CHAPTER V
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

SUMMARY

Physical fitness is considered as an entire human organism's ability to function efficiently and is made up of at least eleven different components, each of which contributes to total quality of life. Physical fitness is associated with a person's ability to work effectively, to resist hypokinetic diseases and the meet emergency situations. Though, the development of physical fitness is the result of many things, optimal physical fitness is not possible without regular exercise. Some people associate good physical fitness as being good at sports and games and in fact, it does take a certain degree of fitness to excel in these activities. But, the ability to perform specific skills may not be a good indicator to total physical fitness because some sports require only a certain specific aspect of fitness.

Both in clinical and sports sciences, various tests have been introduced to determine the fitness level of individuals. The measurement of maximal oxygen consumption (VO$_2$ max) through open circuit spirometry and the accumulation of lactic acid during exercise are vital through which an individual's cardiovascular fitness may be evaluated (American College of Sports Medicine, 1991).
In many cases, maximal exercise testing is not a feasible method for assessing maximal oxygen consumption (VO$_2$ max). Such exercise testing not only requires maximal effort but specialized equipment and additional personnel are also needed which can be costly. As a result, sub-maximal tests were developed, not only are sub-maximal test cost effective but also they are highly practical in which they mimic a typical exercise session. While maximal tests allow for the direct measurement of VO$_2$ max, sub-maximal tests can be used to estimate VO$_2$ max (ACSM 1991). An incremental exercise protocol is typically employed in order to estimate VO$_2$ max. During each stage of exercise Heart Rate Response was measured and the test is stopped once the subject reaches a predetermined percentage of their age predicted maximum. Therefore, Heart rate can be plotted against exercise intensity allowing for the estimation of VO$_2$ max (ACSM 1991).

The present study was undertaken to find out whether sub-maximal exercise brings about any changes in blood lactate concentration and recovery heart rate among the subjects of different age groups.

For the purpose of this study, twenty men were selected as subjects for each group, thus the sixty subjects of this study were categorized into three age groups of 18 to 22 years, 28 to 32 years and 38 to 42 years.

The subjects in the age groups from 18 to 22 years were the students of Maharajas College, Ernakulam who were staying in the college hostel. The
subjects of the other groups were all working men, belonging to the other two age groups of 28 to 32 years and 38 to 42 years were living in and around Ernakulam. All the subjects were actively participating in sports and games and were selected after a detailed examination by a registered medical practitioner. No attempt was made to equate their day to day life and the exercise pattern followed with regard to the concerned study.

After finalizing the subjects, subjects were briefed about the nature and purpose of the study, the exercise and the tests they have to do. All of them whole heartedly co-operated with the investigation.

The purpose of the study was to investigate how the same exercise pattern affects the different age groups and the parameters to measure the fatigue level was to measure the lactic acid produced. Hence, lactic acid produced has been selected as a variable for this study. Similarly, heart rate being an indicator of exercise intensity, was also selected as a variable.

Stephan and Baltimore in their longitudinal study (1979) had set the different age category as ten and hence in the present study, inorder to evaluate how different age groups respond to sub-maximal exercise, the different age groups thus selected were 18 to 22, 28 to 32 and 38 to 42 years.

The pre-test and post-test data collected from both the groups were statistically examined for significant differences by applying the analysis of co-variance (ANCOVA). After eliminating the influence of the pre-test
means, the adjusted post-test means of the two groups were tested for significance and later the LSD post-hoc test was applied on those variables, whose F-ratios were found to be significant, inorder to find out whether the significant difference between paired means do actually exist or not.

Further, analysis of variance was done within the three different age groups, to find out the mean differences on (1) Recovery heart rate and (2) Blood lactate level after different types of exercises. Later the LSD post-hoc test was applied on those F-ratios, which were found to be significant, so as to find out whether significant difference do exist or not among the means at 0.05 level of significance.

CONCLUSIONS

In the present study different age groups were examined and the blood lactate level and recovery heart rate after 15 seconds, 30 seconds and 45 seconds were measured after two different sub-maximal exercise bout like 12 minutes contains such and 4 minutes treadmill run.

The results indicates that there was significant difference among all the three groups in all the variables except the data acquired for recovery heart rate after 30 seconds and 45 seconds after 4 minutes treadmill run.

As Stephan Arthur and Arthur Baltimore stated in their longitudinal test (1979) the result of this study also showed significant differences in
10 years many not influence the lactic acid concentration and recovery heart rate in sub-maximal exercises selected for this study.

1. There was significant difference on Recovery heart rate measurements after 12 minutes run after 15 seconds in relation to Normal heart rate between the age group 18 to 22 years and 28 to 32 years.

2. There was significant difference on Recovery heart rate measurements after 12 minutes run after 15 seconds in relation to Normal heart rate between the age group 18 to 22 years and 38 to 42 years.

