CHAPTER II

REVIEW OF RELATED LITERATURE

The Research scholar has made every attempt to acquire literature to this study from various sources such as journals, periodicals, encyclopedia and other books in some of the renowned libraries related to Physical Education, Sports and Education.

A review of literature has been done to present study on the prediction of performance as well as on the relationship of Physical and Anthropometrical assessment to the performance of jumpers.

Bareett (2008) the purpose of this paper was to investigate whether perceived sports competence mediates the relationship between childhood motor skill proficiency and subsequent the relationship between childhood motor skill proficiency and subsequent adolescent physical activity and fitness. In 2000, children’s motor skill proficiency was assessed as part of school based physical activity intervention in 2006/07, participants were followed up as part of the physical activity and skills study and completed assessment for perceived sports competence (physical self perception profile) physical activity (adolescent physical activity recall questionnaire) and cardio respiratory fitness (multistage fitness test) structural equation modeling techniques were used to determine whether perceived sports competence mediated between childhood object control skill proficiency
(composite score of catch and overhand throw) and subsequent adolescent self-reported time in moderate-to-vigorous physical and cardio respiratory fitness of 928 original intervention participants, 48 were located in 28 school and 276 (57%) were assessed with at least one follow-up measure. Slightly more then half were female (52.4%) with a mean age of 16.4 years (rang 14.2 to 18.3 yrs.) relevant assessments were completed by 250(90.6%) students for the physical activity model and 227 (82.3%) for the fitness model. Both hypothesized mediation model had a good fit to the observed date with the physical activity model accounting for 18% (R2=0.030) of fitness variance. Sex did not act as a moderator in either model.¹

Nayeli Macias and et.al (2007) studied on body composition in specific populations by techniques such as bio-impedance analysis (BIA) requires validation based on standard reference methods. The aim of this study was to develop and cross-validate a predictive equation for bioelectrical impedance using air displacement plethysmography (ADP) as standard method to measure body composition in Mexican adult men and women. This study included 155 male and female subjects from northern Mexico, 20-50 year of from low, middle, and upper income levels. Body composition was measured by ADP. Body weight (BW, kg) and height (Ht, cm) were obtained by standard anthropometric

techniques. Resistance, R (ohms) and reactance, X-C (ohms) were also measured. A random-split method was used to obtain two samples: one was used to derive the equation by the “all possible regressions” procedure and was cross-validated in the other sample to test predicted versus measured values of fat-free mass (FFM). The final model was: FFM (kg) = 0.7374* (Ht2/R) + 0.1763* (BW) - 0.1773* (Age) + 0.1198* (XC) - 2.4658. R² was 0.97; the square root of the mean square error (SRMSE) was 1.99 kg and the pure error (PE) was 2.96. There was no difference between FFM predicted by the new equation (48.57 ± 10.9 kg) and that measured by ADP (48.43±11.3kg). The new equation did not differ from the line of identity, had a high R² and a low SRMSE, and showed no significant bias (0.87± 2.84 kg). The new bioelectrical impedance equation based on the two-compartment model (2c) was accurate, precise, and free of bias. This equation can be used to assess body composition and nutritional status in populations similar in anthropometric and physical characteristics to this sample²

Bick C (2007) The aim of this investigation was to develop a test battery to measure the motor abilities of 4 and 5 years old children. The subject were 932 healthy kindergarten children from Tartu, Estonia: boys, 4 years, n=205; boys, 5 years, n=267; girls, 4 years, n=224, 5 years, n=236 height and body mass used: min run (cardio reparatoray endurance), standing long jump

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(explosive strength), 4×10 m shuttle-run (running speed agility), sit-ups for 3 sec (trunk strength sit-and-reach (flexibility), and sand bag (150g) throw with the dominant hand (explosive strength coordination). The motor tests were repeated 1 week later in subgroup of 28-33 children. Most of the tests had an acceptable reliability (r>0.75) and none had a poor reliability (r>0.40) there were significant (p<0.05-0.001) differences between 4 and 5 years old girls. Performance of boys were generally better then those of girls of the same age. Test result were often dependent on height and body mass, but not on the ability of INCT student tended to be statistically below the average of high school students. 2). Cardio respiratory endurance was the academic years. 3). The consciousness to the physical fitness and health tended to be overestimated in comparison with the practical data of INCT students. 3

**Aniteli T M and et.al (2006)** investigates body composition as a determinant of bone mineral density. The present study was developed in order to propose a predictive equation to calculate body fat percentage by means of skin folds thickness using bone densitometry (DXA) as a reference in a group of elderly women with osteoporosis and osteopenia. Twenty-nine women, mean age 67 to 84 years old, in attendance at the Osteoporosis Clinic at Rheumatology division, School of Medicine, University of Sao Paulo, were evaluated. Four skin folds thicknesses were

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3 Bick C- Chow, L.Fung “Correlates of children’s physical Activity, motor and physical self-perception socio culture” (Japan-University of Tatu-2007)
measured (biceps, triceps, sub scapular and supra iliac) and body composition by DXA was evaluated. The statistical analysis consisted of Kolmogorov-Smirnov test, Pearson’s coefficient correlation, simple linear regression analysis, intra-class correlation coefficient, t student test, Bland-Altman test and calculus of equation total error according to Lohman (1992). The best skin fold model that explained the percentage of body fat mass included the supra iliac, bicipital and tricipital values, determining up to 72% of body fat mass. The fat mass average values in kilograms estimated by the skin fold and measured by DXA were not statistically different and had been highly correlated (r=0.82; p<0.001). Comparing the fat mass percentage evaluated by the proposed equation and the percentage measured by DXA, the total error was of 0.7% and 0.4 kg. In view of the presented results, the resultant equation of the regression model is adequate for elderly women with osteoporosis and osteopenia, and may be an alternative for the body fat mass estimate in this population4.

