Chapter – II

REVIEW OF RELATED LITERATURE

A review of the research reports related to this study which the research scholar could gather is cited in this chapter. The literature reviewed has been collected mainly from libraries of Lakshmibai National University of Physical Education, Gwalior, Sports Authority of India, Netaji Subas, National Institute of Sports, Patiala and Sports Authority of India, Jawhar Lal Nehru, Stadium, New Delhi.

Measurements of body size include such descriptive information as height, weight and surface area, while measures of body proportion describe the relationship between height & weight and among length, width and circumference of various body segments. It has been found that top athletes in some sports tend to have those propositions that bio-mechanically aid the particular performance required.
Anthropometric measurements are the objective measurements of the structure and function of the body. The measurements of structure include such items on weight, height, width, depth and circumference of the body.

1 Sinclair A, et al conducted a study to assess the anthropometrics of Australian male and female cricket fast bowlers to ascertain the relevance for player selection and latent talent and performance. The results noted the relation between body structure and performance but concluded that much scope remains for further investigation.

2 O'Connor, et al Conducted a study with an aim to describe the physique characteristics and competition nutrient intake of professional Rugby League players and to assess use of a statistical technique for evaluating validity of dietary reporting. Findings suggest that accurate measurement of dietary information in athletes is complex as they often

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1 Sinclair, Peter, Stuelken, Max, Pyne, David, Anthropometric characteristics of elite cricket fast bowlers, Journal of Sports Sciences, 2007
2 O'Connor, Helen, Lundy, Bronwen, Pelly, Fiona, Caterson, Ian, Anthropometric characteristics and competition dietary intakes of professional Rugby League players, International Journal of Sport Nutrition and Exercise Metabolism, 2006
have extremely high or low energy intakes, unusual or unconventional eating patterns, and consume a range of special or sport specific foods.

3 Dragom Radovanovic, et.al Aimed to determine the physiological profile of the best female water polo players in Serbia, with the purpose to use the obtained results as a guideline in the process of selection and planning of the sports form development. The parameters which should show physiological adaptation to specific kind and type of training were followed during preparatory period before the 2006 European Championship. Twelve water polo players (mean±/-SD: age 23.8±/-3.1 years, height 173.2±/-3.9 cm, body mass 65.7±/-7.4 kg, fat mass 17.8±/-5.3) of the Serbian women’s national waterpolo team participated in the investigation. The results of our investigation show great anaerobic capacity and muscular strength of upper body (mean±/-SD: peak power 8.05±/-0.8 W.kg-1, mean power 6.5±/-0.4 W.kg-1, very high aerobic endurance (mean±/-SD: VO2(max) 46.52±/-7.0 mL O2 (min-1kg-1) on arm ergometer, VO2 (max) 61.8±/-11.9 mL O2(min-1kg-1).

1 Dragom Radovanovic, Tomislav Okicic And Aleksandar Ignjatovic Physiological Profile Of Elite Women Water Polo Players, Faculty of Pedagogy in Jagodina, University of Kragujevac.
1kg-1 on leg ergometer)) and high values of lung function parameters. The great strength of the upper body and pronounced aerobic endurance of the whole organism are dominant characteristics of elite female water polo players. Along with a relatively pronounced body height, and a low percentage of the fat tissue, these female athletes are very well predisposed for adaptation on great physical demands over the whole match.

Daniel J Hornery, et al To describe the physiological responses to tournament tennis in relation to prevailing environmental conditions, match notation, and skills that underpin performance. 14 male professional tennis players (mean (SD) age, 21.4 (2.6) years; height, 183.0 (6.9) cm; body mass, 79.2 (6.4) kg) were studied while contesting international tennis tournaments. Environmental conditions, match notation, physiological (core temperature, hydration status, heart rate, blood variables), and performance indices (serve kinematics, serve

