Height, weight, skinfold thicknesses (triceps, subscapular, abdominal, iliac-crest, thigh and medial calf) and circumferences (upper arm, chest, waist, hip, thigh and calf) were measured in adolescents (414 males and 400 females) and adults (330 males and 320 females) of Chandigarh zone in North-West India. Subjects were divided into various age-groups: 12-17 years (adolescents), 18-29, 30-39 and 40-49 years (adults). Adolescents were further divided into six groups at one year intervals i.e. 12, 13, 14, 15, 16 and 17 years.

2. Age of a subject was converted into decimal age and computed in complete whole years. If the fraction was less than 0.5 it was ignored but if 0.5 or more, it was taken as one whole year. In case of school children, the age was noted from the admission registers and later verified from the parents. The age of the adults was noted from their school and service records and sometime from horoscopes. Some subjects could give their date of birth according to Indian calendar which were converted into Christian calendar by calculation. Sometimes family history was also helpful. In case of doubt, the subjects were excluded from the study.
3. Chandigarh zone included Union Territory of Chandigarh, and neighbouring areas of Punjab, Haryana and Himachal Pradesh. The subjects were divided into three socioeconomic groups; upper, middle and lower which were primarily based on the criteria of income as given by the ICMR in their study of 1956-65 and as applicable in 1980-89; in addition the number of mouths to be fed in a family and educational status of the family members were also taken into consideration. For purpose of investigation the subjects belonging to upper and lower socioeconomic groups were examined, so that there was no overlap in the criteria of the two groups. Subjects of the middle socioeconomic group were thus excluded from the study.

4. The author learnt the method of measuring thickness of the skinfold from
the guide. The former was allowed to carry out the work only when his results and those arrived at by the guide tallied.

5. Specific anatomical points were delineated for taking the medial calf, thigh and iliac-crest skinfold thicknesses.

6. All the skinfold thicknesses were transformed into log to give a normal distribution. The 't' test was applied to study the differences between two comparable groups of log converted values of skinfold thicknesses and absolute values of height, weight and circumferences. Coefficient correlations 'r' were calculated between height, weight, absolute values of skinfold thicknesses and circumferences. In addition to means, percentiles were also calculated for skinfold thicknesses.

1. Height and weight

   i) Height

   In the upper socioeconomic group, the females were taller than the males between the ages of 12 and 14 years; thereafter, trend got reversed and the males
became taller than females at the age of 15 years and remained so even in adults. The maximum mean body height in males was 170.18 ± 8.27 cm at the age of 17 years and in females the maximum height was 159.44 ± 4.58 cm at the age of 16 years.

In the lower socioeconomic group, the males were taller than the females at all ages both in adolescents and adults. The maximum mean height in both sexes was reached at the age of 17 years, when it was 162.51 ± 5.17 cm in the males and 150.90 ± 5.16 cm in the females.

The adolescents of two sexes of upper socioeconomic group were taller at all ages than those belonging to lower socioeconomic group (p < .001). The adult males of upper socioeconomic group were taller than those belonging to lower socioeconomic group in all the age-groups (p < .001). Similarly, the adult females of upper socioeconomic group were taller than those belonging to lower socioeconomic group in all the age-groups (p < .001).

ii) Weight

In the upper socioeconomic group, the females were heavier than males between the ages of 12 and 14.
years; thereafter, the males became heavier than the females and continued to remain so even in the adult age-groups. In the males, weight went on increasing after the age of 14 years till the last adult age-group of 40-49 years, when the maximum weight was 72.78 ± 9.80 kg. In the females, the weight slightly increased from 15 years to first adult age-group of 18-29 years but it considerably increased in the second and the third age-groups reaching the maximum weight of 63.61 ± 9.39 kg, in the last age-group. Statistically, the sexual differences in weights after the age of 16 years in all ages were highly significant ($p \leq .001$).

In the lower socioeconomic group, both adolescent adult males were always heavier than females at corresponding ages. The maximum weight of males was found to be 53.00 ± 6.46 kg in the second adult age-group, but it decreased in the last adult age-group ($p \leq .001$) possibly due to lack of nourishment. In the adolescent females the weight steadily increased from 12 years onwards, the maximum weight was reached at 17 years when it was 41.03 ± 4.07 kg, while in the first adult age-group of 18-29 years the weight decreased ($p \leq .01$) and remained almost stationary in the last two adult age-
groups. Statistically, the sexual differences in weights from 16 years onwards were highly significant ($p < .001$).

The mean weight of both adolescents and adults of the two sexes were greater in the upper socioeconomic group than those of the subjects of the lower socioeconomic group ($p < .001$).

In the present study, both in the upper and lower socioeconomic groups, the adolescents (12-17 years) and adults (19-21 years) of the two sexes were taller and heavier than the figures given by the ICMR (1956-65, published in 1984). In the upper socioeconomic group, adolescents of the two sexes were smaller and lighter than the English, East Germans and American Whites and Blacks, while they were taller but lighter than the Japanese and Egyptians. However, they were taller and heavier than the Nigerians.

