SUMMARY AND CONCLUSION
SUMMARY

A cross-sectional study to study anthropometric measurements and pubertal changes was carried out on 1100 apparently healthy children (6-16 years) belonging to affluent class of Ludhiana.

(A) The anthropometric measurements, utilizing standard equipment and technique, taken on each case were:

1. Weight
2. Standing height
3. Sitting height
4. Head circumference
5. Chest circumference
6. Mid arm circumference
7. Triceps skinfold
8. Subscapular skinfold
9. Suprailiac skinfold
10. Total upper extremity length
11. Upper arm length
12. Forearm length
13. Hand length
14. Total lower extremity length
15. Thigh length
16. Leg length
17. Foot length

Mean and standard deviations for all the anthropometric measurements have been calculated for each age group separately for boys and girls.

1. Weight and Height

(a) In the present study the mean values for height and weight were comparable with the 50th percentile values of NHIS and British standards while the values of the present study were higher than the mean values of ICMR (1972). This secular trend highlights the presence of remediable environmental factors like intake of food, dietary habits and customs, health education, general standard of living and possibly other unidentified factors.

(b) Girls showed a pubertal growth spurt at the mean age of 9 years till 13 years and boys from 11 to 16 years.
2. Upper and Lower Extremities and their Segments

(a) All the segments of body like height and weight also show a pubertal growth spurt. In girls the spurt starts at the mean age of 9 years and in boys at the age of 10 years. The upper and lower limbs in female are more in length than the boys from age group 9-13 years and after 13 years the boys take over till the age of 16 years.

(b) Various indices have also been calculated like:

1. Total upper extremity length : Crown heel length index
2. Total lower extremity length : Crown heel length index
3. Brachial index
4. Crural index
5. Hand length : Forearm length
6. Foot length : Leg length index
7. Intermembral index

All these indices change between a very narrow range, thus showing that all the parts grow proportionately.

(c) Correlation coefficient and regression equations have also been computed for some of more important pairs
of dimensions to study the changes in body proportions. These are:

(a) Between hand length and weight
(b) Between hand length and standing height
(c) Between hand length and head circumference
(d) Between foot length and weight
(e) Between foot length and standing height
(f) Between foot length and hand circumference

Significant and positive correlation has been found between hand length, crown heel length, head circumference, and weight. Correlation values for each have been calculated and regression equation has also been derived in each case, which are as follows:

(a) Hand length (X)/Crown heel length (Y):

Correlation coefficient:
- Boys = 0.99
- Girls = 0.99

Regression equation:
- Boys $Y = 14.98 + 7.70X$
- Girls $Y = 4.73 + 8.34X$
(b) Hand length (X)/Head circumference (Y):

Correlation coefficient (r):
- Boys = 0.98
- Girls = 0.99

Regression equation:
- Boys Y = 12.01 + 0.65X
- Girls Y = 39.55 + 0.77X

(c) Hand length (X)/Weight (Y):

Correlation coefficient (r):
- Boys = 0.99
- Girls = 0.98

Regression equation:
- Boys Y = -50.88 + 5.24X
- Girls Y = -65.35 + 6.19X

Significant and positive correlation has also been found between foot length with crown heel length, head circumference and weight separately. Correlation value for each of these parameters with the other has been calculated and regression equation has also been derived in each case as follows:

(a) Foot length (X)/Crown heel length (Y):

Correlation coefficient (r):
- Boys = 0.98
- Girls = 0.99

Regression equation:
- Boys Y = 21.61 - 5.63X
- Girls Y = 11.31 - 6.17X
(b) Foot length (X)/Head circumference (Y):

Correlation coefficient (r): Boys = 0.97  
Girls = 0.99  

Regression equation:  
Boys Y = 31.28 + 0.44X  
Girls Y = 40.16 + 0.57X  

(c) Foot length (X)/Weight (Y):

Correlation coefficient (r): Boys = 0.97  
Girls = 0.98  

Regression equation:  
Boys Y = -45.72 + 3.60X  
Girls Y = -61.40 + 4.60X  

3. Circumferences

Various circumferences, viz., head, chest  
and mid arm have been studied and were observed to  
increase at all successive ages and circumferential growth also shows a pubertal growth spurt, starting  
at the mean age of 9 years in females and at 10 years in males. But the head and chest circumferences of  
males are higher at all ages and the difference in head circumferences statistically significant. Girls  
have a higher mid arm circumference between age group  
11-13 years but the difference is not statistically significant.
4. Skinfold Thicknesses

The mean value for all the skinfold thicknesses (Triceps, subscapular and suprailiac) were slightly higher in girls than in boys for all age groups and the differences were statistically significant.

(B) Development of Secondary Sex Characters

(a) In Girls:

The mean age for stage 2 of breast development was 10.39 years and stage 2 of pubic hair 10.69 years.

Probit analysis reveals that 99 per cent completion of stage 4 of breast development and pubic hair would be 20.24 and 19.36 years respectively. Similarly, 99 per cent attainment of menarche and axillary hair will be 17.66 and 18.75 years, respectively. The median age of stage 5 of the same characteristics could not be calculated due to the low percentage of girls in stage 5, and because of the limitation of age groups i.e. 16 years in the present study.

(b) In Boys:

The mean age for stage 2 of genital growth and pubic hair development in boys were 9.34 and 10.65 years respectively.
Probit analysis reveals that 99 per cent completion of stage 4 of the same characteristics would be 19.27 and 18.42 yrs respectively. Similarly the 99 per cent completion of axillary hair, facial hair, voice change, apocrine sweat gland function will be 17.08, 17.19, 18.64 and 17.30 years respectively.

The median of stage 5 of pubic hair development and genital growth in boys could not be seen by the age of 16 years.
CONCLUSIONS

1. In the present study the pubescent growth spurt in girls was from 9 to 13 years and in boys it was from 11 to 16 years.

2. Interesting findings have emerged when indices of various body proportions were computed to express one segment of body as percentage of the other. The significant correlation of hand length and foot length with weight, height and head circumference is of tremendous value. By knowing the hand length or the foot length alone, we can calculate the height, weight and head circumference by utilizing one of the regression equations as discussed earlier. From these derived values, surface area can also be found using standard nomograms. The knowledge may be of practical use in medico-legal investigations and in anthropology as often only a limb or its part may be available from which the stature and various other values can be calculated.

3. The median age of stage 5 of breast and pubic
hair development in girls and genital growth and pubic hair development in boys could not be calculated because of the appearance of low percentage of stage 5 up to the age of 16 years.

Thus to evaluate the growth process which is continuing beyond the age of 16 years in the present study and is consistent with the documentation of growth process, a longitudinal study well beyond the age of 16 years is proposed to ascertain the complete biological maturation and growth process.