CHAPTER V

DISCUSSION OF RESULTS (Contd.)

A LONGITUDINAL STUDY OF PHYSICAL GROWTH

The earlier discussion in preceding chapter has been devoted to the cross-sectional study of physical growth. As described earlier in Chapter III, the problem of the study of some aspects of physical growth (thirteen measures of different physical aspects) has also been extended to the investigation of same measures through a longitudinal approach, analysing the data on observations of measures of same children over a specific range of age. This chapter is devoted to the discussion of results of the longitudinal study of the problem. Very truly, it may not be strictly called a longitudinal study from 2-0 to 6-0 years. Same children of only specific age ranges (nine different age ranges) have been studied, and the results of preceding age-range are continued with those of next age-range. Thus, on the whole it is a mixed approach, though for a specific range, it is a longitudinal study.

Sample

As mentioned earlier, the cross-sectional study was undertaken on a large sample of 1858 children of both sexes from urban and rural areas, providing in all 5699 observations for actual analysis, including data on some children observed

continuously over a specific period possible for observation within limits of time of study and availability of subjects for study. The data of these children available for continuous observation were separated out of the main study and analysed with statistical techniques appropriate for a longitudinal growth study. The sample for such longitudinal study consisted of 600 urban children - 316 boys and 284 girls - at different age ranges from 2-0 to 6-0 years, each being observed continuously at interval of three months for at least five times. The rural group could not provide subjects for such a study in view of some difficulties noted earlier specifically in rural area. Only those urban children of both sexes, who were available at least for five times continuously at a time starting from any age-point first available, were included as subjects for longitudinal study. For convenience and uniformity the data over continuous five age-points were retained for analysis (dropping the data on continuous age-points beyond five as well as dropping the subjects with data on less than five continuous age-points). Thus, nine such continuous age-ranges, starting at specific age-point and going over a period to cover data of continuous five age points, were available. Table 5.1 shows thus actual size of sample (sex-wise) at each of nine age-ranges for which continuous data of same subjects with repeated observations were available.

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It should be noted from table 5.1 that some of the age-points in these nine age ranges are overlapping. For example, at 2-0 age point only 48 subjects (29 boys and 19 girls) are available for study, but at 3-0 age point, 48 subjects of first age-range (2-0 to 3-0) as well as 59 subjects of second age-range (3-0 to 4-0) i.e. 107 in all are available, and so on at other age-points, from 3-6 to 5-9 . These figures of overlap at different age-points within each of nine age-ranges are presented again in table 5.2 and the total size of sample and the number of observations at each of 17 age-points including overlapping data are summarized in table 5.3 for convenience even though they have been given in Chapter III while describing the total sample. The socio-economic break-up of this sample of 600 children is presented in table 5.4(i) on the whole and in table 5.4(ii) for each age-range. (Fig.5.1).

Results

Mixed Longitudinal Study and General Representation of all Data.

The data on observations of each of 13 different physical measures of the total sample of 600 urban children at each age-range over continuous five age-points as shown in table 5.2 were subjected to adequate statistical analysis and the results have been summarized in tables 5.5 to 5.8 . They are represented graphically in figures 5.2 to 5.14, and discussed briefly below.

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It should be noted here, however, that for want of time and space and owing to limitations of such doctoral work the vigorous statistical analysis as well as detailed discussion of data has been dropped and simply the summary of findings has been presented briefly, with the hope that this longitudinal study may be taken up independently as a follow-up work in future, in view of much useful data available even in the present case; the present data need to be supplemented by continuous data over large age-ranges. The results of the present study are quite obvious even from the graphs presented and hence these are simply summarized in the general summary sheet of table 5.5 showing the means of each of 13 measures of children at each of 17 age-points separately for boys and girls. The pooled results are graphically represented in figures 5.2 to 5.14 for each of the 13 measures. This represents on the whole the combination of both longitudinal approach for each of nine age-ranges of same children as well as cross-sectional approach as far as data on next age-ranges of different groups of children are pooled along with the data of the preceding age-range.

