Chapter II

REVIEW OF RELATED LITERATURE

Sincere efforts have been made by the research scholar to locate literature related to this study. The relevant studies found from various sources which the investigator has come across are enumerated below.

Sidhu et al. studied the effect of age and altitude on physical performance. The sample consists of 1080 boys ranging in age from 10 to 18 years inhabiting two different altitudes in the Himalayas namely, Bilaspur (610 metres) and Shimla (2147 metres). Anthropometric measurements which included stature, body mass and skin folds were taken using standard techniques. The physical performance was assessed by employing the AAHPER battery which includes 50 metres dash, standing broad jump, flexed arm hang, bent knee sit-up, shuttle run (4 x 10 metres), forward bend and reach and 600 metres walk/run. The differences of 1555 metres in altitude upto 2147 metres did not significantly effect the growth pattern from 10 to 18 year old males as far as height, weight and body fat was concerned. Though the Shimla boys were found to be slightly taller than their Bilaspur counter parts upto 15 years of age. After this period, the differences narrows down to the extent that at the end of this study no differences were noticeable. In body weight, this difference was more prominent in later part of the study. In the

performance of fitness tests, it was observed that altitudinal differences of 1555 metres has played a role indicating considerably better performances of Shimla population in standing broad jump, 50 metres sprint and 4 x 10 metres shuttle run. Among these tests, the performance was statistically significant at 14, 15, 17 and 18 years of age in standing broad jump and at 15 and 18 years of age 4 x 10 metres shuttle run. No significant difference was observed in 50 metres sprint. But in 600 metres walk/run tests, the Bilaspur subjects has shown considerably better performance in all age groups as compared to their counter parts who live at 2165 metres above sea level. The soci-economic difference has clearly indicated that the boys belonging to affluent families ranging from 10 to 18 years of age living at 2165 metres above sea level were significantly heavier and taller than as compared to their counter parts who live at the same altitude but belonged to non-affluent families. The boys from affluent class possess greater amount of fat also. In the performance of fitness tests it was observed that the non-affluent have shown considerably better result in the majority of the tests as compared to the affluent. It was only in 50 metres sprinting at 18 years of age that the affluent group have shown performance significantly better than non-affluent.

Singh and Jayadhas² compared physical fitness and selected physiological variables of sea coast (n= 200) and high altitude (n=60) secondary school

students living at 2050 meters above sea level in Tamilnadu. The study revealed the following results. There was no significant difference in physical fitness level as obtained from AAHPER youth fitness tests between sea coast and high altitude living secondary school students. The performance of high altitude students in standing broad jump and sit ups were significantly better than the sea coast school students. The sea coast students were found to be superior in pull ups as compared to high altitude students. Their was no significant difference between sea coast and high altitude school students in their performance in 50 yards dash, 40 yards shuttle run and 600 yards run/ walk. The high altitude students demonstrated their superiority in cardiorespiratory endurance and haemoglobin concentration as compared to sea coast students. There was no significant difference between sea coast and high altitude school students in resting pulse rate and vital capacity.

Sodhi and Singh ¹³ compared the physical growth and motor ability development of 10-14 years boys from India and Nigeria. The physical growth was measured with respect to variable height and weight. Standing broad jump and 50 metres sprint were selected to measure motor development. They found that Nigerian boys had a higher rate of growth as compared to Indian boys during the ages of 12, 13 and 14 years. The growth pattern were, by and large of similar

nature. In motor performance, Nigerian boys out performed their Indian counterparts during all the years under study. The patterns of development, however, were mostly of similar nature.

Dey et al.\textsuperscript{4} conducted a comparative study on selected anthropometric and motor quality profiles of healthy school going girls (8-14 years, n=700) of Eastern and North Eastern region of India. The study revealed that the selected anthropometric and motor quality variables have shown major increment between 10-12 years with advancement of age among both the groups. Eastern region girls were taller than the north eastern region girls but north eastern region girls were heavier than their eastern region counterparts except at the age of 13 years, where eastern region girls were found to be heavier. All the fitness scores showed positive correlation with age, height and weight but 30 metres run, agility run, and 800 metres run showed significant negative relationships. Height and weight were found to be the strong predictor of strength and anaerobic performance, where adiposity has reflected by sum of skinfolds (fat %) is the weakest predictor of running, jumping, and endurance performance. The percentile values of test scores indicated that north eastern region girls are superior to eastern region girls in weight between eight to 14 years of age, but the trend in height was just reversed. The 50th percentile value of height of eastern region girls were found to be

higher than the 75th percentile value of north eastern region girls 10-12 years of age. From the study it was concluded that the regional variation for different anthropometric and motor quality variables may be attributed to geographical variations, environmental influences, genetic factors, nutritional variation and differences in socio-economic status of eastern region and north eastern region girls.

