REVIEW OF RELATED LITERATURE
CHAPTER II

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

Collection of relevant literature provides the basic understanding of the problem, a deep insight and a clear perspective of the overall field. No experienced researcher would think of undertaking a study without acquainting himself with the contribution of previous studies. A great number of research articles have been published on the structure of physical fitness and several international norms have been estimated in the past and used for international comparisons. The investigator has attempted to review some of the important research reports on physical fitness, the effect of exercises on physical fitness, the relationship of age and physical fitness and the relationship of physical fitness to height and weight.

2.2 STUDIES ON PHYSICAL FITNESS

Huang and Malina (2007) conducted a study on Body Mass Index (BMI) and health-related physical fitness in Taiwanese youth 9-18 years. In this study height, weight, and four measures of physical fitness (sit-ups completed in 60 sec. standing long jump, sit and reach, and 800- or 1600-mtr. run/walk) were measured in a national sample of 1,02,765 Taiwanese youth 9-18 yrs of age: 50,940 girls and 51,825 boys. BMI was calculated for each subject. Within each sex-specific half-year age group, students were classified into five BMI categories based on national
percentiles: very low, BMI < 5th percentile; low, BMI \( \geq 5 \) but < 15th percentiles; normal, BMI \( \geq 15 \) but < 85th percentiles; high, BMI \( \geq 85 \) but < 95th percentiles; and very high, BMI \( \geq 95 \) percentiles. Z-scores based on sex- and age-specific means and standard deviations were calculated, and the sum of z-scores for the four fitness tests was used as a Physical Fitness Index (PFI). Differences in PFI between BMI categories within each sex-specific half-year age group were compared with ANOVA with Bonferroni adjustments. Sex-specific regressions of PFI on BMI, using a nonlinear quadratic model, were done in four broader age categories. The study result shows that relationships between BMI and PFI are nonlinear and vary with age from late childhood through adolescence. With increasing age during adolescence, the relationship becomes parabolic, and the peaks of the parabola are sharper in adolescent boys than girls. Finally this study concludes PFI declines in a curvilinear manner with increasing BMI among youth 9-18 yrs of age, but the slope of the relationship varies with age.

Ondrak et al (2007) conducted a study on influence of aerobic power and percent body fat on cardiovascular disease risk in youth. In this study a sample of 1,824 young persons were divided into age groups (8-10, 11-13, and 14-16 years). Aerobic power (VO2 max) was predicted using a sub maximal cycle ergo meter test, whereas percent body fat was assessed using the sum of skin folds. The results of this study was the percentages of participants with elevated risk scores was low, despite the high mean percent body fat and low mean aerobic power. Correlations among the six risk variables and either body fat or aerobic power were the strongest in the youngest participants. In the multiple regression
models adjusted for gender and SES, percent body fat was a stronger predictor of CVD risk score than aerobic power. The variance in risk score attributed to fatness was the greatest in the youngest participants and declined in older age groups. Finally this study concludes percent body fat had a greater influence on CVD risk than aerobic power. The relationship between body fat and total risk score was the strongest in the youngest participants. Thus, interventions to improve CVD risk in youth should target body fat reduction beginning at an early age.

Rinne et al (2007) conducted a study on evaluation of required motor abilities in commonly practiced exercise modes and potential training effects among adults. In their study nominal group technique was used to establish the consensus statement concerning motor abilities and physical fitness in 31 exercise modes. The results shows that walking, running, jogging and calisthenics were regarded as the most suitable exercise modes for most people with no specific requirements. Finally concluded that the consensus statement gives theoretical basis for the components of motor abilities and physical fitness components in different exercise modes. The statement is instructive in order to promote health-enhancing physical activity among sedentary people. This study completes the selection of the exercise modes more detailed than current physical activity (PA) recommendation and guidelines for public health. A variety of exercise modes with one or none motor requirements is available to start. When amount and intensity of exercise is increased the training effects can be found in most components of motor ability and physical fitness.
Thomas et al (2007) studied on relationship of fitness, fatness, and coronary-heart-disease risk factors in 12- to 13-year-olds. In this study the data were obtained from 208 school children (100 boys; 108 girls) ages 12.9 +/- 0.3 years. An inverse relationship was found between AF and fatness (p<or=.05). Fatness was related to a greater number of coronary-heart-disease (CHD) risk factors than fitness was (p<or=.05). Further analysis revealed fatness to be an independent predictor of triglyceride and blood-pressure levels (p<or=.05). The findings indicated that, for young people, fatness rather than fitness is independently related to CHD risk factors.

Warburton et al (2007) evaluated the effectiveness of interactive video games (combined with stationary cycling) on health-related physical fitness and exercise adherence in comparison with traditional aerobic training (stationary cycling alone). College-aged males were stratified (aerobic fitness and body mass) and then assigned randomly to experimental (n = 7) or control (n = 7) conditions. Program attendance, health-related physical fitness (including maximal aerobic power (VO2 max), body composition, muscular strength, muscular power and flexibility), and resting blood pressure were measured before and after training (60%-75% heart rate reserve, 3 day/week for 30 min/day for 6 weeks). VO2 max was significantly increased after interactive video game (11% +/- 5%) but not traditional (3% +/- 6%) training. There was a significantly greater reduction in resting systolic blood pressure after interactive video game (132 +/- 6 vs. 123 +/- 6 mmHg) than traditional (131 +/- 7 vs. 128 +/- 8 mmHg) training. There were no significant changes in body composition after either training program. The present
investigation indicates that a training program that links interactive video games to cycle exercise results in greater improvements in health-related physical fitness than that seen after traditional cycle exercise training.

Littman et al (2005) investigated the effects of physical activity intensity, frequency and activity type on 10-year weight change in middle-aged men and women with the purpose of examining how intensity, frequency, and type of recreational physical activity are associated with weight gain attenuation over a 10-year period. For this study over 15,000 adults between 53 and 57 year living in western Washington State recruited between 2000 and 2002 were used as samples. The data were collected from self-reported measures of physical activity (using a questionnaire), height and weight. They examined associations between physical activity and weight change after age 45 year. All analyses controlled for age at baseline, weight at age 45 year (continuous), diet, education, smoking and weight change between ages 30 and 45 year, and were stratified by sex and body mass index (BMI) at age 45 year (normal weight, overweight or obese). From the results they concluded that in this free-living population, long-term, regular physical activity, particularly common activities carried out at a moderate intensity such as walking, prevented some of the weight gain associated with aging.

