ANTHROPOMETRIC MEASUREMENTS AND BONE AGE IN CHILDREN WITH CONGENITAL HEART DISEASE AT KENYATTA NATIONAL HOSPITAL

BY

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DECLARATION

This dissertation is my original work and has not been presented for a degree in any other University.

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CONTENTS

ABBREVIATIONS

CHD	-	Congenital Heart Disease
MUAC	-	Mid Upper Arm Circumference
SFT	-	Skinfold Thickness
PCC	-	Paediatric Cardiology Clinic
PDA	-	Patent Ductus Arteriosus
VSD	-	Ventricular Septal Defect
TOF	-	Tetralogy of Fallot
ASD	-	Atrial Septal Defect
S.D.	-	Standard Deviation
n	-	Number of Observations
aCHD	-	Acyanotic CHD
cCHD	-	Cyanotic CHD.
PHT	-	Pulmonary Hypertension
SEX - M	-	Male
- F	-	Female
SES	-	Socio-Economic Status
- l	-	Low Income Group
- m	-	Middle Income Group
- u	-	Upper Income Group
HT	-	Height
WT	-	Weight
HEAD C.	-	Head Circumference
C.C.	-	"Chest Circumference
B.A.	-	Bone Age
KNH	-	Kenyatta National Hospital
%	-	Percentage

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SUMMARY:

In order to document the growth of children with Congenital Heart Disease (CHD) in this part of East Africa, anthropometric measurements and bone ages of 175 children aged 0 to 12 years with CHD attending the paediatric cardiology clinic (PCC) at Kenyatta National Hospital (KNH) between February 1985 and January 1986 were taken. These results were compared to those of 175 normal children matched for age, sex, and socio-economic status. The controls were recruited from the nearby child welfare clinic, paediatric filter clinic, nursery schools, and primary schools. CHD was an incidental finding in some patients and an obvious cause of failure to thrive in others. As many as 164/175 (93.7%) of the patients had heights below control values, 156/175 (89.1%) had weights below control values, and 150/175 (85.7%) had both heights and weights below control values. 149/175 (84.6%) of the patients had bone ages below control values, 142/175 (81.1%) had mid upper arm circumferences(MUAC) below controls, 136/175 (77.7%) had skinfold thickness (SFT) below controls, 124/175 (70.9%) had chest circumferences below controls and 110/175 (62.9%) had smaller head circumferences compared to the normal controls. There was no statistically significant

difference in the anthropometric measurements and bone ages of children with the different cyanotic and acyanotic cardiac lesions. Incidentally the bone ages of the controls were more advanced in the first 36 months of life compared to the standards for the European counterparts used. This clearly demonstrated the need for local standards for bone age. Early corrective surgery where possible would prevent permanent anatomic and funtional effects of CHD. Studies to elucidate the mechanism of growth failure in children with CHD were recommended.

INTRODUCTION:

Congenital heart disease (CHD) may be considered as a gross structural abnormality of the heart or great vessels that is actually or potentially of functional importance [1]. The reported incidence of CHD ranges from 8 to 10 of 1000 live born children [1,2,3,4,5,6,7]. Without aggressive intervention 2.3 in 1000 live births develop lethal cardiac problems in infancy [4].

Children born with any CHD may show a stunting and retardation of growth, the severity of which is generally dependent on the anatomic lesion and its functional effects [4,8,9,10]. Surgical correction of these lesions especially when performed early, usually leads to rapid catch up growth [9,11,12,13,14,15]. Retardation in both weight and height in all children with CHD and which is more pronounced in those with cyanosis has been reported [16,17,18,19]. Weight is affected more than height in acyanotic conditions whereas in cyanotic conditions the two parameters are equally suppressed [19]. However, Feldt et al (1969) noted no significant difference in growth between cyanotic and acyanotic children with CHD [13]. Most children with pulmonary stenosis and coarctation of the aorta have normal growth although delay in linear growth relative to weight has been observed [19].

Growth retardation is associated with retardation in skeletal bone age. Danilowicz (1973) reported retardation in bone age to be greater in cyanosed children with CHD than in the acyanotic group [20]. However, while confirming presence of delayed skeletal maturation in CHD, Fellows et al (1972) could not say from their results if this was more severe in the cyanotic group [21].

Boys are reported to be more retarded in growth than girls, especially in the second decade [12,16,19,22].

A number of hypotheses have been advanced to explain growth failure in children with CHD. Insufficient nutrients and caloric intake may be the most important factors: anorexia may result from cardiac decompensation, fatigue due to excessive respiratory work, recurrent infection or psychologic factors [9,23]. In addition patients with cyanotic heart disease or heart failure frequently have gastrointestinal malabsorption and protein losing enteropathy [24,25,26,27]. It is in this light that Steier et al (1977) [24] felt that the conclusion made by Strangway et al (1976) [17] that nutrition is not an important limiting factor in the growth of these children was not relevant to those with severe CHD.

Malnutrition in CHD may start during the intrauterine life [4,28]. After birth relative postmortem brain weights progressively decreased in infants with malformed hearts to approximately two standard deviations below the mean value of controls [4,9].

Hypermetabolism has been implicated as a cause of growth failure [29]. This may result from increased metabolic demands of specific tissues such as the muscles of respiration due to dyspnoea, myocardium due to hypertrophy, haematopoietic system due to erythroid hyperplasia and the calorigenic effect of a raised body temperature [23]. Studies by Krieger (1970) and Stocker et al (1972), however, suggested that hypermetabolism may be the effect of growth inhibition rather than the cause of failure to thrive [30,31]; while Huse (1965) had found the metabolic rate of children with CHD to be normal [32].

Hypoxaemia in CHD appears to be a significant factor in both growth and bone age retardation and those living at high altitude exhibit marked growth and skeletal retardation [20,28].

A mild metabolic acidosis has been documented in both cyanotic and acyanotic patients [33]. Acidosis is associated with growth retardation although the exact mechanism remains to be elucidated [34].

The delay in adolescence in patients with CHD [16,18,19] suggests possible endocrine involvement or central nervous system derangement. However, adrenal and thyroid function have been shown to be normal in a small group of infants with CHD and severe growth retardation [35].

Disturbed parent - child relationship may play a role in growth failure [36]. Also a number of syndromes associated with CHD, such as Down's, congenital rubella, Turner's, Noonan's, Edward's, et cetera, may in themselves account for growth retardation as may other extracardiac anomalies associated with cardiovascular disease [5,9,37,38].

Malnutrition during the period of rapid growth may result in permanent anatomic and functional impairement, stressing the need for early corrective surgery [9]. Feldt et al (1967) have shown that a group of children with small head measurements had statistically poorer chances of increasing their height percentiles than the normocephalic group, suggesting that the central nervous system may be an important factor in determining growth [33].

Many studies have been done on growth in children with CHD; however, none that the author is aware of has been done in East Africa. It is this lack of local data that has been a stimulus to this study aiming at documenting the local situation of children with CHD.

OBJECTIVES:

1. To obtain anthropometric measurements in children with CHD.

2. To assess bone age in these patients.

3. To compare the results with those of normal children, matched for age, sex and socio-economic status.

MATERIALS AND METHODS

Patients for the study were recruited from the weekly paediatric cardiology clinic (PCC) at the Kenyatta National Teaching Hospital, the weekly attendance of which ranges from 60 to 80 follow up cases and 6 new cases. These are referred from hospitals all over the country. The study period was between February 1985 and January 1986.

The author personally visited this clinic and recruited all patients with CHD after an informed consent was obtained from the parents. After completing the questionnaire (APPENDIX I), anthropometric measurements as described by Jelliffe, D.B. [39], (APPENDIX II), were taken by the author. X-ray of the left hand was carried out for bone age in each patient and examined as described by Danilowicz using Greulich and Pyle standards [20,40]. The analysis was done by the author with the help of a radiologist who at the time was only aware of the sex of the patient.

Children aged 0 to 12 years with CHD confirmed by a paediatric cardiologist were included in the study. These patients had cardiac defects with clear cut clinical pictures or had the diagnosis already confirmed by echocardiography and cardiac catheterization at the time of recruitment. Those with more complex cardiac lesions presenting for the first time during the study period were excluded as confirmatory diagnostic facilities were unavailable then. The study population also excluded

the emergency admissions to the wards through other clinics and those who died before any follow up at PCC. Children with CHD having obvious chromosomal abnormalities, evidence of congenital rubella, extracardiac malformations, prematurity or who had undergone palliative or corrective surgery were excluded. A total of 175 patients, 35 for each of age groups (A) 0-11 months, (B) 12-23 months, (C) 24-35 months (D) 3-5 years, and (E) 6-12 years were selected (APPENDIX III).

Controls (APPENDIX III), matched for age, sex, and socio-economic status (APPENDIX IV) were generally healthy children without heart disease from the child welfare clinic, nearby nursery schools and primary schools, and some with minor complaints attending the paediatric filter clinic. All controls were subjected to a similar questionnaire as the study cases after an informed consent was obtained. Anthropometric measurements were taken by the author and xray of the left hand carried out in each case.

ETHICAL CONSIDERATION:

These children were subjected to weighing a procedure carried out in all paediatric clinics, and in addition, measuring of height, head circumference, chest circumference, mid upper arm circumference, and skinfold thickness, all of which are painless and of no risk to them. X-rays of the hands were of no health hazard to these children as the radiation exposure was minimal and the rest of the body was protected.

RESULTS:

Tables Ia and Ib show the distribution of the study population and controls according to age, sex, and socio-economic status. 92/175 (52.6%) of both patients and controls were girls and 83/175 (47.4%) were boys. 47/175 (26.9%) of both patients and controls were of low income group, 112/175 (64%) middle income group and 16/175 (9.1%) were of high income group. Since no significant differences were shown in the anthropometric measurements and bone ages of the different socio-economic groups, no further analysis by socio-economic status was done.

TABLE I (a)

AGE AND SEX DISTRIBUTION OF PATIENTS WITH CHD AND CONTROLS

GROUP	PATIENTS						CONTROLS				
	AGE IN MONTHS			SEX		TOTAL	AGE IN MONTHS		SEX		TOTAL
	RANGE	MEAN	SD	MALE	FEMALE		MEAN	SD	MALE	FEMALE	
A	0-11	7.3	2.8	14	21	35	7.3	2.8	14	21	35
B	12-23	17.4	4.2	15	20	35	17.4	4.2	15	20	35
C	24-35	29.5	3.3	17	18	35	29.5	3.3	17	18	35
D	36-71	56.4	9.6	22	13	35	56.4	9.6	22	13	35
E	72-143	97.0	16.6	15	20	35	97.0	16.6	15	20	35
	TOTAL			83	92	175			83	92	175

TABLE I (b)

DISTRIBUTION OF PATIENTS AND CONTROLS ACCORDING TO SOCIO-ECONOMIC STATUS

GROUP		A	B	C	D	E	TOTAL
Low Income Group	PATIENTS	11	11	7	8	10	47
	CONTROLS	11	11	7	8	10	47
Middle Income Group	PATIENTS	23	21	25	24	19	112
	CONTROLS	23	21	25	24	19	112
High Income Group	PATIENTS	1	3	3	3	6	16
	CONTROLS	1	3	3	3	6	16
	TOTAL	70	70	70	70	70	350

Table II and Figure I show the distribution of cardiac defects in the different age groups. It was observed that VSD was the most frequent cardiac defect in all age groups. PDA decreased in frequency with advancing chronological age with no cases recorded after the age of 5 years, whereas PS and ASD increased with age. The frequency of TOF fluctuated with age.

Table III and Figure II show the mean heights of patients in the different age groups. All the mean heights of patients were below control values.

Table IV and Figure III show the heights of each of the patients in relation to the control values. 164/175 (93.7%) of the patients fell below the control values. Only 11/175 (6.3%) of the patients had heights similar to or above the control values.

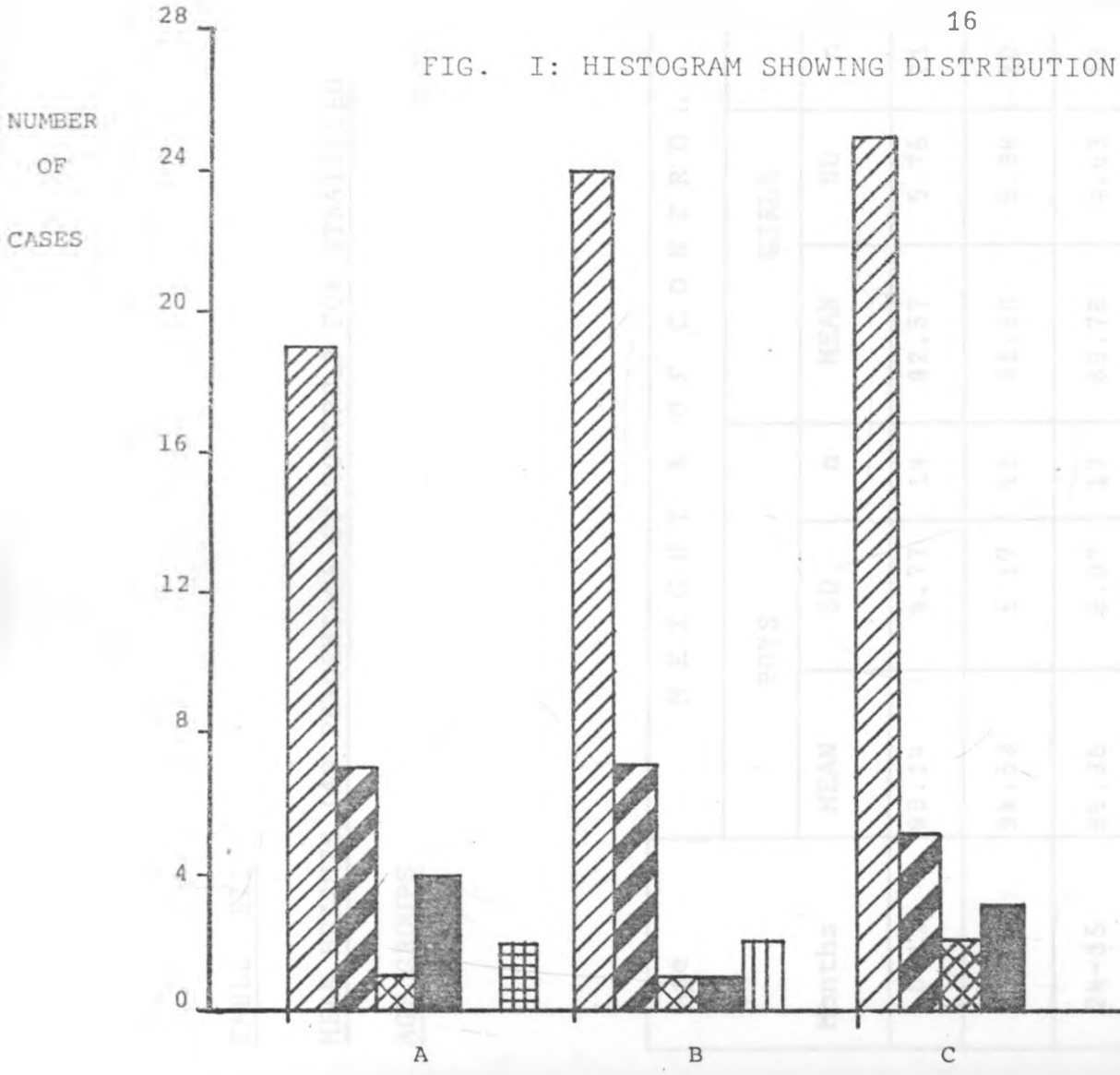
TABLE II

DISTRIBUTION OF CARDIAC DEFECTS

GROUP	A	B	C	D	E	TOTAL	%
VSD	21	24	25	17	20	107	61.1
PDA	7	7	5	5	0	24	13.7
PS	1	1	2	4	9	17	9.7
TOF	4	1	3	5	3	16	9.1
ASD	0	2	0	3	3	8	4.6
OTHER	2	0	0	1	0	3	1.7
TOTAL	35	35	35	35	35	175	

VSD - Ventricular Septal Defect
PDA - Patent Ductus Arteriosus
PS - Pulmonary Stenosis
TOF - Tetralogy of Fallot
ASD - Atrial Septal Defect
OTHER - include one patient each of Tricuspid Atresia, Truncus Arteriosus, and Endocardial Cushion Defect.