velocity, error rates) were recorded. Hard and clay court tournaments elicited similar peak core temperature (38.9 (0.3) v 38.5 (0.6)°C) and average heart rate (152 (15) v 146 (19) beats/min) but different body mass deficit (1.05 (0.49) v 0.32 (0.56)%, p<0.05). Average pre-match urine specific gravity was 1.022 (0.004). Time between points was longer during hard court matches (25.1 (4.3) v 17.2 (3.3) s, p<0.05). Qualitative analysis of first and second serves revealed inverse relations between the position of the tossing arm at ball release and the position of the ball toss and progressive match time (respectively, $r = -0.74$ and $r = -0.73$, p<0.05) and incurred body mass deficit ($r = 0.73$ and $r = 0.73$, p<0.05). Participants began matches in a poor state of hydration, and experienced moderate thermoregulatory strain and dehydration during competition. These adverse physiological conditions may compromise performance and influence notational analyses.
Studied the current anthropometric profiles of elite Australian female and male cricket fast bowlers and establish a set of reference values useful for future investigations on player selection, talent identification, and training programme development. The participants were 26 female (mean age 22.5 years, $s = 4.5$; height 1.71 m, $s = 0.05$; body mass 66.2 kg, $s = 7.5$) and 26 male (mean age 23.9 years, $s = 3.5$; height 1.88 m, $s = 0.05$; body mass 87.9 kg, $s = 8.2$) fast bowlers. The anthropometric profiles included the measurement of skinfolds, and segment lengths, breadths, and girths. A series of derived variables assessing the distribution of subcutaneous adipose tissue, the bivariate overlap zone, relative body size and proportionality, and somatotype were also calculated. The male bowlers had larger length, breadth, and girth measurements than their female counterparts. There were differences in proportionality between the sexes, with only the male bowlers exhibiting characteristics that could be considered “large”

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relative to height. The female bowlers had a higher sum of seven skinfolds ($P < 0.001$), were more endomorphic ($F_{1,50} = 30.18$, $P < 0.001$), and less mesomorphic ($F_{1,50} = 10.85$, $P < 0.01$) than the male bowlers. These reference data should be useful to practitioners and researchers interested in cricket. Further research is needed to clarify why only male fast bowlers had variables that were proportionally large relative to height.

Pyne, D.B., G.M. Duthie, P.U. Saunders, C.A. Petersen, and M. Portus. Anthropometric and strength correlates of fast bowling speed in junior and senior cricketers. J. Strength Cond. Res. 20(3):620–626. 2006.—The aim of this study was to characterize relationships between anthropometric and isoinertial strength characteristics and bowling speed in junior and senior cricket fast bowlers. Subjects were first-class senior ($n = 24$; mean $\pm$ SD age $= 23.9 \pm 4.8$ years, height $= 187.4 \pm 4.8$ cm, mass $= 87.8 \pm 8.4$ kg) and junior representative ($n = 48$; mean $\pm$ SD age $= 14.8 \pm 1.3$ years, height $= 175.7 \pm 9.8$ cm, mass $= 65.8 \pm 12.9$ kg) male

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fast bowlers. A full anthropometric profile, upper- and lower-body isoinertial strength tests, and peak bowling speed ($V_{\text{peak}}$) were assessed on the same day. The senior bowlers had a substantially faster $V_{\text{peak}}$ (126.7 km•h$^{-1}$) than the juniors (99.6 km•h$^{-1}$), a larger estimated muscle mass (seniors 40.0 ± 3.9 kg, juniors 28.3 ± 5.6 kg), and a greater bench press throw and deltidoid throw (all $p < 0.01$). The best multiple predictors of $V_{\text{peak}}$ for the junior bowlers were the static jump, bench throw, body mass, percentage muscle mass, and height (multiple-correlation $r = 0.86$). For the senior bowlers, static jump and arm length correlated positively with $V_{\text{peak}}$ (multiple-correlation $r = 0.74$). The 1-legged countermovement jump was negatively correlated with $V_{\text{peak}}$ in both groups. We conclude that differences in $V_{\text{peak}}$ between junior and senior bowlers relate primarily to body mass and upper-body strength. However, lower body strength is a more important contributor to $V_{\text{peak}}$ in senior bowlers.
Pyne DB, et al studied to characterize relationships between anthropometric and isoinertial strength characteristics and bowling speed in junior and senior cricket fast bowlers. Subjects were first-class senior (n = 24; mean +/- SD age = 23.9 +/- 4.8 years, height = 187.4 +/- 4.8 cm, mass = 87.8 +/- 8.4 kg) and junior representative (n = 48; mean +/- SD age = 14.8 +/- 1.3 years, height = 175.7 +/- 9.8 cm, mass = 65.8 +/- 12.9 kg) male fast bowlers. A full anthropometric profile, upper- and lower-body isoinertial strength tests, and peak bowling speed (Vpeak) were assessed on the same day. The senior bowlers had a substantially faster Vpeak (126.7 km.h(-1)) than the juniors (99.6 km.h(-1)), a larger estimated muscle mass (seniors 40.0 +/- 3.9 kg, juniors 28.3 +/- 5.6 kg), and a greater bench press throw and deltoid throw (all p < 0.01). The best multiple predictors of Vpeak for the junior bowlers were the static jump, bench throw, body mass, percentage muscle mass, and height (multiple-correlation r = 0.86). For the senior bowlers, static jump and arm length correlated positively with Vpeak (multiple-correlation r = 0.74). The 1-legged countermovement jump was negatively correlated