The pooled data of mixed approaches on each measure in table 5.5 show almost the same trend of results as the findings on each measure in cross-sectional approach in the earlier chapter. The graphs reveal clearly the sex differences in most

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of the measures except perhaps only a slight difference in case of shoulder width. Wherever there were sex differences, boys were found superior except in case of thigh circumference where girls were found superior. In case of upper arm circumference, girls were superior to boys in age range from 3-9 to 4-9 years; in case of fore-arm circumference girls caught up with boys at 4-0 years, though at all other age-points they were significantly below the boys. Similarly in case of calf circumference, girls matched with boys at 4-3 to 4-6 age-range and in leg length at 2-9 to 3-0 age range, remaining far lower at other age-points.

In short, the findings from this mixed longitudinal approach corresponded to those in the cross-sectional approach.

Pure Longitudinal Study of One Group and Its Statistical Trend Analysis .

As noted earlier, limitations of the study were such that all data in this section were not subjected to rigorous statistical analysis. Graphs are quite revealing. Yet, in order to study the trend of growth in case of such repeated measurements during a specific age range, pure longitudinal data on only one measure of only one age-range were subjected to a special statistic technique of trend analysis, normally used to study such growth trend or growth curve. Similar procedure can be

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used to analyse the trend in case of each of the other measures of each age range separately. But this statistical analysis is not attempted here for each measure in view of limitations of the work; the graphs are self-explanatory of the trend which can be substantiated statistically in a follow-up work with a true longitudinal approach. An attempt is simply made here to illustrate the use of this statistical technique of trend analysis, discussed by Grant (1956) and adopted by Grant and Patel, as quoted by Edwards (1971). It is applied here to analyse data on only weight of only one age range, viz. 2-0 to 3-0 years, consisting of repeated observations on same subjects at five stages or age points at intervals of three months. This group consisted of 29 boys and 19 girls, each giving five observations at five age points. These data for boys and girls separately were subjected to the statistical technique of analysis of variance and trend analysis (details of procedure being shown in the Appendix 6) and the results have been summarized in table 5.6 showing the means and SDs for both boys and girls, and in tables 5.7 for boys and 5.8 for girls, showing the summary of results of analysis of variance as well as significance of specific trends.

Results in table 5.6 show that weight increases with age in case of both boys and girls; and results in tables 5.7 and 5.8 reveal that both in case of boys as well as girls there were significant differences between age-points i.e. the

overall trend in increase was significant, and further trend analysis shows that only the linear trend was highly significant and not any other, i.e. the increase showed linearity, or a straight line increase or a uniform rate of increase at each successive age point. This finding substantiates the earlier similar finding in cross-sectional study.

It should also be noted that the results show also significant differences between individual means or subjects as well in case of both boys and girls.

Similar statistical analyses can be adopted in case of each of the remaining measures of physical growth, taking account of repeated observations of children of each age range. Thus, there being nine age-ranges for boys (same for girls) and 13 measures of study, there would be 2 x 9 x 13 = 234 such trend analyses - a huge task. However, all these are not done in the present study in view of specific limitations and time-consuming nature for the present study. However, same findings are apparent even from the graphs in figures 5.2 to 5.14 respectively for each measure. The data on weight and height for the nine age-ranges are graphically presented in figures 5.15 and 5.16 respectively. The study with a thorough longitudinal approach and rigorous statistical analysis may be followed up for further research.

Table 5.1 - showing Actual Size of the Sample at each age range (Longitudinal study).

L.S. Group	Age-range			Boys	Girls	Total
	Years Months	to	Years Months			
i	2 - 0	-	3 - 0	29	19	48
ii	3 - 0	-	4 - 0	29	30	59
iii	3 - 6	-	4 - 6	36	28	64
iv	3 - 9	-	4 - 9	51	33	84
v	4 - 0	-	5 - 0	34	54	88
vi	4 - 3	-	5 - 3	33	20	53
vii	4 - 6	-	5 - 6	39	32	71
viii	4 - 9	-	5 - 9	36	35	71
ix	5 - 0	-	6 - 0	29	33	62
			Total	316	284	600

Table 5.2 - showing the sex-wise distribution of the total number of urban subjects (N) at each of the 17 age-points. (Longitudinal study).

