Chapter II

REVIEW OF RELATED LITERATURE

Sincere efforts have been made by the research scholar to locate literature related to this study. The relevant studies found from the library of the Lakshmibai National Institute of Physical Education, Gwalior, which the research scholar has come across are cited below.

Seven flexibility measurements of a college rowing team (N = 22) were taken before and following a 14 week season of training and competition. The flexibility measurements, administered by means of a Lightoon Flexometer, were shoulder, elbow, wrist, knee, ankle, hip, and trunk flexion – extension. Two of the measurements, wrist flexion – extension and knee flexion – extension, increased significantly following the rower's participation in the training programme. In a correlation to determine the relationship between range of movement of the selected joints of the rowing team and their relative rowing performance, shoulder flexion – extension was found to correlate significantly with ratings of rowing ability. The mean flexibility of the rowers exceeded those of swimmers, baseball players, short putters, and discuss throwers and non-athletes of previous studies in elbow, knee, ankle and hip flexion – extension.¹

Nine varsity and six freshmen rowers were given brachial sphygmograph tests every week during an intensive training programme lasting ten weeks. Fifteen measurements were made on each sphygmograph. The ten values for each measurements were tested for linearity of regression. Only heart rate and blood pressure measurements of some rowers were linearly related to time spent in training. The mean values of most of the cardiovascular measurements were excellent compared with mean values of other athletic groups reported in the literature.²

This study was conducted to investigate the difference in HR, VO₂, rate pressure product (RPP) SBP and DBP responses for subjects who performed arm cranking (AC) and rowing (R) exercise to volitional peak effort. Data were collected on twenty male subjects during four volitional max exercise: two on a R machine and two on an AC device. For each individual relationship between percentage of peak VO₂ (% VO₂) and HR, VO₂, RPP, SBP and DBP linear regression equations were calculated. The group M for predicted values for each variables at exercise intensities of 50, 60, 70, 80, and 90% VO₂ and at peak VO₂ were computed for each type of test. The group M and the M slopes of the individual regression equations for each variable

were tested for difference between the two types of upper extremity exercises. There were no difference (P > .05) in any predicted values of the variables at any of the submax exercise intensities. There was no difference (P > .05) in the absolute values for any of the measured variables at peak effort between the two arm exercises. No difference (P > .05) was found in the M slopes of the individual regression equations used to determine the predicted submax values for each of the measured variables. The results indicated that the cardio-respiratory response to R and AC is similar at relative submax and peak efforts.3

Standard measurements of static long volumes, ventilatory capacity, pulmonary diffusing capacity, and body blood volume were made at rest. Ventilation, pulmonary diffusing capacity, oxygen consumption, and heart rate were made during steady state exercise on a bicycle ergometer at work loads of 600, 1000, 1400, 1800, kilo-pond metres per minute. Variance analysis showed no differences among the athletic groups in pulmonary function and gas exchange at rest or during exercise when adjustments were made for differences in body size and the athletic groups did not differ from untrained college men in lung volume or ventilatory capacity at rest or in pulmonary diffusing capacity at rest or

during exercise.\textsuperscript{4}

Mishra\textsuperscript{5} studied the relationship of selected physical and physiological variables to performance in fifty metre front crawl swimming. The subjects were twenty-five professional male students of physical education studying in Lakshmibai National College of Physical Education, Gwalior. Data was collected on arm strength (Roger's Physical Fitness Index), ankle flexibility (Goniometer), vital capacity and body surface area. Performance was recorded in seconds. Product moment correlation was computed to assess the relationship of physical and physiological variables to speed in fifty metre swimming. It was concluded that 1) there was a significant positive relationship between arm strength, ankle flexibility and vital capacity to swimming speed and 2) there was no significant relationship between body surface area and swimming speed.

Relationship of selected physical and psychological factors of the beginning swimmer's ability and performance in crawl stroke was determined by Crites.\textsuperscript{6} He used forty subjects


\textsuperscript{5}Laljee Mishra, "Relationship of Selected Physical and Physiological Variables to Performance in 50 m. Front Crawl Swimming," (Unpublished Master's Thesis, Jiwaji University, 1983).

\textsuperscript{6}Jerry Keith Crites, "A Study of Selected Physical and Psychological Factors to Determine their Relationship to the Performance of the Crawl Stroke by Beginning Swimmers," Dissertation Abstraction International 36 (October 1975): 2084-A.
from two beginning swimming classes. The beginning swimming classes met for forty minutes twice a week. Prior to any swimming instruction, measurements were collected on shoulder rotation, shoulder extension, strength, hip extension strength, body composition, swimming anxiety and swimming ability as measured by the Fox Power Test (revised). After five weeks of crawl stroke instruction, measurements were again collected on swimming anxiety and swimming ability. Pearson's Product Moment Correlation was used to analyse the data. It was found that: (1) shoulder rotation, shoulder extension strength, hip extension strength and body composition were not significant factors in the performance of crawl stroke, and (2) a significant relationship was indicated between swimming anxiety and the ability to perform the crawl stroke.