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According to L Justham, A West & A Cork, Cricket bowling has traditionally been referenced using ball release speed, and existing classifications consider the four major bowling types as fast, fast-medium, medium, and spin. A research project based at Loughborough University has recognized the need for an extended bowling classification that not only considers the ball speed, but also its initial flight characteristics, including any spin imparted at release. The purpose of this paper has been the development of an extended bowling classification, which has been used in the development of a requirements specification for an advanced ball delivery system for cricket, to ensure the accurate recreation of technically correct bowling deliveries.

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Data collected during training and match play have been used to define bowling quantitatively. The initial ball flight characteristics of 30 elite-level bowlers have been filmed in training using a Photron FASTCAM ultima APX high-speed video camera. These videos have been used to determine the speed, the rate of spin, and the initial flight trajectory of the ball at release. Additionally, Hawk-Eye ball-tracking software has been used to investigate the full flight characteristics of seven elite bowlers during a five Test match series.

9Ostojic, S.M., et al studied to describe structural and functional characteristics of elite Serbian basketball players and to evaluate whether players in different positional roles have different physical and physiological profiles. Five men's basketball teams participated in the study and competed in the professional First National League. Physiological measurements were taken of 60 players during the final week of their preparatory training for competition. According to positional roles, players were categorized as guards (n = 20), forwards (n = 20), and centers (n = 20). Guards were older (p < 0.01) and more

experienced ($p < 0.01$) as compared with both forwards and centers. Centers were taller and heavier than guards and forwards ($p < 0.01$), whereas forwards had significantly higher height and weight than guards ($p < 0.01$). Centers had more body fat ($p < 0.01$) as compared with forwards and guards. Also, centers had significantly lower estimated O2max values ($p < 0.01$) compared with forwards and guards. In addition, the highest heart rate frequencies during the last minute of the shuttle run test were lower in guards ($p < 0.01$) as compared with forwards and centers. Vertical jump power was significantly higher in centers ($p < 0.01$) as compared with guards. The results of the present study demonstrate that a strong relationship exists between body composition, aerobic fitness, anaerobic power, and positional roles in elite basketball.

10Stewart, L., et al Investigated in the study twenty-six aspirant cricket fast-bowlers were tested and a battery of basic physical tests consisting of eleven variables was conducted after an eight-week training period. The purpose of this study was to develop and implement

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a sport-specific strength-training program to increase bowling speed performance of fast-bowlers. Electronic Development House-Speedster (velocity-sensing instrument) was used. The players were divided into two groups, the experimental group, who performed specific upper-body exercises with maximum concentric acceleration, and the control group who applied conventional strength training with no attempt to accelerate. Results indicated that the experimental group had six variables that had significant correlation with bowling speed, bench press (p < 0.03), pull-over (p < 0.032), medicine ball putt (p < 0.011), shoulder flexion-torque acceleration energy (p < 0.009), shoulder extension-torque acceleration energy (p < 0.0001) and cricket ball throw (p < 0.011) and the control group only one, shoulder extension-peak torque (p < 0.019). Furthermore results observed by method of regression, indicated a definite improvement in the medicine ball putt, cricket ball throw and bowling speed for the experimental group. Control group was somewhat low. It can be concluded that sport-specific strength training with maximum concentric acceleration with upper-body strength training probably causes an accelerated improvement in bowling speed
Cunningham and Anderson tested six high school cross country runners, who were members of the team which was the Messachus State high school champions. Mean anthropometric values found this team to be shorter, lighter and of 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 are characteristics of endurance athletes. Team members show little inter individual variation. No adverse effects of season long training were noted. Several well known cardio-vascular risk factors were considered low- normal in this group.

