A SURVEY OF INFANT GROWTH, DIET AND RELATED FACTORS IN GLASGOW.

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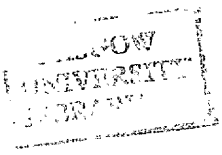

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A SURVEY OF INFANT GROWTH, DIET AND RELATED FACTORS IN GLASGOW.

SUMMARY.

Deprivation is often associated with short stature and Glasgow is a city of short stature (Common Services Agency, 1975) and of deprivation (Holterman, 1975). This survey looks at some aspects of nutrition and growth in Glasgow infants.

A group of infants from a severely deprived area (Blackhill) was examined at approximately monthly intervals from just after birth until one year. Another group from an area more typical of Glasgow (Carntyne) was similarly examined. A cross sectional group of infants, who provided reference data, was seen, each child at one of five ages: 6 weeks, 3, 6, 9 or 12 months. Data were collected concerning various family and social factors, infant feeding practice, present diet, obstetric factors and hospital admissions, in addition to measuring the children. Children in the two longitudinal groups were assessed developmentally, examined medically and had morbidity records kept.

The Blackhill children were smaller at birth than those of the cross section. There were more low birth weight infants and more of short gestation. After birth, they remained shorter and lighter than the cross sectional children, with the differences greatest below the 10th centiles. Thus, whereas the larger Blackhill children approximated those of the cross section and Carntyne, the smaller ones were very much smaller. No dietary deficiences were found, with the exception of vitamins A and D at 12 months. The Blackhill children

suffered from more respiratory tract infections than did those from Carntyne and had approximately twice as many episodes of gastro-enteritis.

CHAPTER I.

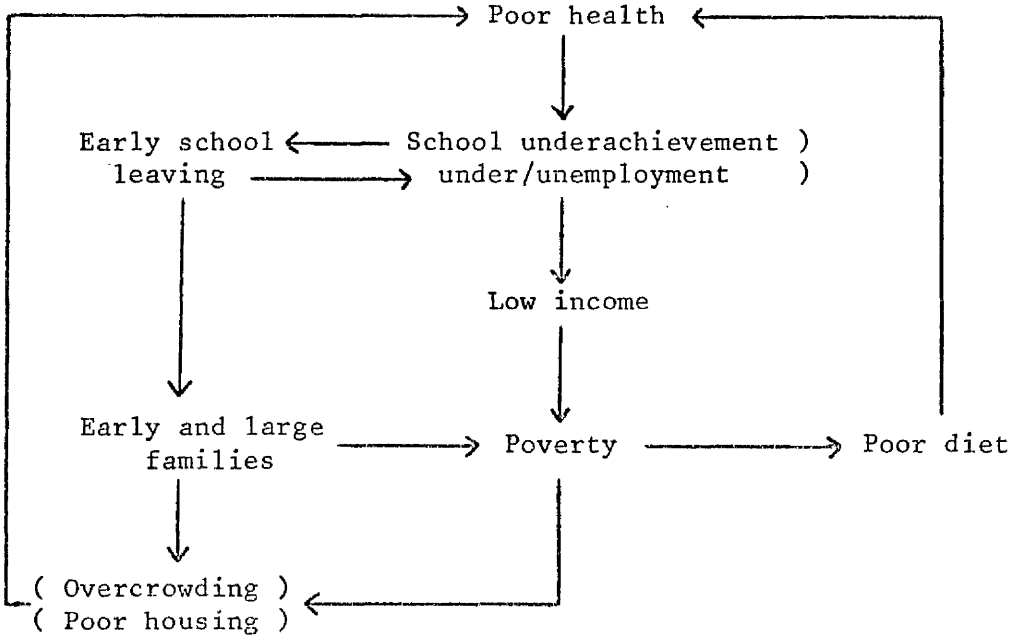
INTRODUCTION.

Short stature is often associated with deprivation. Vimpani et al (1981) found, from their research into growth hormone deficiency in Scottish school children, that there existed a 20-fold variation in the incidence of constitutionally short children among the different postal districts within Glasgow. They also found that 75 per cent of the constitutionally short children lived in Glasgow, although the sample was drawn from Edinburgh, Aberdeen and Glasgow. Their results showed a significant correlation ($p < 0.01$) between the prevalence of short stature and census indicators of urban deprivation (Holterman, 1975).

Deprivation is a term which has been used increasingly over the past 10 - 15 years. "They've never had it so good". Harold MacMillan's words of 1957 were soon adopted as a catch phrase by society (Oxford University Press, 1979). Unfortunately for some members of that society, their situation was far from good. The publication of "The Poor and the Poorest" by Abel-Smith & Townsend (1965) was a major landmark in the rediscovery of the existence of family poverty, although their finding that poverty had been increasing during the 1950's would not have come as a surprise to those who had kept abreast of the situation (Bull, 1971). One such was Titmuss (1962), who had already challenged the assumed fact that the Welfare State had provided all the answers. Deprivation is now seen to exist in many areas, such as income, housing, family structure, health and education, and each of these factors is inter-related.

Birch & Gussow (1970) prefaced their book "Disadvantaged Children: Health Nutrition and School Failure" with the following quotation from G.H.T. Kimble, "It is bad enough that a man should be ignorant, for this cuts him off from the commerce of other men's minds. It is perhaps worse that a man should be poor, for this condemns him to a life of stint and scheming in which there is no time for dreams and no respite from weariness. But what surely is worst is that a man should be unwell, for this prevents him doing anything much about his poverty or his ignorance". These words reflect the inter-dependence of differing aspects of disadvantage. A simple flow chart demonstrates some of these points (Fig 1).

Fig 1.



Aspects of Disadvantage.

Wedge & Prosser in 'Born to Fail?' (1973), highlighted the concept and problem of multiple deprivation. Their work was based on the results of the National Child Development study which sought to follow the progress from birth to maturity of all the children in England, Scotland and Wales who were born during the week of 3 - 9 March, 1958. Complete data were available for 10,504 children at the age of eleven years. Three factors which appeared to be fundamentally important were identified: family composition, low income and poor housing. Specific paramaters of deprivation were set for each factor. The description of socially disadvantaged children was restricted to those who fell within all three groups and were thus in a badly housed, low income family which was either very large or had only one parent. This appallingly strict definition applied to 6 per cent of the population. The circumstances were extreme and yet, on average, it will have been the experience of two children in every British classroom. Distribution of these disadvantaged children throughout the country was uneven. The national average was one in 16 but in Scotland the proportion rose to one in 10. Eleven per cent of British 11 year olds lived in Scotland but 19 per cent of the disadvantaged children were found there.

In Scotland, the distribution of disadvantaged people is uneven. In the early 1970's discussions had occurred concerning 'pockets of urban deprivation' and yet there was little known about them. This generated a need and a desire to know what was happening in small localised areas within cities. Holterman (1975) used the 1971 Census of Population data to show the extent and location of areas of urban deprivation in Great Britain. She

concluded that the national picture was dominated by Scotland, whose cities, particularly on Clydeside, appeared to contain areas of severe deprivation on a scale not matched in England and Wales. The spatial unit used was the Enumeration District, (ED) of which 87,578 urban EDs were included. Clydeside contained 4 per cent of them. Yet, when identifying the EDs which represented the worst 1 per cent of various indices of deprivation, Clydeside had 75 per cent of Britain's severe overcrowding and 42 per cent of the highest rate of male unemployment.

Glasgow is the major city on Clydeside. In attempting to understand the inherent situation, something of Glasgow's history must be known. Professor Howe (1972) traced the stages in the development of the city and described how its fortunes in trading were firmly established between 1660 and 1750. The built-up area remained confined within the medieval topographic limits until the mid-18th century when these bounds were burst and planned expansion was undertaken. Prior to this, with the coming of the industrial revolution and the concentration of much industry within Glasgow, there had been a massive increase in the city's population. Table I, taken from the Registrar General's (Census) Report (1922), shows how in the first half of the 19th century the population of Glasgow and its suburbs increased by nearly 350 per cent.

TABLE I.

Population of Glasgow and its Suburbs.

Year	1801	1811	1821	1831	1841	1851
Population	77,385	100,749	147,043	202,426	274,324	344,986

Overcrowding in appalling conditions of poverty, with little or no sanitation, was commonplace. Horrifying examples of squalor and deprivation were reported to the Poor Law Commissioners by Dr Neil Arnott (1842), who commented that none could wonder at the origin and spreading of pestilential disease in such situations.

The period of the 'fever years', as it came to be known, started between 1815 and 1818. Annual admissions to the fever wards of the Royal Infirmary averaged about 60 from 1802 - 14 but rose to 230 in 1815 and 1,371 in 1818 (Chalmers, 1930). Two years of notoriety were 1818, when the first recorded typhus epidemic occurred and 1832 - the "cholera year". Baird (1842) presented data showing that between 1836 and 1840, the number of deaths from fever in Glasgow averaged over 1,000 per year. Chalmers (1930) told how ill health and poverty are interchangeable forces in the vicious circle from which the slum emerges.

From 1851 onwards, a series of Housing Acts was passed, initially to relieve overcrowding, but subsequently for restoration and slum clearance. With these clearances from many of the worst properties in the 1870's, the 'fever years' came to an end.

In 1916, a Housing Sub-Committee of the Corporation of Glasgow was formed and directed its attention to the improvement of slum areas. The following year, a report by the Royal Scottish Commission on Housing, recommended that Local Authorities should be made responsible for the housing of the working classes within their areas. This was made law in 1919. The added responsibility led the Corporation to create the Housing Department as a separate entity. Its new Committee set a target to build 57,000 homes. These were to relieve overcrowding, provide for three years population growth and

meet the needs of the demobilised forces and their families (Glasgow Corporation Housing Dept, 1948).

'Farewell to the Single End' (Reoch, 1976) gives an account of Glasgow's housing situation from the end of the last century up to the 1970's. In the mid 1920's, 10,000 acres were added to the city boundaries from Lanarkshire, Dumbartonshire and Renfrewshire. A small number of massive schemes were then developed and standards of spaciousness set which were never again matched. A further 10,000 acres was annexed early in the 1930's.

During the 1930's, a big drive to clear the slums took place, aided by government subsidies to rehouse the homeless. Although by 1939, the initial target of over 50,000 new homes had been reached, this was not net gain, as many had been demolished. The war years and those immediately after, cut drastically the rate of house building. 'Overspill' and the idea of 'New Towns' took root. East Kilbride, in 1947, was the first to be set up.

The 1950's and part of the 60's saw the building of three massive estates, all on the outskirts: Drumchapel, Easterhouse and Castlemilk. Comprehensive Development Areas were instigated, with the first in the Gorbals and Hutcheson area.

By the 1960's, the face of Glasgow was altering with multi-storey blocks increasing in number and the construction of motorways, both within and around the city. The demand for housing was still insatiable. Jobs were lost as factories closed and new firms often opted for industrial estates elsewhere. Many families chose to emigrate rather than wait in long housing queues and thus, young skilled people were lost to the community.

Cullingworth (1968), profiled Glasgow housing in 1965 and,

with Watson, surveyed that of the whole of Clydeside in 1970 (Cullingworth & Watson, 1971). They showed an improvement in home facilities over the 5 year span. The later survey classified the state of homes using the standards set out in the 1969 Housing (Scotland) Act. Only 56 per cent of the stock was satisfactory, while 30 per cent might be and 12 per cent definitely were below the 'Tolerable Standard'.

The housing situation was assessed almost yearly, by the 1970's and the report 'Areas of Need' (Mansley, 1972), spelled out the problems. Claims on the land for housing, industry and schooling had to be balanced against claims for those facilities which would make life more agreeable. Meanwhile, one third of the city was suffering severe social, economic and environmental stress, with many of the post-1919 schemes having the highest levels of multi-deprivation.

Deprivation exists in Glasgow and is associated with short stature (Vimpani et al, 1981). Although short stature is not itself, necessarily a disadvantage, it is associated with low I.Q. and lower social class (Lacey & Parkin, 1974) and with mental retardation (Vimpani et al, 1981). Evelyth & Tanner (1976), considered the height of a population and the rate of growth of children, accurate reflections of the state of both Public Health and nutrition.

There was a need to know more about the constitutionally short stature found in Glasgow and to what extent it is caused by deprivation. It was logical to focus attention on areas where deprivation was known to occur. The Plowden Report (Central Advisory Council for Education, 1967) stated, ". . . . there appears a strong case for saying that socially deprived families are frequently found in confined geographical areas identifiable by

certain physical and social characteristics . . . . ".

Consequently, a study was set up to establish the growth pattern of children living in a deprived area in Glasgow and to attempt to ascertain which factors in the lives of these children were influencing that pattern.

CHAPTER II.

THE SURVEY.

Short stature is associated with deprivation. Glasgow is a city of short people (Common Services Agency, 1975) and of deprivation (Holterman, 1975).

The survey had two main aims. The first was to establish the growth pattern of children in a deprived area in Glasgow and the second, to evaluate factors influencing that pattern.

A group of children living in a deprived area was observed from just after birth until one year of age. Since the greatest post-natal growth spurt before adolescence occurs during the first year of life, this is the time when the child's growth is most likely to be influenced by either favourable or adverse circumstances. Blackhill was the chosen area of deprivation.

Examination of the growth of a group of children is relatively meaningless unless there is available a suitable standard of reference. In Britain, the most commonly used reference data for heights and weights are those of Tanner, Whitehouse & Takaishi (1966). As there is already evidence that Glasgow people are short, any deviation from Tanner et al (1966) standards found in the reference children could be attributed to their genetic endowment rather than to their environment. Hence, it was decided that a more appropriate standard was one based on contemporary cross sectional data from Glasgow children which, in turn, could be compared with the Tanner et al (1966) data.

It was impractical in terms of both time and money to follow up a sufficiently large number of representative Glasgow children for

a year. The less satisfactory, but for us more practical option of investigating cross sections at specific ages within the year was taken.

As a further comparison, a group of children from an area which was thought to be more typical of the city as a whole was also followed from just after birth to one year of age. Carntyne was the area chosen.

The survey therefore contained three groups: a Glasgow cross section, Blackhill and Carntyne longitudinal study groups. Throughout the analysis of the results, those of the cross sectional group were first compared with other relevant data and subsequently with the longitudinal study groups.

660 children were seen in the cross section at one of five ages: 6 weeks, 3, 6, 9 or 12 months. Each of those children was seen on only one occasion.

In the longitudinal groups, children were seen from shortly after birth until one year, at approximately monthly intervals. There remained in the survey at one year, 50 and 53 children from Blackhill and Carntyne, respectively. The survey was subsequently extended to allow children of both longitudinal study groups a visit at 15 months and those from Blackhill a final visit at 24 months.

Data were collected concerning various family and social factors, infant feeding practice, present diet, obstetric factors and hospital admissions, in addition to measuring the children. Children in the two longitudinal groups were assessed developmentally, examined medically and had morbidity records kept.

The survey was conducted during 1975 and 1976 and the extension during 1977. This paper reports on the children up to 12 months.

CHAPTER III.

THE STUDY AREAS.

Glasgow's local authority housing was divided initially into two categories according to the level of rent charged. The first, known as 'rehousing', had very low rents. Tenants were either from slum clearances or had a very low fixed income. The second, 'ordinary' group, had much higher rents. Subsequently, it was found necessary to include a third group comprising those who failed to qualify for rehousing homes yet could not afford ordinary rents. This group was termed 'intermediate' (Glasgow Corporation Housing Department, 1948).

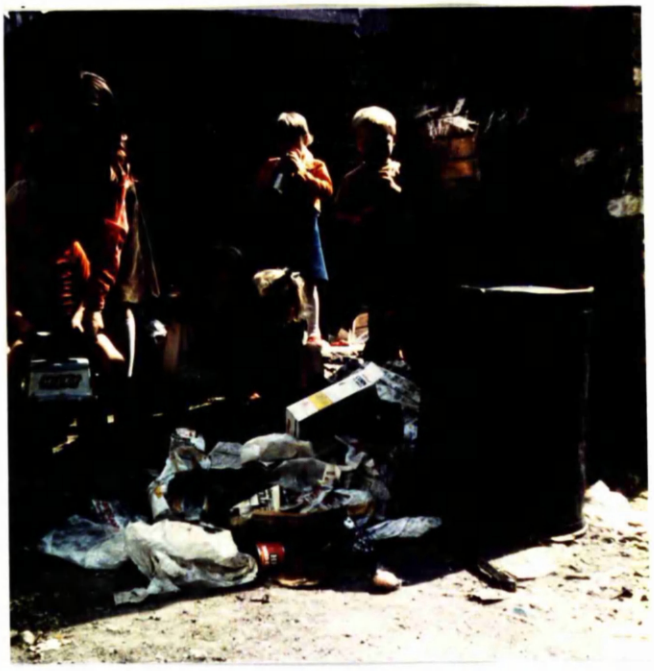
Blackhill was chosen as the study area of deprivation. It was built in the 1930's after the Housing (Scotland) Acts of 1930 and 1935, which were passed to speed up the removal of slums and relieve overcrowding. The initial scheme comprised 980 tenement apartments of rehousing classification and 344 flatted or cottage intermediate homes. All had modern conveniences.

A previous study conducted there early in the 1970's by Richards, McIntosh & Sweenie (1979) highlighted the problems of 100 of its vulnerable families and had already described the 'air of neglect and impoverishment' which abounds. Houses were in disrepair both internally and externally and the open spaces and pavements were covered with litter and broken glass. Two shops served the community and these had bricked up windows and metal doors. The local Health Authority clinic was two miles away although the health visitor did have an office in the community. However, this office accommodation was not suitable for holding clinics. A subsequent

local government paper has cited Blackhill as an area requiring priority treatment (Strathclyde Regional Council, 1977).

Carntyne was chosen for study as an area thought to be fairly representative of the city as a whole. The fact that it lies in close proximity to Blackhill and the knowledge of co-operative health visitors at the local clinic were practical considerations which influenced its choice. It was built following the 1924 Housing (Scotland) Act and originally comprised 1732 tenement flatted or cottage homes all of ordinary classification. At the time of the survey the area covered by the local clinic also included some more recently built high rise flats and privately owned homes. Housing was of a very mixed condition, ranging from well maintained red sandstone tenements to some which were partly vacated and boarded up.

The Centre of Blackhill.



Children in Blackhill.

Tenements in Carntyne.

CHAPTER IV.

METHODS.

(a) Personnel.

(b) Selection.

- i. Cross Section.
- ii. Longitudinal Section.

(c) Recruitment and Follow-Up.

- i. Cross Section.
- ii. Longitudinal Section.

(d) Data Collection.

- i. Social and Family Background.
- ii. Dietary Factors.
- iii. Anthropometry.
- iv. Morbidity.
- v. Pregnancy and Birth Events.
- vi. Developmental Screening.

(a) Personnel.

In the cross sectional population, a nursing sister questioned the mothers and measured the children. She was assisted in taking the measurements by an auxiliary nurse. In both longitudinal sections, the children were measured and mothers questioned with regard to dietary and social factors by the author. An auxiliary nurse assisted with the measurements. Morbidity histories and development which were restricted to the longitudinal sections were always ascertained by a doctor and, in the main, by one of two doctors.

(b) Selection.

i. Cross Section.

Children born and residing within the pre-regionalisation boundary of the city of Glasgow were ascertained from the city birth register. All live births were included, irrespective of home or hospital delivery, legitimacy and whether singleton or multiple birth. The children were selected in five age groups: 6, 13, 26, 39 and 52 weeks (the latter being close to 3, 6, 9 and 12 months). Prior to each week of visiting, children were listed who were of the required age on the Tuesday or Wednesday. They were actually seen on one of the five weekdays and so ages could differ from the requirement by up to -2 or +3 days. Prior to any visits, the city death register was checked to ensure that no listed children had died.

From approximately 40 names thus obtained each week, 20 were selected using random number tables. No account was taken of sex in the selection. The socio-economic group of each infant's father was noted and selection continued until each age group contained a social distribution similar to that of the births occuring in the city of

Glasgow between January and September, 1974. Although the socio-economic group of the father was not available for the 6 week old group, it was found subsequently that random number selection alone had provided a comparable distribution.

ii. Longitudinal Section.

The names of children born in Glasgow are sent routinely either to their area Health Visitor (HV) or to their GP practice, if it has an attached HV. Consecutive births in Blackhill and Carntyne were ascertained from these two sources. The area HV s supplied the majority of names and the registration board the names of those notified to GP attached HV s. The numbers seen in each area were chosen to leave approximately 50 babies still in the study at 12 months, allowing for a higher fall-out rate in Blackhill.

(c) Recruitment and Follow-Up.

i. Cross Section.

A full explanation of the project, accompanied by a request for co-operation, was posted to each mother (Appendix I). An appointment for the proposed visit was given with an opportunity for change or refusal. Those who refused, had moved outwith the survey area or were unable to participate, were omitted. The remainder were visited.

Revisits were made during the same week if there was no reply at the door. Attempts were made to trace and visit any infants who had moved but still resided within the city boundary.

ii. Longitudinal Section.

At the first routine visit to the homes of all new infants within the two defined areas, the Health Visitor - either local or GP attached - explained the aims and outlined the plan of the survey.

The parents' co-operation was sought. Two mothers (both from Blackhill), who were unsure at this stage, were persuaded to join the study after a further visit from one of the doctors. An appointment was given to each mother to attend the local Health Visitor Office or Clinic at a time when the infant would be between 4 and 6 weeks old.

First defaulters were reminded by post-card and second defaulters visited. Three mothers in Carntyne were visited routinely at home for various justifiable reasons. In Blackhill, the number of defaulters gradually increased until, latterly, all the infants were seen at home as a matter of course.

The infants were seen at 4 weekly intervals, wherever possible, up to the age of one year. They were seen again at 15 months and the Blackhill infants, now toddlers, were seen again at the age of 2 years. This paper reports on the children up to 12 months.

(d) Data Collection.

i. Social and Family Background.

The team leader interviewed the mother or guardian, according to a coded questionnaire (Appendix II). It should be noted that where a discrepancy occurred between the occupation of the father, as given by the mother, and as recorded on the registration form, the former was used.

ii. Dietary Factors.

At each visit, in both the cross sectional and longitudinal sections, the mother was asked to recall the infant's diet over the previous 24 hours. Some controversy surrounds this method and, therefore, its choice should be justified.

It was necessary that a uniform method be used throughout the

cross sectional and longitudinal sections. Two factors influenced the choice. The first was a concern to avoid overtaxing mothers involved in the longitudinal study and hence jeopardise their co-operation for the full survey period. The second, based on information from the local HV's, was the likelihood of some illiterate mothers in the longitudinal section. The following are five methods of dietary assessment in fairly common use:

- current record using scales.
- current record using standard household measures.
- store cupboard inventory.
- dietary recall.
- dietary history.

The first method, if achieved, is the most accurate but both it and the second method are time consuming, involve a high level of co-operation and require literate participants. The third method is that utilised in compiling the National Food Surveys and is not applicable to the study of individual diets. The final two methods are retrospective, 'recall', providing the actual food consumed and 'history', the usual diet. Both make minimal demands on the subject but have been criticised as being dependent on the subject's memory and the interviewer's skill.

The aim of the study was to investigate infants from a deprived area. Any method which eliminated the children of illiterate or overworked mothers had to be avoided as it was they who were the reason for the study. Black (1972) had already pointed out the difficulty of obtaining satisfactory co-operation from the most socially inadequate problem families. Subsequently, the Department of Health and Social Security (1975) failed to obtain usable dietary records from a higher percent of socio-economic groups

III manual, IV and V, than from groups I, II and III non-manual. The two retrospective methods were, therefore, the only practicable and it was thought that, with respect to infants, recall was more accurate.

The team leader questioned the mother or guardian regarding the food given that day, up to the present time (x hours) and, reverting to the previous day, what had been given from x hours onwards. In this fashion, the participant was always working forwards. Details, where applicable, were taken of the type of food, the brand, its preparation, the amount offered and the amount left. Particular attention was paid to the preparation of milk mixtures and to additions such as sugar or cereal. Prompting was also used concerning periods between meals. Amounts were recorded in household measures.

In order that the household measures be quantified, the author weighed measured samples of all the foods recorded. Manufacturers' standard weights for the various dried milk powders were used. McCance and Widdowson Food Tables (Paul & Southgate, 1978) were employed in the nutrient analysis of the major portion of diets. Manufacturers supplied their own analyses in the case of certain baby foods and vitamin supplements.

A questionnaire concerning breast feeding and weaning was completed by the team leader, initially only for those mothers who had breast fed but, latterly, for all participants.

After the cross section survey had been in progress for a few weeks, the mothers were given a prospective diary and asked to complete and return it. The team leader explained how it should be done. The aim of the diaries was to assess the mothers' response and compare

the diets with those provided by 24 hour recall.

iii. Anthropometry.

Six anthropometric measurements were made. These were weight, length, triceps and subscapular skinfolds, mid-upper arm and head circumferences. Measurements were made by the team leader, assisted by an auxiliary nurse.

The children were measured naked. Skinfolds were measured first,using the method described by Tanner & Whitehouse (1975), followed by head and mid-upper arm circumferences. The former is described by Tanner (1973) and the arm circumference was taken at the site of triceps measurement. The child was then weighed, the scale having been 'zeroed' and finally, length was measured (Tanner,1973).

One set of equipment was used throughout the cross section survey and one set for each of the longitudinal sections. Each set comprised a light-weight platform beam scale (Homs Model 25 KTP), weighing up to 25kg in 10g intervals; a Harpenden infantometer; a Holtain skinfold caliper and a steel measuring tape.

Measurements in the cross section and longitudinal studies were carried out by different observors using different equipment. The resulting intra-observor variation was assessed in two ways, first by both observors measuring 5 children on the same day (same day comparison) and second, by a comparison of 17 children who were selected into both the cross section and longitudinal section (different day comparison). These children had different identifying numbers in the two surveys and provide a genuinely 'blind' comparison. However, none of them were measured on the same day by both observors, the closest visits being one day apart and, in a few cases, they were four or more weeks apart.

To get round this, longitudinal data for the same day as the cross sectional data were constructed by interpolating or extrapolating between adjacent longitudinal values and 3 cases, where the cross sectional and nearest longitudinal visits were more than 12 days apart, were excluded. This procedure, although not ideal, does give an idea of the variation of the six measurements. Table II shows very similar biases or mean differences for all measurements, except length. The measurements made on the cross section children tended to be less than those on the longitudinal sections.

TABLE II.

Comparison of the Bias of Two Anthropometry Observors.

Assessment	Length (mm)	Weight (g)	M.U.A.C. (mm)	Head Circum. (mm)	Triceps Skinfold (mm)	Subscapular Skinfold (mm)
Same day	+0.8	-48	-6.6	-0.8	-1.5	-0.3
Different day	-8.5	-46	-6.7	-0.4	-1.4	-0.3

iv. Morbidity.

Data collection in the cross section was limited to recall of the number of hospital admissions since birth, together with diagnosis and duration of stay.

In the longitudinal section, a between visit morbidity recall was obtained at each visit by one of the doctors. For the purpose of simplification of data, six categories of morbidity were defined: diarrhoea ± vomiting, respiratory, feeding difficulties, skin problems, accidents and 'others'. The duration of the illness and of any period of anorexia were recorded.

A rough assessment of severity was based on the management of

the illness as recorded from the mother. If she had taken no action, treated the illness herself or taken the child to the local Health Visitor Clinic, the illness was reported as 'mild'. A visit to a General Practitioner or hospital casualty or out-patient department, with no evidence of antibiotic therapy or follow-up, led to an illness being termed 'moderate'. The term 'severe' was restricted to those illnesses where antibiotics had been administered or the child admitted to hospital.

The cross section infants were examined clinically at each visit and a record taken of fontanelle width, number of teeth and of any abnormality.

v. Pregnancy and Birth Events.

The birth weight and gestation period of each survey infant were extracted from the hospital records. In the longitudinal sections, each mother was asked for details of her health during pregnancy, smoking during pregnancy and problems during delivery.

vi. Developmental Screening.

This applied only to longitudinal section children. The developmental screening method used in Woodside Health Centre (Barber, Boothman & Stanfield, 1976), was applied in the longitudinal section by one of the doctors. It was derived originally from Sheridan's screening tests for infancy and early childhood (Sheridan, 1968). There were four basic development areas - speech & language; vision & fine motor; social and gross motor. Each plot on the age achievement charts was scored in respect of its relationship to the standard steps and a total score obtained for each visit.

Despite the wide variations, which are normal in the first year of life, it was hoped that any large differences in mean developmental achievement between the two sections might be detectable.

CHAPTER V.

RESPONSE.

(a) Cross Section Participation.

(b) Longitudinal Section Participation.

(c) Prospective Diaries.

CHAPTER V.

RESPONSE.

(a) Cross Section Participation.

The total number of infants selected in the cross section with the reduction at various stages is shown in Table III.

TABLE III.

Response Rate: Cross Section

	Number
Mothers approached	916
'Prior' default or refusal	90
Scheduled for visit	826
Failure for technical reasons	72
Visits attempted	754
Visits achieved	660

'Prior' default included those who had moved outwith the survey area and those who were unable to participate for a variety of reasons such as, going on holiday during the appropriate survey week. There was also one death.

TABLE IV.

Reasons for Failure by Age Group.

Reason	6 weeks			3 months			6 months			9 months			12 months			Total
	Prior	After	Total %	Prior	After	Total %	Prior	After	Total %	Prior	After	Total %	Prior	After	Total %	%
Moved	5	4	5.8	11	9	9.3	5	11	11.1	12	10	14.3	38	15	21.5	13.1
Refused	1	-	0.6	3	3	2.8	2	1	2.1	1	2	2.0	1	6	2.8	2.2
'Unable'	1	-	0.6	-	4	1.9	-	4	2.8	3	-	2.0	5	2	2.8	2.1
No reply	-	5	3.2	-	4	1.9	-	2	1.4	-	2	1.3	-	1	0.4	1.5
Died	-	1	0.6	1	1	0.9	-	-	-	-	1	0.7	-	1	0.4	0.6
Cdn't locate house	-	1	0.6	-	-	-	-	-	-	-	3	2.0	-	-	-	0.4
Wrong age	-	-	-	1	-	0.5	-	-	-	-	-	-	-	1	0.4	0.2
Nurse ill/car broken down	-	-	-	-	10	4.7	-	-	-	-	-	-	-	62	25.1	7.9
Total Failures	-	-	11.5	-	-	21.9	-	-	17.4	-	-	22.1	-	-	53.4	28.0

The failure rate rose with age group, reflecting not only the increasing time from birth for movement from the city but also an unfortunate gap, due to illness of the investigators at the time when the 12 month old children were to be visited. Table V condenses the results and gives the numbers of children who required more than one visit to achieve contact.

TABLE V.

Summary of Failures & Numbers Requiring More Than 1 Visit to Achieve Contact.

Age	No. Approached	No. Failed	No. Seen	% Seen	No. Req. > 1 Visit	%
6 weeks	156	18	138	88.5	1	0.7
3 months	215	47	168	78.1	6	3.6
6 months	144	25	119	82.6	1	0.8
9 months	154	34	120	77.9	7	5.8
12 months	247	132	115	46.6	4	3.5
Total	916	256	660	72.1	19	2.9

TABLE VI.

Reasons for Failure by Socio-Economic Group.

Reason	I		II		III		IV		V		-		'6 weeks'	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Moved	5	9.8	9	10.7	53	11.9	29	18.2	11	7.2	4	21.1	9	5.8
Refused	-	-	1	1.2	10	2.3	5	3.1	2	1.3	1	5.3	1	0.6
'Unable'	-	-	2	2.4	9	2.0	1	0.6	3	2.0	3	15.8	1	0.6
No reply	-	-	1	1.2	6	1.4	1	0.6	-	-	1	5.3	5	3.2
Died	-	-	-	-	4	0.9	-	-	-	-	-	-	1	0.6
Cdn't locate house	-	-	-	-	3	0.7	-	-	-	-	-	-	1	0.6
Wrong age	-	-	-	-	1	0.2	-	-	-	-	1	5.3	-	-
Nurse ill/car broken down	5	9.8	7	8.3	35	7.9	17	10.7	8	5.2	-	-	-	-
Total Failures	10	19.6	20	23.9	121	27.3	53	34.0	24	15.7	10	52.6	18	11.5

The 6 week old group was unable to be categorised according to social class until after the visit and, therefore, the social class of those not seen is unknown. When percentage failure was related to social class, the greatest rate occurred within groups III and IV and not as might be expected with group V. This again, reflected the increased mobility within those two social groups.

(b) Longitudinal Section Participation.

TABLE VII.

Initial Response Rate (Per Cent).

Result	Blackhill	Carntyne
Entered survey	100.0	91.4
Refused	-	5.7
Already moved	-	1.4
Already died	-	1.4
'n'	78	70

TABLE VIII.

Success Rate at 15 Months (Per Cent).

Result	Blackhill	Carntyne
Still in survey	64.1	82.8
Moved out of area	24.4	12.5
Died	3.9	-
Refused to continue	3.9	1.6
Child unobtainable	2.6	-
Failure to maintain contact	1.3	3.1
'n'	78	64

As expected, the failure rate was higher in Blackhill than in Carntyne - the most common reason being the movement of the family outwith the survey area.

(c) Prospective Diaries.

From week 5 of the cross section survey onwards, mothers were asked to complete and return a prospective diary. Approximately two-thirds complied and of those returned, 62 per cent were suitable for coding. Thus, of the number asked to participate, 40 per cent produced an adequate response. (Table IX).

TABLE IX.

Completion Rate of Prospective Diaries.

	Number
Asked to participate	582
Diary returned	374
Diary suitable for coding	231
Diary unsuitable for coding	143

No analysis has been made of the data collected, partly because of the poor response and it was further felt that any results obtained would not add materially to the value of the study.

CHAPTER VI.

SOCIAL AND FAMILY BACKGROUND.

(a) Social Structure.

(b) Unemployment.

(c) Ethnic Group.

(d) Housing Conditions.

(e) Maternal Characteristics.

(f) Handicap.

(g) Mobility.

(h) Discussion.

Appendix II shows the social and family background questionnaire. Satisfactory forms were completed for 655 children (99.3 per cent).

(a) Social Structure.

The social structure of the cross section, divided into age group, is given in Table X. The proportions shown, as reference of births in the City of Glasgow, were those most recently available when data collection was started, i.e. January - September, 1974.

TABLE X.

Social Structure of the Cross Section (Per Cent).

Socio-Economic Group	City of Glasgow Jan.-Sep. 1974	Total Cross Section	Age Group 6 weeks	3 months	6 months	9 months	12 months
I	4.7	6.1	7.5	4.8	6.7	7.7	3.8
II	8.4	9.1	8.3	11.5	9.8	6.0	9.4
III	51.5	48.8	51.1	46.4	43.5	49.6	54.7
IV	21.5	15.7	15.0	13.3	19.1	18.0	14.2
V	12.4	18.8	17.3	22.9	20.0	15.4	17.0
-	1.6	1.4	0.8	1.2	0.9	3.4	0.9

The cross sectional distribution of socio-economic groups was similar to the reference data, apart from a slight excess in groups I and V and deficiency in groups II and IV. However, combining group I with II and group IV with V gave a very satisfactory distribution.

The social structure of the two longitudinal and the cross sectional group is seen in Table XI.

TABLE XI.

Social Structure of the Longitudinal Section (Per Cent).

Socio-Economic Group	Cross Section	Blackhill	Carntyne
I	6.1	-	1.6
II	9.1	1.3	6.3
III	48.8	12.8	68.7
IV	15.7	2.6	6.3
V	18.8	71.8	9.4
-	1.4	5.1	1.6
?	-	6.4	6.3
n	655	78	64

The proportion of socio-economic groups I and II was lower in both longitudinal groups than in the cross section. This was notably so in Blackhill where there was a complete absence of group I and only 1 percent from group II. Blackhill was predominantly group V and Carntyne predominantly group III.

The relatively high rate of unclassifiable babies in Blackhill is accounted for by homes where there was no male present and no female in employment.

Both longitudinal groups contained some babies who left the survey before completion of the questionnaire.

(b) Unemployment.

The West of Scotland has, for some time, had the misfortune to have one of the country's highest unemployment rates. During the period of the survey, both national and local rates increased. This is demonstrated by Table XII, which is taken from the relevant British Labour Statistics Year Books (Department of Employment, 1977 & 1978).

TABLE XII.

Unemployment Rates: 1975 & 1976 (Per Cent).

Annual rates	1975	1976
U.K.	4.2	5.8
Scotland	5.2	7.0

Quarterly rates	1975 Mar.10	1976 Mar.11	1975 Jun.9	1976 Jun.10	1975 Sep.8	1976 Sep.9	1975 Dec.11	1976 Dec.9
Greater London	2.0	3.7	2.2	3.8	3.2	4.3	3.3	n.a.
Birmingham	3.5	6.8	4.4	6.5	7.0	7.4	6.7	n.a.
Manchester	3.4	5.2	3.7	5.7	5.4	6.0	4.9	n.a.
Edinburgh	3.7	5.2	3.8	5.1	4.9	5.8	4.7	n.a.
Glasgow	5.4	7.4	5.5	7.6	6.8	8.7	6.7	n.a.

n.a. : not available.

Glasgow had one of the highest unemployment rates of the industrial cities. The cross sectional data were collected from October, 1975 to September, 1976 and, at 8.9 per cent, showed an even higher rate than the overall Glasgow figures.

Blackhill had an extremely high level of unemployment at 50 per cent, while Carntyne had the much lower rate of 3 per cent.

(c) Ethnic Group.

While there has been a gradual drop in the total population of Glasgow since the drift to the new towns, there has been a rise in the immigrant population. Table XIII is drawn from the tables of birthplace of the Glasgow population in the 1961 and 1971 Censuses (Registrar General, 1963, 1973). It shows an increase in the number of African, Asian and Chinese-born living in the city, with the Asian community the largest of the three. These data have limitations. They do not include second or third generations from the various ethnic groups, nor do they distinguish caucasian from non-caucasian.

TABLE XIII.

Countries of Birth of Glasgow Population: 1961 & 1971.

	African	Asian	Chinese
1961	871	3159	280
1971	1120	5350	800

Goel (1979) conducted a nutrition survey of immigrant children in Glasgow at the same time as the present survey was conducted. He stated:

"The population of Glasgow includes about 12,000 Asians, 1,100 Africans and 3,000 Chinese. The immigrant community is dispersed throughout the city but is mainly concentrated within two major areas on either side of the River Clyde. .... The majority of Asian immigrants in Glasgow are from the Punjab (North India and West Pakistan). Of the 12,000 Asians, 7,500 are Muslims, 4,300 are Sikhs and the rest are Christians, Jains and Hindus".

