Chapter – III

PROCEDURE

In this chapter the selection of subjects, selection of variables, experimental design, collection of data, reliability of data, training programme, administration of tests and statistical techniques for analysis of data have been described.

Selection of Subjects

Ninety Students, with age ranging between 17 to 22 years and studying in Bachelor of Engineering were randomly selected as subjects from Madhav Institute of Technology and Science, Gwalior, M.P.

All subjects were, then, randomly assigned to two experimental groups (A and B) and one control group (C), each consisting of 30 subjects. The experimental treatments were also assigned to the groups at random. The groups A and B were treated as experimental groups and were given training programmes of Bhastrika Pranayama and Ujjayi Pranayama respectively. The Group – C served as a control group and continued participating in the normal programme of the college.

Selection of Variables

The research scholar gleaned through all the scientific literature pertaining to Yoga from books, magazines, journals, periodicals available in the library of Lakshmibai National Institute of Physical Education, Gwalior.
Keeping the feasibility criterion in mind, especially in the case of availability of instruments, the following variables were chosen:

**Physiological variables:**

1. Anaerobic Power
2. Vital Capacity
3. Resting Heart Rate
4. Resting Respiratory Rate
5. Total Body Fat Percentage
6. Lean body Weight
7. Positive Breath Holding Capacity
8. Negative Breath Holding Capacity.

**Co-ordinative Abilities:**

1. Reactive Ability
2. Orientation Ability
3. Differentiation Ability
4. Balance Ability
5. Rhythmic Ability.

**Experimental Design**

Random group design was adopted for this study as all the subjects were randomly selected and randomly divided into three groups. Further the experimental treatments also were assigned at random to both experimental groups and the third group served as the control group. The experimental groups participated in two training programmes i.e. Group A (Bhashrika Pranayama), Group B (Ujjayi Pranayama). The training programme was conducted for a total duration of ten weeks.
Collection of Data

The data was collected for each variable administering their respective tests. The tests were administered at Gymnasium hall and Sports ground of Madhav Institute of Technology and Science, Gwalior. To ensure that the data collected was reliable each subject was given sufficient number of trials to perform the respective test for each variable.

The data were collected before the starting of experimental treatment (pre-test) and the end of training period (post-test).

The tests used were explained to the subjects prior to their administration. The subjects were given chance to practice the tests and made them familiar with.

Reliability of Data

Data reliability was ensured by establishing the instrument reliability, testing reliability, reliability of tests and subjects reliability.

Instrument Reliability

The instrument used in the study were obtained from standard firms, which cater to the needs of various research laboratories in India and abroad and their celebrations were accepted as accurate enough for the purpose of the study.
Tester competency

To ensure that the investigator was well versed in the techniques of conducting the tests, the investigator had a number of practice sessions in the testing procedure under the guidance of the experts.

Tester competency was also evaluated together by reliability of tests (given in reliability of test).

Reliability of Tests

Reliability of tests were established by test-retest method using product moment method of correlation. The score of subjects for various qualities were recorded on two days with a gap of one day in between under identical conditions.

The obtained correlation have been shown Table 1. Since very high correlation from 0.87 to 0.99 were obtained, investigator’s competency to administer the tests as well as reliability of tests were established. From the Table 1, it is evident that tester reliability was significantly high. This establishes competency of scholar to administer the tests.
Table 1