FIG. I: HISTOGRAM SHOWING DISTRIBUTION



OF CARDIAC DEFECTS

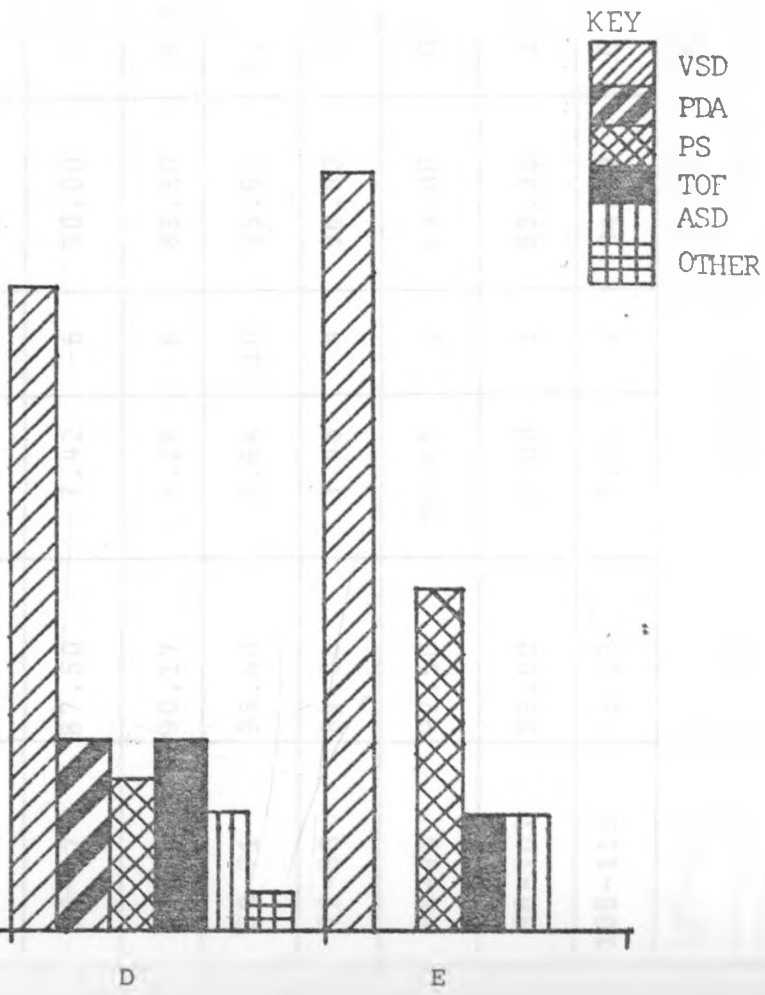
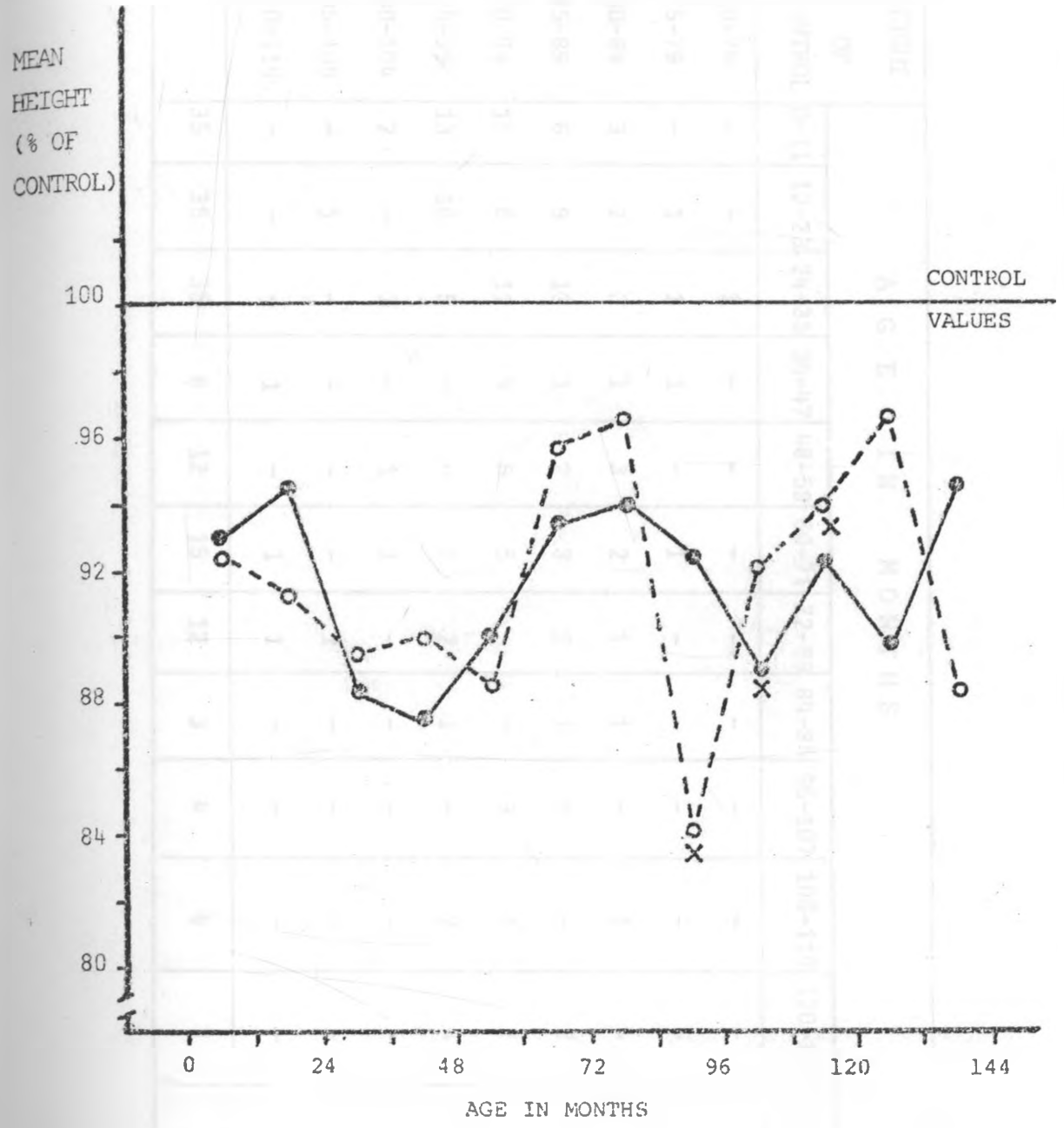


TABLE III

MEAN HEIGHTS (AS PERCENTAGE OF CONTROL) FOR STRATIFIED AGE GROUPS

Age in Months	HEIGHT % OF CONTROL					
	BOYS			GIRLS		
	MEAN	SD	n	MEAN	SD	n
0-11	93.14	4.77	14	92.57	5.76	21
12-23	94.53	5.17	15	91.30	5.98	20
24-35	88.35	6.07	17	89.78	4.63	18
36-47	87.50	7.42	6	90.00	0.00	2
48-59	90.17	4.26	6	88.50	6.63	6
60-71	93.40	8.64	10	95.80	11.48	5
72-83	94.00	3.46	4	96.63	9.23	8
84-95	92.50	10.61	2	84.00	0.00	1
96-107	89.00	0.00	1	92.33	2.08	3
108-119	92.33	7.23	3	94.00	0.00	1
120-131	89.67	7.23	3	96.75	4.50	4
132-143	94.50	23.33	2	88.33	11.15	3

FIG. II: MEAN HEIGHTS (% CONTROL) FOR AGE



KEY:

●—●: BOYS

o-o: GIRLS

X : ONLY ONE OBSERVATION

All mean heights of patients (boys and girls) were below control values.

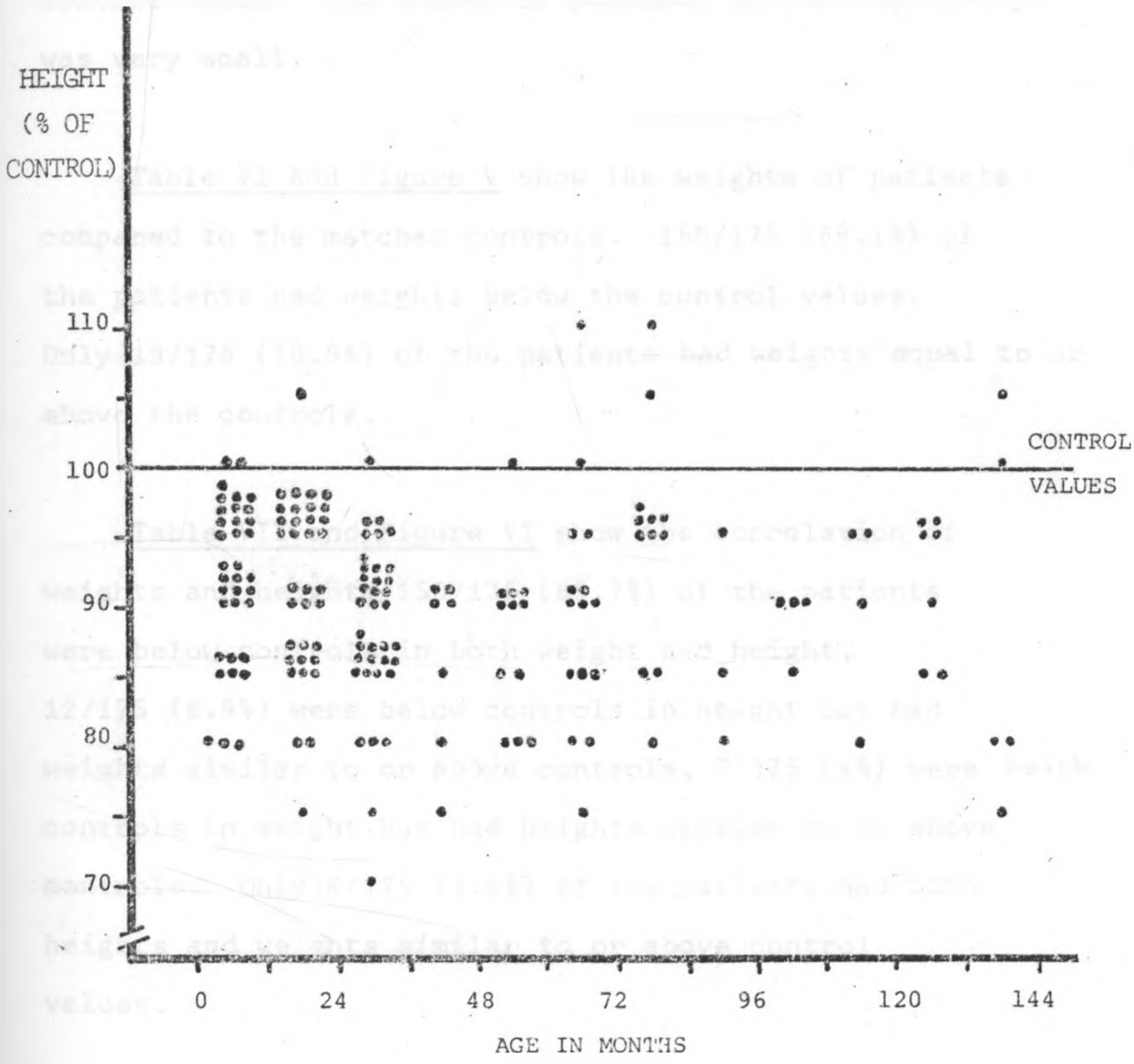
TABLE IV

HEIGHT (AS % OF CONTROL) FOR STRATIFIED AGE GROUPS

HEIGHT % OF CONTROL	A G E I N M O N T H S												TOTAL
	0-11	12-23	24-35	36-47	48-59	60-71	72-83	84-95	96-107	108-119	120-131	132-143	
70-74	-	-	1	-	-	-	-	-	-	-	-	-	1
75-79	-	1	1	1	-	1	-	-	-	-	-	1	5
80-84	3	2	3	1	3	2	1	1	-	1	-	2	17
85-89	6	9	13	1	2	3	2	1	1	-	2	-	41
90-94	11	6	11	4	6	5	-	-	3	1	1	-	45
95-99	13	16	5	-	-	2	7	1	-	2	4	-	53
100-104	2	-	1	-	1	1	-	-	-	-	-	1	7
105-109	-	1	-	-	-	-	1	-	-	-	-	1	3
110-114	-	-	-	1	-	1	1	-	-	-	-	-	3
	35	35	35	8	12	15	12	3	4	4	7	5	175

FIG. III:

CORRELATION DIAGRAM OF HEIGHT (% OF CONTROL) AND AGE



KEY:

● : EACH OBSERVATION

164/175 (93.7%) patients had heights below control values.

Table V and Figure IV show the mean weights of patients with CHD. All the mean weights of patients were much lower than the control values. However in boys aged 108-119 months, the mean weight was above the control value. The number of patients in this age group was very small.

Table VI and Figure V show the weights of patients compared to the matched controls. 156/175 (89.1%) of the patients had weights below the control values. Only 19/175 (10.9%) of the patients had weights equal to or above the controls.

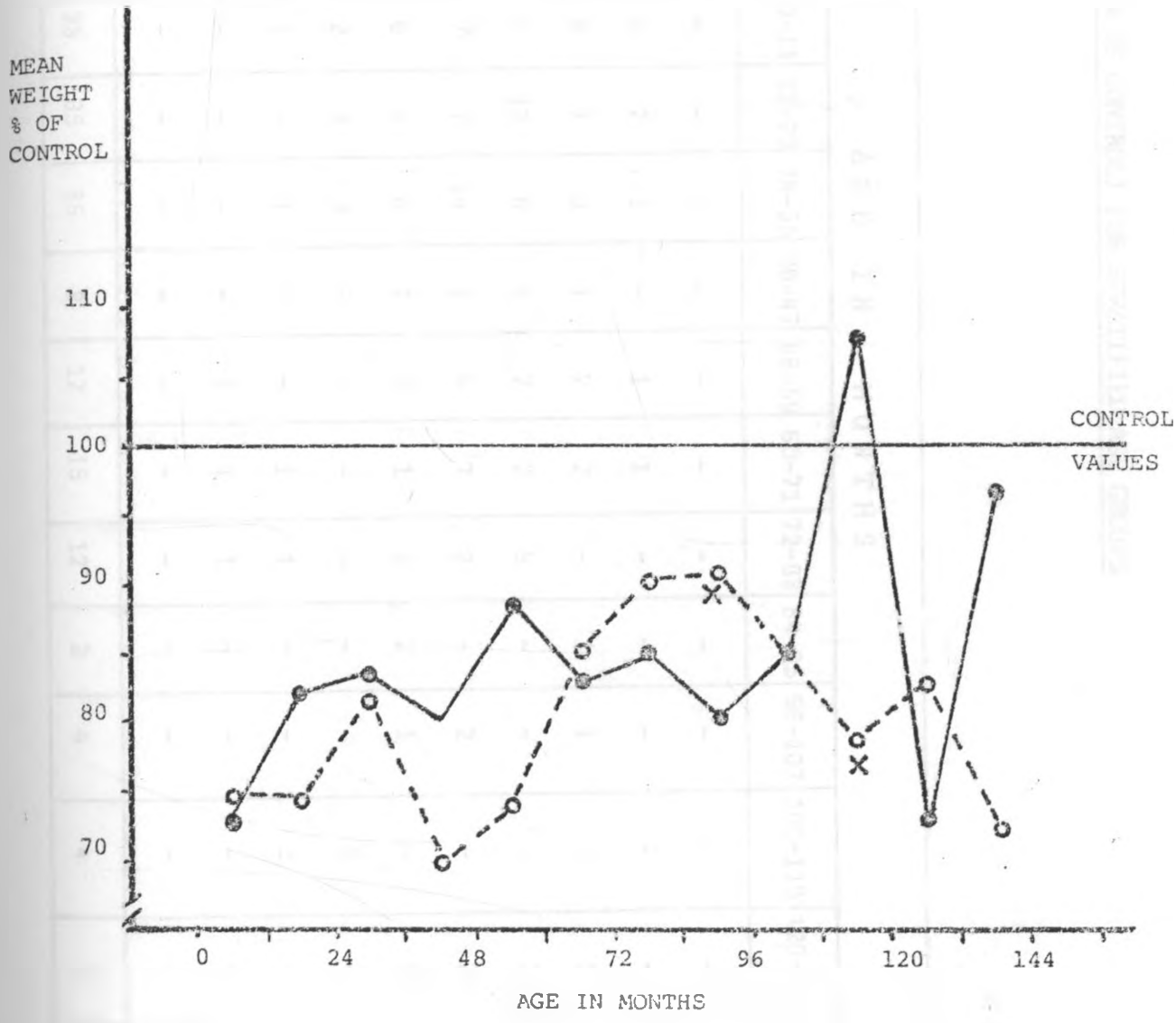
Table VII and Figure VI show the correlation of weights and heights. 150/175 (85.7%) of the patients were below controls in both weight and height, 12/175 (6.9%) were below controls in height but had weights similar to or above controls, 7/175 (4%) were below controls in weight but had heights similar to or above controls. Only 6/175 (3.4%) of the patients had both heights and weights similar to or above control values.

TABLE V

MEAN WEIGHTS (AS % CONTROL) FOR STRATIFIED AGE GROUPS

Age in Months	W E I G H T % O F C O N T R O L					
	BOYS			GIRLS		
	MEAN	SD	n	MEAN	SD	n
0-11	73.50	22.68	14	74.95	17.98	21
12-23	82.33	12.12	15	74.70	13.28	20
24-35	83.88	15.35	17	82.61	13.03	18
36-47	80.33	9.03	6	70.00	2.83	2
48-59	88.67	21.64	6	74.33	12.83	6
60-71	83.10	15.44	10	85.40	21.10	5
72-83	85.00	9.09	4	90.63	18.33	8
84-95	80.50	21.92	2	91.00	0.00	1
96-107	85.00	0.00	1	84.67	14.64	3
108-119	108.00	3.61	3	79.00	0.00	1
120-131	73.00	7.21	3	83.25	6.80	4
132-143	97.00	59.40	2	72.67	21.13	3

FIG. IV: MEAN WEIGHT (% OF CONTROL) FOR AGE



KEY

●—●: BOYS

○—○: GIRLS

X: ONLY ONE OBSERVATION

All mean weights of patients were below control values except for boys aged 108 - 119 months. The number of patients studied in this age group was only 3.