Gordon predicted basketball playing ability from cardiovascular capacity, leg power, upper body strength and endurance, body composition, and body weight, subjects were twenty women varsity basketball players from two colleges, ten from each college. Separate prediction equations were developed for five criterion measures: an ability rating consisting of four offensive, defensive descriptive terms, the Tutko Richards General Personality Rating,

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a composite score of the two measures, the Noll Comparative Rating Scale which utilized game statistics and a ranking of the players by the coach. The data were analysed by the step-wise multiple regression programme. The best prediction equation was found to be: basketball ability = 9.053 + 1.364 (12 minute run) - 0.113 ht.

Amusa selected 46 students, who were well conditioned soccer players with at least two years playing experience on the college level. They were tested for running speed, power, agility, max. VO₂, strength, anaerobic capacity and flexibility. In addition, 11 anthropometric measurements consisting of skinfold and body diameters were taken. Soccer playing ability served as the criterion and was measured by the ratings of three experienced soccer coaches based on selected soccer skills and strategies. Analysis of data was by zero order correlations and multiple regression analysis resulting in the following conclusions: age (experience) is the best single predictor of playing ability. Weight, L.B.W. and height are considered good predictors of playing ability. Max. VO₂ and running speed are considered important factors in soccer performance. Flexibility, agility, lactate concentration and leg power are not considered as valid indicators of playing ability.

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Cunningham and Anderson\(^9\) tested six high school cross country runners, who were members of the team which was the Messachus State High School Championship. Mean anthropometric values found this team to be shorter, lighter and less fat when compared to age related norms. The mean somatotype was considered more ectomorphic and less mesomorphic than elite endurance athletes. It was concluded that members of a championship cross country team exhibit a physiological profile which is characteristics of endurance athlete. Team members show little inter-individual variation. No adverse effects of season long training were noted. Several well known cardio-vascular risks factors were considered low normal in this group.

Elhardt and Orth\(^10\) investigated the effect of water polo on blood pressure and pulse rate. In this investigation twenty members of the water-polo squad of Illinois University were used as subjects. Normal records of blood pressure and pulse rate were obtained preceding the game. After twelve minutes of play records were made again. Approximately 15 seconds of time elapsed from the time a man left the pool until his record was taken.


After various types of competition in a water-polo contest systolic and diastolic blood pressure of thirteen subjects were found to have increased above those of twenty controls by an average of 38 mm.Hg. of systolic and 9.6 mm.Hg. for diastolic pressure. Pulse rate increases of the competitors averaged 60.4 per minute.

Joseph\textsuperscript{11} determined the relationship of power, agility, shoulder flexibility, arm length, and leg length to volleyball playing ability. Thirty male volleyball players of the Lakshmibai National College of Physical Education, Gwalior were selected as subjects. Power was measured by sargent jump; agility by 40 m. shuttle run; shoulder flexibility by graded stick and arm length and leg length by steel tape. The playing ability was based on the average subjective judgement of three experts. Product Moment Correlation was used to statistically analyse the data and it was concluded that: 1) power is the most reliable single variable in prediction of playing ability of men volleyball players; 2) arm length and leg length are also reliable variables in prediction of playing ability of male volleyball players and 3) the variables of agility and shoulder flexibility show insignificant relationship in prediction of playing ability of male volleyball players.

Bloomfield\textsuperscript{12} studied about the anatomical and physiological differences between varsity ability swimmers. One hundred twenty senior level swimmers who were divided into three groups on the basis of two criteria of the means from 39 test administered in the study in any three of comparisons did the means of national level group significantly surpass those of the high level varsity swimmers. In contrast the means of national level group were significantly higher than those of low level varsity swimmers, in nine instances. In no instance were the means of the high and low level swimmers significantly higher than those of the national level swimmers in any instance higher than those of either of the other two groups.

Abdo\textsuperscript{13} conducted a study on leg length, height, weight, factors in relation to cardio-vascular efficiency of college women. Data collected from 198 subjects inter correlated. The results indicated that excess weight had effect on cardio-vascular efficiency while leg strength correlated positively with step test performance. The linear correlation between cardio-vascular efficiency and ponderal index was significant. But regression line levelled for


women with high cardio-vascular efficiency.

Scott\textsuperscript{14} studied that male S.H.S. (senior high school) swimmers who catterered or equal a time of 56 seconds for 100 metres crawl stroke were tested for the flexibility of ankle, knee, hip, trunk and shoulder, followed by strength test of knee, hip, shoulder, trunk, upon completion of tests. The students were timed for 100 yards swimming. It was concluded that certain flexibility measures were significantly related to swimming time. However, it was determined that knowledge of certain flexibility and strength measures could not be used to predict 100 yards crawl stroke time.