Stefancic and Seljak carried out two years longitudinal study on growth and physical development based on the anthropometrical data of 275 children (132 boys, 143 girls) from Ljubljana, initially aged 10.5, 11.5 and 12.5 years. The measurements took place in the school years from 1991-1992 and 1992-1993. Sixteen anthropometric parameters namely, stature, ilio-spinal height, total arm length, bicromial breadth, chest breadth, bi-iliac breadth, elbow breadth, knee breadth, ankle breadth, chest circumference, upper arm circumference, calf circumference, subscapular skinfolds, triceps skin fold, calf skinfolds and body weight were measured. The two year increases of the measurements were calculated to establish the velocity of growth during adolescence. The study reveals that the growth dynamics during puberty confirms the specific earlier adolescence development of girls in comparison with boys. The girls attain the most intensive spurt of growth already between 10.5 to 12.5 years. The boys do it two years later.

between 12.5 to 14.5 years. Considering the dimensions of limb only one year delay was established. The skinfolds shows the progressive intensity of thickness in girls while some assigned trend of thinning is noticed in boys.

Sidhu and Singh ⁶ conducted a study on pre-adolescent boys with a view to find out the relationship between body measurements and physical performance tests during growth. Body measurements studied were height, extremity lengths, foot length, thigh, calf circumferences and skinfolds. Physical performance was measured through Sargent jump and 200 metres run.

The result indicated that as the child grows, the capacity to perform also improves. The means scores of Sargent jump and 200 metres time for eight year old boys were 20.4 cms and 48.8 seconds respectively. The values improved to 27 cms and 33.2 seconds respectively at the age of 13 years. The correlation coefficients between various anthropometric measurements and physical performance tests indicated that the relationship between performance and body measurements also change with age. The highest values of correlation coefficient had been obtained at the age of 12 among all the six age groups studied.

Joon ⁷ conducted a study on motor development of Indian male children

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and youth from nine to 16 years of age (N= 276). Subjects were taken from different states of India and the following tests were conducted to assess the motor development: 40 metres dash, forward bend and reach, standing broad jump, zig-zag run, eight Kgs shot put, 800 metres run and 1500 metres run. Apart from these, the height and weight were also taken. The data was statistically analyzed age wise. The result showed significant improvement in physical growth and motor development in different phases of growth and development of Indian children and youth.

Ahluwalia et al. studied the anthropometric measurements of school going rural adolescent girls aged 11 to 15 years, and it relationship with three motor performance tests namely broad jump, Sargent jump and shot put. For the purpose of this study, cross sectional observations were made on nine anthropometric measurements and three physical performance tests on 150 nonathlete Punjabi rural girls. A gradual increase in anthropometric dimensions with increasing age were seen. The total increase between 11 to 15 years is found to be 38.6% for weight, 12% for height vertex, 13% sitting height vertex, 11% for bicromial diameter, 13.5% for bi-crystal diameter, 15.15% for total arm length, and 10% for foot length. The total change over the four year period in physical

activity events is 20.5% for Sargent jump, 25.5% for standing broad jump and 89% for shot put. Thus, the maximum change over the initial value at 11 years is seen for the shot put event (89%), while the minimum change (20.5%) is seen for the Sargent jump event. In an effort to visualize the association of physical activity performance with growth pattern simple coefficient of correlation (r) between various anthropometric measurements and physical activity events at each age level have been administered. Only at the age of 14 years, anthropometric variables exhibit significant association with standing broad jump and shot put events.

David conducted a longitudinal analysis of the rate and pattern of growth, strength and motor ability measures of boys 10 to 16 years of age. The yearly velocity rate of skeletal age and most of the functional variables of 100 boys were relatively consistent up to 16 years, the structural variables showed less consistency. Most of the variables displayed a near linear growth pattern. The highest correlation between velocity rates and the experimental variables were for the structural measures. The correlation between the velocity rates and standing height and leg strength increasing from .44 at 11 years and .81 at 16 years. The relationship between the skeletal age and structural velocity rates were low but generally significant. Those between the structural and functional measures were mostly insignificant.