3. There was significant difference on Recovery heart rate measurements after 12 minutes run after 15 seconds in relation to Normal heart rate between the age group 28 to 32 years and 38 to 42 years.

4. There was significant difference on Recovery heart rate measurements after 12 minutes run after 30 seconds in relation to Normal heart rate between the age group 18 to 22 years and 28 to 32 years.

5. There was significant difference on Recovery heart rate measurements after 12 minutes run after 30 seconds in relation to Normal heart rate between the age group 18 to 22 years and 38 to 42 years.

6. There was significant difference on Recovery heart rate measurements after 12 minutes run after 30 seconds in relation to Normal heart rate between the age group 28 to 32 years and 38 to 42 years.
7. There was significant difference on Recovery heart rate measurements after 12 minutes run after 45 seconds in relation to Normal heart rate between the age groups 18 to 22 years and 28 to 32 years.

8. There was significant difference on Recovery heart rate measurements after 12 minutes run after 45 seconds in relation to Normal heart rate between the age group 18 to 22 years and 38 to 42 years.

9. There was significant difference on Recovery heart rate measurements after 12 minutes run after 45 seconds in relation to Normal heart rate between the age group 28 to 32 and 38 to 42 years.

10. There was significant difference in Blood lactate level after 12 minutes run in relation to Resting blood lactate level between the age group 18 to 22 years and 28 to 32 years.

11. There was significant difference in Blood lactate level after 12 minutes run in Relation to resting blood lactate level between the age group 18 to 22 years and 38 to 42 years.

12. There was significant difference in Blood lactate level after 12 minutes run in relation to Resting blood lactate level between the age group 28 to 32 years and 38 to 42 years.

13. There was no significant difference on Recovery heart rate measurements after 4 minutes treadmill run after 15 seconds in relation
to Normal heart rate between the age group 18 to 22 years and 28 to 32 years.

14. There was significant difference on Recovery heart rate measurements after 4 minutes treadmill run after 15 seconds in relation to Normal heart rate between the age group 18 to 22 years and 38 to 42 years.

15. There was significant difference on Recovery heart rate measurements after 4 minutes treadmill run after 15 seconds in relation to Normal heart rate between the age group 28 to 32 years and 38 to 42 years.

16. There was no significant difference on Recovery heart rate measurements after 4 minutes treadmill run after 30 seconds among the various age groups.

17. There was no significant difference on Recovery heart rate measurements after 4 minutes treadmill run after 45 seconds among the various age groups.

18. There was significant difference in Blood lactate level after 4 minutes treadmill run in relation to Resting blood lactate level between the age group 18 to 22 years and 28 to 32 years.

19. There was significant difference in Blood lactate level after 4 minutes treadmill run in relation to Resting blood lactate level between the age group 18 to 22 years and 38 to 42 years.
20. There was significant difference in Blood lactate level after 4 minutes treadmill run in relation to Resting blood lactate level between the age group 28 to 32 years and 38 to 42 years.

21. There was significant difference on Recovery heart rate after 15 seconds after 4 minutes treadmill run and Normal heart rate of 18 to 22 years of age.

22. There was significant difference on Recovery heart rate after 30 seconds after 4 minutes treadmill run and Normal heart rate of 18 to 22 years of age.

23. There was significant difference on Recovery heart rate after 45 seconds after 4 minutes treadmill run and Normal heart rate of 18 to 22 years of age.

24. There was significant difference between Recovery heart rate after 15 seconds after 12 minutes run and Normal heart rate of 15 of 18 to 22 years of age.

25. There was significant difference between Recovery heart rate after 30 seconds after 12 minutes run and Normal heart rate of 18 to 22 years of age.

26. There was significant difference on Recovery heart rate after 45 seconds after 12 minutes run and Normal heart rate of 18 to 22 years of age.
27. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Recovery heart rate after 30 seconds after 4 minutes treadmill run of 18 to 22 years of age.

28. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Recovery heart rate after 45 seconds after 4 minutes treadmill run of 18 to 22 years of age.

29. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Recovery heart rate after 15 seconds after 12 minutes run of 18 to 22 years of age.

30. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Recovery heart rate after 30 seconds after 12 minutes run of 18 to 22 years of age.

31. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Recovery heart rate after 45 seconds after 12 minutes run of 18 to 22 years of age.

32. There was significant difference between Recovery heart rate after 30 seconds after 4 minutes treadmill run and Recovery heart rate after 45 seconds after 4 minutes treadmill run of 18 to 22 years of age.

33. There was significant difference between Recovery heart rate after 30 seconds after 4 minutes treadmill run and Recovery heart rate after 15 seconds after 12 minutes run of 18 to 22 years of age.
34. There was significant difference between Recovery heart rate after 30 seconds after 4 minutes treadmill run and Recovery heart rate after 30 seconds after 12 minutes run of 18 to 22 years of age.