Tsimeas et al (2005) conducted a study on physical fitness in relation to fatness in urban and rural Greek children by means of algometric scaling. In this study the sample consisted of 360 (189 urban and 171 rural; age 12.3+/-.0.42 years) boys and 247 (125 urban and 122
rural; age 12.3+/−0.43 years) girls. The sample was highly representative (32-64%) of all 12 year old children registered in the prefecture of Trikala, Greece. All volunteers were assessed for body mass index (BMI) and % body fat, as well as sit and reach, basketball throw (BT), vertical jump (VJ), handgrip strength (HG), 40 mt. sprint, agility run, and 20 mt. shuttle run. The findings of this study reveals that independent-samples’ t’ tests revealed that VJ (p<0.05) was significantly higher in boys living in urban settings compared to their rural counterparts. Similarly, BT was found to be significantly better (p<0.05) in urban girls, whereas HG was significantly higher (p<0.05) in rural girls. This study concludes that (a) only three out of the 14 possible cases (seven fitness parameters for boys and seven for girls) were significantly different between urban and rural children, and (b) these differences were not uniformly distributed in children living in either urban or rural environments, it is concluded that the place of residence has no clear impact on physical fitness as studied herein.

Ohta et al (2004) conducted a study to investigate the effects of different levels of physical activity at work on physical fitness, analyze the effects of 12-week lifestyle modification outside of working hours on physical fitness, work satisfaction and subjective symptoms, and to consider the role of lifestyle modification in occupational health. Lifestyle modification, consisting of aerobic exercise and diet counseling, was conducted for 12 weeks. The data before and after the intervention from 49 male workers were obtained. Physical fitness such as exercise endurance, flexibility, agility, balance, muscular strength, muscular endurance, and muscular power was measured before and after the
intervention. Subjects were divided into active work group (n = 14) and sedentary work group (n = 35) for analysis according to their work activities. As for differences in physical fitness due to different levels of physical activity, the active work group had superior exercise endurance and balance compared to the sedentary work group. In addition, the sedentary work group tended to experience greater fatigue than the active work group. In the active work group, flexibility and muscular strength were significantly increased with lifestyle modification and, in the sedentary work group, exercise endurance; flexibility and muscular endurance were significantly improved while balance also showed a tendency to improve. In the sedentary work group, lifestyle modification resulted in reduced fatigue and stiff neck as well as an increased work satisfaction. In the active work group, no change was observed in complaints or work satisfaction, but improved physical fitness led to a reduction in subjective complaints and an increase in work satisfaction. The level of physical activity at work contributes to the physical fitness of the worker and the addition of aerobic exercise in the worker's leisure time improves physical fitness and thereby contributes to increased work ability regardless of differences in the level of physical activity at work.

Guomundsdottir et al (2004) conducted a study on the relationship between physical activity, body mass index, body composition and grip strength in an Icelandic population. In this study a randomly selected participants, 30-85 years of age, answered questions regarding exercise and diet. The prevalence of regular physical activity was studied for men and women in the age groups of 30-45 years, 50-65 years and 70-85 years and the relationship to body mass index, body composition and grip
strength examined. The possible preventive effect of exercise on overweight and obesity was also studied. The study results states, of 2310 invited, 1630 subjects (70.6%) participated. Mean participation in regular physical activity was 3-4 times a week but 19% of the women and 24% of the men did no exercise at all. In general, swimming, walking and calisthenics of various types and intensities were the most common forms of exercise and in the age group 30-45 year old 16% of the women and 8% of the men did strength training. 50.4% of women 30-45 years of age and 68.2% of 50-65 year old men were overweight or obese. Mean fat mass was highest in 70-85 year old women (38%) and men (27%). Occupational activity was not related to body mass index, body composition or grip strength. Significant negative relationship was found between frequency of exercise and fat mass. The relationship between grip strength and lean mass or exercise was non-significant. The odds ratio of being overweight or obesity was 0.5 (CI was 0.37-0.77 for women and 0.37-0.94 for men) for those who exercised five or more days per week compared to those who exercised less frequently. It was found to conclude that one of four Icelandic men and one of five women do not participate in regular physical activity despite of strong scientific indications of various positive health effects of exercise. More than half of adult Icelanders are overweight or obese but the risk is halved among those who exercise at least five days per week, compared to those who exercise less frequently. Sedentary lifestyle is more common amongst Icelanders than in the neighboring countries and realistic goals need to be set to increase the participation in regular physical activity.
Tomkinson et al (2003) in their study on Australian children's aerobic performance have used a variety of performance tests (600 mtr. run, 1600 mtr. walk/run, 20 mtr. multistage, 10- and 12-min. run), cover a wide range of ages (7-15 years), geographical areas and socio-economic strata, and have been conducted at national, regional and local levels. In spite of this, they paint a consistent picture. Analysis of data on 18,631 12-15 year old South Australians from the talent search program (conducted by the South Australian Institute of Sport) shows a decline of about 0.6% per year in 20 meter multistage shuttle run performance across all age and gender subgroups.

Hill (2002) in his study on 165 South Australian children, aged 10-13 years, used the multimedia activity recall for children and adolescents (MARCA) over three days to predict usual physical activity levels. Results indicate that 81.5% of boys and 47.6% of girls participated in at least 60 minutes of moderate activity per day. However, this study used a higher activity cut-point of 5 METs, rather than the customary 3 MET cut-point and therefore is likely to be underestimating the proportion of children who met the current guideline.

Katznarzyk and Craig (2002) conducted a study with the purpose to quantify the relationship between musculoskeletal fitness and all-cause mortality in the Canadian population. The sample consisted of 8116 people (3933 men and 4183 women), aged 20-69 yrs. who participated in the 1981 Canada fitness survey. Measures of musculoskeletal fitness included sit-ups, push-ups, and grip strength and sit-and-reach trunk flexibility. In the 13 yrs after the Canada fitness survey, there were 238
deaths and a total of 101,685 person-years. The results suggest that some components of musculoskeletal fitness, particularly sit-ups (abdominal muscular endurance), are predictive of mortality in the Canadian population.

Shingo and Takeo (2002) conducted a study on the educational experiments of school health promotion for the youth in Japan: analysis of the 'sport test' over the past 34 years. Means and standard deviations of total scores from physical fitness and athletic ability tests in 11-year-olds (6th graders in elementary school), 14-year-olds (3rd graders in junior high school) and 17-year-olds (3rd graders in senior high school) were analyzed. From the results, the investigators concluded that strategies for health promotion in youths, especially for proper nurturing of physical fitness and athletic ability, should include not only delivery of physical fitness training in schools, but also continuous monitoring of multiple indicators, and ensuring proper 'learning of the body'.

Maia et al (2001) tracking in physical fitness (PF) viewed as a whole, a multidimensional trait of the subject, and to establish the stability of each factor of PF in adolescence from the perspective of a panel study using the structural equation modeling approach. In this study a sample of 454 boys followed from 12 to 18 yrs of age of the leuven growth study, the investigators considered only three consecutive measurement occasions with a mean age of 12.76, 14.69, and 17.73 yrs. Physical fitness was evaluated by means of a battery composed of the following tests: plate tapping, sit and reach, vertical jump, arm pull, leg lifts, bent arm hang and shuttle run. Structural equation models were
fitted to the data, namely autoregressive models with latent variables. These models were used to quantify the tracking of PF as a whole and also of the individual marker variables of fitness. The study results states stability estimates of PF as a whole are rather high, \( \beta_{21} = 0.86 \) and \( \beta_{32} = 0.68 \), with an explained variance of 74\% and 73\%, respectively. Tracking coefficients represented by disattenuated autocorrelations among the fitness factor gave high results: \( r_{1,2} = 0.86; r_{1,3} = 0.78; \) and \( r_{12,3} = 0.85 \). This study concludes physical fitness as a whole is highly stable in adolescent years and very predictable from early years. The same is observed for each factor of fitness.

