THE RELATIONSHIP BETWEEN GROWTH, DEVELOPMENT AND SOCIAL MILIEU - A LONGITUDINAL STUDY INVOLVING PRESCHOOL COLOURED CHILDREN IN CAPE TOWN

CHRISTOPHER D MOLTENO
B.A.(Hons)(SA), M.D.(Cape Town),
M.Med (Paed)(Cape Town) F.C.P.(S.A.),
D.C.H., R.C.P.& S.(Eng)

Thesis submitted for the
Degree of Doctor of Philosophy

UNIVERSITY OF CAPE TOWN

JUNE 1985

TO

ROSALIND, CATHERINE, STEVEN AND GILLIAN

ABSTRACT

A prospective longitudinal study was carried out to establish the relationship between growth, development and social milieu in Coloured pre-school children in Cape Town. This population was selected because, on the basis of previous studies, a wide range of nutritional status as well as a spectrum of socio-economic conditions were known to exist.

A pilot study was conducted to establish the feasibility of obtaining information about factors to be included in the study as well as to determine the most suitable sampling methods.

A cohort of 1 000 consecutive Coloured infants born in the Cape Town municipal area and notified to the Cape Town City Council was identified. A random sample of 187 was selected from the cohort for longterm study.

Anthropometric data were documented from birth until 5 years and compared to the NCHS reference values. Developmental data consisted of milestones recorded during infancy, language assessment on the Reynell Language Scale at 2½ years carried out by the Logopaedics Department, University of Cape Town, and at 5 years, a specially constructed developmental assessment designed to assess gross motor function, fine motor development including visuo-motor skills and language, both comprehension and expression as well as basic colour and number concepts. Social data were collected during home visits by two experienced, full-time research social workers, who were both integrally involved in the planning of the study.

At birth infants were relatively light and short for gestational age. Size at birth correlated with social class. A rapid post-natal weight gain rendered them relatively overweight between 3 and 6 months. Thereafter they again became lighter and shorter than the NCHS reference values and this persisted during the pre-school period. Mother's weight was related to weight at birth, 12 months and 30 months. The genetic influence on growth was reflected in a correlation between parental height and child's length from 12 months onwards. Environmental influences as assessed by social class by occupational grading of the breadwinner, income and family stability were also correlated with growth from 12 months onwards.

Infant development as indicated by milestones was very similar to internationally reported studies. Motor development was not associated with social class by occupational grading of the breadwinner but with father's education, mother's personality and family stability. It was also highly correlated with growth during infancy. Early language milestones were associated with the child's micro-environment as indicated by marital status, family unit, setting and stability. Language development at 30 months reflected a general lag in verbal skills and was correlated with parental education and family stability. At five years there was a good correlation between growth, development and social milieu, although the social variables accounted for far more of the variation in development than did growth.

Social class by occupation grading of the breadwinner and income reflected the general socio-economic status and there was a good cross-correlation between the social variables. Approximately one third of the families lived in a middle class environment. However, poor maternal education, low incomes and over-crowding were prevalent and must constitute risk factors in child rearing. Sixty five percent of the mothers were not educated further than primary school level and over half of the families were living below an effective minimum level of income. Similarly over half the families lived in grossly overcrowded conditions.

In conclusion, therefore, during infancy developmental milestones were similar to those reported in the literature. Later, however, there was a fall off in development and this coincided with a greater association with social circumstances. Just prior to school entry social factors far outweighed growth indices as predictors of developmental variation. Social stability of the family a composite evaluation based on a number of social characteristics,was most consistently associated with development. The implications for intervention are that this would need to be broad based and aimed at improving incomes, housing, family cohesion and child centredness and eliminating social pathology. Such intervention would require a concerted effort from a variety of sources which should include administrators, community workers and health professionals.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

I am deeply indebted to my supervisor Professor M.D. Bowie. I was fortunate in being able to draw on his extensive knowledge and experience.

I wish to record my gratitude to Janet Hollingshead and Miss A.D. Moodie, the social workers who contributed so much to the study. Their experience and knowledge of the community proved invaluable. Furthermore, their rapport with the families ensured that none of them declined to co-operate and, over the 5 years, only one child was lost to follow-up.

I wish to thank Dr D. Bradshaw and Mr J.P.G. Pretorius of the National Biostatistical Research Centre of the South African Medical Research Council. They assisted in the planning of the study and carried out the statistical analysis.