Age-point Years-months	Total N (O)	Boys	Girls
2 - 0	48	29	19
2 - 3	48	29	19
2 - 6	48	29	19
2 - 9	48	29	19
3 - 0	107	58	49
3 - 3	59	29	30
3 - 6	123	65	58
3 - 9	207	116	91
4 - 0	295	150	145
4 - 3	289	154	135
4 - 6	360	193	167
4 - 9	367	193	174
5 - 0	345	171	174
5 - 3	257	137	120
5 - 6	204	104	100
5 - 9	133	65	68
6 - 0	62	29	33
	3000	1580	1420

Table 5.3 - showing the sex-wise distribution of the total number of observations (O) of urban subjects (N) at each of 17 age-points indicating the over-laps of different age-ranges. (Longitudinal study)

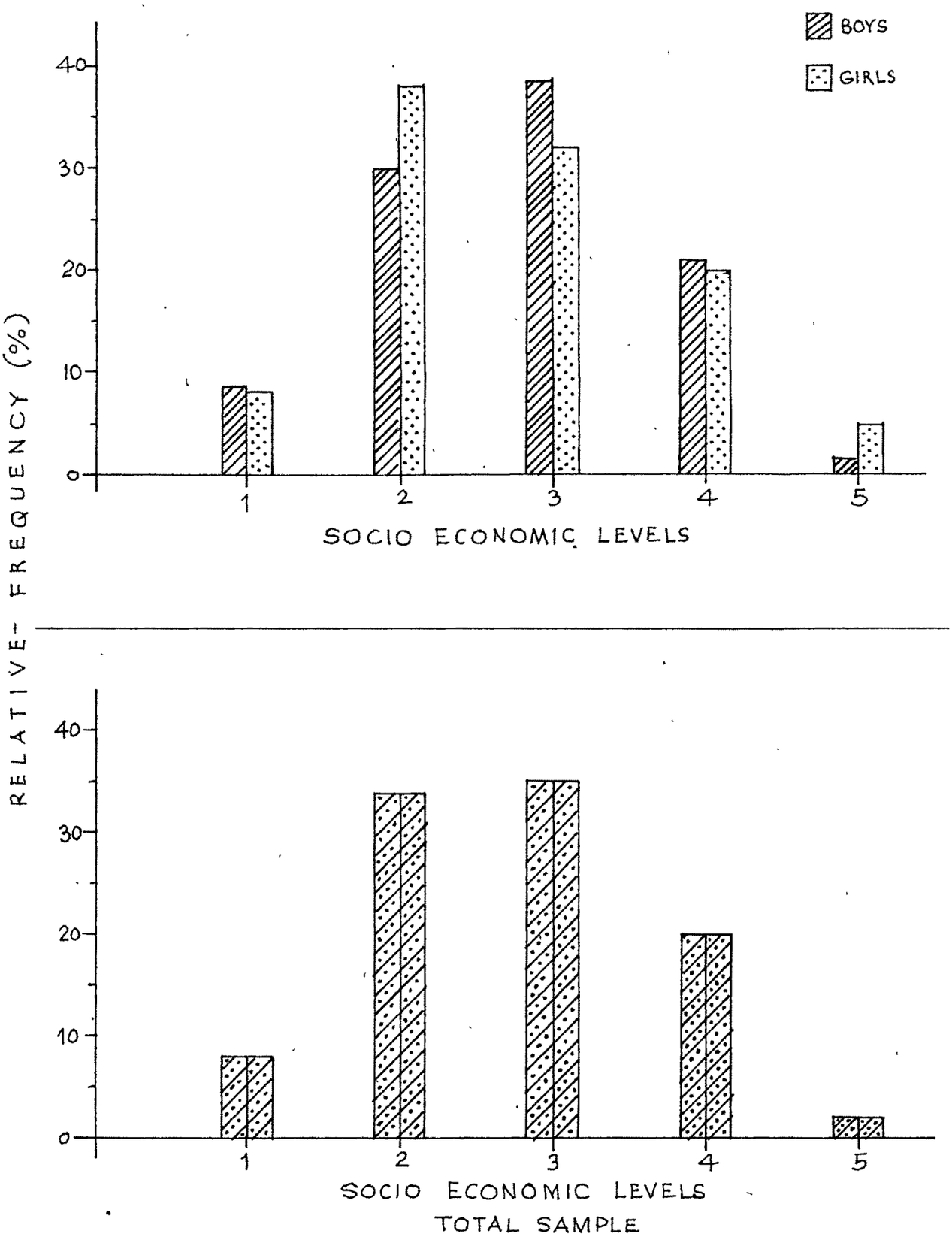
Age-range		2-0	2-3	2-6	2-9	3-0	3-3	3-6	3-9	4-0	4-3	4-6	4-9	5-0	5-3	5-6	5-9	6-0	
2-0 to 3-0 yrs.	Boys N	29	29	29	29	29													
	Girls N	19	19	19	19	19													
3-0 to 4-0	Boys					29	29	29	29	29									
	Girls					(30)	(30)	(30)	(30)	(30)									
3-6 to 4-6	Boys							36	36	36	36	36							
	Girls							28	28	28	28	28							
3-9 to 4-9	Boys								51	51	51	51	51						
	Girls								33	33	33	33	33						
4-0 to 5-0	Boys									34	34	34	34	34					
	Girls									54	54	54	54	54					
4-3 to 5-3	Boys										33	33	33	33	33				
	Girls										20	20	20	20	20				
4-6 to 5-6	Boys											39	39	39	39	39			
	Girls											32	32	32	32	32			
4-9 to 5-9	Boys												36	36	36	36	36		
	Girls												35	35	35	35	35		
5-0 to 6-0	Boys													29	29	29	29	29	
	Girls													33	33	33	33	33	
'O' at each age level	Total Boys	29	29	29	29	58	29	65	116	150	154	193	193	171	137	104	65	29	1580
	Total Girls	19	19	19	19	49	30	58	91	145	135	167	174	174	120	100	68	33	1420
N	Total Children (Boys + Girls)	48	48	48	48	107	59	123	207	295	289	360	367	345	257	204	133	62	3000