Payne et al (2000) conducted a study on health implications of musculoskeletal fitness. Musculoskeletal fitness was measured in 312 females and 259 males aged 15-69 years. Health levels were determined using two previously validated questionnaires and expressed as composite health scores derived from principal components analysis. Grip strength, push strength, pull strength, push-ups and trunk forward flexion were significant predictors of health scores after controlling for the potentially confounding effects of gender, age, aerobic fitness, waist circumference, and smoking status. These findings indicate that musculoskeletal fitness is related to health in males and females aged 15 to 69 years.

Caspersen et al (2000) found there is substantial evidence of a decline in physical activity over the lifespan. A number of international tracking studies have identified adolescence, typically between 13-18 years, as the period of greatest decline in physical activity in both males
and females over the lifespan. However, as there is a lack of data on physical activity levels of children less than 10 years old, trends within childhood are unclear. It is possible that substantial declines in physical activity in childhood may also be apparent. Physical activity continues to decline in adulthood, most significantly between the ages of 65-74 years (4% decline) and 75 years and over (10% decline). During the age range of 30-44 years and 45-64 years, the percentages of males and females participating in sustained physical activity are relatively similar. However there is a widening gap at retirement, with males actually increasing their physical activity by approximately 9%, while female activity levels remain unchanged. It is likely that the typical leisure activities of men in retirement, such as golf and gardening are more active than the retirement activities chosen by women.

Rowlands et al (2000) studied the relationship between habitual physical activity and body fat in children in a meta-analysis of 50 studies. Of the 50 studies analysed, 78% showed an inverse relationship (that is, increased physical activity was related to decreased body fat), 18% found no relationship and 4% found a positive relationship. The mean effect size was small to moderate, but was largely dependent on the activity measure used.

Miller and Berry (2000) conducted a survey on health-related physical fitness knowledge of student allied health professions. The purpose of this investigation was to assess the health-related physical fitness knowledge of three allied health professions using a 40 item multiple-choice test designed to assess knowledge in five domains of
health-related physical fitness. Results indicated that student athletic
trainers scored significantly higher on the post-test compared to pre-test.
On the post-test, athletic training and physical therapy groups scored
significantly higher than the nursing group. The information from this
study may be valuable in aiding educators in developing appropriate
curricula to better prepare students for their role as allied health
professionals.

Dollman et al (1999) based on the Australian health and fitness
survey, 1985 (Pyke, 1987) for comparison for state-wide surveys into
health-related fitness, South Australian data showed the median time on
the 1.6-km run/walk increased by 38-45 seconds in 10-11 year old
children. In contrast, the South Australian data revealed 0.5-2.0%
decrements across both the fastest and slowest sprinters.

MacAuley et al (1999) conducted a study to establish patterns of
respiratory function in Northern Ireland and to examine the relationship
between physical activity, physical fitness and respiratory function. The
investigators identified 1600 adults over 16 yrs using two stage
probability sampling. Physical activity was measured using a
questionnaire, physical fitness from oxygen uptake while walking on a
treadmill, and respiratory function using spirometry. The main outcome
measures were a physical activity profile based on computer assisted
interview, physical fitness by predicted VO2 max, Forced Vital Capacity
(FVC) and Forced Expiratory Volume (FEV1). The main findings of this
study were of relationships between activity and FVC and FEV 1 which
remained after adjustment for possible confounders in men, and between
fitness and FVC and FEV 1 in both men and women although these were not sustained after adjustment for possible confounders.

Morris and Hardman (1997) studied the effect of walking in relation to health. Walking, faster than customary, and regularly in sufficient quantity into the 'training zone' of over 70% of maximal heart rate, develops and sustains physical fitness: the cardiovascular capacity and endurance (stamina) for bodily work and movement in everyday life that also provides reserves for meeting exceptional demands. Muscles of the legs, limb girdle and lower trunk are strengthened and the flexibility of their cardinal joints preserved; posture and carriage may improve. Walking is also the most common weight-bearing activity, and there are indications at all ages of an increase in related bone strength. Walking is beneficial through engendering improved fitness and/or greater physiological activity and energy turnover. Two main modes of such action are distinguished as: (i) acute, short term effects of the exercise; and (ii) chronic, cumulative adaptations depending on habitual activity over weeks and months. There is, nevertheless, growing evidence of gains in the prevention of heart attack and reduction of total death rates, in the treatment of hypertension, intermittent claudication and musculoskeletal disorders, and in rehabilitation after heart attack and in chronic respiratory disease. Walking is ideal as a gentle start-up for the sedentary, including the inactive, immobile elderly, bringing a bonus of independence and social well-being. As general policy, a gradual progression is indicated from slow, to regular pace and on to 30 minutes or more of brisk (i.e. 6.4 km/h) walking on most days. These levels should achieve the major gains of activity and health related fitness.
without adverse effects. Alternatively, such targets as this can be suggested for personal motivation, clinical practice, and public health. The average middle-aged person should be able to walk 1.6 km comfortably on the level at 6.4 km/h and on a slope of 1 in 20 at 4.8 km/h, however, many cannot do so because of inactivity-induced unfitness. The physiological threshold of 'comfort' represents 70% of maximum heart rate.

Beunen et al (1997) conducted a study on development and tracking in fitness components: Leuven longitudinal study on lifestyle, fitness and health. In the Leuven growth study of Belgian boys the growth and physical performance of Belgian boys followed longitudinally between 12 and 19 years were studied. Subsequently, a subsample (n = 240) of Flemish-speaking males were reexamined at 30 and 35 years. A first question relates to the individual growth patterns in a variety of physical fitness characteristics. The three strength tests (static, functional and explosive) show curves that are qualitatively similar to those for height and weight. Their adolescent spurts occur after the height spurt. Flexibility and the two speed tests appear to reach maximum velocities prior to the height and weight spurts. Longitudinal principal component analysis was applied to the study of growth patterns of several somatic and motor characteristics. The results for height show three components sufficient to provide an adequate representation of the original information. The first component characterizes the general position of an individual growth curve. Components 2 and 3 reflect fluctuation in percentile level during the age period studied and can be conceived as indices of stability and are related to age at peak height.
velocity (APHV) and peak height velocity (PHV), respectively. Relationships between somatic characteristics, physical performance, and APHV have been studied in a sample of 173 Flemish boys, measured yearly between +/- 13 and +/- 18 years and again as adults at 30 years of age. The sample was divided into three contrasting maturity categories based on the APHV. There are consistent differences among boys of contrasting maturity status during adolescence in body weight, skeletal lengths and breadths, circumferences, and skin folds on the trunk. There are no differences in skin folds on the extremities. None of the differences in somatic dimensions and ratios among the three contrasting maturity groups are significant at 30 years of age except those for subscapular skin fold and the trunk/extremity skin fold ratio. During adolescence, speed of limb movement, explosive strength and static strength are negatively related to APHV; thus, early maturers performed better than late maturers. However, between late adolescence and adulthood (30 years), the late maturers not only caught up to the early maturers, but there were significant differences for explosive strength and functional strength in favor of late maturers. Finally, age-specific tracking, using inter-age correlations, of adult health- and performance-related fitness scores were investigated. In addition, the independent contribution of adolescent physical characteristics to the explanation of adult fitness scores was also studied. Tracking between age 13 and age 30 years was moderately high (46% of variance explained) for flexibility, low to moderate (between 19% and 27% of variance explained) for the other fitness parameters and low for pulse recovery and static strength (7% to 11% of variance explained). Between age 18 and age 30 years the tracking was high for flexibility, moderately high for explosive and static
strength, and moderate for the other fitness parameters except for pulse recovery. The amount of variance of adult fitness levels explained increased significantly when other characteristics observed during adolescence entered the regressions or discriminant functions.