David, "longitudinal Analysis of the Rate and Pattern of Growth of Selected Maturity, Structural Strength and Motor Ability Measures of Boys Ten to Sixteen Years of Age." Completed Research in Health, Physical Education and Recreation, 10 (1968), 78.
Sodhi and Saini \(^{10}\) conducted a study on physical growth and performance of Punjabi males aged thirteen to sixteen years. The purpose of the study was to understand the role of maturity of physical growth in performance. A cross sectional data of 234 males of Punjab were tested on anthropometric measurements and jumping ability, both horizontal and vertical with and without approach. On the basis of these tests, the students were divided into different performance groups. They found that the body mass and height increases from 13 to 16 years of age. The different anthropometric measurements also showed a general increase. Thus, it was concluded that the maturity status of children play a dominant role in determining their performance and physical growth. The earlier maturer have been found better than late maturer.

Geraldine \(^{11}\) conducted a study on the motor performance of primary grade Negro and White six - seven and eight year old children and concluded that static balance, broad jump and vertical jump improved significantly from six to eight years. Flexibility means decreased with age but age differences were not significant. Sex comparisons showed that boys were consistently superior in jumps and girls were superior in static balance and flexibility, but few of the differences

\(^{10}\) H.S. Sodhi and Kulwant Saini, "Physical Growth and Performance of Punjabi Males Aged Thirteen to Sixteen Years." *SNIPES Journal*, 7 (December 1984), 11.

\(^{11}\) Lauro Geraldine, "Motor Performance of Primary Grade Children." *Completed Research in Health, Physical Education and Recreation*, 10 (1968), 15.
were significant. Racial comparisons indicated that Negro children were significantly better in jump and reach and three of the six broad jumping groups.

Drowtzkey and Madary \(^{12}\) evaluated the physical and motor fitness of 3,400 boys and girls in grade four through twelve, and also the effectiveness of the current physical education programme in the development of fitness. The results showed a marked decline in the girls fitness scores means through the junior and senior high school grades. The results further disclosed that the fitness levels of children who participated in physical activities outside the regular physical education classes were found more fit than those who did not participate in such activities. Tenth grade boys and girls demonstrated higher levels of motor fitness than 11th and 12th grades, who were exempted from physical education.

Rajni et al \(^{13}\) carried out study on the development of motor abilities of trained \((n=75)\) and untrained \((n=75)\) girls aged 10-14 years. The results revealed that there were significant difference in body height and body weight between trained and untrained girls of 10-14 years. The pattern of development of height and weight indicated an earlier growth spurt in case of untrained girls. Significant


differences were also observed in the average performance in motor ability tests, the trained subjects showed higher value than their untrained counterparts. ANOVA and results of post hoc tests showed significant differences in body height, weight, leg strength, situps, arm strength and 40 meter dash among the various age groups of trained subjects. However, in untrained girls significant age group differences were found only in body height, weight and arm strength.

Sohi 14 conducted a study on development of speed and agility among six to 14 years boys and girls. The improvement in performance was observed with respect to year by year increase, inter sex differences in performances, overlapping of performances by age and sex and leveling off the performance. To observe these conditions, two motor task, one each for speed and agility were selected. A cross-sectional population of 499 boys and 470 girls were subjected to test on the motor tasks. The analysis of data revealed that the boys showed linear improvement on the motor tasks. The girls improved interruptedly in sprinting and linearly in agility. The boys were superior to girls in agility. The boys also outperformed the girls in sprinting except during the age of eight years. The girls levelled off in their performance earlier. The overlapping of performances on these motor tasks were observed by age and sex of the performers.

Santammaria\textsuperscript{15} made a longitudinal analysis of maturity and physical growth of boys ages 12 through 17 years. The subjects were tested for maturity, body linearity, body bulk and indexes reflecting body proportions. Analysis employed were inter-age correlations among all the ages of each variable: means, standard deviations, and coefficient of variations, construction of mean velocity curves, differences in growth patterns, high and low maturity growth strengths, weight and height groups. Except for lung capacity between 0.64 and 0.94 within the highest correlations between adjacent ages and the lowest when five year intervened. As the boys advanced in age, their mean in all measures, but the indexes increased gradually, standard deviations also increase with age. Differences between high and low maturity groups, gross strength groups and height groups found at twelve years of age maintained significant mean differences on the other tests for the six years of the study.

Clyde\textsuperscript{16} made a study to determine the selected differences occur in Neuro-muscular power in boys and girls ranging between five through seventeen years. He concluded that boys and girls follow a parallel progression in power performance with girls only slightly below the boys until the early teenage years.