Table 5.4 (i) - Frequency showing socio-economic (SE) level-wise distribution of the sample.

(Longitudinal Study)

	Socio-Economic (SE) levels					Total
	Low	Low-middle	Middle	High-middle	High	
	SE 1	SE 2	SE 3	SE 4	SE 5	
Boys	27	96	122	65	6	316
Girls	23	108	90	56	7	284
Total	50	204	212	121	13	600

L·S·
GRAPH NO. 5·1



L.S.

GRAPH NO. 5·2

L.S.

GRAPH NO. 5-3

L.S.

GRAPH NO. 5.4

L.S.

GRAPH NO.5.5

L.S.

GRAPH NO. 5·6

L.S.

GRAPH NO. 5.7

L.S.

GRAPH NO. 5.8

GRAPH NO. 5·9

A. UPPER ARM CIRCUMFERENCE IN Cm.
16
15
14
13
BOYS
GIRLS
A
B
B. YEARLY INCREASE OF Once IN Cm.
1·0
0·5
0
BOYS
GIRLS
2·0
2·3
2·6
2·9
3·0
4·0
5·0
6·0
AGE IN YEARS

L.S.

GRAPH NO 5.10

L.S.

GRAPH NO. 5.11

L.S.

GRAPH NO. 512

L.S.
GRAPH NO. 5-13

L.S.

GRAPH NO. 5-14

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Table 5.4(ii) - showing distribution of the total sample (Sex x Socio-Economic Level) at each of nine age-ranges.
(Longitudinal study)