I wish to thank Mrs L. Heuer, who typed the thesis, most sincerely for her patience. I am also grateful to Jenny Altschuler for the preparation of the figures.

To the children and their families I extend my sincere appreciation. They patiently tolerated our intrusion into their private lives and displayed trust and understanding throughout.

Finally I am indebted to the Medical Research Council for the generous financial support for the study.

CHAPTER 1

INTRODUCTION AND AIMS OF THE STUDY

INTRODUCTION

Paediatric practice in South Africa is still largely concerned with the interacting effects of infection and poor nutrition upon survival. However, the recent decline in mortality rates (Department of Statistics, 1974) signifies an overall improvement in child health. This trend encourages a shift in attention from measures to ensure mere survival, to those that would improve the so-called 'quality of life'. The ultimate goal is to create a situation in which no child need be prevented from reaching his full potential. Today, unfortunately, there are still a significant number of children who, because of disadvantage and poverty, fail to achieve this potential.

To be poor, according to Birch and Gussow (1970) 'is to be assailed by a whole range of physical conditions which, by endangering life, growth and health depress mental development and educational potential'. Poor children, they claim, are not merely born into poverty: they are born of poverty. They are at risk of defective development even before birth and are often of low birth weight. Infant mortality is high and, for those who survive, early childhood is punctuated by frequent, severe and persistent illness. Throughout the preschool years they are poorly fed and grow slowly. The failure of such children in school is, in their opinion, virtually foreordained.

Gross pathological malnutrition is undoubtedly detrimental to the development of the young child. Less severe forms of undernutrition as evidenced by slow growth are far more common in underprivileged children, but the effect on child development is not well documented. Moreover, such children usually also live in unstimulating environments. Klein et al (1972) have questioned the notion that protein calorie consumption directly affects the quality of cognitive functioning and remain sceptical about the nature of the association between nutrition and intellectual status. They were, in a study of rural Guatemalan children, unable to differentiate the independent contributions to cognitive functioning of physical growth from social factors. In

practice it is difficult to separate nutrition and social environment. A hungry child in a hungry family, according to Stein and Susser (1984), is deprived of far more than food.

In Cape Town a number of studies, both short and long-term, have incriminated the environment for the suboptimal growth that exists among the underprivileged children, for their scholastic failure and, in extreme cases, for abnormal neurological maturation (Wittmann et al, 1967; Keet et al 1971, Evans et al, 1971; and Stoch and Smythe, 1976). Stoch and Smythe commenced a developmental study in 1955 based on the hypothesis that the ill effects of undernutrition were determined by its occurrence during the critical period of brain growth. The inhibition of the growth of the brain during the first two years of life, they postulated, would lead to a permanent reduction in brain size and impaired cognitive functioning. The index group, consisting of masrasmic children, were matched for age, sex, socio-economic status and ethnicity in a repeat-measurement longitudinal design. Both groups were followed up at periodic intervals and the findings reported after five (Stoch and Smythe 1963), ten (Stoch and Smythe, 1967), fifteen (Stoch and Smythe, 1976) and twenty years (Stoch et al, 1982). At the end of the study they concluded that children who had been marasmic had smaller head circumferences, deficits in visuo-motor perception and a higher incidence of abnormal EEG records and CT scan findings, suggesting an organic basis for brain dysfunction, predominantly at a neurointegrative level. An unexpected finding was that girls appeared more vulnerable to the effects of early malnutrition than boys.

A similar longterm follow-up study on the effects of kwashiorkor was started in Cape Town in 1959. In contrast to the outcome in children who had been marasmic, there was no difference in growth achievement between ex-kwashiorkor cases, siblings and the community and neither were there differences in scholastic attainment or social adjustment (Evans et al, 1971; Keet et al 1971). A further prospective study was undertaken to determine the effect of dietary supplementation during the first two years of life of newborn babies in families who had previously had a child with kwashiorkor (Evans et al, 1980). The early growth spurt which occurred was not sustained when the child returned to the normal family diet. Although the heights and weights were similar to those of the siblings, the IQ's were on average ten points higher due mainly to better language abilities.