The 1971 Census (Registrar General, 1973) gave the population

of Glasgow as 982,315. Using that figure and those of Goel (1979), approximate percentages of ethnic groups have been calculated. These are given in Table XIV, with the proportions found in the survey.

TABLE XIV.

Ethnic Groups (Per Cent).

	City of Glasgow (approx).	Cross Section	Blackhill	Carntyne
Caucasian	98.4	94.4	98.7	100.0
Asian	1.2	5.0	-	-
Mongoloid	0.3	0.2	-	-
Negroid	0.1	0.3	-	-
Mixed	-	-	1.3	-

The main difference between the cross section rates and those calculated for Glasgow was the higher proportion of Asians in the survey.

The immigrant community tend to live in two concentrated areas. Neither of the longitudinal groups encompassed these areas, which is reflected by Table XIV. The one non-caucasian living in Blackhill was of mixed race, having a Chinese mother.

(d) Housing Conditions.

Holman (1970) made comparisons of various housing deprivations in Britain and within some cities. The source was the 1966 Sample Census. Later data from the 1971 Census of Population were used to provide similar indices in urban areas of Britain (Holterman, 1975). Examples from both are given in Table XV for comparison with the results of the Glasgow cross section from the present survey.

TABLE XV.

Housing Conditions in Britain (Per Cent).

	Share or lack hot water	Share an inside w.c.	Have only outside w.c.	More than 1.5 persons per room
[1] 1966 data:				
Gt.Britain	14.5	4.4	16.7	1.6
Gtr.London	20.6	13.3	12.6	2.4
Coventry	16.6	2.0	17.6	1.5
Liverpool	24.2	6.4	31.6	2.6
Glasgow	25.3	16.1	1.8	11.8
[2] 1971 data:				
Gt.Britain	9.7	n.a.	12.5	2.3
1975-6 data:				
Glasgow cross section	5.8	0.3	3.7	34.3

1 : From Holman (1970).
2 : From Holterman (1975).

From the 1966 data, Glasgow was shown to contain some of the worst housing deprivations in Britain, with the exception of a relatively low number of outside w.c.'s. Conditions of overcrowding compared very unfavourably.

Holterman's 1971 data suggested a general improvement

throughout Britain.

A further demonstration of improvement can be made by comparing the sanitation indices of the cross section with those of Glasgow in 1966. Overcrowding, conversely, had worsened to nearly three times the previous level. It is possible that this could be partly accounted for by confusion over whether or not to include the kitchen in the room tally. However, both interviewers were instructed to include it if used as a living room, so this alone cannot account for such a large rise.

The same indices are used in Table XVI, giving the levels at which they were found in the longitudinal sections and again, in the cross section.

TABLE XVI.

Housing Conditions in Glasgow (Per Cent).

	Share or lack hot water	Share an inside w.c.	Have only outside w.c.	More than 1.5 persons per room
Cross section	5.8	0.3	3.7	34.3
Blackhill	9.0	-	-	54.3
Carntyne	3.1	1.6	4.7	25.8

Thus, sanitation in the two longitudinal areas differed. The Blackhill homes all contained their own inside w.c. but 9 per cent were without a hot water system. In Carntyne, 5 per cent had only an outside w.c. while a lower figure of 3 per cent were without hot water.

Overcrowding in Carntyne was lower than in the cross section although still high compared with previous data. In Blackhill, it was very high. 54 per cent of the families lived in a density of more than 1.5 persons per room. Larger numbers of children were one

cause but often three generations lived together and, in some instances, two families shared a home after one of them had been evicted. Table XVII gives further details of this situation. It shows the percentages of homes where there were 8 or more people living together and also where there were 3 or more children under the age of 5 years.

TABLE XVII.

Large Family Units and Young Children (Per Cent).

	Cross Section	Blackhill	Carntyne
8 or more persons per house	6.4	21.8	3.1
3 or more children under 5 years	8.6	19.2	3.1

(e) Maternal Characteristics.

Table XVIII summarises some of the variations related to the mothers of the survey children and includes reference data for Glasgow.

TABLE XVIII.

Maternal Characteristics (Per Cent).

	Glasgow 1976	Cross Section	Blackhill	Carntyne
Age:[1] less than 20	12.3	9.8	32.1	6.3
20 - 29	67.2	64.6	50.0	65.6
30 - 39	18.8	23.2	12.8	17.2
40 and over	1.5	2.4	3.9	7.8
?	0.2	-	1.3	3.1
Parity:[1] 0	42.1	41.1	38.5	48.4
1	32.7	30.4	24.4	32.8
2	13.4	15.0	10.3	7.8
3	6.3	6.9	6.4	3.1
4 and over	5.5	6.7	19.2	6.3
?	0.1	-	1.3	1.6
Illegitimate child/ single mother[2]	15.5	4.9	12.8	3.1
Mean height (cm).[3]	158.6	159.6	157.0	160.7
Minimal or no formal education	n.a.	85.0	98.7	85.9

1 : Glasgow 'age' and 'parity' data refer to legitimate births only for the City of Glasgow (Registrar General Scotland, 1977).

2 : 'Illegitimate child' refers to City of Glasgow data (Registrar General Scotland, 1977) and 'single mother', to that of the survey. It is appreciated that they are not synonymous.

3 : Glasgow 'mean height' is that of Greater Glasgow (Common Services Agency, 1976).

The Glasgow data did not, strictly speaking, provide a true comparison for the cross section. 'Age'and 'parity' data referred to legitimate births only and the quoted'mean height' was for Greater Glasgow rather than the City of Glasgow. Nontheless, the source was sufficiently close to the ideal to test the authenticity of the cross section.

The most striking divergence in the cross section was the low rate for single mothers. This was, to some extent, an artefact as was the older age distribution, due to the difficulty of gaining access to young unmarried mothers. Apart from the illegitimacy rate, the sets of data were very alike.

A close match was found between the cross sectional and Carntyne groups, although the latter had slightly fewer young mothers. In contrast, mothers who lived in Blackhill were approximately three times more likely to be aged under 20 years, to have a parity of 4 or more or be single. Their mean height was 2.6cm less than the cross sectional group mean. One mother who had attended school after the minimum age, was not originally from Blackhill but was the Chinese mother of the boy of mixed race.

(f) Handicap.

Significant handicaps were found in 1 per cent of the cross section and 1 and 2 per cent, respectively, in Blackhill and Carntyne children. Table XIX gives further details.

TABLE XIX.

Handicap Rates (Per Cent).

	Cross Section	Blackhill	Carntyne
No handicap	97.3	96.2	98.5
Physical	0.3	1.3	1.6
Mental	0.9	-	-
Both	0.2	-	-
Possible	1.4	2.6	-

(g) Mobility.

Details of mobility were available for the longitudinal sections only. Table XX shows mobility within these two groups over 2 years.

TABLE XX.

Mobility.

	Blackhill	Carntyne
% age who moved outwith survey area	24.4	12.5
Mean no. of moves within area	0.18	0.08
Mean no. of moves (total)	0.42	0.20

The Blackhill families moved approximately twice as often as those from Carntyne. One family lived in 4 different houses, all in Blackhill, during the two survey years.

(h) Discussion.

The picture which emerged confirmed high levels of deprivation in Glasgow. The cross section had better sanitation but worse overcrowding than might have been expected from previous reports. The marked similarity between the cross sectional and Carntyne data confirmed the choice of the latter as an area typical of the City. Blackhill was chosen as a survey area, specifically because it was known to be deprived. Throughout examination of the social factors data, it was found consistently in a much worse position than the cross section, with the one exception that all homes had indoor w.c.'s. Some factors, which have been shown to be detrimental to the achievement of children, have been summarised in Table XXI.

TABLE XXI.

Detrimental Factor Rates (Per Cent).

	Cross Section	Blackhill	Carntyne
Density more than 1.5 persons per room	34.3	54.3	25.8
Socio-Economic Group V	19.2	71.8	9.4
Unemployed father	8.9	50.0	3.1
Mother less than 20 years	9.8	32.1	6.3
Single mother	4.9	12.8	3.1
Parity 4 or more	6.7	19.2	6.3

Unemployment, overcrowding and single mothers were indices used by Wedge and Prosser (1973) in identifying their vulnerable children who were more likely to be handicapped, to be ill, to be maladjusted and to have poor school achievement. In the Blackhill sample, 50 per cent had unemployed fathers, 54 per cent lived in overcrowded homes and 13 per cent with single mothers. Illsley (1967) showed that a child's I.Q. increased with increasing maternal age. 32 per cent of the Blackhill sample were born to mothers aged 19 years or less. Neligan, Prudham & Steiner (1974), Illsley (1967) and Davie, Butler & Goldstein (1972) have all shown an association between low I.Q. and high parity within social group. The mothers of 19 per cent of the Blackhill sample had had 4 or more previous children.

When these results are considered together, all showing the debilitating effect of poor social background, then the outlook for the Blackhill children is grim.

CHAPTER VII.

BIRTH WEIGHT AND GESTATION.

(a) Birth Weight.

(b) Gestation.

(c) Discussion.

CHAPTER VII.

BIRTH WEIGHT AND GESTATION.

(a) Birth Weight.

The birth weight of a child is dependent on genetic potential, gestational period, pregnancy number and fetal environment. This last factor is related to maternal nutrition, as was shown by war-time studies, based on the siege of Leningrad (Antonov, 1947) and the Dutch famine (Smith, 1947). More recent work has established that improving the diet of Guatemalan mothers resulted in bigger babies (Lechtig et al, 1975). These children, when later assessed, were shown to have better intellectual status than the babies of non-supplemented control pregnancies. Illsley & Kincaid (1963) have demonstrated that birth weight is related to social class after standardisation for maternal height.

Various surveys of birth weight and related factors have been made. Two extensive British studies were The 1958 British Perinatal Mortality Survey (Butler & Alberman, 1969) and The Assessment of Fetal Growth (Thomson, Billewicz & Hytten, 1968). Tanner & Thomson (1970) noted that the Aberdeen infants of Thomson et al (1968) were amongst the largest reported. Those of Sterky (1970) were larger, while infants surveyed by Butler & Alberman (1969); Freeman (1970); Gruenwald (1967) and Lubchenco et al (1963), were all smaller.

Results: Cross Section.

Table XXII (i) shows that the birth weight of the cross sectional infants fluctuated between and around the data of Butler & Alberman (1969) and Thomson et al (1968).

TABLE XXII.

A Comparison of Cross Sectional Birth Weights.
(i) With Other Survey Results.

Gestational Age (Weeks)	Lubchenco et al (1963) (Mean)	Gruenwald (1967) (50th Centile)	Butler & Alberman (1969)	Thomson et al (1968) (50th Centile)	This Survey (Mean)
33	1.96	1.98	2.14	2.20	1.92
34	2.28	2.24	2.26	2.47	2.09
35	2.48	2.45	2.57	2.70	2.67
36	2.75	2.65	2.79	2.90	2.93
37	2.87	2.85	3.00	3.07	2.97
38	3.03	3.03	3.15	3.22	3.25
39	3.13	3.17	3.31	3.33	3.24
40	3.23	3.26	3.42	3.42	3.42
41	3.31	3.32	3.49	3.47	3.45
42	3.31	3.37	3.54	3.49	3.42
43/43 +	-	3.40	3.48	-	-

Table XXII (ii) relates the data to other Scottish births. The cross sectional infants birth weights were between those of the Glasgow Royal and the Queen Mother's Hospital. Mean birth weight, by gestational age, tended to be high but the overall mean was less than those of the Simpson and Queen Mother's Hospital means and slightly less than those of Dundee and Aberdeen.

TABLE XXII.

A Comparison of Cross Sectional Birth Weights.
(ii) With Other Scottish Births (1975). 1

Gestational Age (Weeks)	This Survey	Glasgow Royal	Queen Mother's (Glasgow)	Aberdeen Maternity	Simpson Maternity (Edinburgh)	Nine-wells (Dundee)
< 35	1.96	1.59	2.15	1.74	1.74	1.78
35	2.67	2.36	2.54	2.46	2.35	2.44
36	2.93	2.51	2.76	2.74	2.83	2.65
37	2.97	2.78	3.06	2.85	2.94	2.91
38	3.25	3.13	3.16	3.15	3.13	3.10
39	3.24	3.27	3.32	3.28	3.31	3.17
40	3.42	3.38	3.43	3.40	3.40	3.34
41	3.45	3.43	3.48	3.49	3.51	3.45
42	3.42	3.39	3.40	3.42	3.44	3.41
43/43 +	-	3.53	3.18	3.39	3.61	3.39
Total	3.24	3.21	3.27	3.25	3.29	3.25

1 : Dr. Susan Cole of the Common Services Agency very kindly extracted the mean birth weights, by gestational age, of the various Scottish hospitals, from the Scottish Maternity Statistics.

Regression analysis of the cross sectional data showed that various factors had a significant effect on birth weight ($p < 0.05$). These factors and their effect on birth weight are given in Table XXIII.

TABLE XXIII.

Birth Weight Regression.

Factor	Effect on Birth Weight (g)	Unit
'Premature' (< 38 weeks)	- 446	-
Female	- 181	-
Unemployed father	- 164	-
Gestational age	+ 78	Per week
Parity	+ 41	Per child
Mother's height	+ 14	Per cm

Results: Longitudinal Section.

Table XXIV compares the birth weights of Blackhill, Carntyne and the cross section. In Blackhill, the mean birth weights by gestational age were lower than in the cross section and there were more low birth weight babies. 17 per cent weighed 2.5 kg or less, compared with 6 per cent in the cross section and 2 per cent in Carntyne. The Carntyne birth weights by gestational age fluctuated around those of the cross section but there were more heavy babies born, 44 per cent weighing over 3.5 kg, compared with 25 per cent in the cross section and 19 per cent in Blackhill.

TABLE XXIV.

Birth Weights. Cross Section - Blackhill and Carntyne.
No. of Infants in Parenthesis.

(i) Mean Birth Weight by Gestational Age (kg).

Gestational Age (Weeks)	Cross Section	Blackhill	Carntyne
36	2.93 (17)	2.48 (4)	2.69 (2)
37	2.97 (18)	1.90 (4)	-
38	3.25 (60)	3.14 (8)	2.92 (6)
39	3.24 (104)	2.96 (5)	3.43 (19)
40	3.42 (311)	3.35 (39)	3.38 (25)
41	3.45 (83)	2.98 (7)	3.56 (8)
42	3.42 (9)	3.03 (4)	-

(ii) Percentage Distribution of Birth Weights.

Birth Weight (kg)	Cross Section	Blackhill	Carntyne
$\leq$1.5	0.3 (2)	1.3 (1)	-
>1.5 - 2.0	0.8 (5)	6.4 (5)	-
>2.0 - 2.5	4.7 (31)	9.0 (7)	1.6 (1)
>2.5 - 3.0	22.4 (147)	21.8 (17)	23.4 (15)
>3.0 - 3.5	38.6 (253)	32.1 (25)	28.1 (18)
>3.5 - 4.0	21.1 (138)	16.7 (13)	37.5 (24)
>4.0 - 4.5	4.0 (26)	2.6 (2)	6.3 (4)
>4.5	0.3 (2)	-	-
Unable to trace	7.8	10.3 (8)	3.1 (2)

Mean birth weights for Blackhill and Carntyne were corrected for those variables found to have a significant effect, after regression analysis of the cross section data. The discrepancy between the means was partially reduced. A smoking history had, unfortunately, been omitted in the cross section survey. The longitudinal birth weights were pooled and regression analysis, including smoking, was applied to the data. The mean birth weights were then corrected to take account of the smoking history and the discrepancy was further reduced. A residual difference of 120 g between the means remained unexplained by any environmental factor examined. Table XXV gives the details.

TABLE XXV.

Birth Weight Comparisons: Before and After Correction.
Standard Deviation in Parenthesis.

	Blackhill	Carntyne	C - B
Mean (kg)	3.00	3.34	0.34
	(0.64)	(0.48)	-
Mean (kg) after correction excluding smoking	3.18	3.32	0.14
	(0.51)	(0.43)	-
Residual discrepancy after correction for smoking (kg)	-	-	0.12

(b) Gestation.

TABLE XXVI.

Percentage Distribution of Gestational Age. Cross Section and Longitudinal Section. No. of Infants in Parenthesis.

Gestational Age (Weeks)	Cross Section	Blackhill	Carntyne
32	-	1.3 (1)	-
33	0.5 (3)	1.3 (1)	-
34	0.2 (1)	1.3 (1)	-
35	1.1 (7)	-	1.6 (1)
36	2.6 (17)	5.1 (4)	3.1 (2)
37	2.8 (18)	5.1 (4)	-
38	9.2 (60)	10.3 (8)	9.4 (6)
39	15.9 (104)	6.4 (5)	29.7 (19)
40	47.5 (311)	50.0 (39)	39.1 (25)
41	12.7 (83)	8.8 (7)	12.5 (8)
42	1.4 (9)	5.1 (4)	-
?	6.4 (41)	5.1 (4)	4.7 (3)
n	655	78	-

Table XXVI shows that 9 per cent of the Blackhill babies were born before 37 weeks, compared with 4 per cent and 5 per cent, respectively, in the cross section and Carntyne.

(c) Discussion.

The Glasgow cross section birth weights were generally intermediate to those of Butler & Alberman (1969) and Thomson et al (1968). In Blackhill, mean birth weights, by gestational age, were less than those of the cross section, which were similar to those of Carntyne. The distributions of birth weights were very different in the three groups. This is highlighted by Fig 2, which shows that in Blackhill, there was a much greater difference in the proportion of light babies than of heavy babies, compared with the cross section. Carntyne births demonstrated the opposite, with more heavy babies.

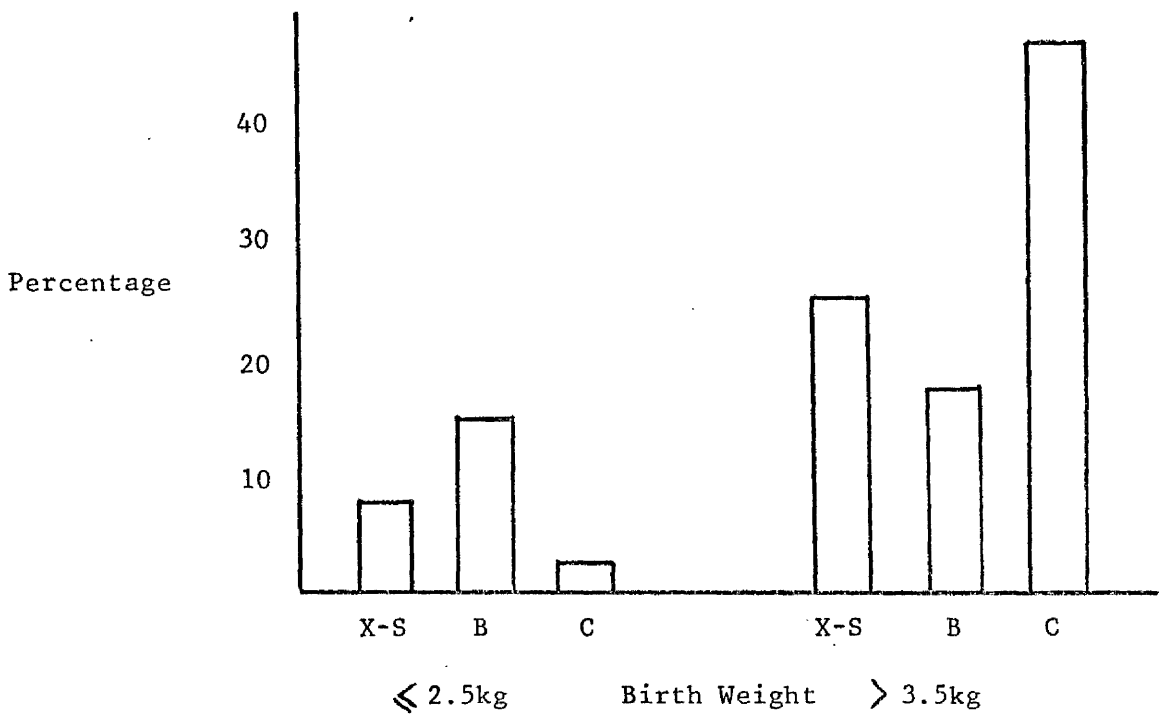


Fig 2.

Distribution of Birth Weights. Cross Section (X-S), Blackhill (B) and Carntyne (C).

Karlberg (1978) studied births in Palermo, Sicily and Gothenburg, Sweden. He showed that the distribution of birth weights in Palermo, the more deprived area, was of a broader base and that that of the lower social groupings had the largest "tails" of both light birth weights and heavy birth weights. The distribution of birth weights in Blackhill demonstrated the light but not the heavy birth weight tail.

There were more babies born of short gestation in Blackhill, which confirms the findings of Thomson et al (1968) who demonstrated a marked social class gradient in length of gestation among primiparae.

Gestational age, parity and mother's height have already been shown to be related to birth weight by other workers (Gruenwald, 1967; Thomson et al, 1968; Tanner & Thomson, 1970). Regression analysis of the cross sectional data also showed that the fact of having an unemployed father was associated with a decrease of birth weight (164g, $p < 0.05$). This is of especial interest, as the number of unemployed increases. Correction of the mean birth weights in the longitudinal section, for those factors which were found significant in the cross sectional analysis and also for smoking during pregnancy, left a residual difference of 120g between the two areas, that of Blackhill being less. This difference is unaccounted for by any investigation carried out.

CHAPTER VIII.

GROWTH.

(a) Anthropometry Readings.

i. Length.

ii. Weight.

iii. Mid-upper arm Circumference.

iv. Head Circumference.

v. Triceps Skinfold.

vi. Subscapular Skinfold.

vii. Summary.

(b) Growth Status.

i. Statistical Philosophy.

ii. Length-for-age.

iii. Weight-for-age.

iv. Weight-for-length.

v. Summary.

(c) Discussion.

(a) Anthropometry Readings.

Six measurements were made on each child, namely, length, weight, mid-upper arm and head circumferences, triceps and subscapular skinfolds. 10th, 50th and 90th centiles of these measurements are given by age, sex and area.

Reference data are presented. The Glasgow cross section results are compared to the reference material and the longitudinal results, in turn, to those of the cross section.

i. Length.

Cross Section.

At 3 months, the length centiles were almost identical with those of Tanner, Whitehouse & Takaishi (1966) but at 6, 9 and 12 months, the values were all slightly less (Tables XXVII and XXVIII). Figs 3 and 4 plot the cross sectional lengths against the standards of Tanner et al (1966).

Longitudinal Section.

Compared with the cross section, the Blackhill 10th centiles were always less, while the 50th and 90th centile values were only slightly less or similar. In Carntyne, amongst the boys, there was no consistent pattern but, on balance, the lengths were slightly greater than in the cross section. The girls tended to be longer than their counterparts throughout the study.

TABLE XXVII.

Length Centiles by Age and Area (cm). Boys.

Age	Centile	Tanner, Whitehouse & Takaishi (1966)	Cross Section	Blackhill	Carntyne
6 weeks	10	-	52.3	50.1	51.6
	50	-	55.5	54.9	55.5
	90	-	58.1	58.1	58.4
3 months	10	57.9	57.6	52.7	56.3
	50	60.7	60.4	60.5	61.1
	90	63.4	63.4	65.0	63.3
6 months	10	65.2	63.1	58.3	65.2
	50	68.2	67.0	64.6	67.7
	90	71.2	69.5	69.7	69.7
9 months	10	69.4	67.2	66.4	68.6
	50	72.7	70.8	70.2	71.2
	90	75.9	74.0	72.9	73.1
12 months	10	72.8	72.7	70.5	72.2
	50	76.3	75.0	73.1	75.2
	90	79.7	77.0	76.5	78.0

TABLE XXVIII.

Length Centiles by Age and Area (cm). Girls.

Age	Centile	Tanner et al (1966)	Cross Section	Blackhill	Carntyne
6 weeks	10	-	51.5	49.0	50.9
	50	-	53.4	53.6	54.0
	90	-	56.3	56.0	56.8
3 months	10	56.2	56.8	53.6	57.4
	50	59.0	59.0	59.1	60.3
	90	61.8	61.5	61.4	61.5
6 months	10	62.5	62.7	57.7	63.5
	50	65.5	64.6	64.5	66.0
	90	68.5	67.9	66.8	68.3
9 months	10	67.0	66.0	63.6	67.5
	50	70.2	69.7	68.3	70.5
	90	73.5	72.0	71.2	72.7
12 months	10	70.8	68.6	66.8	72.2
	50	74.2	73.2	71.5	74.7
	90	77.7	75.6	74.4	76.7

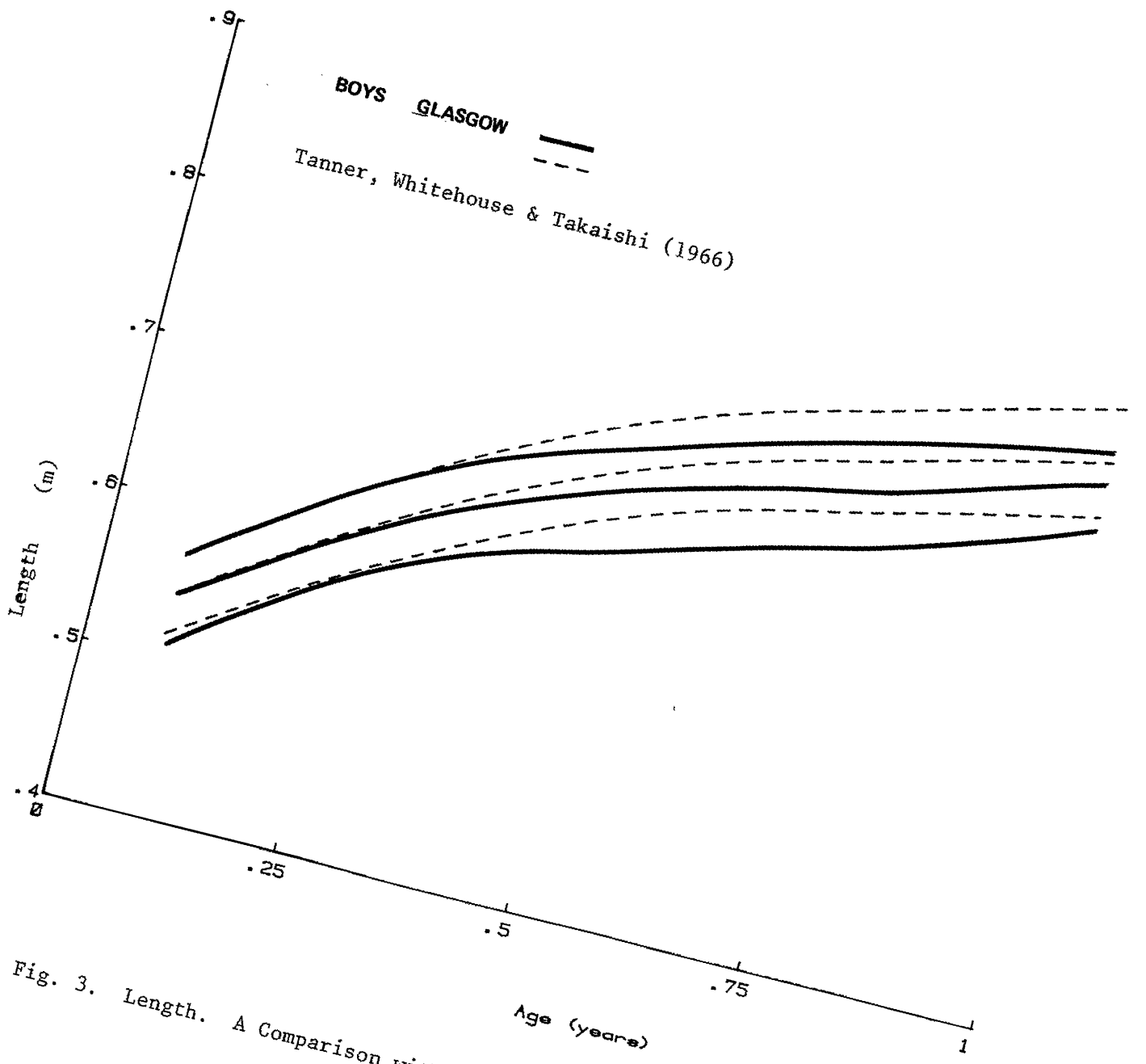


Fig. 3. Length. A Comparison with Tanner, Whitehouse & Takaishi (1966) Data. Boys.

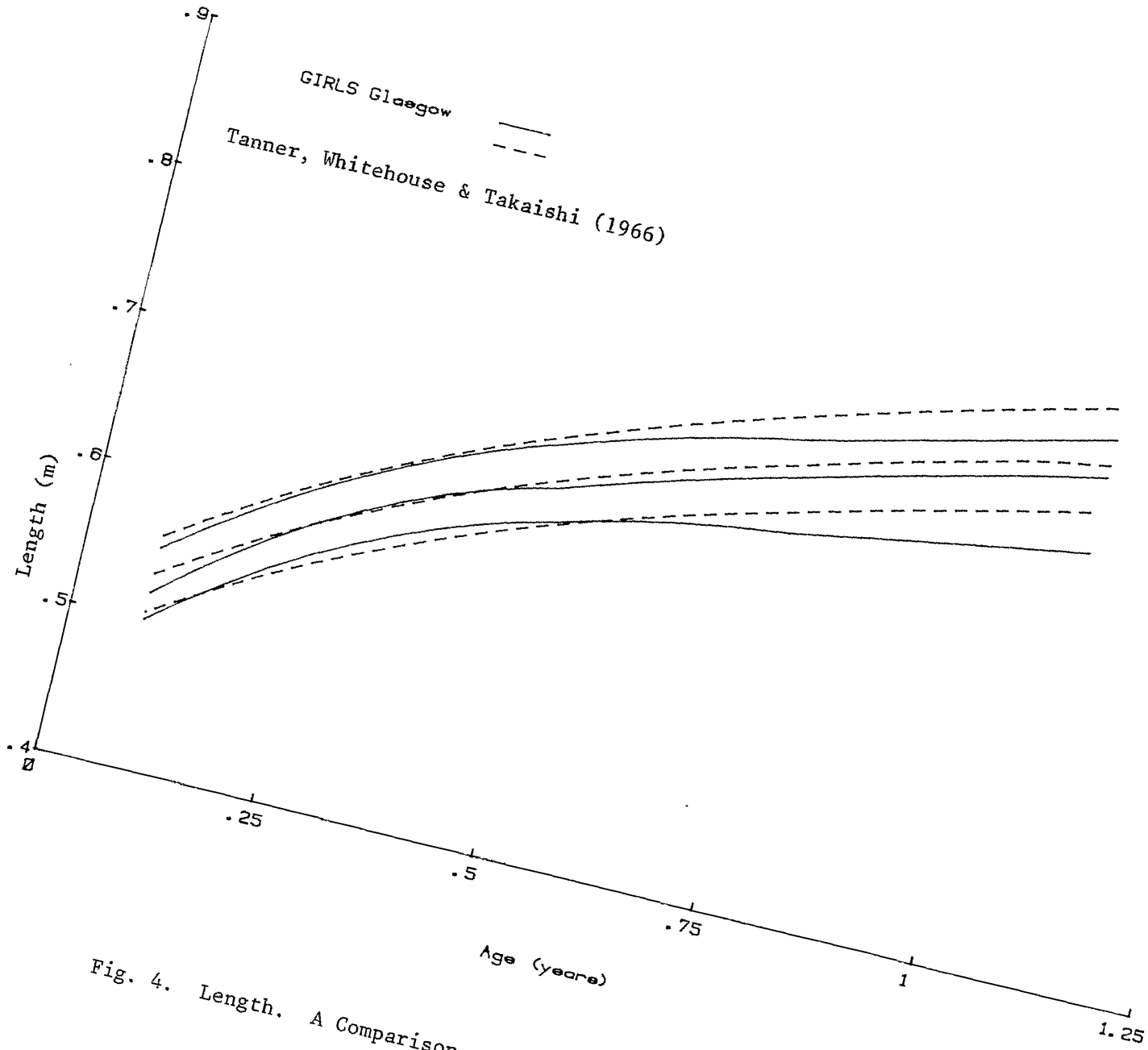


Fig. 4. Length. A Comparison with Tanner, Whitehouse & Takaishi (1966) Data. Girls.

ii. Weight.

Cross Section.

At 3 months, the weights of the girls were identical to those of Tanner et al (1966), while the boys values were very slightly less. From 6 months onwards, both boys and girls tended to weigh slightly less than the reference children (Tables XXIX and XXX; Figs 5 and 6).

Longitudinal Section.

In Blackhill, the centiles tended to be below those of the corresponding cross section group, with least difference between the 90th centiles and most between the 10th centiles. There was no consistent pattern when Carntyne was compared with the cross section but a tendency for the weights to be slightly larger.

TABLE XXIX.

Weight Centiles by Age and Area (kg). Boys.

Age	Centile	Tanner et al (1966)	Cross Section	Blackhill	Carntyne
6 weeks	10	-	3.78	2.87	3.24
	50	-	4.57	4.13	4.31
	90	-	5.27	5.25	5.02
3 months	10	5.01	5.30	3.56	4.55
	50	5.93	5.85	5.82	6.00
	90	6.99	6.85	7.25	7.08
6 months	10	6.80	6.31	5.09	6.71
	50	7.90	7.45	6.98	7.85
	90	9.20	8.79	9.16	9.43
9 months	10	7.98	7.99	7.70	7.68
	50	9.20	9.13	8.78	9.00
	90	10.63	10.41	9.65	10.39
12 months	10	8.8	8.68	8.25	9.04
	50	10.2	10.00	9.37	10.00
	90	11.7	10.72	10.94	11.52

TABLE XXX.

Weight Centiles by Age and Area (kg). Girls.

Age	Centile	Tanner et al (1966)	Cross Section	Blackhill	Carntyne
6 weeks	10	-	3.63	3.10	3.38
	50	-	4.14	3.76	3.96
	90	-	4.85	4.65	4.62
3 months	10	4.81	4.80	3.90	4.88
	50	5.56	5.53	5.37	5.43
	90	6.41	6.40	6.19	6.51
6 months	10	6.44	6.25	5.34	6.39
	50	7.39	7.10	6.78	7.58
	90	8.49	8.60	8.14	8.45
9 months	10	7.58	7.53	6.36	7.37
	50	8.72	8.58	7.66	9.18
	90	10.02	9.37	9.97	9.94
12 months	10	8.4	8.30	7.29	8.50
	50	9.7	9.32	8.56	10.00
	90	11.2	10.35	10.21	11.08

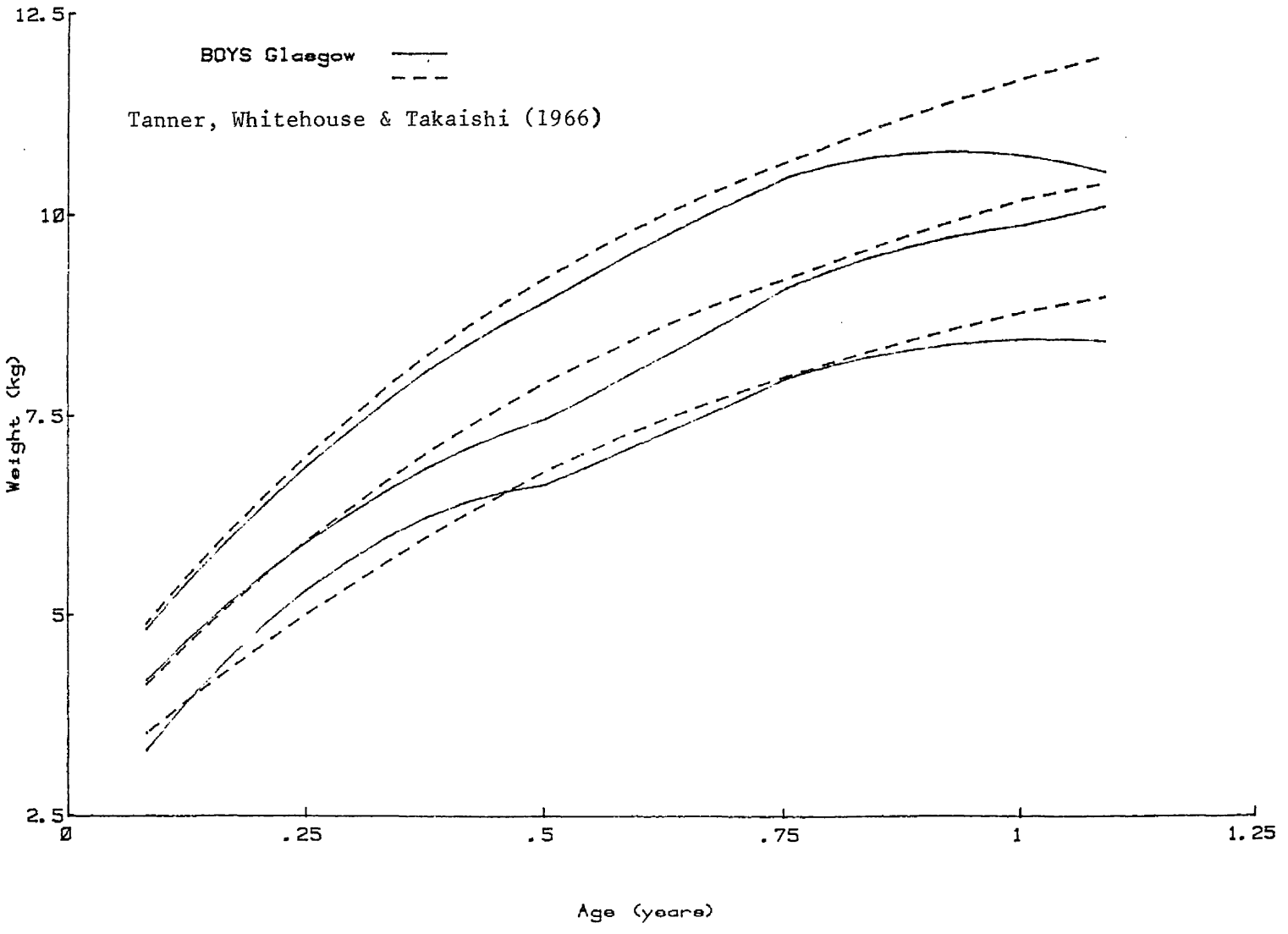


Fig. 5. Weight. A Comparison with Tanner, Whitehouse & Takaishi (1966) Data. Boys.