_Su-Mei, et.al (2006)_ studied on relationships of trunk fat mass (FMtrunk) and four anthropometric indices in Chinese males. 1090 males aged 20-40 years were randomly recruited from the city of Changsha, China. Waist circumference (WC) and hip circumference (HC) were measured using standardized equipment, and three other anthropometric indices of BMI, waist:  

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4 Anteli T.M, Florindo A.A, Pereira RMR et.al. “Development of an equation for measurement of body fat mass of elderly women with osteoporosis or osteopenia through skin fold thickness using dual energy X-ray absorptiometry as a reference” _Revista Brasileris de Medicina do Esporte_ 12 (16), (2006)
hip ratio (WHR) and iconicity index (Col) were calculated using weight, height, HC and WC. FM trunk (in kg) was measured using a Hologic QDR 4500 W dual-energy X-ray absorptiometry scanner. There was an increasing trend of FM trunk, %FM trunk (percentage of FM trunk) and BMI, WC, WHR, Col in successively older age groups (e.g. the mean FM trunk values were 4.63 (SD 2.58), 5.39 (SD 2.74), 5.93 (SD 2.82), 6.57 (SD 2.94) in four 5-year age groups, respectively). %FM trunk were significantly correlated with four anthropometric indices with the Pearson’s correlation coefficients ranging from 0.25 to 0.86. Principal component analysis was performed to form three principal components that interpreted over 99.5% of the total variation off our related anthropometric indices in all age groups, with over 65% of the total variation accounted by principal component 1. Multiple regression analyses showed that three principal components explained a greater variance (R² 70.0-80.1%) in FM trunk than did BMI or WC alone (R² 57.8-74.1%). The present results suggest that there is an increasing trend of FM trunk and four anthropometric indices in successively older age groups; that age has important effects on the relationships of FM trunk and studied anthropometric indices; and that the accuracy of predicting FM trunk using four anthropometric indices is higher than using BMI or WC alone.

Wrotniak (2006) youth with better motor abilities may find it easier to be physically active and may be more likely to engage in

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physical activity compared with peers with poorer motor competence. The purpose of this study was to examine the relationship between motor proficiency toward physical activity was also assessed. Sixty five children (34 girls and 31 boys) were studied. Children’s physical activity was assessed by the manufacturing Technologies incorporated/computer science and applications incorporated mode 7164 accelerometer, and their motor proficiency was determined by the Bruininks-Oseretsky test of motor proficiency. The children self-perceptions of adequacy in and predilection for physical activity scale measured children’s self perception for adequacy in performing and to desire to participate in physical activities.6

Nguyen, Tuan V. and Rajata Rajatanavin (2005), studied to develop and validate sex-specific equations for predicting percentage body fat (%BF) in rural Thai population, based on BMI and Anthropometric measurements %BF (DXA; GE Lunar Corp., Madison, WI) was measured in 181 men and 255 women who were healthy and between 20 and 84 years old. Anthropometric measures such as weight (kilograms), height (centimeters), BMI (Kilograms per meter squared), waist circumference (centimeters), hip circumference (centimeters), thickness at triceps skin fold (millimeters), biceps skin fold (millimeters), sub scapular skin fold (millimeters), and supra iliac skin fold (millimeters) were also measured. The sample was randomly divided into a development group (98 men and 125

women) and a validation group (83 men and 130 women). Regression equation of % BF derived from the development group were then evaluated for accuracy in the validation group. The equation for estimating % BF men was: %BF (men) = 0.42 \times \text{subscapular skin fold} + 0.62 \times \text{BMI} - 0.28 \times \text{biceps skin fold} + 0.17 \times \text{waist circumference} - 18.47, and in women: %BF (women) = 0.42 \times \text{hip circumference} + \text{for both equation was 0.68. Without anthropometrical variables, the predictive equation using BMI, age and sex was: %BF = 1.65 \times \text{BMI} + 0.06 \times \text{age} - 15.3 \times \text{sexes} - 10.67 (where sex = 1 for men and sex = 0 for women), with R^2 = 0.83. When these equations were applied to the validation sample, the difference between measured and predicted %BF ranged between 9%, and positive predictive values were above 0.9. These results suggest that simple, noninvasive, and inexpensive anthropometric variables may provide an accurate estimate of %BF and could potentially, aid the diagnosis of obesity in rural Thais.\footnote{Nguyen V Tuan and Rajatanavin Rajata, “Prediction of Percentage Body fat in Rural Thai Population Using Simple Anthropometric Measurements” \textit{Obesity Research} 13, (2005): PP-729-738.}