McNaughton et al (1996) based on the Australian health and fitness survey, 1985 (Pyke, 1987) for comparison for state-wide surveys into health-related fitness, a Tasmanian survey found the performance of 7-10 year old Tasmanian children on the 1.6 k run/walk had declined between 1985 and 1995, by approximately 0.2% per year. There is little evidence of trends in other components of fitness among Australian children reported no overall declines in 50 mtr. sprint performance. In fact, faster times were recorded by 7 and 8 year olds in 1995.

Shea et al (1994) conducted a study on the rate of increase in blood pressure in children 5 years of age is related to changes in aerobic fitness and body mass index. The main objective of the study was to determine whether changes in aerobic fitness and body mass index are related to the age-related rise in blood pressure in healthy preschool children. This study designed to longitudinal analyses of 196 free-living children aged 5 years at baseline who were followed over a mean of 19.7 months. The result states mean systolic blood pressure was 95.3 mmHg (SD 8.38) at baseline and increased by 4.46 mmHg per year. Mean diastolic blood pressure was 53.9 mmHg (SD 5.81) at baseline and did not change significantly. Children in the highest quintile of increase in fitness had a significantly smaller increase in systolic blood pressure compared to children in the lowest quintile (2.92 vs. 5.10 mmHg/year; P = .03). Children in the lowest quintile of increase in body mass index did not
differ significantly in rate of increase in systolic blood pressure compared to children in the highest quintile (3.92 vs. 4.96 mmHg / year). In a multiple regression model including baseline systolic blood pressure, fitness, height, body mass index and other covariates, greater increase in fitness ($P = .03$) and lesser increase in body mass index ($P < .01$) were associated with lower rates of increase in systolic blood pressure. In a similar multivariate analysis, an increase in fitness was also associated with a lower rate of increase in diastolic blood pressure ($P = .02$). This study concludes young children who increase their aerobic fitness or decrease their body mass index reduce the rate of the age-related increase in blood pressure. These observations may have implications for development of interventions directed at the primary prevention of hypertension.

Morrow and Freedson (1994) conducted a research on the relationship between physical activity and aerobic fitness in youth, suggests a small to moderate association, despite a much clearer link in adults. Any true association is likely to be attenuated by methodological problems with measuring physical activity and defining aerobic fitness, as well as the relatively high levels of both among youth.

Corbin and Pangrazi (1992) found little change in the data from the National School Population Fitness Surveys (NSPFS) between 1975 and 1985. Of the five fitness tests performed: 50 yd. dash; standing broad jump; shuttle run; pull-ups for boys; and flexed arm hang for girls, performance declines were only found in the 50 yd. dash for 11 year old boys and 10, 11, 14 and 16 year old girls.
Blair (1989) studied the relationship between physical fitness and mortality from all causes. The uniqueness of this study was twofold: first, the researchers measured the physical fitness level of all subjects by treadmill testing and second, more than three thousand of the 13,344 subjects were women. Because of their lower risk for cardiovascular disease women have essentially been neglected as subjects in heart disease studies. The results of this study indicated that a low physical fitness level increased the risk of death from cardiovascular disease, cancer and all other forms of disease. The difference in all cause mortality was greatest between those who were in the moderately fit category and those in the low fit category. The difference between the moderately fit and highly fit was insignificant.

Humphry (1985) studied the comparison of fitness level in elementary children taught by the specialists and non-specialists. In this study, analysis of the data showed that when the total scores of the two sample groups were compared, the specialist group had significantly higher scores on nine of the twelve tested components. The evidence from this study supported the results of previous work in this area and indicated that the specialist taught subjects obtained a significantly higher score than those taught by non-specialist.

Barbanti and Valdir Jose (1983) in their work on a computer study of selected anthropometric and physical fitness measurement of Brazilian and American school children measured the status of physical fitness of selected Brazilian boys and girls, to provide norms for Brazilian school children from schools achieved on selected physical fitness tests. They
investigated the difference between the performance of the Brazilian boys and girls, and studied the difference that existed between the norms of Brazilian and American boys and girls for selected physical fitness measurements. The second purpose was to provide a basis for the evaluation of effectiveness of Brazilian programme of physical education on the development of physical fitness as reflected by results of measurements taken. Subjects for study were 2342 boys and girls enrolled in the public school system in Brazil during 1982. A trained team collected two anthropometric measurements (ht. and wt.) administered the health related physical fitness test battery and the test of athletic ability (50 mts. dash and standing broad jump). Results of the study were: 1. For selected Brazilian school population between ages 6 to 14 years height and weight of both sexes increased at approximately same rate; 2. Girls were significantly taller and heavier than boys during adolescence; 3. The comparison between norms of Brazil and American boys and girls showed that the American boys and girls in general were taller and heavier. It was suggested that the physical education curriculum in school system of Itapira, be revised and upgraded by introducing activities that lead to improve physical fitness.

Sloan (1963) in his study on physical fitness of college students in South Africa, the United States of America and England took limited samples and (not randomly selected) found that the english men and women of physical education majors had significantly higher mean fitness indexes than their counterparts in North Corolina University. South African male physical education majors were also significantly superior to their counter parts of the North Corolina University.
Ikeda (1962) reported that Tokyo children did better than IOWA (USA) children in pull-ups (boys) bent-arm hang (girls) and the grosshopper (test of endurance), while IOWA children scored better in sit-ups.

Campbell (1961) compared physical fitness of British and the United States children, and found that Great Britain boys and girls are superior to the United States children.

Cooper (1968) found that out of 3544 men between ages of 17 and 35 (mean age was 24.37 years) only 27% could cover 1.5 miles within 12 minutes. This figure was increased to 70% after 6 weeks of a regular progressive exercise program.

Hubert et al (1987) expressed the incidents of high blood pressure is three times greater among the obese than among normal weight people. Jequier (1987) also observed the same relationship among the school children.

Must et al (1992) found individuals who were overweight in adolescence are shown to have significant association with long term morbidity, independent of their adult weight.