RELIABILITY CO-EFFICIENT OF TEST-RETEST SCORES

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Tests</th>
<th>Co-efficient of Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bhashrika Pranayama Group</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pre-test</td>
</tr>
<tr>
<td>1.</td>
<td>Jump and Reach</td>
<td>0.89*</td>
</tr>
<tr>
<td>2.</td>
<td>Weight</td>
<td>0.99*</td>
</tr>
<tr>
<td>3.</td>
<td>Resting Heart Rate</td>
<td>0.87*</td>
</tr>
<tr>
<td>4.</td>
<td>Resting Respiratory Rate</td>
<td>0.89*</td>
</tr>
<tr>
<td>5.</td>
<td>Vital Capacity</td>
<td>0.92*</td>
</tr>
<tr>
<td>6.</td>
<td>Thigh Skinfold</td>
<td>0.90*</td>
</tr>
<tr>
<td>7.</td>
<td>Subscapular Skinfold</td>
<td>0.88*</td>
</tr>
<tr>
<td>8.</td>
<td>Positive Breath Holding Capacity</td>
<td>0.90*</td>
</tr>
<tr>
<td>9.</td>
<td>Negative Breath Holding Capacity</td>
<td>0.92*</td>
</tr>
<tr>
<td>10.</td>
<td>Reactive Ability</td>
<td>0.95*</td>
</tr>
<tr>
<td>11.</td>
<td>Orientation Ability</td>
<td>0.87*</td>
</tr>
<tr>
<td>12.</td>
<td>Differentiation Ability</td>
<td>0.92*</td>
</tr>
<tr>
<td>13.</td>
<td>Balance Ability</td>
<td>0.87*</td>
</tr>
<tr>
<td>14.</td>
<td>Rhythmic Ability</td>
<td>0.89*</td>
</tr>
</tbody>
</table>

* Significant at 0.01 level of confidence.

N = 30
r.01(28) = 0.463

Subjects Reliability

The above test-retest coefficient of correlation method also established that subjects reliability was significant at 0.01 level of confidence, as the same subjects were used under similar conditions by the
same tester and no motivational techniques were used nor any training was given.

Experimental Procedure

The study was conducted for a period of ten weeks in the month of February. The climatic condition was moderate with temperature ranging from 28°C to 30°C.

Ninety subjects were assembled in the Gymnasium of Madhav Institute of Technology and Science, Gwalior at 6.00 A.M. Three groups comprising of 30 subjects each were formed i.e. Group A and B experimental groups and Group C Control group.

All subjects were voluntarily ready to learn Bhastrika and Ujjayi Pranayama. The scholar briefed the subjects about the objectives of the study and also explained both varieties of Pranayamas in details with practical demonstration.

KAPALBHATI:

It is exactly like bellows of the blacksmith. While sitting in a comfortable asana Sahajasana, Samasana, Padmasana etc. with the back erect, the abdominal wall moves in and out. The concentration is on the forceful exhalation, as a result the abdomen goes in, with the release of the abdomen the inhalation takes place automatically.
Initially it is done slowly with a little practice the movement becomes rhythmical. The standard rhythm is 120 strokes per minute i.e. 2 per second. Only the abdominal wall moves other parts of the body are steady.

**NADI SODHAN:**

This is the preliminary training for Pranayama. The student breathes through left nostril as slow as possible while closing the right nostril, by use of thumb as per practice. Immediately after the left inhalation the exhalation phase starts by opening the right nostril. This also is as slow as possible, in a flow like manner. The exhalation is followed by inhalation through same i.e. right nostril and exhalation by left nostril. This completes one round of Nadi Shodhana. There is no retention or Kumbhaka in it.

**ANULOMA VILOMA:**

This is the preliminary beginning of Pranayama for the beginners. The practice is same as Nadi Shodhana with one change i.e. introduction of Kumbhaka. Following the inhalation by left nostril, the left nostril is closed and by putting the chin down in Jugular Notch, Jalandhara Bandha is performed. The Kumbhak initially should be equal to inhalation time in seconds. After the Kumbhaka the Rechaka or exhalation is performed by right nostril. While the latter half is performed, Kumbhaka is performed
following inhalation by right nostril. So during one round of Anuloma Viloma the Kumbhaka is performed two times.

BHASTRIKA:

While performing Bhastrika one has to go for a stipulated number of strokes of Kapalbhati e.g. 20, then you breathe in by right nostril slowly and fully, perform Kumbhaka with Jalandhara Bandh and release the breath slowly and fully by left nostril. This completes one round of Bhastrika. For easy understanding some people use a formula Kapalbhati + Suryabhedan = Bhastrika.