\textit{Pongchaiyakul chatlert, and Kosulwat Vongsvat, et. al. (2004)} studied to develop and validate sex-specific equations for predicting percentage body fat (%BF) in rural Thai population, based on BMI and anthropometric measurements. %BF (DXA; GE Lunar Corp., WI) was measured in 181 men and 255 women who were healthy and between 20 and 84 years old. Anthropometric measures such as weight (kilograms), height (centimeters), BMI (kilograms per meter squared), waist circumference (centimeters),
hip circumference (centimeters), thickness at triceps skin fold (millimeters), biceps skin fold (millimeters), sub scapular skin fold (millimeters), and supra iliac skin fold (millimeters) were also measured. The sample was randomly divided into a development group (98 men and 125 women) and a validation group (83 men and 130 women). Regression equations of %BF derived from the development group were then evaluated for accuracy in the validation group. The equation for estimating %BF in men was

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%BF \text{(men)} = 0.42 \times \text{sub scapular skin fold} + 0.62 \times \text{BMI} - 0.28 \times \text{biceps skin fold} + 0.17 \times \text{waist circumference} - 18.47
\]

and in women:

\[
% BF \text{(women)} = 0.42 \times \text{hip circumference} + 0.17 \times \text{supra iliac skin folds} + 0.46 \times \text{BMI} - 23.75
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The coefficient of determination (R2) for both equations was 0.68. Without anthropometric variables, the predictive equation using BMI, age, and sex was: %BF = 1.65 x BMI + 0.06 x age - 15.3 x sex - 10.67 (where sex = 1 for men and sex = 0 for women), with R2 = 0.83. When these equations were applied to the validation sample, the difference between measured and predicted %BF ranged between +9% and the positive predictive values were above 0.9. These results suggest that simple, noninvasive, and inexpensive anthropometric variables may provide an accurate estimate of %BF and could potentially aid the diagnosis of obesity in rural Thais.

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Raja C, Hansen R, Colagiuri S. et.al. (2004) developed anthropometric equations to estimate adiposity in the field for Aboriginal Australian Women. Twenty-four Aboriginal urban dwelling women were measured for height, weight, skin folds and body fat. Total fat (kg) and body fat percentage (%BF) were obtained directly from dual energy X-ray absorptiometry (DEXA) scans. Skin folds (biceps, triceps, subscapular and supra iliac) were measured and the Durnin and Womersley equation was used to estimate %BF. The mean (SD) age of the women was 47 (14) years and the average body mass index (BMI) was 30.8 (7.8) kg/m2. Biceps, triceps, sub-scapular and supra iliac skin fold were significantly correlated with measured %BF by DEXA (r= 0.83 to 0.89; P>0.001). Age was significantly correlated with both %BF estimated from skin folds (r=0.76, P<0.001) as well as %BF measured by DEXA (r=0.68, P<0.01). Individual skin folds and the sum of four skin folds were highly correlated with %BF from DEXA, but the Durnin and Womersley equation (%BF=1.2* %BF D&W-8.2), the SEE of predicted %BF was 3.2% with an explained variance of 0.88. It is concluded that the correlated anthropometric skin fold model can be applied in field studies as an alternative measure of total fat in Aboriginal Australian women.

Teary T.K. Huang, and Michael P. Watkins, Michael I. Goran (2003) studied to develop prediction equations for total body fat specific to Latino children, using demographic and anthropometric measures. Ninety-six Latino children (7 to 13 years old were studied. Two-thirds of the sample was randomized into the equation development group; the remainder served as the cross-validation group. Total body fat was measured by DXA. Measures included weight, eight, waist and hip circumferences, and skinfolds (supra iliac triceps, abdomen, subscapula, thigh, and calf). The previously published equation from Dezenberg et al. did not accurately predict total body fat in Latino children. However, newly developed equations with either body weight alone (intercept ± SE = 1.78 ± 1.53 KG, P > 0.05; slope ± SE = 0.90 ± 0.07, p > 0.05 against slope = 1.0; R2 = 0.86), weight plus age and gender (intercept ± SE = 2.28 ± 1.20 kg, p > 0.05; slope ± SE = 0.91 ± 0.05, P > 0.05; against slope = 1.0; R2 = 0.92), or weight plus height, gender, Tanner stage, and abdominal skin fold (intercept ± SE = 2.28 ± 1.20 kg, P > 0.05; slope ± SE = 0.91 ± 0.05 P > 0.05; against slope = 1.0; R2 = 0.92), weight plus height, gender, Tanner stage, and abdominal skin folds (intercept ± SE = 1.47 ± 1.01 kg, P > 0.05; slope ± SE = 0.93 ± 0.04, P > 0.05; against slope = 1.0, R2 = 0.97) predicted total body fat without bias. Unique prediction equations of total body fat may be needed for Latino children. Weight, as the single most significant predictor, can be used easily to estimate total body fat.
in the absence of any additional measures. Including age and gender with weight produces an equally stable prediction equation with increasing precision. Using a combination of demographic and anthropometric measures, we were able to capture 97% of the variance in measured total body fat\textsuperscript{10}.