Dollman (2003) found club sport participation in the South Australian health and fitness survey was strongly associated with cardio respiratory fitness (1.6 km run/walk) among boys and girls.
2.3 STUDIES ON PHYSICAL FITNESS NORMS

Volbekiene and Griciute (2007) conducted a study on health-related physical fitness among schoolchildren in Lithuania: a comparison from 1992 to 2002. For this study the height and weight of the children were measured, and the euro fit test battery was used to analyze the children's fitness. For the analyses of differences, 2,009 children aged 12 (n = 697), 14 (n = 733), and 16 (n = 579) years were tested. The study results were that the boys and girls of all three age groups performed better in the sit and reach test (12.4-19.8%, p<0.001) and in the 20 mtr. shuttle run test (30.0-46.0%, p<0.001) but did fewer sit-ups (3.5-7.3%, p<0.05) in 1992 compared with the results in 2002. The girls' performance was better in the long broad jump test (4.9-5.5%, p<0.001) in 1992 than in 2002. These differences were not significantly influenced by weight, body mass index (BMI), and "height+BMI". The study concluded that there was a marked decrease in aerobic fitness and flexibility and a slight increase in abdominal muscle endurance among Lithuanian schoolchildren. Leg muscular power decreased slightly in girls but remained unchanged in boys. A decrease in daily physical activity is the most likely contributing factor to the decrease in aerobic fitness and flexibility and physical efficiency (PE) reform has not been able to compensate for this effect.

Milde et al (2006) conducted a study on physical fitness of short-statured boys as related to percentile norms for calendar or growth age. The main objective of the study was to assess the physical fitness of short-statured boys aged 7-20 years by applying fitness norms established
for the polish population in relation to calendar or growth age. For this study the results of EUROFIT fitness tests recorded in 3517 short-statured (below percentile 10 for body height) boys, aged 7-20 years, selected from a large (n=37 000) representative male cohort, were analyzed. Individual results were confronted with the respective percentile norms related to calendar age (CA) or growth age (GA), since body height deficiency at given CA could have affected the results of fitness tests expected for that CA. The percentages of subjects below, the percentile 3 or above percentile 97 for given fitness test and CA or GA for the Polish population, were determined. No differences between the percentages computed for CA and GA were noted in case of the following tests: sit-and-reach (SAR) and bent-arm hang (BAH). Significant differences in percentages for both percentiles were found for the following tests: standing broad jump (SBJ), endurance shuttle run (ESR), handgrip (HGR) and plate tapping (PLT). In case of sit-ups (SUP) significant differences in percentages between CA and GA norms were found below the percentile 3, and in case of shuttle run (SHR) and Flamingo balance (FLB) - above percentile 97. Finally it concluded that fitness tests were classified into two categories according to the differences between the results related to norms for calendar or growth age: those independent of whether CA or GA norms were applied (SAR and BAH), and those susceptible to the kind of norm (SBJ, HGR, PLT, SHR, FLB and SUP). The results of tests from the latter category should thus be evaluated by confronting them with the norms established for the growth age and not calendar age.
Chen et al (2002) conducted a study on approaching healthy body mass index norms for children and adolescents from health-related physical fitness. They evaluated the existing data from a nation-wide fitness survey for students in Taiwan to examine the relationship between BMI and fitness tests. The fitness tests used included: an 800/1600-mtr. run / walk; a standing long jump; bent-leg curl-ups; and a sit-and-reach test. The BMI percentiles developed from the subgroup whose test scores were better than the 'poor' quartile in all four tests were compared with those of the whole population and linked to the adult criteria for overweight and obesity. The BMIs were significantly related to the results of fitness testing. A total of 43% of students had scores better than the poorest quartile in all of their tests. The upper BMI percentile curves of this fitter subgroup were lower than those of the total population. The 85th and 95th BMI percentile values of the fitter 18 year old students (23.7 and 25.5 kg m (-2) for boys; 22.6 and 24.6 kg m (-2) for girls) linked well with the adult cut-off points of 23 and 25 kg m (-2), which have been recommended as the Asian criteria for adult overweight and obesity. Hence, the BMI norms for children and adolescents could be created from selected subgroups that have better physical fitness.

Okun et al (2002) in their study on clarifying the contribution of subjective norm to predicting leisure-time exercise used a sample of 530 college students completed a questionnaire that assessed descriptive and injunctive social norms related to family and friends, perceived behavioral control, attitude, intention and leisure-time exercise. The result shown friend descriptive social norm was a significant predictor of both intention (p<.05) and leisure-time exercise (p<.001). Finally it was
concluded that the descriptive norms should be incorporated into tests of the theory of planned behavior in the exercise domain.

Payne et al (2000) conducted a study on Canadian musculoskeletal fitness norms. The purpose of this study was to provide representative norms for measurements of musculoskeletal fitness (partial curl-ups, vertical jump and leg power) for which Canadian norms are not currently available. Partial curl-ups, vertical jump, trunk flexion (sit and reach), grip strength, muscular endurance (push-ups), body mass index, and subcutaneous adiposity (sum of five skin folds) were assessed, and leg power was calculated in 571 self-reportedly healthy participants (312 females and 259 males) aged 15-69 yrs. The representativeness of the sample was confirmed by statistically comparing the fitness characteristics of the participants in the present study to those in the Canada fitness survey of 1981 and the Campbell's survey of 1988. Normative data for partial curl-ups, vertical jump, and leg power were generated for males and females in six age groups (15-19, 20-29, 30-39, 40-49, 50-59 and 60-69) for use in fitness appraisal protocols for the Canadian population.

Robbine (1985) in his study on Alabama motor fitness and health related fitness norms, for ages 6-14 compared the fitness norms. The major purpose of the study was to develop percentile norms for Alabama students in grade 1-9 based on the performances on both AAHPER youth fitness test (YFT) and AAHPERD health related fitness test (HRFT). The two tests were administered to 2545 Alabama boys and girls ages 6-14. Percentile table were constructed for each test item based on age and sex. A second purpose was to compare the Alabama means
with American norms, at the P<0.5 level. Alabama means were compared with National norms for all test items except skin fold measures. (National skin fold measures were not available at that time). A total of 54 YFT comparisons were made. 13 Alabama means were significantly better (7 of boys and 6 of girls, 19 National means were significantly better (8 for boys and 11 for girls), 22 means did not have significant difference. A total of 42 HRFT comparisons were made, 2 Alabama means were significantly better (1+1) and 27 National means were significantly better 9 (3 boys and 14 girls) and 13 means were not significantly different.

Robson et al (1978) constructed norms on a simple fitness test battery for elementary polytechnic students. They selected 152 students of Kendriya Vidyalaya, Gwalior. The test battery is practicable and simpler than the existing fitness tests and measures most of the essential motor qualities at the elementary polytechnic students. All the subjects and assistants were oriented to the test battery comprising 50 meters dash, 600 meters run and walk, straight leg sit-ups, vertical jump, 4x10 meters shuttle run and modified push-ups. The subjects were given practice in these items so that they were able to give the correct performance in each item. The test items were administered to the subjects on two days administering three items each day. The value of “r” obtained was 0.87 which shows that subject had achieved consistency of performance in the test items. The norms were prepared for classifying the students into ability groups by assessing the fitness.
Dorothy (1967) evolved norms of fitness for college women from 57 colleges and the data of 3800 subjects were collected for seven test items in order to be constants with the already published norms for children, youth and college men. Percentile norms were calculated from 0 to 100.

