedentary humans. Each subject was examined thoroughly clinically to exclude any organic or cardio-respiratory disease which may affect cardio-respiratory efficiency and only healthy non smoker and non addict subjects were selected for the study. Height in centimeters and weight in kilograms were measured and body surface area in square meters was calculated with the help of DUBOIS NOMOGRAM (DUBOIS, 1951). The aim and procedures of the tests were explained to the subjects and then the tests were done for this study.

Subjects were divided into three groups.

GROUP I Consisted of sixty male subjects. They were further divided into five groups of twelve for training. Each group was trained for a period of twelve weeks (Table No.1).

GROUP II Consisted of seventy five male subjects and forty five female subjects. They were further divided into five training groups of fifteen and nine. Each group was trained for a period of twelve weeks (Table No. 2).
GROUP III Consisted of twenty male subjects. They were further divided into two training groups of ten. Each group was trained for a period of 12 weeks (Table No. 3).

MATERIAL AND METHOD FOR GROUP - I

(A) Respiratory efficiency tests

Spirometry was performed in standing posture. The subjects were asked to take deep inspiration and then blow out fast, forcefully and completely into the water filled BENEDICT ROTH recording spirometer and FVC maneuvers were recorded with a writing device, recording on a rotating Kymograph at a speed of 1 REV in 17 sec. (Plate No. 1).

Three to four efforts were recorded and record showing good reproducibility, regularity and maintenance of effort was only considered valid (Plate No. 2).

1 By analyses of these FVC maneuvers the following parameters were found out.

(a) Forced vital capacity (FVC) in ml
(b) Forced expiratory volume in one second (FEV₁) in ml.

(c) FEV₁/FVC %

(d) \( \text{FEF}(0.2 - 1.2 \text{L}) \) in L/S

Mean forced expiratory flow between 200 ml and 1200 ml of FVC in Litre/Second.

(e) \( \text{FEF}(25 - 75 \%) \) in L/S

Mean forced expiratory flow between 25 % and 75 % of FVC in Litre/Second.

(f) \( \text{FEF}(50 - 75 \%) \) in L/S

Mean forced expiratory flow between 50 % and 75 % of FVC in Litre/Second.

(g) \( V_{\text{max}} \text{ 25 \% in L/S} \)

Maximum expiratory flow at 25 % of FVC in Litre/Second.
(h) $V_{max}$ 50 \% in L/S

Maximum expiratory flow at 50 \% of FVC in Litre/Second.

(i) $V_{max}$ 75 \% in L/S

Maximum expiratory flow at 75 \% of FVC in Litre/Second.

2 Maximum voluntary ventilation (MVV) in L/M

This test was done by asking the subject to breath as fast and as deeply as possible in to the mouth piece of BENEDICT ROTH RECORDING SPIROMETER for 15 seconds. In mouth piece there is valvular arrangement which allows inhalation from atmosphere and exhalation in the spirometer.

The MVV is calculated for one minute. During the measurement nostrils of subjects were closed by nose-clip.

3 Breath holding time (in seconds)

This test was done by asking the subejcts to hold their breath after normal expiration and the maximum.
time for which they could hold their breath was recorded.

4 Respiratory endurance test (40 mmHg) in seconds

The subjects were asked to expire as deeply as possible and then to take a deepest possible inspiration. Nose-clip was applied and the subject was asked to blow the mercury up to 40 mmHg in sphygmomanometer and to maintain it steadily at that level. The maximum possible time was noted.

5 Maximum expiratory pressure (MEP) in mmHg

After a deepest possible inspiration, nose clip was applied. The subject was asked to blow as forcefully as possible into the tube of sphygmomanometer trying to push up the mercury column steadily as high as possible.

Above respiratory efficiency tests were done in each subject twice (i) before and (ii) after exercise training of 12 weeks.

B CARDIAC EFFICIENCY TESTS

1. Measurement of resting pulse rate/minute.
2. Measurement of resting systolic blood pressure in mmHg.
3. Measurement of resting diastolic blood pressure in mmHg.


This test was done by asking subjects to step up and down a bench 50 cm. high at the rate of 30 times per minute for five minutes and the recovery pulse was counted for 30 seconds in the post-exercise period, between 1 and one and half minutes, 2 and two and half minutes and 3 and three and half minutes. The three counts were added and the fitness index was calculated as per formula given below:

\[
\text{Fitness index} = \frac{\text{Duration of exercise in seconds}}{2} \times \frac{100}{\text{Sum of recovery pulse counts}}
\]

<table>
<thead>
<tr>
<th>Fitness index</th>
<th>Category of fitness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 0</td>
<td>Poor</td>
</tr>
<tr>
<td>50-80</td>
<td>Average</td>
</tr>
<tr>
<td>More than 80</td>
<td>Good</td>
</tr>
</tbody>
</table>

Above cardiac efficiency tests were done in each subject twice (i) before and (ii) after exercise training of 12 weeks.
MATERIAL AND METHOD FOR GROUP II

(A) RESPIRATORY EFFICIENCY TESTS

1. Forced expiratory volume in one second - FEV$_1$ in litres

For the measurement of FEV$_1$ in liters the SPIROMETER SP-1A (Battery operated digital spirometer for measurement of FEV$_1$, in litre) was used. Subjects were asked to breath in deeply in up right position, then to take mouthpiece firmly between their lips and breath out as strongly as possible for more than two seconds; measurement was repeated and the highest measured values was taken.