\textsuperscript{15} D. Line Santammria, "Longitudinal Analysis of Maturity and Physical Growth of Boys Ages 12 through 17 Years." \textit{Completed Research in Health, Physical Education and Recreation}, 12 (1970), 177.

At thirteen years of age, the females tends to level of in power development, while the females continue to advance through age seventeen.

Sodhi and Chopra \(^{17}\) conducted a study on the menarcheal maturity and physical performance of 12 to 18 years girls of Punjab (\(N = 236\)). Each girl was examined for body weight, stature, standing broad jump, standing vertical jump, dynamic flexibility, flexed arm hang, sit ups, shuttle run, sitting basketball throw, 50 m. dash, and 600 m. run. The menarcheal age was determined on the basis of memory recall method and accordingly seven age groups were formed. On the basis of the menarcheal maturity in each age group, the data was sub-divided into two. The results indicated that the early maturing girls perform better in most of the performance tests up to fourteen years. However, at 17 and 18 years, the difference between the performance of early and late maturing girls were considerably reduced.

Milne \(^{18}\) conducted a longitudinal study of 110 children belonging to five through eleven years and the data expressed in cross sectional of performance changes in motor items. The test items were 30 yard dash, flexed arm hang, sit and reach, jump and reach, agility shuttle run, standing long jump, and 400 feet

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shuttle run. Longitudinal performance curves, based upon the mean score for each age group were plotted for each motor performance items semi-annually from five to eleven years. Motor performance scores generally indicated an improvement with successive years for both sexes in all items with the exception of sit and reach.

Ikeda \(^9\) took the Iowa Motor fitness test in order to compare the physical fitness of children from Iowa and Tokyo. The results indicated that Tokyo children scored better in all motor performance tests except in sit ups. He also stated that Tokyo children had more chances for activity through physical education classes than the Iowa children.

Using the AAHPER Youth Fitness test, Toddonico \(^20\) studied physical fitness of public school students from economically backward area with national norms. He compared the physical fitness of public school students from high poverty and low poverty areas. He found that there was no significant difference in the physical fitness of boys or girls from the economically deprived areas and boys and girls represented by the 1975 national norms. No significant difference was found in physical fitness of subjects from high poverty and low poverty areas.


Sharma et al. investigated the growth pattern of adolescence girls belonging to Punjabi population with reference to their socio-economic status. For the purpose of the study 13 anthropometric measurements and three derived measurements in the adolescent Punjabi girls were investigated. The data were based on a sample of 223 girls ranging in age from 10 to 16 years from Government and Public schools of Chandigarh. The study revealed that the Public school girls (high SES) were superior in body size traits than their counterparts from Government school (low SES). The growth pattern remains more or less similar in both the groups but the differences lay in magnitude and age peak velocity was observed between 12 to 13 years in high SES girls and between 13 to 14 in low SES girls for weight, stature and chest circumference. However there was no uniform pattern in their circumferential and skin fold traits. As compared to American and British girls the public school girls of the present study were shorter and lighter.

Minucci and Shows determined possible age and race differences between black and Caucasian girls aged six, seven and eight years (N= 90). Twenty eight test items measuring speed, muscular power, agility, flexibility,


balance, muscular endurance, and cardio-respiratory endurance were administered.

Few significant differences were observed between adjacent ages but eight years old females were significantly superior to six year old subjects on most of the motor performance variables utilized. The Black subjects were significantly superior in two measures of agility, while Caucasian subjects performed significantly better in the time limit shuttle run and grip strength.

Mathew conducted a study on 3000 boys from three distinct ethnic groups found in Uttar Pradesh and Bihar ranging from 12 to 16 years. The subjects were tested to determine their standing height, sitting height, weight, upper arm length, chest girth, thigh girth and calf girth, and motor fitness was measured by AAHPER Youth Fitness test. To determine the difference between the means of different ethnic groups, two way analysis of variance was applied and to find out the correlation between the motor fitness and selected growth variables, coefficient correlation was employed. Significant differences obtained for upper arm girth, calf girth, chest girth and weight, and not significant in standing height, thigh girth, and sitting height. No relationship was found between any growth determine variables and the motor fitness.