*N. Stephen D. Ball and Pamela D. Swan (2003)* examined the accuracy of a previously developed equation by Treuth, Hunter, and Kekes-Szabo (1) using dual-energy absorptiometry (DXA) combined with anthropometry for predicting IAF in obese women. Thirty-five pre and post-menopausal obese women (age: 47.0 yr±7.0; BMI: 32.2±6.3 KG/M\(^2\); and percent fat: 43.5±6.7 %) underwent a single-slice computed tomography (CT) scan at the level of l4-l5. In addition, a total body DXA scan and anthropometric measures including waist circumference and supine sagittal diameter measures at the level of the umbilicus, were also made. Was predicted using the equation: 

\[-208.2 + 4.62(\text{SD}) + 0.75(\text{A}) + 1.73(\text{W}) + 0.78(\text{DXA}).\text{(SD=anthropometric sagittal diameter, A=age, yrs; W=waist circ., DXA=DXA trunk fat, \%)}.

DXA-IAF was significantly correlated with CT-IAF (r=0.628, p<0.001, SEE=53.0 cm\(^2\)). However, DXIAF values (172.2±46.9 cm\(^2\)) significantly overestimated CT-IAF (114.0±67.1 cm\(^2\)) in this population. The results from the current study indicate that the Treuth et al. equation was not able to adequately estimate IAF in

obese women. Although this equation was originally generated on a wide selection of women, a limited number of the original cohort were obese. In summary, this equation may be more generalizable for normal weight women that for obese women.11

*Deurenberg Paul and Deurenberg Mabel (2003)*, measured Body Composition by using a chemical four compartment model in 291 Singaporean, Chinese, Malays and Indians of both sexes, and body fat percentage (%BF) obtained via this model was used as a reference. In addition biceps, triceps, sub scapular and supra iliac skin folds were measured following the Durnin and Womeseley protocol and %BF was predicted using age and sex specific prediction formulas from the sum of biceps and triceps and from the sum of all four skinfolds. In Singapore females, especially Malays and Indians predicted mean %BF from two skinfolds was an underestimation. Mean %BF predicted from four skinfolds was also underestimated in Malays and Indians females, but not in Chinese females. The differences in validity from predictions based on two or four skinfolds could be explained by differences in subcutaneous fat pattern, with the Singaporean females having a more truncal fat pattern than the Scottish population in which the formulas had been developed. In males, predicted mean %BF from two skinfolds was underestimated only in Indians. Mean %BF from four skinfolds did not differ from the

reference value in Chinese, Malays and Indian males. The bias of predicted %BF was positively correlated with level body fatness and negatively with age in both gender groups, resulting in considerable underestimations of %BF fatter and younger subjects. Differences in validity of predicted %BF across the ethnic groups could be explained by differences in body fatness and age across the groups. It is correlated that the Durnin and Womersley equations are not valid in Singaporeans because of a different body fat distribution (in females) and because of different age-related increase in body fatness (in males and females), compared to the population in which the formulas were developed\textsuperscript{12}.

\textit{S. Singh, J. Singh and H. Singh, (2003)} conducted a study to see the difference between fitness of senior and junior (girls) hockey players. The subjects for this study were hockey girls attending the camp at SAI NSNIS, Patiala. Five tests were administered to assess the physical fitness level. The data was statistically analyzed. It was found that there is no significant difference between senior and junior group in 30m and standing broad jump test performance. The junior group was found to be significantly better in shoulder strength\textsuperscript{13}.

\textit{Nakarmi and Bawa (2003)} conducted an investigation with a purpose to determine significant differences, if any, in the physical


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abilities level of Nepalese Gymnastics girls with a training age of only 3 months in Nepal School girls of 10 to 13 years of age. The study has been conducted on 34 subjects (17 girls Gymnasts and 17 school girls) who were students of the same class and school in Katmandu. To ascertain the physical abilities level of all the subjects a few physical abilities level measuring tests i.e. shoulder rotation, back extension, Trunk flexion, split sitting (fang), Standing broad jump, Vertical jump, Push-ups, Sit-ups and Grip-strength were administered on each subject. Analysis of the data has revealed that Nepalese Gymnastics girls possess significantly better trunk flexibilities, hip flexibilities, leg explosive strength, arms and shoulder strength and abdominal strength when compared with the Nepalese school girls. The results also reveal non-significant differences in shoulder flexibility and grip strength between the two groups\(^{14}\).

Oliveira, et.al (2002) compared the anthropometric profile of 132 female adolescents, 11 to 18 years old, of different social and economic level. 58 were student of Fernando rodrigues of silveira Aplicacao School of the stat university of Rio De Janeiro (CAP/UERJ) and 74 were students of two unprivileged school. In order to classify social and economic level. The job and level of education of both parents have been used as criteria wall as the number of family members who live in the same home. The social

and economic evaluation showed that 75% of the CAP/UERJ students parents have a university level education and they have a job which corresponds to it; while among the parents of those adolescents of the other school, 94% have an elementary school level education. The anthropometric evaluation consisted of measuring the weight, stature, mid arm circumference and seven skin folds. The anthropometric studies showed that the privileged social and economic level adolescents presented a large number of percentiles of body fat and they were significantly taller than the socially and economically unprivileged level adolescents\textsuperscript{15}.

