CHAPTER V
SUMMARY AND CONCLUSION
In the foregoing chapters, physical growth pattern, nutritional status, physiological variables, physical fitness variables and body composition of JNV and KV boys have been dealt in detail. In the present chapter, an attempt has been made to focus and enlighten the salient features observed in the present study.

Optimal health and a high level of physical fitness have long been recognized as the key to future of any human population and human resource development. Appropriate education, nutrition, health care and stimulation during childhood are elements that encourage desirable morphologic, functional, metabolic and nutritional development of children. Specifically a proper diet and an adequate level of physical activity for all individual are essential factor for achievement of this aim.

The standard of living and nutritional status of a population may be measured in terms of infant and child growth, which is not only a direct evaluation of the health and nutritional status of children but it is also indirect measure of quality of life of entire society to which children belong (UN, 1985; Tanner, 1986). One in every two or three child suffers from some degree of growth failure (UNICEF, 1991; NFHS–2, 2000) and it is highly prevalent among several socially divergent communities. Health and physical education programs aid children in achieving their maximum potential through the acquisition of knowledge and skill necessary to attain healthy levels of well-being and to maintain active life styles through out their life span, thereby also helps to increase capacity for effective work, positive behavioral choices and increased academic success. Researchers have not paid much attention to study the growth and nutritional status of the school going boys belonging to two different geographical areas (rural / urban) and different socio-economic and ethnic groups particularly in nascent Chhattisgarh state.

Keeping this in mind, a cross sectional study was under taken to investigate and compare physical growth, physiological component, physical fitness
and health status of JNV and KV boys of 10+ to 18+ years. The specific aims and objectives were:

1. To assess the patterns of growth in terms of magnitude for various measurements.
2. To study somatotype changes with advancement of age.
3. To study fitness status of the Jawahar Navodaya Vidyalaya and Kendriya Vidyalaya boys.
4. To assess various physiological components among boys of Jawahar Navodaya Vidyalaya and Kendriya Vidyalaya.
5. To compare the patterns of growth, somatotype, fitness status and various physiological components between Jawahar Navodaya and Kendriya Vidyalaya boys and to assess the pattern of growth, in terms of magnitude, for various measurements.
6. To study the relationship of anthropometric parameter with different physical fitness component.
7. To compare the various groups under study among each other and adjoining population groups.

The targeted schools were intentionally selected to understand the variation and differences in the selected objectives in two different situations. The JNV boys under study residing in the hostel of schools belonged to various geographically scattered locations / villages of Chhattisgarh, which can be taken as fairly representatives of rural areas of Chhattisgarh. They mostly belong to the most vulnerable segment of the under privileged communities i.e. ST, SC, and OBC. The KV boys under study residing at home belonged to urban area and were predominantly representatives of general caste group. These comparative study offer insight in to issues of geographic variations (rural and urban), socio-
economic variations, ethnic variations and life style variation on growth, nutritional, physiological and physical fitness status of JNV and KV boys.

The sample of the present study was collected from 08 JNV and 08 KV schools of various districts of the nascent Chhattisgarh state, India. The sample consists of 900 boys (450 of JNV and 450 of KV), aged 10 to 18 years. The investigator collected all the measurements and other information.

Anthropometric measurements of JNV and KV boys were taken as per the IBP recommendation (Weiner and Lourie, 1981), Singh and Bhasin, (1968) and Singh & Malhotra, (1989). Motor Ability parameters were measured by means of standard tests (Baumgartner & Jackson, 1995) to assess the level of different motor qualities. On each boy 05 physiological variables were measured as per Goyal and Patel, (2005). Body fat % was calculated from skinfold thickness (Katch and McArdle, 1973), which was taken from the two different sites (triceps, biceps and subscapular) of the body with GMP skinfold caliper. Somatotype was calculated by the formula of Heath and Carter, (1990).