35. There was no significant difference between Recovery heart rate after 30 seconds after 4 minutes treadmill run and Recovery heart rate after 45 seconds after 12 minutes run of 18 to 22 years of age.

36. There was significant difference between Recovery heart rate after 45 seconds after 4 minutes treadmill run and Recovery heart rate after 15 seconds after 12 minutes run of 18 to 22 years of age.

37. There was significant difference between Recovery heart rate after 45 seconds after 4 minutes treadmill run and Recovery heart rate after 30 seconds after 12 minutes run of 18 to 22 years of age.

38. There was significant difference between Recovery heart rate after 45 seconds after 4 minutes treadmill run and Recovery heart rate after 45 seconds after 12 minutes run of 18 to 22 years of age.

39. There was significant difference between Recovery heart rate after 15 seconds after 12 minutes run and Recovery heart rate after 30 seconds after 12 minutes run of 18 to 22 years of age.

40. There was significant difference between Recovery heart rate after 15 seconds after 12 minutes run and Recovery heart rate after 45 seconds after 12 minutes run of 18 to 22 years of age.
41. There was significant difference between Recovery heart rate after 30 seconds after 12 minutes run and Recovery heart rate after 45 seconds after 12 minutes run of 18 to 22 years of age.

42. There was significant difference between Resting blood lactate level and Blood lactate level after 4 minutes treadmill run of 18 to 22 years of age.

43. There was significant difference between Resting blood lactate level and Blood lactate level after 12 minutes run of 18 to 22 years of age.

44. There was significant difference between Blood lactate level after 4 minutes treadmill run and Blood lactate level after 12 minutes run of 18 to 22 years of age.

45. There was significant difference on Recovery heart rate after 15 seconds after 4 minutes treadmill run and Normal heart rate of 28 to 32 years of age.

46. There was significant difference on Recovery heart rate after 30 seconds after 4 minutes treadmill run and Normal heart rate of 28 to 32 years of age.

47. There was significant difference on Recovery heart rate after 45 seconds after 4 minutes treadmill run and Normal heart rate of 28 to 32 years of age.
48. There was significant difference on Recovery heart rate after 15 seconds after 12 minutes run and Normal heart rate of 28 to 32 years of age.

49. There was significant difference on Recovery heart rate after 30 seconds after 12 minutes run and Normal heart rate of 28 to 32 years of age.

50. There was significant difference on Recovery heart rate after 45 seconds after 12 minutes run and Normal heart rate of 28 to 32 years of age.

51. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Recovery heart rate after 30 seconds after 4 minutes treadmill run of 28 to 32 years of age.

52. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Recovery heart rate after 45 seconds after 4 minutes treadmill run of 28 to 32 years of age.

53. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Recovery heart rate after 15 seconds after 12 minutes run of 28 to 32 years of age.

54. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Recovery heart rate after 30 seconds after 12 minutes run of 28 to 32 years of age.
55. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Recovery heart rate after 45 seconds after 12 minutes run of 28 to 32 years of age.

56. There was significant difference between Recovery heart rate after 30 seconds after 4 minutes treadmill run and Recovery heart rate after 45 seconds after 4 minutes treadmill run of 28 to 32 years of age.

57. There was significant difference between Recovery heart rate after 30 seconds after 4 minutes treadmill run and Recovery heart rate after 15 seconds after 12 minutes run of 28 to 32 years of age.

58. There was no significant difference between Recovery heart rate after 30 seconds after 4 minutes treadmill run and Recovery heart rate after 30 seconds after 12 minutes run of 28 to 32 years of age.

59. There was significant difference between Recovery heart rate after 30 seconds after 4 minutes treadmill run and Recovery heart rate after 45 seconds after 12 minutes run of 28 to 32 years of age.

60. There was significant difference between Recovery heart rate after 45 seconds after 4 minutes treadmill run and Recovery heart rate after 15 seconds after 12 minutes run of 28 to 32 years of age.

61. There was significant difference between Recovery heart rate after 45 seconds after 4 minutes treadmill run and Recovery heart rate after 30 seconds after 12 minutes run of 28 to 32 years of age.
62. There was significant difference between Recovery heart rate after 45 seconds after 4 minutes treadmill run and Recovery heart rate after 45 seconds after 12 minutes run of 28 to 32 years of age.

63. There was significant difference between Recovery heart rate after 15 seconds after 12 minutes run and Recovery heart rate after 30 seconds after 12 minutes run of 28 to 32 years of age.

64. There was significant difference between Recovery heart rate after 15 seconds after 12 minutes run and Recovery heart rate after 45 seconds after 12 minutes run of 28 to 32 years of age.