Timothy Kwok, and Jean Woo, et.al. (2001) studied to derive regression equation for fat percentage by using simple anthropometric measurements applicable in normal and immobile (cannot stand or walk) older people. The study population comprised 352 females and 261 males, apparently well and community-dwelling, aged 69 to 82 years. Fifty one female and twenty seven males were recruited for external validation. Body weight, standing height, arm span, triceps and biceps skin folds thickness, (SFTs), and midarm circumference were measured. The reference method of total body fat percentage was dual-energy X-ray densitometry. Predictive equation for fat percentages were derived by stepwise multiple linear regression on anthropometric indices and gender. Upper-limb SFTs, body mass index, and gender yielded the more predictive equation. The SEE was 4.1% weight. There was a significant trend of underestimation in

overweight subjects, especially in females. The equation using SFTs and midram circumference was less reliable but more applicable to older immobile people and those with significant kyphoscoliosis. The combination of body mass index and upper-limb SFTs gives reliable prediction of fat percentages in older Chinese people, except in the obese\textsuperscript{16}.

\textit{Udea Fumio (2001)} it goes without saying that measuring analyzing and understanding of each student’s physical fitness and motor ability are very important for effective exercise and training in physical education. We have been measuring analyzing and evaluating each student’s physical fitness and motor ability since 1973. But we thought that related physical fitness was more important for each student’s then physical fitness and motor ability. We measured 1. Body height, 2. Body Weight and, 3. Body fat and using those values calculated, 4. body mass index. We also Measured, 5. Side steps as agility index, 8. Verticals jump as legs power index and 9. 12 min running as whole body endurance index. Our results were summarized as follows:- 1) there was the obesity tendency in our male students, 2). Our students did not have total Physical fitness of the age correspondence and muscle Endurance and Whole – body Endurance which were health-related physical fitness were remarkable inferior, 3). For out student, it must be guided in Order to acquire the healthy lifestyle vhabit.\textsuperscript{17}

\textsuperscript{17} FumioUder, Y. Tabahiko, T. Nobuki “A Report on the physical fitness and motor ability of kanazawa medical University” (Pub. Country: japan-2001)
Lohman and Caballero, et.al (2000) worked on obesity as measured by body mass index, is highly prevalent in Native American children’s, yet there are no valid equations to estimate total body fatness for this population. This study was designed to develop equations to estimate percentage body fat from anthropometry and bioelectrical impedance as a critical part of pathways, a multisite study of primary prevention of obesity in Native American children. Percentage fat was estimated from deuterium oxide dilution in 98 Native American children (Pima=Maricopa, Tohono O’odham and white Mountain Apache tribes) between 8 and 11 years of age. The mean fat content (38.4%-8.1%) was calculated assuming the water content of the fat-free body was 76%. Initial independent variables were height, weight, waist circumference, six skinfolds and whole body resistance and reactance from bioelectrical impedance (BIA). Using all-possible subsets regressions with the mallows C (p) criterion and with age and sex included in each regression model, waist circumference, and calf and biceps skinfolds contributed least to the multiple regression analysis. The combination of weight, two skinfolds (any two out of the four best: triceps, suprailiac, subscapular and abdomen) and bioelectrical impedance variables provided excellent predictability. Equations without BIA variables yielded \( r=2 \) almost as high as those with BIA variables. The recommended equation predicts percentage fat with a root mean square error 3.2% and an adjusted \( r^2 = 0.840 \). The combination of
anthropometry and BIA variables can be used to estimate total body fat in field studies of Native American children. The derived equation yields considerably higher percentage fat values than other skin folds equation in children\(^\text{18}\).

**Borrow (1990)** conducted a study on Korean secondary Students of physical fitness, the purpose of this study was to Compare 1979 KSPFT and 1986 KSPFT result and to see if change is Occurring. Analysis of the data supports the following conclusions- (1) A significant difference between grade level was found between the body and girls with the 12\(^{\text{th}}\) grade students. Scoring better on most Items of the KSPFT, with the girl there were mixed performance between 9\(^{\text{th}}\) and 10\(^{\text{th}}\) grade. (2) A significant difference in gender was Found on all 1979 group and 1986 group. The 1986 group in the distance throwing and pull ups and flexed arm hang for girls. (4) A significant grade gender interaction was found in sit=ups, standing long jump, and 100m. Run and distance throwing.(5) A significant grade by year interaction was found in the distance throwing and 800m. run/walk. (6) A significant grade by year interaction was found in the standing board jump and sit-ups. (7) No significant grade by gender year interaction was found in the KSPFT item.\(^\text{19}\)

**Katch (1984)** at all studied the effects of a twenty seven days sit up exercise training program on adipose cell size and


adiposity Fat biopsies were taken from abdomen sub scapular and gluteus slides by needle aspiration in thirteen experimental and six control male subjects before and after a fix day per week progressive training segment. Repeated measure ANOVA revised significant decreases in cell diameter at three biopsy sites but there is no significant difference in the rate of change (pre to post) in cell diameter between cities for the experimental and control group. Body weight, total body fat, fat folds and girths remained unstirred. The results revealed that the conventional sit up does not pre parentally reduced adipose cell size or subcutaneous fat thickness in the abdominal region to a greater extent compared to other adipose sites. Significant change in fat cell size may occur in the absence of changes in fat cell size may occur in the absence of changes in fat folds, girth, total body composition20.