Diet survey was conducted by step method as suggested by Rao et al, (1986). Quantitative dietary assessment was made by weightment of raw food items and simultaneously cooked food in order to estimate the individual daily intake of food. Food intake for three consecutive days from each subject was recorded. The average dietary intake of food per item was calculated and was compared with the RDA (Recommended Dietary Allowances) of India using the values as per "Nutritive Value of Indian Food" (Gopalan et al, 2002). The malnutrition was assessed through 'weight for age' (Jelliffe, 1966; Gomej et al, 1955), 'height for age' index (Waterlow, 1972), 'body mass index' (Ferro-Luzzi et al, 1992); 'Pelidisi's index' and 'Ponderal index'. The NCHS (Frisancho, 1990) and ICMR, (1972) growth standards were used as reference. Clinical signs of nutritional deficiency survey were conducted on each boy as recommended by Jelliffe, (1966) as well as World Health Organization (WHO, 1995).
Assessment of exact age is very much important in growth and nutritional study. Ages of boys were recorded from school registers and cross checked from the subject himself, from the teachers and as far as possible from the guardian of the boys. The age was recorded in complete years. For analysis of the data the age grouping was done according to the age at the last birthday. All the boys who had completed 10 years but less than 11 years were grouped as 10+ years and likewise age group was calculated.

After the collection of data it was subjected to editing and coding in MS Excel. The data was analyzed by using descriptive analysis and comparative statistics. The data was further analyzed to develop percentile ranking. Correlation coefficient was also computed for both JNV & NV boys separately to find out the relationship between the anthropometric, physiological and motor quality variables.

All statistical analysis was performed employing a system of computer programs known as the Statistical Package for the Social Science (SPSS) (Nie et al, 1975).

The results of the present study revealed following few facts:

The results of the present study revealed that most of the anthropometric measurements exhibit increase with the advancement of age in both the groups. Comparative statistics revealed that the KV boys had higher values in most of the anthropometric measurements than JNV boys. JNV boys were shorter at all ages and experienced growth spurt later than KV boys. No consistent group differences in mean stature, weight, skeletal breadths, extremity, circumferences and skinfold thickness were found.

50th percentile of stature and body weight of JNV and KV boys was compared with the 50th percentile of ICMR and NCHS data. ICMR boys are shorter and lighter than the boys of present study at all ages. NCHS boys were always
heavier and taller than the boys of present study. The distance between NCHS
and present study is always remarkably high. The significant difference in stature
and weight between KV and JNV boys and with NCHS data may be attributed to
genetic and environmental factors.

Rates of growth of anthropometric variables observed in the present study
are highest during the adolescent period. It was observed that most of the variables
showed adolescent growth spurt, as indicated by the 'HPV' between 13+ to 16+
years age in JNV boys and between 12+ to 13+ years of age in KV boys for
various anthropometric measurements.

Growth of the human body from birth to adulthood does not proceed as
simple enlargement of the body tissue, organs and parts. It is obvious that body
proportions change considerably from the newborn to the grown-up male or female.
If we take the size of individual body parts of a child at the age of 10 years as a
starting point (zero) and the same body parts at the age of 18 years as final (100
percent), for the present study, we get different rates of growth and growth gradients
of individual body measurements at each chosen age.

It is apparent from the value of growth gradients of different anthropometric
variables that more than 70% of total growth completed by 10+ years for all the
anthropometric variables except body weight in both the groups. Further, of all the
anthropometric variables under study, the maximum of total growth took place in
the skinfold measurement during the period under study.

The maturational sequences for stature and its components, i.e. sitting
height and length of lower extremity indicated cephalo-caudal direction. The pattern
remains unaltered at all ages in JNV boys except at 12+ years. In KV boys the
pattern remains altered till 12+ years, after which the length of lower extremity out
grows sitting height, thus reversing the gradient to a caudo-cephalic direction
between 13+ to 16+ years. The maturational sequence is reverted back to cephalo-
caudal direction at age 17+ years by achieving 99.1% growth in sitting height in contrast to 99.04% growth attained by length of lower extremity. The stature was ahead of reaching at maturity earlier than the sitting height and length of lower extremity.

The body of the growing child and youth changes its proportions year by year. Length, widths, circumferences of the body and its parts and body weight set out for their individual journeys from 10+ years of age towards their goal in early adulthood at the age of 20. They proceed at different speeds reflecting the changing morphology and individuality of the child in the course of its pre-school and school years, and throughout its teens until each of them reaches its 100 percent final size at the age of 20 where they all meet (Marshall, 1977).