Knuttgen (1961) reported that 70 percent of the Danish school boys scores and 86 percent of the girls scores exceeded the American mean scores on the AAHPER youth test.

2.4 STUDIES ON PHYSICAL ACTIVITY PROGRAM

Physical education teachers have claimed that participation on physical education program would develop activity, skill development, physical growth and particularly physical fitness.

Verstraete et al (2007) conducted a study on a comprehensive physical activity promotion programme at elementary school: the effects on physical activity, physical fitness and psychosocial correlates of physical activity. To achieve the aim of this study a pre-test and post-test over two school years were designed. For this study sixteen elementary schools (764 children, mean age: 11.2 +/- 0.7 years) were randomly assigned to the intervention condition (n = 8) and the control condition (n = 8). The intervention included a health-related physical education programme, an extracurricular PA promotion programme and classroom-based PA education lessons. In the total sample, leisure-time PA, psychosocial correlates of PA and physical fitness were measured using a PA questionnaire and the Eurofit test battery. In a sub-sample, total PA
levels were measured using an accelerometer. The results of the study revealed that according to accelerometer data, children's moderate PA and moderate-to-vigorous PA (MVPA) levels decreased less in the intervention schools than in the control schools (P < 0.01). The average time spent on MVPA decreased by 9 min. per day in the intervention schools compared with 33 min. per day in the control schools. Children in the intervention schools reported significantly more moderate PA in leisure time than the controls (P < 0.05). No overall improvement of physical fitness and no effects on the psychosocial correlates of PA were found. Finally this study concludes that the comprehensive PA promotion programme was successful in preventing a decline in children's total activity levels. Furthermore, the intervention increased children's PA engagement in leisure time. Therefore, implementation needs to be encouraged.

Koutedaklis et al (2007) conducted a study on the effects of three months of aerobic and strength training on selected performance and fitness related parameters in modern dance student. The sample consisted of 32 men and women (age 19 +/- 2.2 years) who were randomly assigned into exercise (n = 19) and control (n = 13) groups. Anthropometric and flexibility assessments, treadmill ergometry, strength measurements, and- on a separate day—a dance technique test were conducted pre- and post exercise training in both groups. After the end of the program, the exercise group revealed significant increases in dance (p < 0.02), and Vo2 max (p < 0.04), flexibility (p < 0.01), and leg strength (p < 0.001) tests compared to controls. It is concluded that in modern dance students (a) a 3 month aerobic and strength training program have
positive effects on selected dance performance and fitness-related parameters, (b) aerobic capacity and leg strength improvements do not hinder dance performance as studied herein, and (c) the dance-only approach does not provide enough scope for physical fitness enhancements.

Coe et al (2006) conducted a study on effect of physical education and activity levels on academic achievement in children. For this study the participants were 214 sixth-grade students randomly assigned to physical education during either first or second semesters. Moderate and vigorous physical activity (MVPA) (number of 30-min. time blocks) outside of school was assessed using the 3d physical activity recall (3DPAR). The 3DPAR time blocks were converted to ordinal data with scores of 1 (no activity), 2 (some activity), or 3 (activity meeting Healthy People 2010 guidelines). Academic achievement was assessed using grades from four core academic classes and standardized test scores (Terra Nova percentiles). From the results of the study they concluded that although academic achievement was not significantly related to physical education enrollment, higher grades were associated with vigorous physical activity, particularly activity meeting recommended healthy people 2010 levels.

Mikkelsson et al (2006) conducted a study on school fitness tests as predictors of adult health-related fitness. The main purpose of this study was to find out the relationships between adolescent physical fitness and adult health-related fitness was investigated. In this study forty-five subjects (20 males, 25 females) participated in physical fitness
tests in 1976 and again in 2001. The adolescent physical fitness tests were distance running (2,000 mtr. for boys or 1,500 mtr. for girls), 50 mtr. run, pull-ups (boys) or flexed arm hangs (girls), shuttle run, a 30-sec sit-up test, standing broad jump, hand grip-test, and sit-and-reach test. The adult health related physical fitness index (APFI), stratified by sex, was formed by summing the z-scores of a bicycle ergometer test, sit-up test, hand-grip test and sit-and-reach test. Height- and weight-adjusted correlations between adolescence and adulthood for exactly similar tests for men and women were, respectively, 0.74 (95% CI, 0.44-0.89) and 0.53 (95% CI, 0.17-0.76) in sit-and-reach tests, 0.41 (95% CI, -0.04 to 0.72) and 0.55 (95% CI, 0.20-0.78) in sit-up tests, and 0.53 (95% CI, 0.11-0.44), and 0.44 (95% CI, 0.05-0.71) in hand-grip tests. When all adolescent tests were put in regression analysis together with BMI in 2001, the significant explanatory factors for APFI were distance running ability and the sit-and-reach test for men and sit-up test, flexed arm hang and BMI in 2001 for women.

Zahner et al (2006) conducted a study on a school-based physical activity program to improve health and fitness in children aged 6-13 years. For this study 15 schools were randomized to the intervention (n = 9) or the control (n = 6) group, stratified by geographic region (urban vs. rural) and by age (1st and 5th grade). Participation was given for all children in the intervention group since in this group the intervention was part of the normal school curriculum. All children underwent anthropometric measurements, blood pressure assessment, fitness testing, measurement of PA and they filled out questionnaires. The primary endpoints of the study after one year were an increase in total PA by
accelerometer, an increase in aerobic fitness measured by the 20 meters shuttle run, a decrease in percent body fat derived from skin fold measurements and an increase in quality of life as assessed by the child health questionnaire in the intervention group compared to the control group. Secondary outcomes were overall fitness, differences in body composition including body fat distribution, cardiovascular risk factors, psychosocial health, bone mineral content and density of femur, lumbar spine and total body and food intake. Based on the data, they aim at providing important information regarding the influence of such an intervention on these outcome measures in school-aged children and providing nationwide guidelines to improve PA in children.

Christodoulou et al (2006) conducted a study on obesity and physical fitness of pre-adolescent children during the academic year and the summer period: effects of organized physical activity. This study examined obesity and parameters of physical fitness in 178 elementary schoolchildren during an academic year as well as after the summer holidays. Results showed significant physical fitness improvements during the school year, with little or no changes in the summer holidays. Children who reported less than 30 minutes of daily participation in physical activity demonstrated lower prevalence rates for overweight and obesity as well as superior fitness performance. The detrimental effect of the summer break on the progress of physical fitness was less in children who did participate in physical activity than in those who did not. Longitudinal modeling using generalized estimating equations demonstrated that physical activity is a major contributing factor for obesity over time, masking the singular effect of various fitness
parameters. It is concluded that pre-adolescent children advance in physical fitness mainly during the school year, with physical activity being a beneficial countermeasure for the development of obesity.