II. Skinfold thicknesses

**Upper socioeconomic group**

As seen from the graphs 18 and 19, the trends in the increase of skinfold thicknesses of thorax and abdomen (subscapular, abdominal and iliac-crest) were similar in the two sexes both in the adolescents and
adults; they increased considerably from 12 to 17 years, increased tremendously from 17 years to the second adult age-group of 30-39 years and increased only slightly thereafter in the last adult age-group of 40-49 years. However, the skinfold thickness of the upper limb viz. triceps increased more in the females than in the males both in the adolescents and the adults after the age of 17 years. The increase in triceps skinfold thickness was less marked than those of the thorax and abdomen but was more marked than those of lower limbs. The trend in the increase of skinfold thicknesses of lower limbs was also similar in the two sexes, both in adolescents and adults. They increased marginally from 12 to 17 years, only slightly from 17 years to second adult age-group of 30-39 years and remained almost stationary in the last adult age-group of 40-49 years.

The maximum thicknesses of all the skinfolds were reached in the last adult age-group of 40-49 years, when the triceps in males was $14.59 \pm 4.89$ mm and in females was $24.88 \pm 6.88$ mm, subscapular $21.98 \pm 5.11$ mm and $27.57 \pm 5.30$ mm, abdominal $27.95 \pm 6.71$ mm and $31.15 \pm 6.10$ mm, iliac-crest $28.20 \pm 6.21$ mm and
and 30.12 ± 5.48 mm, thigh 12.50 ± 4.51 mm and
16.19 ± 5.45 mm and medial calf 13.67 ± 3.90 mm and
20.65 ± 5.36 mm respectively. All the skinfolds in the
females were greater than in the males. Statistically,
the sexual differences in thicknesses of all the
skinfolds from 12 years to the last adult age-group
of 40-49 years were highly significant (p < .001).

**Lower socioeconomic group**

In the subjects of the lower socioeconomic group,
increase in the skinfold thicknesses in the two sexes
was not similar to that seen in those of upper socio­
economic group. In the males, the skinfold thicknesses
of the thorax and abdomen increased considerably from
15 years onwards till the second adult age-group of
30-39 years, whereas the triceps increased only slightly
and those of the lower limbs decreased steadily. In
the last adult age-group of 40-49 years, all the skinfold
thicknesses decreased simultaneously. The maximum
thicknesses of skinfolds of upper limbs, thorax and
abdomen were seen in the second adult age-group when
the skinfold thicknesses were: triceps 7.2 ± 4.32 mm,
subscapular 10.55 ± 3.79 mm, abdominal 12.96 ± 3.14 mm
and iliac-crest 13.23 ± 9.44 mm. While the maximum thicknesses of skinfold of lower limbs were present at 17 years, when the thigh skinfold was 7.70 ± 2.25 mm and medial calf 8.11 ± 2.16 mm.

In the females, in the adolescents the skinfold thicknesses of upper limbs, thorax and abdomen increased considerably, whereas those of lower limbs increased only moderately. However, in the first adult age-group of 18-29 years all the skinfold thicknesses decreased simultaneously and remained almost stationary in the last two adult age-groups of 30-39 years and 40-49 years. The maximum thicknesses of all the skinfolds were present at 17 years, when the triceps was 12.50 ± 3.30 mm, subscapular 13.12 ± 4.25 mm, abdominal 15.68 ± 3.32 mm, iliac-crest 16.99 ± 4.15 mm, thigh 13.18 ± 2.16 mm, and medial calf 14.22 ± 1.97 mm. Statistically, the sexual differences in all the skinfold thicknesses from 12 years to the last adult age-group of 40-49 years were highly significant (p < .001)

The mean thicknesses of all the skinfolds of both the adolescents and adults of the two sexes were larger in the upper socioeconomic group than those in the lower socioeconomic group and this difference was
statistically either highly significant ($p \leq .001$) or significant at 1% level ($p \leq .01$). It is difficult to compare the present results with those recorded in previous studies (Sharma and Kaul, 1970; Berry, 1971; Satwanti et al., 1977, 1980 a and 1980 b). The reasons for the same are:

1. The previous workers used different types of skinfold calipers
2. Either they did not define the socioeconomic groups or different criteria were used to do so
3. Exact site of measuring some of the skinfolds had not been indicated.

Sharma and Kaul (1970) did not mention the type of caliper used and they had taken the subjects from "lower middle" and "lower" socioeconomic groups. The present author had not made any observations on the subjects of "lower middle" class. As regards the lower socioeconomic group males in the present study, the adolescents had better nutrition than those recorded by Sharma and Kaul (1970).

Berry (1971) and Satwanti et al. (1977, 1980 a and 1980 b) had taken subjects from middle socioeconomic group without defining them. The site of iliac-crest skinfold thickness measured by Berry (1971) was
different from that in the present study, while it was not defined by Satwanti et al. (1977).