The body proportionality of the human being which has been reached at the age of 20 years developed hundreds of thousands of years and may be considered as stabilized, as a final product of human evolution and any stage preceding it may be thus viewed as immature, unfinished, as a state of transition. Naturally, some individuals may reach the mature stage earlier than at 20 years, say already at the age of 16 in females and 18 in males. It is obvious that further changes in the human body take place after the age of 20 years, but they need not be considered here as important. On the other hand the body proportions of a physiologically normal newborn are the product of its prenatal development "in utero" and must be taken as granted.

Somatotype components showed significant differences in endomorphy at all ages, except 16+ and 18+ years, and only minor differences in mesomorphy at 10+ years and in ectomorphy at 11+ years of age.

It is really illuminating to follow the wandering pattern of the mean changes in somatotype with age. In JNV and KV boys, the mean somatotypes in childhood period could be found in the balance ectomorph and mesomorphic ectomorph
field. In KV and JNV boys, mean somatotypes shifted with age through the central field to the mesomorph endomorph and mesomorph ectomorph respectively at 12+ years. At 13+ years boys of both the groups shifted to balance ectomorph. JNV boys remain to continue in the field of balance ectomorph at 14+ and 15+ years and then shifted to endomorphic ectomorph while in KV boys these mean moved through the endomorphic ectomorph (14+ and 16+ years) to balance ectomorph.

The present study provides convincing evidence that somatotype analysis results in adequate information about changes in physique from early childhood to adolescence. Changes in body proportions and body composition during puberty are mirrored in somatotypes.

Somatotype distribution showed that 22.44% KV boys belonged to endomorphic ectomorph, followed by 20.22% to balanced ectomorph. Rest of the boys were distributed to other categories in all the age groups, similarly in JNV boys 22.22% belonged to balanced ectomorph, 18.44% to endomorphic ectomorph and rest to other categories.

There is no gradual change in the entire three-somatotype component in both the groups according to age. However, significant difference was observed in endomorphy component between JNV and KV boys, KV boys having significantly higher endomorphic score in most of the age groups except at 16+ and at 18+ years, and in the age group 17+ years where the endomorphic values were higher for JNV boys. In case of mesomorphic component it was found to be similar between JNV and KV boys. Similar results were reported by Dey et al, (1997) for girls of Eastern and North eastern region of India. Various factor like early maturation in height and weight, climatic conditions are responsible for difference in somatotype component between the different groups (Beunan, 1986; Tanner, 1977). Danby, (1953) described the physique of east Africans as low in endomorph, but moderately
high in Mesomorphy and variable in Ectomorphy. Roberts and Bainbridge, (1963) in a study of Nilotic body build noted physique low in endomorphy and mesomorphy but extremity high in ectomorphy.

Body composition analysis revealed that the fat percentage did not show increasing trend with increase of age. The comparative statistics demonstrated significant difference between the two groups. KV boys showed higher values in most of the age groups. Lower % of fat in JNV boys may be due to their regular diet pattern and exercise program in school whereas KV boys were day scholars and coming from their home. Their diet pattern was not very regular and they were also not involved in regular physical education program. Physiological variables showed maturation with increase in age. Cardio respiratory system is very important as each cell of the body works in the presence of $O_2$ which is transported to it by means of blood circulation and $O_2$ is continuously required for energy and metabolism. Thus heart rate, respiratory rate, peak flow rate and blood pressure are important means to assess the function of cardio respiratory system. The heart rate and respiratory rate ranges of the present study are comparable to UK derived reference ranges ((Wallis et al, 2005) and (Wallis and Maconochie, 2006). Peak flow rate increased with increment of age. Velocity curve of peak flow rate exhibited peak velocity at the age 13+ years for both JNV and KV boys, and next growth spurt was observed at 15+ years for JNV boys and at 16+ years in KV boys. The mean score of systolic blood pressure ranged between 102.46 and 115.86 mmHg in JNV boys of 10+ to 18+ years and between 104.30 and 114.18 mmHg between for KV boys of same age group. From the distribution of mean for diastolic blood pressure it is evident that with increment of age there was increase in this parameter among the two groups.