UJJAYI:

In Ujjayi, one breathes through both the nostrils with body erect. Here the special attention is paid to partial closure of the epiglottis, due to which a ‘hissing’ like sound is produced. Following full inhalation or puraka the Kumbhaka is performed with Jalandhara Bandha. Raise the head to erect position and perform Rechaka, while repeating the similar practice of partial closure of epiglottis.

SHAVASANA:

The name itself indicates that the body is in similar position like a dead body. In supine lying one remains as quiet as possible with legs spread away from each other. Similarly the arms also are spread out with the palms facing upwards. There is a distance of about 2 feet between the
legs toes facing outwards. Eyes partially closed. Neck relaxed. Breathing should be in a continuous flow like movement the abdomen inflating fully with inhalation and making a ditch like with exhalation. Link the mind with breathing while watching the body organs with eyes of the mind (Manah Chakshu).

Both the experimental groups performed the Pranayama as randomly assigned, each day, six days a week. The preparation to Bhastrika and Ujjayi was done as explained with sufficient rounds and repetitions as advised by experts and gradually increased with the passage of time, giving sufficient time to the subjects for adaptation.

The detailed training programme of Bhastrika and Ujjayi Pranayama is explained and attached in Appendix.

**Administration of Tests**

**Anaerobic Power**

**Objective:** To measure Anaerobic Power

**Equipments:** Measuring tape, Back Board with 0.5 cm. marking and chalk powder.

**Description:** The score of vertical jump was obtained in meters by measuring the difference between a person's reach and the height to which he touched with jump. The body weight was calculated in Kilograms.
Fig. 1: Lewis Nomogram for determining Anaerobic Power from Jump – Reach score and body weight.
Scoring: To obtain a score of anaerobic power, a straightedge was laid across the Lewis Nomogram connecting the scores of the distance of Sargent jump and body weight. Where the straightedge intersected the middle scale was the anaerobic power.

Resting Heart Rate

Objective: To measure the Resting heart rate.

Equipment: Stop Watch.

Description: The resting heart rate of each of the subjects was recorded between 6.00 A.M. and 7.00 A.M. before recording the resting heart rate, the subjects who were hostlers were instructed to remain lying on their bed. To record the heart rate, the pulse rate was recorded by palpation at the radial artery per minute.

Score: The score was expressed in terms of number of pulse beats per minute.

Resting Respiratory Rate

Objective: To measure the resting respiratory rate.

Equipments: Stop Watch

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Description: The Resting respiratory rate of each subject was recorded between 6.00 AM to 7.00 AM. Before recording the resting respiratory rate, the subject who were hostlers was instructed to remain lying on their beds in supine lying position. The tester then recorded rate of respiration in unit counts per minute by carefully watching the movements of subjects’ abdomen.

Scoring: The total number of respiratory movements per minute were finally recorded.

Vital Capacity

Objective: To measure the Vital Capacity

Equipments: Dry Spirometer, Nose Clip.

Description: The spirometer was brought in to zero position. The subject performed maximum inspiration and after clipping the nose, the air was blown out as intensely as possible in the mouth piece.

Scoring: The amount of expired air was read directly from the calibrated scale and that was the score of vital capacity and was recorded in litres\(^2\).

Total Body Fat Percentage

Objective: To measure the Total Body Fat Percentage.

Equipments: Skinfold Calliper.

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Description: For calculating total body fat percentage of the subjects, Slown Weir Nomogram Technique was used. In this technique two sites (Thigh and Subscapular) skin thickness was used.

Scoring: To obtain a score of total body fat percentage, a straightedge was laid across the nomogram connecting the scores of thigh and subscapular skinfolds, where the straightedge intersected the middle scale was the total body fat percentage\(^3\).