Kim and Park (2006) have analyzed the effects of an exercise program on body composition and physical fitness of obese female college students. Data was collected from forty four students, 20 in the experimental group and 24 in a control group, with more than 30% body fat were randomly assigned. The subjects in the experimental group participated in an exercise program for 12 weeks, sixty minutes per session, five times per week. Body composition and physical fitness were measured by a body composition analyzer-cardiovascular endurance, muscle endurance, muscle strength (grip strength, back strength), flexibility, balance, agility (whole body reaction time) and power (standing long jump). Body weight (F=4.76, p=0.035), body fat (kg) (F=5.68, p=0.022) and body mass index (F=5.73, p=0.021) of the experimental group were significantly different from the control group, but there were no significant differences in body fat (%), lean body mass, muscle mass and WHR. Back strength (F=6.50, p=0.015), flexibility (F=14.62, p=0.000), muscle endurance (F=7.98, p=0.007), power (F=5.76, p=0.021) and balance (F=2.46, p=0.018) of the experimental group were significantly different from the control group, but there were no significant differences in cardiovascular endurance, grip strength or agility. The exercise program has become effective in improving body weight, body fat (kg), body mass index, back strength, muscle endurance, flexibility, balance and power of obese female college students.
Carrel et al (2005) conducted a study on improvement of fitness, body composition, and insulin sensitivity in overweight children in a school-based exercise program: a randomized, controlled study. This study was designed with fifty overweight middle school children with a body mass index (BMI) above the 95th percentile for age were randomized to lifestyle-focused, fitness-oriented gym classes (treatment group) or standard gym classes (control group) for 9 months. The main outcome measures were baseline test results for cardiovascular fitness, body composition and fasting insulin and glucose levels. Finally it was concluded children enrolled in fitness-oriented gym classes showed greater loss of body fat, increase in cardiovascular fitness and improvement in fasting insulin levels than control subjects. The modification to the school physical education curriculum demonstrated that a small but consistent change in the amount of physical activity has beneficial effects on body composition, fitness and insulin levels in children. Partnering with school districts should be a part of a public health approach to improving the health of overweight children.

Delecluse et al (2004) conducted a study on exercise programs for older men: mode and intensity to induce the highest possible health-related benefits. The methods adopted in this study were men at the age of 55-75 years, were randomly assigned to a control group (N = 13) or one of three exercise groups (20 weeks, two to three times per week): endurance plus moderate resistance (MR) training (N = 22), endurance plus low resistance (LR) training (N = 22) and endurance training only (N = 22). Cardiovascular (CV) risk factors, muscular fitness and postural control were assessed before and after training. The results indicated all
exercise groups revealed significant (P < 0.05) improvements in resting heart rate, work capacity and recovery, waist girth, insulin response and knee-extensor strength with no differences among groups. Body composition, resting metabolic rate (RMR), VO2 peak and postural control did not change in exercise groups. Finally it was concluded in older men, a fitness program consisting of 20 weeks endurance training combined with resistance training is equally effective as endurance training alone. Moderate vs. low resistance training added to endurance training yields similar health-related benefits.

Norton et al (2001) investigated the trends in organized sports by compared four large scale surveys. Prevalence of participation in sports and recreational activities (both organized and non-organized) reported in the 1985 Australian health and fitness survey (Pyke, 1987) was compared to data from the South Australian schools fitness and physical activity survey (Dollman, 2003), and two recent surveys undertaken by the Australian Sports Commission (Australian Sports Commission, 1991) and the Australian bureau of statistics (Australian Bureau of Statistics, 2001b). Throughout the surveys, most children participated in one sport, with the number participating in two, three and four sports decreasing fairly linearly. Sport participation was high in the 1980s (82.5% of all children surveyed participated at some level). However, subsequent studies show the participation rate drop by approximately 60-64%. The most dramatic drop off was the percentage of children who were involved in more than two sports per year. In 1985, 40% of children played three or more organized sports within a year. In 2000, only 11% of children reported playing three or more sports. The reasons behind
these declines are the roles of parents, family and peers in physical activity are likely to have an impact.

Fortier et al (2001) conducted a study on seven-year stability of physical activity and musculoskeletal fitness in the Canadian population. The study was based on a sample of 951 male and 958 female subjects, aged 11-69 yrs, for whom the appropriate measurements were available in the 1981. Measures of physical activity were estimated activity energy expenditure (AEE) and time spent on activity, whereas indicators of musculoskeletal fitness consisted of sit-ups, push-ups, grip strength, and sit-and-reach (trunk flexibility). They found out 7yr inter-age correlations ranged from - 0.08 to 0.39 for AEE, - 0.10 to 0.33 for time on activity, 0.42 to 0.80 for sit-ups, - 0.07 to 0.73 for push-ups, 0.44 to 0.82 for grip strength, and 0.47 to 0.85 for sit-and-reach. Finally the study concluded that the physical activity level was not a very stable characteristic in the Canadian population; however, indicators of musculoskeletal fitness are moderately stable over 7 years.

Brown et al (1999) in his recent survey of South Australian schools found that approximately 40% of primary schools fail to provide the 100 minutes per week of structured physical activity recommended by the department of children and human services at Years 2 and 3, while approximately 25% similarly fall short at Years 5, 6 and 7. The same survey reported that in about 20% of primary schools, Physical Education was not compulsory at any of the year levels. Of the primary school principals interviewed, 86% expressed the view that overcrowding in the curriculum made implementation of the 100 minutes recommendation difficult in their schools.
Duncan et al (1991) in a study completed using only women as subjects, investigated the physical fitness benefits versus the health benefits of three levels of walking intensity. In this study one group walked at 5 mph, a second group walked at 4 mph, and a third group walked at 3 mph. The results showed that physical fitness improved on a predictable dose response basis. The fastest walkers improved the most and the slowest walkers improved the least, but the cardiovascular risk was reduced equally among the three groups. Low-level exercise was as effective as the highest level in promoting cardiovascular health. Exercise for health does not have to be as strenuous as exercise for physical fitness.

Paffenbarger et al (1986) in their study a total of 17,000 men were followed for more than 20 years, those who regularly walked, climbed stairs or participated in sports activities decreased their risk from all causes of mortality. Those who expended a minimum of 500 calories per week (5 miles of walking) to a maximum of 3500 calories per week (35 miles of walking) experienced a progressive increase in longevity. The greatest health benefits were gained by those who expended 2000 calories per week (20 to 22 miles of walking) in physical activity.

Sallis et al (1986) found that although moderate physical activity did not produce measurable improvement in cardio respiratory endurance, it did produce healthy changes in the coronary risk factors.