Piscopo\textsuperscript{24} analyzed the skinfolds and other anthropometric measurements of preadolescent boys from three ethnic groups. The purpose of the study was to establish percentile norms and to compare skinfolds and other anthropometric measurements of 647 Italian, Jewish and Negro preadolescent boys from Boston, Massachusetts area. Skinfolds were measured at five sites. Other measurements include height, weight, bi-iliac diameter, and selected girths. Correlations were determined between skinfolds and selected body build components. Inter skinfolds correlation’s ranged from moderate to high values. The largest percentile scores were found within the Jewish group. Significant difference were found relative to certain skinfolds and weight between ethnic groups at percent one level.

Nemour \textsuperscript{25} did a comparative study of anthropometric measurements of Caucasian and Negro Boys and girls and also their performance in standing broad jump, medicine ball put and zig-zag run (N= 900). The subjects were of different age groups of six to ten years. The anthropometric measurements were standing height, sitting height, weight, arm length, forearm length, hand length, upper leg length, lower leg length, and total leg length. He found that at the age of six to eight and ten years, boys differed from girls in most of the anthropometric

\textsuperscript{24} John Piscopo, old and Other Anthropometrical Measurements of Preadolescent Boys from Three Ethnic Groups." \textit{Research Quarterly}, 33 (May, 1962), 255.

measurements. However, there were no differences in standing height, and leg length. Negro girls and boys had longer appendages and were taller than Caucasians. Negro boys and girls were not found superior in power and agility.

Barbanti carried out a comparative study of selected anthropometric and physical fitness measurements of Brazilian and American School Children (N=2342). Physical fitness battery consisting of 50 metres dash, nine minutes run, 12 minutes run, standing broad jump, sit and reach test and modified sit ups were administered to the subjects of the both the countries. The results revealed that American boys and girls, in general, were taller and heavier and their scores in 50 metres dash, standing broad jump, sit and reach, and modified sit ups tests were higher than their Brazilian counterparts. On the other hand, Brazilian children scored higher in nine minutes run test.

investigated ethnic differences in body structure and physical fitness in Surinamese boys aged 14 years belonging to diverse ethnic/racial groups (n=270) belonging to Negroids, Indonesians and India-Pakistani origin. The subjects were tested on health related and performance related fitness using


Eurofit test battery. Results showed a significant difference between ethnic groups for somatic developments and some factors of performance; and health related fitness. Indonesians were smaller in height and do have a shorter legs and shorter arms as compared to the two other groups. The India-Pakistani boys were fatter than two other groups. India-Pakistani boys were smaller in bone breadth measurements. The Negroid boys tend to have relatively longer extremities for a given stature and are smaller in bi-iliocristal breadth as compared to the two other groups. Indonesians boys obtained better results on limb eye coordination and flexibility tests than the Negroid boys. The Indonesian were better for explosive power and total body balance as compared to India-Pakistani boys. Racial differences can be explained by somatic developments, maturation level, genetic and environmental factors.

Kurimoto \(^2^8\) conducted a study in which the same boys were measured annually from 15 through 17 years of age. Skeletal age and strength increased more than structural measures when mean growth gains were expressed in standard deviation units. Mean mesomorphy increased significantly from 4.05 to 4.65 and mean ectomorph decreased significantly from 3.71 to 3.18. The standard deviation at a give age often appeared large. Inter age correlations tended to be

\(^2^8\) Etsuo Kurimoto, "longitudinal Analysis of Maturity, Structural Strength and Motor development of Boys Fifteen through Eighteen Years of Age." *Completed Research in Health, Physical Education and Recreation*, 6 (1964), 80.
high: 0.90 to 0.96 for skeletal age, above 0.80 for structural measures and somatotype components, and slightly lower for strength and motor tests. The advanced maturity group at age 15 maintained their superiority in weight, lung capacity and leg lift strength through seventeen.

Smaoll 29 collected data from the grades of four to eleven levels from 24 boys and 24 girls participating in a longitudinal growth study. Static strength measures of the ankle extensor, hip flexor and extensor, and knee extensor were measured with a cable tensio meter. Motor performance was represented by standing broad jump and 30 yards dash. The analysis primarily depended on zero order and multiple correlations, where poor predictors of performance within the age and sex groups. The aggregate lower limb strength had a moderate positive relation with performance. Performance in the standing broad jump during adolescence can be predicted more accurately than in the 30 yards dash on the basis of growth strength and performance taken during middle childhood.