(2) Peak Expiratory Flow rate (PEFR) in litres/minute

To measure the peak expiratory flow rate, the MINI WRIGHT'S PEAK FLOW METER was used. The subjects were asked to take a full and deep inspiration and then to blow out fast and forcefully into the mouthpiece of peak flow meter (Plate No. 3). The highest of three readings after one or two practice trials was taken as peak expiratory flow rate.
(B) CARDIAC EFFICIENCY TESTS

(1) Measurement of resting pulse rate/minute.
(2) Measurement of resting systolic blood pressure in mmHg.
(3) Measurement of resting diastolic blood pressure in mmHg.

(C) EXERCISE PERFORMANCE TESTS

1. WALKING TESTS

(a) 6 MWD = Six minute maximum walking distance in meters.

This test was conducted as described by McGavin et al., 1976.

(b) 12 MWD = Twelve minute maximum walking distance in meters.

This test was originally described by Cooper by a guide to physical fitness (Cooper K. H., 1968).

6MWD and 12 MWD tests were carried out on a level enclosed passage. Each subject was instructed to walk as much distance as he could in six minutes and
twelve minutes time. He was instructed to walk continuously as fast as possible without any stoppage or slowing down in speed. Our aim was that the subject should put his maximum effort to cover maximum distance. A physical instructor accompanied the subject, acting as time keeper and giving the necessary encouragement. Maximum walking distance covered by subjects in six minutes and 12 minutes were measured in meters.

2. **6MBE = SIX MINUTE MAXIMUM BICYCLE ERGOMETER TEST**

   This test was performed on "HERO ALLEGRO EXER-BIKE". The subjects were instructed to pedal (at moderate tension of 30 kgm/sec) as fast as possible for a period of six minutes (Plate No. 4). During the test, they were continuously encouraged to reach a maximal pedaling. The test was expressed as distance covered in kilometers.

   **6MAE = SIX MINUTE MAXIMUM ARM ERGOMETER TEST**

   This test was performed by setting a moderate tension 30 kgm/sec. on handle bars of Hero Allegro Exer Bike. The subjects were instructed to row as maximally as
possible for a period of six minutes (Plate No. 5). During the test, they were continuously encouraged to reach a maximal "ROWING SPEED". The maximum Rowing completed during period of six minutes was measured in total numbers.

Above cardio-respiratory efficiency and exercise performance tests were done in each subject twice (i) Before and (ii) after exercise training of twelve weeks.

MATERIAL AND METHOD FOR GROUP III

(1) Tread mill walking exercise fatigue time in seconds (TWEFT)

At 'O' inclination at the speed of 10 km/h, twenty subjects were asked to walk. Voluntary fatigue time was noted. Pulse rate and arterial blood pressure were recorded immediately before and after exercise.

This group of twenty subjects was divided into two groups of ten each. One group was trained for walking exercise at the level ground at the speed of 10 km/h and other group of ten was trained for combined limbs exercises at the HERO ALLEGRO EXER BIKE for a
period of 12 weeks. After training, time for fatigue, pulse rate and arterial blood pressure were recorded immediately before and after exercise (Table Nos. 23 and 24).

(2) Psychological effects of exercise training

For this purpose Goldberg health questionnaire (G.H.Q) score (Goldberg et al., 1979) was used before and after training. This (G.H.Q.) is a health questionnaire. It is a objective type scoreable test and self reporting scale. Each subject has to answer all questions on a four point scale.

Scores 0 to 7 - Definite psychological benefit.
Scores 8 to 14 - Psychological benefit.
Scores 15 to 21 - Suspected psychological benefit.
Scores 22 to 28 - No psychological benefit.

This questionnaire covers almost all the aspects of psychological well being of the individual. The effect of exercise training on the psychological aspect of well being was also recorded after training under the same headings of this test (Table Nos. 23 and 24).
All the tests mentioned above were performed as far as possible in identical physiological conditions of the body and the time (between 7.00 to 8.00 a.m.).
PLATE No. 1
THE BENEDIC ROTH SPIROMETER
Sample record of forced vital capacity (FVC) Maneuver (Expired volume against time, Heavy red line) Showing the FVC FeV1, FEFO.2 - 1.2 L, FEF 25 - 75%, FEF 50 - 75%, Vmax 25%, Vmax 50% and Vmax 75%.
PLATE NO. 3

MINI-WRIGHT'S PEAK FLOW METER FOR THE MEASUREMENT OF PEFR in L/M.
PLATE NO. 4

PEDALING ON HERO ALLEGRO EXERBIKE
PLATE No. 5
ROWING ON HERO ALLEGRO EXERBIKE