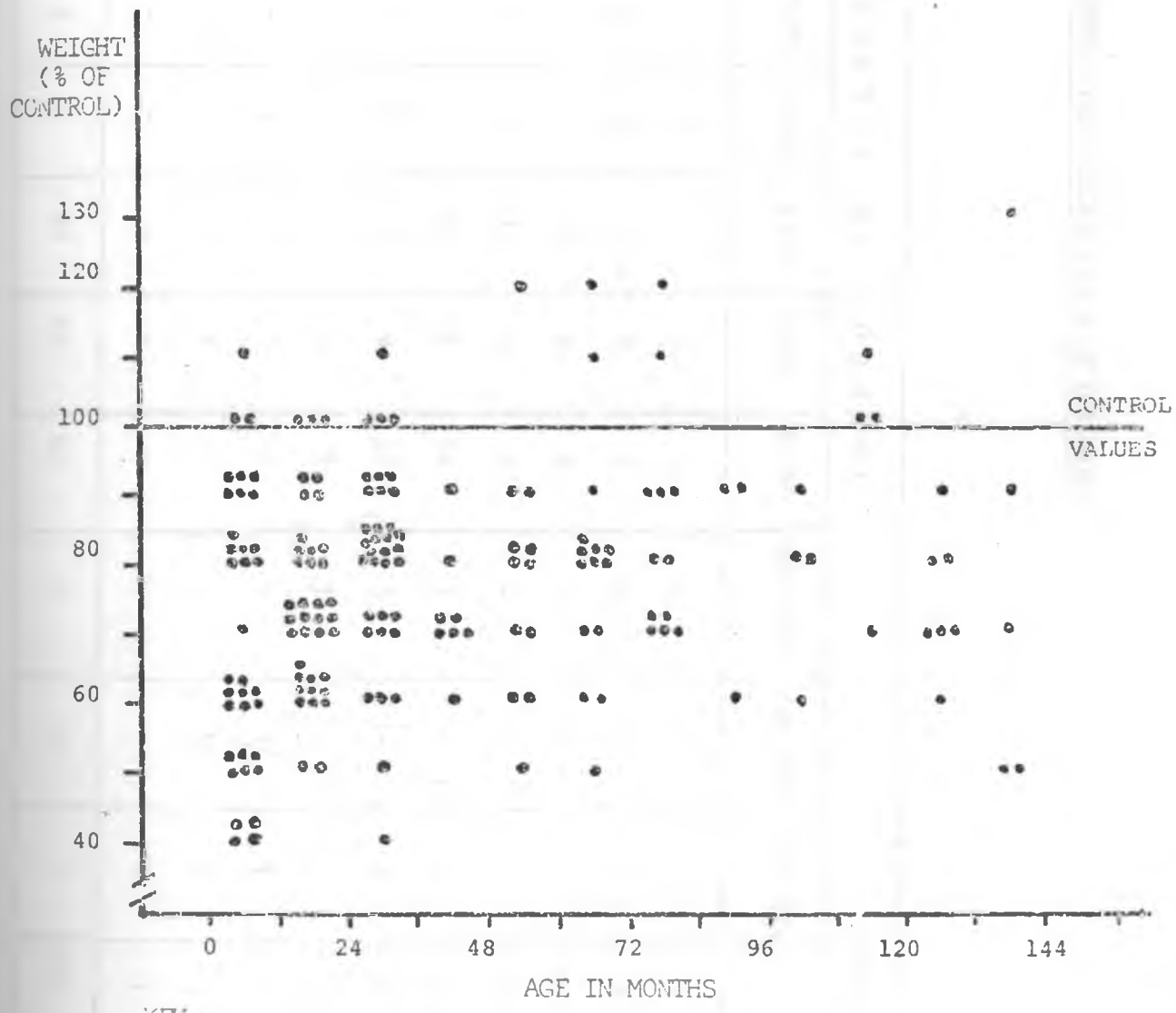
TABLE VI

WEIGHT (AS % OF CONTROL) FOR STRATIFIED AGE GROUPS

WEIGHT % OF CONTROL	AGE IN MONTHS												TOTAL
	0-11	12-23	24-35	36-47	48-59	60-71	72-83	84-95	96-107	108-119	120-131	132-143	
40-49	4	-	1	-	-	-	-	-	-	-	-	-	5
50-59	6	2	1	-	1	1	-	-	-	-	-	2	13
60-69	8	7	3	1	2	2	-	1	1	-	1	-	26
70-79	1	12	6	5	2	2	5	-	-	1	3	1	38
80-89	7	7	14	1	4	7	2	-	2	-	2	-	46
90-99	6	4	6	1	2	1	3	2	1	-	1	1	28
100-109	2	3	3	-	-	-	-	-	-	2	-	-	10
110-119	1	-	1	-	-	1	1	-	-	1	-	-	5
120-129	-	-	-	-	1	1	1	-	-	-	-	-	3
130-139	-	-	-	-	-	-	-	-	-	-	-	1	1
TOTAL	35	35	35	8	12	15	12	3	4	4	7	5	175

FIG. V

CORRELATION DIAGRAM OF WEIGHT (% OF CONTROL) AND AGE



KEY:

● : EACH OBSERVATION

156/175 (89.1%) of the patients had weights below control values

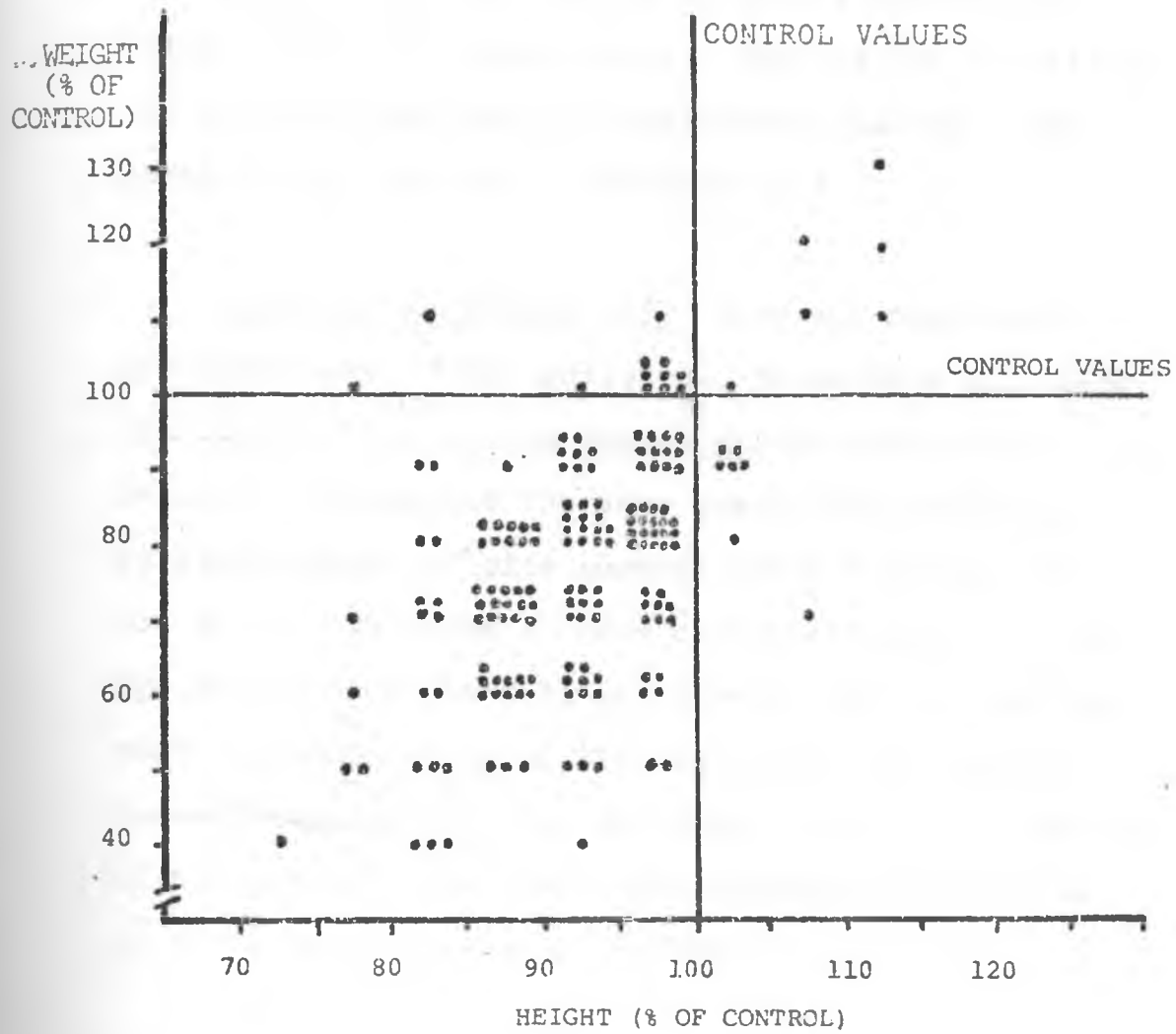
TABLE VII

WEIGHT (AS % OF CONTROL) FOR HEIGHT (AS % OF CONTROL)

WEIGHT % OF CONTROL	HEIGHT % OF CONTROL									TOTAL
	70-74	75-79	80-84	85-89	90-94	95-99	100-104	105-109	110-114	
40-49	1	-	3	-	1	-	-	-	-	5
50-59	-	2	3	3	3	2	-	-	-	13
60-69	-	1	2	11	8	4	-	-	-	26
70-79	-	1	4	15	9	8	-	1	-	38
80-89	-	-	2	10	14	19	1	-	-	46
90-99	-	-	2	1	8	12	5	-	-	28
100-109	-	1	-	-	1	7	1	-	-	10
110-119	-	-	1	1	-	1	-	1	1	5
120-129	-	-	-	-	1	-	-	1	1	3
130-139	-	-	-	-	-	-	-	-	1	1
TOTAL	1	5	17	41	45	53	7	3	3	175

FIG. VI

CORRELATION DIAGRAM OF WEIGHT (% OF CONTROL) AND HEIGHT (% OF CONTROL)



KEY:

● : EACH OBSERVATION

150/175 (85.7%) of the patients had both weights and heights below control values.

Table VIII and Figure VII show the mean head circumferences of patients in the different age groups. These were smaller than the control values especially in infancy with a tendency to rise towards the control values with advancing chronological age. In the age group 84-95 months, however, the head circumference of one girl was observed to be 92% of the control value, much lower than others. Only 65/175 (37.1%) of the patients had head circumferences similar to or above control values. (APPENDIX III).

Table IX and Figure VIII show the mean chest circumferences of the patients. These were all below the control values, the lowest values recorded in infancy. Thereafter the mean chest circumferences of patients tended to rise towards control values but not as much as those of head circumferences. In the age groups 36-47 months, and 108-119 months, low mean chest circumferences of 91% and 89% of the control values respectively were recorded. Only 51/175 (29.1%) of the patients had chest circumferences similar to or above control values. (APPENDIX III).

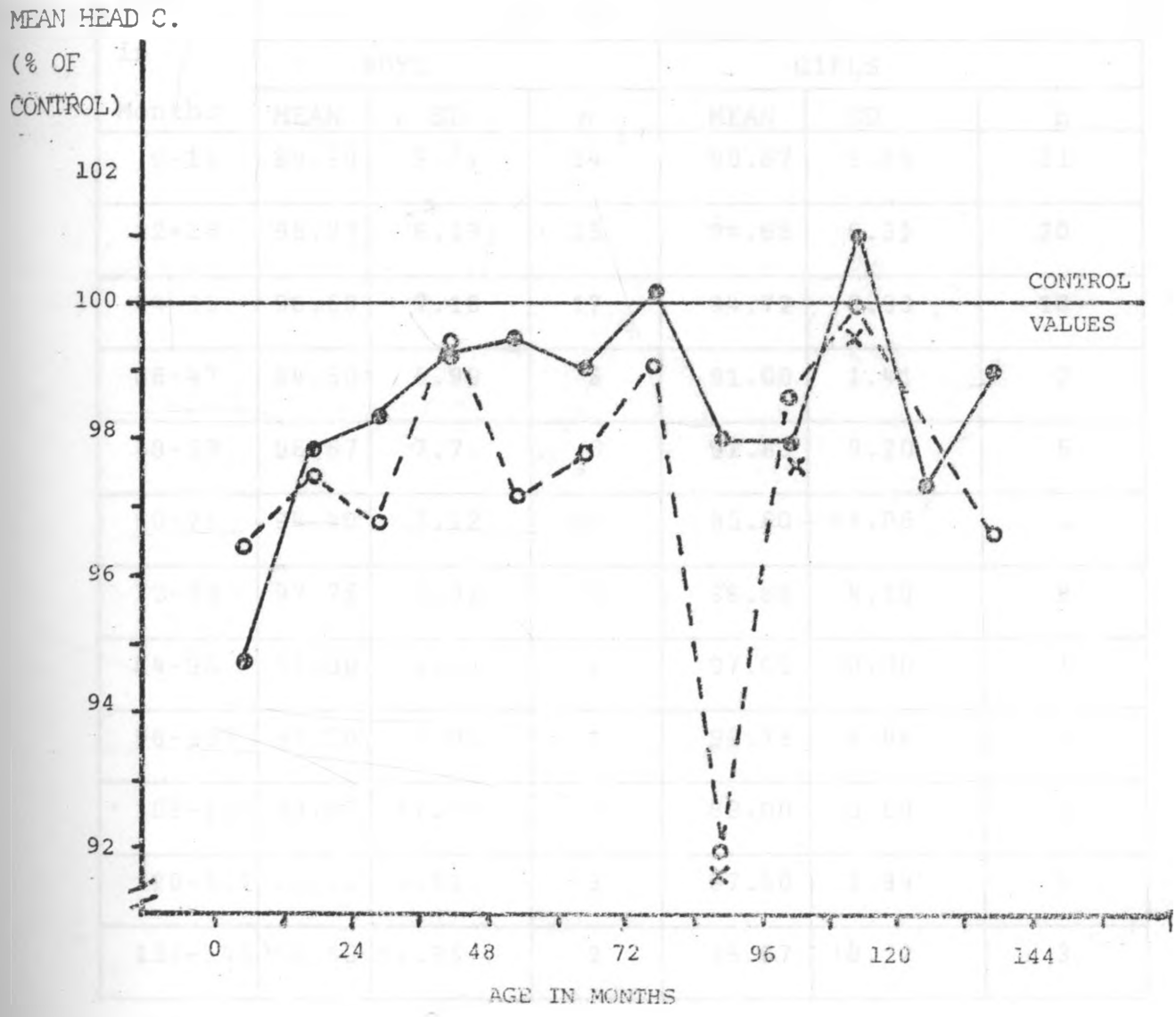
TABLE VIII

MEAN HEAD CIRCUMFERENCE (AS % OF CONTROL)

FOR STRATIFIED AGE GROUPS

Age in Months	HEAD CIRCUMFERENCE % OF CONTROL					
	BOYS			GIRLS		
	MEAN	SD	n	MEAN	SD	n
0-11	94.71	5.92	14	96.43	5.22	21
12-23	97.93	3.94	15	97.50	5.46	20
24-35	98.35	5.06	17	96.78	4.04	18
36-47	99.33	4.55	6	99.50	4.95	2
48-59	99.50	5.65	6	97.17	4.58	6
60-71	99.00	3.89	10	97.80	3.77	5
72-83	100.25	6.18	4	99.13	5.99	8
84-95	98.00	1.41	2	92.00	0.00	1
96-107	98.00	0.00	1	98.67	3.21	3
108-119	101.00	7.21	3	100.00	0.00	1
120-131	97.33	2.31	3	98.25	5.56	4
132-143	99.00	14.14	2	96.67	5.03	3

FIG. VII: MEAN HEAD CIRCUMFERENCE (% OF CONTROL) FOR AGE



KEY:

●——● :Boys

0- - -0 :Girls

:ONLY ONE OBSERVATION

The mean head circumferences of patients were lowest in infancy with a tendency to rise towards control values thereafter. However, the head circumference of one girl aged 84-96 months was only

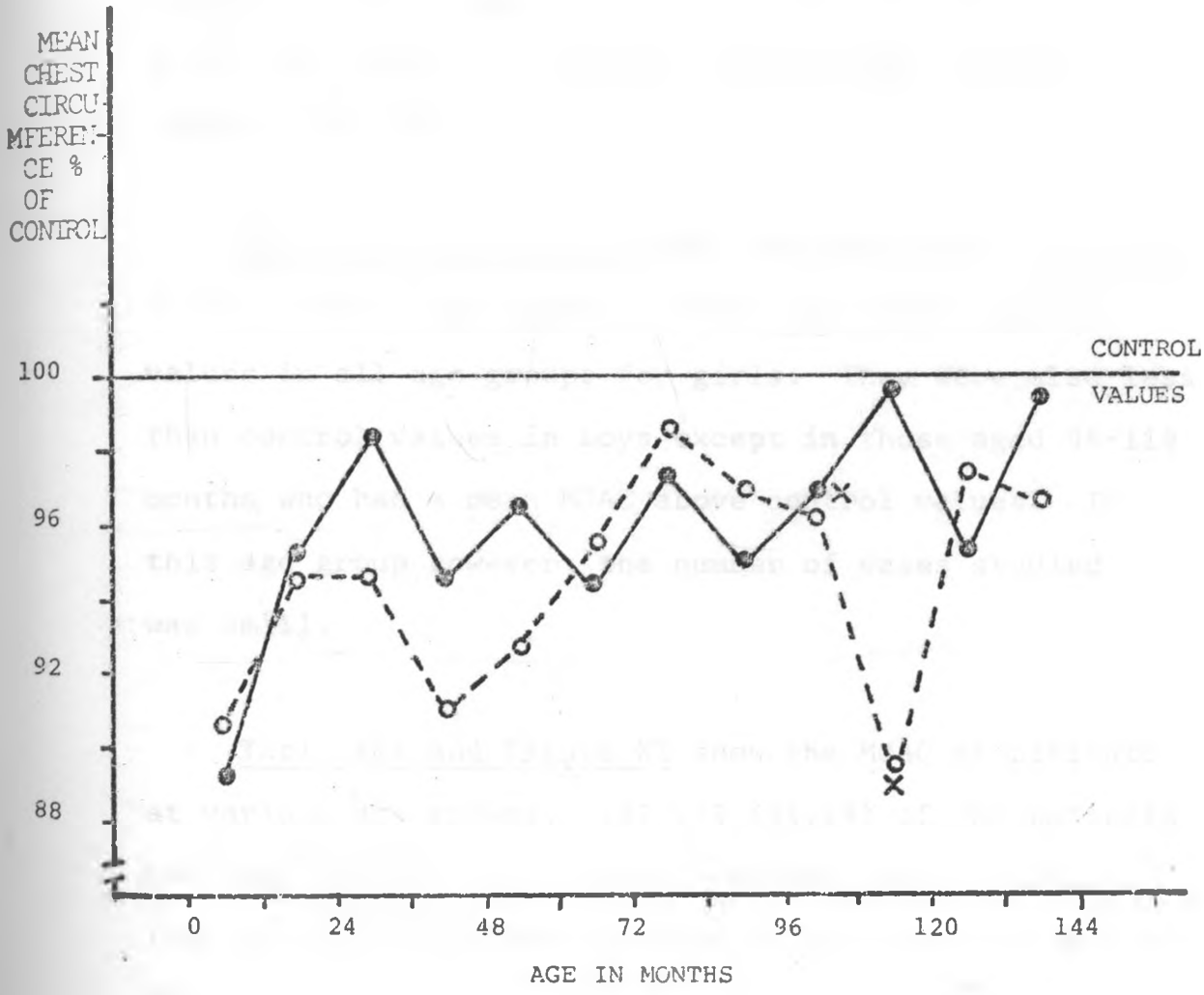
TABLE IX

MEAN CHEST CIRCUMFERENCE (AS % OF CONTROL)

FOR STRATIFIED AGE GROUPS

Age in Months	CHEST CIRCUMFERENCE % OF CONTROL					
	BOYS			GIRLS		
	MEAN	SD	n	MEAN	SD	n
0-11	89.29	9.54	14	90.67	9.85	21
12-23	95.27	6.13	15	94.65	6.31	20
24-35	98.59	7.18	17	94.72	6.93	18
36-47	94.50	5.99	6	91.00	1.41	2
48-59	96.67	7.74	6	92.83	9.20	6
60-71	94.40	7.12	10	95.60	11.06	5
72-83	97.75	5.32	4	98.88	4.19	8
84-95	95.00	4.24	2	97.00	0.00	1
96-107	97.00	0.00	1	96.33	4.04	3
108-119	99.67	12.70	3	89.00	0.00	1
120-131	95.33	4.51	3	97.50	2.89	4
132-143	99.50	14.85	2	96.67	10.12	3

FIG. VIII: MEAN CHEST CIRCUMFERENCE (% OF CONTROL) FOR AGE



KEY:

●——● : Boys

O---O : Girls

X : ONLY ONE OBSERVATION

All the mean chest circumferences of patients were below the control values.