These studies may be critised on a number of points. In the follow-up of marasmic infants, there was no mention of prematurity or intrauterine growth, the numbers were small and there were differences between study and control groups in terms of social circumstances. In the kwashiorkor study, sibling controls were used in an attempt to minimise the effect of socio-economic variables. The use of intrafamilial controls does not entirely eliminate non-nutritive factors, as a well nourished child may elicit his own social and emotional stimulation, in contrast to an apathetic malnourished child. The food supplementation study also involved small numbers. In addition, the groups were assessed at different ages and the tests used were not standardised for the population. It cannot therefore be assumed that the children would have similar scores at different ages.

In spite of the criticisms, these studies have made important contributions to the understanding of the longterm effect of malnutrition on development. Taken together they would suggest that marasmus which affects brain growth during the first two years of life, results in organic brain dysfunction as judged by a reduced head circumference, visuo-motor perceptual difficulties and a higher incidence of EEG and CT scan abnormalities. In contrast, kwashiorkor resulting from a single severe nutritional insult between the ages of ten months and four years, does not have a measurable retarding effect. There is some evidence that nutritional intervention during the first two years will improve the IQ even if it has no longterm effect on stature. The finding of biological differences in marasmic children would tend to refute the criticism of lack of similarity in social background. Psychosocial adversity could explain the lesser drive and initiative, maturity, social intelligence and general intelligence, especially verbal quotients found in exmarasmic children. In the kwashiorkor children no evidence of brain damage was demonstrated. The improvement in IQ in food supplemented infants was reflected in higher verbal scores. The improvement in verbal ability was evident six years after the cessation of supplementation suggesting that these effects far outlast the physical benefits of feeding on height and weight. It is not obvious whether this results from organic factors in brain maturation or from environmental stimulation during a sensitive period of language acquisition.

The micro-environment is extremely important for both nutrition and development. In a study in the Bonteheuwel suburb of Cape Town Wittman et al (1967) demonstrated the interaction between infection and nutrition in early childhood. They also showed that the household income had a significant effect on growth even within the relatively homogeneous population. Poor maternal weight-height ratio and low weight gain in pregnancy have also been shown to be associated with the most adverse socio-economic conditions and the lowest mean birth weights (Moodie et al, 1970). More recently Power (1982), reporting on an anthropometric study of Coloured children who had just entered school in a working class area of Cape Town, concluded that despite finding a considerable proportion of children below the NCHS (National Centre for Health Statistics) 5th centile, the general picture represented an improvement compared to previous studies.

Because of the improved nutritional status of the children in Cape Town and the relative importance of the micro-environment on development, it was felt that a study was indicated to determine the effects of milder forms of malnutrition and of the social circumstances on child development.

In 1973 a commission of inquiry was appointed under the chairmanship of Prof E Theron to investigate matters relating to the Coloured Population Group. The Commission found that the group consisted of a mosaic of heterogenous subgroups each with its own stratification pattern dependent upon its origin, skin colour, religion, social and professional status, life style etc. There exists therefore, within a statutory population group, a wide spectrum of life styles and standards of living.

Against the background of the Theron Commission, and in view of the studies already carried out on the Coloured children in Cape Town, it was felt that this group would provide a suitable population for the study of growth and development in preschool children.

AIMS OF THE STUDY:

It was decided that a sample should be drawn from a birth cohort of Coloured infants, the sampling method having been determined by the

findings of a pilot study. The sample would then be followed for five years. Anthropometric data, periodic assessments of developmental progress and details of social circumstances derived from home visits would be collected over the 5 year period.

The specific aims of the study were:

i. to investigate the relationship between growth, development and social milieu -
   - in infancy
   - at 5 years of age
   - with reference to certain aspects of development i.e. gross motor, fine motor and language development.

ii. to determine whether growth, as an index of nutritional history, relates to development independent of social environment.

A functional orientation with its related systems theoretical approach was adopted. Functionalism is a way of assigning meaning to phenomena according to the effects they produce (McGee, 1972). One of the basic assumptions of the functional orientation is that phenomena, whether social or biological, are viewed as systems comprised of a number of interrelated parts (Hagedorn and Labovitz, 1973). Each system in turn interacts with others to form a larger one. Growth, development and social milieu are therefore considered as systems which contribute to the global 'being' of the child.

CHAPTER 2

THE ORIGIN AND ORIENTATION OF THE CAPE COLOURED COMMUNITY

A. ORIGIN

The Population Registration Act (Act 30 of 1950) defines a 'Coloured person' as a person who is not a white person or a Bantu and does not form part of the Chinese, Indian or other Asiatic groups. Section 5 (1) and (2) of the Act distinguishes various subgroups, the Cape Coloured comprising the overwhelming majority with the Malay next in size. In 1980 54% of the Coloured population lived in the 01 Economic Area (Cape Peninsula).