Schmalz Hill and Sandra Rose (1986) conducted a study on physical fitness program development project. They designed the physical fitness program to facilitate the development of effective
physical fitness program in the schools. The following goals were designed to meet the needs, of enhancing the awareness to meet the needs of teacher in the area of physical fitness, facilitate the development of effective program components in the existing physical education curriculum and increase the student’s knowledge of fitness concepts, fitness levels and attitude and motivation towards physical fitness. 10 teachers representing all 5 districts were involved in the project. They participated in five workshops over a 16 months period. Each teacher initiated a series of program development segment through the study. These segments were developed in part at periodic workshop and outlined methods by which the teacher was expected to successfully complete the project goals.

Govern Miccael (1983) in his study on the effect of circuit weight training on the physical fitness of prepubescent children analyzed the regular school physical education programme. The interest of his study was to determine whether there are significant differences in the strength of skin fold and maximal O₂ uptake of prepubescent school children who participated in a circuit weight training programme when compared with those same measures among peers who participated in a regular physical education programme. The study employed a randomized group, pre-test, post test experiment design. Children from 4th grade to 6th grade of a single grade school were randomly assigned. The major findings include, after twelve weeks there was a significant increase in the strength of all children in the experimental group, and no significant difference in the control group and after twelve weeks there was no significant change in the girth and skin fold of children in the experimental and control groups.
Deiry and Allmahid (1983) conducted a study on evaluation of the physical education programme in selected secondary schools in Jordan. The general problem was to evaluate the physical education programme in selected secondary schools districts in Jordan. The basic intention of the study was to make the strength and weakness of physical education programme. Specific and general recommendations were made for improvement of the physical education program in Jordan.

Johnson (1969) in his study on “Effect of 5 day a week Vs 2 and 3 day a week physical education classes” has concluded that daily physical education classes would be extremely desirable and that such a program would probably be more effective in developing a high physical fitness level and desirable activity, skills in controlling subcutaneous adipose tissue deposit and would have a great influence in physical growth than a similar program meeting only 2 or 3 times a week.

The calisthenic exercise program advocated for adults by the president council of physical fitness was listed by Richard (1965) for it effects on related components of physical fitness. 19 subjects participated in the exercise program for 10 weeks. The training was proceeded and followed by measurements relative to the council objective for the program, strength, flexibility, improved general appearance, endurance, co-ordination and efficiency. Flexibility in males and segment of the endurance (complex) in females appeared significant at the 0.05 level of confidence when the difference observed for the pre-training to post-training, but this significance did not appear in any of the other components of physical fitness.
Iven (1954) conducted a study on 2 junior high school boys. They were tested before and after on 8 weeks progressive resistance training programme. The experimental group participated in the training programme in addition to regular programme, but the control group took part only in regular scheduled physical education classes. At the end of 8 weeks it was found that the experimental group increased their ability to do pull-ups, push-ups, hard ward step test, dodge run, the burpee test and trunk extension and flexion. The controlled group improved in the push-ups, dodge run and the burpee test and trunk extension.

2.5 STUDIES ON PHYSICAL FITNESS (AGE-HEIGHT-WEIGHT)

Przeweda and Dobosz (2003) conducted a study on growth and physical fitness of polish youths in two successive decades. The aim of the study was to determine changes in somatic growth and physical fitness of polish school children aged 7 to 19 years over the last 2 decades of the 20th century, during which Poland underwent a political and socio-economic transformation. Apart from determining basic somatic variables, all children were subjected to 8 tests of the International Committee on the Standardization of Physical Fitness Tests (ICSPFT), 9 EUROFIT tests and Cooper's test. Results indicated that a clear-cut secular trend was observed for body height and mass, the former incrementing by about 2 cm per decade. Ponderal index increased which indicated a slightly excessive slimming tendency, especially in older girls. Physical fitness indices did not parallel the somatic trend, and in the last decade the results were even worse than at the beginning of the
study. This was attributed to altered life styles induced by system transformation. When somatic and fitness variables were related to fathers' education, a markedly pronounced diversification was found that lower the education, the worse were all indices studied. It was concluded that special programmes should be designed to improve health-oriented attitudes and physical fitness, especially of children from the lowest social classes, in order to arrest and, possibly, to reverse the progressing decline in physical fitness.

Suliga (2002) conducted a study on assessment of the physical development and physical fitness of children and youths with simple body height deficiency. As samples, comprised 471 individuals: 143 girls aged 5-18 years and 328 boys aged 5-19 years. A different degree of the skeleton age is connected with a different dynamic of growth of short-stature girls and boys. The level of physical working capacity of short-stature children does not show any significant difference in comparison with that in individuals with correct body height, and relative values of the indicators of physical fitness, related to body mass, are even higher in short-stature children. Individuals with a greater body height deficiency are characterized by a lower level of physical fitness.

Chatterjee et al (1993) conducted a study on physical and motor fitness level of Indian school-going boys. A cross-sectional study of physical and motor fitness measurements was undertaken on 629 healthy Indian (Bengalee) school-going boys of 9-18 years. The study brought to light the gradual increase in physical and motor fitness measurements with the advancement of age except physical fitness score. Major
increments were recorded between 13 and 15 years of age. All the fitness test scores showed significant positive correlations with age, height and weight, but dash, shuttle run and PFI showed significantly negative relationship. Indian boys of the present study were superior in sit and reach and inferior in vertical jump to the Belgian boys of comparable ages. These boys showed higher values in vertical jump than American boys after the age of 13. Dash and shuttle run test scores of Indian boys fall between 15th to 25th and 30th to 45th percentiles of American standard respectively. Besides, American boys are superior in grip strength than Indian boys. Percentile values of physical and motor fitness test scores of Indian (Bengalee) boys are, therefore, useful for determining their present fitness status and potentiality in that particular community for specific sports activity.

Fleishman (1987) was one of the very few investigators who work extensively on different aspects of physical fitness. In his studies conducted on age and physical fitness, he found linear increases in the performance of different components of physical fitness. Upto some critical age, beyond which a small additional increases occurred. For most of the test he conducted this critical age for boys were either 15 or 16 years.

Ramesh (1978) in his study on the relationship of physical fitness to selected anthropometric measurements, tested 1100 students of the first year class of bachelor of physical education of Lakshmi Bai National college of physical education, Gwalior. AAHPER youth fitness tests were administered to obtain the physical fitness of the subjects. He
concluded that height was the most valuable anthropometric measurements in prediction of physical fitness of men students and also the most valid combination of anthropometric measurements in producing physical fitness consisted of height, weight and chest girth.

Espensehade (1963) tested 1600 California school children of 10 to 18 years to determine relationship between performance, age, height and weight. In this study she found a change in performance with age was seen both in boys and girls. Pull-ups and sit-ups correlations with age were 0.31 and 1.19 respectively. Mean score of boys at each succeeding age was significantly higher than the proceeding ages 10 to 17 in dash, broad jump and throw, 10 to 13 years in sit-ups, 12 to 17 years in pull-ups. When the researcher repeated this study on different sample, she found increase in mean scores in broad jump, dash, throw and pull-ups with age up to 18 years. A detailed study into various literature shows that many attempts have been made to study physical fitness and construction of norms. However, the effect of participation in the calisthenics physical training program is found to be a less explored area and hence, the researcher chooses this topic as his research area.

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