Table X and Figure IX show the mean SFT of patients at various age groups. These were below control values except in the girls aged 84-95 months and boys aged 96-119 months. In these age groups the mean SFT were above control values. However the number of patients studied in each case was small. Only 39/175 (22.3%) of the patients had SFT equal to or above control values. (APPENDIX III).

Table XI and Figure X show the mean MUAC of patients at the various age groups. These were below control values in all age groups for girls. They were also less than control values in boys except in those aged 96-119 months who had a mean MUAC above control values. In this age group however, the number of cases studied was small.

Table XII and Figure XI show the MUAC of patients at various age groups. 142/175 (81.1%) of the patients had MUAC smaller than control values. Only 33/175 (18.9%) of the patients had MUAC equal to or above the control values

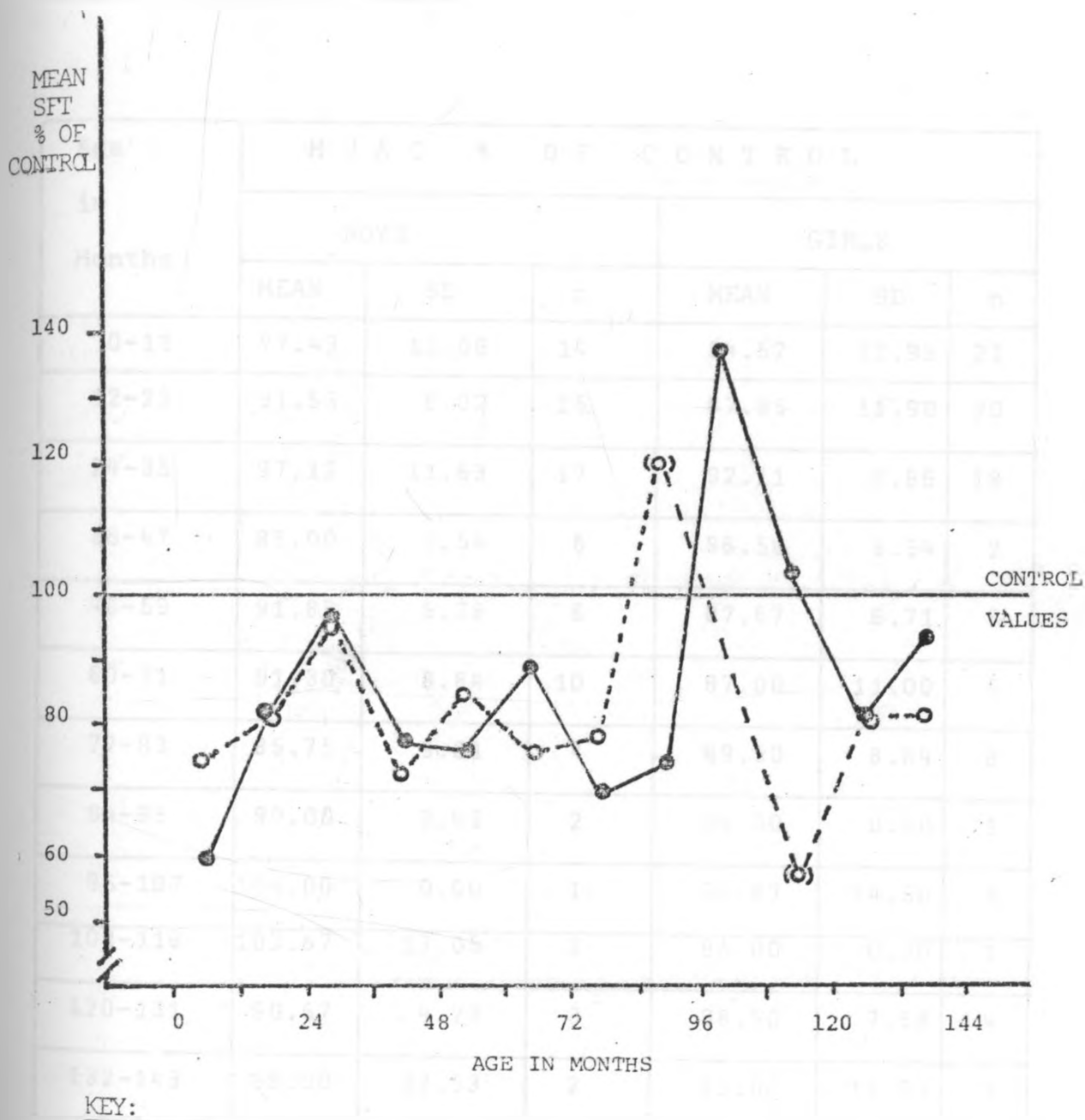
TABLE X

MEAN SKINFOLD THICKNESS (AS % OF CONTROL)

FOR STRATIFIED AGE GROUPS

Age in Months	S. F. T. % OF CONTROL					
	BOYS			GIRLS		
	MEAN	SD	n	MEAN	SD	n
0-11	59.50	26.26	14	74.43	31.01	21
12-23	80.20	19.76	15	80.10	24.19	20
24-35	96.53	21.28	17	96.11	19.76	18
36-47	77.00	11.31	6	71.50	13.44	2
48-59	75.67	12.31	6	84.83	19.02	6
60-71	87.60	24.72	10	74.60	21.79	5
72-83	68.00	5.94	4	76.50	13.51	8
84-95	72.50	2.12	2	119.00	0.00	1
96-107	135.00	0.00	1	92.67	38.73	3
108-119	101.00	24.02	3	54.00	0.00	1
120-131	78.67	11.02	3	78.75	14.89	4
132-143	91.00	7.07	2	79.00	15.00	3

FIG. IX MEAN SFT (% CONTROL) FOR AGE



KEY:

●—● Boys

O---O Girls

( ) ONE OBSERVATION

All the mean SFT of patients were below controls except in girls aged 84-95 months and boys aged 108-119 months in which the numbers of patients studied were very small.

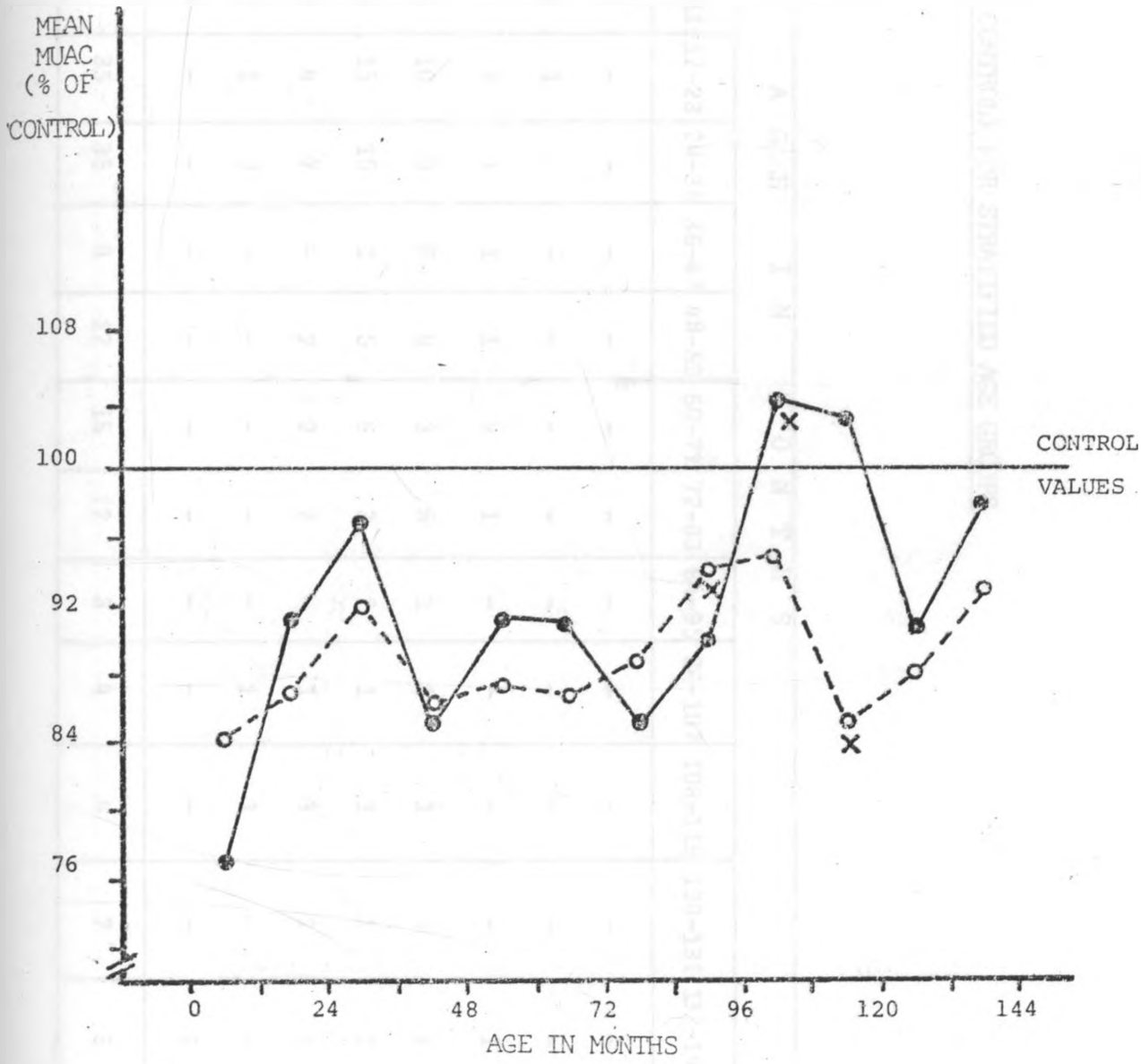
TABLE XI

MEAN MID-UPPER ARM CIRCUMFERENCE (MUAC) (AS % OF CONTROL)

FOR STRATIFIED AGE GROUPS

Age in Months	MUAC % OF CONTROL					
	BOYS			GIRLS		
	MEAN	SD	n	MEAN	SD	n
0-11	77.43	15.08	14	84.52	12.93	21
12-23	91.53	8.02	15	87.85	11.90	20
24-35	97.12	11.63	17	92.11	8.66	18
36-47	85.00	6.54	6	86.50	3.54	2
48-59	91.83	5.78	6	87.67	9.71	6
60-71	91.30	8.84	10	87.00	11.00	5
72-83	85.75	9.81	4	89.50	8.64	8
84-95	90.00	2.83	2	94.00	0.00	1
96-107	104.00	0.00	1	95.67	14.50	3
108-119	103.67	13.05	3	85.00	0.00	1
120-131	90.67	4.73	3	88.50	7.68	4
132-143	98.00	32.53	2	93.00	11.53	3

FIG. X: MEAN MUAC (% OF CONTROL) FOR AGE



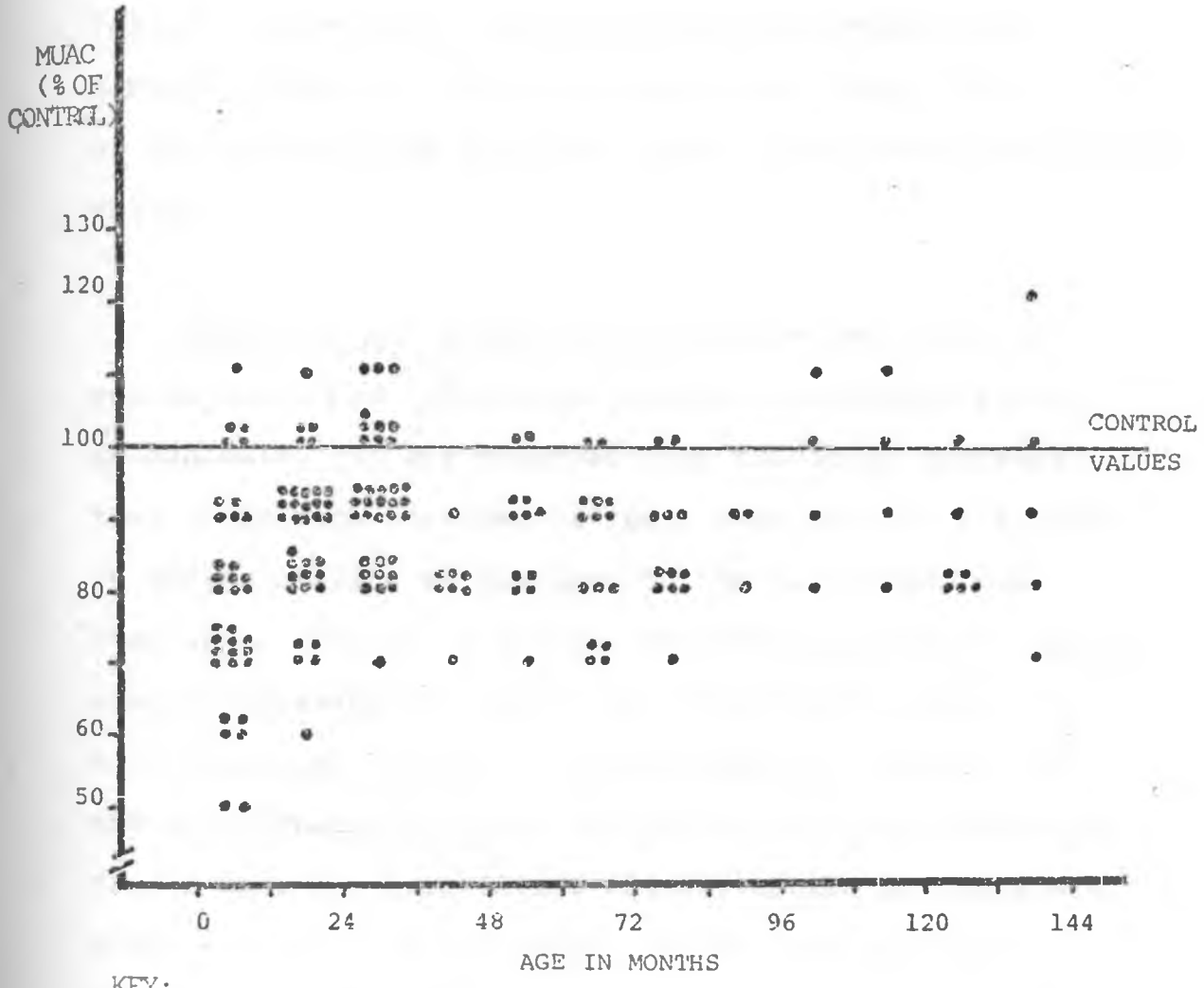
All mean MUAC of patients were below control values in girls. In boys all mean MUAC were below controls except in age group 96-119 months. The number of patients studied in this age group was only 8.

TABLE XII

MUAC (AS % OF CONTROL) FOR STRATIFIED AGE GROUPS

MUAC	AGE IN MONTHS												TOTAL
% CONTROL	0-11	12-23	24-35	36-47	48-59	60-71	72-83	84-95	96-107	108-119	120-131	132-143	
50-59	2	-	-	-	-	-	-	-	-	-	-	-	2
60-69	4	1	-	-	-	-	-	-	-	-	-	-	5
70-79	11	4	1	1	1	4	1	-	-	-	-	1	24
80-89	8	10	9	6	4	3	5	1	1	1	5	1	55
90-99	5	15	15	1	5	6	3	2	1	1	1	1	56
100-109	4	4	7	-	2	2	2	-	1	1	1	1	25
110-119	1	1	3	-	-	-	-	-	1	1	-	-	7
120-129	-	-	-	-	-	-	-	-	-	-	-	1	1
TOTAL	35	35	35	8	12	15	12	3	4	4	7	5	175

FIG. XI: CORRELATION DIAGRAM OF MUAC (% CONTROL) AND AGE



KEY:

● : EACH OBSERVATION

142/175 (81.1%) of patients had MUAC below control values.

Table XIII and Figure XII show the mean bone age of patients expressed as % of mean bone age of controls. Due to lack of local standards for bone age, the hand X-rays of patients and controls were analysed using Greulich and Pyle standards. The values obtained for patients were then expressed as mean % of control values. These were found to be markedly below the control values for both boys and girls. Only 27/175 (15.4%) of the patients had bone ages equal to or above the control values.