Duana\textsuperscript{15} studied the relationship of physical factors of football performance. Players were measured in arm strength (push and pull), 50 yards dash, right grip, left grip, speed correlated 60 per cent to total strength 40 with the criterion both correlation were significant.

Schwartz and companions\textsuperscript{16} conducted a study a vital


capacity of sixty-eight adolescent boys who took regular exercise for a period of four months and fifty other boys without any regular exercise. The study did not indicate any significant difference in vital capacity.

Pilch\textsuperscript{17} in his findings on the cardio-vascular responses of selected middle-aged subjects to regular periods of exercise. Other variables taken were haemoglobin. Here the experimental group pedaled the ergometer bicycle thirty minutes per day, four days per week, for six weeks at a work load that kept the heart-rate at 135 beats per minute. Finally it was found no significant change in haemoglobin from pre to post training on the experimental group.

Novak and Woodward\textsuperscript{18} investigated to determine working capacity at heart rate of 170 beats/min. body composition and anthropometry of female Olympic athletes. The subjects were eight distance runners, seven swimmers, and five gymnasts. The working capacity was determined on bicycle ergometer, oxygen intake, carbondioxide, respiratory rate, pulse rate and RQ were

\textsuperscript{17}Arthur Henry Pilch, "Cardio-vascular Responses of Selected Middle Aged Subjects to Regular Periods of Exercises," Dissertation Abstracts International 32 (August 1971) : 775-A.

determined by Siregnost - FD 88. In relative values distance runners showed significantly higher oxygen intake which was also achieved at significantly higher work-load compared to swimmers and gymnasts. Vital capacity who significantly higher and lean body mass were lower in swimmers. Various subcutaneous skinfold were higher in swimmer.

Clarke\(^{19}\) stated that early in the use of the sphygmomanometer, investigators considered the use of blood pressure measures as a possible indication of physical fitness. A common approach was bond on circulatory adaptotions to changes in body position from lying to sitting to standing. In 1905 the Crompton Blood Pressure Piosis Test included the difference between standing and reclining blood pressures as one item. In 1914, the Borach Index required both systolic and diastolic pressures taken in the sitting position. In 1920, the Schneider cardio-vascular test battery of six items included "increase in systolic pressure standing compared with reclining." Later in 1925, the McCardy Larson Organic Efficiency Test contained blood pressure measures among its five items: sitting diastolic pressure, sitting pulse pressure and standing pulse pressure.

Carlson\textsuperscript{20} investigated on morphological, cardio-respiratory and biomechanical model of endurance running performance. It was concluded that selected cardio-respiratory, body size, composition and structure and bio-mechanical variables contribute significantly to endurance running performance in trained adult recreational runners. The degree of the contribution of the cardio-respiratory measures as determinants of endurance performance was greater than the contributions of the body size, composition structure and other running mechanics variables.

Ronald\textsuperscript{21} found at the contribution of selected variables to college football performance. Thirty members of the south Eastern State Collegiate Football Teams were selected for this study. From the Multiple Correlation Coefficient, it was found that best predictor of game percentage for backs was lateral movement. For the line best predictor of game percentage score was the bench step. When the combined groups were the best predictor of game percentage score was to vertical jump. It was conducted that for the total group of vertical jump and 12 minutes run were the two best predictors.


Johnson\textsuperscript{22} conducted a study to investigate the effect of season of inter-collegiate soccer participation on selected components of physical fitness. The elements of physical fitness measure were agility, cardio-vascular endurance, muscular strength of the leg and running speed. The subjects were 16 members of Emory University Soccer Team 1971. The pre-season practice and the competitive season lasted approximately ten weeks. It was found that participation in inter-collegiate soccer programme was likely to cause adoption in the circulatory and respiratory system that would result in increased efficiency or improved cardio-respiratory endurance. It produced significant improvement in agility, muscular strength of the leg and running speed also.

Roy\textsuperscript{23} compared selected physical and physiological variables between national level sprint swimmers and long distance swimmers. He observed the following:

1. There was significant difference in arm and shoulder strength between sprint and long distance swimmers.

2. There were no significant differences in height, weight,

\textsuperscript{22}Thomas C. Johnson, "The Effect of Season of Inter-collegiate Soccer on Selected Component of Physical Fitness," Dissertation Abstracts International 32 (May 1972): 3355-A.

lean body weight, percentage of fat, grip strength (left hand) and grip strength (right hand) between sprint and long distance swimmers.

3. There were significant differences in maximum oxygen consumption, anaerobic power, peak flow rate, air flow rate and vital capacity between sprint and long distance swimmers.