A comparison of the skinfold thicknesses of adolescents of two sexes, as found in the present study in the upper socioeconomic group with those of the other races is given below:

**Skinfold thicknesses**

**Adolescent males of upper socioeconomic group**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Triceps</td>
<td>Smaller than</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subscapular</td>
<td>Smaller than</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iliac-crest</td>
<td>Smaller than</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Medial calf  Smaller than  American Whites
Larger than  American Blacks

Skinfold thicknesses

Adolescent females of Upper Socioeconomic Group

Triceps  Smaller than  East Germans
Larger than  British
Japanese
American Blacks
Tanzanians
Comparable to  American Whites

Subscapular  Larger than  Japanese
American Whites
American Blacks
British
Tanzanians

Iliac-crest  Larger than  American Whites
American Blacks

Medial calf  Smaller than  American Whites
Larger than  American Blacks

In adolescent males of Chandigarh zone the skinfold thicknesses were smaller than those of the American Whites,
East Germans and Japanese but were larger than those of American Blacks and Tanzanians and were almost similar to those in the English. However, in adolescent females the skinfold thicknesses were smaller than those of the East Germans, but were larger than of the English, American Blacks, Japanese and Tanzanians and were almost the same as in American Whites.

III. Circumferences

Upper socioeconomic group

Both in males and females, the hip, chest and waist circumferences increased slightly during the adolescence but increased more considerably after the age-group of 17 years till the last adult age-group of 40-49 years when the circumferences increased either slightly or remained stationary. However, the circumferences of the thigh, calf and upper arm both in the adolescents and adults of the two sexes, either increased slightly or remained stationary. The maximum circumference in the two sexes was reached in the last age-group of 40-49 years, when in the males the upper arm circumference was 28.54 ± 3.30 cm and in the females it was 28.43 ± 3.55 cm; chest 93.79 ± 4.60 cm and
and 89.45 ± 5.95 cm; waist 88.53 ± 5.77 cm and
84.16 ± 8.27 cm; hip 94.89 ± 5.38 cm and 98.79 ± 7.76 cm;
thigh 51.62 ± 3.96 cm and 51.17 ± 3.00 cm; calf 33.68 ±
2.65 cm and 32.98 ± 2.47 cm respectively. Statistically,
the sexual differences of all the circumferences in the
subjects from 12 to 17 years were of variable significance.
However, the sexual differences of circumferences of chest,
waist and hip in three adult age-groups of 18-29, 30-39
and 40-49 years were highly significant (p < .001),
while that in circumferences of the upper arm, thigh and
calf were insignificant (p > .05).

**Lower socioeconomic group**

In the males all mean circumferences increased
equally from 12 to 17 years, while in the first adult
age-group of 18-29 years the increase continued as
regards the chest, waist and hip circumferences, but
other circumferences remained almost stationary. In
the second adult age-group of 30-39 years, although
the waist circumference did increase slightly, the
remaining circumferences remained almost stationary.
In the third age-group of 40-49 years, all the
circumferences decreased simultaneously, but the chest circumference remained almost stationary. The decrease in circumferences seems to be due to lack of nourishment which have not affected the chest circumference which is dependable mostly on volume of the lungs. The maximum circumferences of the males reached in the second adult age-group of 30-39 years, when they were, upper arm 23.82 ± 1.83 cm, chest 81.91 ± 5.37 cm, waist 71.26 ± 7.47 cm, hip 80.45 ± 8.78 cm, thigh 42.92 ± 3.13 cm and calf 29.71 ± 2.30 cm.

In the females all the circumferences increased slightly from 12 to 17 years, thereafter, they decreased in the first adult age-group of 18-29 years and remained almost stationary in the last two adult age-groups of 30-39 and 40-49 years. The maximum circumferences of the females were present at the age of 17 years, when they were, upper arm 21.16 ± 1.94 cm; chest 72.50 ± 3.22 cm; waist 62.30 ± 4.98 cm; hip 79.82 ± 3.85 cm; thigh 39.65 ± 3.29 cm and calf 27.29 ± 1.75 cm. Statistically, the sexual differences of all the circumferences in the subjects of 12 to 17 years were of variable significance. However, the sexual differences of all
the circumferences in three adult age-groups of 18-29, 30-39 and 40-49 years were highly significant ($p < .001$).

The mean values of all circumferences of both adolescents and adults of the two sexes were higher in the subjects of the upper socioeconomic group than those in the lower socioeconomic group at all ages ($p < .001$).

In the present study, in adolescents (12-17 years) and adults (18-21 years) of both sexes of upper socioeconomic group and males of the lower socioeconomic group, the chest circumferences were larger than those noted in the ICMR study (1956-65, published in 1984). However, in the adolescent and adult females of the lower socioeconomic group, the chest circumferences were smaller than those recorded by the ICMR (1956-65, published in 1984).

In adolescents of two sexes belonging to upper socioeconomic group in the present study, the circumferences of the upper arm, chest and calf were smaller than those of the English, East Germans and American Whites and Blacks, but circumferences of upper arm and calf were almost the same as found in the Hong Kong Chinese. However, in adolescent males the circumferences of the upper arm and calf were similar
to those in the Tanzanians and in the adolescent females, the circumference of the chest was also the same as in the Ghanians.