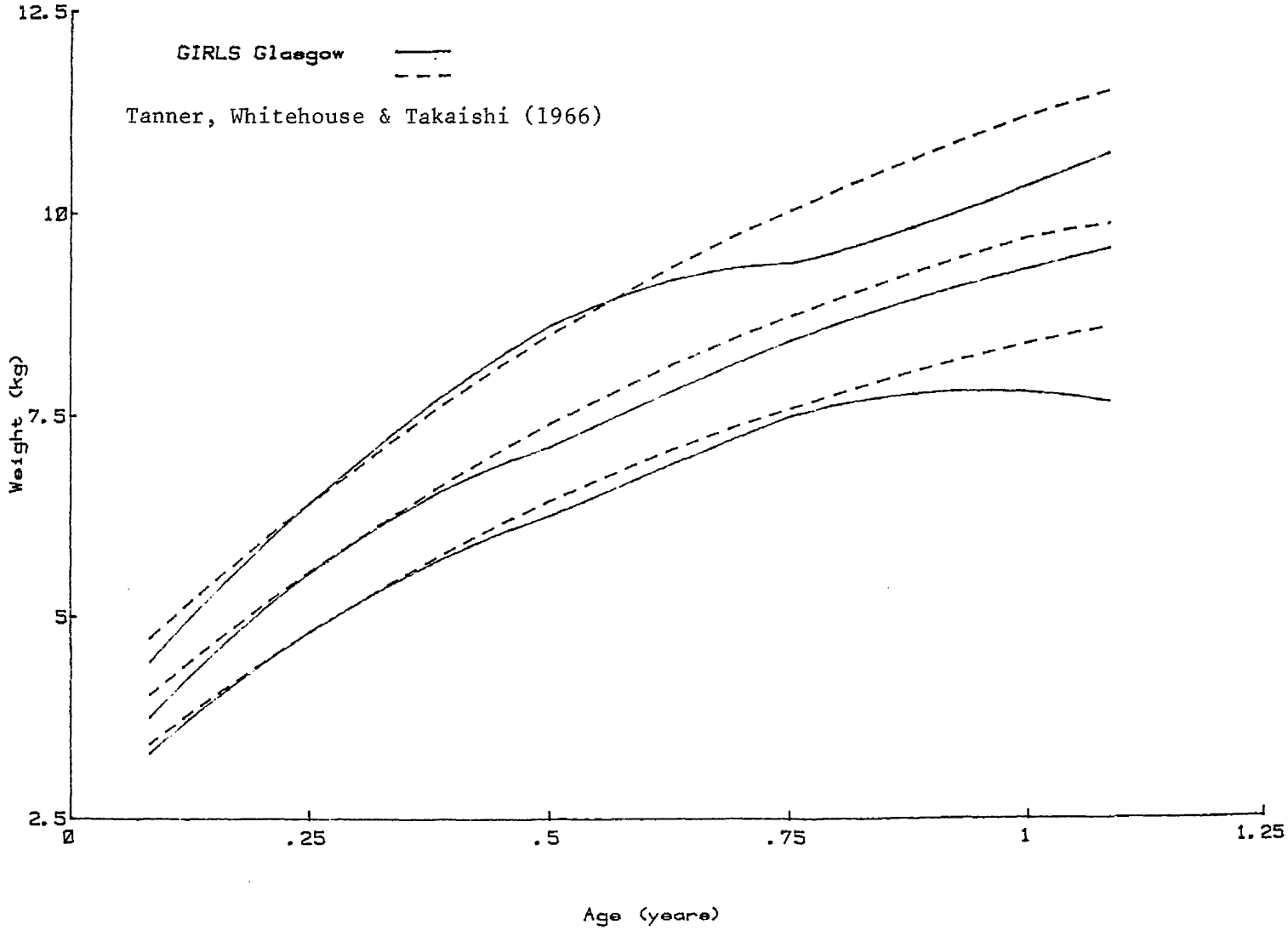


Fig. 6. Weight. A Comparison with Tanner, Whitehouse & Takaishi (1966) Data. Girls.

iii. Mid-upper Arm Circumference.

Cross Section.

Compared with the results of Tanner & Whitehouse (1973), the cross section values were lower. At 3 and 12 months, the difference was slight, with the 50th centiles of the boys identical. The discrepancy was greater at 6 months (Tables XXXI and XXXII).

Longitudinal Section.

Initially in Blackhill, the mid-upper arm circumferences were less than those of the cross section, with most difference at the 10th centile level. Throughout the year, there was a gradual comparative increase to similar values at 9 and 12 months. The 6 week centiles in Carntyne were also less than those of the cross section. A more marked relative increase occurred in Carntyne and, by 6 months, all centiles were greater than in the cross section. The gap had widened by 12 months.

TABLE XXXI.

Mid-Upper Arm Circumference Centiles by Age and Area (cm). Boys.

Age	Centile	Tanner & Whitehouse (1973)	Cross Section	Blackhill	Carntyne
6 weeks	10	-	10.5	8.1	9.3
	50	-	11.5	10.3	10.9
	90	-	12.5	12.1	11.9
3 months	10	11.8	11.3	10.0	11.0
	50	13.2	12.2	12.1	13.0
	90	14.0	13.5	14.1	14.2
6 months	10	13.4	12.1	11.2	12.5
	50	14.8	13.4	13.3	14.1
	90	16.2	14.5	15.6	15.3
9 months	10	-	13.0	13.4	13.3
	50	-	14.7	14.6	14.7
	90	-	15.6	15.5	16.5
12 months	10	14.2	12.9	13.7	14.5
	50	14.9	14.9	14.5	15.3
	90	17.0	16.0	15.5	17.5

TABLE XXXII.

Mid-Upper Arm Circumference Centiles by Age and Area (cm). Girls.

Age	Centile	Tanner & Whitehouse (1973)	Cross Section	Blackhill	Carntyne
6 weeks	10	-	10.2	9.2	9.2
	50	-	11.0	10.3	10.7
	90	-	12.2	11.7	11.3
3 months	10	11.2	11.3	10.4	11.0
	50	12.8	12.0	12.0	12.1
	90	14.2	13.5	13.1	13.5
6 months	10	13.0	12.0	11.1	13.0
	50	14.6	13.2	13.2	14.1
	90	16.5	14.5	14.3	15.1
9 months	10	-	12.6	12.2	13.3
	50	-	14.0	14.1	15.2
	90	-	15.0	15.2	16.4
12 months	10	13.6	13.0	13.0	14.0
	50	15.6	14.5	14.5	16.0
	90	17.2	16.0	15.5	16.8

iv. Head Circumference.

Cross Section.

The 50th and 90th centiles were almost identical to those of Tanner (1973), while the 10th centiles were slightly greater (Table XXXIII and XXXIV).

Longitudinal Section.

The Blackhill head circumferences were smaller than those of the cross section with less difference between the girls. At 6 weeks, the Carntyne centiles tended to be slightly below those of the cross section. There was a gradual relative increase to similar or slightly greater values.

TABLE XXXIII.

Head Circumference Centiles by Age and Area (cm). Boys.

Age	Centile	Tanner (1973)	Cross Section	Blackhill	Carntyne
6 weeks	10	-	37.0	35.0	35.3
	50	-	38.5	37.3	37.8
	90	-	40.1	39.1	39.2
3 months	10	38.6	39.7	37.1	39.3
	50	40.7	40.6	40.0	40.9
	90	42.8	42.2	42.0	41.9
6 months	10	41.5	42.0	41.0	42.4
	50	43.6	43.9	42.4	43.5
	90	45.7	45.2	43.8	44.8
9 months	10	43.7	44.5	43.9	44.0
	50	45.7	46.0	45.0	46.2
	90	47.7	47.7	46.5	47.2
12 months	10	44.8	45.5	44.6	45.9
	50	46.8	47.0	45.5	47.4
	90	48.8	48.5	47.2	48.9

TABLE XXXIV.

Head Circumference Centiles by Age and Area (cm). Girls.

Age	Centile	Tanner (1973)	Cross Section	Blackhill	Carntyne
6 weeks	10	-	35.9	34.2	35.2
	50	-	37.4	37.0	36.8
	90	-	38.5	38.2	38.6
3 months	10	37.9	38.9	37.2	38.4
	50	39.8	39.9	39.6	39.9
	90	41.7	41.0	41.3	41.3
6 months	10	40.6	41.4	40.1	41.4
	50	42.5	42.5	42.1	43.0
	90	44.4	43.9	43.5	44.0
9 months	10	42.8	43.6	41.9	43.4
	50	44.6	44.5	43.6	44.9
	90	46.4	46.5	45.6	46.3
12 months	10	43.8	44.0	42.9	44.9
	50	45.6	45.7	44.8	46.8
	90	47.4	47.0	46.9	47.9

v. Triceps Skinfold.

Edwards et al (1955)showed that the frequency distribution of skinfold measurements in the general population is skewed and suggested an approximately Gaussian distribution of values can be obtained if recorded measurements are transformed to a logarithmic scale before analysis. The results of this study are presented in both forms. Table XXXV (i) compares the transformed 50th centile results with the mean values of Hutchinson-Smith (1973), whose data are incorporated in the charts of Tanner & Whitehouse (1975) along with those of R. A. Dixon (unpublished results). Table XXXV (ii) gives the 10th, 50th and 90th centiles of the recorded measurements in the cross section Blackhill and Carntyne.

Cross Section.

50th centile values of both boys and girls were lower than the mean values of Hutchinson-Smith (1973). They approximated most closely at 6 months when there was a peak. Tanner & Whitehouse (1975) also found a peak at 6 months. There was slightly less difference in the girls' comparison than in that of the boys. Values were more similar to those of Tanner & Whitehouse (1962) which were based on Belgian data.

Longitudinal Section.

Initially, the Blackhill centiles were less than those of the cross section but there was a gradual relative increase to similar values between the boys and to slightly higher relative values amongst the Blackhill girls. The centile values of the Carntyne boys tended to be slightly greater than those of the cross section, while amongst the girls, values fluctuated and no clear pattern was evident.

TABLE XXXV.

Triceps Skinfolds.

i. Log Triceps Skinfold. 50th Centiles: Cross Section (X-S), Blackhill (B), and Carntyne (C). Mean Values: Hutchinson-Smith (1973) (H-S).

Age	Boys				Girls			
	H-S	X-S	B	C	H-S	X-S	B	C
3 months	192	185	181	188	189	183	177	182
6 months	197	193	189	192	195	191	192	194
9 months	201	192	193	199	196	188	198	198
12 months	198	187	194	192	199	194	194	196

ii. Triceps Skinfold (mm). By Age, Sex and Area.

Age	Centile	Boys			Girls		
		Cross Section	Blackhill	Carntyne	Cross Section	Blackhill	Carntyne
6 weeks	10	5.4	3.5	5.6	5.2	4.6	4.4
	50	7.0	5.6	6.8	7.4	6.1	6.6
	90	9.4	8.8	9.8	8.6	7.8	8.1
3 months	10	6.8	4.3	6.6	6.0	5.7	6.6
	50	8.8	8.3	9.3	8.6	7.7	8.4
	90	11.0	11.0	10.3	10.4	10.2	10.8
6 months	10	8.0	6.8	8.6	8.0	7.4	9.1
	50	10.4	9.6	10.2	10.0	10.1	10.6
	90	12.0	11.5	11.6	12.0	11.4	11.6
9 months	10	8.2	8.3	8.6	7.0	7.6	8.5
	50	10.2	10.4	11.5	9.4	11.3	11.4
	90	13.0	11.8	13.8	12.4	13.2	13.5
12 months	10	7.2	7.2	7.7	8.0	8.9	6.0
	50	9.2	10.6	10.2	10.6	10.5	11.0
	90	11.6	11.4	11.9	12.8	13.3	13.0

vi. Subscapular Skinfold.

The transformed results are compared with those of Hutchinson-Smith (1973) and the actual measurements are also given (Table XXXVI i, ii).

Cross Section.

The 50th centiles were less than the mean values of Hutchinson-Smith (1973) at each age group. There was slightly less difference between the girls' values than those of the boys at 6 and 12 months. The results were more similar to those of Tanner & Whitehouse (1962).

Longitudinal Section.

Values for the Blackhill boys were initially below those of the cross section but became slightly greater as the year progressed. Those of the girls showed less difference at 6 weeks but also increased comparatively, throughout the study, to be slightly greater than the cross section centiles at 12 months. The 10th and 50th centiles of the Carntyne boys were very slightly greater than those of the cross section while the 90th centiles fluctuated. Amongst the girls, as with the triceps results, no clear pattern was evident.

TABLE XXXVI.

Subscapular Skinfolds.

i. Log Subscapular Skinfold. 50th Centiles: Cross Section (X-S), Blackhill (B) and Carntyne (C). Mean Values: Hutchinson-Smith (1973) (H-S).

Age	Boys				Girls			
	X-S	B	C	H-S	X-S	B	C	H-S
3 months	162	157	165	181	162	162	163	182
6 months	158	160	160	183	166	162	160	184
9 months	158	162	161	183	158	165	164	183
12 months	156	160	165	198	162	169	166	199

ii. Subscapular Skinfold (mm). By Age, Sex and Area.

Age	Centile	Boys			Girls		
		Cross Section	Blackhill	Carntyne	Cross Section	Blackhill	Carntyne
6 weeks	10	4.2	3.1	3.8	4.2	4.1	4.0
	50	5.4	4.7	5.4	5.6	4.8	5.2
	90	7.8	6.7	7.0	7.2	7.4	7.2
3 months	10	4.6	3.3	4.4	4.6	4.2	4.2
	50	6.0	5.5	6.3	6.0	6.0	6.1
	90	7.8	7.8	8.1	8.0	7.8	8.0
6 months	10	4.4	4.2	4.8	4.4	4.2	4.8
	50	5.6	5.8	5.8	6.4	6.0	5.8
	90	7.4	7.2	7.0	8.8	7.7	8.0
9 months	10	4.4	4.7	4.8	4.4	4.2	4.7
	50	5.6	6.0	5.9	5.6	6.3	6.2
	90	6.8	7.2	8.8	7.4	7.6	9.0
12 months	10	4.4	4.1	5.3	4.8	4.9	5.3
	50	5.4	5.8	6.3	6.0	6.7	6.4
	90	7.0	7.1	7.7	8.0	8.1	7.7

Table CXXXIII demonstrates that the mean gains in length, weight, mid-upper arm and head circumferences were greater in Carntyne than in Blackhill, while the opposite was true of skinfold thicknesses. Standard deviations tended to be greater in Blackhill. A comparison of mean monthly increments, from 1.5 - 12 months, showed that the Blackhill gain in length was 96 per cent that of Carntyne. The corresponding figure for weight gain was 90 per cent. Fluctuations throughout the year failed to show a consistent trend.

TABLE CXXXIII.

Growth Velocities over Various Periods.
Blackhill (B) and Carntyne (C).

Time period (months)		1.5-3	3-6	6-9	9-12	1.5-12	3-12
Length (mm)							
B	mean	44.8	61.2	45.2	34.4	182.7	138.7
	s.d.	7.5	12.0	18.6	13.7	22.3	22.4
	mean/month	29.9	20.4	15.1	11.5	17.4	15.4
C	mean	45.4	65.3	41.9	39.2	189.5	144.9
	s.d.	7.6	12.8	7.2	9.1	18.4	14.9
	mean/month	30.3	21.8	14.0	13.1	18.1	16.1
Weight (g)							
B	mean	1250	1830	1220	750	4940	3750
	s.d.	320	480	650	450	900	850
	mean/month	830	610	410	250	470	420
C	mean	1300	1930	1310	960	5410	4140
	s.d.	310	480	360	400	850	770
	mean/month	870	640	440	320	520	460

TABLE CXXXIII (contd.).

Time period (months)		1.5-3	3-6	6-9	9-12	1.5-12	3-12
Mid-upper arm circumference (cm)							
B	mean	1.27	1.40	0.83	0.52	3.91	2.74
	s.d.	0.86	1.01	1.74	0.92	1.25	1.34
	mean/month	0.85	0.47	0.28	0.17	0.37	0.30
C	mean	1.53	1.53	0.92	0.62	4.45	2.96
	s.d.	0.82	0.86	0.61	0.58	1.27	1.13
	mean/month	1.02	0.51	0.31	0.21	0.42	0.33
Head circumference (cm)							
B	mean	2.05	2.79	2.09	1.46	8.28	6.34
	s.d.	1.94	2.55	5.32	2.08	1.60	2.40
	mean/month	1.37	0.93	0.70	0.49	0.79	0.70
C	mean	2.43	2.87	2.31	1.24	8.77	6.36
	s.d.	1.52	2.25	2.21	0.34	1.63	0.72
	mean/month	1.62	0.96	0.77	0.41	0.84	0.71
Triceps skinfold (mm)							
B	mean	1.48	1.73	0.51	0.36	4.02	2.66
	s.d.	1.07	1.78	2.18	1.64	1.98	1.93
	mean/month	0.99	0.58	0.17	0.12	0.38	0.30
C	mean	1.60	1.56	0.77	- 0.21	3.51	2.09
	s.d.	1.03	1.41	1.41	2.90	3.08	3.04
	mean/month	1.07	0.32	0.26	- 0.07	0.32	0.23
Subscapular skinfold (mm)							
B	mean	0.61	0.06	0.08	0.24	0.96	0.44
	s.d.	0.82	1.08	1.34	0.76	1.57	1.70
	mean/month	0.41	0.02	0.03	0.08	0.09	0.05
C	mean	0.61	0.02	0.07	0.16	0.69	0.15
	s.d.	0.98	1.16	0.97	0.95	1.58	1.35
	mean/month	0.41	0.01	0.02	0.05	0.07	0.02

vii. Summary.

Glasgow children were thus smaller, from 6 months, with slightly less body fat and only head circumference values identical to, or slightly greater than, those of the various reference groups. The girls corresponded more closely to the reference groups than did the boys, with regard to weight and some triceps values. At all ages, the triceps values of both boys and girls were greater than the sub-scapular values. This agrees with the results of Hutchinson-Smith (1973) but not with the results of Gampel (1965) and Farr (1966), both of whom found the reverse.

Blackhill children were shorter, lighter and with smaller head circumferences than the cross section children. Most difference, with regard to both length and weight, was seen at the 10th centile level, while the larger children were similar in size to those of the cross section.

The Carntyne children were very slightly longer and heavier than the cross section children, with the girls comparatively longer than the boys. Head and arm circumferences, which were initially less than those of the cross section, were greater by 12 months and skinfolds tended to be similar or slightly greater.

(b) Growth Status.

i. Statistical Philosophy.

It is inevitable in any growth study involving a large group of children, that anthropometric changes occur with increasing age and development. Of far greater interest is the way in which individual children deviate from the general trend and to what extent their deviations can be related to features of the child's environment in the immediate past.

The present study was designed with this in mind, using the cross sectional study to estimate the growth of Glasgow infants at various ages during their first year of life. This background information was then used to age-standardize the information collected longitudinally in Blackhill and Carntyne. The standardization was made in the following way - for a longitudinally assessed child of a given age, the values of anthropometry for the median (50th centile) Glasgow child of the same age and sex were obtained by quadratic interpolation. The child's own values were then divided by the reference values to give dimensionless ratios, centred around unity, which are independent of age. The resulting variables for length and weight are commonly called length-for-age and weight-for-age, in the context of nutritional status assessment. Weight-for-length was also calculated, as defined in Cole, Donnet & Stanfield (1981):

$$\text{Weight-for-length} = \frac{\text{Weight-for-age}}{(\text{Length-for-age})^{2}}$$

The squared term is justified since the log - log regression of weight-for-age on length-for-age gives a power close to 2 for all the cross sectional age groups. Fig 7 shows the Glasgow standard and the length-for-age curve of 1 subject.

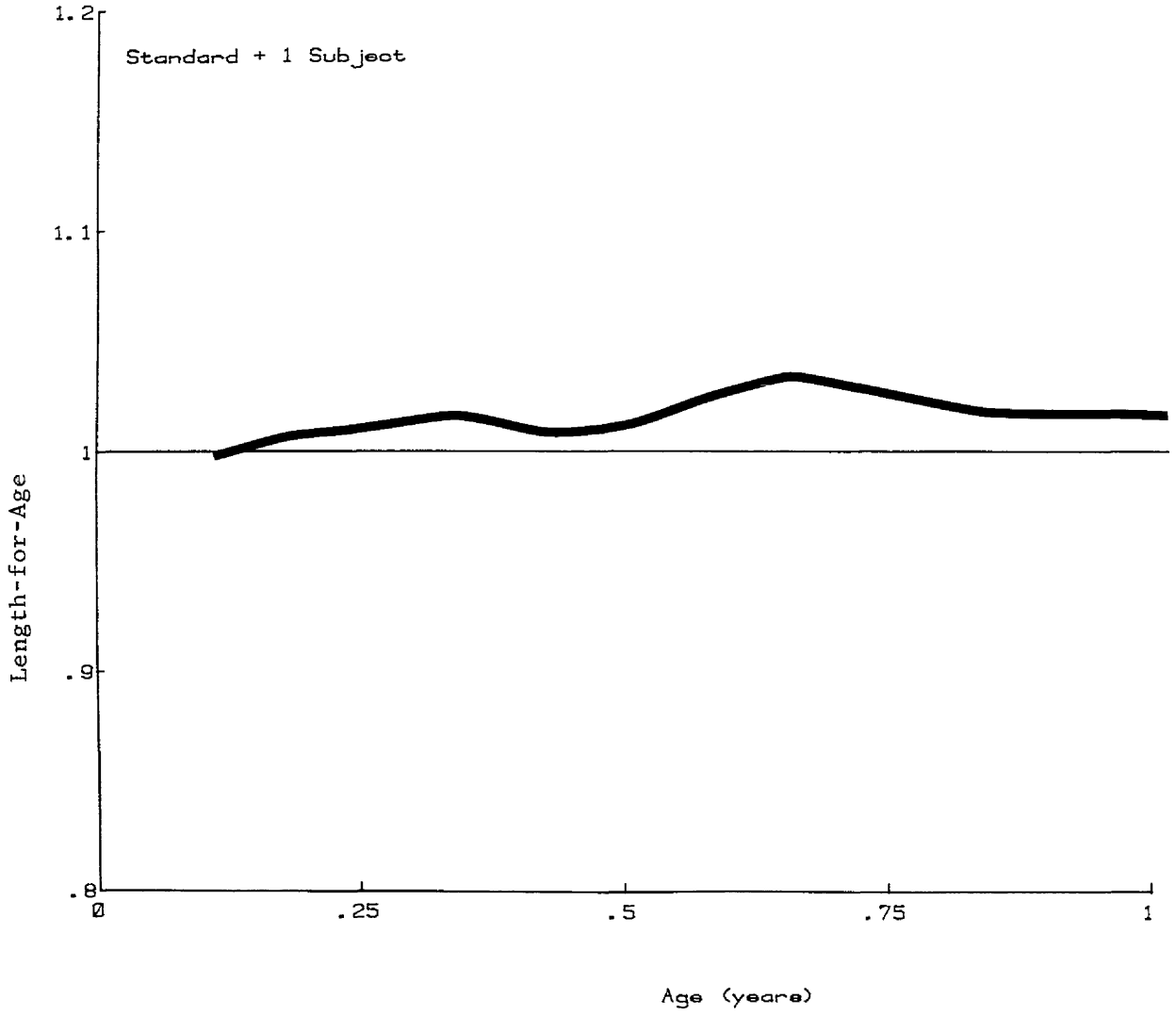


Fig. 7. Glasgow Standard Plus One Subject.

ii. Length-for-age.

Figs 8 - 11 show the length-for-age plots of the Blackhill and Carntyne boys and girls. From these, it can be seen that the distribution of lengths was greater in Blackhill than in Carntyne. The upper plots for boys and girls were similar in the two areas but in Blackhill, the range included shorter children. The range of distribution decreased slightly throughout the year, except in the case of the Blackhill girls, where it remained constant.

A few initial catch-ups, which occurred amongst the Blackhill boys, were almost obliterated when plotted as length-for-conceptual age, i.e. age, plus gestation period. Fig 12, which is drawn to a different scale, demonstrates this.

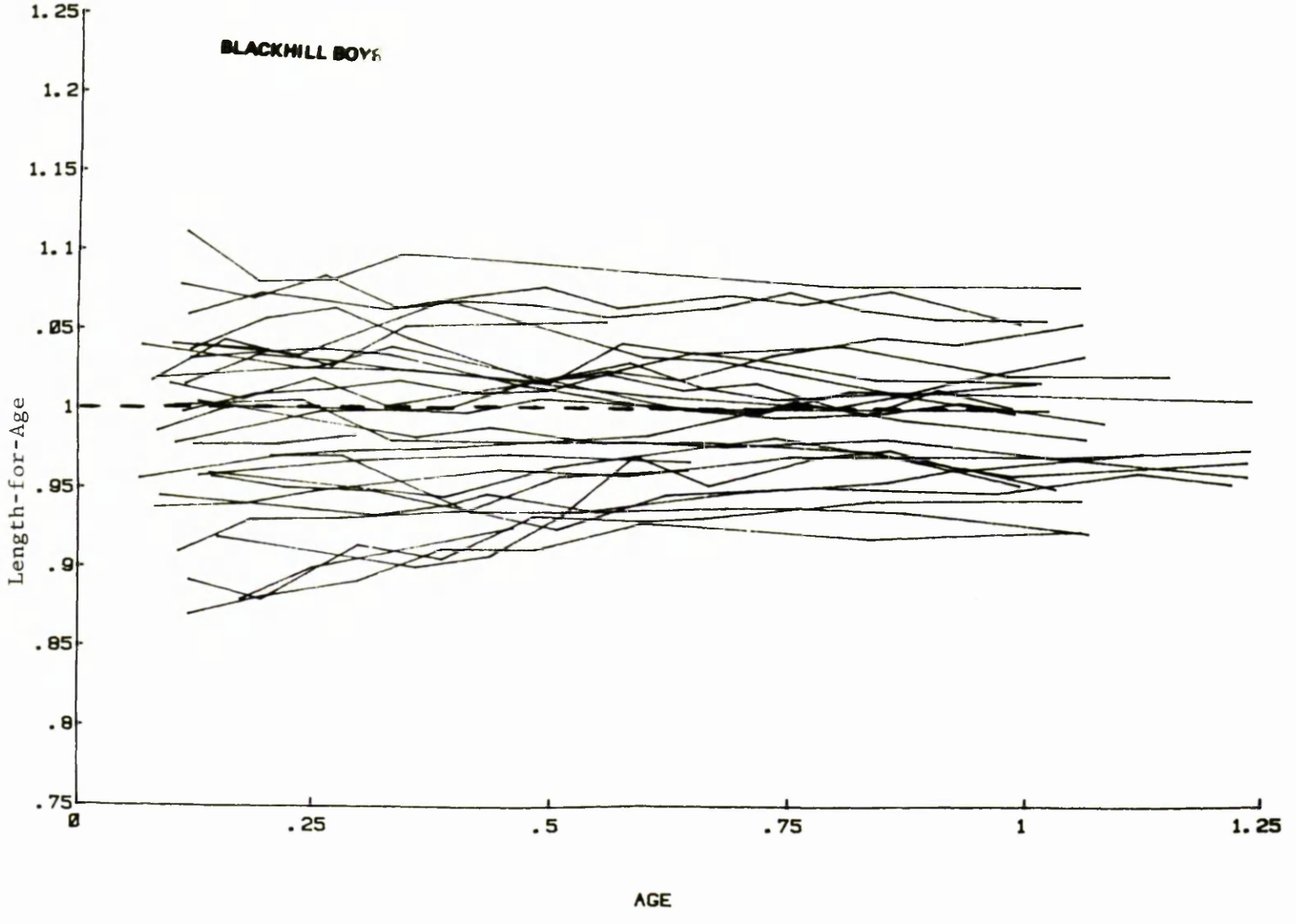


Fig. 8. Length-for-Age. Blackhill Boys.

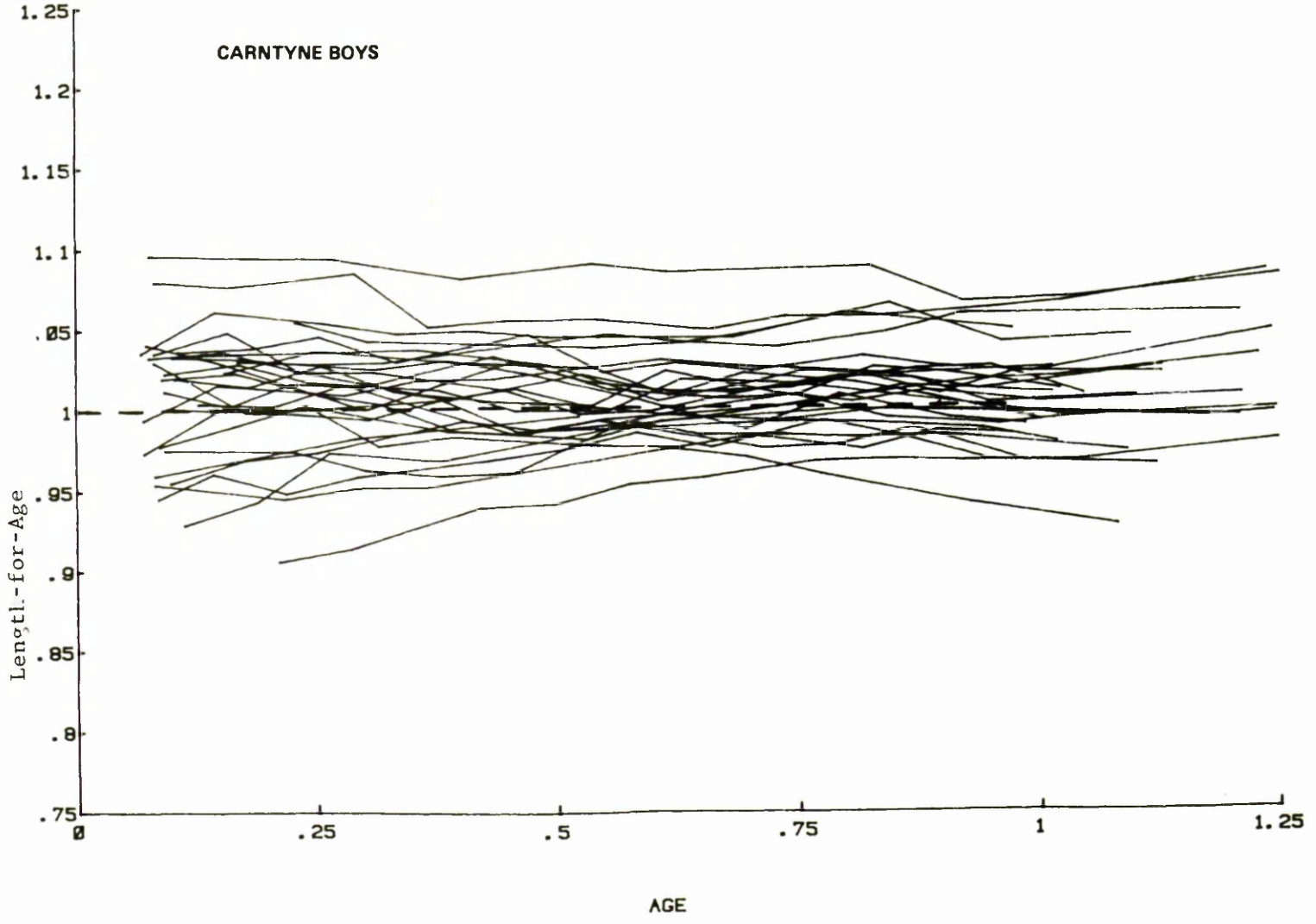


Fig. 9. Length-for-Age. Carntyne Boys.

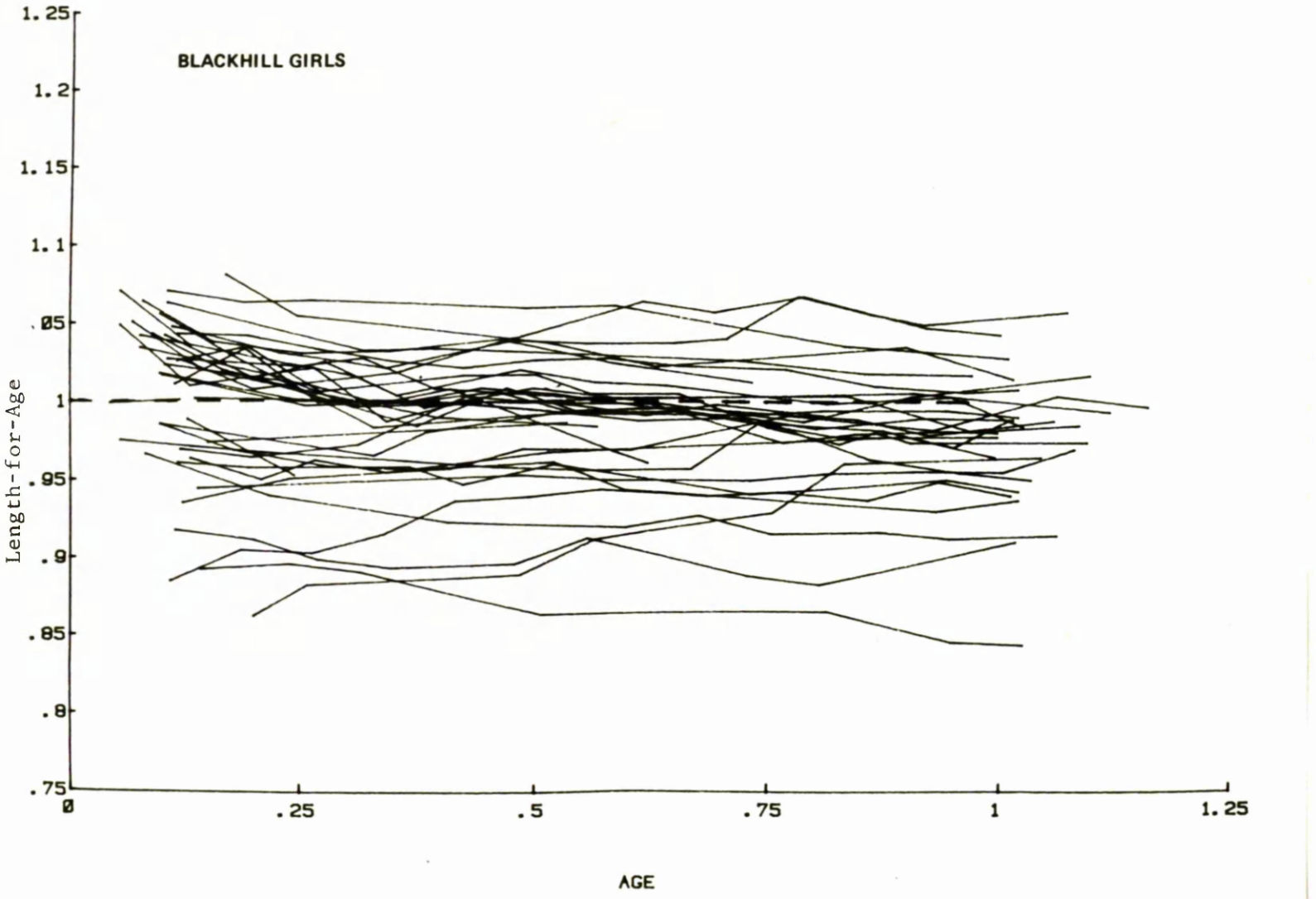


Fig. 10. Length-for-Age. Blackhill Girls.

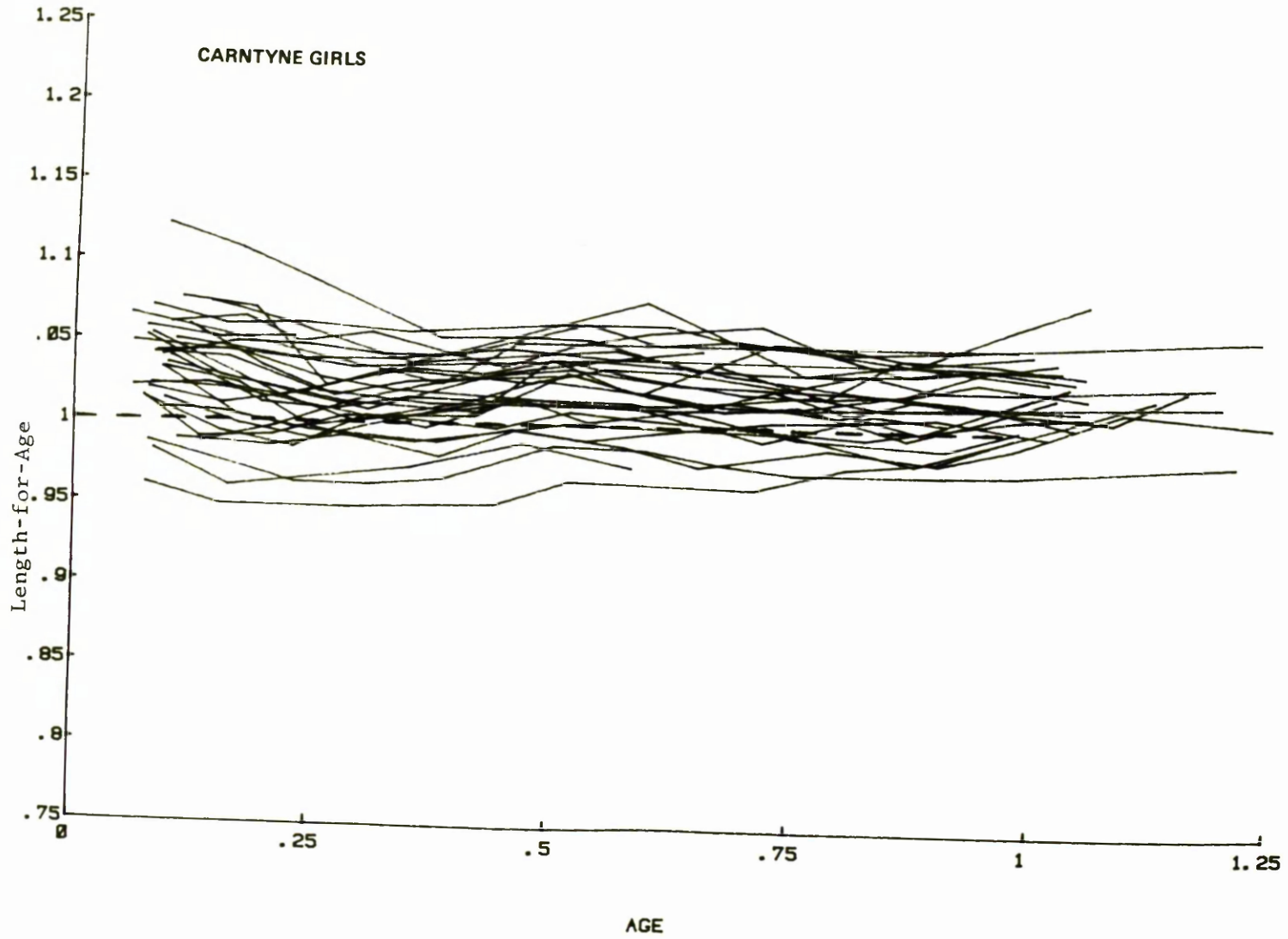


Fig. 11. Length-for-Age. Carntyne Girls.