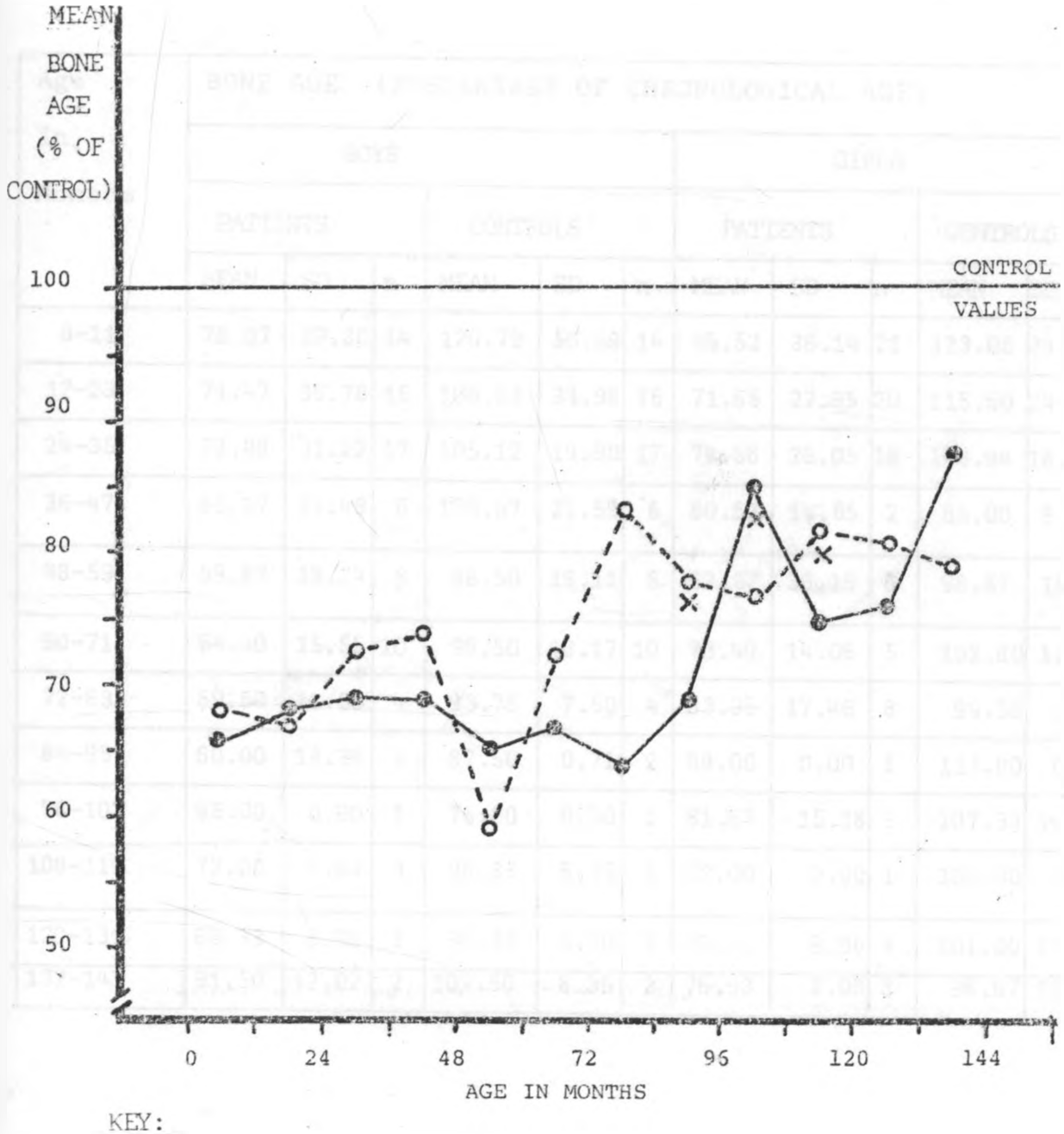
Table XIV and Figure XIII show the mean bone age expressed as % of chronological age for patients as well as controls. It was observed that the local controls tend to be more advanced in their bone age for the first 36 months of life as compared to the given European standards. Beyond 36 months, the bone age fell to values almost comparable to the given standards in girls but a little lower in boys. The patients had delayed bone age most marked in girls aged 36-60 months and boys aged 48-102 months. Only 27/175 (15.4%) of the patients had bone ages similar to or above the matched controls. There was a low negative correlation between bone age and advancing chronological age, r= -0.056 for patients and r=-0.301 for controls.

TABLE XIII

MEAN BONE AGE (AS % OF CONTROL) FOR STRATIFIED AGE GROUPS

Age in Months	BONE AGE % OF CONTROL					
	BOYS			GIRLS		
	MEAN	SD	n	MEAN	SD	n
0-11	66.57	24.91	14	68.24	24.80	21
12-23	68.27	33.82	15	67.20	32.09	20
24-35	69.12	25.84	17	72.89	23.41	18
36-47	69.17	21.13	6	74.00	24.04	2
48-59	65.33	16.79	6	59.17	26.89	6
60-71	67.30	15.18	10	72.60	18.77	5
72-83	64.25	16.74	4	83.63	18.23	8
84-95	69.00	22.63	2	78.00	0.00	1
96-107	85.00	0.00	1	77.00	18.36	3
108-119	75.00	13.53	3	82.00	0.00	1
120-131	76.33	5.51	3	81.00	19.97	4
132-143	87.50	6.36	2	79.00	7.00	3

FIG. XII: MEAN BONE AGE (% OF CONTROL) FOR EACH AGE GROUP



KEY:

●—● : BOYS
O--O : GIRLS
X : ONLY ONE OBSERVATION

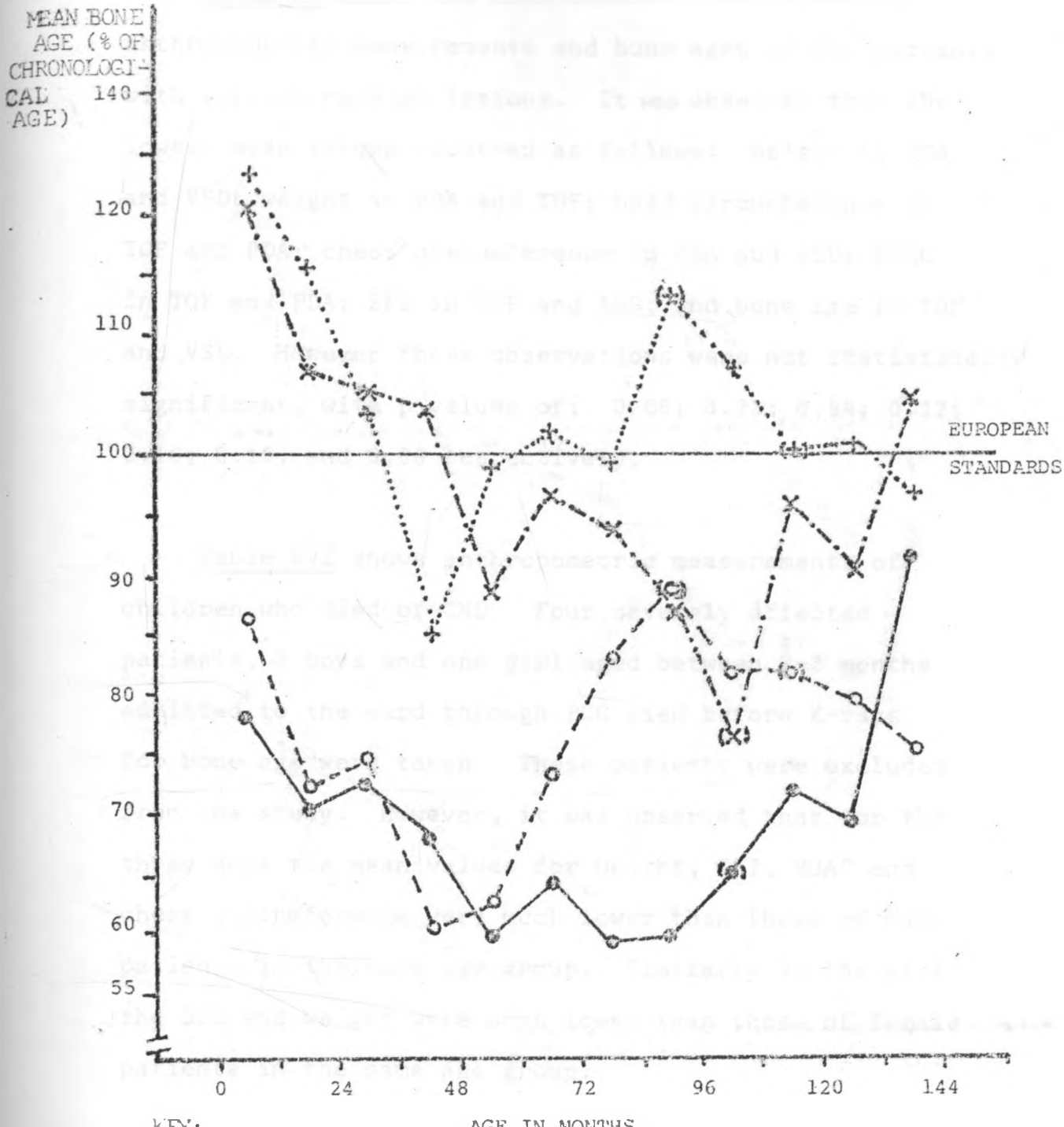
All mean bone ages of patients were markedly below control values.

TABLE XIV

MEAN BONE AGE (AS % OF CHRONOLOGICAL AGE) FOR STRATIFIED AGE GROUPS

Age in Months	BONE AGE (PERCENTAGE OF CHRONOLOGICAL AGE)											
	BOYS						GIRLS					
	PATIENTS			CONTROLS			PATIENTS			CONTROLS		
	MEAN	SD	n	MEAN	SD	n	MEAN	SD	n	MEAN	SD	n
0-11	78.07	27.30	14	120.79	30.59	14	86.52	36.14	21	123.05	34.81	21
12-23	71.47	36.78	15	106.53	31.98	15	71.65	27.95	20	115.50	24.22	20
24-35	72.88	31.22	17	105.12	19.90	17	74.56	26.05	18	103.94	18.69	18
36-47	68.17	12.48	6	103.67	21.59	6	60.50	14.85	2	85.00	8.49	2
48-59	59.67	19.24	6	88.50	18.11	6	62.67	33.16	6	98.67	15.87	6
60-71	64.40	15.55	10	96.50	16.17	10	73.40	14.06	5	102.80	11.52	5
72-83	59.50	11.00	4	93.75	7.50	4	83.35	17.46	8	99.38	2.77	8
84-95	60.00	18.38	2	87.50	0.71	2	69.00	0.00	1	113.00	0.00	1
96-107	65.00	0.00	1	76.00	0.00	1	81.67	15.18	3	107.33	14.47	3
108-119	72.00	9.64	3	96.33	6.35	3	82.00	0.00	1	100.00	0.00	1
120-131	69.33	6.66	3	90.33	9.50	3	79.75	8.96	4	101.00	12.27	4
132-143	91.50	12.02	2	104.50	6.36	2	76.33	2.08	3	96.67	10.69	3

FIG. XIII: MEAN BONE AGE (% OF CHRONOLOGICAL AGE) FOR EACH AGE GROUP



KEY:

+...+: GIRLS - (CONTROLS)
X-.-X: BOYS - (CONTROLS)
O---O: GIRLS - (PATIENTS)
●——●: BOYS - (PATIENTS)
( ): ONLY ONE OBSERVATION

The mean bone ages of the local controls were higher than those of the European standards used for the first 36 months.

Table XV shows the mean values of the different anthropometric measurements and bone ages of the patients with various cardiac lesions. It was observed that the lowest mean values occurred as follows: height in PDA and VSD; weight in PDA and TOF; head circumference in TOF and PDA; chest circumference in PDA and VSD; MUAC in TOF and PDA; SFT in TOF and ASD; and bone age in TOF and VSD. However these observations were not statistically significant, with p values of; 0.06; 0.23; 0.54; 0.12; 0.16; 0.15; and 0.86 respectively.

Table XVI shows anthropometric measurements of children who died of CHD. Four severely affected patients, 3 boys and one girl aged between 2-5 months admitted to the ward through PCC died before X-rays for bone age were taken. These patients were excluded from the study. However, it was observed that for the three boys the mean values for weight, SFT, MUAC and chest circumference were much lower than those of male patients in the same age group. Similarly in the girl the SFT and weight were both lower than those of female patients in the same age group.

TABLE XV

MEAN (AS % OF CONTROL) OF HEIGHT,WEIGHT,HEAD CIRCUMFERENCE, CHEST CIRCUMFERENCE, MUAC, SFT, AND BONE AGE FOR DIFFERENT CARDIAC LESIONS

		VSD	PDA	PS	TOF	ASD	OTHER	X^2	P Value
HEIGHT	MEAN	91.40	91.33	92.12	92.75	91.50	103.67	10.38	0.06
	SD	6.40	5.80	7.58	5.83	9.07	8.96		
WEIGHT	MEAN	80.48	76.79	84.35	79.75	82.25	101.33	6.84	0.23
	SD	16.76	13.88	15.58	16.04	24.29	16.92		
HEAD CIRCUM-FERENCE	MEAN	97.52	97.13	98.59	96.94	98.88	102.00	4.09	0.54
	SD	5.11	4.19	5.10	4.85	5.57	2.00		
CHEST CIRCUM-FERENCE	MEAN	94.09	93.54	97.18	95.38	95.88	105.00	8.55	0.12
	SD	7.52	7.51	7.17	9.32	7.14	8.89		
MUAC	MEAN	88.83	87.58	95.41	85.94	93.50	91.67	7.83	0.16
	SD	12.17	11.23	11.03	8.54	12.12	1.53		
SFT	MEAN	81.83	81.29	89.71	69.31	79.63	99.67	8.11	0.15
	SD	24.71	21.77	25.64	21.50	22.06	2.89		
BONE AGE	MEAN	69.32	75.17	70.06	67.31	70.88	80.00	1.94	0.86
	SD	24.64	27.93	15.22	20.77	26.88	3.6		

TABLE XVI

MEAN (AS % OF CONTROL) OF ANTHROPOMETRIC MEASUREMENTS OF CHILDREN WHO DIED OF CHD AS COMPARED TO OTHER PATIENTS

AGE IN MONTHS	MEAN AS % OF CONTROL											
	BOYS						GIRLS					
0-11	ALIVE			DEAD			ALIVE			DEAD		
	MEAN	SD	n	MEAN	SD	n	MEAN	SD	n	MEAN	SD	n
HEIGHT	93.14	4.77	14	89.98	5.25	3	92.57	5.76	21	92.18	0.00	1
WEIGHT	73.50	22.68	14	48.29	8.31	3	74.95	17.98	21	62.23	0.00	1
HEAD CIRC.	94.71	5.92	14	88.52	3.13	3	96.43	5.22	21	89.41	0.00	1
CHEST CIRC.	89.29	9.54	14	75.52	7.28	3	90.67	9.85	21	83.52	0.00	1
MUAC	77.43	15.08	14	58.01	8.38	3	84.52	12.93	21	83.33	0.00	1
SFT	59.50	26.26	14	36.98	11.41	3	74.43	31.01	21	43.05	0.00	1

Table XVII shows the overall mean values of each anthropometric measurement and bone age. It was observed that the mean values as % of control were lowest in bone age, weight, SFT and MUAC and highest in head circumference, chest circumference and height.

TABLE XVII

OVERALL MEAN OF EACH VARIABLE STUDIED

VARIABLE	MEAN	SD	n
HEIGHT (% OF CONTROL)	91.80	6.67	175
WEIGHT (% OF CONTROL)	80.72	16.71	175
HEAD CIRCUMFERENCE (OF CONTROL)	97.66	4.95	175
CHEST CIRCUMFERENCE (% OF CONTROL)	94.70	7.75	175
MUAC (% OF CONTROL)	89.30	11.68	175
SFT (% OF CONTROL)	81.58	24.10	175
BONE AGE (% OF CONTROL)	70.26	23.81	175
BONE AGE OF PATIENT (% OF CHRONOLOGICAL AGE)	73.90	26.54	175
BONE AGE OF CONTROL (% OF CHRONOLOGICAL AGE)	106.59	24.33	175

DISCUSSION:

The group of patients presented in this study was highly selected and the pattern of cardiac lesions encountered does not necessarily reflect that of CHD in the general or hospital population. However, comparison of anthropometric measurements and bone ages of fully diagnosed patients with those of their controls matched for age, sex and socio-economic status is valid.

The male to female ratio of patients with CHD in this study was 1:1.1 (Table Ia). The most frequent cardiac lesion in all age groups was VSD with an overall frequency of 61.1%. PDA occurred in 13.7% of patients, PS in 9.7%, TOF in 9.1%, and ASD in 4.6% of the patients (Table II and Figure I).

HEIGHT AND WEIGHT:

The mean heights of patients were lower than the control values in all age groups. These values fluctuated between 84-96% of the mean values for controls (Table III and Figure II). 164/175 (93.7%) of the patients had heights below the control values, of normal children matched for age, sex, and socio-economic status. In some of these patients the heights were as low as 70% of the expected values (Table IV and Figure III).

Only 11/175 (6.3%) of the patients were as tall as or a little taller than the controls. The variations in the heights of these patients were not surprising as the study population was heterogenous both in type and severity of the cardiac lesions (APPENDIX III). It was observed for example, that patients with large left to right shunts who had already developed pulmonary hypertension were more affected than other patients with similar lesions without complications (APPENDIX III). Many workers have reported retardation in height in all patients with CHD [16,17,18,19]. The severity of the retardation was found to be dependent on the anatomic lesion and its functional effects. Children with mild defects were noted to grow normally [9]. The eleven patients with similar heights to the controls can be assumed to be those with mild cardiac defects or those who were picked incidentally from child welfare clinics.

The mean weights of the patients were markedly below the control values, most lying between 70-90% of the mean values for controls (Table V and Figure IV). 156/175 (89.1%) of the patients had weights below the control values. Some individual readings were as low as 40% of the control values (Table VI and Figure V).