The performance in standing broad jump increased with increase in age in both the groups. The test for explosive strength and standing broad jump
exhibited significantly higher scores for JNV boys at 13+, 14+, 15+, 17+ & 18+ years. The performance in vertical jump increased with increase in age in both the groups. Performance of JNV children was significantly higher in all the age groups except at 18+ years. The scores of pull-up (modified) test for shoulder strength showed significant difference between the two groups JNV children scores were high as compared to KV boys. The bend knee sit-up test for abdominal strength showed the similar result. The JNV boys scored significantly higher values than KV boys. Flexibility did not show increasing trend according to the age but performance on this test was maximum at 13+ years in both the age groups. Physical fitness variables exhibited maximum spurt between 11+ to 13+ years of age in JNV boys and between 10+ to 17+ years of age in KV boys.

The present study revealed that there was increase in performance of all the motor components according to age in both the groups. The interesting result is that there is significant difference between JNV boys and KV boys in all the motor components at all ages. JNV boys being at higher side for all motor components, whereas in case of anthropometric measurements the KV boys exceeded the JNV boys. This might be due to the fact that the JNV boys followed a set routine life style in the residential schools that included proper regular diet, and regular exercise programme. Correlation statistics showed positive relationship between various physical fitness variables and anthropometric measurements as well as body composition variables.

Nutritional aspect of JNV and KV boys were evaluated by dietary survey (Rao et al, 1986). Nutritional anthropometric and clinical signs for malnutrition survey were also done according to Jelliffe, (1966) and W.H.O., (1995) to evaluate their nutritional and health status. Results indicate that the KV boys consumed more amount of energy as compare to JNV boys. The intake of various nutrients was also more in case of KV boys. When compared to RDA (Gopalan(ICMR),
2004), it was lesser for most of the nutrients in both the groups. By the close examination of the results of dietary survey it is evident that average nutrient intake in JNV boys was much below the KV boys. The diet of both the groups was rich in protein. Boys were always in very high positive protein balance in both the groups. Protein intake requirements remained high for all ages in both the groups, and always remain above 100% of requirements. However, boys at any age did not achieve positive energy balance in both the groups, but adolescent boys were more in negative energy balance than others.

The energy protein imbalance suggest that diet of both the groups composed overwhelming of various types of pulses, milk and egg intake that are rich in protein while rice is the main source of energy. Several questions arise from the patterns of energy–protein balance. It is possible that protein was being used as a source of energy during some ages. Thus there is a need to raise energy intake by providing energy rich food.

The better level of nutrition status among the KV boys as evaluated by the BMI, is corroborated by their higher socio-economic status. Norgan, (1994) suggested that BMI is correlated with sitting height. The findings of present study supported this view.

According to Ferro - Luzzi et al, (1992), BMI alone is sufficient to define CED in adults. A cutoff point for BMI of 18.5 has been taken for most cases in the literature (Bailey and Ferro – Luzzi, 1995; Ferro- Luzzi et al, 1992; Shetty and James, 1994). In fact it has become standard practice to take 18.5 as the cutoff point. Shetty and James, (1994) are of the opinion that a BMI above 18.5 is compatible with good health among male soldiers and women in the United Kingdom and in individuals belonging to the high socio-economic class in developing countries. In another report Shetty, (1984) mentioned that male Indian laborers with BMI less than 17 are physically fit according to standard texts, although
their physical capacity is not known. Thus, in view of their findings, it can be said that apparently healthy individuals with CED grade I in the present study may be thin but physically active and healthy. However, further intensive investigation in these population is called for, because BMI, as a measures of CED, should be analyzed along with other aspects, such as morbidly and health status of a population.