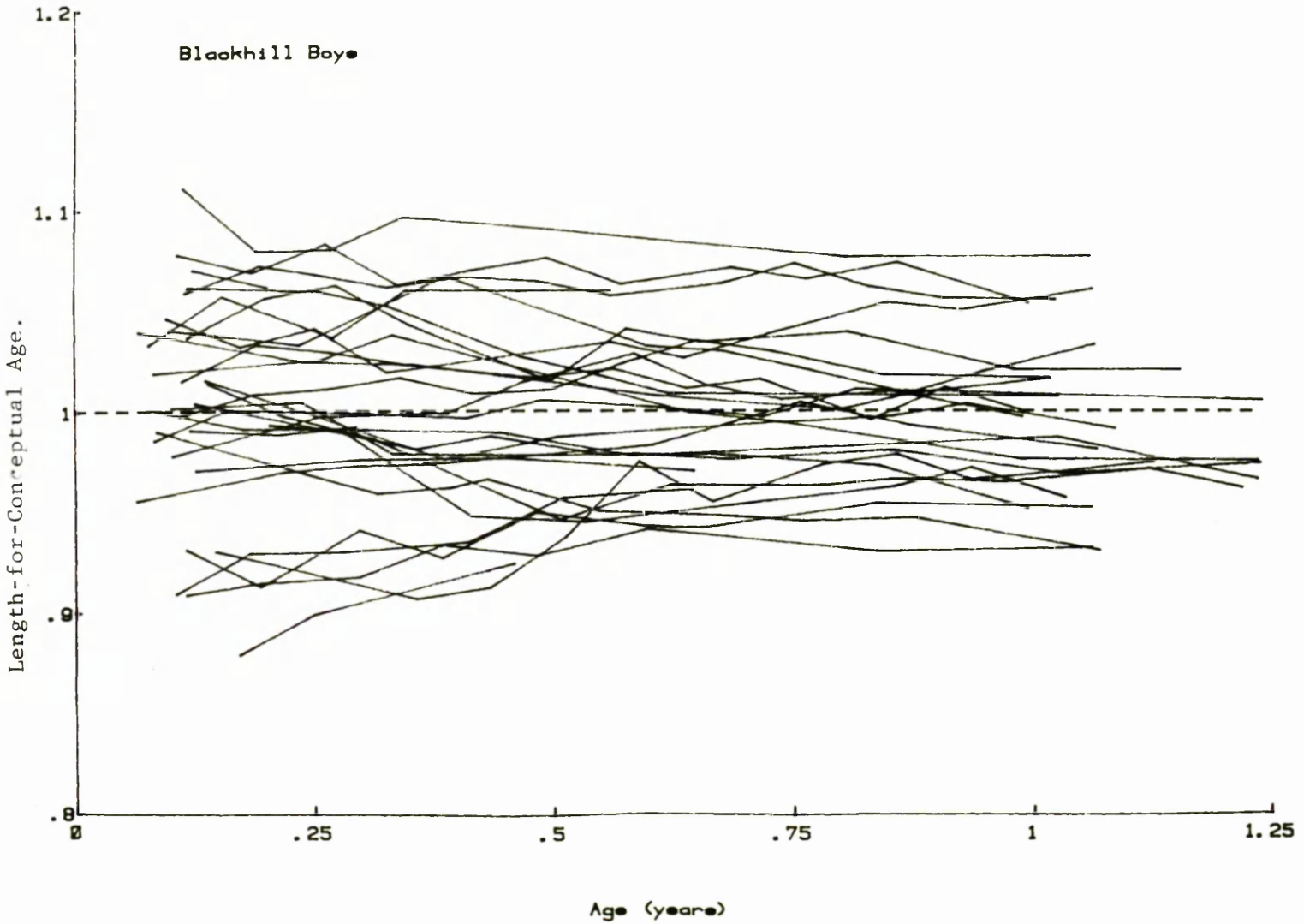


Fig. 12. Length-for-Conceptual Age. Blackhill Boys.

iii. Weight-for-age.

Figs 13 - 16 show the weight-for-age plots of the Blackhill and Carntyne boys and girls. Range of distribution of weights was greater in Blackhill than in Carntyne, though the difference was less than in range of distribution of length. The reduction of range of distribution throughout the year was less marked than for the length plots. Initial catch-up of the Blackhill boys was again partially obliterated by plotting weight-for-conceptual age (Fig 17).

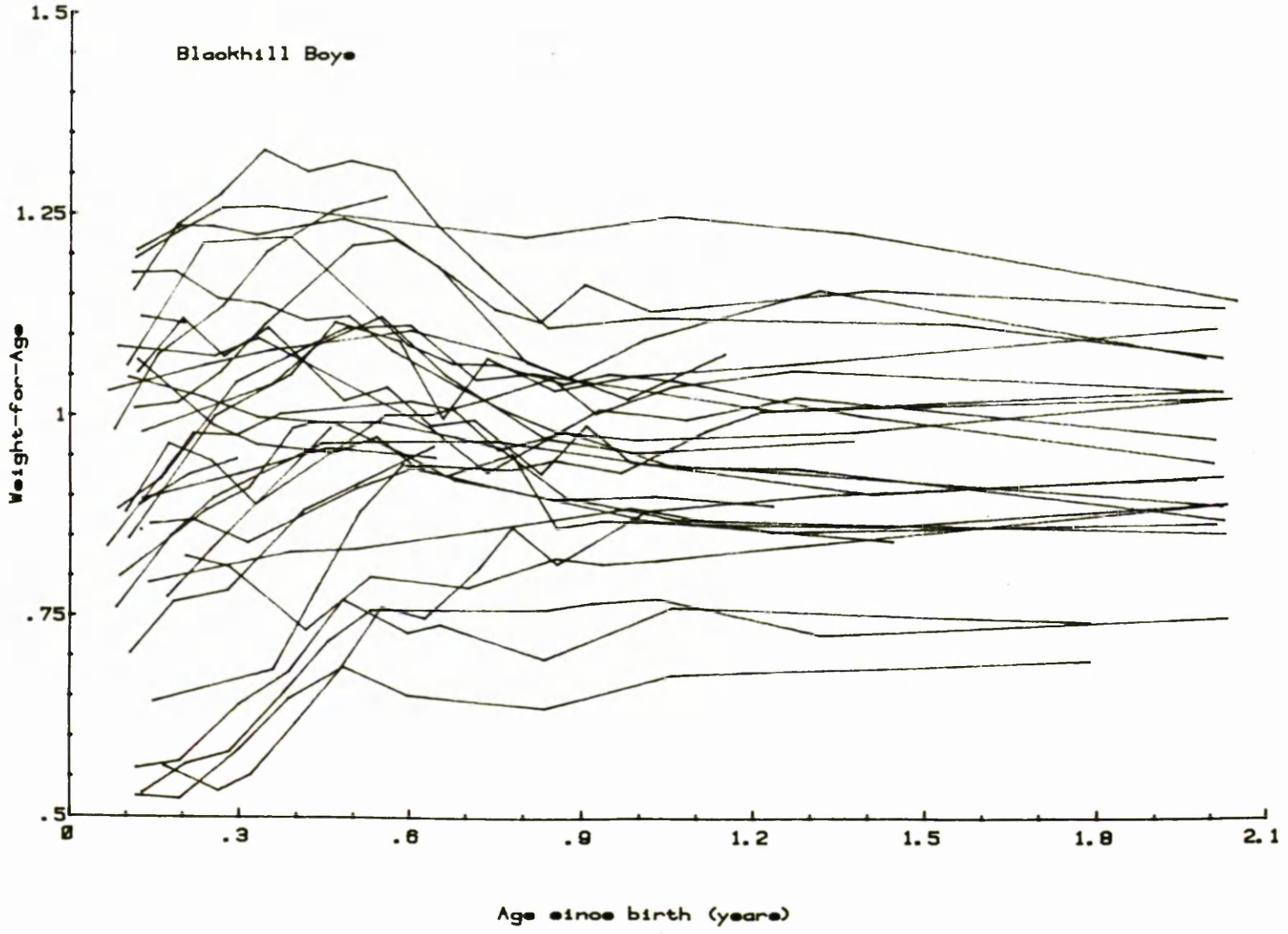


Fig. 13. Weight-for-Age. Blackhill Boys.

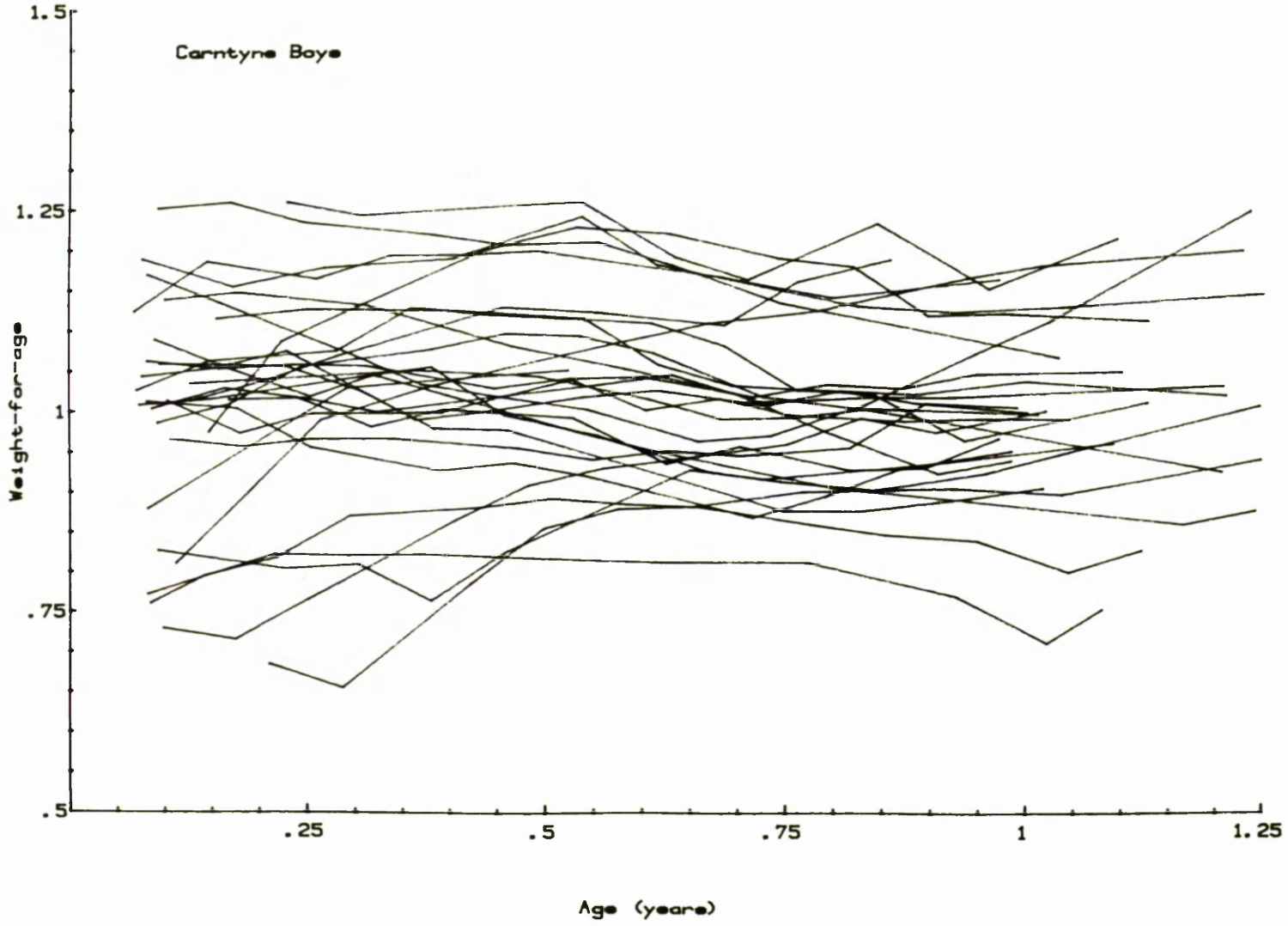


Fig. 14. Weight-for-Age. Carntyne Boys.

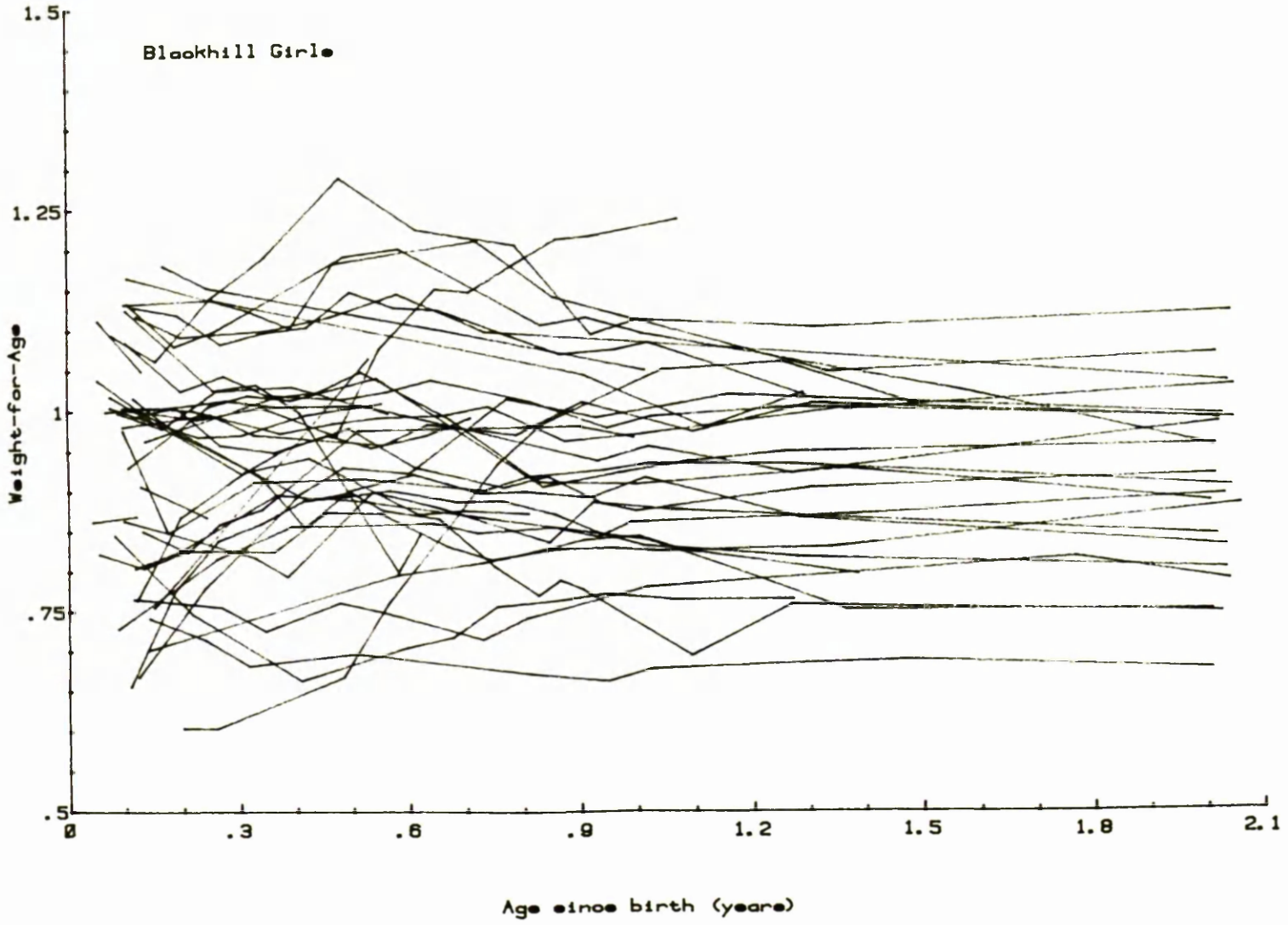


Fig. 15. Weight-for-Age. Blackhill Girls.

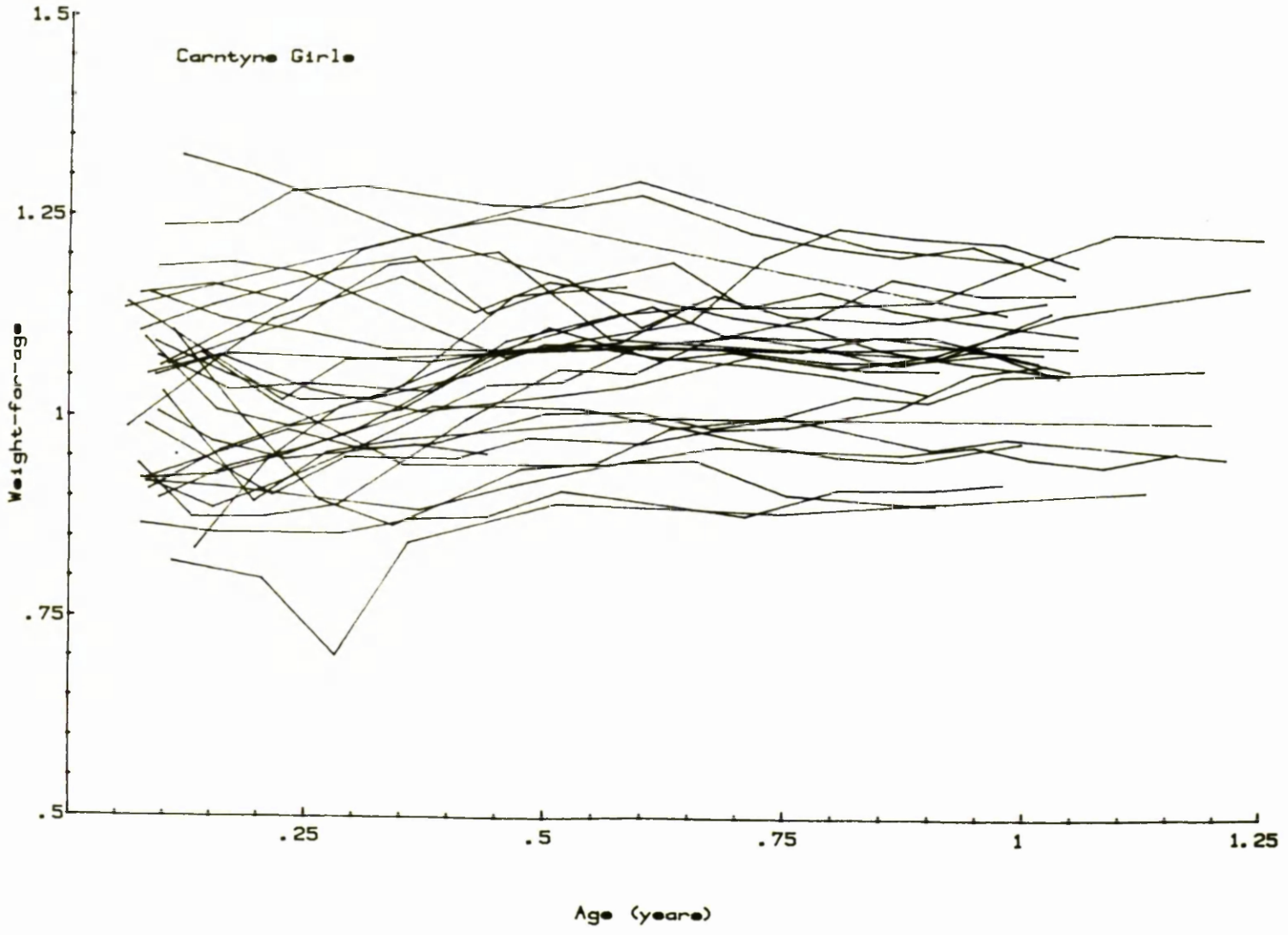


Fig. 16. Weight-for-Age. Carntyne Girls.

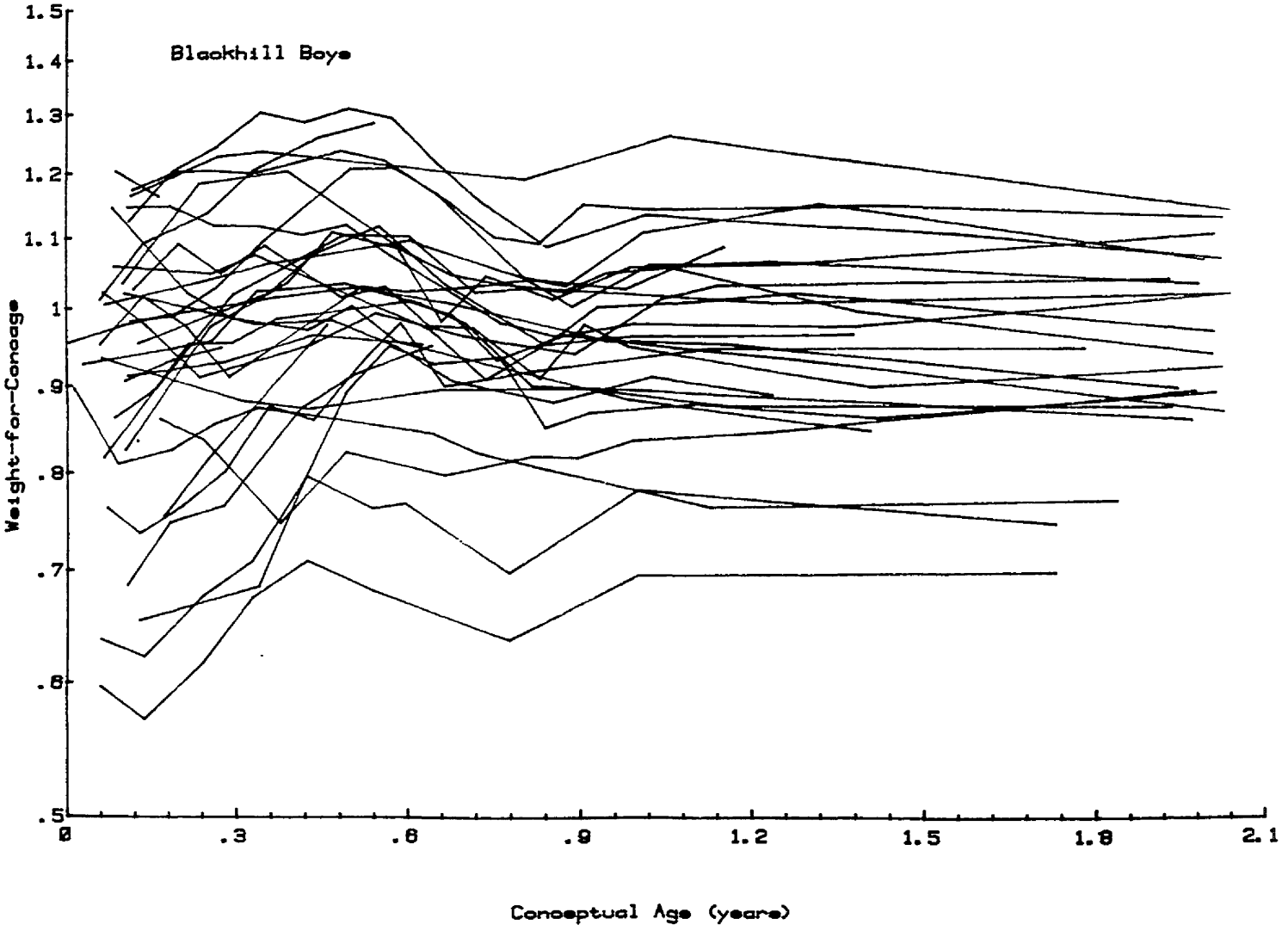


Fig. 17. Weight-for-Conceptual Age. Blackhill Boys.

iv. Weight-for-length.

Figs 18 - 21 show the plots of weight-for-length for Blackhill and Carntyne boys and girls. The difference between the ranges of distribution was less marked than for either length-for-age or weight-for-age. A slight rise occurred in the Blackhill boys' plots from birth to about 6 months. This then flattened out again. It was not seen in the plots of Blackhill girls and Carntyne boys and girls.

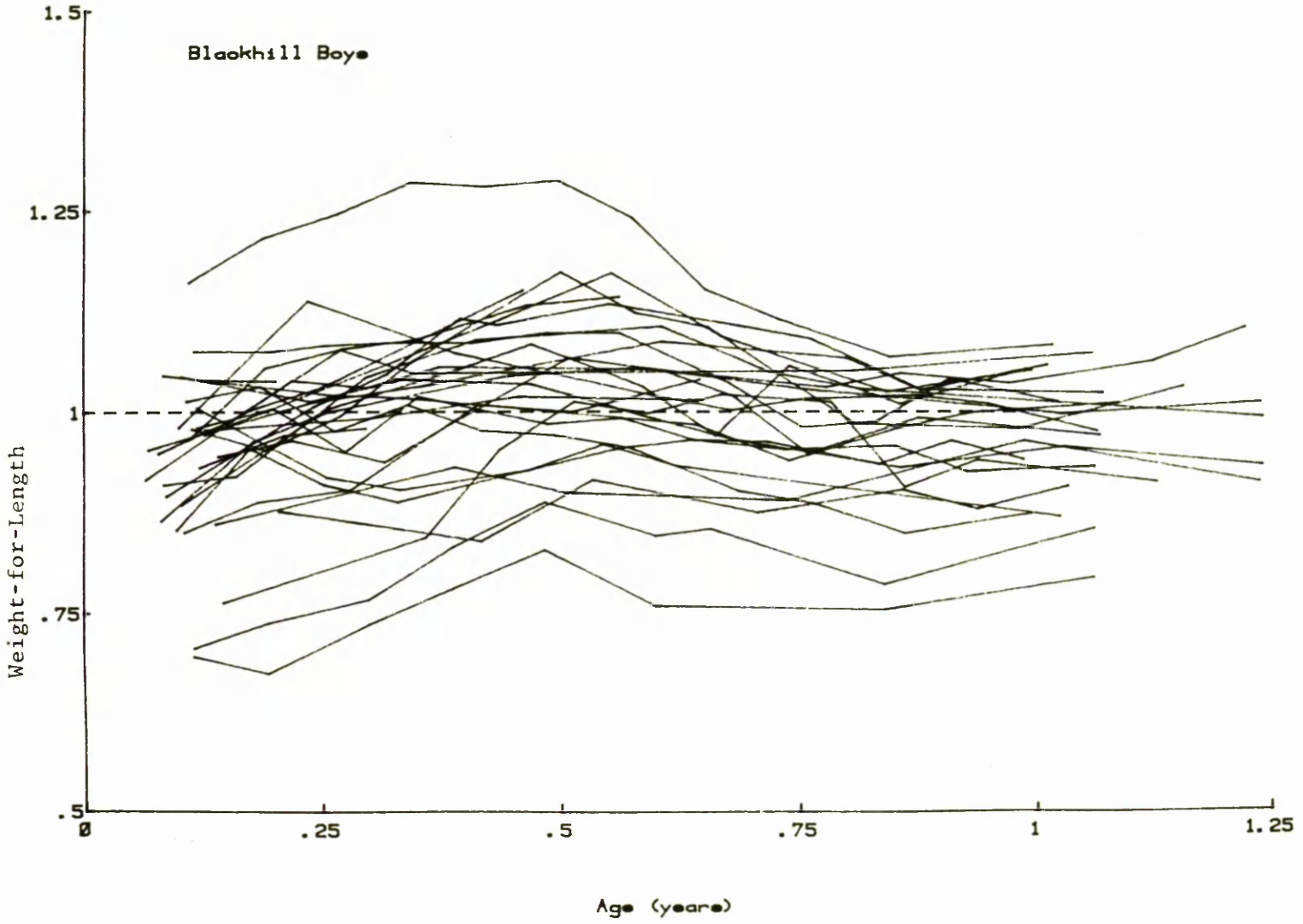


Fig. 18. Weight-for-Length. Blackhill Boys.

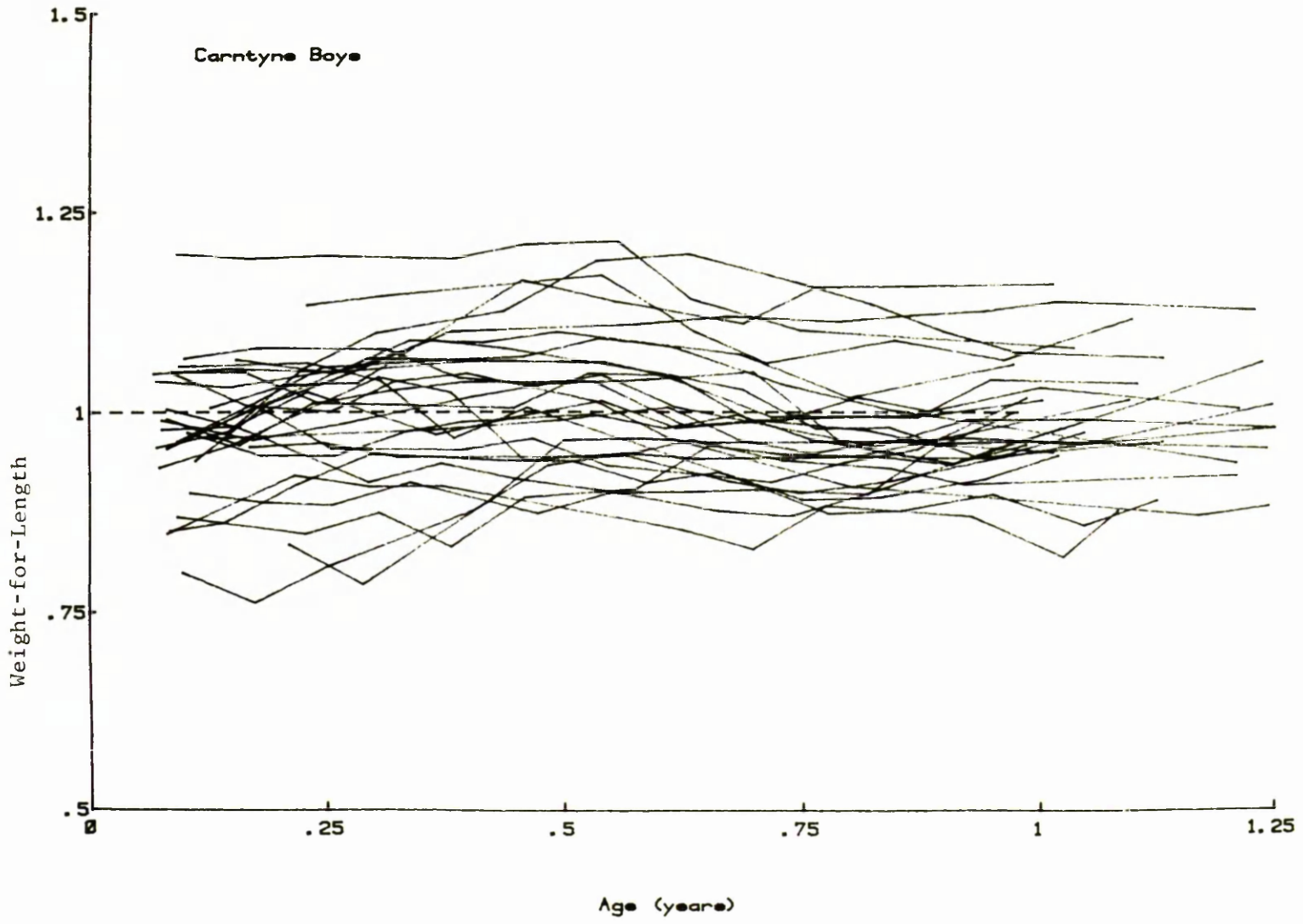


Fig. 19. Weight-for-Length. Carntyne Boys.

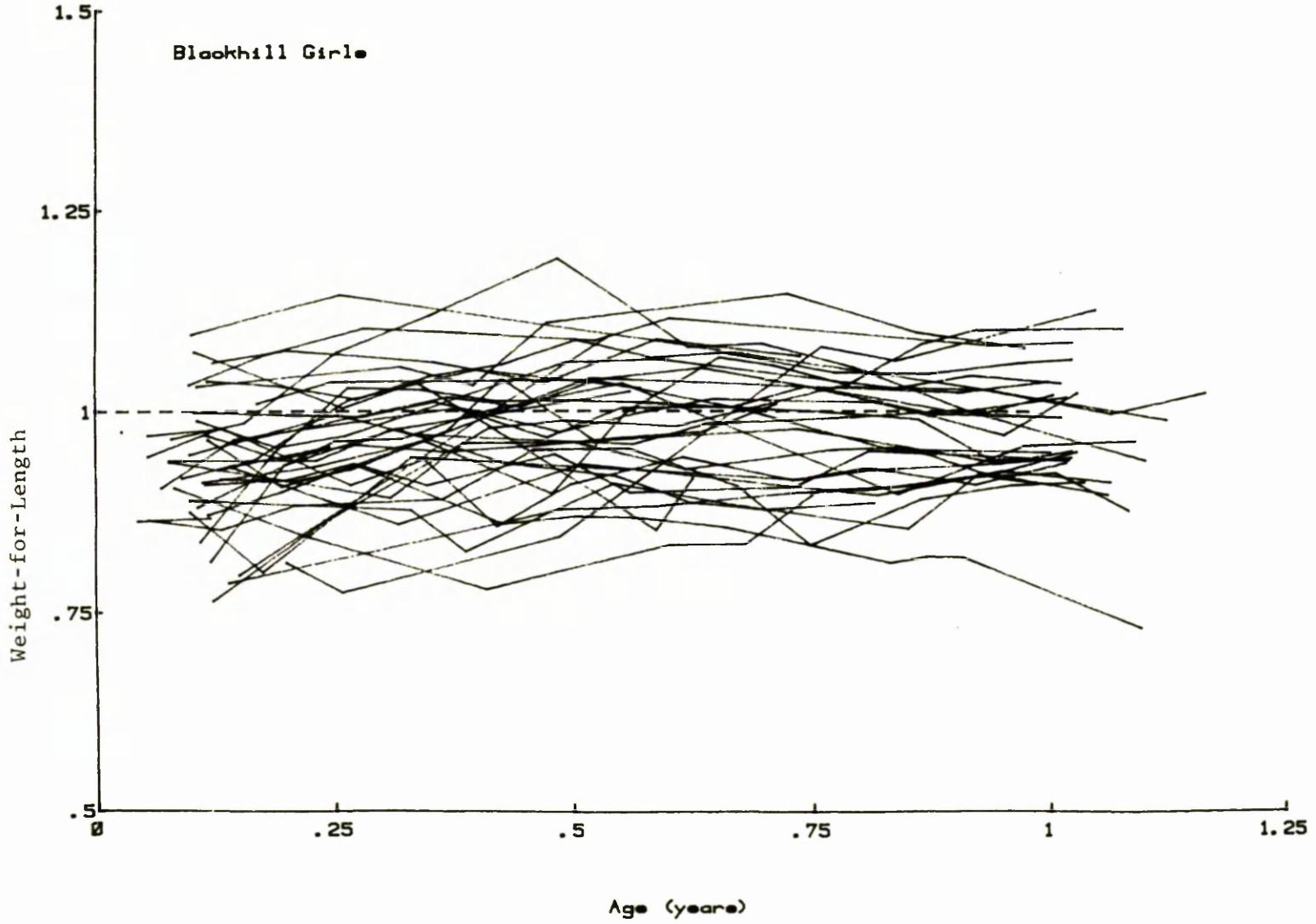


Fig. 20. Weight-for-Length. Blackhill Girls.

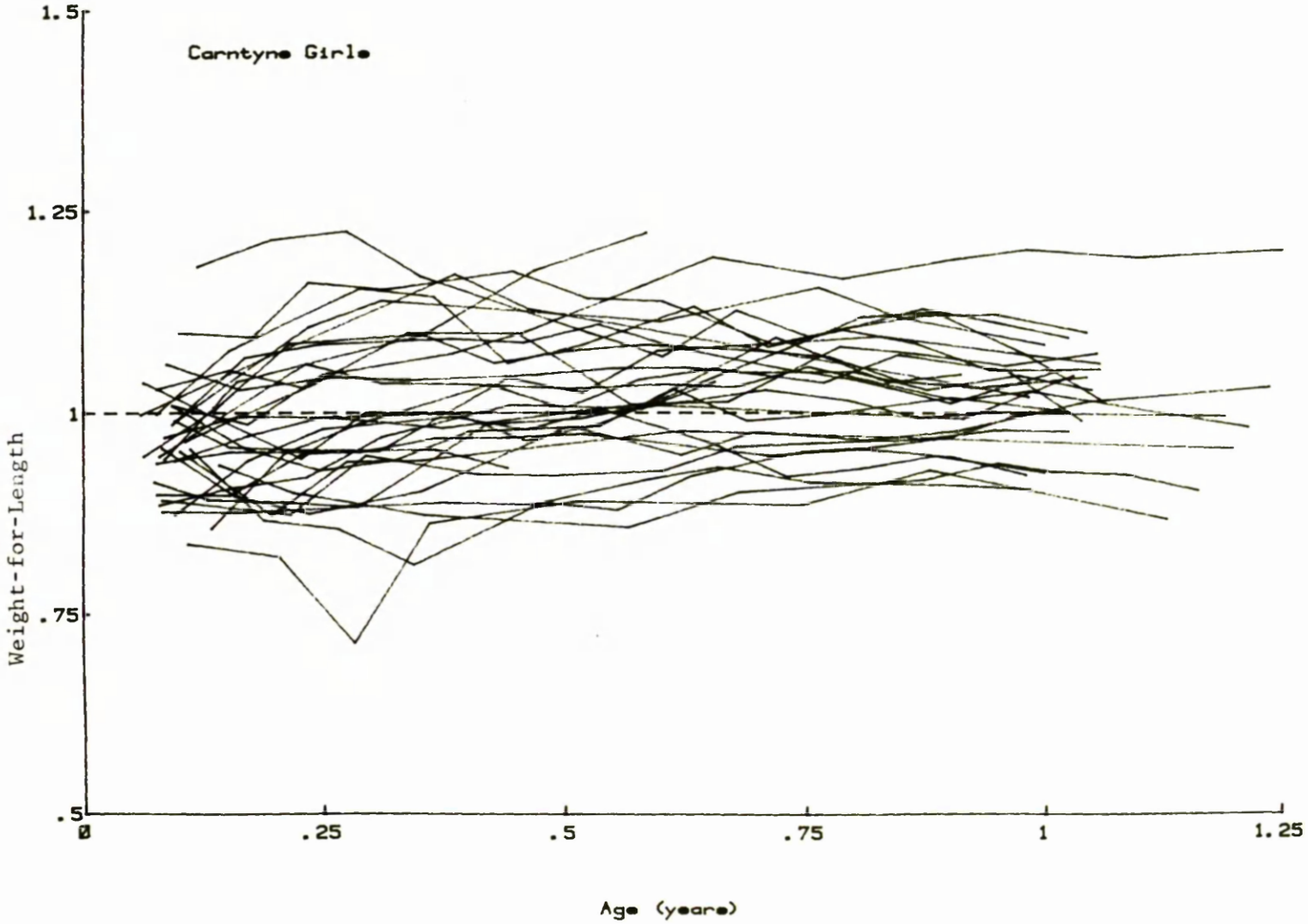


Fig. 21. Weight-for-Length. Carntyne Girls.

v. Summary of Growth Status.