Only 19/175 (10.9%) of the patients weighed as much as or a little more than their normal counterparts. These could have been patients with mild defects. Workers elsewhere have also noted retardation in weight in all patients with CHD [16,17,18,19]. Weight was more affected than height in acyanotic conditions whereas the two parameters were equally suppressed in the cyanotic conditions [19]. In this study however, there were no statistically significant differences in the heights and weights of children with different cyanotic and acyanotic cardiac lesions with p values of 0.06, and 0.23 respectively (Table XV). This was in agreement with Feldt et al who noted no significant difference in growth between cyanotic and acyanotic children with congenital heart disease (CHD) [13]. The majority of patients in this study (89.7%) had acyanotic congenital heart disease (CHD) compared to (10.3%) with cyanotic CHD (Table II Figure I). The differences between the two groups if any may not be obvious just because of the small number of cyanotic children with CHD.

It is worthy of note that corrective surgery results in acceleration of growth, catch up growth and subsequent return to normal dimensions [9]. This has been documented in PDA [12], VSD, TOF, and PS [13]; however, surgical closure of an ASD does not significantly affect the patient's height or weight percentile [13]. In one study including 50 patients with isolated PDA and growth impairement

(both height and weight below the 10th percentile) return to normal heights and weights occurred 6 months after corrective surgery in 30% of cases [9]. Better results are to be expected when corrective surgery is done at an early age [9].

Since there were no differences in heights and weights of children with CHD in the different socio-economic groups, it would appear that growth failure associated with CHD is not directly related to availability of food.

SKINFOLD THICKNESS, HEAD, CHEST AND MID UPPER ARM CIRCUMFERENCES:

There is a paucity of literature on work on skinfold thickness, head, chest and mid upper arm circumferences in children with CHD.

In this study, the mean values of SFT of patients were below the control values in most age groups (Table X and Figure IX). These values fluctuated between 60-90% of the control values. In girls aged 84-95 months and boys aged 108- 119

months, the mean values of SFT were above control values, but the number of patients studied in each case were small. Only 39/175 (22.3%) of the patients had SFT equal to or above control values (APPENDIX III).

The mean head circumferences of patients were lower than the control values (Table VIII and Figure VII). The lowest values were recorded in infancy, after which they rose and fluctuated between 97-101% of the control values. Head circumference was the least affected compared to height and weight. However, only 65/175 (37.1%) of the patients had head circumferences similar to or above control values (APPENDIX III). Naeye observed that the brain weights of stillbirths with CHD did not vary significantly from control values; however,at subsequent ages, relative post-mortem brain weights in infants with malformed hearts progressively decreased to approximately two standard deviations below the mean value for controls [4,9]. The small head circumferences in children with CHD observed in this study may therefore represent a comparatively smaller brain mass.

The mean chest circumferences of patients were lower than the control values (Table IX and Figure VIII). The lowest values were recorded in infancy after which there was a rise towards control values. Most mean values were between 92-99% of the control values. However only 51/175 (29.1%) of the patients had chest circumferences similar to or above control values (APPENDIX III).

The mean mid upper arm circumferences of patients were lower than the control values in both boys and girls (Table XI and Figure X). In boys aged 95-119 months, however the mean MUAC was higher than the control value. The number of cases studied was very small in this age group (Table XI). 142/175 (81.1%) of patients had MUAC below the control values (Table XII and Figure XI).

BONE AGE:

The mean bone ages of patients were markedly lower than the control values (Table XIII and figure XII). 148/175 (84.6%) of the patients had bone ages below control values (APPENDIX III). These findings were in agreement with those of Danilowicz [20] which demonstrated retardation of bone age in children with CHD. He found this to be more marked in children with cyanotic CHD as compared to those with acyanotic CHD. In this study

however there was no statistically significant difference in bone ages of children with the different cyanotic and acyanotic CHD, P= 0.86 (Table XV).

Incidentally it was observed that the local controls had more advanced bone age in the first 36 months of life compared to the standards for European counterparts used [40]. This, too, coincided with the observations of many clinicians that the average African child is much more advanced developmentally compared with the European counterpart up to 3 years [41]. This brought to light the need for local standards for bone age.

Finally, this study had not addressed itself to the elucidation of the mechanisms of the global growth failure that has clearly been demonstrated in children with CHD. However, it serves as a stimulus for research into the possible mechanisms of growth failure. The hypotheses advanced include inadequate nutrient and caloric intake, gastrointestinal malabsorption and protein losing enteropathy, hypermetabolism, hypoxaemia and metabolic acidosis, apart from severe haemodynamic abnormality especially congestive heart failure, recurrent respiratory infections, intrauterine growth retardation, emotional disturbance, physical incapacity, associated extracardiac anomalies and associated recognizable syndromes [9].

CONCLUSION:

1. It is abundantly clear from this study that CHD is associated with both physical and skeletal growth retardation compared to normal controls matched for age, sex and socio-economic status.

2. There is no significant difference in growth of children with the different cyanotic and acyanotic cardiac lesions.

3. Inclusion of children with more complex and severe lesions into this study would have emphasized further the already obvious growth retardation.

RECOMMENDATION:

1. As the normal African child appears to be more advanced in bone age than the European counterpart up to the age of 36 months, local standards for bone age would be desirable.

2. As physical and skeletal growth retardation occurring during periods of rapid growth may cause permanent anatomic and functional effects, it is recommended that corrective surgery where possible, should be performed early.

3. A similar study including larger numbers of each cardiac defect, cyanotic and acyanotic may bring to light any differences which could have been missed due to the small numbers of all defects except VSD.

4. Studies to elucidate the mechanism of growth failure in children with CHD are recommended.

APPENDIX I

PROFORMA

I. PERSONAL IDENTIFICATION:

NAME: ---------- TRIBE: ----------

AGE: ---------- MONTHS/YEARS UNIT NO. ----------

SEX: ---------- MALE/FEMALE STUDY NO. ---------

DIAGNOSIS:

AGE AT DIAGNOSIS ---------- MONTHS/YEARS

FREQUENCY OF RESPIRATORY TRACT INFECTIONS:

EPISODES OF DIARRHOEA:

EPISODES OF VOMITING:

HISTORY OF CYANOTIC ATTACKS: YES ☐ NO ☐

FINGER CLUBBING YES ☐ NO ☐

CYANOSIS YES ☐ NO ☐

II. SOCIAL STATUS:

Father's Occupation: ----------

Father's Educational Level: ----------

Mother's Occupation: ----------

Mother's Educational Level: ----------

Combined Income: ----------

APPENDIX I CONT'D.

Residential Area: ----------

No. of Rooms: ----------

HOUSE: OWN/RENTED: ----------

No. of Children in Family: ----------

Does Family Live Together: ----------

If No Specify: ----------

How Many Wives?: ----------

How Many Children?: ----------

Do They Have a Shamba?: ----------

What Do They Grow?: ----------

Do They Sell It?: ----------

Do They Eat It?: ----------

Is Child Staying With Mother?: ----------

Does Mother Get Money From Father?: ----------

III. IMMUNIZATION:

BCG

DPT 1st, 2nd, 3rd

Polio 1st, 2nd, 3rd

Measles

Boosters: BCG: Tetanus:

APPENDIX I CONT'D.

IV. NUTRITION:

Duration of Breastfeeding: (FOR INFANTS):

Age at Weaning (FOR INFANTS):

Weaning Diet (FOR INFANTS):

Dietary 24 Hour Recall:

Breakfast	Lunch	Tea	Supper

V. ANTHROPOMETRY:

HEIGHT:		CMS				
WEIGHT:		KG				
HEAD CIRCUMFERENCE:		CMS				
CHEST CIRCUMFERENCE:		CMS				
MID UPPER ARM CIRCUMFERENCE:		CMS				MEAN
SKINFOLD THICKNESS :	TRICEPS:	MM				
	SUBSCAPULAR:	MM				
	MEAN:	MM				
BONE AGE						

APPENDIX I CONT'D.

VI. CONSENT:

I, MR/MRS ----------

being a person aged 18 years and over and being the lawful/legal guardian of Master/Miss ----------

do hereby give consent/permission to DR. ----------

to include Master/Miss ----------

in the intended research as explained to and understood by me.

Guardian's Signature: ----------

Guardian's Full Name: ----------

Child's Full Name: ----------

Date and Place: ----------

Person Obtaining Consent: ----------

APPENDIX II

ANTHROPOMETRY

I. (a) HEIGHT:

A vertical scale 2.13 metres and measuring to an accuracy of 0.1 cms. was used for older children. The child stood on the flat board bare footed or with soaks, feet parallel, heels, buttocks, shoulders and back of head touching the scale, head held comfortably erect with lower border of the orbit in same horizontal plane as the external auditory meatus, arms hanging at sides in a natural manner. A wooden block was gently lowered crushing the hair and making contact with top of the head. The height was read at this level.

(b) CROWN HEEL LENGTH:

A wooden length board 78cm and measuring to an accuracy of 0.1cm was used for young children. The infant was laid on the board, the head positioned firmly against the fixed head board with the eyes looking vertically. The knees were extended by firm pressure applied by an assistant and the feet flexed at right angles to the

APPENDIX II CONT'D.

lower legs. An upright sliding foot piece was moved to obtain firm contact with the heels and the length read.

II. WEIGHT:

Beam balance scales were used for weighing, seca type serial No. 57334 with sensitivity of ± 10gms for younger children. These were weighed nude. A different balance was used for older children who were weighed without shoes and with minimal clothing. This was WHO type Serial No. 15029 with sensitivity of ± 0.5kg. The child sat in the middle of the chair without touching anything else.

III. HEAD CIRCUMFERENCE:

A flexible, non-stretch steel tape about 1cm wide measuring to an accuracy of 0.1cm was used. The child's head was steadied and the greatest circumference measured by placing the tape firmly round the frontal bones just superior to the supra-orbital ridges, passing it round the head at the same level on each side and laying it over the maximum occipital prominence at the back.

APPENDIX II CONT'D.

IV. CHEST CIRCUMFERENCE:

A flexible, non-stretch steel tape about 1cm wide measuring to an accurancy of 0.1cm was used. The chest circumference was measured at the nipple line in mid-inspiration, the young child sitting on mother's lap, the older child standing.

V. SKINFOLD THICKNESS:

A Harpenden calipers with contact surface of $20mm^2$ measuring to an accuracy of 0.1mm was used, all measurements taken on the left side of the body.

Triceps Skinfold:

The measurement was taken at a marked point Half way down the arm between the tip of the acromion process of the scapula and olecranon process of the ulna, the arm hanging relaxed at the side. Skinfold parallel to the long axis was picked up between the thumb and index finger of the left hand, clear away from the underlying muscle, about 1cm above the point described and the calipers applied. Three measurements were made and results averaged, the skin-fold gently held throughout the measurement.

Subscapular skinfold:

A skinfold lying in the line 45° to the spine in a natural line of skin cleavage was picked up between the thumb and index finger of the left hand. The calipers was applied and the measurement taken as in triceps skinfold. Three readings were recorded and average calculated.

The mean of the triceps and subscapular skinfold was then calculated and used as SFT in Appendix III.

VI. MID UPPER ARM CIRCUMFERENCE:

A flexible, non-stretch steel tape was applied gently but firmly round the left arm hanging freely at its mid-point, avoiding compression of the soft tissues and the measurements read.

APPENDIX III

STUDY GROUP A 0-11 MONTHS

NO	MONTHS ACE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	MONTHS B.A	SES
1	4	F	aCHD - PDA	61.0	5.5	40.0	40.2	12.0	5.84	6	l
2	6	M	aCHD - PDA	63.5	4.86	41.2	40.0	11.2	3.94	4½	m
3	3	F	aCHD - PDA	55.0	4.15	40.5	35.0	11.0	5.10	2	m
4	5	F	aCHD - VSD	62.0	6.20	43.0	43.0	12.5	5.90	6	l
5	9	F	aCHD - PS	71.0	8.00	44.5	46.0	14.0	6.50	10	m
6	10	F	aCHD -VSD + PHT	61.0	5.0	42.0	39.0	10.5	4.10	3	l
7	8	F	cCHD - TRICUSPID ATRESIA	63.5	7.0	45.3	43.00	14.00	11.80	6	u
8	7	M	aCHD - PDA	69.0	8.0	45.8	45.8	12.5	6.00	7	m
9	11	F	aCHD-VSD	71.0	8.5	45.3	45.3	14.5	6.45	6	l
10	7	F	cCHD - TOF	64.0	7.0	44.5	46.0	13.5	8.50	10	l
11	9	F	aCHD - VSD	60.0	5.9	41.0	38.00	12.5	9.20	7	m
12	7	M	aCHD - VSD	66.0	4.8	44.5	39.0	10.0	4.30	5	m
13	11	M	aCHD - VSD	71.0	8.0	48.0	46.0	14.0	7.90	7	m
14	4	F	aCHD - PDA	51.0	3.8	40.0	36.0	10.5	4.30	2	m
15	5	M	aCHD - VSD	60.5	5.5	40.7	38.5	11.0	5.80	6	l
16	9	M	aCHD - VSD	66.0	7.0	44.5	41.5	11.5	3.80	6	l
17	11	M	aCHD - VSD	74.5	10.0	45.0	47.0	16.0	7.40	10	m
18	11	F	aCHD - ENDOCARDIAL CUSHION DEFECT	70.0	9.0	45.0	47.0	14.0	6.80	12	m

APPENDIX III - CONT'D

STUDY GROUP A - 0-11 MONTHS

NO	MONTHS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	MONTHS B.A	SES
19	3	M	aCHD - VSD	56.0	3.5	37.0	33.0	10.5	3.20	4	l
20	9	F	cCHD - TOF	63.0	7.5	42.7	40.0	12.0	5.60	4	m
21	7	M	aCHD - VSD	59.5	3.95	40.0	37.0	8.5	2.50	5	l
22	8	M	cCHD - TOF	66.0	6.15	42.0	40.5	11.0	4.90	3	m
23	2	F	cCHD - TOF	56.0	3.45	37.0	34.5	11.5	3.40	2	m
24	9	F	aCHD - VSD	68.5	6.5	44.5	41.0	12.5	4.00	12	m
25	8	M	aCHD - VSD	58.0	4.35	43.5	36.0	9.0	3.00	2	l
26	7	F	aCHD - VSD	64.0	5.00	44.0	39.5	11.0	5.10	5	m
27	6	F	aCHD - VSD	64.0	5.10	40.2	40.2	12.0	7.85	2	m.
28	11	F	aCHD - VSD + PHT	61.0	4.10	42.0	37.0	9.50	3.30	4	m
29	7	F	aCHD - PDA	62.0	5.50	43.6	39.0	11.5	6.00	4	m
30	2	F	aCHD - VSD	59.0	6.20	42.0	40.0	14.0	11.5	3	m
31	11	F	aCHD - PDA	74.0	8.10	45.0	44.0	14.5	6.00	9	m
32	3	M	aCHD - VSD	62.0	6.40	41.0	41.0	14.5	8.00	3	m
33	9	M	aCHD - VSD	62.5	11.0	41.4	40.0	12.0	4.50	6	m
34	6	M	aCHD - VSD	68.0	5.28	43.5	39.5	10.5	4.00	4	l
35	9	F	aCHD - VSD	69.0	6.15	45.0	44.0	14.5	8.00	10	m

APPENDIX III CONT'D.

CONTROL GROUP A 0-11 MONTHS

NO	AGE	SEX	DIAGNOSIS	CMS HT	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	B.A	SES
1	4	F	NORMAL CONTROL	68.0	7.00	43.5	42.5	14.5	9.10	10	1
2	6	M	" "	65.5	9.30	46.5	48.0	16.5	10.80	6	m
3	3	F	" "	62.0	7.20	43.0	45.0	15.0	9.80	3	m
4	5	F	" "	64.0	6.80	42.5	42.5	12.0	7.20	17	1
5	9	F	" "	72.0	9.30	44.7	47.5	16.0	9.00	12	m
6	10	F	" "	68.0	8.50	44.0	44.5	13.5	9.00	15	1
7	8	F	" "	65.0	8.09	44.6	44.0	15.0	12.10	8	u
8	7	M	" "	71.0	9.00	45.0	46.0	15.0	8.30	7	m
9	11	F	" "	72.0	8.38	44.5	43.5	15.0	9.50	6	1
10	7	F	" "	64.0	7.14	43.0	44.0	13.5	8.00	13	1
11	9	F	" "	71.0	8.50	45.5	45.0	15.0	8.00	9	m
12	7	M	" "	71.0	8.20	46.0	43.5	15.5	6.10	9	m
13	11	M	" "	71.0	8.60	45.0	46.0	16.0	11.0	8	m
14	4	F	" "	64.0	7.80	44.0	44.0	16.0	10.50	3	m
15	5	M	" "	68.0	8.14	44.0	46.5	15.5	8.60	6	1
16	9	M	" "	67.0	8.50	44.0	42.0	14.5	9.20	9	1
17	11	M	" "	77.0	9.70	49.0	44.5	14.5	6.60	20	m
18	11	F	" "	71.0	9.30	45.0	46.0	15.5	6.60	15	m

APPENDIX III CONT'D.