65. There was significant difference between Recovery heart rate after 30 seconds after 12 minutes run and Recovery heart rate after 45 seconds after 12 minutes run of 28 to 32 years of age.

66. There was significant difference between Resting blood lactate level and Blood lactate level after 4 minutes treadmill run of 28 to 32 years of age.

67. There was significant difference between Resting blood lactate level and Blood lactate level after 12 minutes run of 28 to 32 years of age.

68. There was significant difference between Blood lactate level after 4 minutes treadmill run and Blood lactate level after 12 minutes run of 28 to 32 years of age.
69. There was significant difference between Normal heart rate and Recovery heart rate after 15 seconds after 4 minutes treadmill run of 38 to 42 years of age.

70. There was significant difference between Normal heart rate and Recovery heart rate after 30 seconds after 4 minutes treadmill run of 38 to 42 years of age.

71. There was significant difference between Normal heart rate and Recovery heart rate after 45 seconds after 4 minutes treadmill run of 38 to 42 years of age.

72. There was significant difference between Normal heart rate and Recovery heart rate after 15 seconds after 12 minutes run of 38 to 42 years of age.

73. There was significant difference between Normal heart rate and Recovery heart rate after 30 seconds after 12 minutes run of 38 to 42 years of age.

74. There was significant difference between Normal heart rate and Recovery heart rate after 45 seconds after 12 minutes run of 38 to 42 years of age.

75. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Resting heart rate after 30 seconds after 4 minutes treadmill run of 38 to 42 of age.
76. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Resting heart rate after 45 seconds after 4 minutes treadmill run of 38 to 42 of age.

77. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Resting heart rate after 15 seconds after 12 minutes run of 38 to 42 of age.

78. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Resting heart rate after 30 seconds after 12 minutes run of 38 to 42 of age.

79. There was significant difference between Recovery heart rate after 15 seconds after 4 minutes treadmill run and Resting heart rate after 45 seconds after 12 minutes run of 38 to 42 of age.

80. There was significant difference on Recovery heart rate after 30 seconds after 4 minutes treadmill run and Recovery heart rate after 45 seconds after 4 minutes treadmill run of 38 to 42 years of age.

81. There was no significant difference on Recovery heart rate after 30 seconds after 4 minutes treadmill run and Recovery heart rate after 15 seconds after 12 minutes run of 38 to 42 years of age.

82. There was significant difference on Recovery heart rate after 30 seconds after 4 minutes treadmill run and Recovery heart rate after 30 seconds after 12 minutes run of 38 to 42 years of age.
83. There was significant difference on Recovery heart rate after 30 seconds after 4 minutes treadmill run and Recovery heart rate after 45 seconds and 12 minutes run of 38 to 42 years of age.

84. There was no significant difference on Recovery heart rate after 30 seconds after 4 minutes treadmill run and Recovery heart rate after 15 seconds and 12 minutes run of 38 to 42 years of age.

85. There was significant difference on Recovery heart rate after 45 seconds after 4 minutes treadmill run and Recovery heart rate after 15 seconds and after 12 minutes run of 38 to 42 years of age.

86. There was no significant difference on Recovery heart rate after 45 seconds after 4 minutes treadmill run and Recovery heart rate after 30 seconds after 12 minutes run of 38 to 42 years of age.

87. There was no significant difference on Recovery heart rate after 15 seconds after 12 minutes run and Recovery heart rate after 30 seconds after 12 minutes run of 38 to 42 years of age.

88. There was significant difference on Recovery heart rate after 15 seconds after 12 minutes run and Recovery heart rate after 45 seconds after 12 minutes run of 38 to 42 years of age.

89. There was no significant difference on Recovery heart rate after 15 seconds after 12 minutes run and Recovery heart rate after 30 seconds after 12 minutes run of 38 to 42 years of age.
90. There was significant difference on Recovery heart rate after 30 seconds after 12 minutes run and Recovery heart rate after 45 seconds after 12 minutes run of 38 to 42 years of age.

91. There was significant difference between Resting blood lactate level and Blood lactate level after 4 minutes treadmill run of 38 to 42 years of age.

92. There was significant difference between Resting blood lactate level and Blood lactate level after 12 minutes run of 38 to 42 years of age.

93. There was significant difference between Blood lactate level after 4 minutes treadmill run and Blood lactate level after 12 minutes run of 38 to 42 years of age.
RECOMMENDATIONS

1. Further studies may be undertaken by extending the training period by a much further period than taken for this study.

2. A similar study may be done using other variables which have not been used in this study.

3. It is recommended that coaches and Physical Education teachers should take advantage of sub-maximal exercise for better performances of athletes.

4. It is recommended that further studies may be conducted by increasing the number of subjects more than what has been used in this study.