Renfrow concluded that aerobic training programme has little or no effect on cardio-vascular endurance in elementary school

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children. However, he said that the aerobic programme does have a significant effect on percentage of body fat.

Fal Nell and cyolc investigated 18 experienced male distance runners on physical characteristic and responses to maximal exercise on an average of eight treadmill runs at various speeds. The relationship between heart rate and treadmill velocity was linear (r = .95). Thus, as a predictive tool, heart rates at a standardized treadmill velocity may be preferable due to the ease at data collection.

Tharp, Johnson and Thorland measured the anaerobic capacity in elite young track athletes using win gate test and compared the anaerobic capacity of male and female sprinters and long distance runners. The result indicated that the males had a significantly higher anaerobic capacity level then females. Sprinters in both the groups had better anaerobic capacity than long distance runners.

Paris et al conducted a study of physiological profiles of world class decathlon athletes. The subjects demonstrated high aerobic capacity (X 57.57). The average maximum heart rate was 184 p.m.

Wither compared aerobic power, anaerobic power and body composition of South Australian male representative track and field, basketball, field hockey and soccer. The runners and walkers exhibited the highest mean VO2 max and the no virtual difference between hockey and basketball players. The team game players scored much higher than runners and walkers on absolute power. The average percentage of body fat for runners and walkers, basketball players, hockey players and soccer players were 13.1, 16.6, 16.7 and 15.7 respectively.

Singh and Gill conducted a study to examine the physical and physiological characteristics and volleyball players, football players and cross country runners. Under physiological variables, vital capacity,

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maximum breath holding capacity, maximum expiratory pressure, heart rate, systolic and diastolic blood pressure were taken and dynamic cardio-pulmonary index was calculated results showed that cross country runners had higher cardiopulmonary index than football and volleyball players.

\[18\] Kin Tac-Un conducted a study to identify which physiological and psychological variables discriminate good (G.D.R) from moderate (M.D.R) distance runners and to examine the relationship between their variables and 10 K. performance, max O2 consumption, anaerobic threshold and percentage body fat, multiple regression analysis also indicated that VO2 max accounted for most of the variable on 10 K. performance for composite \((R^2 = .80 \ P \ .01)\), for G.D.R \((R^2 = .41, \ P \ .01)\) and for M.R.D group \((R^2 = .64, \ P = .01)\) other variables had little effect on increasing \(R^2\) for composite group \((R = .82, \ P = .05)\) and no effect for G.D.R or M.R.D. group.

\[18\] Kim Tac-Un, "An Analysis of Physiological and Psychological Difference between Good and Moderate Performance Distance Runners", Dissertation Abstract International 48:7 (June 1988) : 1700-A.
Mehta compared the fitness of tribal and non-tribal school girls of Indore Division. The subjects were seventy five girl students of each tribal and non-tribal schools and age was between 12 and 17 years. There was significant difference found in physical fitness level as obtained from AAPHER Youth Fitness Test Between tribal and non-tribal girls. The performance of tribal girls was significantly greater in flexed arm hang, sit-ups and shuttle run. Non-tribal girls were significantly better than tribal girls in total fitness.

Craig compared the physical fitness level of Canadian and South African School boys. He used AAPHER Physical Fitness Test battery. The results showed that physical fitness levels of South African High School boys was higher than those of Canadian High School boys.