CONTROL GROUP A 0-11 MONTHS

NO	MONTHS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	MONTHS B.A	SES
19	3	M	NORMAL CONTROL	62.5	7.69	43.5	45.5	15.0	10.80	7½	l
20	9	F	" "	72.0	9.15	45.5	46.0	14.5	8.00	10	m
21	7	M	" "	67.0	7.71	45.0	45.0	14.5	7.50	7	l
22	8	M	" "	73.0	9.99	45.0	48.0	15.0	7.60	13	m
23	2	F	" "	62.5	6.70	44.0	44.0	15.0	9.50	4	m
24	9	F	" "	73.0	9.50	46.0	51.0	14.0	9.50	8	m
25	8	M	" "	69.0	9.50	47.0	46.0	15.0	10.50	10	l
26	7	F	" "	66.0	7.60	43.0	46.5	15.0	10.30	6	m
27	6	F	" "	69.5	8.50	43.0	47.0	17.0	11.00	9	m
28	11	F	" "	74.5	10.00	47.0	48.0	16.0	10.00	12	m
29	7	F	" "	68.5	8.50	45.0	48.0	16.0	10.50	6	m
30	2	F	" "	62.0	6.28	42.0	43.0	15.0	8.60	3	m
31	11	F	" "	77.0	9.90	46.0	46.0	15.0	6.80	16	m
32	3	M	" "	67.0	6.70	43.3	44.0	14.0	7.60	3	m
33	9	M	" "	70.0	8.35	45.0	46.0	14.5	7.80	9	m
34	6	M	" "	70.0	7.93	44.0	43.0	14.5	9.00	9	l
35	9	F	" "	73.5	9.50	44.5	41.0	13.5	4.00	12	m

APPENDIX III CONT'D.

STUDY GROUP B 12-23 MONTHS

NO	MONTHS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	MONTHS B.A	SES
1	12	M	aCHD-VSD	64.5	6.1	46.4	41.5	11.5	3.77	6	m
2	14	M	aCHD-VSD	74.0	10.5	48.0	49.0	14.0	8.10	9	m
3	23	M	aCHD-VSD	84.0	11.5	47.0	51.0	15.5	5.45	32	m
4	19	M	aCHD-VSD	72.0	7.5	45.3	46.5	13.0	6.09	6.5	l
5	22	F	aCHD-PDA	81.0	11.0	47.7	49.4	14.0	6.20	9	l
6	19	M	aCHD-PDA	79.0	10.5	47.2	47.8	14.6	6.00	28	m
7	12	F	aCHD-VSD	64.0	4.8	42.0	39.0	11.8	4.85	4	u
8	21	F	aCHD-PS	75.0	10.5	48.0	50.0	15.5	8.20	18	m
9	12	F	aCHD-VSD	72.0	9.0	46.0	47.0	14.5	7.40	15	l
10	19	F	aCHD-VSD+PHT	71.0	9.0	45.3	47.0	14.0	6.90	9	l
11	12	F	aCHD-VSD	70.0	6.5	43.6	40.8	11.0	5.00	8	l
12	20	M	aCHD-VSD	79.5	11.0	49.0	49.0	16.0	8.00	14	m
13	12	M	aCHD-PDA	71.0	9.3	45.5	50.0	16.0	8.85	12	u
14	20	F	aCHD-VSD	75.6	7.0	45.0	45.0	12.0	3.50	10	m
15	17	F	aCHD-VSD	69.5	8.5	45.6	44.5	14.0	5.50	6	m
16	15	F	aCHD-VSD+PHT	73.0	8.0	44.0	45.0	11.0	3.60	12	l
17	17	M	aCHD-VSD	76.0	10.5	48.0	49.0	16.0	7.40	7	m
18	13	F	aCHD-VSD	75.5	10.5	52.0	47.5	16.0	7.30	12	l

APPENDIX III CONT'D.

STUDY GROUP B 12-23 MONTHS

NO	MONTHS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	MONTHS B.A	SES
19	23	M	aCHD-VSD	79.0	11.0	48.5	51.5	15.0	7.00	17	m
20	16	F	aCHD-VSD	73.0	7.1	43.5	41.0	12.5	5.10	18	m
21	14	F	aCHD-PDA	74.0	9.1	48.0	47.0	14.5	8.10	9	m
22	23	F	cCHD-TOF	81.0	8.5	46.0	45.0	11.5	4.30	12	m
23	18	F	aCHD-VSD	74.5	9.0	46.5	46.5	15.0	6.40	10	l
24	13	M	aCHD-ASD	72.0	7.5	43.5	43.5	13.0	4.20	6	l
25	23	M	aCHD-VSD	75.0	9.0	48.0	46.0	14.0	6.80	7	m
26	17	F	aCHD-PDA	78.0	10.0	48.0	49.0	15.5	7.90	19	m
27	12	F	aCHD-VSD	66.5	7.5	45.3	47.0	15.0	9.80	12	m
28	16	M	aCHD-PDA+PHT	76.0	10.0	47.0	47.0	14.0	6.00	12	m
29	14	F	aCHD-VSD	74.5	8.0	48.0	48.0	14.0	7.50	10	l
30	23	F	aCHD-ASD	75.0	9.0	47.0	48.0	14.0	5.70	24	l
31	23	M	aCHD-VSD	83.5	10.0	47.5	52.0	14.0	6.40	25	m
32	12	F	aCHD-PDA	64.0	7.1	47.0	47.0	13.5	6.30	24	u
33	23	F	aCHD-VSD	70.0	7.5	44.8	44.8	11.5	6.05	9	m
34	18	M	aCHD-VSD	75.0	9.0	48.0	47.0	13.5	5.40	9	m
35	22	M	aCHD-VSD	78.0	11.0	50.0	50.0	14.0	6.20	7	m

APPENDIX III CONT'D.

CONTROL GROUP B 12-23 MONTHS

NO	MONTHS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	MONTHS B.A	SES
1	12	M	NORMAL CONTROL	75.0	9.5	47.0	47.0	14.0	6.60	32	m
2	14	M	" "	78.0	11.5	49.5	49.5	15.5	9.10	18	m
3	23	M	" "	80.0	15.0	50.2	56.0	16.0	8.50	34	m
4	19	M	" "	80.0	11.0	49.0	52.0	16.0	8.10	16	l
5	22	F	" "	82.0	11.5	47.0	48.0	15.5	8.00	26	l
6	19	M	" "	80.0	10.3	48.0	48.0	15.5	6.20	20	m
7	12	F	" "	72.0	9.5	47.0	47.0	15.5	8.90	9	u
8	21	F	" "	90.0	11.6	48.0	51.5	16.0	6.90	24	m
9	12	F	" "	77.0	12.0	48.0	49.0	16.0	10.00	12	l
10	19	F	" "	80.00	11.5	49.6	51.5	16.0	9.60	28	l
11	12	F	" "	74.0	8.93	46.0	46.0	15.0	6.30	25	l
12	20	M	" "	83.0	12.0	49.2	50.0	16.8	9.50	21	m
13	12	M	" "	75.0	11.0	46.0	48.0	15.0	7.90	12	u
14	20	F	" "	79.5	14.0	49.0	50.0	18.0	9.80	24	m
15	17	F	" "	83.0	10.0	45.0	44.0	14.5	8.00	19	m
16	15	F	" "	82.0	10.8	47.0	48.0	15.5	7.60	39	l
17	17	M	" "	78.0	10.0	46.0	48.5	15.0	7.50	13	m
18	13	F	" "	76.0	10.5	46.0	48.0	14.5	8.00	15	l

APPENDIX III CONT'D.
CONTROL GROUP B 12-23 MONTHS

NO	MONTHS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	MONTHS B.A	SES
19	23	M	NORMAL CONTROL	88.0	14.0	50.0	51.2	17.0	8.65	36	m
20	16	F	" "	82.0	11.5	48.0	49.0	15.5	8.00	19	m
21	14	F	" "	74.5	10.5	45.5	50.5	16.0	9.20	12	m
22	23	F	" "	83.0	12.6	47.0	47.0	14.0	8.00	24	m
23	18	F	" "	80.0	12.0	49.0	52.0	14.5	8.20	16	l
24	13	M	" "	74.0	10.5	48.5	48.5	15.0	11.0	7	l
25	23	M	" "	86.0	13.5	50.0	52.0	16.0	8.20	25	m
26	17	F	" "	80.0	13.0	48.0	50.0	15.5	6.80	21	m
27	12	F	" "	73.5	11.5	46.7	49.0	16.0	8.90	12	m
28	16	M	" "	78.5	11.5	48.0	49.5	15.5	9.10	10	m
29	14	F	" "	79.0	10.70	49.0	44.5	14.5	6.60	20	l
30	23	F	" "	86.0	11.5	48.0	51.0	16.0	9.00	21	l
31	23	M	" "	84.0	12.5	48.0	52.0	15.5	6.00	24	m
32	12	F	" "	75.0	9.5	46.5	46.0	14.5	5.80	15	u
33	23	F	" "	90.0	12.5	47.0	50.0	16.5	6.90	24	m
34	18	M	" "	78.0	11.0	47.0	47.0	14.0	6.40	21	m
35	22	M	" "	88.0	12.9	48.0	59.0	17.0	9.30	18	m

APPENDIX III CONT'D.

STUDY GROUP C 24-35 MONTHS

NO	MONTHS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	MONTHS B.A	SES
1	27	F	aCHD - PDA	79.5	9.5	46.5	44.5	15.0	6.39	15	m
2	24	M	aCHD - VSD	82.0	10.0	48.3	48.3	13.0	5.30	30	l
3	30	F	aCHD - VSD	86.0	11.0	47.0	47.5	14.0	5.75	24	l
4	30	F	aCHD - VSD	88.0	11.0	50.0	50.0	16.6	6.90	30	m
5	32	F	aCHD - VSD	87.5	12.5	48.5	54.0	14.0	7.20	30	m
6	34	M	aCHD - PDA	80.0	10.5	48.0	50.5	15.0	6.80	9	l
7	25	F	aCHD - VSD	77.5	9.0	46.0	46.0	13.0	4.95	18	m
8	34	M	cCHD - TOF	80.0	11.0	50.4	49.0	15.0	6.80	20	u
9	29	M	aCHD - VSD	71.0	6.5	43.0	46.0	12.0	5.30	8	l
10	30	F	aCHD - VSD	82.7	9.5	48.0	44.5	13.5	4.77	36	m
11	26	M	aCHD - VSD	77.0	10.5	45.0	50	16.5	7.10	18	u
12	33	F	aCHD - VSD	84.0	11.0	48.5	49.5	14.5	6.70	13	m
13	30	F	aCHD - VSD	90.5	13.0	48.3	50.5	14.8	8.50	41	m
14	35	M	aCHD - VSD	94.0	14.0	51.0	49.3	14.5	5.90	34	m
15	32	F	cCHD - TOF	88.0	12.0	48.0	51.2	14.5	5.60	20	m
16	26	M	aCHD - VSD	78.5	9.0	49.0	47.5	13.0	5.60	12	m
17	28	F	aCHD - VSD	86,5	12.0	46.0	48.5	15.0	7.60	22	u
18	31	F	aCHD - VSD	84.5	12.0	49.0	50.0	13.0	6.60	18	m

APPENDIX III CONT'D.

STUDY GROUP C 24-35 MONTHS

NO	MONTHS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	MONTHS B.A	SES
19	26	F	aCHD - PDA	84.0	10.0	46.0	46.5	13.0	5.00	15	m
20	31	M	cCHD - TOF	80.0	11.0	49.2	52.0	13.0	6.70	17	m
21	24	M	aCHD - VSD	84.0	11.5	49.0	53.0	14.5	6.40	18	l
22	30	F	aCHD - VSD	84.0	11.5	46.0	48.0	14.0	6.50	24	m
23	26	M	aCHD - VSD	85.0	12.0	49.5	50.0	15.5	6.00	32	m
24	30	M	aCHD - VSD	85.0	14.0	49.5	54.5	16.8	7.00	24	l
25	26	M	aCHD - PDA	84.5	11.0	48.0	48.0	14.5	6.20	32	m
26	24	F	aCHD - PDA	79.5	9.5	46.0	45.5	12.0	5.80	18	m
27	33	M	aCHD - VSD	92.5	13.0	50.0	50.5	14.0	4.90	34	m
28	31	F	aCHD - VSD	82.0	10.0	47.5	48.0	14.0	7.30	24	m
29	33	M	aCHD - VSD	85.5	12.5	49.0	50.0	14.5	7.40	18	m
30	24	M	aCHD - VSD	71.0	7.5	47.0	44.0	12.5	5.30	16	m
31	30	F	aCHD - VSD	75.0	7.5	46.7	46.0	12.0	6.40	9	l
32	34	M	aCHD- VSD	82.0	13.5	51.0	54.5	16.0	6.20	17	m
33	32	M	aCHD - PS	84.0	11.0	49.5	47.0	16.0	7.30	16	m
34	33	F	aCHD - VSD	90.0	13.5	49.0	49.0	15.5	8.40	18	m
35	30	F	aCHD - PS	75.0	10.0	48.6	49.0	14.0	7.90	19	m

APPENDIX III

CONTROL GROUP

NO	MONTHS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.
1	27	F	NORMAL CONTROL	89.0	13.0
2	24	M	" "	90.0	12.0
3	30	F	" "	91.0	13.0
4	30	F	" "	92.0	12.5
5	32	F	" "	96.0	14.0
6	34	M	" "	91.0	14.0
7	25	F	" "	85.0	12.0
8	31	M	" "	92.5	13.5
9	29	M	" "	96.0	14.0
10	30	F	" "	96.0	13.5
11	26	M	" "	88.0	11.0
12	33	F	" "	98.0	13.5
13	30	F	" "	94.0	14.0
14	35	M	" "	102.0	15.0
15	32	F	" "	90.0	10.5
16	26	M	" "	90.0	14.0
17	28	F	" "	96.0	14.0
18	31	F	" "	93.5	14.5

CONT'D.

C 24-35 MONTHS

CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	MONTHS B.A	SEX
47.0	50.0	14.0	6.50	17	m
48.5	49.5	14.0	7.20	30	l
49.0	55.0	17.0	8.50	23	l
50.0	52.0	16.5	8.00	30	m
50.0	49.5	15.5	6.90	36	m
50.5	52.0	17.5	8.10	30	l
47.5	49.0	15.5	6.00	18	m
52.2	48.0	15.5	5.60	24	u
50.3	52.5	14.8	4.80	27	l
50.0	52.5	15.0	7.60	36	m
50.0	50.0	14.0	7.40	18	u
52.0	49.0	16.0	8.00	42	m
49.5	53.0	15.0	8.60	42	m
49.0	54.0	15.5	4.00	51	m
46.0	46.0	14.8	7.70	36	m
50.0	50.0	15.5	7.70	29	m
49.0	50.0	15.0	6.00	31	u
51.0	53.5	16.0	7.00	33	m

APPENDIX III CONT'D.

CONTROL GROUP C 24-35 MONTHS

NO	MONTHS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	MONTHS B.A	SES
19	26	F	NORMAL CONTROL	96.0	12.5	47.0	49.0	14.5	5.30	24	m
20	31	M	" "	89.0	11.7	48.5	48.5	14.0	8.50	39	m
21	24	M	" "	88.0	12.5	49.0	50.0	15.0	6.40	27	l
22	30	F	" "	94.0	13.5	50.5	50.5	16.0	7.00	30	m
23	26	M	" "	94.0	13.5	48.5	50.5	15.0	7.20	32	m
24	30	M	" "	90.0	14.5	47.0	50.0	16.0	7.00	26	l
25	26	M	" "	95.0	12.5	48.0	48.0	14.5	5.60	31	m
26	24	F	" "	87.0	11.5	50.0	51.0	14.0	6.00	24	m
27	33	M	" "	92.5	12.5	50.7	48.0	15.5	7.90	36	m
28	31	F	" "	96.0	14.5	50.8	51.0	14.5	4.60	36	m
29	33	M	" "	96.5	14.5	49.0	54.0	15.5	6.10	37	m
30	24	M	" "	85.5	12.5	50.0	50.5	15.0	7.40	24	m
31	30	F	" "	90.0	13.0	50.0	53.0	16.0	6.80	30	l
32	34	M	" "	105.0	13.5	49.5	50.0	13.5	6.30	31	m
33	32	M	" "	94.0	14.0	50.0	52.0	14.0	6.00	34	m
34	33	F	" "	98.5	13.0	46.0	52.0	15.0	7.50	36	m
35	30	F	" "	92.5	14.0	50.0	51.5	14.5	6.20	34	m

APPENDIX III CONT'D.

STUDY GROUP D 3-5 YEARS

I.D	YEARS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	YEARS B.A	SES
1	5	M	aCHD-PDA	112.0	19.0	52.5	56.0	16.0	5.40	$3\frac{7}{12}$	u
2	4	M	aCHD-PDA+PHT	92.8	12.5	48.0	50.0	14.0	5.40	$1\frac{6}{12}$	m
3	4	F	aCHD-PDA	93.0	13.0	49.6	51.0	15.0	6.90	3	m
4	5	M	aCHD-VSD	109.0	16.5	52.0	52.0	15.0	5.07	3	m
5	3	F	aCHD-VSD	89.0	11.5	48.7	49.0	14.7	5.72	2	m
6	4	F	cCHD-TOF	84.5	10.5	47.0	50.5	14.0	4.14	$2\frac{3}{12}$	m
7	5	F	aCHD-VSD	106.5	16.5	51.3	54.4	16.5	5.49	$2\frac{10}{12}$	u
8	5	M	aCHD-VSD	104.0	15.5	51.0	52.3	15.5	5.75	$3\frac{10}{12}$	m
9	3	F	aCHD-ASD	92.0	11.0	51.3	47.5	13.1	5.69	$1\frac{9}{12}$	m
10	5	M	aCHD-VSD	112.5	19.5	53.0	57.0	16.5	6.00	3	m
11	5	F	cCHD-TRUNCUS ARTERIOSUS	122.5	24.0	54.0	64.0	18.0	8.69	$4\frac{7}{12}$	m
12	5	M	aCHD-PS	114.4	21.0	53.4	58.0	18.0	5.70	$3\frac{9}{12}$	m
13	3	M	aCHD-VSD	87.5	17.0	50.9	51.5	14.0	7.93	$2\frac{8}{12}$	l
14	4	F	aCHD-VSD	105.5	16.0	51.5	53.0	18.0	8.40	5	l
15	5	M	cCHD-TOF	115.5	17.0	52.0	55.5	13.8	3.70	$4\frac{4}{12}$	l

APPENDIX III CONT'D.