Nelson 30 conducted a study to determine the physical fitness as a function of gender, if so, could these gender differences be explained by age and body size characteristics. The sample consisted of 12,362 boys and girls, aged six through


seventeen from throughout United States. the performance of boys were superior to girls by age. The performance of boys were superior to girls in one mile run and sit up tests, while the girls out-performed boys in sit and reach test. For all three tests, an age by gender performance interaction existed which demonstrated that the cross sectional performance curves for boys and girls were not parallel over the ages studied. Boys continue to improve through seventeen, while girls levelled off and decreased in performance after the age of fifteen.

Khanna and Bhatnagar \(^{31}\) investigated the health and fitness level of the children by monitoring the normal growth and development. The study was conducted on 313 boys of age ranging from 8 to 18 years with an aim to study the growth and developmental aspects of physiological responses during the ergometry in Indian boys. The subjects were given a graded protocol of exercise till maximum exhaustion. Oxygen consumption, carbon dioxide production, ventilation, heart rate, oxygen pulse and breathing equivalent were recorded after every thirty seconds in a computerized ergoneumo test. The \(O_2\) debt was calculated from sum of recovery oxygen consumption. Results revealed that the \(VO_2\) max increases from 0.9 L/min to 2.7 L/min (three fold) within a span of 10 years where as relative \(VO_2\) max does not change. \(VE\) max increases with an average of 5 L/min

per year. Maximum heart rate ranges from 201 bpm at 10 years to 185 bpm at 18 years of age. Mean $O_2$ pulse in 8 years of age group is 4.5 ml/beat it increases to 14.98 ml/beat of the age of 18 years. However, in relation to the body weight $O_2$ pulse does not reveal any significant change. Breathing equivalent ranges from 42.5 l/l of $O_2$ at 11 years to 31.38 l/l of $O_2$ at 18 years of age. $O_2$ debt increases at a slower rate till the age of 12 years, thereafter it increases till the age of 16 years. Maximum work load tolerance increases at the rate of 14 Watts/year. The present finding were compared with the international counter parts. It was concluded that Indian children has less functional abilities and rate of development as compared to the International counterparts.

Verma et al.\textsuperscript{32} investigated the reliability and reproducibility of maximum $O_2$ uptake measurements in young Punjabi boys of 10 to 13 years of age. The maximum aerobic capacity of 132 subjects were measured on bicycle ergometer for determining the reliability and reproducibility of maximum $O_2$ uptake measurements in preadolescent children. The tests was repeated in 48 school children within three to four weeks of conducting the first test. The mean value of $V_O_2 \text{ max.}$ in these boys were found to be 43.7 ml/kg/min. which is lower than the reported value for contemporary male children in the west. No significant

differences were observed when the mean values of VO$_2$ max. were compared from one age group to another. The results of the repeated measurements of VO$_2$ max. were grouped on the basis of presence or absence of plateau in O$_2$ uptake during the last work loads. There were insignificant differences in the mean value of VO$_2$ max. at test -1 and test -2, for any of the measurements made. Therefore, the test was considered to be highly reproducible. However the reliability of the tests was found to be depended upon the attainment or non attainment of plateau at maximum work load. The relationship between the two VO$_2$ max. measurements were found to be quite higher ($r=0.95$) in case of the children who demonstrated plateau in O$_2$ uptake at the maximum load as compared to the value of $r=0.72$ observed in the group of children who failed to attain plateau. The results of this study also indicates that with increase in age the percentage of children who demonstrated plateau in VO$_2$ max. also increased from 33% at 10 years to 42% at 13 years.

Atomi et al $^{33}$ investigated the physical activity level in nine to 10 year old boys (n=11), with reference to aerobic power or lactate threshold (LT). Daily physical activity levels were evaluated from HR monitoring system for 12 hours on three different days. VO$_2$ max., VO$_2$-HR relationship and LT were determined

by progressive treadmill tests. LT was 36.7 ± 3.1 ml. kg⁻¹ . min⁻¹ and 71.0 ± 6.6% \( \text{VO}_2 \text{ max.} \) Mean total time of activity with heart rate above the level corresponding to 60% \( \text{VO}_2 \text{ max.} \) (T-60%) and that above LT (T-LT) were 34.0± 7 and 18 ± 7 min, respectively. \( \text{VO}_2 \text{ max.} \) (ml. kg⁻¹ . min⁻¹) correlated significantly with T- 60% (P<0.01), while no significant relationship was found with LT in ml. kg⁻¹ . min⁻¹. In conclusion, longer daily physical activities at moderate to higher intensity for preadolescence children seem to increase \( \text{VO}_2 \text{ max.} \) rather than LT.