Thus it appears from the nutritional anthropometry analysis that CED is a major public health problem especially in boys of JNV. Undernutrition in the form of underweight, stunting and wasting and low consumption of dietary intake(energy and protein) was found to be widely prevalent among Kamar tribal children of Chhattisgarh (Mitra et al, 2007). The result indicates towards such socio-economic and micro environmental factors as poverty, poor socio-economic status of parents, and poor environmental sanitation due to low literacy of parents etc. as probable contributors towards poor nutritional status. The patterns of CED observed in the children are primarily of mild to moderate intensity in JNV & KV boys. However, the rate of malnutrition is significantly lower in KV boys than JNV boys. In fact, there is no simple univariate explanation as to what account for quite high prevalence of mild to moderate CED in the study sample. It is not socio-economic factor or illness or parental behaviour alone, rather it is a complex mixed of factors that probably varies in exact composition from child to child. Some differences in dietary quality & quantity are a logical expectation in a situation characterized by differences in rates of malnutrition in boys of these two groups. Thus it is necessary to make them aware and educate the population to adopt the easy methods to improve their dietary quality & quantity. The factors responsible for the same to be identified & proper interventions strategy to be evolved in the future.

Coefficient of correlation between selected anthropometric variables of JNV & KV boys revealed that stature, weight and fat% showed significant positive correlation with the entire motor component under study except sit & reach test
for flexibility. Mesomorphic component exhibited negative correlation with standing broad jump & bend knee sit-ups for both JNV and KV boys. The results indicated that stature, weight & fat% have significant influence on the performance of most of the motor component. In the present study normative growth charts for various variables were plotted by calculating seven percentile values for each anthropometric variables under study to represent the standards or norms of the population under study. Percentiles are used as indicators of growth standard of child against the standard of that particulars population (Stuart and Sternson 1963, Illingworth and Lutz, 1965, Tanner et al 1966a, 1966b). In the present study, as is used 5th, 10th, 25th, 50th, 75th and 95th percentile values have been calculated and plotted against age.

Ages at which the curves of individual measurements are most wide apart in their paths may indicate a period of unbalanced, unconsolidated, disproportionate state of the body which may be associated with greater demand on energy regulating body integrity and thus resulting in an increased health risk. It may be useful to know at which age this time period comes in a child population as a whole or in an individual. The first decade of life is a period at which the quickly developed head (and brain) governs the yet much less developed body parts, which may be an advantage in learning.

From the results of the present study it can be concluded that the difference in stature, weight and fat is due to geographical variation, genetic factor, nutritional, rural-urban and socioeconomic status. The majorities of JNV boys belonged to rural area and most of them were SC, ST, and OBC and belonged to poor families, whereas the KV boys belonged to urban area and from higher socioeconomic group. The interesting finding is the differences between the entire motor fitness variable, which were significantly higher in JNV boys in spite of lower value in stature, weight and body fat%. Factors contributing to it may reflect regular routine, diet and exercise, cultural habits, life style, physical activities and other variables,
which helped these children to excel in motor fitness variables. This clearly indicated that genetically equipped children also need proper environment to excel in physical fitness. These issues, and undoubtedly others, need further exploration. Result of present investigation may have implications for the policies aimed at implementation for reducing the health risk of population under study.

Implementation of the Result:

- The result of the present study may help in understanding growth pattern of children of Chhattisgarh of 10+ to 18+ years of age and this knowledge will help educational planners to take care of growth and development of school going children.

- The result of the present study will help the educational administrator to understand difference in growth pattern of children belonging to different population, and socio-economic and environmental factors responsible for the same.

- Various physiological factors are vital in the maturation process the result of the present study will give insight in understanding functional development of children.

- The result of the present study provides detailed information about adequacy and inadequacy of various nutrients which will help the parents and school administrator to plan balanced diet for children.

- Information regarding performance of motor fitness variables and the differences in the performance of the two groups under study will help physical education professionals to understand the factors responsible, and to plan physical education program accordingly.

- The result of the present will highlight the effectiveness of present nutritional and physical education programs of schools.
• Similar study of this nature can be conducted for children of other schools regions and population and can be compared with result of the present study.

• The most important aspect of the study is it enlightens the fact that proper nutrition and physical education program is vital for growth and development and to be healthy and fit.
Plate 5.3: Biarcromial diameter

Plate 5.4: Billiocristal diameter
Plate 5.7: Peak Flow Rate

Plate 5.8: Blood pressure
Plate 5.9: Co-curricular activities of JNV
Plate 5.9: Co-curricular activities of JNV