STUDY GROUP D 3-5 YEARS

NO	YEARS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	YEARS B.A	SES
16	3	M	aCHD-VSD	92.5	11.5	48.0	47.5	13.5	3.40	$2\frac{6}{12}$	l
17	5	F	cCHD-TOF	108.5	17.0	49.0	52.4	16.0	6.50	4	l
18	4	M	aCHD-PS	93.5	14.0	50.8	56.7	15.7	5.10	$2\frac{8}{12}$	l
19	5	M	cCHD-TOF	105.5	16.5	51.0	57.0	15.5	5.40	$5\frac{3}{12}$	m
20	4	M	aCHD-PS	95.5	14.5	49.7	52.0	16.0	6.20	2	u
21	4	M	aCHD-VSD	104.5	16.0	50.0	59.0	16.0	6.50	$4\frac{2}{12}$	m
22	5	M	aCHD-VSD	90.0	11.0	48.0	50.0	13.5	6.40	$2\frac{6}{12}$	m
23	4	M	aCHD-VSD	93.0	19.5	53.0	53.0	15.3	7.80	$2\frac{9}{12}$	l
24	5	F	cCHD-TOF	99.5	15.0	50.0	53.0	14.0	5.00	4	m
25	3	M	aCHD-VSD	91.0	12.5	50.4	53.5	14.0	5.90	2	l
26	5	F	aCHD-VSD	93.0	13.0	48.0	52.0	13.5	5.65	$3\frac{9}{12}$	m
27	3	M	aCHD-VSD	83.0	11.5	48.5	51.0	16.0	8.30	$2\frac{7}{12}$	m
28	4	F	aCHD-PS	100.0	13.5	47.2	49.5	14.5	5.80	$2\frac{6}{12}$	m
29	5	M	aCHD-VSD	99.5	16.0	52.7	57.0	16.0	6.00	$2\frac{7}{12}$	m
30	5	M	aCHD-ASD	98.5	15.0	52.0	54.0	15.0	5.90	$2\frac{7}{12}$	m

APPENDIX III CONT'D.

STUDY GROUP D 3-5 YEARS

NO	YEARS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	YEARS B.A	SES
31	4	F	aCHD-ASD	90.5	13.0	49.5	49.0	14.0	5.90	$1\frac{6}{12}$	m
32	3	M	aCHD-PDA+PHT	91.5	12.0	51.0	49.5	14.0	4.90	$1\frac{6}{12}$	m
33	4	M	aCHD-VSD	103.5	15.0	51.5	53.0	14.5	4.80	2	m
34	4	F	aCHD-PDA	98.0	14.5	48.5	52.5	14.0	6.50	$1\frac{8}{12}$	m
35	3	M	aCHD-VSD+PHT	91.0	13.0	50.0	52.0	14.0	5.40	$2\frac{7}{12}$	m

APPENDIX III CONT'D.

CONTROL GROUP D 3-5 YEARS

NO	YEARS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	YEARS B.A	SES
1	5	M	NORMAL CONTROL	118.0	22.0	54.0	58.0	17.0	6.50	4	u
2	4	M	" "	113.4	20.5	54.0	56.5	16.7	6.60	$4\frac{4}{12}$	m
3	4	F	" "	113.5	24.0	51.5	61.0	20.0	10.75	4	m
4	5	M	" "	112.0	20.5	53.7	60.0	17.3	7.20	6	m
5	3	F	" "	98.5	16.0	50.6	54.4	16.5	9.20	$2\frac{9}{12}$	m
6	4	F	" "	100.0	14.0	47.7	48.0	15.5	6.70	4	m
7	5	F	" "	115.0	19.0	52.5	60.0	16.0	5.80	$5\frac{9}{12}$	u
8	5	M	" "	119.5	20.5	52.6	60.0	16.5	5.10	$6\frac{7}{12}$	m
9	4	F	" "	109.0	18.0	50.5	53.0	16.0	7.40	$4\frac{1}{12}$	m
10	5	M	" "	116.0	22.0	53.3	63.5	16.7	5.50	$4\frac{3}{12}$	m
11	5	F	" "	107.5	20.0	52.0	55.8	19.5	8.90	5	m
12	5	M	" "	108.0	18.5	49.5	54.5	17.0	8.10	$5\frac{10}{12}$	m
13	3	M	" "	105.0	19.5	51.0	56.0	18.8	9.70	4	l
14	4	F	" "	106.0	17.5	49.5	53.5	17.5	8.20	$3\frac{10}{12}$	l
15	5	M	" "	114.0	19.2	52.0	56.0	17.5	6.60	$5\frac{8}{12}$	l
16	3	M	" "	96.5	15.0	49.0	54.0	15.5	6.10	$3\frac{1}{12}$	l

APPENDIX III CONT'D.

CONTROL GROUP D 3-5 YEARS

NO	YEARS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	YEARS B.A	SES
17	5	F	NORMAL CONTROL	110.0	20.5	52.0	58.0	18.5	9.50	$5\frac{9}{12}$	l
18	4	M	" "	102.5	14.5	49.0	52.8	15.5	6.80	$3\frac{4}{12}$	l
19	5	M	" "	109.0	24.0	52.0	64.0	19.5	10.70	$5\frac{6}{12}$	m
20	4	M	" "	105.0	18.0	50.5	55.0	17.5	9.00	$3\frac{6}{12}$	u
21	4	M	" "	112.0	19.0	50.0	58.0	17.0	10.90	5	m
22	5	M	" "	118.5	20.0	51.5	56.5	16.0	5.60	4	m
23	4	M	" "	103.0	15.5	52.0	53.0	16.5	8.10	$3\frac{9}{12}$	l
24	5	F	" "	112.5	21.5	52.0	60.0	18.5	10.80	$4\frac{9}{12}$	m
25	3	M	" "	101.0	16.5	50.0	54.0	17.0	7.90	3	l
26	5	F	" "	109.5	19.5	49.5	55.5	17.2	8.60	$6\frac{6}{12}$	m
27	3	M	" "	109.0	16.5	53.5	57.8	18.0	9.40	$2\frac{9}{12}$	m
28	4	F	" "	113.0	20.0	52.5	60.0	16.0	5.80	$5\frac{9}{12}$	m
29	5	M	" "	116.5	19.5	52.0	56.0	17.0	5.60	$4\frac{3}{12}$	m
30	5	M	" "	105.5	16.5	52.0	55.0	15.5	5.70	5	m

APPENDIX III CONT'D.

CONTROL GROUP D 3-5 YEARS

NO	YEARS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	YEARS B.A	SES
31	4	M	NORMAL CONTROL	106.0	17.0	51.5	55.0	16.0	5.80	$4\frac{3}{12}$	m
32	3	M	" "	107.0	15.5	50.0	50.5	15.0	5.80	$4\frac{7}{12}$	m
33	4	M	" "	110.0	18.0	49.5	60.5	16.5	6.70	$3\frac{6}{12}$	m
34	4	F	" "	106.0	17.5	49.5	53.5	17.5	8.20	$3\frac{10}{12}$	m
35	3	M	" "	97.0	13.7	48.0	51.0	16.5	7.00	$3\frac{4}{12}$	m

APPENDIX III CONT'D.

STUDY GROUP E 6-12 YEARS

NO	YEARS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	YEARS B.A	SES
1	6	M	aCHD-VSD	111.0	19.2	55.5	57.5	16.0	5.44	$4\frac{11}{12}$	u
2	10	F	aCHD-PS	132.5	23.0	52.0	60.5	15.5	5.37	$7\frac{4}{12}$	l
3	7	M	aCHD-ASD+PHT	110.0	16.0	51.9	55.5	14.5	4.52	3	m
4	8	M	aCHD-PS	112.0	17.5	52.0	56.5	16.0	5.70	$5\frac{6}{12}$	l
5	9	M	aCHD-PS	125.5	25.0	55.8	63.0	19.8	7.23	$5\frac{10}{12}$	l
6	6	F	aCHD-VSD	122.5	21.0	52.0	57.0	17.0	5.59	$6\frac{10}{12}$	l
7	11	F	aCHD-PS	141.0	27.5	54.0	64.0	17.9	7.20	$8\frac{10}{12}$	l
8	10	M	cCHD-TOF	114.5	20.5	52.0	59.0	16.0	5.25	6	m
9	10	M	aCHD-VSD	124.5	23.0	52.0	62.0	16.3	4.64	$7\frac{6}{12}$	m
10	6	F	aCHD-PS	100.0	15.0	49.2	54.0	16.0	5.17	$3\frac{4}{12}$	u
11	9	M	aCHD-VSD	132.0	23.0	55.6	57.0	14.8	3.99	7	m
12	11	M	aCHD-ASD	155.0	39.0	58.6	69.0	20.0	4.80	11	u
13	11	F	aCHD-PS	119.0	20.0	50.0	60.6	16.4	6.34	$8\frac{10}{12}$	m
14	7	M	aCHD-PS	122.0	21.5	52.0	59.0	16.0	5.09	5	u
15	11	F	aCHD-ASD	124.0	22.5	51.5	66.0	17.5	5.80	8	l
16	9	F	aCHD-VSD	129.5	23.0	51.2	58.5	16.5	5.17	$7\frac{10}{12}$	u

APPENDIX III CONT'D.

STUDY GROUP E 6-12 YEARS

NO	YEARS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	YEARS B.A	[illegible]
17	6	F	aCHD-VSD	120.0	19.5	54.0	57.5	15.0	4.80	$5\frac{10}{12}$	m
18	6	M	aCHD-VSD+PHT	110.0	14.5	52.8	52.0	12.5	3.30	$3\frac{6}{12}$	m
19	10	F	aCHD-VSD	114.0	22.5	50.0	56.8	17.0	6.10	$7\frac{10}{12}$	m
20	10	M	aCHD-VSD	132.5	22.5	49.8	62.0	15.7	4.30	$7\frac{10}{12}$	m
21	6	F	aCHD-VSD	109.5	16.0	51.0	55.5	14.8	6.00	$4\frac{2}{12}$	l
22	6	F	aCHD-VSD	108.5	16.0	51.2	56.0	14.2	5.30	5	m
23	6	M	aCHD-VSD	113.0	19.0	53.7	55.6	14.0	6.20	3	u
24	8	F	aCHD-DEXTROCARDIA +VSD	117.5	20.0	53.0	57.0	16.3	6.25	$8\frac{4}{12}$	l
25	8	F	aCHD-VSD	114.5	22.0	53.4	57.0	18.0	9.70	$5\frac{9}{12}$	l
26	10	F	aCHD-VSD+PHT	133.5	25.0	55.0	64.0	17.0	6.20	9	m
27	7	F	aCHD-VSD	116.0	21.5	50.0	58.0	17.0	7.60	$6\frac{8}{12}$	m
28	9	M	aCHD-VSD	127.5	26.0	48.0	64.5	17.3	5.00	$7\frac{3}{12}$	m
29	6	F	cCHD-TOF	109.5	17.0	50.0	53.0	16.0	6.70	$5\frac{3}{12}$	m
30	6	F	cCHD-TOF	112.5	19.5	51.0	57.0	16.3	5.20	$5\frac{9}{12}$	m

APPENDIX III CONT'D.

STUDY GROUP E 6-12 YEARS

NO	AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	B.A	[illegible]
31	10	F	aCHD-VSD+PHT	133.3	24.0	50.0	63.0	16.5	4.70	$8\frac{10}{12}$	l
32	6	M	aCHD-VSD	108.0	17.0	48.3	58.0	15.0	4.00	3	m
33	11	M	aCHD-VSD	123.5	21.5	52.0	61.5	15.0	5.00	9	m
34	6	F	aCHD-PS	108.5	16.0	50.8	55.5	14.0	5.50	$6\frac{6}{12}$	m
35	8	F	aCHD-PS	124.0	22.0	50.2	59.5	17.5	5.60	$6\frac{9}{12}$	m

APPENDIX III CONT'D.

CONTROL GROUP E 6-12 YEARS

NO	YEARS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	YEARS B.A	SES
1	6	M	NORMAL CONTROL	114.5	23.0	54.0	58.0	19.0	8.10	5	u
2	10	F	" "	134.0	25.5	51.2	60.5	18.5	6.00	11	l
3	7	M	" "	129.5	24.5	52.6	60.0	16.5	6.10	$6\frac{7}{12}$	m
4	8	M	" "	126.0	20.5	53.0	58.0	15.4	4.00	$6\frac{6}{12}$	l
5	9	M	" "	130.0	23.0	52.0	59.0	17.0	6.00	9	l
6	6	F	" "	116.0	17.5	50.5	57.5	16.5	6.00	$6\frac{3}{12}$	l
7	11	F	" "	139.0	29.0	53.0	62.0	17.5	7.70	10	l
8	10	M	" "	134.0	30.5	54.0	64.5	18.0	6.10	8	m
9	10	M	" "	144.0	32.5	52.0	65.0	17.0	5.50	$10\frac{6}{12}$	m
10	6	F	" "	119.5	20.5	54.0	55.0	16.4	7.70	$6\frac{2}{12}$	u
11	9	M	" "	158.0	20.8	54.0	67.0	16.5	5.40	8	m
12	11	M	" "	140.0	28.0	54.0	63.0	16.5	5.00	12	u
13	11	F	" "	149.0	38.0	54.5	71.0	20.5	9.90	12	m
14	7	M	" "	122.0	22.5	53.7	60.0	17.3	7.20	6	u
15	11	F	" "	147.0	32.0	53.5	65.0	18.0	7.35	$10\frac{4}{12}$	l
16	9	F	" "	138.0	29.0	51.0	65.5	19.5	9.50	$9\frac{6}{12}$	u
17	6	F	" "	106.0	17.0	49.0	62.0	16.0	6.00	6	m
18	6	M	" "	124.0	19.8	51.2	58.0	16.0	5.50	$5\frac{10}{12}$	m

NO	YEARS AGE	SEX	DIAGNOSIS
19	10	F	NORMAL CONTROL
20	10	M	" "
21	6	F	" "
22	6	F	" "
23	6	M	" "
24	8	F	" "
25	8	F	" "
26	10	F	" "
27	7	F	" "
28	9	M	" "
29	6	F	" "
30	6	F	" "
31	10	F	" "
32	6	M	" "
33	11	M	" "
34	6	F	" "
35	8	F	" "

APPENDIX III CONT'D.

CONTROL GROUP E 6-12 YEARS

CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	YEARS B.A	SES
127.0	25.5	53.5	59.5	17.0	6.50	11	m
135.0	27.8	52.0	62.0	18.0	6.50	9	m
113.5	18.5	51.0	55.5	17.8	6.00	$6\frac{9}{12}$	l
123.0	20.2	51.5	53.5	17.0	8.50	6	m
119.5	20.5	51.5	55.5	17.2	8.60	$6\frac{6}{12}$	u
125.0	23.0	53.0	59.0	17.0	7.40	8	l
127.5	22.5	53.0	57.0	16.3	6.25	$8\frac{4}{12}$	l
135.0	31.5	53.0	64.0	20.0	9.60	$8\frac{10}{12}$	m
136.0	23.5	54.5	60.0	18.0	6.40	8	m
132.5	25.0	51.5	60.0	16.5	4.60	9	m
114.5	22.5	49.5	57.0	20.0	10.00	6	m
118.5	20.0	55.0	56.5	17.5	7.30	$6\frac{6}{12}$	m
135.0	31.5	53.0	66.0	19.5	7.00	10	l
114.0	18.6	53.0	57.0	15.0	5.50	$6\frac{6}{12}$	m
158.5	39.0	58.6	69.0	20.0	5.80	11	m
114.0	20.5	53.0	54.5	17.2	7.60	$6\frac{6}{12}$	m
134.0	32.0	53.0	65.0	21.5	9.50	10	m

APPENDIX III CONT'D.

RESULTS FOR PATIENTS WHO DIED

NO	MONTHS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	B.A	SES
1	5	F	cCHD-TRICUSPID ATRESIA + VSD	59.0	4.3	38.0	35.5	10.0	3.10	-	l
2	2	M	cCHD-TOF	52.0	2.45	37.0	29.0	7.0	2.00	-	m
3	4	M	cCHD-TOF	59.0	3.85	39.0	35.5	8.5	3.80	-	m
4	3	M	cCHD-TOF	60.0	4.1	39.5	38.0	10.0	5.10	-	m

C O N T R O L S

NO	MONTHS AGE	SEX	DIAGNOSIS	CMS HT.	KG. WT.	CMS HEAD C.	CMS CC	CMS MUAC	MM SFT	B.A.	SES
1	5	F	NORMAL CONTROLS	64	6.8	42.5	42.5	12.0	7.20	-	l
2	2	M	" "	62.5	6.7	44.0	44.0	15.0	9.50	-	m
3	4	M	" "	65.0	7.00	43.0	46.0	14.0	8.90	-	m
4	3	M	" "	62.5	7.69	43.5	45.5	15.0	10.80	-	m

APPENDIX IV

NAIROBI CONSUMER PRICE LISTS - CENTRAL BUREAU OF STATISTICS, MINISTRY OF FINANCE AND PLANNING, REPUBLIC OF KENYA

BASE: JANUARY-JUNE 1975 = 100
JUNE 1984

COMMODITY GROUP	INCOME GROUP		
	LOWER	MIDDLE	UPPER
Food	279.1	266.9	282.4
Drink and Tobacco	300.0	272.8	314.7
Clothing and footwear	384.2	254.2	268.7
Rent	364.6	331.6	300.5
Fuel and power	406.5	378.0	343.2
Furniture,furnishing,household equipment and household operation	340.8	328.5	298.4
Health and personal care	236.3	314.8	417.0
Transport and communications	289.7	399.5	323.8
Recreation,entertainment and education	159.6	208.9	226.4
Miscellaneous goods and services	315.9	255.7	317.1
Average weighted index for all groups	314.1	294.4	300.1
% change from June 1983 to date	10.4	8.9	7.4
Average weighted index for all groups excluding rent	299.1	287.3	300.0

FOR THE PURPOSE OF THE INDICES

1. Lower Income Group comprises persons with monthly earnings below KSh.699/=
2. Middle Income Group comprises persons with monthly earnings between Ksh. 700/= - Ksh.2,499/=
3. Upper Income Group comprises persons with monthly earnings of Ksh. 2,500/= and above.

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