Age-range		BOYS						GIRLS						BOYS & GIRLS COMBINED					Total
		SOCIO-ECONOMIC LEVEL					Total	SOCIO-ECONOMIC LEVEL					Total	SOCIO-ECONOMIC LEVEL					
		SE 1	SE 2	SE 3	SE 4	SE 5	Boys	SE 1	SE 2	SE 3	SE 4	SE 5	Girls	SE 1	SE 2	SE 3	SE 4	SE 5	
	Yrs.Months																		
(i)	2 - 0 to 3 - 0	2	6	14	6	1	29	2	6	7	4	0	19	4	12	21	10	1	48
(ii)	3 - 0 to 4 - 0	1	15	11	2	0	29	3	14	10	3	0	30	4	29	21	5	0	59
(iii)	3 - 6 to 4 - 6	1	15	15	4	1	36	2	8	6	12	0	28	3	23	21	16	1	64
(iv)	3 - 9 to 4 - 9	8	12	21	9	1	51	0	13	9	10	1	33	8	25	30	19	2	84
(v)	4 - 0 to 5 - 0	1	7	14	12	0	34	5	22	17	8	2	54	6	29	31	20	2	88
(vi)	4 - 3 to 5 - 3	4	8	11	9	1	33	0	8	6	5	1	20	4	16	17	14	2	53
(vii)	4 - 6 to 5 - 6	4	10	14	10	1	39	3	13	10	5	1	32	7	23	24	15	2	71
(viii)	4 - 9 to 5 - 9	5	15	11	5	0	36	5	12	14	3	1	35	10	27	25	8	1	71
(ix)	5 - 0 to 6 - 0	1	8	11	8	1	29	3	12	11	6	1	33	4	20	22	14	2	62
	Total	27	96	122	65	6	316	23	108	90	56	7	284	50	204	212	121	13	600

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Table 5.5 - showing summary of all measurements at each of the 17 age-points along with yearly increase at age levels 3,4,5 and 6 years. (Longitudinal study)

variable		Age-points (years - months)																
		2-0	2-3	2-6	2-9	3-0	3-3	3-6	3-9	4-0	4-3	4-6	4-9	5-0	5-3	5-6	5-9	6-0
Weight in kg.	Boys	10.2	10.5	11.2	11.6	11.8 (1.6)	12.1	12.7	12.9	13.3 (1.5)	13.7	14.0	14.3	14.9 (1.6)	15.2	15.7	16.3	16.8 (1.9)
	Girls	9.5	10.2	10.7	11.1	11.2 (1.7)	11.6	12.0	12.5	12.9 (1.7)	13.4	13.7	13.9	14.1 (1.2)	14.4	14.7	15.1	15.9 (1.8)
Height in cm.	Boys	80.9	82.7	84.5	86.2	88.3 (7.4)	89.9	92.8	94.2	95.8 (7.5)	97.7	99.5	100.9	102.6 (6.8)	104.2	105.9	107.2	109.2 (6.6)
	Girls	79.5	81.6	83.7	86.0	87.4 (7.9)	88.8	90.9	93.0	94.5 (7.1)	96.5	97.9	99.2	100.7 (6.2)	102.1	103.3	104.5	106.9 (6.2)
Head circumference in cm.	Boys	47.3	47.7	48.1	48.3	48.4 (1.1)	48.4	48.5	48.7	48.7 (0.3)	48.7	48.9	49.1	49.2 (0.8)	49.6	49.9	50.2	50.2 (1.0)
	Girls	46.1	46.7	46.9	47.1	47.2 (1.1)	47.2	47.6	47.8	47.8 (0.6)	48.3	48.4	48.7	48.7 (0.9)	48.8	48.9	49.1	49.3 (0.7)
Chest circumference in cm.	Boys	47.0	47.8	48.3	48.6	48.9 (1.9)	49.0	49.7	49.9	50.4 (1.5)	50.6	50.8	51.2	51.5 (1.1)	52.0	52.6	53.1	53.5 (2.0)
	Girls	46.1	46.8	47.1	47.7	47.8 (1.7)	48.0	48.3	49.1	49.3 (1.5)	49.7	49.9	50.0	50.2 (0.9)	50.5	50.7	51.2	51.9 (1.7)
Shoulder breadth in cm.	Boys	21.0	21.6	21.9	22.6	23.0 (2.0)	23.2	24.0	24.5	24.8 (1.8)	25.1	25.3	25.5	25.7 (0.9)	25.9	26.4	26.8	27.2 (1.5)
	Girls	20.6	21.3	22.3	22.7	22.8 (2.2)	23.2	23.7	24.1	24.5 (1.7)	24.9	25.1	25.1	25.4 (0.9)	25.6	26.0	26.3	26.8 (1.4)
Arm length in cm.	Boys	35.9	36.6	37.7	38.4	39.2 (3.3)	39.8	41.0	41.6	42.5 (3.3)	43.2	44.0	44.6	45.4 (2.9)	46.3	46.9	47.8	48.9 (3.5)
	Girls	35.4	36.3	37.1	37.8	38.7 (3.3)	39.4	40.1	40.9	41.4 (2.7)	42.3	43.0	43.5	44.1 (2.7)	44.9	45.5	46.1	47.1 (3.0)
Sitting Height in cm.	Boys	47.0	47.8	48.9	49.8	49.8 (2.8)	49.8	51.0	51.7	52.7 (2.9)	53.6	54.7	55.4	56.0 (3.3)	56.9	58.0	58.6	59.0 (3.0)
	Girls	46.3	47.2	48.2	49.0	49.0 (2.7)	49.0	50.0	51.3	51.8 (2.8)	52.8	53.7	54.3	54.8 (3.0)	55.4	56.2	56.8	57.9 (3.1)
Upper arm circumference in cm.	Boys	14.0	14.1	14.3	14.5	14.4 (0.4)	14.4	14.6	14.6	14.7 (0.3)	14.7	14.7	14.8	15.1 (0.4)	14.8	15.0	15.1	15.3 (0.2)
	Girls	13.7	13.9	14.1	14.2	14.1 (0.4)	14.1	14.5	14.7	14.8 (0.7)	14.9	14.9	14.8	14.9 (0.1)	14.8	14.9	14.9	15.2 (0.3)