TABLE XXXVII.

Growth Status. (Per Cent of Cross Section Standard).

		Blackhill (B)	Carntyne (C)	C - B
Length-for-age	[a]Initial	98.9	102.2	3.3
	[b]Final	98.0	101.4	3.4
Weight-for-age	Initial	91.5	102.1	10.6
	Final	93.7	103.7	10.0
Weight-for-length	Initial	92.3	97.2	4.9
	Final	97.2	100.7	3.5

a :'Initial' refers to the first visit at approximately 6 weeks.

b :'Final' refers to the visit at 12 months.

Table XXXVII summarises the previous plots. The Blackhill means were always below 100 per cent, while those of Carntyne were above, with the exception of initial weight-for-length. The largest difference between the two areas was seen in the weight-for-age means.

Length-for-age decreased by 1 per cent in both areas. Weight-for-age, however, increased slightly in both areas and, consequently, weight-for-length also increased. The difference between the various Blackhill and Carntyne means tended to be constant throughout the year. This suggests that while the Blackhill means were always smaller than the Carntyne means, mean growth rates were similar in both areas.

(c) Discussion.

The Glasgow children were shown to be slightly smaller than various reference groups of British children. Vimpani et al (1981) had shown that there was a higher proportion of short school children in Glasgow, than in Aberdeen or Edinburgh and statistics of the Common Services Agency (1976) demonstrated the short stature of Glasgow mothers.

Social class and deprivation have been shown to correlate with height (Lacey & Parkin, 1974) and sibling number (Goldstein, 1971). The different circumstances of parents in Blackhill and Carntyne were reflected in the lengths of their children, with mean length-for-age between 98 and 99 per cent in Blackhill and between 101 and 102 per cent in Carntyne.

Similar means may camouflage widely differing ranges of distribution. In Blackhill, the larger children approximated those of the cross section and of Carntyne but it was the small children who were considerably shorter and lighter.

The differences between Blackhill and Carntyne means of length-for-age, weight-for-age and weight-for-length were constant from initial to final examination at 12 months, which suggests that mean growth rates were similar in the two areas.

Eveleth & Tanner (1976) showed that in industrialised countries, weight-for-height is greater amongst the less well off than the well to do, the reverse being the case in underdeveloped countries. In this study, however, Blackhill's mean weight-for-length was consistently less than that of Carntyne.

CHAPTER IX.

INFANT FEEDING PRACTICE.

(a) Breast Feeding.

(b) Bottle Feeding.

i. Dried milk products - incidence and contribution to the diet.

ii. Dried milk products - types of preparation.

iii. Alternatives to dried milk products.

(c) Introduction of solids.

(a) Breast Feeding.

"Because we are convinced that satisfactory growth and development after birth is more certain when an infant is fed an adequate volume of breast milk, we recommend that all mothers be encouraged to breast feed their babies for a minimum of two weeks and, preferably, for the first four to six months of life", (Department of Health and Social Security, 1974).

A working party of the Panel on Child Nutrition made the above recommendation after reviewing, from 1973 - 1974, the current practices of infant feeding. It concluded that the United Kingdom was not, in general, a breast fed or breast feeding nation. Various studies throughout the country bear this out. Arneil (1967) found 31 per cent of babies from all areas in Scotland were started on breast milk but only 7 per cent were still receiving it at twelve weeks. Corresponding figures of 28 per cent and 6 per cent were given by Shukla et al (1972) for Dudley, Worcestershire. More recently, Goel (1979) demonstrated that of the ethnic Scottish children in his Glasgow study, 14 per cent were initially fed breast milk, but by the age of twelve weeks, the figure had dropped to 2 per cent.

Results: Cross Section.

An attempt to breast feed was made by 21 per cent of the Glasgow mothers. 13 per cent carried on doing so for more than one month and 2 per cent for more than six months. Table XXXVIII compares these results with those of Arneil (1967) and Goel (1979).

TABLE XXXVIII.

A Comparison of the Duration of Breast Feeding in Glasgow (per cent).

Duration	Arneil (1967)[1]	Goel (1979)[2]	This study[3]
Not at all	74.6	86.3	79.4
Less than 4 weeks	16.3	2.0	7.5
4 weeks or longer	9.1	10.8	13.1
n	90	100	655

1 : Glasgow children surveyed in 1965.

2 : Glasgow children of Scottish origin surveyed from 1974 - 76.

3 : Glasgow children surveyed from 1975 - 76.

Regression analysis shows that the best predictor as to whether a mother breast fed, was the age at which she completed her full-time education ($t > 4$). Next was social class of the father ($t > 3$). The parity of the mother was significant only at the 5 per cent level.

Results: Longitudinal Section.

An attempt to breast feed was made by 12 per cent of the Blackhill mothers, 5 per cent continuing until after the baby was one month old. In Carntyne, the corresponding rates were 17 per cent and 14 per cent. Tables XXXIX and XL show the differing attempts and durations of breast feeding found in the survey.

TABLE XXXIX.

Attempts to Breast Feed (per cent).

Duration	Cross Section	Blackhill	Carntyne
Not at all	79.4	88.5	82.8
Up to 1 day	0.5	1.3	-
1 week	2.4	2.6	1.6
2 weeks	1.8	2.6	-
1 month	2.8	-	1.6
More than 1 month	13.1	5.1	14.1
n	655	78	64

TABLE XL.

Duration of Breast Feeding (per cent). No. of children in parenthesis.

Duration	Cross Section	Blackhill	Carntyne
Still breast fed			
at 6 weeks	13.0 (655)	1.3 (78)	12.5 (64)
at 8 weeks	9.8 (522)	-	7.8 (64)
at 12 weeks	6.7 (522)	-	4.7 (64)
at 16 weeks	5.1 (354)	-	4.7 (64)
at 20 weeks	4.2 (354)	-	3.1 (64)

Discussion.

These figures confirm the low incidence of breast feeding in Glasgow already reported by Arneil (1967) and Goel (1979). The very early cessation of breast feeding in Blackhill is striking, with no mothers continuing until eight weeks.

Jean Martin (1978), carried out a comprehensive investigation into the incidence and prevalence of breast feeding in England and Wales in 1975. She found 51 per cent of mothers put their baby to the breast. By the age of six weeks, only 24 per cent of babies were receiving any breast milk and the proportion dropped to 13 per cent by four months. These results show a higher incidence of breast feeding than in either the present or past Glasgow studies. Her predictors of breast feeding were the same as those of the present study. The better educated mothers and those in the higher social class categories were more likely to commence breast feeding and to continue for longer than other mothers. She also showed that among mothers of first babies, those who were aged under twenty were less likely to breast feed. This relationship persisted after standardisation for social class and mother's education.

There is evidence that bottle fed babies are exposed to greater risk of infection, chemical disturbance, obesity, cow's milk allergy in infancy and necrotising enterocolitis. Addy (1976), provided an excellent review of the literature and reiterated the advocation of breast feeding.

Breast feeding is thus an advantage to all babies but the single factor of its imparting protection against infection is sufficient to make it of especial importance in areas of over-crowding and poor housing, where standards of hygiene are difficult

to maintain. Blackhill is one such area of overcrowding which would benefit from a higher level of breast feeding. In a separate study conducted by Angrove (1978), a group of 41 mothers from Blackhill was asked what was the most nourishing food for baby and given the optional answers of breast milk, baby milk powder and ordinary cow's milk. Baby milk powder was thought to be best by 29 of them.

There is an obvious lack of knowledge of breast feeding, although this alone, does not deter women. Martin (1978), identified many differing attitudes which can be classed under "distaste" for breast feeding. These are difficult to overcome.

Education of prospective mothers, with regard to breast feeding, can prove difficult. The subject is highly emotive for many women. "Aggressive attitudes by medical or nursing attendants, either pre or post-natally, are likely to produce aggressive reactions in the mother and such reactions are likely to be unhelpful for all concerned", (Scottish Home and Health Department, 1970).

Education does succeed with some mothers. Since the publication of the DHSS Report (1974), there has been much publicity both by the media and the medical professions, concerning the advantages of breast feeding. An evaluation study was conducted in Edinburgh by Kirk (1979). The incidence of breast feeding was monitored over two 12 monthly periods from 1974-75 and 1976-77. A 25 per cent increase in breast feeding was found. (Table XLI).

TABLE XLI.

Breast Feeding in 1974-75 and 1976-77 (per cent).

Breast Fed	1974-75	1976-77	Increase
Initially	43.6	68.5	24.9
At 2 weeks	29.5	49.0	19.5
At 1 month	26.9	43.5	16.9
At 4 months	10.3	37.0	26.7
n	78	200	-

Further analysis revealed that the advice was not uniformly received and that the education programme was relatively ineffective with mothers of low social economic status. Better methods of promoting breast feeding in these groups are needed.

(b) Bottle Feeding.

Bottle fed babies run a greater risk of infection, chemical disturbance, obesity, cow's milk allergy in infancy, necrotising enterocolitis and possibly atopic diseases and cot death, when compared with those breast fed (Addy, 1976). In spite of this, Britain is a predominantly bottle fed nation (DHSS, 1974), although there has been a slight trend away from this over the past years (Kirk, 1979). In the present study, 79 per cent of the cross sectional babies received no breast milk.

i. Dried milk products - incidence and contribution to the diet.

Results: Cross Section.

The proportion of non-breast fed babies receiving dried milk products ranged from 100 per cent at 6 weeks, to 29 per cent at 12 months. (Table XLII).

TABLE XLII.

Non-Breast Fed, Cross Sectional Infants Receiving Dried Milk Products (per cent).

	6 weeks	3 months	6 months	9 months	12 months
Uptake	100.0	97.4	89.5	58.5	29.0
n	113	152	114	118	114

Initially, dried milk products were the main source of energy and nutrients. Their contribution to the diet decreased with increasing age of the child. Further analysis of the results, with regard to social status, revealed that mothers from socio-economic group V homes tended to withdraw dried milk products from the diet at an earlier age than those from groups I and II. This trend was accompanied by an earlier introduction of milk, yoghurt and cream. (Table XLIII).

TABLE XLIII.

Mean Percentages of Total Energy Intake Derived from Dried Milk Products and Milk, Yoghurt and Cream, related to Social Status. (Non-Breast Fed Babies).

Age	Food	Socio-Economic Group I & II	III	IV	V
3 months	D.m.p.[1]	89.9 (21)	83.5 (70)	88.2 (22)	80.1 (37)
	M.y.cr.[2]	-	1.9	0.9	4.2
6 months	D.m.p.	56.5 (17)	56.6 (49)	59.1 (22)	44.2 (23)
	M.y.cr.	8.2	5.1	7.4	21.5
9 months	D.m.p.	30.5 (16)	20.6 (57)	22.4 (21)	21.5 (18)
	M.y.cr.	14.2	18.0	22.5	25.0

1 : Dried milk products.

2 : Milk, yoghurt and cream.

Results: Longitudinal Section.

Table XLIV shows the proportions of infants given dried milk products at various ages. The Carntyne and cross sectional proportions were similar throughout the first year of life, while those of Blackhill were continually less than those of the other two groups. At 3 months, the proportion in Blackhill was 95 per cent that of the cross section and this fell to 82 and 59 per cent at 6 and 9 months,respectively.

TABLE XLIV.

Non-Breast Fed Babies Receiving Dried Milk Preparations (per cent). No. of children in parenthesis.

Age	Cross Section	Blackhill	Carntyne
3 months	97.4 (152)	92.7 (206)	97.4 (192)
6 months	89.5 (114)	73.5 (132)	90.9 (142)
9 months	58.5 (118)	34.7 (121)	58.0 (131)
12 months	29.0 (114)	17.1 (88)	26.0 (100)

Table XLV shows the contribution of dried milk products to the total energy intake. Again, their earlier withdrawal in Blackhill is demonstrated. This is offset, to an extent, by the earlier introduction of "doorstep" milk, yoghurt and cream.

TABLE XLV.

Mean Percentages of Total Energy Intake Derived from Dried Milk Products and Milk, Yoghurt and Cream: by Area. (Non-Breast Fed Babies). No. of children in parenthesis.

Age	Food	Cross Section	Blackhill	Carntyne
3 months	D.m.p.[1]	84.4 (152)	76.2 (206)	82.9 (192)
	M.y.cr.[2]	1.8	5.4	2.1
6 months	D.m.p.	54.0 (112)	40.0 (132)	48.1 (141)
	M.y.cr.	8.3	15.1	7.1
9 months	D.m.p.	22.9 (116)	14.7 (121)	18.1 (131)
	M.y.cr.	19.5	24.6	18.8

1 : Dried milk products.

2 : Milk, yoghurt and cream.

ii. Dried milk powder - types and preparation.

As shown in the previous section, the majority of artificially fed babies are given reconstituted dried milk preparations. These are based on cow's milk and can be divided into the three categories of unmodified, modified by the addition of carbohydrate and modified by replacement of milk fat with other fats. All are fortified with vitamins and iron. Unmodified milks have been manufactured considerably longer than those which are modified. Table XLVI categorises the dried milk preparations in common use at the time of the present study.

TABLE XLVI.

Dried Milk Products Available from 1974-76.

Dried Milk Powders - Unmodified:	Cow & Gate - Babymilk 2 Ostermilk Two Golden Ostermilk National Dried Milk National Dried Milk (half-cream)
Dried Milk Powders - Modified by the Addition of Carbohydrate:	Cow & Gate - Babymilk 1 Cow & Gate - Trufood Cow & Gate - Babymilk Plus Ostermilk One Ostermilk Complete Formula
Dried Milk Powders - Milk Fat Replaced with Other Fats:	Cow & Gate V Formula SMA SMA S26

In 1975, there was considerable discussion regarding the optimum composition of dried milk preparations. Evidence accumulated to the effect that the feeding of unmodified milk powder leads to a greater risk of chemical imbalance and of dehydration. This is due to the solute content which is higher than those of the other two groups. At that time, most maternity hospitals started bottle fed infants with half-cream milks and graduated to full-cream milks after two weeks. Cow & Gate Babymilk 2 and Ostermilk 2 were the most commonly used milks in Glasgow. They are both unmodified high solute milks.

As a consequence of the risks highlighted, maternity hospitals had, by early 1976, begun to provide modified lower solute milks which met the needs of both new-born and older infants. In line with this change of policy, Health Visitors advised mothers to use modified milks and, in particular, that National Dried Milk was unsuitable for babies under six months.

The present study spanned the decision taken by the medical profession, to promote modified milks. For various reasons, unrelated to the milk formula debate, the 3 month and 6 month old infants were seen in two groups, some before January, 1976 and others from April, 1976 onwards. In addition, the 6 week old infants were all seen from April, 1976 onwards. This afforded an excellent opportunity to examine the change-over from unmodified to modified milks.

Results: Cross Section.

Table XLVII gives the main energy and nutrient source for the 6 week, 3 and 6 month old infants. It is divided into those seen up until January, 1976 and those seen from April, 1976 onwards. It shows that the use of unmodified milks decreased from 75 per cent to 12 per cent, while that of modified milks increased from 18 per cent to 84 per cent. Also demonstrated are the reduced uptake of National Dried Milk and the preference of milk fat replaced products over those modified by addition of carbohydrate.

TABLE XLVII.

Percentage Use of Unmodified and Modified Dried Milk Products (D.m.p). 6 weeks, 3 and 6 month old, Non-Breast Fed Infants.

Main Source of Energy and Nutrients		Seen Up to Jan. 1976	Seen From April,1976
(i)	D.m.p. unmodified	75.0	12.1
	D.m.p. modified	17.8	84.3
(ii)	National Dried Milk	31.0	3.0
	D.m.p. modified by replacement of milk fat	9.2	54.7
	D.m.p. modified by addition of CHO	8.6	29.6
	n	152	223

Results: Longitudinal Section.

The longitudinal section infants all entered the survey before 1975. This is reflected in the milk preparations used. Table XLVIII gives the types of milk fed to longitudinal section infants at 3 months. It highlights the differing uptake of National Dried Milk, which was used by 29 per cent of Carntyne mothers and 4 per cent from Blackhill.

TABLE XLVIII.

Main Source of Energy and Nutrients of Predominantly Bottle Fed Longitudinal Section Infants Aged 3 Months (per cent).

Source		Blackhill	Carntyne
(i)	D.m.p. unmodified	89.3	86.4
	D.m.p. modified by addition of CHO	4.0	6.8
	D.m.p. modified by replacement of milk fat	2.7	3.4
	"Doorstep" milk	2.7	1.7
	Evaporated milk	1.3	1.7
(ii)	National Dried Milk	4.0	28.8
	n	75	59

iii. Alternatives to dried milk products.

Table IL shows the numbers of infants given alternatives to dried milk products and how less than half of them were given a vitamin supplement.

TABLE IL.

Use of Alternatives to Dried Milk Products and of Vitamin Supplements (±) Amongst Non-Breast Fed Infants.

Main Source of Energy and Nutrients	Cross Section 6 weeks	Cross Section 3 months	Blackhill 6 weeks	Blackhill 3 months	Carntyne 6 weeks	Carntyne 3 months
"Doorstep" milk	-	-	1 (-)	2 (--)	-	1 (+)
Evaporated milk	-	1 (-)	-	1 (-)	-	1 (+)
Other	-	1 (+)	-	-	-	-
n	113	152	77	75	56	59

Discussion.

Reconstituted dried milk products form the staple diet of non-breast fed babies. While still advocating breast feeding, the fact that so many mothers do not choose this method must be recognised and the most suitable alternatives advised. Dried milk products based on cow's milk are now modified to approach, as near as possible, the composition of breast milk. A rapid changeover to these powders was made by mothers on the recommendation of the medical profession. (Table XLVI).

Before the promotion of modified milks, uptake of National Dried Milk amounted to 31 per cent by bottle feeding mothers.

DHSS (1974) recommended a modified reformulation of National Dried Milk which would be suitable for young babies. This need still exists. It is interesting to note that 29 per cent of the Carntyne mothers used National Dried Milk, a proportion similar to that of the cross section. In Blackhill, however, where its economical aspect would have been of even greater importance, uptake was low at only 4 per cent. This is most probably linked with the fact that the local clinic, where supplies were available, was some distance away, involving a bus ride. The saving on the milk would have to be offset against the cost of transport and the "nuisance factor".

A total of 8 bottle-feeding mothers were found to use a main dietary source other than dried milk powder at either 6 weeks or 3 months. This is a relatively satisfying low number and is similar to the findings of Goel (1979). A vitamin supplement was given by 3 of them. None of the cross section mothers used "doorstep" milk, which agrees with Goel's results (1979). The one Blackhill mother who fed it to her baby, from birth, did so because her own mother had likewise fed her own large family with no apparent detrimental effect. Grandmother's advice was considerably more potent in this case than that of the Health Visitor.

(c) Introduction of Solids.

The terms "solid food" or "solids" are used to refer to foods other than milk, dried milk products and sugar. The most commonly used first solids are cereal powders and rusks. The DHSS (1974) was adamant in stating that, "the introduction of any food to the baby, other than milk, should be unnecessary, in general, before the age of four to six months".

Evidence shows that early introduction of solids coincided with early presentation of coeliac disease (Arneil, Hutchinson & Shanks, 1973). There are reports of an increase in the number of children diagnosed as having coeliac disease, both in Glasgow (Arneil et al,1973) and the West of Ireland (Mylotte et al,1973). Uncertainty exists as to whether the early introduction of dietary gluten induces gluten sensitivity. However, since malnutrition is especially undesirable in the first months of life (Dobbing 1968, 1974), even a postponement of coeliac disease is relatively beneficial and, therefore, the use of wheat cereal should be discouraged before four to six months. Other evidence suggests that the early introduction of solids leads to the development of hyperosmolar states (Davies 1975). There has also been an association of early solids with an increased weight gain (Shukla et al, 1972), although Davies et al (1977), were unable to establish it.

Table L which is extracted from DHSS (1974), summarises some reports which were published before the commencement of the present study. It demonstrates that between 80 and 100 per cent of the mothers gave solids to their babies by the age of three months.

TABLE L.

Percentages of Infants Eating Cereal at Different Ages.

Reference	No. of Children		Age 1 month	6 weeks	2 months	3 months	4 months
Arneil (1967)	1345		14	-	39	93	-
Hutchinson-Smith (1970)	200	Breast Fed	19	-	62	-	90
		Bottle Fed	21	-	80	-	100
Taitz (1971)	40		-	100	-	-	-
Tracey & Harper (1971)	223		-	-	-	80	-
Shukla et al (1972)	300		40	-	-	93	-
Oates (1973)	100		18	-	-	-	-
Seacombe (1973)	85		-	-	52	85	-

Results.

The age at which solids were introduced into the infants' diets is given in Table LI. Most had received solids by seventeen weeks - the minimum age recommended by DHSS (1974). In the Blackhill cohort, 27 per cent were given solids within the first five weeks of life. The proportions given solids before the age of twelve weeks were 30 per cent in the cross section and 76 and 83 per cent in Blackhill and Carntyne, respectively.

TABLE LI.

Age of Introduction of Solids (Per Cent). Cross Section and Longitudinal Section. 'n' in Parenthesis.

Age (weeks)	Cross Section	Blackhill	Carntyne
0-5	6.1 (560)	27.3	6.9
6-11	29.5 (427)	48.5	75.9
12-17	57.3 (323)	19.7	17.2
7/18	13.6 (323)	3.0	-
Unknown	-	1.5	-
n	-	(66)	(58)

Discussion.

The incidence of very early introduction of solids, within the first month, was much lower in the cross section and Carntyne than in previously quoted reports. (Table L). Blackhill, on the contrary, had an alarmingly high level of 27 per cent. Although the method of introduction was not investigated, most of these Blackhill mothers volunteered the information that rusk or cereal powder was added to the infant's bottle.

In the longitudinal section, the most common age of

introduction was between six and eleven weeks. The cross section mothers reported to have started slightly later, with over 50 per cent between twelve and seventeen weeks. This may reflect, to an extent, a difference between prospective and retrospective studies. Many cross section mothers quoted the age to be either exactly three or four months.

In view of the reported risks of early coeliac disease (Arneil et al 1973), excessive weight gain (Shukla et al 1972) and hyperosmolar states (Davies, 1975) and of no apparent benefits attached to early introduction of solids, more emphasis should be put on detering their use before four months.

It is realised that this study was conducted before the major change in policy of advocating the age of four, rather than three months.

CHAPTER X.

DIET.

(a) Nutrient Content.

i. Energy.

ii. Protein.

iii. Fat.

iv. Carbohydrate.

v. Calcium.

vi. Iron.

vii. Phosphorus, Sodium and Potassium.

viii. Vitamin A.

ix. Vitamin D.

x. Ascorbic Acid.

xi. Water.

(b) Food Groups.

(c) Discussion.

DIET.

In India in the 1920's, Sir Robert McCarrison carried out an experiment demonstrating the importance of diet which is described by Fisher & Bender (1970). India contains a wide variety of people of different race, physique and fitness. Some are tall and healthy, others small and healthy and a third group comprises people small and thin or large and fat, who are not particularly healthy. Interested to determine the reasons for this, Sir Robert designed an animal experiment to find out. He took identical pairs of rats, kept them in identical housing conditions but fed them on one of three diets, typical of the three classifications of people found in different parts of India. After several months on the diets, the identical pairs had become groups of quite different rats. Some were thin and weak, others large fat and moulting. The group fed on the diet of the tall healthy northern Indians was sleek and splendid with numerous progeny. Food was the deciding factor in determining their health, stamina and physique.

Clearly this carefully controlled experiment is not strictly analagous with the considerably more complex human situation. Nontheless, the United Nations Conference on Food and Agriculture, held at Hot Springs Virginia in 1943, declared, "that the first essential of a decent standard of living is the provision to all men of those primary necessities which are required to promote freedom from disease and for the attainment of good health" and, "that the most fundamental of these necessities is adequate food . . .".

McCarrison & Sinclair's book, 'Nutrition and Health' (1953) was prefaced with the above quotation. Later in the book, Sir Robert McCarrison stated:

"the newer knowledge of nutrition is the greatest advance in

medical science since the days of Lister. When physicians, medical officers of health and the lay public learn to apply the principles which this newer knowledge has to impart . . . then will it do for medicine what aspesis has done for surgery".

Lavoisier is often thought of as the father of nutrition (Davidson, Passmore & Brock, 1972). "La vie est un fonction chimique" (Pyke, 1970). His realisation in 1780 that life is a chemical process led to the establishment of the science of nutrition. In order to understand the relationship of food with the living body it must be thought of in chemical terms.

The diets from the present survey are analysed in terms of energy content, protein, fat, carbohydrate and certain minerals and vitamins. All results refer to non-breast feeding infants. Where relevant, comparisons are made with other surveys of British children, although unfortunately, the age groupings do not coincide exactly. The following surveys are referred to:

(i) Bransby & Fothergill (1954). This survey, conducted in 1951, sampled representative groups of children aged from 6 months to 4 years. The youngest group, which contained 150 children, was aged from 6 to 12 months and can be compared with the 9 month old group in the present study.

(ii) Taitz (1971). A consecutive unselected series of 240 normal 6 week old infants from Sheffield was surveyed. A dietary history was obtained from 40 of them.

(iii) Shukla et al (1972). A 10 per cent sample of normal infants in Dudley was surveyed. They were aged up to 12 months and divided into four 3 monthly groups.

(iv) Department of Health and Social Security (1975). A nationally

representative sample of children from 6 months to 4½ years was surveyed from 1967-68. 201 children were in the age group 6 to 18 months. It can be compared with the 12 month old group in the present study.

(v) Morgan et al (1976). Children in the London area were surveyed in 1975. The largest relevant age group of 22 children was aged 9 to 12 months. It can be compared with the 12 month old group in the present study.

(vi) Black, Billewicz & Thomson (1976). This survey, conducted from 1968-71, sampled children up to the age of 4 years. It was deliberately biased to include an excess from both the upper and lower ends of the socio-economic spectrum. 44 dietary records were acceptable in the 8 month old group which can be compared with the 9 month old group of the present study.

(vii) Goel (1979). Asian, African and Chinese children living in Glasgow were studied from 1974-76 and compared with Scottish children from the same district. There were 30 children under 1 year, of whom 5 were Scots.

(a) Nutrient Content.

(i) Energy.

Animals derive their energy from food, as part of a food chain, where the sun is the original source and green plants the convertors of solar to chemical energy. Energy is needed by humans for muscular work, organ activity, maintenance of body temperature and growth.

The energy content of a food is determined, either by combusting a sample of it in an oxygen enriched environment and measuring the heat liberated, or by the use of food tables. These give the composition of foods and their energy content, which is calculated by multiplying the amounts of protein, fat and carbohydrate in the item of food, each by a conversion factor related to its heat of combustion (Widdowson, 1955; McCance & Widdowson, 1960).

Results: Cross Section.

TABLE LII.

Mean Energy Intake. Cross Section.
Standard Deviation in Parenthesis.

Age	No. of Diets	Rec. Intake (MJ)[1] Boys	Girls	Mean Intake (MJ) Boys	Girls	Mean Intake, Sexes Comb. MJ	Kcal
6 weeks	113	2.2	2.1	2.52 (0.51)	2.34 (0.48)	2.44	583
3 months	152	2.2	2.1	2.80 (0.61)	2.69 (0.51)	2.75	656
6 months	112	3.0	2.8	3.34 (0.87)	3.06 (0.75)	3.21	767
9 months	116	3.7	3.4	3.99 (1.34)	3.78 (1.05)	3.85	919
12 months	106	4.1	3.8	4.07 (1.10)	4.34 (1.40)	4.22	1007

1 : Recommended Intake (Department of Health and Social Security, 1979).

The mean intake of energy and the standard deviation increased steadily with age. (Table LII). All sex separate values were greater than those recommended by DHSS (1979), except that of the 12 month old boys which was very slightly less. The boys' mean, expressed as a percentage of the recommended intake, decreased from 127 per cent at 3 months, to 99 per cent at 12 months.

Table LII demonstrates that the lower intake of the girls up until 9 months is mainly accounted for by body size, as the mean intakes per kg body weight of boys and girls were similar. The intakes of both sexes, related to body weight, decreased with age until 9 months. At 12 months, that of the boys decreased still further, while that of the girls increased.

TABLE LIII.

Mean Intake of Energy Per Kilogram Body Weight. Cross Section.

	6 weeks		3 months		6 months		9 months		12 months	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
MJ/Kg	0.55	0.56	0.47	0.49	0.45	0.43	0.44	0.44	0.41	0.47
Kcal/Kg	131	134	113	116	107	103	106	106	99	113

The Glasgow results can be compared with those of other surveys. (Table LIV). There is a danger in placing too much emphasis on the comparison of studies which were carried out using different procedures and where the ages of the sampled children were not identical. Bearing this in mind, the Glasgow children at 3 and 6 months had a slightly lower energy intake and at 9 and 12 months, an intake intermediate to those of other survey children.

TABLE LIV.

A Comparison of Energy Intakes with Other Survey Results.

Age	Survey	No. of Diets	MJ	Kcal
~3 months	Shukla et al (1972)	88	3.24	775
3 months	This survey	152	2.74	656
- 6 months	Shukla et al (1972)	99	3.65	872
6 months	This survey	112	3.21	767
6-12 months	Bransby & Fothergill (1954)	150	4.52	1080
8 months	Black et al (1976)	44	3.75	896
- 9 months	Shukla et al (1972)	69	3.79	905
9 months	This survey	116	3.84	919
6-18 months	DHSS (1975)	201	4.40	1050
9-12 months	Morgan et al (1975)	22	3.56	850
- 12 months	Shukla et al (1972)	44	3.97	948
12 months	This survey	106	4.22	1007

Energy consumption has been shown to alter with social status (Bransby & Fothergill, 1954; DHSS, 1975; Black et al 1976). The mean intakes of energy in the different socio-economic groups are given in Table LV.

TABLE LV.

Mean Energy Intake Related to Socio-Economic Group. No. of Diets in Parenthesis.

Unit	Age	Socio-Economic Group I & II	III	IV	V	-
MJ	6 weeks	2.37 (14)	2.38 (57)	2.48 (18)	2.61 (23)	2.17 (1)
	3 months	2.64 (21)	2.78 (70)	2.73 (22)	2.73 (37)	3.11 (2)
	6 months	2.99 (17)	3.22 (49)	2.94 (22)	3.59 (23)	3.70 (1)
	9 months	3.46 (16)	4.01 (57)	3.49 (21)	4.19 (18)	3.32 (4)
	12 months	3.57 (14)	4.18 (58)	4.23 (15)	4.83 (18)	3.76 (1)
Kcal	6 weeks	565	568	594	624	518
	3 months	630	665	652	652	742
	6 months	715	769	703	858	885
	9 months	827	959	833	1000	795
	12 months	853	998	1011	1155	898

The pattern was similar to those of other surveys, namely the greatest energy intake was found in socio-economic group V. This was already apparent at 6 weeks and by 12 months, the mean intake was 135 per cent that of groups I and II.

Results: Cross Section.

Table LVI compares the longitudinal section energy intakes with those of the cross section and DHSS (1979) recommended intakes. From 6 months onwards, the Blackhill intakes were greater than those of the cross section. The difference increased with age and tended to be greater for boys. The Carntyne means were similar to those of the cross section.

TABLE LVI.

Mean Energy Intake. Cross Section and Longitudinal Section. No. of Diets in Parenthesis.

Unit of Energy	Age	Rec. Intake[1] Boys	Rec. Intake[1] Girls	Cross Section Boys	Cross Section Girls	Blackhill Boys	Blackhill Girls	Carntyne Boys	Carntyne Girls
MJ	3 months	2.2	2.1	2.80 (74)	2.69 (78)	2.77 (94)	2.55 (112)	2.48 (95)	2.49 (97)
	6 months	3.0	2.8	3.34 (59)	3.06 (53)	4.10 (61)	3.82 (71)	3.25 (75)	3.16 (66)
	9 months	3.7	3.4	3.99 (60)	3.78 (56)	5.30 (60)	4.65 (61)	3.88 (71)	3.78 (60)
	12 months	4.1	3.8	4.07 (50)	4.34 (56)	5.90 (34)	4.94 (54)	4.50 (49)	4.32 (51)
Kcal	3 months	530	500	670	643	661	609	593	596
	6 months	720	670	798	732	979	912	777	754
	9 months	888	810	953	902	1267	1110	927	902
	12 months	980	910	973	1036	1410	1179	1076	1033

1 : Recommended intake (DHSS, 1979).

TABLE LVII.

Mean Intake of Energy Per Kilogram Body Weight. Cross Section and Longitudinal Section. No. of Diets in Parenthesis.

Energy/Kg Body Weight	Age	Cross Section	Blackhill	Carntyne
MJ/Kg	3 months	0.48 (152)	0.54 (206)	0.48 (192)
	6 months	0.44 (112)	0.58 (132)	0.42 (141)
	9 months	0.44 (116)	0.61 (121)	0.43 (131)
	12 months	0.44 (106)	0.60 (88)	0.46 (100)
Kcal/Kg	3 months	115 (152)	130 (206)	114 (192)
	6 months	105 (112)	138 (132)	101 (141)
	9 months	106 (116)	146 (121)	102 (131)
	12 months	106 (106)	143 (88)	109 (100)

Table LVII shows that when energy intake is expressed per kg body weight, the increased intake of Blackhill infants is magnified. At 9 and 12 months, the values were 139 and 135 per cent, respectively, of those of the cross section. (Table LVIII).

TABLE LVIII.

Mean Energy Intakes of the Longitudinal Section Expressed as Percentages of Those of the Cross Section.

Age	Blackhill		Carntyne	
	Energy	Energy/Kg. Body Wt.	Energy	Energy/Kg.Body Wt.
3 months	96.5	113.4	90.7	99.5
6 months	123.0	131.8	100.0	96.1
9 months	129.3	139.7	99.7	97.8
12 months	125.9	135.2	104.7	102.4

Similar mean intakes may conceal varying ranges. Examination of the 10th, 50th and 90th centiles provides more detail. Table LIX gives these and shows that in Blackhill, the range of diets was greater than in the cross section, with a bias towards higher intakes. The Carntyne distributions were similar to those of the cross section except at 12 months, when there was an overall shift to higher intakes.

TABLE LIX.

Energy Intake (MJ) : 10th, 50th and 90th Centiles.
Sexes Combined.

Age	Centile	Cross Section	Blackhill	Carntyne
6 weeks	10	1.73	1.26	1.47
	50	2.43	1.93	2.06
	90	3.12	3.01	2.98
3 months	10	2.07	1.80	2.04
	50	2.72	2.93	2.52
	90	3.41	3.98	3.52
6 months	10	2.26	2.70	2.22
	50	3.08	3.88	3.16
	90	4.22	4.98	4.05
9 months	10	2.62	2.61	2.23
	50	3.66	4.90	3.92
	90	5.37	7.47	5.01
12 months	10	2.82	2.38	3.05
	50	3.99	5.35	4.45
	90	5.64	8.23	5.92

It is of interest to know what proportion of diets failed to provide the recommended intake of energy (DHSS, 1979). Table LX gives the centile positions for recommended intakes of energy. It should be noted that the recommended figure is a mean and that, "About one half of the individuals in the group would be expected to have intakes less than, and half more than, the recommended amount;".

All positions were well below the 50th centile, with the exception of the cross section boys at 9 and 12 months. The Blackhill centile positions were especially low.

TABLE LX.

Centile Position of the Recommended Energy Intake. (DHSS 1979).

Age	Cross Section		Blackhill		Carntyne	
	Boys	Girls	Boys	Girls	Boys	Girls
3 months	15.5	11.5	25.0	16.0	22.9	7.7
6 months	44.1	32.7	5.3	12.5	33.3	22.7
9 months	50.8	43.6	18.8	23.8	45.5	31.6
12 months	56.0	41.1	18.8	25.0	42.9	31.8

(ii) Protein.

All living creatures contain protein. It is manufactured by plants, from nitrogen in the soil and carbon-dioxide in the air. All animals must obtain their protein by eating either plant protein or other animals.

The other main components of the diet - fat and carbohydrate - contain neither nitrogen or sulphur, both of which are essential elements in all proteins.

Protein is needed in a growing animal for laying down new tissue as its bones and muscles increase in size. In both adults and children, protein is required for the continual replacement and renovation of all tissues in the body. Protein can also be converted to fat and stored or used to produce energy. This occurs when an excess of protein over requirements has been eaten or when the total energy content of the diet is insufficient.

In infancy, assuming that the diet is satisfactory, protein is used almost entirely for growth. Degkwitz (1935) showed that animals which grow rapidly, produce milk with a higher protein content than man, who is a relatively slow grower. Some examples are given in Table LXI.

TABLE LXI.

Growth Rate and Protein Content of Milk in Some Animals (Degkwitz, 1935).

Animal	Day on Which Birth Weight Doubles	Protein in Milk (Per Cent)
Man	120	1.3
Horse	60	2.1
Cow	47	3.5
Sheep	15	5.2
Dog	9	9.7

Protein contains approximately 16 per cent nitrogen. The protein content of most foods has been determined by estimating, chemically, the total nitrogen content and multiplying it by 6.25 or other appropriate factor. These figures are available in food tables.