**Lean Body Weight (Fat Free Weight)**

Equipments: Weighing Machine

The lean body weight was calculated by subtracting the fat weight of the subjects from their total body weight\(^4\).

\[\text{[Lean Body Weight} = \text{Total Body Weight} – \text{Fat Weight}]\]

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\(^3\) Fox, Bowers and Foss, “The Physiological Basis of Physical Education and Athletics”, pp. 566.

Fig. 2: Sloen-Weir Nomogram for Prediction of Total Body Fat Percentage from Skinfolds Measurement (Sub Scapular and Thigh)
Positive Breath Holding Capacity

Objective: To measure Positive Breath Holding Capacity.

Equipments: Stop Watch and Nose Clip.

Procedure: To measure the positive breath holding capacity, the subjects were instructed to place nose clip tightly. They were asked to inhale through the mouth to the maximum capacity.

As soon as the subjects took a deep breath to the fullest capacity of their lungs and close the lips, the stop watch was started.

Scoring: As soon as the subjects opened their lips to exhale, the stop watch was stopped and the time given by the watch was recorded as the score of positive breath holding capacity.

Negative Breath Holding Capacity

Objective: To measure Negative Breath Holding Capacity.

Equipments: Stop Watch and Nose Clip.

Procedure: To measure the negative breath holding capacity, the subjects were instructed to place nose clip tightly. They were asked to exhale through the mouth to the maximum capacity.

As soon as the subjects exhaled and closed the lips, the watch was started.

Scoring: As soon as the subjects opened their lips to inhale, the watch was stopped and the time given by the watch was recorded as the score of negative breath holding capacity.
Administration of Co-ordinative Abilities Test

The necessary data was collected by administering co-ordinative abilities tests as suggested by Peter Hirtz\(^5\).

The necessary work was done before the start of the test. All the tests were administered and explained to the subjects by the scholar.

**Ball Reaction Exercise Test**

Objective: To measure the reaction ability.

Equipments: (i) Two wooden planks, each of 4m. length.
(ii) One inflated Volleyball.
(iii) A supporting stand
(iv) Pencil, Papers and Clipboard

Description: Two wooden planks of 4 meter in length were taken and each were kept inclined by a supporting stand having a height of one meter and twenty centimetres. So that it could enable a volleyball to roll freely from a height of 1.20 mt. The lower ends of the wooden planks were kept at a distance of 1.5 mt. away from the starting line, outsides of one of the planks was graduated in centimetres.

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\(^5\) Peter Hirtz, "Koordinative Fahigkeiten in Schul Sport", p.7.
REACTION ABILITY

Fig. 3: Reaction Ability Test
A Volleyball was held by the tester at the top of the planks. The subjects were asked to stand behind the starting line, facing opposite to the planks on clapping, the subject took a turn and ran towards the planks and stopped the ball with both the hands which was dropped on the signal. Each subject was given a practice trial before actual commencement of the test.

Instructions : 1. The ball should be stopped with both the hands.

2. The ball should not be pushed upwards while stopping.

Scoring : The score was the distance measured in centimetres from the top of the planks to a point where the subjects stopped the ball. Only two trials were given and the best one was recorded as the score.

**Numbered Medicine Ball Run Test**

Objective : To determine Orientation Ability of the Subjects.

Equipments : (i) Five medicine balls each weighing 3 Kg.

(ii) One medicine ball weighing 4 Kg.

(iii) Stop Watch

(iv) Five metallic numbered plates

(v) Clapper

(vi) Pencil, Papers and Clipboard.
NUMBERED MEDICINE BALL RUN TEST
ORIENTATION ABILITY

Fig. 4: Numbered Medicine Ball Run Test
Description: All the medicine balls weighing 3 kg. were arranged on an even ground in a semi circle. The sixth medicine ball weighing 4 kg. was kept 3 m. away from these medicine balls. Behind all the medicine balls of 3 kg., metallic number plates of 1 square foot size were kept from 1 to 5. Before the start of the test, the subjects were asked to stand behind the sixth medicine ball facing towards the opposite direction. On signal, the subject turned and ran towards the ball, number called by the tester and touched the medicine ball and run back to touch the sixth medicine ball, immediately another number was called, similarly a total of three times the number was called by the tester and the subject performed accordingly. Before the actual test was administered, one practice trial was given to all the subjects.