Table 5.5 - contd.

Variable		Age-points (years - months)																
		2-0	2-3	2-6	2-9	3-0	3-3	3-6	3-9	4-0	4-3	4-6	4-9	5-0	5-3	5-6	5-9	6-0
Fore-arm circumference in cm.	Boys	14.0	14.2	14.4	14.6	14.7 (0.7)	14.6	14.8	14.8	14.9 (0.2)	15.1	15.1	15.2	15.3 (0.4)	15.3	15.5	15.7	15.8 (0.5)
	Girls	13.6	14.0	14.2	14.2	14.3 (0.7)	14.3	14.5	14.7	14.9 (0.6)	14.9	15.0	14.9	14.9 (0.0)	15.0	15.1	15.1	15.5 (0.4)
Thigh circumference in cm.	Boys	25.8	26.5	27.0	27.3	27.0 (1.2)	26.6	27.4	27.4	27.9 (0.9)	28.1	28.4	28.7	29.1 (1.2)	29.2	29.1	30.0	30.6 (1.5)
	Girls	25.8	26.8	27.5	27.8	27.2 (1.4)	27.1	27.9	28.3	28.7 (1.5)	29.2	29.4	29.4	29.6 (0.9)	29.8	30.1	30.4	31.4 (1.8)
Calf-circumference in cm.	Boys	17.7	18.0	18.3	18.4	18.4 (0.7)	18.8	19.1	19.1	19.3 (0.9)	19.5	19.6	19.8	20.1 (0.8)	20.1	20.4	20.6	21.0 (0.9)
	Girls	17.2	17.7	18.0	18.1	18.2 (1.0)	18.5	18.8	19.0	19.2 (1.0)	19.5	19.6	19.6	19.7 (0.5)	19.8	19.9	20.1	20.5 (0.8)
Foot length in cm.	Boys	13.5	13.7	14.0	14.4	14.8 (1.3)	15.0	15.4	15.6	16.0 (1.2)	16.2	16.5	16.7	17.0 (1.0)	17.2	17.5	17.8	18.1 (1.1)
	Girls	13.2	13.4	13.7	14.1	14.5 (1.3)	14.7	15.1	15.4	15.6 (1.4)	15.9	16.1	16.3	16.5 (0.6)	16.7	16.9	17.1	17.4 (0.9)
Leg (lower-limb) length in cm.	Boys	33.9	34.9	35.6	36.4	38.5 (4.6)	40.4	41.8	42.5	43.1 (4.6)	43.9	44.8	45.5	46.6 (3.5)	47.3	48.0	48.6	50.2 (3.6)
	Girls	33.2	34.4	35.5	36.5	38.3 (5.1)	40.0	41.1	41.7	42.6 (4.3)	43.7	44.2	44.9	45.8 (3.2)	46.7	47.1	47.7	49.0 (3.2)

Figures within brackets show yearly increase at age-levels.