Results: Cross Section.

Protein intake increased with age. The mean intakes of both boys and girls were always greater than those recommended and became increasingly greater with age. (Table LXII).

TABLE LXII.

Mean Protein Intake (g). Cross Section.
Standard Deviation in Parenthesis.

Age	No. of Diets		Rec. Intake[1]		Mean Intake	
	Boys	Girls	Boys	Girls	Boys	Girls
6 weeks	62	51	13	12.5	16.3 (6.4)	15.0 (5.0)
3 months	74	78	13	12.5	25.4 (9.3)	22.1 (9.1)
6 months	59	53	18	17	31.8 (11.4)	29.1 (12.0)
9 months	60	56	22	20	39.1 (16.7)	35.7 (10.6)
12 months	50	56	24.5	23	40.4 (12.2)	40.4 (13.1)

1 : Recommended Intake (DHSS, 1979).

The Glasgow intake was similar to that of other surveys at 9 months but greater at 12 months. (Table LXIII).

TABLE LXIII.

A Comparison of Protein Intakes with Other Survey Results.

Age	Survey	No. of Diets	Protein
6-12 months	Bransby & Fothergill (1954)	150	38.0
8 months	Black et al (1976)	44	35.2
9 months	This survey	116	37.1
6-18 months	D.H.S.S. (1975)	201	33.9
12 months	This survey	106	40.4

Table LXIV relates mean protein intake with social status. Socio-economic group V consistently had the highest intake of protein. Groups I and II had the lowest intake, though this was still greater than the recommended intake (DHSS, 1979).

TABLE LXIV.

Mean Protein Intake (g) Related to Socio-Economic Group. No. of Diets in Parenthesis.

Age	Socio-economic Groups				
	I and II	III	IV	V	-
6 weeks	13.6 (14)	16.0 (57)	14.2 (18)	17.5 (23)	12.2 (1)
3 months	20.9 (21)	23.9 (70)	22.9 (22)	24.6 (37)	35.7 (2)
6 months	28.2 (17)	28.1 (49)	29.8 (22)	37.6 (23)	34.0 (1)
9 months	31.6 (16)	38.8 (57)	33.9 (21)	41.7 (18)	30.3 (4)
12 months	35.9 (14)	39.7 (58)	41.5 (15)	45.0 (18)	40.6 (1)

Results: Longitudinal Section.

TABLE LXV.

Mean Protein Intake (g). Cross Section and Longitudinal Section. No. of Diets in Parenthesis.

Age	Rec. Intake[1]		Cross Section		Blackhill		Carntyne	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
3 months	13	12.5	25.4 (74)	22.1 (78)	30.0 (94)	27.7 (112)	26.7 (95)	27.8 (97)
6 months	18	17	31.8 (59)	29.1 (53)	40.3 (61)	36.7 (71)	34.2 (75)	31.4 (66)
9 months	22	20	39.1 (60)	35.7 (56)	48.7 (60)	43.7 (61)	39.5 (71)	36.9 (60)
12 months	24.5	23	40.4 (50)	40.4 (56)	52.9 (34)	45.3 (54)	43.4 (49)	41.9 (51)

1 : Recommended Intake (DHSS, 1979).

Blackhill and Carntyne both had mean protein intakes greater than those of the cross section throughout the year. Blackhill intakes were the greatest.(Table LXV). Table LXVI expresses the longitudinal intakes as percentagesof the cross section intakes, with sexes combined.

TABLE LXVI.

Mean Protein Intakes of the Longitudinal Section Expressed as Percentages of Those of the Cross Section.

Age	Blackhill	Carntyne
3 months	121.1	114.8
6 months	126.3	108.2
9 months	124.5	103.3
12 months	119.3	105.5

Protein intake, as measured absolutely, is important. Also relevant, is the proportion of dietary energy provided by protein. Table LXVII gives the proportions found in both the cross and longitudinal sections. The D.H.S.S. (1979) recommended a level of 10 per cent.

TABLE LXVII.

Protein Energy (Percentage of Total).

Age	Cross Section	Blackhill	Carntyne
3 months	14.5	18.4	18.4
6 months	15.7	16.4	17.0
9 months	16.3	15.8	16.8
12 months	16.5	15.2	16.4

The proportion of protein energy gradually increased in the cross section, while in both longitudinal sections, it decreased. The Blackhill decrease was greater than that of Carntyne and, at 9 and 12 months, the value was below the cross section value. The Carntyne value was similar to that of the cross section at 12 months. In all cases, the proportion was well above that recommended (DHSS, 1979).

Table LXVIII gives the 10th, 50th and 90th centiles of protein intake. The span from the 10th to 90th centiles increased with age in all three groups but the increase was greatest in Blackhill. The cross section span at 3 months was 24g and that of Blackhill 23g, while the comparative figures at 12 months were 32g and 57g.

TABLE LXVIII.

Protein Intake(g)10th, 50th and 90th Centiles.

Age	Centile	Cross Section	Blackhill	Carntyne
6 weeks	10	10.5	12.3	16.1
	50	14.6	23.8	24.0
	90	20.8	32.0	32.5
3 months	10	16.8	18.1	19.3
	50	20.3	30.3	28.4
	90	34.7	41.4	40.1
6 months	10	18.7	29.2	20.0
	50	27.6	38.8	31.5
	90	44.5	53.0	46.0
9 months	10	21.1	25.3	19.3
	50	34.0	45.5	35.9
	90	53.9	66.8	59.4
12 months	10	25.8	20.0	28.4
	50	38.6	45.8	44.4
	90	57.9	76.7	57.3

Recommended Intakes.

TABLE LXIX.

Centile Position of the Recommended Protein Intake. (DHSS,1979).

Age	Cross Section		Blackhill		Carntyne	
	Boys	Girls	Boys	Girls	Boys	Girls
3 months	4.1	10.3	0.0	8.0	0.0	0.0
6 months	6.8	4.8	0.0	0.0	0.0	4.5
9 months	10.2	5.5	0.0	4.8	13.6	10.5
12 months	8.0	3.6	6.3	15.0	4.8	4.5

Table LXIX gives the centile position of the recommended intake of protein and shows how few diets contained less than the recommended level.

(iii) Fat.

Fats and oils belong to a larger group of naturally occurring substances called lipids. They are of importance in the diet as a concentrated form of energy and as a vehicle for the fat soluble vitamins A, D, E and K. They contain essential fatty acids. Although adult man has only rarely been shown to suffer from essential fatty acid deficiency, this is not true for infants (British Medical Journal, 1963). The growth of infants on a grossly deficient diet eventually slows and the skin becomes dry and thickened.

Infants store fat for insulation and use as an emergency energy store. Newborn infants absorb only 80 per cent of their dietary fat. This figure soon rises to 95 per cent, although immature infants retain less. If the fat content of the diet is too high, calcium absorption is impaired (Widdowson, 1969).

Results: Cross Section.

TABLE LXX.

Mean Fat Intake (g). Cross Section.

Age	No. of Diets	Fat (g)	S.D.
6 weeks	113	29.5	6.5
3 months	152	30.3	6.8
6 months	112	33.8	10.3
9 months	116	41.7	17.6
12 months	106	46.9	18.9

The fat intake increased with age until 6 months. (Table LXX). By 9 months, there was a large increase and a further one occurred by 12 months. The standard deviation also increased.

Table LXXI compares the results with those of other surveys and shows the relatively high fat intake of the Glasgow children at 12 months.

TABLE LXXI.

A Comparison of Fat Intakes with Other Survey Results.

Age	Survey	No. of Diets	Fat (g)
6-12 months	Bransby & Fothergill (1954)	150	46
8 months	Black et al (1976)	44	37.3
9 months	This survey	116	41.7
6-18 months	D.H.S.S. (1975)	201	42.6
12 months	This survey	106	46.9

TABLE LXXII.

Mean Fat Intake (g) Related to Socio-Economic Group. No. of Diets in Parenthesis.

Age	Socio-economic Groups				
	I and II	III	IV	V	-
6 weeks	28.8 (14)	28.5 (57)	30.7 (18)	31.1 (23)	28.4 (1)
3 months	28.4 (21)	30.9 (70)	31.1 (22)	29.8 (37)	33.2 (2)
6 months	29.8 (17)	33.5 (49)	31.0 (22)	39.6 (23)	40.3 (1)
9 months	33.9 (16)	42.9 (57)	37.9 (21)	50.7 (18)	34.9 (4)
12 months	40.2 (14)	45.2 (58)	47.8 (15)	57.5 (18)	40.5 (1)

At 6 weeks and 3 months, the intake of fat differed little within the various socio-economic groups. (Table LXXII). From 6 months onwards, socio-economic group V had the highest intake and groups I and II the lowest.

A report on the adult dietary intakes of fat in six social groups in Ireland (Gibney & Upton, 1977), based on data compiled by the Central Statistics Office (1976), showed a different trend. The fat intake was highest amongst non-manual workers with the exception of farmers and fishermen.

Results: Longitudinal Section.

TABLE LXXIII.

Mean Fat Intake (g). Cross Section and Longitudinal Section. No. of Diets in Parenthesis.

Age	Cross Section	Blackhill	Carntyne
3 months	30.3 (152)	29.5 (206)	28.0 (192)
6 months	33.8 (112)	41.8 (132)	32.7 (141)
9 months	41.7 (116)	53.9 (121)	40.0 (131)
12 months	46.9 (106)	60.7 (88)	46.8 (100)

The mean fat intake of Blackhill infants was higher than that of the cross section from 6 months onwards. That of Carntyne was similar, although always slightly below the cross section mean. Table LXXIV expresses the longitudinal intakes as percentages of those of the cross section.

TABLE LXXIV.

Mean Longitudinal Fat Intakes Expressed as Percentages of Those of the Cross Section.

Age	Blackhill	Carntyne
3 months	97.4	92.4
6 months	123.7	96.8
9 months	129.3	95.9
12 months	129.4	99.8

TABLE LXXV.

Fat Energy (Percentage of Total).

Age	Cross Section	Blackhill	Carntyne
3 months	40.5	42.7	42.6
6 months	39.5	40.1	38.3
9 months	40.4	41.0	38.9
12 months	41.9	42.5	39.5

In Blackhill infants, the proportion of energy provided by fat was always greater than in the cross section, even at 3 months when the total fat was less. (Table LXXV). The proportion decreased at 6 months but increased again at 9 and 12 months. Amongst Carntyne infants, the proportion of energy provided by fat was greater than that of the cross section infants at 3 months but less for the rest of the year. A decrease, similar to that found in Blackhill, occurred at 6 months but the increase which followed was less.

Perissé, Sizaret & Francois (1969) showed that the proportion of energy derived from fat rises steeply with income and yet, that in Blackhill was consistently greater than that in Carntyne.

The 10th, 50th and 90th centile positions of fat intake are given in Table LXXVI. At 6 weeks in Blackhill, the fat intake centiles were below those of the cross section. There was a gradual, relative increase in the range of intakes, initially due to an increase in the 90th centile in Blackhill. At 12 months, the Blackhill 10th centile was less than the cross section 10th centile and the span of intakes from 10th - 90th centiles was 63g compared

with 40g. The Carntyne centiles were similar to, though tending to be slightly less, than those of the cross section.

TABLE LXXVI.

Fat Intake (g): 10th, 50th and 90th Centiles.

Age	Centile	Cross Section	Blackhill	Carntyne
6 weeks	10	21.6	12.7	16.8
	50	28.4	23.9	24.8
	90	37.0	32.6	33.1
3 months	10	21.7	21.0	21.5
	50	30.7	31.8	29.6
	90	38.6	41.7	37.7
6 months	10	21.4	28.6	22.2
	50	32.3	42.6	31.3
	90	46.0	56.3	45.8
9 months	10	23.6	28.8	20.1
	50	38.5	50.5	37.9
	90	64.0	91.2	55.5
12 months	10	28.1	23.7	27.5
	50	43.2	63.3	47.0
	90	67.7	86.9	75.7

(iv) Carbohydrate.

Carbohydrates are produced by green plants from carbon dioxide and water. The process is known as photosynthesis and it converts solar to chemical energy.

Carbohydrates provide the major portion of energy in most human diets, although the proportion ranges from only 40 per cent, in some very rich societies, to 90 per cent amongst the very poor. Neither extreme is thought to be beneficial.

Results: Cross Section.

TABLE LXXVII.

Mean Carbohydrate Intake (g). Cross Section.

Age	No. of Diets	Carbohydrate (g)	S.D.
6 weeks	113	67.8	18.4
3 months	152	77.0	25.1
6 months	112	90.9	29.5
9 months	116	105.3	37.1
12 months	106	112.4	32.2

Total carbohydrate intake increased steadily from 6 weeks to 12 months.

Table LXXVIII compares the results with those of other surveys and shows the relatively low carbohydrate intake of the Glasgow children.

TABLE LXXVIII.

A Comparison of Carboyhydrate Intake with Other Survey Results.

Age	Survey	No. of Diets	Carbohydrate (g)
6-12 months	Bransby & Fothergill (1954)	150	131
8 months	Black et al (1976)	44	111.9
9 months	This survey	116	105.3
6-18 months	DHSS (1975)	207	141
12 months	This survey	106	112.4

There was no consistent pattern when mean intake of carbohydrate was related to socio-economic group. (Table LXXIX).

TABLE LXXIX.

Mean Carbohydrate Intake (g) Related to Socio-Economic Group. No. of Diets in Parenthesis.

Age	Socio-eccnomic Groups. I and II	III	IV	V	-
6 weeks	66.8 (14)	65.8 (57)	69.4 (18)	73.2 (23)	56.8 (1)
3 months	77.2 (21)	77.9 (70)	75.1 (22)	76.3 (37)	80.4 (2)
6 months	89.3 (17)	94.3 (49)	81.3 (22)	93.7 (23)	102.9 (1)
9 months	105.5 (16)	111.4 (57)	95.0 (21)	100.4 (18)	96.0 (4)
12 months	91.9 (14)	115.0 (58)	110.6 (15)	122.0 (18)	98.6 (1)

Results: Longitudinal Section.

TABLE LXXX.

Mean Carbohydrate Intake (g). Cross Section and Longitudinal Section. No. of Diets in Parenthesis.

Age	Cross Section	Blackhill	Carntyne
3 months	77.0 (152)	67.3 (206)	61.8 (192)
6 months	90.9 (112)	110.2 (132)	90.4 (141)
9 months	105.3 (116)	138.0 (121)	106.6 (131)
12 months	112.4 (106)	141.0 (88)	122.9 (100)

Among Blackhill infants, the mean carbohydrate intake was less than in the cross section infants at 3 months. (Table LXXX). By 6 months, their intake was greater and it continued thus throughout the year. In Carntyne infants, the intake was lower than in the cross section infants at 3 months, similar at 6 and 9 months and greater at 12 months. Table LXXXI expresses the intakes as percentages of those of the cross section.

TABLE LXXXI.

Mean Longitudinal Carbohydrate Intakes Expressed as Percentages of Those of the Cross Section.

Age	Blackhill	Carntyne
3 months	87.4	80.3
6 months	121.2	99.5
9 months	131.1	101.2
12 months	125.4	109.3

TABLE LXXXII.

Carbohydrate Energy (Percentage of Total).

Age	Cross Section	Blackhill	Carntyne
3 months	45.5	38.9	38.2
6 months	44.7	43.4	44.5
9 months	43.3	43.1	44.1
12 months	41.6	41.2	44.0

In Blackhill infants, the proportion of dietary carbohydrate was, initially, less than in the cross section infants, but from 6 months onwards, was similar. In Carntyne infants, the proportion was less than in the cross section infants at 3 months, similar at 6 months and slightly greater at 9 and 12 months.

The 10th, 50th and 90th centile positions are given in Table LXXXIII. In Blackhill, at 6 weeks, the values of the centiles were all less than those of the cross section. Throughout the year, there was an increase in the range of intakes and at 12 months, the span of the Blackhill 10th - 90th centiles was 186g compared with 82g in the cross section. The Carntyne intakes were also less than the cross section values at 6 weeks. There was a very gradual increase in values until, at 12 months, the 50th and 90th centiles were larger than those of the cross section, producing a wider range.

TABLE LXXXIII.

Carbohydrate Intake (g): 10th, 50th and 90th Centiles.

Age	Centile	Cross Section	Blackhill	Carntyne
6 weeks	10	45.4	24.7	28.5
	50	65.9	45.1	42.8
	90	93.2	69.4	80.9
3 months	10	48.2	40.2	45.3
	50	72.7	77.4	65.4
	90	110.1	116.5	89.3
6 months	10	55.3	61.9	49.6
	50	89.7	100.2	97.6
	90	127.7	150.8	124.4
9 months	10	61.9	76.8	59.4
	50	102.8	140.5	101.2
	90	163.0	222.2	151.9
12 months	10	72.1	65.1	69.3
	50	107.4	136.1	117.6
	90	154.3	251.3	161.4

(v) Calcium.

Approximately 1200g of calcium are contained in the adult human body and of this, at least 99 per cent is in the form of calcium salts present in the skeleton.

Vitamin D is essential for the absorption of calcium and proteins also promote it (McCance,Widdowson & Lehmann, 1942). Phytic acid, phosphate, fats and oxalic acid can all inhibit absorption.

Infants have a greater need for calcium than most adults. The absorption of calcium from artificial feeds can pose problems and the calcium/phosphorus ratio may be of importance (Widdowson, 1965). In breast fed infants,however, a supplement of phosphates did not hinder absorption (Widdowson et al, 1963).

Results: Cross Section.

TABLE LXXXIV.

Mean Calcium Intake (mg). Cross Section.

Age	No. of Diets	Rec.Intake[1]	Calcium	S.D.
6 weeks	113	600	532	202
3 months	152	600	802	338
6 months	112	600	866	339
9 months	116	600	829	323
12 months	106	600	820	337

1 : DHSS (1979)

Table LXXXIV shows there was an increased intake of calcium between 6 weeks and 3 months. Thereafter, the level remained fairly steady, though with a slight peak at 6 months. The standard deviation remained steady from 3 to 12 months.

Table LXXXV shows the low intake of calcium among Glasgow children at 9 months in comparison with other survey results. The 12 month group had a higher intake than the comparable DHSS group.

TABLE LXXXV.

A Comparison of Calcium Intake with Other Survey Results.

Age	Survey	No. of Diets	Calcium (mg)
6-12 months	Bransby & Fothergill (1954)	150	970
8 months	Black et al (1976)	44	974
9 months	This survey	116	829
6-18 months	DHSS (1975)	201	771
12 months	This survey	106	820

Table LXXXVI demonstrates that socio-economic group V had the highest intake of calcium throughout the year, while groups I and II tended to have the lowest.

TABLE LXXXVI.

Mean Intake of Calcium (mg) Related to Socio-Economic Group. No. of Diets in Parenthesis.

Age	Socio-economic Groups				
	I and II	III	IV	V	-
6 weeks	451 (14)	548 (57)	486 (18)	585 (23)	359 (1)
3 months	678 (21)	806 (70)	782 (22)	848 (37)	1262 (2)
6 months	863 (17)	762 (49)	910 (22)	1042 (23)	1071 (1)
9 months	703 (16)	803 (57)	829 (21)	1016 (18)	842 (4)
12 months	690 (14)	804 (58)	876 (15)	936 (18)	633 (1)

Results: Longitudinal Section.

TABLE LXXXVII.

Mean Intake of Calcium (mg). Cross Section and Longitudinal Section. No. of Diets in Parenthesis.

Age	Rec. Intake[1]	Cross Section	Blackhill	Carntyne
3 months	600	802 (152)	985 (206)	898 (192)
6 months	600	866 (112)	1121 (132)	913 (141)
9 months	600	829 (116)	1111 (121)	832 (131)
12 months	600	820 (106)	1008 (88)	841 (100)

1 : Recommended Intake (DHSS, 1979).

Both Blackhill and Carntyne had mean intakes of calcium greater than that of the cross section. That of Blackhill was considerably greater throughout the year. Table LXXXVIII expresses the longitudinal intakes as percentages of those of the cross section.

TABLE LXXXVIII.

Mean Calcium Intakes of the Longitudinal Section Expressed as Percentages of the Cross Section.

Age	Blackhill	Carntyne
3 months	122.8	112.0
6 months	129.5	105.4
9 months	134.0	100.4
12 months	122.9	102.6

TABLE LXXXIX.

Calcium Intake (mg): 10th, 50th and 90th Centiles.

Age	Centile	Cross Section	Blackhill	Carntyne
6 weeks	10	339	407	528
	50	500	820	765
	90	720	1227	1050
3 months	10	430	575	652
	50	709	1094	909
	90	1257	1448	1364
6 months	10	460	749	572
	50	789	1101	934
	90	1344	1711	1267
9 months	10	510	534	466
	50	798	1111	810
	90	1341	1629	1065
12 months	10	438	468	515
	50	790	855	808
	90	1261	1595	1154

In Blackhill infants, the 10th, 50th and 90th centiles were all above those of the cross section, with the greatest differences occurring between the 50th centiles and 90th centiles. (Table LXXXIX). Most of the centiles of the Carntyne infants were greater than in the cross section but from 6 months onwards, the 90th centile was lower.

Table XC demonstrates that throughout the year, more children in both Blackhill and Carntyne received the recommended intake of calcium, compared with the cross section.

TABLE XC.

Centile Positions of the Recommended Intake of Calcium (DHSS,1979).

Age	Cross Section	Blackhill	Carntyne
3 months	37.5	12.2	6.0
6 months	24.3	0.0	11.6
9 months	22.6	13.5	24.4
12 months	31.1	16.7	16.3

(vi) Iron.

The body of a healthy adult contains about 4g iron, of which over half is present in haemoglobin. Iron is an essential component in oxygen transfer.

Absorption of iron is increased by an increased dietary intake of ascorbic acid.

Infants store iron in the liver during the last month of pregnancy. Pre-term infants are thus at risk from iron deficiency (Mackeith & Wood, 1977). Most artificial milks are fortified with iron and breast fed infants may require a complement until mixed feeding is well established.

Results: Cross Section.

TABLE XCI.

Mean Iron Intake (mg). Cross Section.

Age	No. of Diets	Rec. Intake[1]	Iron	S.D.
6 weeks	113	6.0	10.2	2.7
3 months	152	6.0	10.4	4.0
6 months	112	6.0	11.0	4.6
9 months	116	6.0	9.9	8.7
12 months	106	6.0	7.4	3.8

1 : Recommended Intake (DHSS, 1979).

Table XCI shows that the intake of iron for the cross section infants increased to a peak at 6 months and, thereafter, dropped to below the 6 week level, by 12 months. The standard deviation was greatest at 9 months.

Table XCII shows the relatively high intake or iron by Glasgow children at 9 months.

TABLE XCII.

A Comparison of Iron Intake with Other Survey Results.

Age	Survey	No.of Diets	Iron (mg)
6-12 months	Bransby & Fothergill (1954)	150	6.7
8 months	Black et al (1976)	44	8.8
9 months	This survey	116	9.9
6-18 months	DHSS (1975)	201	7.6
12 months	This survey	106	7.4

There was a fairly small range of iron intakes amongst the different socio-economic groups with no consistent pattern. (Table XCIII).

TABLE XCIII.

Mean Iron Intake (mg) Related to Socio-Economic Group. No. of Diets in Parenthesis.

Age	Socio-economic Groups. I and II	III	IV	V	-
6 weeks	10.4 (14)	9.7 (57)	11.0 (18)	10.8 (23)	10.1 (1)
3 months	9.1 (21)	10.7 (70)	10.1 (22)	10.6 (37)	13.0 (2)
6 months	10.5 (17)	11.4 (49)	10.8 (22)	10.6 (23)	8.0 (1)
9 months	10.9 (16)	9.3 (57)	9:3 (21)	12.1 (18)	9.0 (4)
12 months	5.9 (14)	9.3 (16)	8.7 (15)	7.7 (18)	3.8 (1)

Results: Longitudinal Section.

TABLE XCIV.

Mean Iron Intake (mg). Cross Section and Longitudinal Section. No. of Diets in Parenthesis.

Age	Rec.Intake[1]	Cross Section	Blackhill	Carntyne
3 months	6.0	10.4 (152)	9.5 (206)	7.4 (192)
6 months	6.0	11.0 (112)	14.7 (132)	10.2 (141)
9 months	6.0	9.9 (116)	15.1 (121)	8.7 (131)
12 months	6.0	7.4 (106)	10.1 (88)	7.4 (100)

1 : Recommended Intake (DHSS, 1979).

In Blackhill infants, the mean iron intake was greater than in the cross section, except at 3 months when it was lower. In Carntyne infants, the mean iron intake was less than in the cross section, except at 12 months when it was the same. The longitudinal results are expressed as percentages of those of the cross section in Table XCV.

TABLE XCV.

Mean Iron Intake of the Longitudinal Section Expressed as Percentages of the Cross Section.

Age	Blackhill	Carntyne
3 months	91.4	71.2
6 months	133.6	92.7
9 months	152.5	87.9
12 months	136.5	100.0

TABLE XCVI.

Iron Intake (mg): 10th, 50th and 90th Centiles.

Age	Centile	Cross Section	Blackhill	Carntyne
6 weeks	10	6.5	2.3	2.4
	50	10.1	6.5	4.2
	90	13.5	11.9	9.9
3 months	10	4.5	4.0	3.8
	50	10.5	11.4	7.8
	90	15.5	20.8	14.2
6 months	10	5.1	4.9	5.6
	50	11.0	15.1	10.7
	90	16.1	27.4	14.8
9 months	10	4.0	4.2	3.1
	50	8.5	14.3	9.7
	90	16.3	30.7	13.6
12 months	10	3.4	3.9	3.2
	50	6.3	7.1	6.4
	90	12.0	19.2	13.2

In Blackhill infants, from 3 months onwards, the 10th centile was similar to that of the cross section but both 50th and 90th centiles were greater. (Table XCVI). In all Carntyne infants, all three centiles tended to be slightly lower than in the cross section, especially at 6 weeks.

Table XCVII shows how the number of children failing to receive the recommended intake of iron increased with age and also the low intake by Carntyne infants at 3 months, compared with the cross section and Blackhill infants.

TABLE XCVII.

Centile Positions of the Recommended Intakes of Iron (DHSS, 1979).

Age	Cross Section	Blackhill	Carntyne
3 months	15.1	16.3	35.0
6 months	16.2	14.0	9.3
9 months	30.0	17.6	22.0
12 months	43.4	34.7	46.5

By contrast, Goel (1979) found only 5 per cent of Glasgow children received less than the recommended intake of iron.

(vii) Phosphorus, Sodium and Potassium.

Other minerals, essential for the body's growth, maintenance and metabolism, include phosphorus, potassium, sodium, magnesium, chloride and sulphur, together with various trace elements. Deficiencies are rarely found in adult man. The dietary intakes of the first three of these minerals have been calculated.

The quantity of phosphorus in an infant's diet is of importance. Cow's milk contains more phosphorus than human milk. High blood-phosphate acts on the parathyroid glands and induces a relative hypoparathyroidism and hence, a low blood level of calcium. Small infants given cow's milk may develop hypocalcaemic tetany. If the infant also has a high fat intake, unabsorbed fat may retain calcium in the bowel and prevent its absorption (MacKeith & Wood, 1977).

Dehydration is a common and dangerous feature of many infantile illnesses. The dietary intake of both sodium and potassium are of importance in maintaining appropriate water/electrolyte balance and an excess of either mineral can be harmful.

Table XCVIII gives the mean intakes of phosphorus, sodium and potassium. It should be noted that no account was taken in dietary assessment of any salt added to food.

TABLE XCVIII.

Mean Phosphorus, Sodium and Potassium Intakes (mg).
Cross Section (X-S), Blackhill (B) and Carntyne (C).

	P			Na			K		
Age	X-S	B	C	X-S	B	C	X-S	B	C
3 months	607	754	665	450	542	492	1029	1228	1223
6 months	714	899	735	692	896	749	1304	1545	1367
9 months	778	988	796	1034	1267	1164	1454	1836	1484
12 months	825	999	862	1186	1608	1478	1646	2036	1674

In Blackhill infants, the mean intakes of all minerals was greater than in the cross section, averaging 120-130 per cent.

In Carntyne infants, the phosphorus and potassium intakes were similar to, although always greater than, the cross sectional.

(viii) Vitamin A.

The official chemical name of vitamin A is retinol. It is found only in foods of animal origin. Animals obtain the vitamin from carotenes of which there are several in plants, B - carotene being of most importance. As most diets contain both carotene and retinol, the term 'retinol equivalents' is used when referring to the vitamin content. One retinol equivalent = 1 µg retinol or 6 µg B - carotene or 12 µg other biologically active carotenoids.

Deficiencies of retinol affect skin and vision, host resistance to infection and may play a part in teratogenesis (Smithells et al, 1976). Excessive intakes in infancy produce the condition of hypercaroteneaemia.

Results: Cross Section.

TABLE IC.

Mean Intake of Vitamin A (Retinol Equivalents). Cross Section.

Age	No. of Diets	Rec. Intake[1]	Vitamin A (Retinol Equivalents µg)	S.D.
6 weeks	113	450	813	231
3 months	152	450	965	368
6 months	112	450	943	477
9 months	116	450	873	604
12 months	106	450	896	804

1 : Recommended Intake (DHSS, 1979)

The mean vitamin A intake increased to a maximum at 3 months and, thereafter, dropped slightly. The standard deviation increased steadily throughout the year and, at 12 months, was 90 per cent of the mean.

TABLE C.

A Comparison of Vitamin A with Other Survey Results.

Age	Survey	No.of Diets	Vitamin A (µg Retinol Equivalent)
6-12 months	Bransby & Fothergill (1954)	150	650
8 months	Black et al (1976)	44	1080
9 months	This survey	116	873
6-18 months	DHSS (1975)	201	830
12 months	This survey	106	896

The mean vitamin A intake was less than that found by Black et al (1976) and greater than that found by Bransby & Fothergill (1954). (Table C).

When vitamin A intake was related to socio-economic group, no consistent pattern emerged. Groups I and II had the highest intake at 6 and 9 months but the lowest intake at 12 months. (Table CI).

TABLE CI.

Mean Intake of Vitamin A (µg Retinol Equivalents) Related to Socio-Economic Group. No. of Diets in Parenthesis.

Age	Socio-economic Groups. I and II	III	IV	V	-
6 weeks	778 (14)	827 (57)	803 (18)	837 (23)	635 (1)
3 months	973 (21)	964 (70)	961 (22)	948 (37)	1295 (2)
6 months	1099 (17)	971 (49)	944 (22)	734 (23)	1633 (1)
9 months	1068 (16)	921 (57)	783 (21)	701 (18)	650 (4)
12 months	731 (14)	935 (58)	730 (15)	1056 (18)	479 (1)

Results: Longitudinal Section.

TABLE CII.

Mean Intake of Vitamin A (μg Retinol Equivalents). No. of Diets in Parenthesis.

Age	Rec. Intake[1]	Cross Section	Blackhill	Carntyne
3 months	450	965 (152)	941 (206)	823 (192)
6 months	450	943 (112)	1002 (132)	992 (141)
9 months	450	873 (116)	686 (121)	1404 (131)
12 months	450	896 (106)	533 (88)	1424 (100)

1 : Recommended Intake (DHSS, 1979).

In Blackhill infants, the mean intake of vitamin A was at a maximum at 6 months, when it was slightly greater than that of the cross section. The intake dropped at 9 months and again at 12 months, when it was 60 per cent of the cross section intake. In Carntyne infants, the mean intake increased throughout the year from 85 per cent of that of the cross section at 3 months to 159 per cent at 12 months. (Tables CII and CIII).

TABLE CIII.

Mean Intake of Vitamin A of the Longitudinal Section Expressed as Percentage of the Cross Section.

Age	Blackhill	Carntyne
3 months	97.5	85.3
6 months	106.3	105.2
9 months	78.6	160.8
12 months	59.5	158.9

TABLE CIV.

Vitamin A Intake (μg Retinol Equivalents): 10th, 50th and 90th Centiles.

Age	Centile	Cross Section	Blackhill	Carntyne
6 weeks	10	570	334	334
	50	774	835	739
	90	1062	1249	1083
3 months	10	508	455	414
	50	926	1058	841
	90	1430	1554	1214
6 months	10	441	255	462
	50	837	1032	857
	90	1535	1727	2353
9 months	10	392	278	194
	50	728	538	893
	90	1341	1065	3172
12 months	10	314	180	273
	50	667	359	622
	90	1567	1033	1722

In Blackhill infants, the range of intakes from 10th to 90 th centiles was greater than the cross section until 6 months. At 9 and 12 months, the range was less, as were all centile levels. In Carntyne infants, the main difference in comparison with the cross section distribution of intakes, was that from 6 months onwards, the 90th centile was greater. (Table CIV).

Table CV shows that the number of children who received less than the recommended intake of vitamin A increased with age in the cross section. There was a much greater increase in Blackhill, rising to over 60 per cent at 12 months. The level in Carntyne remained fairly steady.

TABLE CV.

Centile Positions of the Recommended Intake of Vitamin A (DHSS, 1979).

Age	Cross Section	Blackhill	Carntyne
3 months	7.9	8.2	20.0
6 months	10.8	20.9	7.0
9 months	13.9	35.1	22.0
12 months	26.4	63.9	24.4

(ix) Vitamin D.

The natural form of vitamin D is cholecalciferol. It is produced by ultraviolet irradiation of 7 - dehydrocholesterol which is present in the oily secretions of mammalian skin. This synthesis provides sufficient vitamin for many people but infants require a dietary source, as do children and adolescents in winter and the housebound. Cholecalciferol is converted in the liver and then in kidney, by hydroxylation, to the active vitamin D hormone 1,25 - dihydroxycholecalciferol, which promotes absorption of calcium and phosphorus. It is required for the formation of normal bone.

Results: Cross Section.

TABLE CVI.

Mean Intake of Vitamin D (µg Cholecalciferol). Cross Section.

Age	No. of Diets	Rec.Intake[1]	Vitamin D	S.D.
6 weeks	113	7.5	11.1	3.2
3 months	152	7.5	15.2	5.0
6 months	112	7.5	15.5	6.8
9 months	116	7.5	11.5	6.8
12 months	106	7.5	9.7	6.5

1 : Recommended Intake (DHSS, 1979).

The mean intake increased to a maximum at 6 months and, thereafter, dropped steadily.

A comparison with two other surveys in Table CVII shows a relatively high intake of vitamin D in Glasgow.

TABLE CVII.

A Comparison of Intake of Vitamin D with Other Survey Results.

Age	Survey	No. of Diets	Vitamin D (µg Calciferol)
8 months	Black et al (1976)	44	9.2
9 months	This survey	116	11.5
6-18 months	DHSS (1975)	201	5.4
12 months	This survey	106	9.7

When the intake of vitamin D was analysed with regard to socio-economic group, the distribution of mean intakes was found to be fairly small at 6 weeks and 3 months. By 6 months, it was slightly increased and at 6, 9 and 12 months, socio-economic groups I and II had the highest intake. (Table CVII).

TABLE CVIII.

Mean Intake of Vitamin D (µg Cholecalciferol) by Social Class. No. of Diets in Parenthesis.

Age	Socio-economic Groups. I and II	III	IV	V	-
6 weeks	10.9 (14)	10.4 (57)	11.1 (18)	11.6 (23)	8.5 (1)
3 months	14.9 (21)	15.3 (70)	15.2 (22)	14.8 (37)	24.1 (2)
6 months	16.8 (17)	15.5 (49)	15.8 (22)	14.8 (23)	7.4 (1)
9 months	14.2 (16)	11.0 (57)	11.7 (21)	9.9 (18)	13.6 (4)
12 months	11.7 (14)	9.1 (58)	9.2 (15)	10.3 (18)	11.4 (1)

Results: Longitudinal Section.

TABLE CIX.

Mean Intake of Vitamin D (µg Cholecalciferol).
Cross Section and Longitudinal Section.
No. of Diets in Parenthesis.

Age	Rec.Intake[1]	Cross Section	Blackhill	Carntyne
3 months	7.5	15.2 (152)	13.1 (206)	14.5 (192)
6 months	7.5	15.5 (112)	15.7 (132)	17.1 (141)
9 months	7.5	11.5 (116)	10.9 (121)	12.0 (131)
12 months	7.5	9.7 (106)	5.0 (88)	7.7 (100)

1 : Recommended Intake (DHSS, 1979).

In Blackhill infants, the intake of vitamin D was less than that of the cross section at 3 months and similar at 6 months, when it was at a maximum. It decreased at 9 months and again at 12 months, to be 52 per cent of the cross section.

In Carntyne infants, the maximum intake of vitamin D was found also at 6 months, mean values being similar to those of the cross section at 3, 6 and 9 months. At 12 months, the intake was 79 per cent that of the cross section infants. (Tables CIX and CX).

TABLE CX.

Mean Vitamin D Intakes of the Longitudinal Section Expressed as Percentages of the Cross Section.

Age	Blackhill	Carntyne
3 months	86.2	95.4
6 months	101.3	110.3
9 months	94.8	104.4
12 months	51.6	79.4

Table CXI gives the 10th, 50th and 90th centiles of vitamin D intake. In Blackhill infants, the distribution of intakes was similar to that of the cross section until 9 months. At 12 months, all three centiles were well below those of the cross section. In Carntyne infants, until 9 months, the range of intakes tended to be greater than those of the cross section but with a similar level for the 50th centile. At 12 months, all centiles were below those of the cross section.

TABLE CXI.

Vitamin D Intake (μg Cholecalciferol): 10th, 50th and 90th Centiles.

Age	Centile	Cross Section	Blackhill	Carntyne
6 weeks	10	7.7	4.3	6.2
	50	10.5	9.2	9.6
	90	14.4	13.6	17.3
3 months	10	9.4	8.8	9.2
	50	14.7	15.3	15.3
	90	22.7	21.4	24.3
6 months	10	5.6	7.1	9.5
	50	15.6	15.3	18.6
	90	23.9	29.0	25.6
9 months	10	2.3	1.3	1.3
	50	11.3	12.0	12.4
	90	20.0	20.8	20.3
12 months	10	1.1	0.2	0.1
	50	10.2	2.2	5.2
	90	18.0	10.6	15.9

TABLE CXII.

Centile Positions of the Recommended Intake of Vitamin D (DHSS,1979).