A study was made by Wear and Miller to find out the relationship of physique and development level, determined by use of

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the Wetzel Grid, to performance of junior high school boys on four fitness tests, namely, Pull-ups, 50 yard dash, standing broad jump and softball throw. Subject of different physique groups (heavy, medium and thin) who were alike developmentally (accelerated, normal and related) differed more markedly in performance than did subjects of different development levels who were alike with regard to physique. Subjects who were medium in physique and normal in development were the best performance. Subjects of heavy physique (over weight) were the poorest performance.

Boone administered AAPHER Youth Fitness test to 100 rural and 100 urban boys. The urban boys were found superior to the rural boys and the difference was significant at .01 level. The two samples were weaker on the same components of physical fitness.

Mookerjee made a comparative study of physical fitness of young boys in the age group of 13-17 years belonging to rural and urban

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and also less active boys of the same age group. The result of this study was that there is no doubt that regular physical activity contributes significant to the enhancement of physical status. Physical fitness of rural active subjects were definitely of superior level than the boys living in the city. Pure food, unpolluted air, and reasonable regular physical hardships are chief contributory factors in promoting physical fitness.

24 Siewart examined the impact of different elementary school experiences upon achievement in certain aspect of physical fitness and sports skills. He tested as grade mine boys (27 with rural back ground, 38 with urban back ground and 20 with parochial school back ground) for speed, power, muscular endurance and skills in different games. Study of total scores showed that boys with rural parochial or urban experience did not differ in physical fitness but boys from urban and parochial schools were superior in sports skill.

Brongdon compared the physical fitness and anthropometric measurements of pre-adolescent Mexican American and Anglo-American males. 300 subjects were tested from each group of AAHPER Youth Fitness test and thirteen anthropometric measurements were made. The findings revealed significant difference between the Mexican American and Anglo-American males in certain physical fitness items and anthropometric measures. When the single factor of age was correlated with each of the individual physical fitness items and each of the anthropometric measure, few significant differences were evident. The results indicated that the Anglo American males are larger in gross body size and they were superior in performing selected physical fitness items. Both groups exhibited higher body measurements and fitness scores at each succeeding age level. That denoted a relationship between age, physical fitness and physical growth. Age as predictive factor is equally important to Anglo American students.

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26 Piscapo studied 647 male subjects of age group 10 to 12 years from each ethnic group of Italian, Tewish and Negros. Eleven skin fold and other anthropometric measurements were made on each subject. He concluded that low correlation was obtained between skin fold and height, higher (r) co-efficient were found between skin fold and weight measurements. Significant differences between the three ethnic groups were found relative to abdominal, chest and posterior arm skin fold measurements of each age level.

27 Accordingly to Willgoose, physical fitness is an essential physiological capacity for an activity. It is bodily strength, vigour and endurance, the where withal for all movement related to physical, mental and emotional status.

28 Craig compared the physical fitness level of Canadian and South African school boys. He used AAHPER Physical Fitness Test

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Saha made a study to compare the selected physical fitness variables and anthropometric measures of tribal and non-tribal students of Tripura. They were tested with selected AAHPER Youth Fitness Test, i.e. 50 yards run, 40 yards shuttle run, 600 yards run/walk and selected anthropometric measurements, i.e. chest girth, height, weight, upper arm girth, thigh girth and calf girth. In all tests and measurements the mean score of the composite scores of tribal students was higher than their non-tribal counter parts but none of the differences in the means were found statistically significant at 0.5 level of confidence.

Berger and Pardis compared the physical fitness scores of white and black seventh grade boys of similar socio-economic levels. It

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29 Umesh Chand Saha, “Comparison of Selected Anthropometric Measurements and Physical Fitness Variables of Tribal and Non-tribal students of Tripura” (Unpublished Master’s Jiwaji University, 1987)

30 Richard A. Berger and Robert L. Paradis, “Comparison of physical Fitness Scores of White and Black Grade Boys of Similar Socioeconomic Level” Research Quarterly 40 (December 1969), pp.668
was concluded that black male students have a higher level of physical fitness.

31 Berand compared the anthropometrical measurements of Caucasian and Negro boys and girls. The selection included 75 Caucasian boys, 75 Caucasian girls, 75 Negro boys and 25 Negro girls. He noticed that although there are significant anthropometric difference between boys and girls and Negro and Caucasian, these differences do not warrant separation by race and sex for purposes of educational instructions.