4. There were no significant differences in resting heart rate, positive breath holding and negative breath holding capacity between national level sprint and long distance swimmers.

5. Quantitatively sprint swimmers were ahead in height, weight, lean body weight, arm and shoulder strength, grip strength (right and left), anaerobic power, resting heart rate (beats/minute), positive breath holding and negative breath holding capacity than long distance swimmers.

6. The long distance swimmers were quantitatively ahead in fat percentage, maximum oxygen composition, peak flow rate, air flow rate and vital capacity than sprint swimmers.

Raman²⁴ conducted tests on thirty male cricket players from graduate and under-graduate courses at Lakshmibai National College of Physical Education, Gwalior in order to determine

the relationship of grip strength, leg power, agility, and hand and foot reaction times to performance in cricket. Data was collected on grip strength (grip dynamometer), leg power (standing broad jump), agility (40 yard shuttle run) and hand and foot reaction time (electronic reaction timer) and performance was the average of subjective rating of three experts during practice and match situations. Product Moment Correlation was employed to statistically treat the data. It was concluded that: (1) hand and foot reaction time is the most important variable in the prediction of performance of a cricketer, (2) leg power is another important variable in the prediction of performance in cricket, (3) grip strength is also an important variable of prediction in cricket playing ability and (4) agility is not an important factor in the prediction of performance in cricket.

Thirty varsity baseball players of the University of Iowa were tested by Everett\(^{25}\) on ability to throw for distance, running speed and agility (shuttle run), ability to visualize partial relationship (Thurstone's 'S' test), ability to make decision quickly (the blocks test) and motor capacity (the General Motor Capacity Score). These subjects were rated according to playing ability by the coach.

Product Moment Correlation, Partial Correlation and Multiple Correlation were computed and the following conclusions were made: 1) the Sargent Jump is the best single measure for selecting baseball talent, 2) the best economical combination to predict baseball ability is the Sargent Jump, 'S' test, and the blocks test.

\[ T\text{ score} = 0.92 \text{ Sargent Jump (cm.)} - 0.08 \ 'S' \text{ test (score)} - 0.23 \text{ Blocks Test (sec.)} + 16.19. \]

Farrell and Goyle\textsuperscript{26} investigated on 18 experienced male distance runners, physical characteristics and responses to maximal exercise on an average of eight treadmill runs at various speeds were taken. The relationship between heart rate and treadmill velocity was linear (\( r = .95 \)). The correlation between performance and most of these variables are not in excess of the correlation found in this study. Thus, as a predictive tool, heart rates at a standardised treadmill velocity may be preferable due to the ease at data collection.

Promoda Devi\textsuperscript{27} studied the relationship of selected physical variables to performance in shot-put. Product Moment

\textsuperscript{26}Peter A. Farrell and Edward F. Goyle, "Exercise Heart Rate as a Predictor of Running Performance," Research Quarterly for Exercise and Sport 51 (October 1980): 417-421.

Correlation method was used to compute correlation and significance of the study. It was concluded that - 1) there were significant correlation between arm strength, leg strength, speed, flexibility and shot-put performance, 2) there were no significant correlation between weight, height, arm length, leg length, foreleg length, thigh length, ponderal index, crural index and shot-put performance.

Mookerjee and his associates\textsuperscript{28} determined the relationship between Isokinetic Strength, Flexibility, and Flutter Kicking speed in female collegiate swimmers. Isokinetic Peak torques were determined at three selected velocities : 2.88, 6.28, and 7.85 rad. sec.\textsuperscript{-1}. Flexibility measurements included ankle planter flexion and dorsiflexion as well as hamstring and lower back flexibility. Flutter kicking times for 22.86 m. (T\textsubscript{1}) and 45.72 m. (T\textsubscript{2}) were obtained in a 22.86 m. pool using a kickboard. Peak torque during knee extension at 6.28 rad. sec.\textsuperscript{-1} correlated significantly with T\textsubscript{1} (r = 0.82) and T\textsubscript{2} (r= 0.71). They observed that there was no relationship between ankle flexibility and flutter kicking speed in the subjects, but back flexibility correlated significantly.

Dey\textsuperscript{29} conducted a study to investigate physical and


physiological profiles of rowers of different performance levels. He observed the following:

1. The mean resting heart rate was highest in state level of rowers followed by inter-varsity and minimum in national level of rowers.

2. The means vital capacity, haemoglobin content, total body weight, lean body mass, arm strength, abdominal strength, explosive leg strength, shoulder flexibility (both right and left) and trunk flexibility were highest in each case in national level of rowers followed by inter-varsity and minimum in state level of rowers.

3. The mean cardio-vascular endurance did not follow either increasing or decreasing order.

4. The weight of fat and resting blood pressure (systolic and diastolic) were found statistically insignificant in case of state, inter-varsity and national level of rowers.