Age	Cross Section	Blackhill	Carntyne
3 months	2.6	6.1	4.0
6 months	14.4	11.6	4.7
9 months	31.3	35.1	29.3
12 months	38.7	69.4	51.2

There was an increase, with age, in the number of children failing to receive the recommended allowance of vitamin D, in all three groups. In both Blackhill and Carntyne, the level was over 50 per cent at 12 months. Blackhill was highest at nearly 70 per cent.

In contrast, Goel (1979) found only 5 per cent of Glasgow children aged 0 - 12 months received an intake of less than the recommended 10µg cholecalciferol.

(x) Ascorbic Acid.

Ascorbic acid, or vitamin C, is required for the formation of the intercellular matrix which binds the cells of the connective tissue, capillaries, bones and teeth. It is easily oxidised and cooked sources are thus susceptible to loss. There is little ascorbic acid in dried milk products and a complement is required from the age of 1 month.

Results: Cross Section.

TABLE CXIII.

Mean Ascorbic Acid Intake (mg). Cross Section.

Age	No. of Diets	Rec. Intake[1]	Ascorbic Acid	S.D.
6 weeks	113	20	60.3	17.4
3 months	152	20	74.0	28.6
6 months	112	20	80.6	50.4
9 months	116	20	65.7	62.5
12 months	106	20	73.1	80.1

1 : Recommended Intake (DHSS, 1979).

The mean intake increased to a maximum at 6 months, decreased at 9 months and increased again at 12 months. The standard deviation increased throughout the year and at 12 months, was 110 per cent of the mean.

Table CXIV compares the results with three other surveys and shows a very high intake of ascorbic acid in Glasgow.

TABLE CXIV.

A Comparison of Ascorbic Acid Intake with Other Survey Results.

Age	Survey	No.of Diets	Ascorbic Acid (mg)
6-12 months	Bransby & Fothergill (1954)	150	14
8 months	Black et al (1976)	44	43.9
9 months	This survey	116	65.7
6-18 months	DHSS (1975)	201	47
12 months	This survey	106	73.1

Table CXV gives the mean intake of ascorbic acid related to socio-economic group and shows that there was little difference between the groups until after 6 months. At 9 and 12 months, groups I and II had the highest intake and group IV was consistently lower. All means were well above the DHSS (1979) recommendations.

TABLE CXV.

Mean Intake of Ascorbic Acid (mg) Related to Socio-Economic Group. No. of Diets in Parenthesis.

Age	Socio-economic Groups. I and II	III	IV	V	-
6 weeks	61.0 (14)	58.3 (57)	64.9 (18)	62.2 (23)	47.1 (1)
3 months	79.6 (21)	73.0 (70)	77.0 (22)	69.8 (37)	92.6 (2)
6 months	73.8 (17)	82.8 (49)	88.3 (22)	74.0 (23)	67.8 (1)
9 months	77.8 (16)	73.3 (57)	57.0 (21)	41.3 (18)	64.6 (4)
12 months	92.5 (14)	71.1 (58)	48.1 (15)	87.5 (18)	36.3 (1)

Results: Longitudinal Section.

TABLE CXVI.

Mean Intake of Ascorbic Acid (mg). No. of Diets in Parenthesis.

Age	Rec.Intake[1]	Cross Section	Blackhill	Carntyne
3 months	20	74.0 (152)	46.3 (206)	63.2 (192)
6 months	20	80.6 (112)	49.1 (132)	85.4 (141)
9 months	20	65.7 (116)	37.5 (121)	75.3 (131)
12 months	20	73.1 (106)	30.1 (88)	80.4 (100)

1 : Recommended Intake (DHSS, 1979).

In Blackhill infants, the intake of ascorbic acid was consistently well below that of the cross section. It fell from 63 per cent of the cross sectional level at 3 months to 41 per cent at 12 months. In Carntyne infants, the intake of ascorbic acid fluctuated with age and was maximal at 6 months. With the exception of the 3 month group, it was above the level of the cross section. (Tables CXVI and CXVII).

TABLE CXVII.

Mean Ascorbic Acid Intake of the Longitudinal Section Expressed as Percentages of the Cross Section.

Age	Blackhill	Carntyne
3 months	62.6	85.4
6 months	60.9	106.0
9 months	57.1	114.0
12 months	41.2	110.0

TABLE CXVIII.

Ascorbic Acid Intake (mg): 10th, 50th and 90th Centiles.

Age	Centile	Cross Section	Blackhill	Carntyne
6 weeks	10	37.5	15.7	19.6
	50	59.2	35.1	34.5
	90	82.1	53.0	77.7
3 months	10	40.2	25.1	36.0
	50	69.6	48.4	67.8
	90	114.6	81.7	115.3
6 months	10	29.1	12.8	41.4
	50	72.0	38.2	86.2
	90	130.2	78.7	148.6
9 months	10	20.0	11.1	25.6
	50	58.3	23.5	67.2
	90	105.4	59.6	150.0
12 months	10	14.7	5.8	12.1
	50	52.2	21.8	54.3
	90	114.3	64.8	213.2

In Blackhill infants, all centiles were well below those of the cross section throughout the year. In Carntyne, at 6 weeks and 3 months, the centiles were below those of the cross section. From 6 months onwards, the centiles were greater, with the largest difference noted at the 90th centile. (Table CXVIII).

The numbers of those receiving the recommended allowance of ascorbic acid were similar in the cross section and Carntyne. In Blackhill, more failed to receive the recommended intake, although the level was always well below 50 per cent. (Table CXIX).

TABLE CXIX.

Centile Positions of the Recommended Intake of Ascorbic Acid (DHSS, 1979).

Age	Cross Section	Blackhill	Carntyne
3 months	1.3	6.1	0.0
6 months	5.4	20.9	0.0
9 months	10.0	37.8	7.3
12 months	15.6	33.3	23.3

Water.

Water accounts for half to three quarters of body weight, depending on age and body fat and, as such, is the most abundant body constituent. Deficits or excesses of more than a few per cent cause discomfort and large deficits may lead to death. Infants are especially vulnerable to water loss because of their high body water content and the greater percentage involved in obligatory daily turnover.

Results:

TABLE CXX.

Mean Water Intake (kg). No.of Diets in Parenthesis.

Age	Cross Section	Blackhill	Carntyne
3 months	0.89 (152)	0.86 (206)	0.88 (192)
6 months	0.90 (112)	0.97 (132)	0.92 (141)
9 months	0.91 (116)	1.01 (121)	0.88 (131)
12 months	0.90 (106)	1.01 (88)	0.92 (100)

Mean water intake increased very slightly with age. There was little difference between groups but Blackhill infants tended to have the highest intake. The DHSS (1979) recommendations do not include water. However, the National Research Council of the United States (1974) recommend an intake of 1.5g/Kcal for infants and 1.0g/Kcal for adults. Table CXXI expresses the results thus. Only at 6 weeks and, in the case of Carntyne at 3 months, were the mean intakes equal to the U.S. recommended intake for infants. In all three groups, the intakes decreased with age and by 12 months all were below the recommended adult intake, Blackhill having the lowest intake per Kcal.

TABLE CXXI.

Mean Water Intake (g/Kcal).

Age	Cross Section	Blackhill	Carntyne
6 weeks	1.5	1.6	1.6
3 months	1.4	1.3	1.5
6 months	1.2	1.1	1.3
9 months	1.0	0.9	1.0
12 months	0.9	0.8	0.9

The 10th, 50th and 90th centiles of water intake are given in Table CXXII. They show similar intakes amongst the groups, with Blackhill infants having the highest intake values.

TABLE CXXII.

Intake of Water (kg): 10th, 50th and 90th Centiles.

Age	Centile	Cross Section	Blackhill	Carntyne
6 weeks	10	0.63	0.48	0.57
	50	0.85	0.74	0.77
	90	1.06	1.03	1.04
3 months	10	0.68	0.61	0.71
	50	0.91	0.90	0.91
	90	1.14	1.21	1.13
6 months	10	0.63	0.64	0.62
	50	0.88	1.00	0.98
	90	1.13	1.35	1.22
9 months	10	0.60	0.66	0.51
	50	0.92	0.99	0.86
	90	1.19	1.37	1.07
12 months	10	0.61	0.59	0.68
	50	0.87	0.93	0.92
	90	1.23	1.62	1.12

(b) Food Groups.

"It is of course foods that people do eat - not nutrients" (Greaves & Berry, 1974). The diets were analysed to show the contribution made by various types of food to the total energy intake.

Table CXXIII gives the results of the cross section diets. A comparison can be made between the cross section 9 month group and the 8 month group of Black et al (1976). There were three main differences:

(i) Glasgow children had a slightly lower intake of dried milk products.

(ii) Glasgow children had a higher intake of 'adult foods' - eggs, meat, vegetables, etc.

(iii) Glasgow children had a lower intake of preserves and sugar.

The first two differences are most probably linked due to the slightly older age of the Glasgow children. The third finding may be due to the addition of sugar to dried milk preparations, as the Newcastle study was conducted before the change to modified milks was instituted nationally.

TABLE CXXIII.

Percentage Total Energy Intake Derived from Various Food Groups. Cross Section.

	3 months	6 months	9 months	12 months
Baby Foods	9.7	22.8	23.7	16.2
Dried Milk	84.4	54.0	22.9	8.6
Milk, Yoghurt, Cream	1.7	8.3	19.5	24.7
Egg, Cheese Dishes	0.5	3.0	5.8	7.4
Bread, Crackers, Pasta	0.2	0.4	2.8	4.5
Meat, Fish	-	1.5	6.2	8.7
Potatoes	-	1.9	5.5	7.5
Vegetables, Fruit, Nuts	-	0.7	1.5	2.5
Fats	0.2	0.5	1.6	4.1
Preserves, Sweets	3.2	2.5	2.9	4.6
Sauces, Soups, Drinks	0.1	1.2	3.2	4.6
Cakes, Biscuits, Puddings	-	2.3	4.4	6.5
Vitamin, Syrup, Supplements	0.1	0.1	-	0.1
No. of Diets	152	112	116	106

The contribution of various food groups to total energy intake related to socio-economic group is given in Table CXXIV.

Four points emerged:

(i) There was a tendency for socio-economic group V to withdraw dried milk and give commercial baby foods, followed by 'adult food' at an earlier age than other groups.

(ii) Group V received a higher proportion of 'protein foods', i.e. meat, fish, cheese and eggs.

(iii) Groups I and II had the highest intake of vegetables, fruit and nuts.

(iv) Groups I and II had the lowest intake of sweet food.

TABLE CXXIV.

Percentage of Total Energy Intake Contributed by Various Food Groups, Related to Social Status.

Food Group	6 weeks				3 months				6 months				9 months				12 months			
	I & II	III	IV	V	I & II	III	IV	V	I & II	III	IV	V	I & II	III	IV	V	I & II	III	IV	V
Baby Foods	1.3	1.1	0.6	1.0	6.6	9.9	7.1	12.5	25.0	25.0	22.8	16.4	27.6	23.0	26.1	19.4	14.2	16.2	18.7	15.8
Dried Milk	98.7	97.8	99.4	97.4	89.9	83.5	88.2	80.9	56.2	56.6	59.1	44.2	30.5	20.6	22.4	21.5	6.8	9.5	11.0	5.8
Milk, Yoghurt, Cream	-	-	-	-	-	1.9	0.9	3.0	8.3	5.1	7.4	13.6	14.2	18.0	22.5	25.0	25.9	24.3	24.1	25.3
Egg, Cheese Dishes	-	-	-	-	0.1	0.8	-	-	2.6	3.4	2.6	2.7	5.2	5.5	5.7	8.3	8.0	5.0	6.6	15.0
Bread, Crackers, Pasta	-	-	-	-	-	0.3	0.3	-	-	0.5	0.1	0.7	2.8	2.5	3.2	3.8	6.5	4.1	4.5	4.2
Meat, Fish	-	-	-	-	-	-	-	-	0.1	1.4	0.7	3.6	4.2	7.5	4.2	6.2	11.0	8.8	6.6	7.9
Potatoes	-	-	-	-	-	-	-	0.1	0.1	1.9	1.9	2.8	3.3	6.0	3.5	7.3	5.9	8.4	5.7	7.7
Vegetables, Fruit, Nuts	-	-	-	-	-	-	-	-	2.3	0.5	0.3	0.2	3.4	1.5	1.2	0.3	4.3	2.3	2.2	1.6
Fats	-	-	-	-	-	0.1	-	0.6	-	0.9	-	0.4	1.8	2.1	0.9	1.2	6.3	3.1	4.5	5.0
Preserves, Sweets	-	1.0	-	1.6	2.0	3.5	3.4	2.8	2.0	2.1	3.1	3.2	1.7	3.4	3.0	2.5	2.3	5.0	6.4	3.8
Sauces, Soups, Drinks	-	-	-	-	-	0.1	-	0.2	1.2	1.1	0.4	2.2	1.4	4.3	3.2	1.8	3.6	5.2	6.3	1.8
Cakes, Biscuits, Puddings	-	-	-	-	-	0.1	-	-	0.2	1.4	1.6	5.7	4.0	5.5	4.1	2.7	5.1	8.0	3.4	5.9
Vitamin, Syrup, Supplements	-	0.04	-	-	0.01	0.03	0.08	-	0.01	0.09	0.08	0.06	-	0.02	-	-	-	0.22	-	-
No. of Diets	14	57	18	23	21	70	22	37	17	49	22	23	16	57	21	18	14	58	15	18

A further breakdown of the socio-economic groups into employed and unemployed was made. Only socio-economic group V had sufficient numbers of unemployed to validate comparison. The results are given in Table CXXV.

When compared with the employed, the unemployed had, throughout the age groups, less commercial baby food and more dried milk. They had less meat and fish and more cakes, biscuits and puddings. At 12 months, they had nearly double the amount of egg and cheese, less bread or crackers and less fat.

TABLE CXXV.

Percentage Total Energy Intake Derived From Various Food Groups. A Comparison Between Employed (E) and Unemployed (U.E.) Socio-Economic Group V.

	3 months		6 months		9 months		12 months	
	E.	U.E.	E.	U.E.	E.	U.E.	E.	U.E.
No. of Diets	29	8	14	9	13	5	10	8
Baby Foods	13.3	9.4	16.3	16.7	17.1	12.7	16.1	15.6
Dried Milk	79.5	86.2	39.6	52.0	21.7	20.8	3.4	8.7
Milk, Yoghurt, Cream	2.9	3.2	12.6	15.4	26.1	21.6	28.8	21.5
Egg, Cheese Dishes	-	-	2.1	3.8	9.0	6.1	10.7	20.3
Bread, Crackers, Pasta	-	-	1.0	0.3	3.2	5.5	6.1	1.9
Meat, Fish	-	-	5.7	-	5.8	7.4	8.9	6.7
Potatoes	0.1	-	4.5	-	6.2	10.7	8.1	7.2
Vegetables, Fruit, Nuts	-	-	0.3	-	0.2	0.8	2.0	1.1
Fats	0.8	-	0.7	-	1.0	1.8	7.5	3.1
Preserves, Sweets	3.3	1.0	3.4	2.8	1.6	5.4	4.4	3.1
Sauces, Soups, Drinks	0.1	0.3	3.1	0.7	2.2	0.4	1.6	1.8
Cakes, Biscuits, Puddings	-	-	4.2	8.2	1.3	6.9	2.3	10.3
Vitamin, Syrup, Supplements	-	-	-	0.1	-	-	-	-
No. of Diets	29	8	14	9	13	5	10	8

Results: Longitudinal Section.

Table CXXVI gives the percentage of total energy intake derived from various food groups for the three areas.

In Blackhill infants, compared with the cross sectional infants, there was an earlier introduction and withdrawal of commercial baby food and an earlier withdrawal of dried milk. More milk, yoghurt and cream were taken throughout the year. More energy was derived from potato products, preserves and sweets, cakes, biscuits and puddings, while there was less from fruit, vegetables and vitamin supplements.

In Carntyne infants, the food pattern was similar to that of the cross section. Two differences were a lower intake of dried milk and a higher intake of vitamin supplements and syrups. There was also a slightly higher intake of cakes, biscuits and puddings.

It is perhaps of interest to note that the percentage of total fat in the diet, contributed by potato products at 12 months, was 5.5 per cent in the cross section, 5.7 per cent in Carntyne and 9.5 per cent in Blackhill.

TABLE CXXVI.

Percentage Total Energy Intake Derived From Various Food Groups. Cross Section and Longitudinal Section.

Food Group	3 months			6 months			9 months			12 months		
	Cross Section	Blackhill	Carntyne	Cross Section	Blackhill	Carntyne	Cross Section	Blackhill	Carntyne	Cross Section	Blackhill	Carntyne
Baby Foods	9.7	11.0	7.6	22.8	23.7	27.0	23.7	20.0	22.9	16.2	12.6	17.4
Dried Milk	84.4	76.2	82.9	54.0	40.0	48.1	22.9	14.7	18.1	8.6	5.2	4.9
Milk, Yoghurt, Cream	1.7	5.4	2.1	8.3	15.1	7.I	19.5	24.6	18.8	24.7	26.7	25.7
Egg, Cheese Dishes	0.5	0.8	0.1	3.0	2.6	3.2	5.8	5.1	5.7	7.4	6.3	6.2
Bread, Crackers, Pasta	0.2	0.6	0.1	0.4	1.2	0.9	2.8	3.2	2.9	4.5	4.5	4.8
Meat, Fish	-	0.1	0.1	1.5	2.5	2.0	6.2	6.2	7.2	8.7	7.2	9.3
Potatoes	-	0.7	0.1	1.9	3.5	1.5	5.5	7.0	5.9	7.5	11.0	8.1
Vegetables, Fruit, Nuts	-	-	-	0.7	0.2	0.6	1.5	0.6	1.5	2.5	0.8	2.0
Fats	0.2	0.1	-	0.5	1.1	0.9	1.6	2.1	3.1	4.1	3.7	4.4
Preserves, Sweets	3.2	4.7	5.7	2.5	5.4	4.0	2.9	6.1	3.1	4.6	7.3	4.5
Sauces, Soups, Drinks	0.1	0.1	0.1	1.2	1.4	1.7	3.2	0.2	2.9	4.6	4.1	4.5
Cakes, Biscuits, Puddings	-	0.3	0.1	2.3	3.4	2.8	4.4	7.3	7.6	6.5	9.6	8.2
Vitamin, Syrup, Supplements	0.1	-	0.3	0.1	-	0.3	-	-	0.3	0.1	-	0.3
No. of Diets	152	206	192	112	132	141	116	121	131	106	88	100

(c) Discussion.

The energy intake of the Glasgow cross section children was less than that of other surveys until 9 months. The comparative difference was greatest at 3 months and slight at 9 months. At 12 months, the intake was of an intermediate value. The difference at 3 months may be partly accounted for by different methods of infant feeding. Taitz (1976) has already reported lower energy intakes in a survey conducted since the change to modified milks.

Protein and fat intakes were similar to other survey results at 9 months but greater at 12 months, while the carbohydrate intakes were comparatively low throughout the survey. This suggests a slightly higher proportion of protein and fat in the diet at 9 months, the proportion being definitely greater at 12 months and offset by low carbohydrate intakes.

Calcium intake values were low at 9 months and high at 12 months, while iron intakes were similar to those of other surveys. Ascorbic acid intakes were consistently greater than in other surveys. Intake of vitamin A was intermediate at 9 months and similar at 12 months. Vitamin D intakes were greater than in most comparable surveys and yet, in comparison with Goel's study of Glasgow children, a greater number of children failed to receive the minimum recommended intake (Goel, 1979).

The intake of vitamin D is of especial interest in Glasgow. Rickets has been recognised in the West of Scotland since the 17th century. The finding that infantile rickets was all but universal in Glasgow and its suburbs was published by Owen (1889) and corroborated by Palm (1890). Five surveys which were carried out more recently (Arneil, 1969; Arneil, McKilligan & Lobo, 1965; Arneil, 1967; Richards et al, 1968 and Richards, Sweet & Arneil, 1968), led to

conclusions summarised by Arneil (1975).

(i) A substantial proportion of Glasgow infants were receiving a grossly inadequate dietary intake of vitamin D.

(ii) Florid, active rickets existed undetected in indigenous white Glasgow children of 1 - 3 years, probably less than 2 per cent being affected.

(iii) 9 per cent of the children had sub-clinical, radiologically detectable bone lesions, resolved by vitamin D supplement.

Since these studies were conducted, a series of measures has steadily reduced the problem. However, as the indigenous problem has come under control, that of rickets amongst 'immigrant' children became apparent (Dunnigan et al, 1962) and remains a problem (Goel, 1979). In the Glasgow cross section of this study, only 3 per cent of the 3 month infants failed to receive the recommended intake of vitamin D (DHSS, 1979), while 39 per cent of the 12 month infants failed to do so.

The overall trend in the cross section is of nutrient intakes lower or similar to those of other studies at 3, 6 and 9 months but greater at 12 months. Apart from energy, other nutrients were being compared only with the DHSS (1975) survey at 12 months. This survey included a wide age range of children from 6 - 18 months. Thus, the most relevant conclusions to be drawn from comparisons with other studies are the higher proportions of protein and fat, offset by a low carbohydrate intake and a relatively high intake of ascorbic acid.

Intakes of most nutrients were related to social status. Socio-economic groups I and II had the lowest intakes of energy, protein and calcium at all ages and of fat from 6 months. Socio-economic

group V, by contrast, had the highest intakes of energy, protein and calcium at all ages and of fat from 6 months. There was no consistent pattern regarding carbohydrate intake. The survey of Black et al (1976) included a group of 8 month old children. These were classified as being from manual or non-manual families, the former being shown to have higher intakes of energy, protein and calcium. These results concur with those of this study. The relationship between class and energy intake had already been observed by Bransby & Fothergill (1954) and the DHSS (1975). Black et al (1976) also noted a higher intake of iron amongst non-manual families but this study found no consistent class trend with regard to iron.

The relationship to vitamin intake was different, however. Distributions tended to be small until 6 months but from then, socio-economic groups I and II had the highest intakes of vitamin D and ascorbic acid, while groups IV and V had low intakes of ascorbic acid and group V had the lowest vitamin D intake. This agrees with the results of DHSS (1975) who also showed groups I and II to have the highest vitamin A intake.

Table CXXVII summarises the longitudinal section intakes with regard to the cross section. With the exception of some 3 month values, the Blackhill intakes of energy, energy per kilogram body weight, protein, fat, carbohydrate, calcium and iron were greater than in the cross section. Most values were in the range of 120 - 130 per cent but those of energy per kilogram body weight and iron were even larger. Water was an exception with the means and ranges fairly similar. By contrast, the intakes of vitamins A and D and ascorbic acid were all below those of the cross section and there was a

TABLE CXXVII.

Mean Nutrient Intakes of the Longitudinal Section, Expressed as Percentages of the Cross Section.

Age	Nutrient	Blackhill	Carntyne	Nutrient	Blackhill	Carntyne
3 months	Energy	96.5	90.7	Calcium	122.8	112.0
6 months		123.0	100.0		129.5	105.4
9 months		129.3	99.7		134.0	100.4
12 months		125.9	104.7		122.9	102.6
3 months	Energy/kg. body wt.	113.4	99.5	Iron	91.4	71.2
6 months		131.8	96.1		133.6	92.7
9 months		139.7	97.8		152.5	87.9
12 months		135.2	102.4		136.5	100.0
3 months	Protein	121.1	114.8	Vitamin A	97.5	85.3
6 months		126.3	108.2		106.3	105.2
9 months		124.5	103.3		78.6	160.8
12 months		119.3	105.5		59.5	158.9
3 months	Fat	97.4	92.4	Vitamin D	86.2	95.4
6 months		123.7	96.8		101.3	110.3
9 months		129.3	95.9		94.8	104.4
12 months		129.4	99.8		51.6	79.4
3 months	Carbohydrate	87.4	80.3	Ascorbic Acid	62.6	85.4
6 months		121.2	99.5		60.9	106.0
9 months		131.1	101.2		57.1	114.0
12 months		125.4	109.3		41.2	110.0
				Water	96.6	98.9
					107.8	102.2
					111.0	96.7
					112.0	102.2

pronounced decrease in their comparative values at 12 months. These results are similar to those found for socio-economic groups IV and V in the Glasgow cross section.

In Carntyne, the intakes of most nutrients fluctuated within a few percent of those of the cross section, although the 3 month levels tended to be somewhat lower. Protein levels were always above and fat levels below the Glasgow data. The intakes of iron were lower than in the cross section while those of the three vitamins assessed were generally higher. Intakes of vitamin A were especially high at 9 and 12 months.

The proportion of total energy intake derived from fat in the cross section was intermediate between the two longitudinal groups with that of Blackhill consistently greater than that of Carntyne. These findings differ from those of Perissé, Sizaret & Francois (1969) who showed that the proportion rises steeply with income. The proportions of protein and carbohydrate showed no such relationship to area.

The DHSS (1979) states that, with regard to recommended intakes, "About one half of the individuals in the group would be expected to have intakes less than and half more than the recommended intake". The centile positions of the recommended intakes were calculated and most values were well below the 50th centile. There were four exceptions and all occurred with the 12 month diets. One was the energy intake of the cross section boys, where the centile position was 56. The other three were in the longitudinal section. In Carntyne, 51 per cent failed to have the recommended intake of vitamin D but the Blackhill situation was worse with the centile positions of recommended intakes of vitamins A and D, 64 and 69, respectively. In general, the centile positions were lowest at 3 months and highest

at 12 months.

The 9 month cross section diets were similar to the 8 month diets of Black et al (1976). The differences can be accounted for, in the main, by slightly different ages of the children and the recent change to modified milk products.

Some variations in food consumption, related to social status, were seen. Socio-economic groups I and II had the highest intakes of vegetables, fruit and nuts and the lowest intake of sweet foods. Group V tended to withdraw dried milk and give commercial baby foods and adult foods at an earlier age than other groups. They also received a higher proportion of meat, fish, eggs and cheese. Within socio-economic group V, the unemployed had less commercial baby food, meat and fish than the employed and more dried milk and sweet foods. At 12 months, their intake of egg and cheese was nearly double that of the employed, while that of bread, crackers and fat was less. Thus, cheaper alternatives of main protein source were used.

Baines, Hollingsworth & Leitch (1963), who surveyed diets of working class families before and after the war, showed that the addition of a child to a family was associated with almost no change in the family's total consumption of fresh green vegetables and with a depressed consumption of fresh fruit. In Blackhill, where there was a higher proportion of large families, a smaller proportion of dietary energy came from fruit and vegetables than occurred in the cross section. Blackhill parents withdrew dried milk and commercial baby foods at an earlier age than the cross section parents, thus demonstrating the socio-economic group V trend. The Blackhill infants derived more dietary energy, more milk, yoghurt, cream, potatoes and sweet food and less from vitamin supplement. Carntyne infants had a lower intake of dried milk than the cross section and more vitamin supplements.

CHAPTER XI.

MORBIDITY.

(a) Mortality.

(b) Morbidity.

(i) Hospital Admissions.

(ii) Episodes of Morbidity.

CHAPTER XI.

(a) Mortality.

Three infants, from Blackhill, died during the longitudinal study. Two were considered to have been cot deaths, although one was suspected as having been a non-accidental death. The third infant died after an acute illness with haemolytic anaemia and cardiac failure. There were no deaths in the other groups.

(b) Morbidity.

(i) Hospital Admissions.

The mean numbers of hospital admissions reported by the cross section mothers are given in Table CXXVIII, as are the mean cumulative numbers of admissions in the longitudinal study. Neonatal special admissions were excluded.

TABLE CXXVIII.

Mean No. of Hospital Admissions. Cross Section and Longitudinal Section.

Age	Cross Section	Blackhill (cumulative)	Carntyne (cumulative)
3 months	0.07	0.10	0.06
6 months	0.14	0.31	0.07
9 months	0.12	0.45	0.12
12 months	0.21	0.77	0.14

The mean number of admissions in Blackhill was greater than in the cross section, the difference between the two groups increasing with age. In Carntyne, the number of admissions was slightly less than the cross section. In both

longitudinal study areas, the number of admissions was distributed non-uniformly. In Blackhill, eight infants were admitted on a total of 26 occasions within the first 9 months. 'Gastro-enteritis' accounted for 21 of these admissions.

It is accepted that hospital admissions are dependent, to an extent, on the social problems of the family and can be misleading as to the seriousness of the child's illness.

(ii) Episodes of Morbidity.

TABLE CXXIX.

Incidence of Diarrhoea. Longitudinal Section.

Age	No.of Episodes		No.of Hospital Admissions		Mean Days Ill	
	Blackhill	Carntyne	Blackhill	Carntyne	Blackhill	Carntyne
0-3 months	27	13	7	4	0.6	0.6
3-6 months	36	16	12	-	1.6	0.5
6-9 months	27	17	3	1	0.9	0.6
9-12 months	26	25	2	-	1.1	0.7

The Blackhill infants had consistently more episodes of diarrhoea than Carntyne. These were of longer duration and led to more hospital admissions (Table CXXIX). There was little relationship between the age of the children and the number of episodes, although Blackhill did have a maximum between 3 and 6 months. Hospital admissions were four times as frequent in the first 6 months as in the second 6 months of life.

TABLE CXXX.

Incidence of Respiratory Infection. Longitudinal Section.

Age	No.of Episodes		No.of Hospital Admissions		Mean Days Ill	
	Blackhill	Carntyne	Blackhill	Carntyne	Blackill	Carntyne
0.3 months	70	27	1	-	2.1	1.2
3-6 months	66	59	1	-	4.5	1.9
6-9 months	92	62	4	-	4.9	3.1
9-12 months	66	62	7	-	4.4	2.9

The incidence of respiratory infection was greater in Blackhill than in Carntyne but the proportional increase was less than was the case of diarrhoea. The severity of the episodes in Blackhill was greater, as measured by the number of hospital admissions and the duration of the episodes.

The incidence of other illnesses was low and similar in both areas.

CHAPTER XII.

DEVELOPMENT.

Table CXXXI gives the mean scores for each of the four areas of development which were assessed. A total for the four areas is also shown. No significant difference was found between the two longitudinal study communities, in either the individual sections or the totals.

TABLE CXXXI.

Mean Developmental Scores. Blackhill (B) and Carntyne (C).

Age	Social		Gross Motor		Speech & Language		Vision & Fine Motor		Total	
	B	C	B	C	B	C	B	C	B	C
0-3 months	4.7	4.7	4.6	4.7	4.3	4.6	4.7	4.5	18.3	18.5
3-6 months	4.7	4.8	4.5	4.6	4.7	4.8	4.5	4.6	18.4	18.8
6-9 months	4.7	4.8	4.7	4.7	4.9	4.8	4.5	4.6	18.8	18.9
9-12months	4.8	4.8	4.9	4.7	4.6	4.5	4.7	4.7	19.0	18.7

Maturity.

TABLE CXXXII.

Mean Measurements of Maturity. Longitudinal Section.

Measurement	Blackhill	Carntyne
Age of 1st tooth eruption (years)	0.73	0.65
Age of fontanelle closure (years)	1.43	1.02

Table CXXXII shows that the mean ages of first tooth eruption and of closure of fontanelle were greater in Blackhill than in Carntyne. Billewicz et al (1973) showed a relationship between birth weight and tooth eruption and the difference between the Blackhill and Carntyne results may well be due to a difference in mean birth weight.

Tanner (1973) recalculated the data of Meredith (1946) to show the mean age of 1st tooth eruption amongst American children was 0.55 years for boys and 0.60 years for girls. The Glasgow longitudinal data were calculated with sexes combined but show greater ages than the American reference data.

CHAPTER XIII.

CORRELATIONS WITH GROWTH.

The longitudinal data were pooled to assess the effect of different variables on growth. The age span was from the initial visit to the 12 month visit. The anthropometric indices were length and weight. The factors which had the greatest effect on achieved size were size at the initial visit and birth weight. Growth between the two dates was standardised using the initial measurements. Table CXXXIII summarises the results.

TABLE CXXXIII.

Factors Correlated with Growth.

Index	Factor	Significance	Correlation
1 Length-for-age	Protein: fat ratio	$P < 0.05$	+ ve
	Moderate diarrhoea	$P < 0.05$	- ve
1 Weight-for-age	Protein: fat ratio	$P < 0.05$	+ ve
	Moderate diarrhoea	$P < 0.05$	- ve
1 Weight-for-length	Mother's education	$P < 0.001$	- ve
	Protein: fat ratio	$P < 0.01$	+ ve
	Gestational age		- ve
	No.children less than 5 years in home		- ve
	Moderate diarrhoea	$P < 0.05$	- ve
	Mild respiratory infection		+ ve

1 : At 12 months: standardised for initial measurements.

The ratio of protein derived energy to fat derived energy was the only dietary factor found to correlate significantly with growth. It was related positively to both length- and weight-for-age and to weight-for-length. Table CXXXIV shows that in Blackhill the ratio decreased steadily throughout the year. In Carntyne, the value was initially equal to that of Blackhill but it fluctuated only slightly and was, from 6 months onwards, greater than the Blackhill ratio. The cross section ratios have been included for reference and show an increase between 3 and 6 months. Thereafter, they remained fairly constant and intermediate to the longitudinal ratios.

TABLE CXXXIV.

Ratio of Protein Derived Energy: Fat Derived Energy.

Age	Cross Section	Blackhill	Carntyne
3 months	0.35	0.43	0.43
6 months	0.40	0.41	0.44
9 months	0.40	0.39	0.43
12 months	0.39	0.36	0.42

Two morbidity factors were related to growth - diarrhoea and respiratory infection. The incidence of moderate diarrhoea was negatively related to all three indices, showing that the smaller and thinner babies suffered more moderate diarrhoea. Mild respiratory infection was related to weight-for-length but positively, thus the fatter children tended to suffer more from mild respiratory infections.

Other factors related to weight-for-length showed that the more highly educated mothers had thinner children, those living in homes with more children under 5 years of age were also thinner and that children of shorter gestation tended to be fatter.

CHAPTER XIV.

SUMMARY OF RESULTS.

(a) Response Rate.

(b) Social and Family Background.

(c) Birth Weight and Gestation.

(d) Growth.

(e) Infant Feeding Practice.

(f) Diet.

(g) Mortality and Morbidity.

(h) Development.

(i) Correlations with Growth.

(a) Response Rate.

In the cross section, 660 infants were successfully visited. This represented 72 per cent of those initially approached. The 6 week group had the highest success rate and the 12 month group the poorest. Socio-economic groups III and IV had the highest failure rates. In Blackhill, of the 78 consecutively born infants, whose mothers were approached to join the study, 50 remained at 12 months. Comparative figures for Carntyne were 70 and 53.

(b) Social and Family Background.

The cross section social class structure was similar to that found in previous Glasgow births with the proportions of socio-economic groups I and II, III, IV and V, 15, 49 and 35 per cent, respectively. Glasgow had a high level of unemployment and the rate in the cross section population was 9 per cent. The largest immigrant group (5 per cent) was Asian. Overcrowding was fairly high. 34 per cent of the homes had more than 1.5 persons per room and 9 per cent housed 3 or more children under 5 years. Of the mothers, 10 per cent were aged under 20 years, 85 per cent had minimum education and their mean height was 159.6 cm. Parity was 4 or more for 7 per cent and the illegitimacy rate was 5 per cent.

Blackhill was predominantly socio-economic group V (72 per cent) with an unemployment rate of 50 per cent. 99 per cent were Caucasian. Overcrowding was more severe than in the cross section, with 54 per cent of homes having more than 1.5 persons per room and 19 per cent with 3 or more children under 5 years. The mothers were younger, shorter and less well educated - 32 per cent under 20 years, mean height of 157 cm and 99 per cent having had minimum education. Parity was greater with 19 per cent being 4 or more and illegitimacy

was higher at 13 per cent. Mobility was approximately twice that observed in Carntyne.

Socio-economic group III families predominated in Carntyne at 69 per cent, while unemployment was 3 per cent. All were Caucasian. Overcrowding was below cross section levels, 26 per cent having more than 1.5 persons per room and 3 per cent, 3 or more children under 5 years. The age distribution, education and parity of the mothers were similar to those of the cross section as was the illegitimacy rate. Mean height was slightly greater at 160.7 cm.

(c) Birth Weight and Gestation.

The Glasgow cross section birth weights fluctuated between those and Butler & Alberman (1969) and Thomson et al (1968). Mean birth weights by gestational age in the cross section and Carntyne were similar while those of Blackhill were less. Distribution of birth weights differed, with 6, 17 and 2 per cent of babies weighing 2.5 kg or less in the cross section, Blackhill and Carntyne, respectively. The comparative percentages of babies over 3.5 kg were 25, 19 and 44.

Regression analysis was used on the available cross section data, which did not include a smoking history. The factors found to influence birth weight were mother's height, parity, gestational age and whether or not the father was employed. The mean birth weights of Blackhill and Carntyne were corrected for the various affecting factors plus incidence of smoking which was recorded in the longitudinal data collection. After correction, an inter-area discrepancy of 120g remained, which was unaccounted for by any environmental factors examined.

Gestational age differed with area. 9 per cent of Blackhill babies were born before 37 weeks, compared with 4 and 5 per cent,

respectively in the cross section and Carntyne.

(d) Growth.

From the age of 6 months, the Glasgow cross section children were smaller than those of the various reference groups in all anthropometric measurements taken, except head circumference. The girls weight and triceps skinfold thickness values corresponded more closely to the reference data than did those of the boys. The Blackhill children were shorter, lighter and with smaller head circumferences than the cross section children throughout the study. Their arm circumferences and skinfolds were also initially smaller but, by 9 and 12 months, were similar to those of the cross section data. The girls had comparatively thicker skinfolds and larger head circumferences than the boys. The Carntyne children were very slightly longer and heavier than the cross section children, with the girls comparatively longer than the boys. Skinfolds were similar to, or slightly greater than those of the cross section, while head and arm circumferences, initially less, were greater by 12 months.

The mean Blackhill length-for-age, weight-for-age and weight-for-length were all below the cross section standards at both the initial and final visit. In Carntyne, the means were all greater than the standards, with the exception of initial weight-for-length. In both areas, length-for-age decreased slightly through the year, while weight-for-age and thus, weight-for-length increased. The difference between the Blackhill and Carntyne means tended to be constant throughout the year.

(e) Infant Feeding Practice.

The incidence of breast feeding in the Glasgow cross section was less than that found during a comprehensive survey in England and Wales.

The figures for Carntyne were very slightly less and for Blackhill, much less than those of the cross section. At 6 weeks, the percentages of babies being breast fed in the cross section, Blackhill and Carntyne were 13.0, 1.3 and 12.5, respectively. Dried milk powders were the main source of energy and nutrients for non-breast fed babies, with very little use of 'doorstep' or evaporated milk. The survey spanned the change from unmodified to modified milks which was recommended by the medical profession and an alteration in type of milk used by mothers was demonstrated. Thirty-five per cent of the cross section mothers reported giving solids before the age of 12 weeks and the figures for Blackhill and Carntyne were 76 and 83 per cent, respectively.