Table 5.6 - showing Means and SDs of weight in kg. of children of 2-0 to 3-0 age range.
(Longitudinal study)

Sex		Age-points					Total
		2-0	2-3	2-6	2-9	3 -0	
Boys (29)	M	10.2	10.5	11.2	11.6	12.0	11.1
	SD	1.39	2.21	1.20	1.37	1.30	1.66
Girls (19)		9.5	10.0	10.7	11.1	11.4	10.6
		1.32	1.32	1.41	1.43	1.52	1.53
Total (48)	M	9.9	10.3	11.0	11.4	11.7	10.9
	SD	1.39	1.90	1.29	1.40	1.41	1.63

Table 5.7 - showing a Summary of Results of Analysis of Variance and Trend Analysis on weight of boys of 2-0 to 3-0 age range. (Longitudinal study)

	Source	df	SS	MS	F	(Error term)	Significance
A	Over-all trend (Age points)	(4)	$W_y - W_I = 58.33$	14.58	14.29	C	Significant beyond .01
	1. Linear	1	$W_{p_1} = 60.17$	60.17	241.68	C : 1	Significant beyond .01
	2. Quadratic	1	$W_{P2} = 0.21$	0.21	3.00	C : 2	Not significant
	3. Cubic	1	$W_{P3} = 0.13$	0.13	0.89	C : 3	Not significant
	4. Quartic	1	$W_{P4} = 0.001$	0.001	0.006	C : 4	Not significant
B	Between Ind.Means (Subjects)	(28)	$U_1 - W_1 = 241.94$	8.64	8.47	C	Significant beyond .01
C	Between Ind.Trends (Age x Sub.)	(112)	$(U_y - U_1) - (W_y - W_1)$ = 114.22	1.02			
	1. Linear	28	$U_{P1} - W_{P1} = 6.98$	0.25			
	2. Quadratic	28	$U_{P2} - W_{P2} = 1.98$	0.07			
	3. Cubic	28	$U_{P3} - W_{P3} = 4.099$	0.15			
	4. Quartic	28	$U_{P4} - W_{P4} = 4.34$	0.16			
D	Total	144	$U_y - W_1 = 414.49$	-			

Table 5.8 - showing a Summary of Results of Analysis of Variance and Trend Analysis on weight of girls of 2-0 to 3-0 age range. (Longitudinal study)

	Source	df	SS	MS	F	(Error term)	Significance
A	Over-all trend (Age points)	(4)	$W_y - W_I = 40.41$	10.10	77.70	C	Significant beyond .01
	1. Linear	1	$W_{P1} = 39.38$	39.38	179.00	C : 1	Significant beyond .01
	2. Quadratic	1	$W_{P2} = 1.023$	1.023	0.73	C : 2	Not significant
	3. Cubic	1	$W_{P3} = 0.001$	0.001	0.01	C : 3	Not significant
	4. Quartic	1	$W_{P4} = 0.005$	0.005	0.42	C : 4	Not significant
B	Between Ind. Means (subjects)	18	$U_1 - W_1 = 165.73$	9.21	70.85	C	Significant beyond .01
C	Between Ind. Trends (Age x Sub.)	(72)	$(U_y - U_1) - (W_y - W_1) = 9.69$	0.13			
	1. Linear	18	$U_{P1} - W_{P1} = 4.00$	0.22			
	2. Quadratic	18	$U_{P2} - W_{P2} = 2.46$	0.14			
	3. Cubic	18	$U_{P3} - W_{P3} = 1.62$	0.09			
	4. Quartic	18	$U_{P4} - W_{P4} = 0.22$	0.01			
D	Total	94	$U_y - W_I = 215.83$	-			