**Bhola (1984)** selected 25 male volleyball players to study the relationship of absolute leg length, foot length and agility to jumping ability in volleyball using three strides rhythm and found that the foot length, dynamic power as well as ankle flexibility and significant relationship with jumping ability using three strides rhythm whereas absolute leg length and relative leg length did not correlate significantly21.

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Ozkan (1984) conducted a study of 77 male high school soccer players between the age of 15 and 18 years. The purpose of this study was to investigate the physical, physiological and motor skill characteristic of the players. A secondary purpose was to compare the experimental variables between playing position, age group and playing qualities test items consist of Age, Height, percentage of Body fat Resting heart rate, 1.5 mile run, 50 yards sprint, Vertical jump, Agility, Trunk Extension and Flexion, Ball control, Wall Volley and obstacle dribble skill tests. The statistical analysis revealed an average height and weight of 174.92 cm and 64.74 kg for entire group. Average resting heart rate and body fat were 70.67 bpm and 10.38%. The other results were excellent in 1.5 mile, fair on the 50 yard and vertical jump, in agility similar level as college, below average in trunk extension and flexion and in three soccer skill tests, the players scored .85th-100th percentile.

Boyd (1983) studied the physiological effect of two variable resistance weight training programs on males and females with the age range from 10 to 35 years. The results revealed that all the groups gained significant increases in shoulder abduction (power and endurance) while the female groups were the only group to increase in strength. Body composition results indicated significant increases for all groups in body density and lean body weight (except female strength.) Girth measurements results showed

significant decreases in thigh and bicep measurement. Work on treadmill showed significant increases in only the female endurance group.\footnote{John Mc MECHON Boyd, “The physiological effects of two variable resistance weight training programs on males and female age 10-35” \textit{Dissertation abstracts international} 44 (November 1983), P- 1375.}

Barbante (1983) conducted a study on Brazilian boys and girls. The purpose of this investigation was to determine the status of physical fitness of selected Brazilian boys and girls and to provide norms for Brazilian school children from the scores achieved on selected physical fitness tests. And to find out difference between performance of Brazilian boys and girls and to determine if difference existed between norms for Brazilian and American boys and girls for selected physical fitness measurements. 342 boys and girls were taken as subjects who were enrolled in a public school system in Brazil during 1982 year.

Results of the study could be summarized as follows:

1. For selected Brazilian Schools Populations age group from 6 to 14 years, height and weight of both sexes increased at approximately at the same rate. Girls were significantly taller and heavier than boys during adolescence.

2. Brazilian girls had higher values than boys for triceps and subscapular skin fold measurements, sit-ups and in reach test.

3. Brazilian boys performed better than Brazilian girl in modified sit-ups tests, nine minute run test, 12 minute test, 50 meter dash test and standing long jump test 4) The comparison
between norms for Brazilian and American boys and girls showed that American boys and girls in general were taller and heavier and had a higher scores in standing long jump.

**Chalerm (1983)** Conducted a study on physical fitness; the purpose of the study was to find out the levels of physical fitness Oklahoma State University faculty group \((n=308)\) who were tested in the mobile lab. Programme in a sub-problem were to compare the physical fitness levels of the following: all tested males in various age groups between male and female who were tested in the mobile lab programme, male and females in various age groups. Various professional groups and the test and retest result on 64 mobile lab subjects who were re-evaluated during the year of this study Comparison were made on the following: Weekly aerobic points total, lying blood pressure, lying pulse rate, present body fat, respiratory functions, Ekg. Predicted maximum o\(_2\) intake strength tests reaction time tests reaction time tests flexibility and o\(_2\) saturation. The data’s was treated with the SAS computer programme. Results and conclusions shows the most of scores of the physiological variables of males of the Oklahoma State University faculty were better than those of in the commercial males. As the mean age increased one year, all tested males showed some decreased in the physiological variables. Most of the physiological variables of male were better than those of females.

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in the commercial group. As the mean age increased one year, males and females in the commercial group showed some decrease in the physiological variables.²⁵

_Terbizan (1982)_ studied the effects of set repetitions combinations on strength gain using isotonic strength training in females with age range from 18 to 35 years. Analysis of the data using covariance indicated that the strength training increased in strength when compared to the control group, but there was no difference in strength between training groups. The absolute maximum strength gain also increased in relative strength ratio. The body composition of the subjects changed by increasing in lean body mass. There was no significant changes in skin fold and girth measurements²⁶.

_Chetia (1982)_ undertook a study to find out the relationship of leg-length, thigh-girth and abdominal strength to standing broad jump on 44 college male students. The result indicated that there were significant relationships between standing broad jump and leg length, calf girth and abdominal strength²⁷.

_Carter and other (1982)_ study on Montrial Olympic athletas, concluded after examination that jumpers were heavier and had

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²⁷ Uday Kamal Chetia, “Relationship of leg-length, Thigh Girth, Calf-girth and Abdominal Strength to Standing Board jump”, _Unpublished Master’s Thesis_, Jiwaji University, 1982). P-34.
larger thigh and calf girth than the sprinters and distance runners. They also had larger lower extremity length than the sprinters and larger sum of six skinfold than the distance runners. The distance runners had smaller upper arm and forearm girth than sprinters or jumpers, but larger bi-iliac breadths than sprinters. There were no significant differences on age, height, sitting height, and upper extremity length or bi-acromial breadths.