(f) Diet.

The cross section intakes of protein and fat were greater than those of other surveys and were offset by a low carbohydrate intake. Ascorbic acid intake was relatively high. Socio-economic groups I and II had the lowest intakes of energy, protein and calcium at all ages and of fat from 6 months, while those of ascorbic acid and vitamin D were highest, again from 6 months. Socio-economic group V had the highest intakes of energy, protein and calcium at all ages and of fat from 6 months but low intakes of ascorbic acid and vitamin D from 6 months. Socio-economic group IV also had a very low ascorbic acid intake.

With the exception of some 3 month values, the Blackhill mean intakes of energy, energy per kg body weight, protein, fat, carbohydrate, calcium and iron were greater than in the cross section. The range of intakes was also larger. By contrast, intakes of vitamins A and D and ascorbic acid were all below those of the cross section and there

was a pronounced decrease in their comparative values at 12 months. In Carntyne, the intakes of most nutrients fluctuated within a few per cent of the cross section, Iron intake was, however, lower and intakes of vitamins, especially vitamin A, tended to be greater. The ratio of protein energy : fat energy remained constant in Carntyne and decreased steadily throughout the year in Blackhill.

The centile positions of the recommended intakes (DHSS, 1979), were calculated and most values were well below the 50th centile. There was a gradual increase in centile positions from 3 to 12 months and the four centile values greater than 50 were all at 12 months. These were the energy of the cross section boys (56) vitamin D in Carntyne (51) and in Blackhill (69) and vitamin A, again in Blackhill (64).

The 9 month cross section diets were similar to those of Black et al's (1976) 8 month diets, allowing for the slightly different ages and the change to modified milk powders. Socio-economic groups I and II had the highest intakes of vegetables, fruit and nuts and the least sweet food. Socio-economic group V progressed to commercial baby foods and adult foods earlier than other groups and received a higher proportion of meat, fish, eggs and cheese. With socio-economic group V, the unemployed had less commercial baby food, meat and fish than the employed and more dried milk and sweet foods. At 12 months, their intake of egg and cheese was nearly double that of the employed, while that of bread, crackers and fat was less.

Blackhill mothers withdrew dried milk and commercial baby foods at an earlier age than those of the cross section. They also gave less fruit, vegetables and vitamin supplements and more milk,

yoghurt, cream, potatoes and sweet food. Carntyne had a lower intake of dried milk than the cross section and more vitamin supplements.

(g) Mortality and Morbidity.

Three infants, all from Blackhill, died during the survey. Hospital admissions, compared with the cross section, were greater in Blackhill and slightly less in Carntyne. The mean numbers of admissions by 12 months in the cross section. Blackhill and Carntyne were 0.2, 0.8 and 0.1, respectively. Blackhill had more episodes of diarrhoea and respiratory infection than Carntyne. The episodes were longer and accounted for more hospital admissions. Incidence of other illnesses was low and very similar in both areas.

(h) Development.

The mean ages of first tooth eruption and of closure of the fontanelle were greater in Blackhill than Carntyne. No significant difference was found between the two longitudinal areas in their developmental scores.

(i) Correlations with Growth.

After standardisation of the longitudinal data for size, at initial visit, the length- and weight-for-age at the 12 month visit were found to be correlated negatively with diarrhoea and positively with the ratio of dietary protein derived energy : fat derived energy. Weight-for-length was correlated with various factors, namely, the protein : fat ratio, gestational age, mother's education, number of children under 5 years in the home, moderate diarrhoea and mild respiratory infection.

CHAPTER XV.

DISCUSSION.

Short stature is associated with deprivation. Glasgow is a city whose population is shorter than that of other British cities and it is also a city of high deprivation. The industrial revolution accounted for a sudden increase in the Glasgow population in the 18th century and this was followed by a 350 per cent increase during the first half of the 19th century. Overcrowding, in conditions of poverty with little or no sanitation, was commonplace and diseases spread easily. From 1851 onwards, various Housing Acts relieved and improved the situation but the standard of housing in Glasgow still falls far short of ideal.

Evelyth & Tanner (1976) considered the height of a population and the rate of growth of children accurate reflections of the state of Public Health and nutrition. This study was set up to establish the growth pattern of infants living in a deprived area of Glasgow and to identify any factors influencing that growth. Two groups, each of over 50 children, were seen monthly during their first year of life. One group was from a deprived area - Blackhill and the other from Carntyne, an area more typical of Glasgow. A cross section of over 600 children was also examined, each child at one of 5 specific ages from 6 weeks to 12 months. Data collected included social background, anthropometric measurements, infant feeding practice, diet and some morbidity and developmental information.

The choice of Blackhill and Carntyne as study areas has been justified. The unemployment rate in Blackhill was 5 times that found in the cross section and nearly twice as many survey families lived in

overcrowded homes. There were more young mothers, levels of education were lower and the mean height of the mothers was also lower. By contrast, the age distribution, educational status and parity of the Carntyne mothers were very similar to those of the cross section. Their mean height was slightly greater and unemployment and overcrowding were less. The social distribution was somewhat distorted with an excess of socio-economic group III, offset by fewer families from groups I and II, IV and V. This imbalance had to be accepted as it would have been highly unlikely to find an area with an exact replica of the Glasgow social structure. That of the cross section was similar to the proportions found in the then most recently known births in Glasgow. The proportion of Asians included in the cross section was slightly higher than would have been expected from the figures of Goel (1979) but the poor housing situation confirmed the reports of Holman (1970) and Holterman (1975) and the low stature of the children that described by Vimpani et al (1981).

Blackhill is an area for concern. Low birth weight, which is associated with various problems (Neligan et al, 1974) was more common than in the cross section. After correction for factors which were found significantly related with birth weight, a discrepancy of 120g remained between the Blackhill and Carntyne means. Some of these factors have already been well documented - mother's height (Tanner & Thomson, 1970), gestational age (Gruenwald, 1967), parity (Thomson et al, 1968), sex (Lubchenco et al, 1963) and smoking (Goldstein, 1977). The factor of father's unemployment was also found related to a reduced birth weight ($p < 0.05$). In view of the ever increasing number of unemployed, this relationship is disturbing. It is unfortunate that alcohol intake during pregnancy was not

recorded, as this might have accounted for part of the discrepancy between corrected mean birth weights in Blackhill and Carntyne.

Gestation periods in Blackhill tended to be shorter than in the cross section. Widdowson (1974 i) stated that the major problem of prematurity is immaturity and in a later paper (1974 ii), showed some of the problems facing the preterm, low birth weight baby, in acquiring sufficient zinc, copper and iron. The centile position of the recommended intake of iron was, in fact, satisfactory, in spite of its deficiency being the most common nutritional disorder (Garby, 1973; Kossner & Kalk, 1973).

The growth pattern of infants in a deprived area has been established. The results show that whereas there were more small children in Blackhill than in Carntyne, the rates of growth in both areas tended to be similar. Lower means of length and weight in Blackhill were due mainly to much greater differences at the 10th centile level than at the 90th centile.

Several factors were found correlated with growth. The relationship of weight and height with diarrhoea had already been demonstrated amongst Guatemalan children by Martorell et al (1975) and that between weight gain and diarrhoea amongst Gambian children by Cole & Parkin (1977). In this study, moderate diarrhoea was correlated with length-for-age, weight-for-age and weight-for-length. The protein : fat ratio of the diet was also correlated with all three indices. Other factors were associated only with weight-for-length. Thus, more highly educated mothers had thinner children and those living in homes with several children under 5 years were thinner. Infants of short gestation tended to be fatter and fatter children tended to suffer more from mild respiratory infection.

Controversy surrounds the hypothesis that infant feeding practices involving high energy intakes and early solids stimulate fat cell replication. Poskitt & Cole (1977), Whitelaw (1977) and Durnin & McKillop (1978) showed that weight in infancy did not necessarily indicate subsequent body build. In view of these findings, it is interesting to note that neither the incidence of breast feeding nor the age of introduction of solids had any relationship with growth in this study. There was no correlation between energy and growth.

Poverty has long been associated with poor diet (Rowntree, 1937) and yet the diet of the Blackhill children did not appear to suffer due to lack of money. Vitamin intakes, certainly, were lower than in the cross section, but that of other nutrients was considerably greater. Many foods were bought in expensive convience form, e.g. tinned macaroni cheese and tinned custard. Consumption of fruit and vegetables, which do tend to be expensive, was low, as is the case throughout Scotland (Buss, 1977). Baines, Hollingsworth & Leitch (1963) who surveyed diets of working class families before and after the war showed that the addition of a child to a family was associated with almost no change in the family's total consumption of fresh green vegetables and with a reduced consumption of fresh fruit. Intake of vitamins A and D were at unacceptably low levels in Blackhill, while uptake of the cheap or free vitamin supplement, readily available in the H.V. office, was also extremely low.

An anomaly exists with regard to the Blackhill infants. They ate considerably more food than the Carntyne children and yet had similar mean growth rates, remaining smaller throughout the survey

period. A child's growth is dependent upon genetics, sickness and nutrition (McCance, 1976). Diarrhoea affects weight and length (Martorell et al, 1975; Cole & Parkin, 1977) and the infants in Blackhill suffered from this more than infants living in Carntyne, especially during the first 6 months of life. The protein energy to fat energy ratio of the diet has also been shown to affect length- and weight-for-age and while this ratio remained constant in Carntyne, in Blackhill it decreased throughout the year, having been equal to that of Carntyne at 3 months. Other factors which were not investigated may have been influential, e.g. irregular sleep patterns or family stress. Widdowson (1951) showed that growth in height and more especially in weight, is influenced by emotional circumstances.

Nelson (1980) has suggested that a diet, adequate for upper class, is not adequate for the lower classes and recommends the need for two standards of dietary adequacy. Orr (1936) suggested that the measure of an adequate diet should be a 'state of well-being such that no improvement can be affected by a change in diet'. It still remains to be seen whether an alteration in the Blackhill diet could improve the well-being of its children.

Blackhill is an area of depression, described by one mother as 'an open prison'. Overcrowding, large numbers of young children and a high infection rate, which tend to be linked, were worse than in the cross section or Carntyne. Probably the single, overriding problem is that of unemployment, which is unlikely to be improved in the near future, given current economic conditions. In any attempt to alleviate the the situation in Blackhill, it should be remembered that those most in need of statutory services tend to use these services least (Davie et al, 1972) and that for the culturally underpriviledged

or deprived child, enriching or compensatory education needs to be provided during the pre-school and school years (Pringle, 1969). Some medical, para-medical and educational recommendations can and should be reiterated.

(1) Improve ante-natal care in deprived areas, either by the use of a mobile clinic or by domiciliary care. The domiciliary Family Planning Service in Blackhill has proved very successful.

(2) Investigate the diets of pregnant women in a deprived area. Naismith (1980) stated that, "Of the many factors, hereditary and environmental, that are believed to influence birth weight, perhaps the most contentious is the diet of the mother". More should be known.

(3) Promotion of breast feeding through schools, hospitals and women's groups. This would be of especial benefit in Blackhill, as gastro-enteritis is much more common amongst bottle fed than breast fed babies (Mellander, Vahlquist & Mellbin, 1959; Mata & Wyatt, 1971).

(4) Promotion of improved standards of hygiene through schools, hospitals and women's groups.

(5) Advocation of vitamin supplements. Perhaps a supply could be given to every mother on leaving hospital.

(6) Nutrition education, meal planning, cooking and budgeting advice in schools, women's groups and individual homes.

(7) Remonitor the Blackhill and Carntyne children. Although 'catch up' and 'lag down' have normally taken place by 11.5 months and 13 months, respectively (Smith et al, 1976),

various long term effects of environmental deprivation or dietary imbalance might be ascertained. Walker (1975) suggested the follow-up of two large scale anthropometric studies and Thomson (1978) stated his belief that, with regard to nutritional surveillance, monitoring growth and body size in children and adults is even more important than the systematic collection of mortality and morbidity statistics.

Appendix I.

University of Glasgow
Department of Child Health and Obstetrics

Greater Glasgow Health Board

SOCIAL PAEDIATRIC AND OBSTETRIC RESEARCH UNIT

23 Montrose Street
Glasgow
G1 1RN.

Tel. 041 221 9600 (Extn.2315)

Dear Mrs

This unit is carrying out a survey in the Glasgow area to find the size and weight of babies and what they are being fed. This is being done in order to increase our knowledge of the growth and feeding of present day infants.

The names of the babies who are to be included in the survey have been selected at random from the birth register. Your son/daughter is one of those selected and we hope you will allow us to see him/her. A nursing sister and auxiliary nurse are visiting the homes where they shall weigh and measure the child and ask about diet. They would like to visit you on at approximately . If this time is not convenient, we should be grateful if you would let us know an alternative time either later on the same day or else on the Friday of that week. To do this, or to let us know another address, please complete the enclosed stamped post card and return it to us as soon as possible. Similarly, if you are not willing to participate, please let us know.

We hope you will be able to help us in this study and should like to thank you in advance.

Yours sincerely,

J. Paget Stanfield (Director).

Appendix II.

Serial No. [ ][ ][ ]

1. Was he/she born two weeks or more before the expected date?

Yes	:	1
No	:	2
Don't know	:	-

[ ]

2. How much did he/she weigh at birth?

__ lbs. __ oz. ___ kg. [ ][ ][ ]

3. Is he/she handicapped by any permanent illness or disability?

Yes - Physical	:	1
Yes - Mental	:	2
Yes - Both	:	3
No	:	4
Don't know	:	-

[ ]

4. How many times has he/she been admitted to hospital? (Code 9 times or more as 9). [ ]

5. How many live births has the mother had altogether? [ ]

6. Ethnic group of child. (Use judgement).

Caucasian	:	1
Negroid	:	2
Mongoloid	:	3
Other Asian	:	4
Mixed	:	5
Not sure	:	-

[ ]

7. Marital status of mother.

Married	: 1	Divorced	: 5	
Single	: 2	Not known	: -	
Widowed	: 3	Mother deceased		
Separated	: 4	or departed	: 9	☐

8. At what age did the mother complete her full-time education?

No formal education	: 0	
Minimum age (15 or 16)	: 1	
16 (having stayed an extra year)	: 2	
17	: 3	
18	: 4	
19	: 5	
20	: 6	
21	: 7	
Over 21	: 8	
Still studying	: 9	☐

9. How old is the mother?

Up to 19	: 1	30 - 34	: 4	
20 - 24	: 2	35 - 39	: 5	
25 - 29	: 3	40 or over	: 6	
		Don't know	: -	☐

10. The parents' heights.

Mother	____ ft	____ in	____ cm	☐☐☐
Father	____ ft	____ in	____ cm	
Mean			____ cm	☐☐☐

11. What type of work does the male of the house do?

_____

_____ ☐

12. Has either parent immigrated to the U.K. within the last 5 years?

Yes - mother	: 1	No	: 4	
Yes - father	: 2	Don't know	: -	☐
Yes - both	: 3			

13. How many people live in the house? (Include lodgers, au pairs, etc. Code 9 or more as 9). ☐

14. How many rooms are in the house? (Exclude bathroom and kitchen unless kitchen used as a living room). ☐

15. What is the ratio of people to rooms? (Divide no. of people by no. of rooms).

Less than 0.5	: 1	2.0 - 2.4	: 5	
0.5 - 0.9	: 2	2.5 - 2.9	: 6	
1.0 - 1.4	: 3	3.0 or more	: 7	
1.5 - 1.9	: 4	Don't know	: -	☐

16. How many children under 5 years live in the house? ☐

17. Is there an indoor lavatory?

Yes - within own home	: 1	
Yes - shared	: 2	
No	: 3	
Don't know	: -	☐

18. Is there a hot water supply?

Yes - piped	: 1	
Yes - geyser	: 2	
No	: 3	
Don't know	: -	☐

REFERENCES.

Abel-Smith, B. & Townsend, P. (1965) In The Poor and the Poorest. London: Bell.

Addy, D.P. (1976) Infant feeding: a current view. British Medical Journal, 1, 1268 - 1271.

Angrove, R. (1978) Personal communication.

Antonov, A.N. (1947) Children born during the seige of Leningrad in 1942. Journal of Paediatrics, 30, 250 - 259.

Arneil, G.C. (1967) Dietary study of 4365 Scottish infants - 1965. Scottish Health Service Studies, No.6. Edinburgh: Scottish Home and Health Department.

Arneil, G.C. (1969) The return of infantile rickets to Britain World Review of Nutrition and Dietetics, 10, 239 - 261.

Arneil, G.C. (1975) Nutritional rickets in children in Glasgow. Proceedings of the Nutrition Society, 34, 101 - 109.

Arneil, G.C., McKilligan, H.R. & Lobo, E. (1965) Malnutrition in Glasgow children. Scottish Medical Journal, 10, 480.

Arneil, G.C., Hutchinson, J.H. & Shanks, R.A. (1973) Cited in Present-day Practice in Infant Feeding. Department of Health and Social Security. p15. London: Her Majesty's Stationery Office.

Arnott, N. (1842) In Reports on the Sanitary Condition of the Labouring Population of Scotland. Official report to the Poor Law Commissioners, pp8 - 9. London: W. Clowes and Sons for Her Majesty's Stationery Office.

Baines, A.H.J., Hollingsworth, D.F. & Leitch, I. (1963) Diets of working-class families with children before and after the Second World War with a section on height and weight of children. Nutrition Abstracts & Reviews, 33, 653 - 668.

Baird, C.R. (1842) In Reports on the Sanitary Condition of the Labouring Population of Scotland. Official report to the Poor Law Commissioners, p171. London: W. Clowes and Sons for Her Majesty's Stationery Office.

Barber, J.H., Boothman, R. & Stanfield, J.P. (1976) A new visual chart for pre-school developmental screening. Health Bulletin, 34, 80 - 91.

Billewicz, W.Z., Thomson, A.M., Baber, F.M. & Field, C.E. (1973) The development of primary teeth in Chinese (Hong Kong) children. Human Biology, 45, 229.

Birch, H.G. & Gussow, J.D. (1970) In Disadvantaged Children. Health, Nutrition & School Failure, pviii. New York: Harcourt, Brace & World, Inc.

Black, A. E. (1972) Dietary patterns and nutritive value. Nutrition, 26, 224 - 226.

Black, A. E., Billewicz, W. Z. & Thomson, A.M. (1976) The diets of pre-school children in Newcastle-Upon-Tyne, 1968 - 71. British Journal of Nutrition, 35, 105 - 113.

Bransby, E.R. & Fothergill, J.E. (1954) The diets of young children. British Journal of Nutrition, 8,195 - 204.

British Medical Journal, Annotation (1963) Linoleic acid in infant nutrition. British Medical Journal, 2, 1080.

Bull, D. (1971) The rediscovery of family poverty. In Family Poverty. Programme for the Seventies, ed. Bull, D. p13. London: Gerald Duckworth and Co. Ltd., published in association with the Child Poverty Action Group.

Buss, D.H. (1977) Food habits in Britain. Proceedings of the Nutrition Society, 36, 247 - 253.

Butler, N.R. & Alberman, E.D. (1969) In Perinatal Problems. The Second Report of the 1958 British Perinatal Mortality Survey, Edinburgh and London: E. & C. Livingstone.

Central Advisory Council for Education (1967) In Children and their primary schools (Plowden Report), Vol.2 p155. London: Her Majesty's Stationery Office.

Central Statistics Office (1976) In Household Budget Survey, 1973, 2, 19.

Chalmers, A.K. (1930) In The Health of Glasgow 1818 - 1925. An outline, pp61, 21. Glasgow: Bell and Bain. Printed by authority of the Corporation.

Cole, T.J. & Parkin J.M. (1977) Infection and its effect on the growth of young children: A comparison of the Gambia and Uganda. Transactions of the Royal Society of Tropical Medicine and Hygiene, 71, 196 - 198.

Cole, T.J., Donnet, M.L. & Stanfield J.P. (1981) Weight-for-height indices to assess nutritional status - a new index on a slide-rule. American Journal of Clinical Nutrition, In Press.

Common Services Agency, Information Services Division (1975) In Scottish Maternity Statistics, 1975, table 25. Edinburgh: Scottish Health Service.

Common Services Agency, Information Services Division (1976) In Scottish Maternity Statistics, 1976, table 25, Edinburgh: Scottish Health Service.

Cullingworth, J.B. (1968) In A Profile of Glasgow Housing, 1965. University of Glasgow Social and Economic Studies. Occasional Papers No.8. Oliver and Boyd.

Cullingworth, J.B. & Watson, C.J.(1971) In Housing in Clydeside, 1970. Edinburgh: Her Majesty's Stationery Office.

Davidson, S., Passmore, R. & Brock.J.F. (1972) In Human Nutrition and Dietetics, p6. Edinburgh and London: Churchill Livingstone.

Davie, R., Butler, N. & Goldstein, H. (1972) In From Birth to Seven. A report of the National Child Development Study. Longman in association with the National Children's Bureau.

Davies, D.P. (1975) Protein intake, osmolality homeostasis and renal function in infancy. Post Graduate Medical Journal, 51 (suppl.3), 25 - 30.

Davies, D.P., Gray, O.P., Elwood, P.C., Hopkinson, C. & Smith, S. (1977) Effects of solid foods on growth of bottle-fed infants in first three months of life. British Medical Journal, 2, 7 - 8.

Degkwitz, R. (1935) Milk. In The Diseases of Children, (Translation of 4th German edn). eds. Pfaundler, M. & Schlossman, A. vol.1, p195. Philadelphia: Lippincott.

Department of Employment (1977) In British Labour Statistics. Year Book 1975, table 94. London: Her Majesty's Stationery Office.

Department of Employment (1978) In British Labour Statistics. Year Book 1976, tables 102,111, 112. London: Her Majesty's Stationery Office.

Department of Health and Social Security (1974) In Present-day Practice in Infant Feeding, Report on Health and Social Subjects, No.9, pp24, 25, 23, 6. London: Her Majesty's Stationery Office.

Department of Health and Social Security (1975) In A Nutrition Survey of Pre-School Children, 1967 - 68, Report on Health and Social Subjects No.10. London: Her Majesty's Stationery Office.

Department of Health and Social Security (1979) In Recommended Daily Amounts of Food Energy and Nutrients for Groups of People in the United Kingdom. Report on Health and Social Subjects, No.15. London: Her Majesty's Stationery Office.

Dobbing, J. (1968) Vulnerable periods in developing brain. In Applied Neurochemistry, ed. Davidson, A.N. & Dobbing, J. pp287 - 316. Oxford: Blackwell.

Dobbing, J. (1974) The later growth of the brain and its vulnerability. Paediatrics, 53, 2 - 6.

Dunnigan, M.G., Paton, J.P.J., Haase, S., McNicol, G.W., Gardner, M.D. & Smith, C.M. (1962) Late rickets and osteomalacia in the Pakistani community in Glasgow. Scottish Medical Journal, 7, 159.

Durnin, J.V.G.A. & McKillop, F.M. (1978) The relationship between body build in infancy and percentage fat in adolescence: a 14 year follow-up on 102 infants. Proceedings of the Nutrition Society, 37, 81A.

Edwards, D.A., Hammon, W.H., Healy, M.J.R., Tanner, J.M., Whitehouse, R.H. (1955) Design and accuracy of calipers for measuring subcutaneous tissue thickness. British Journal of Nutrition, 9, 133.

Eveleth, P.B. & Tanner, J.M. (1976) In Worldwide Variation in Human Growth. IBP Series. London and Cambridge: Cambridge University Press.

Farr, V. (1966) Skinfold thickness as an indication of maturity in the newborn. Archives of Disease in Childhood, 41, 301.

Fisher, P. & Bender, A.E. (1970) In The Value of Food, p1. London: Oxford University Press.

Fitzhardinge, P.M. & Steven, E.M. (1972) The small-for-date infant. 1. Later growth patterns Paediatrics, 49, 671 - 681.

Freeman, M.G. Graves, W.L. & Thompson, R.L. (1970) Indigent Negro and Caucasian birth weight - gestational age tables. Paediatrics, 46, 9 - 15.

Gampel, B. (1965) The relation of skinfold thickness in the neonate to sex, size at birth, length of gestation and maternal skinfold. Human Biology, 37, 29.

Garby, L. (1973) Iron deficiency: definition and prevalence. Clinical Haematology, 2, 245 - 255.

Gibney, M.J. & Upton, P.K. (1977) Dietary intakes of fat and fatty acids in six social groups in Ireland. Proceedings of the Nutrition Society, 36, 93A.

Glasgow Corporation Housing Department (1948) In Review of Operations 1919 - 1947. Glasgow: Glasgow Corporation Printing and Stationery Department.

Goel, K.M. (1979) In A Nutrition Survey of Immigrant Children in Glasgow. (1974 - 1976), Scottish Health Service Studies, No.40, pp6, 5. Edinburgh: Scottish Home and Health Department.

Goldstein, H. (1971) Factors influencing the height of seven year old children - results from the National Child Development Study. Human Biology, 43, 92 - 111.

Goldstein, H. (1977) Smoking in pregnancy: some notes on the statistical controversy. British Journal of Preventive and Social Medicine, 31, 13 - 17.

Greaves, J.P. & Berry, W.T.C. (1974) Medical, Social and Economic aspects of assessment of nutritional status. Bibliography of Nutrition and Dietetics, 20, 1 - 9.

Gruenwald, P. (1967) Growth of the human foetus. In Advances in Reproductive Physiology, vol. II p279, ed. McLaren, A. London: Logos Press.

Holman, R. (1970) In Socially Deprived Families in Britain, ed. Holman, R. p211. The Bedford Square Press of the National Council of Social Service.

Holterman, S. (1975) In Social Trends, No.6, 33. Central Statistical Office. London: Her Majesty's Stationery Office.

Howe, G.M. (1972) In Atlas of Glasgow and the West Region of Scotland, ed. Howe, G.M. p41. Edinburgh: Holmes McDougall.

Hutchinson-Smith, B. (1970) The relationship between the weight of an infant and lower respiratory infection. Medical Officer, 123, 257 - 262.

Hutchinson-Smith, B. (1973) Skinfold thickness in infancy in relation to birth weight. Developmental Medicine and Child Neurology, 15, 628 - 634.

Illsley, R. (1967) Family growth and its effect on the relationship between obstetric factors and child functioning. In Social and Genetic Influences on Life and Death, ed. Platt & Parkes. Edinburgh: Oliver and Boyd.

Illsley, R. & Kincaid, J.C. (1963) In Perinatal Mortality. The First Report of the 1958 British Perinatal Mortality Survey, ed. Butler, N.R. & Bonham, D.G. p270. Edinburgh: E. & S. Livingstone.

Karlberg, P. (1978) Comparison between Palermo and Gothenburg. In Birth-weight Distribution - an Indicator of Social Development, Report from a SAREC/WHO Workshop, SAREC Report No.R: 2, ed. Sterky, G. & Mellander, L. pp43 - 45.

Kirk, T.R. (1979) An evaluation of the impact of breast feeding promotion in Edinburgh. Proceedings of the Nutrition Society, 38, 77A.

Kossner, J. & Kalk, L. (1973) In Strategy for Evaluating Health Services, Washington, D.C.: National Academy of Sciences.

Lacey, K.A. & Parkin, J.M. (1974) The normal short child. Community study of children in Newcastle-Upon-Tyne. Archives of Disease in Childhood, 49, 417 - 424.

Lechtig, A., Delgado, H., Lesky, R., Yarborough, C., Klein, R.E., Habicht, J.-P. & Behar, M. (1975) Maternal nutrition and fetal growth in developing countries. American Journal of Disease in Childhood, 129, 553 - 556.

Lubchenco, L.O., Hansman, C., Dressler, M. & Boyd, E. (1963) Intrauterine growth as estimated from live born birth-weight data at 24 to 42 weeks of gestation. Paediatrics, 32, 793.

Mata, L.J. & Wyatt, R.G. (1971) Host resistance to infection. American Journal of Clinical Nutrition, 24, 976 - 986.

McCance, R.A. (1976) Critical periods of growth. Proceedings of the Nutrition Society, 35, 309.

McCance, R.A. & Widdowson, E.M. (1960) In The Composition of Foods, Medical Research Council. Special Report Series No.297.

McCance, R.A., Widdowson, E.M. & Lehmann, H. (1942) The effect of protein intake on the absorption of calcium and magnesium, Biochemistry Journal, 36, 686.

McCarrison, R. & Sinclair, H.M. (1953) In Nutrition and Health, p60. London: Faber and Faber.

MacKeith, R. & Wood, C. (1977) In Infant Feeding and Feeding Difficulties, Edinburgh, London and New York: Churchill Livingstone.

Mansley, R.D. (1972) In Areas of Need in Glasgow. Second Review of the Development Plan. Glasgow: The Corporation of Glasgow.

Martin, J. (1978) In Infant Feeding 1975: Attitudes and Practice in England and Wales, pp13 - 24, 49. Office of Population Censuses and Surveys. Social Service Division. London: Her Majesty's Stationery Office.

Martorell, R., Habicht, J.P., Yarbrough, C., Lechtig, A., Klein, R.E. & Western, K.A. (1975) Acute morbidity and physical growth in rural Guatemalan children. American Journal of Disease in Childhood, 129, 1296 - 1301.

Mellander, O., Vahlquist, B. & Mellbin, T. (1959) Breast feeding and artificial feeding; a clinical, serological and biochemical study in 402 infants, with a survey of the literature; the Norbotten study. Acta Paediatrica, 48, (suppl.116), 1 - 108.

Meredith, H.V. (1946) Order and age of eruption for the deciduous dentition. Journal of Dental Research, 25, 43.

Morgan, J., Mumford, P., Evans, E. & Wells, J. (1976) Food intake and anthropometric data on children under 4 years old, living in the South of England. Proceedings of the Nutrition Society, 35, 74A - 75A.

Mylotte, M., Egan-Mitchell, B., McCarthy, C.F. & McNicholl, B., (1973) Incidence of coeliac disease in the West of Ireland. British Medical Journal, 1, 703 - 705.

Naismith, D.J. (1980) Maternal nutrition and the outcome of pregnancy - a critical appraisal. Proceedings of the Nutrition Society, 39, 1 - 11.

National Research Council, Food and Nutrition Board (1974) In Recommended dietary allowances, Washington: National Academy of Sciences.

Neligan, G., Prudham, D. & Steiner, H. (1974) In The Formative Years: Birth, Family and Development in Newcastle-Upon-Tyne, Oxford: University Press for Nuffield Provincial Hospitals Trust.

Nelson, M. (1980) Assessing dietary intake and its relation to growth in British children. Proceedings of the Nutrition Society, 39, 35 - 42.

Oates, R.K. (1973) Infant-feeding practices. British Medical Journal, 2, 762 - 764.

Orr, J.B. (1936) In Food Health and Income, 1st edition. London: Macmillan and Co.

Owen, J. (1889) Rickets, acute and subacute rheumatism, chorea, cancer and urinary calculus in the British Islands. British Medical Journal, 1, 113.

Oxford University Press (1979) In The Oxford Dictionary of Quotations, 3rd edition, p325. Oxford: Oxford University Press.

Palm, T.A. (1890) The geographical distribution and aetiology of rickets. Practitioner, 45, 270.

Paul, A.A. & Southgate, D.A.T. (1978) In McCance and Widdowson's The Composition of Foods. London: Her Majesty's Stationery Office.

Perissé, J., Sizaret, F. & Francois, P. (1969) F.A.O. Nutrition Newsletter, 7, 1.

Poskitt, E.M.E. & Cole, T.J. (1977) Do fat babies stay fat? British Medical Journal, 1, 7.

Pringle, M.L.K. (1969) In Policy implications of child development studies. Concern No.3. National Children's Bureau.

Pyke, M. (1970) In Man and Food, p7. World University Library. London: Weidenfeld and Nicolson.

Registrar General (1922) In Census of Scotland, 1921, vol.1, part 2, table 2. Edinburgh: Her Majesty's Stationery Office.

Registrar General (1963) In Census 1961 Scotland. County Report, vol. 1, part 2, table 8. Edinburgh: Her Majesty's Stationery Office.

Registrar General (1973) In Census 1971 Scotland. County Report, vol. 1, part 2. Edinburgh: Her Majesty's Stationery Office.

Registrar General (Scotland) (1977) In Annual Report 1976, part 2, pp156, 166. Edinburgh: Her Majesty's Stationery Office.

Reoch, E. (1976) In Farewell to the Single End. Glasgow: City of Glasgow District Council, successors to the Corporation of the City of Glasgow.

Richards, I.D.G., McIntosh, H.T. & Sweenie, S. (1979) A hundred vulnerable families, Public Health, 93, 16 - 24.

Richards, I.D.G., Sweet, E.M. & Arneil, G.C. (1968) Infantile rickets persists in Glasgow. Lancet, 1, 803.

Richards, I.D.G., Hamilton, F.M.W., Taylor, E.C., Sweet, E.M., Bremner, E. & Price H. (1968) A search for sub-clinical rickets in Glasgow children. Scottish Medical Journal, 13, 297 - 305.

Rowntree, S. (1937) In Human Needs of Labour. London: Longmans, Green and Co.

Scottish Home and Health Department (1970) In Principles of Infant Feeding, p8. Edinburgh: Her Majesty's Stationery Office.

Seacombe, M. (1973) Cited in Present-day Practice in Infant Feeding, Report on Health and Social Subjects. No.9, p6. DHSS (1974) London: Her Majesty's Stationery Office.

Sheridan, M.D. (1968) In The Developmental Progress of Infants and Young Children, 2nd edition. London: Her Majesty's Stationery Office.

Shukla, A., Forsyth, H.A., Anderson, C.M. & Marwah, S.M. (1972) Infantile over-nutrition in the first year of life: a field study in Dudley, Worcestershire. British Medical Journal, 4, 507 - 515.

Smith, C.A. (1947) The effect of wartime starvation in Holland upon pregnancy and its product. American Journal of Obstetrics and Gynaecology, 53, 599.

Smith, D.W., Truog, W., Rogers, J.E., Greitzer, L.J., Skinner, A.L., McCann, J.J. & Harvey, M.A.S. (1976) Shifting linear growth during infancy: illustration of genetic factors in growth from fetal life through infancy. Paediatrics, 89, 225 - 230.

Smithells, R.W. Sheppard, S. & Schorah, C.J. (1976) Vitamin deficiencies and neural tube defects. Archives of Disease in Childhood, 51, 944 - 950.

Sterky, G. (1970) Swedish standard curves for intrauterine growth. Paediatrics, 46, 7 - 8.

Strathclyde Regional Council (1977) In Multiple Deprivation, Glasgow: City of Glasgow District Council Planning Department.

Taitz, L.S. (1971) Infantile over-nutrition among artificially fed infants in the Sheffield region. British Medical Journal, 1, 315 - 316.

Taitz, L.S. (1976) In Paediatric and Adolescent Endocrinology, ed. Laron, Z. vol. 1, p60. Basle.

Tanner, J.M. (1973) In Textbook of Paediatrics, ed. Forfar, J.O. & Arneil, G.C. p270. Edinburgh and London: Churchill Livingstone.

Tanner, J.M. & Thomson, A.M. (1970) Standards for birth weight at gestation periods from 32 to 42 weeks, allowing for maternal height and weight. Archives of Disease in Childhood, 45, 566.

Tanner, J.M. & Whitehouse, R.H. (1962) Standards for subcutaneous fat in British children. Per centile for thickness of skinfolds over triceps and below scapular. British Medical Journal, 1, 446 - 450.

Tanner, J.M. & Whitehouse, R.H. (1973) Personal communication.

Tanner, J.M. & Whitehouse, R.H. (1975) Revised standards for triceps and subscapular. Archives of Disease in Childhood, 50, 142 - 145.

Tanner, J.M., Whitehouse, R.H. & Takaishi, M. (1966) Standards from birth to maturity for height, weight, height velocity and weight velocity: British children, 1965. Part II. Archives of Disease in Childhood, 41, 613 - 635.

Thomson, A.M. (1978) Problems and politics in nutritional surveillance. Proceedings of the Nutrition Society, 37, 329.

Thomson, A.M. & Billewicz, W.Z. (1963) Nutritional status, maternal physique and reproductive efficiency. Proceedings of the Nutrition Society, 22, 55 - 72.

Thomson, A.M., Billewicz, W.Z. & Hytten, F.E. (1968) The assessment of fetal growth. Journal of Obstetrics and Gynaecology of the British Commonwealth, 75, 903 - 916.

Titmuss, R.M. (1962) In Income Distribution and Social Change. A Study in Criticism, p188. London: George Allen & Unwin Ltd.

Tracey, V.V., De, N.C. & Harper, J.R. (1971) Obesity and respiratory infection in infants and young children. British Medical Journal, 1, 16 - 18.

Vimpani, G.V., Vimpani, A.F., Pocock, S.J. & Farquhar, J.W. (1981) Differences in physical characteristics, perinatal histories and social background between children with growth hormone deficiency and constitutional short stature. Archives of Disease in Childhood, In Press.

Walker, A.R.P. (1975) The short-statured child. British Medical Journal, 1, 454.

Wedge, P. & Prosser, H. (1973) In Born to Fail? London: Arrow Books in association with the National Children's Bureau.

Whitelaw, A. (1977) Infant feeding and subcutaneous fat at birth and at one year. Lancet, 2, 1098 - 1099.

Widdowson, E.M. (1951) Contentment and physical growth. Lancet, 1, 1316 - 1318.

Widdowson, E.M. (1955) Assessment of the energy value of human foods. Proceedings of the Nutrition Society, 14, 142 - 160.

Widdowson, E.M. (1965) Absorption and excretion of fat, nitrogen and minerals from 'filled' milks by babies one week old. Lancet, 2. 1099 - 1105.

Widdowson, E.M. (1969) Preparations used for the artificial feeding of infants. Journal of the Royal College of Physicians, 3, 285.

Widdowson, E.M. (1974 i) Feeding the newborn: comparative problems in man and animals. Proceedings of the Nutrition Society, 33, 97.

Widdowson, E.M. (1974 ii) Trace elements in foetal and early post-natal development. Proceedings of the Nutrition Society, 33, 275 - 283.

Widdowson, E.M., McCance, R.A., Harrison, G.E. & Sutton, A. (1963) Effect of giving phosphate supplements to breast-fed babies on absorption and excretion of calcium, strontium, magnesium and phosphorus. Lancet, 2, 1250 - 1251.