Scoring: The time taken to complete the course was noted in seconds. Two trials were given to each subject and the best one was recorded as score.

**Backward Medicine Ball Throw Test**

Objective: To assess the Differentiation Ability of the Subjects.

Equipments: (i) A gymnastic mat, size 3’ x 6’
(ii) One medicine ball weighting 2 kg.
(iii) Five medicine balls weighing 1 kg. each
(iv) Pencil, papers and clipboard.
Fig. 5 : Differential Ability
Description: A gymnastic mat was kept 2 meters away from the starting line. A circle of 40 cm. radius was drawn in the middle of the mat and a medicine ball of 2 kg. was kept at the centre of the circle. The subjects were asked to stand behind the starting line facing the opposite direction. They were asked to throw five medicine balls (1 kg. each) over the head to hit the 2 kg. ball kept on the mat, one after another by using both the hands. One practice trial was given to all the subjects.

Instructions: 1. Only overhead throw was permitted.
2. The students were not allowed to look back.

Scoring: 1. Medicine ball touching the mat – 1 point
2. Medicine ball touching the circle line – 2 points
3. Medicine ball touching inside the circle – 3 points
4. Medicine ball touching the 2 kg. Medicine ball – 4 points.

Points were decided considering the first pitch of the ball. The score of the individual was the total points scored in all the five throws.

Long Nose Test

Objective: To determine the Balance ability of the subjects.

Equipments: (i) Balancing Beam
(ii) One Medicine Ball weighing 2 kgs.
(iii) One Medicine Ball weighing 4 kgs.
(iv) Stop Watch
(v) Pencil, paper and clipboard.
LONG NOSE TEST

Balancing Beam

Medicine Ball 2 Kg.

BALANCING ABILITY TEST

Fig. 6: Balancing Ability Test
Description: A balancing beam of standard size was kept on the floor one and a half meters away from the starting line. The subjects were asked to stand behind the starting line with one kilogram medicine ball in their strong hand fully stretched forward and the other hand holding the opposite ear lobe. On clapping the subject moved over the balancing beam towards the 2 kg. medicine ball which was kept at the other end of the beam push down the medicine ball only by foot and would move back to the starting line without losing the balance over the beam.

Instructions: 1. The arm with which the ball is carried should be kept straight.

2. The medicine ball kept on the balancing beam should be rolled down with either foot.

Scoring: Only one chance was given to each subject. The time taken to complete the course was the score. At the same time, the subject who failed to complete the task without losing balance, was not given any further trial and no score was awarded.

Sprint at the Given Rhythm Test

Objective: To determine the Rhythm Ability of the subjects.

Equipments: (i) Eleven gymnastic hoops each 1 mt. In diameter.

(ii) One Stop Watch

(iii) One measuring tape.
SPRINT AT GIVEN RHYTHM

RHYTHM ABILITY

Fig. 7: Sprint at the Given Rhythm
Description: The subject had to run a distance of 30 mt. with maximum sprinting speed marked between two lines. The sprinting time of the subject was taken by stop watch. In the second attempt the subject had to run at a particular rhythm with maximum speed through eleven hoops which were arranged systematically. Three hoops were kept in a sequence against each other at a distance of 5 m. away from the starting line. Similarly three hoops were kept at a distance of 5 m. from the finishing line. Five more hoops were kept in a sequence in the middle of the running distance. The subject had to run through those hoops stepping in between each hoop. The scholar explained the test along with one demonstration and each subject was given one trial run.

Scoring: The difference between the timing of first and second attempt was taken as the score.

**Statistical Techniques for Analysis of Data**

To find out the effect of Bhasrika and Ujjayi Pranayamas on selected psychological variables and coordinative abilities among engineering students, analysis of co-variance (ANCOVA) was employed at 0.05 level of significance.