There has been debate as to whether the Coloured people constitute a separate race (v.d. Ross, 1979). Beuttner Janish (1973) defined a race as a Mendelian population; a reproductive community of individuals that share a common gene pool. Tobias (1972) maintained that they were one of several groups to have arisen by interracial hybridization during the historical period. Today they are sufficiently numerous to be a self-maintaining population. Using blood group gene frequencies Botha and Pritchard (1972) indicated that the Cape Coloured community contained 34% Western European, 36% South African (Hottentot and Negro) and 30% Asian genes. The origin of the gene input can be traced historically.

Hottentots and Bushmen: The Hottentots are generally accepted to have originated from the intermixture of Hamites of North Africa and Bushmen (Schapera, 1930). This must have taken place in the vicinity of the East African Great Lakes, from where they migrated south across the central plains to the west coast of Africa. From there they moved southwards to the Cape. Together with the Bushmen, whom they resemble, they comprised the 'Koisan' peoples. The Hottentots designated themselves Khoin-Khoin (people of people i.e. people par excellence) and were linked by a group of related languages. They differed from the Bushmen, the San, in that they kept livestock, were less migratory and were organised in larger political units (Schapera, 1930).

Many tribes of Hottentots existed and were distributed from the Kunene River to the Cape and eastwards to the Kei River. They all spoke one of four closely related languages, according to which they were divided into - Nama, Korana, Gonaqua and Old Cape Hottentot (Seligman, 1966).

The first contact with whites occurred in 1652 (Thom 1952). Within 30 years, however, the tribes in the Western Cape were dispossessed of grazing rights and dispersed by the settlers (Moodie, 1960). In addition many groups were decimated by epidemics including smallpox in 1661, 1663, 1713, 1755 and 1767 (Thunberg, 1795). In 1664 there were 80 Hottentots recorded as belonging to the Colony (Thom, 1952). By 1810, 660 males and 645 females were listed as living in the Cape district and 20,000 men and women in Cape, Stellenbosch, Swellendam, Tulbach, Graaff Reinet and Uitenhage. Many of these were called Bastard Hottentots or Javanese Hottentots because of their intermarriage with slaves or their descendents (Mentzel, 1785).

Thus contact with European and Asian immigrants led to the disintegration of the Cape Hottentot society. Illness and intertribal warfare led to the disruption of the clans as units. Wandering bands of robbers comprised of impoverished or fugitive Cape Hottentots ventured inland in the early 19th century. The leaders, who were not pure Hottentot, adopted the Dutch language, European dress and professed Christianity. They were known as Oorlams and travelled as far as Namaqualand, the Vaal basin and South West Africa (Schapera, 1930).

During the 18th Century relations between the colonists and Bushmen were hostile and several large punitive expeditions were undertaken by the colonists. Many men, women and children were captured and retained as servants (Moodie, 1960).

Slaves: In 1652 there were reported to have been a 'substantial number' of negroes accompanying the early settlers. In 1658 approximately 300 boys and girls from Angola and Guinea remained behind when a large assignment of slaves stopped at the Cape (Blommaert, 1938). From 1670 to the end of the eighteenth century

many were brought from Madagascar and East Africa (Marais, 1939).

Slaves were brought to the Cape from the East during the 17th and 18th Century. Although they have been called Malays, the majority came from Indonesia and many from the Moluccas, Ceylon, India and Bengal (Leibbrant, 1906). Official slave lists suggest that the majority of the slaves originated from Madagascar and East Africa and the minority from Asia (c.f. Slave Lists 1802 - Madagascar 91, Mozambique 161, Asiatics 67) (Cape Archives). Many families brought Asians as house servants (Leibbbrant, 1906). Between 1715-1806 the Governor and council records report 1290 'slaves and free blacks' - Madagascar 20, Mozambique 8, Asia 774 (Indonesia 409, Bengal 199, India and Ceylon 166), Cape born 480 (Leibbrant, 1906).

