Chapter V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The human body is built for action not for rest. This was a historical necessity; the struggle for survival demanded good physical condition. But optimal function can only be achieved by regularly exposing the heart, circulation, respiration, the muscles, skeleton and nervous systems to some loading i.e. training. In olden days the body got its exercise both in work and at leisure. In our modern society, however, machines have taken over an ever increasing share of the work elements which were formerly accomplished with muscular power alone. Our life style has been dominated by sitting, riding, and lying. Thus, the natural and vital stimulation that tissues and internal organs received through physical work has largely disappeared.

In today's world which is characterized by rapid changes the physical education and sports activities took a new turn experiencing new trends due to scientific development and advancement of technology. The physical educators and coaches came to realize that values of training and coaching programmes completely based on scientific knowledge. The athletes of today are being exposed to every aspect of training and competitions including psychological preparations, nutritive diet, environmental conditions
and many others. Experts in the profession took up various types of investigations and research works leading to change in techniques, training methods, equipments, surfaces, stadia besides in preventing, treating and rehabilitating aspects of athletic injuries. This resulted in stupendous record breaking performances by athletes in various sports.

The natural environment is a fundamental factor in the development of living being and influence the normal function of their body. Similarly, the environmental temperature is an important factor in which training and competition takes place. The human efficiency and working capacity mainly depends upon the environment of his surrounding. When a person is suddenly exposed from cold to hot climate or vice-versa, he is affected not only physically but also physiologically. Similarly when an athlete is exposed to a variety of climatic conditions during his participation, it will have considerable effect on his performance depending on the severity of the climate. Hence, it is very vital to consider the environmental aspect of competition in training and also its influence on various physiological responses.

The purpose of this study was to investigate the effect of environmental stress (cold, hot-dry, and hot-humid) on selected physiological functional status (heart rate, systolic blood pressure, diastolic blood pressure, respiratory rate and sweat loss) and endurance capacity with special reference to submaximal work
and recovery pattern in the above stated physiological variables after the submaximal work.

The subjects were thirty Inter I.I.T. level hockey playing male students of Indian Institute of Technology, Bombay. Their ages ranged from 18 years to 21 years. All the subjects formed a single group for the purpose of this study. They were subjected to endurance performance under cold, hot-dry, and hot-humid environmental conditions in an environmental chamber.

The resting data for heart rate, systolic blood pressure, diastolic blood pressure and respiratory rate were calculated early in the morning under basal conditions, and the resting body weight for the purpose of determining sweat loss was recorded just before the start of the endurance performance. For the collection of immediate and post exercise recovery data, the subjects were asked to work on a cycle ergometer with a load of 3 kp. (900 kpm/m) with 50 pedal revolutions per minute. The subjects were asked to work till they felt tired and or were not in a position to maintain the required pedal revolution any more. The endurance test was conducted under cold (12°C - 20% Rh), hot-dry (40°C 30% Rh) and hot-humid (37°C - 80% Rh) environmental conditions simulated artificially in an environmental chamber at I.I.T., Bombay. Further to collect the data for recovery phase for the above mentioned parameters the recordings were taken immediately after the exercise (0 minute) and at 3rd, 6th, 9th, 12th, 15th,
18th and 21st minutes after the endurance performance under cold, hot-dry and hot-humid environmental conditions respectively. The post-exercise weighing (to determine sweat loss) was carried out with minimum possible cloth on the body.

The data for resting heart rate and for post-exercise data were recorded administering the pulse count at the carotid artery with the help of a stop watch. The systolic blood pressure and diastolic blood pressure were recorded with the help of sphygmomanometer and stethoscope. The respiratory data were collected counting the upward and downward movements of abdomen. The body weight for the purpose of determining the sweat loss were recorded with the help of a standard weighing machine. The temperatures, relative humidity were recorded using a standard dry-bulb and wet-bulb thermometer.

To analyse the data at post-exercise and recovery phases of above parameters, the difference between means of the group under cold hot-dry and hot-humid environmental conditions of the sweat loss and endurance performance were tested by applying one way analysis of variance, for finding the immediate and after exercise (post-test) recovery on heart rate, systolic blood pressure, diastolic blood pressure, and respiratory rate under three chosen environmental conditions were examined by applying two way analysis of variance. Further analysis of variance and covariance was applied to find the specific effects of cold, hot-dry
and hot-humid environmental conditions on submaximal work with special references to its physiological responses. Analysis of data revealed that there were significant differences existed among different environmental conditions except that of in hot-dry and hot-humid conditions in sweat loss and endurance performance.

It was quite clear from the two way analysis that the recovery periods of heart rate, there were significant differences found between the recoveries after every three minutes from zero minute to 21 minutes in hot-dry environmental conditions. Whereas in cold and hot-humid environmental conditions significant differences were observed between the recoveries, except in 12th and 15th minutes after performing the submaximal work. In case of systolic blood pressure recovery, there were significant differences found between recoveries after every three minutes from zero to 21 minutes in cold and hot-dry conditions. In case of hot-humid, it was from zero to 18 minutes after performing the submaximal work. In diastolic blood pressure recovery, there were no significant differences found under any of the conditions chosen. In the recovery duration of respiratory rate there were significant differences found only upto 6 minutes, 12 minutes and 9 minutes of recoveries after performing the submaximal work under cold, hot-dry and hot-humid conditions respectively. No significant differences were found after 6 minutes to resting position in cold; 12 minutes to 21 minutes in hot-dry and 9 minutes to 21 minutes
of recovery in hot-humid environmental conditions. In all the cases the recovery periods were observed after every 3 minutes from zero minute (immediately after exercise) to 21 minutes.

The analysis of variance and covariance and the post-hoc analysis for the adjusted means of heart rate and sweat loss were greater than the critical difference required to be significant at .05 level in cold, hot-dry and hot-humid conditions, revealed beyond doubt that the above physiological response shoots up during identical submaximal work and induces sweat loss, in hot-dry and hot-humid environmental conditions than that of cold condition. There were no significant differences found between the means of diastolic blood pressure under three chosen environmental conditions.

Conclusions

1. The effect of hot-humid environmental condition influenced greater changes in heart rate, systolic blood pressure and respiratory rate immediately after the submaximal exercise compared to that of hot-dry and cold conditions.

2. Immediately after the exercise the changes in diastolic blood pressure were almost identical in all the three conditions.

3. The recovery period of 21 minutes was inadequate for heart rate, systolic blood pressure and respiratory rate to
reach the resting level under all three chosen environmental conditions.

4. Working under hot-humid and hot-dry conditions induced greater sweat loss than that of cold environmental condition.

5. In cold environmental condition the subjects were able to do cardio-respiratory endurance work for a much longer duration than that of in hot-dry and hot-humid conditions.

6. The hot-humid and hot-dry conditions impair the ability to perform the work for longer duration.

Recommendations

In light of the conclusions drawn, it is recommended that:

1. A similar study may be undertaken using variables other than those employed in this study.

2. A similar study may be conducted with different environmental conditions than those used in this study.

3. A similar study may be conducted using our National and International athletes.

4. Similar study may be conducted using subjects from different zones of India.

5. Proper attention must be given regarding adequate hydration of athletes while training/participating in hot-dry or
hot-humid environmental conditions.

6. For any training programme due importance must be given to environmental temperature and humidity and whenever there is too much of fluctuation in these two components, training intensity can be optimally modified.

7. Whenever any athlete has to participate in either training or competition under extreme environmental conditions, adequate importance must be given about the type and nature of dress he uses.