The physique may be useful in choosing a suitable physical activity for individual because of the fact that according to physique they have many mechanical advantages e.g. longer legs are helpful to take the necessary long strides over hurdles without the loss of time that jumping entails.

Cureton in his study of champion athletes has concluded that all-around athletic ability is characterized by wide shoulders compared to hip width. Track and field champions are significantly differentiated from normal young men by this ratio. Track and field champions are significantly differentiated from normal young men by this ratio.

Levine and Carter after an intensive study of anthropometric measures of Olympic athletes established high relationship between structure of an athlete and specific task or event in which he excelled.

Apgar in his study on relationship of body fat to 40 yard shuttle run concluded that body fat had a significant effect upon performance of 40 yards shuttle run.

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Terrell in his study compared American Negro and Caucasian females and came to the conclusion that the Negro females have significantly longer legs, longer arms and hands, longer feet, wider shoulder girdle and narrow pelvic girdle than Caucasians and therefore they proved better in 50 yards dash and softball throw for distance.

Baker studied the factors associated with the success in Volleyball. Height, weight, leg extensor strength, grip strength, skin fold, measurements, reaction time etc. were tested and found that jumping ability and reaction time were significantly related to success in volleyball.

Hoster, Morrow and Jackson studied 180 collegiate women volleyball players and concluded that women collegiate volleyball players tended to be slightly taller, heavier and had broader shoulder and narrow hips and the mean 20 yard sprint obtained was faster.

55 Ruth E. Terrell, "Relationship of Pre and Post Puberty anthropometric Measurements and Physical Fitness Test Scores of American Negro and Caucasian Females as Measured by the AAPHER physical Fitness Battery" Compared Research in Health, Physical Education and recreation 10 (1968) : 73.
Kansal and others studied the physique and body composition of the Inter-varsity soccer players of zonal champion and runner up teams of the North zone. They concluded that defense line players were significantly taller and heavier than forward line players, and had broader femur bicondylar diameter in comparison to offensive players. The forward line players had slightly less percentage of body fat and more of lean body mass compared to defensive players.

Vaccaro, Clarke and Wrenn conducted a study on physiological profiles of elite women basketball players. 15 members of the university of Maryland Women Basketball Team were assessed for body composition, somatotype, muscular strength, endurance pulmonary and aerobic capacity during the 1976-77 basketball season. Result of the analysis indicated that (1) measures of height and weight established here were greater than that of the average female and most greater than that of the average female and most other women athletes; (2) mean

percentage of fat was less than those values reported for female athletes, but somewhat greater than those reported for women distance runners, (3) mean somatotype was similar to those reported for normal group women.

40 Joseph attempted to determine the relationship of selected strength and anthropometric variables to performance in sprints. The analysis of data showed a significant relationship between leg power, abdominal strength, thigh girth and calf girth to speed performance whereas the relationship of height and leg length to speed performance was insignificant.

41 Housh and et al studied the body build and composition characteristic of the elite participants of track and field, swimming, wrestling and gymnastics. They found that throwers were taller, heavier and had more fat and least values of ponderal index among the different

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groups studied. Sprinters had average height of 178.19 cms weight of 67.3 kg. ponderal index 47.93 and fat weight of 8.2 kg.

Sodhi et al studied selected kin anthropometric characteristics of Indian volleyball players of National, State and District level. Each subject was examined with 12 anthropometric measurements and 10 tests of performance. The latter consisted of block jump, three successive jump, 20m. dash, agility, basketball throw, 30 sec. sit-ups, maximum sit ups, flexibility and 2.4 Km run.

Butts tested 127 high school female cross country runners on percent body fat, ratings of perceived exertion and maximal oxygen consumption during a continuous running treadmill test. The high school female runners had higher (Vo) 2 max than previously reported for this age groups. However, they were considerably below these values reported for national caliber distance runners.

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Hall studied the anthropometric estimation of body density of women athletes in selected athletic activities. Twenty-two anthropometric measurements were evaluated to determine their relationship to body density of women varsity athletes on four intercollegiate teams. Analysis of the data indicated that women athletes must be considered as distinct population in relation to a particular sport.

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