**Grewal and Sidhu (1982)** carried an intensive study on 17 female volleyball players of Indian Volleyball Team. They observed that by taking age, height, and weight and ponderal index along with Herat’s Method of “Absolute Evaluating Method of physique” the women volleyball players at national level can be selected.

**Helling (1981)** investigated the effect of isotonic training, isokinetic training and jumping practice on the vertical jump performance of college age women. Sixty three colleges female were assigned to three training programs (isotonic, isokinetic and jumping) and one control group. Each subject was given two given two pre-tests and two post tests on a modified vertical jump test. Subjects trained three days per week. An over was the statistical treatment used in this study. The results revealed that isokinetic and isotonic training groups were the only treatments to

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significantly improve vertical jump ability\textsuperscript{30}.

\textit{Beiter (1981)} studied 46 players served as subjects for the construction of a football prediction test using general and specific motor performance tests. The 18 tests included measurements of strength, power, speed, agility and body composition All raw data were converted to T-scores, multiple regression analysis selected the top tests to estimate the sum of 18 T-SCORES. Neither the four nor eighteen item profile significant predicted started in the spring game. Multiple regression to predicted coaches rating (Mean of 5 coaches) produced and R=66using 1-RM bench press power clean seven skin folds, blocking RT and Margaria Val amen anaerobic power. On the contrary to the result of other studies to predict success in football. The test battery developed in the study did not speed, strength and size does not guarantee success in a highly skilled game such as football\textsuperscript{31}.

\textit{Miller (1980)} conducted a study on body segment contributions to sports skills performance. He analyzed the skills of kicking, throwing, jumping and running. He concluded that physical immobilization of joint may provide some general insights into segmental contribution to performance\textsuperscript{32}.

\textsuperscript{30} T. R. Helling, "Effects of Isotonic training, Isokinetic training and jumping practice on the vertical jump performance of college women", \textit{Completed research in health, physical Education and Recreation} 23 (1981). P. 223
Amvsa (1979) studied subjects (n – 46) were well conditioned college soccer level two years playing experience on the college level. They were tested for running, speed, power, agility, maximum VO₂, strength, anaerobic capacity, and flexibility. In addition, eleven anthropometrics measurements consisting of skin fold 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 the data was by zero order correlation and multiple ‘R’ analysis resulting in the following conclusion age (experience) is the best single predictor of playing ability, weight, L.B.W. and height are considered good predictors of playing ability. Maximum VO₂ and running aped are considered important factors in soccer performance flexibility, agility, locate concentration, and leg power are not considered as valid indicators of playing ability.

Oyster (1979) studied fourteen women champion tennis players on a high intensity weight training program for seven week. Significant strength increases were found in the lower extremity measurements of ankle planter flexion and hip flexion. All other strength measures except elbow strength, showed increases although not significant. These strength increases were accompanied by decreases in all girth measurement (calf girth,

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pectoralis and lower arm girth decreased significantly. There of the four skin fold measurements also decreased although not significantly. There was also a decrease in percent body fat and a slight decrease in weight. Neither of these was significant\textsuperscript{34}.

Novak and others (1977) investigated to determine working capacity, body composition and anthropometry of female Olympic athletes. The subjects in his study were eight distance runners, seven swimmers and five gymnasts. He concluded that distance runners showed significantly higher oxygen intake which was also achieved at significantly higher work loads compared to swimmers, lean body mass was significantly lower in swimmers\textsuperscript{35}.

Hosler (1976) student the electromyographic, strength and girth alterations in selected male and female subjects consequent to a seven week strength improvement program. The two experimental groups considered of nineteen male and twenty three female volunteers. The two control groups were of eight males and twelve females. According to the date collected and analyzed, the following conclusions were drawns:

1. The experimental design of the investigation demonstrated that surface electromyograms were reliable for both male and female subjects in a test re-test situation.

2. Following a particular sever week strength improvement

\textsuperscript{34} Nancy Oyster, “Effects of Heavy Resistance weight training program on college women athletes” Journal of sports medicine and physical fitness 19 (March 1979), 79.

Program both male and female subjects significantly increased their quadriceps strength. However, only the male subjects experienced a significant increase in their high girths during the same period.

3. Consequent to strength training both men and women demonstrated a significant decrease in the action potential required to extend the lower leg against a sixteen pound load. However only men showed a significant decrease in action potential required for lower leg extension against a twenty six pound load.

4. There was no significant association between quadriceps action potential and quadriceps strength for either male or female subjects\textsuperscript{36}.

Sanders (1976) studied the effects of a program of progressive resistance exercise on strength muscle girth and body composition of college women. Fifty two college women participated in the study. Twenty serving as control and thirty two participating in ten week of progressive resistance exercises. The data gathered were statistically analyzed using test and analysis of covariance. It was concluded that this program of progressive resistance exercise produced marked increases in strength, with no significant effects on muscle girth or body composition\textsuperscript{37}.

\textsuperscript{36} Williin Wolker, Hosler, "Electromyographic, strength and girth alterations in Elected male and female subjects consequent to a seven week strength improvement program" \textit{Dissertation abstracts international} 36 (January 1976), P.327.

\textsuperscript{37} Rose Thoman, Sandero, "The effects of a program of progressive resistance exercise on strength, muscle girth and body composition of college women" \textit{Dissertation abstracts international} 36 (May 1976) P. 7276.
**Review of Related Literature**

*Bronoden (1973)* did a study on a comparison of physical fitness and anthropometric measurements of preadolescent Mexican American and 300 Mexican American males between the age of eight to eleven. Taken camper youth fitness test was used to test physical fitness. Thirteen anthropometric measurements were taken. They were standing height, sitting height, weight, shoulder width, arm length, chest girth, waist girth, hip width, thigh girth, leg length, calf girth, foot length and arm girth. The finding revealed significant differences between the Mexican American and Anglo American males in certain physical fitness items and anthropometric measurements. The relationship between selected anthropometric measurements and various physical fitness items were significantly higher for the Mexican American males. The results indicated that the Anglo American males are larger in gross body size and they are superior in performing selected physical fitness items.

*Veeraswami (1973)* conducted a study to evolve physical fitness norms for boys of higher secondary schools of Greater Gwalior. AAPHER physical fitness Test battery was administered in this study. The results obtained show:

1. As per the norms for pull-ups, sit-ups, shuttle run, standing broad jump, 50 meter dash and soft ball throw, 600 meter run/walk, for boys, age group up to and including 13, 15, 16 and 17 and above, the mean scores of Indian boys in all age

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groups are lower than 50\textsuperscript{th} percentile in the American norms.

2. There is positive but low order of relationship between physical fitness and participation in physical activities. The physical fitness was found to be related to degree of regularity in physical activities. The more the degree of regularity, the higher was the physical fitness score.

3. Physical fitness depended on the economic status of the subjects\textsuperscript{39}.

\textit{Brogdon (1973)} conducted a study on comparing certain physical fitness and anthropometric measures for early adolescent Mexican American and Anglo American males in certain physical fitness item and anthropometric measures. The Anglo American males were superior in performance of sit-ups and the standing broad jump. The findings also revealed significantly large anthropometric measures for Anglo-American male in all, but four measurements; these were hip width, shoulder width, waist girth and chest girth. The relationship between selected anthropometric measures and various physical fitness test items were significantly higher for the Mexican American male\textsuperscript{40}.


Nemour (1971) did a comparatives study of anthropometric measurements of Caucasian and Negro boys and girls to find out the differences in standing broad jump, medicine ball put, and zigzag runs performance of the boys and girls of both races.

Anthropometric measurements were standing height, sitting height, weight, length of the upper extremity, and length of the one of six to eights and ten years boys differed from girls in most anthropometric measurements. However, there were no differences in standing height leg or lower extremity length. Negro boys and girls had longer appendages and were taller than Caucasians. Still Negro boys and girls were not superior in the event of power and agility\(^{41}\).

Hammes (1969) examine the relationship of selected anthropometric measures to the vertical jump of high school girls. In this study the total height, sitting height, foot length, metatarsal phalangeal to calcaneus, and medial malleolus to calcaneus length had no relationship to vertical jumping ability using 146 girls as subjects. There was a relationship, but not of predictive value, of weight, total leg length, and lower leg length to vertical jumping ability\(^{42}\).

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Harris (1969) studied the effects of isometric and isotonic training programs on leg extension strength, leg extension power, leg speed, leg reaction time, muscular girth of the calf, thigh, hip and leg flexibility. Sixty male students were divided into three groups of twenty. The three groups were isotonic group, and a control group. Analysis of variance was used as the statistical analysis in the study. The results revealed a significant difference in the measurement for leg speed, reaction time and flexibility. The schepfes test indicated that the isotonic training methods made more significant contribution to leg extension strength and girth of the hips than did isometric training. A conclusion of the statistical evidence to support the hypothesis that one training method could be selected over the other 43.

Medved (1966) investigated 596 sports women and equal number of controls above the age of 17 years. It was concluded that the track and field athletes and athletes of rowing events were found to be taller in height at 1% level of significance. No significant differences were found in height between the control group and tennis, hockey, basketball, volleyball, skiers, swimmers and bowling players 44.

Edelatein (1965) studied the change in strength, girth and adipose tissue of the upper arm resulting form daily and alternate

43 Irvin David Harrish, The effects of Isometric and Isotonic training programs on selected variables” Dissertation abstracts international 30 (December 1969), P-2359.
day progressive weight training the conclusion was that the strength and girth of the exercised are increased in both group and the adipose tissue decreased, but the final mean differences were not significant\textsuperscript{45}.

Wells (1963) studied the relationship of leg strength/body weight ratio and length of the lower limb segments to the vertical jump on 49 male college students and concluded that none of the relationships proved to be statistically significant\textsuperscript{46}.

\textsuperscript{45} Elliott S. Edelstoin, “Changes in Strength, Girth and Adipose Tissue of the upper arm resulting from daily and alternate day progressive weight training” \textit{Completed research in Health, Physical Education and Recreation} 7 (1965), P-99