The indigenous South African population was never taken as slaves, but the Hottentots and slaves mixed freely (Moodie, 1960). Offspring of slaves and Hottentot women were not born in bondage and could be taken up into the free community (Moodie, 1960). Boëseken (1977) described the Free Blacks as 'the ancestors of today's Coloured population'. In 1767 all importation of slaves ceased and slavery was abolished by Britain in 1807 - on 1 December 1834 'the ignoble title of slave was erased for ever from the annals of the Cape of Good Hope' (De Kock, 1950). By 1834 the Hottentot and slave had merged together as the Cape Coloured people (MacMillan, 1968).

Europeans: The first contacts between Europeans and Hottentots were made well before Jan van Riebeeck arrived at the Cape. Sporadic incidents of biological assimilation took place during this period (Cilliers, 1963). Once the settlement had been established, marriages between Europeans and other population groups professing the Christian faith, took place and received social and religious sanction. Some of these children were accepted into the white group. (Report of the Commission on Mixed Marriages in South Africa, 1939). In the period 1757-1766, 6-7% of all marriages registered were between European men and non-white women (Botha and Pritchard, 1972). The early colonists accepted mixed marriages and there was a surplus of men. Many did not contract marriage bonds

and especially in the case of visitors, relationships were irregular and temporary, but were responsible for the transfer of genes from Europeans to other population groups (Botha and Pritchard, 1972). There were several unsuccessful attempts to prevent mixed marriages (Moodie 1960). In 1671, however, three quarters of children born to slave mothers were of European fathers (Theal, 1909). In 1817 the Church officially declared itself against racial intermarriage. Between 1807 and 1837 mixed marriages occurred mainly on the borders of the colony and were more frequent with British than other colonists. Most of their offspring were taken up into the mothers race i.e. Coloured (Heese, 1971). In 1819 the colony consisted of 47 000 whites (4 000 British although a further 5 000 arrived in 1820) 30 000 Hottentot and 35 000 slaves (Hackley, 1948).

Bantu: In recent times another element in the form of assimilation between Coloured and Bantu has come to be of increasing importance. This has resulted from penetration of Bantu in increasing numbers into the Western Cape, which is the traditional centre of concentration of the Coloured people (Cilliers, 1963).

The Coloured population therefore has its origin in the process of contact and assimilation between various ethnic and racial groups over a period of more than 300 years (Cilliers, 1963). Few communities in the world claims Venter (1974) have origins as disparate, widespread and complex. Their roots can be traced to all of five continents.

B. ORIENTATION

Social action, according to Weber (Timasheff and Theodorson, 1976) refers to human behaviour, whether overt or not, to which the acting individual attaches subjective meaning. In the study of social action Weber (Timasheff and Theodorson, 1976) called for the method of the pure or ideal type. This refers to a mental construct, formed by exaggerating or accentuating one or more traits or points of view of observable reality. Note that it is 'ideal' because it exists as an idea. The ideal type is not a hypothesis but rather a tool for analysis of concrete events or situations.

Weber, in Economy and Society (1968), cited as an illustration of an ideal type, rational action. An action was rational if use was made of appropriate means for attaining rationally chosen ends. Other non-rational types of behaviour were seen as deviations from the rational ideal type e.g. traditional action determined by social custom, affective action determined by emotion.

Societies, he believed (Weber, 1947) could be classified according to their mode of orientation based on the degree of rationality of their behaviour. They may be traditional on the one hand or modern (rational) on the other. In addition, Weber described an intermediate type characterised by an affectual mode of orientation. These divisions have been used by Beshers (1967) in relation to decision-making, as follows:

- traditional (tribal) peoples where decisions are imposed upon the individual by society
- affectual, referred by Beshers as 'short-run hedonistic', where decisions take account of a brief time period in the future and are influenced by evanescent situational factors. This type of society is characterised by localised overcrowding, squatting and degeneration of family form, resulting in clusters of children with female family heads. Employment and incomes are erratic and day-to-day survival is emphasized. It follows a break-up of traditional living patterns, resulting in widespread social disorganization.
- modern (rational purposive). Here sequential decision-making occurs.

Character, according to Riesman (1970), is socially conditioned and consequently there must be a link between a particular society and the kind of character it produces. Societies may be classified in terms of demography and social character. Population theorists distinguish three demographic phases represented by an S-shaped curve. Initially there is a high birth rate and high death rate (high growth potential). This gives way to a decreased death rate (transitional period of rapid population expansion). Finally both birth rate and death rate decline (incipient population decline). Social character is divided into traditional directed, inner-directed and other-directed according to the orientation of the members of the society.

Society is classified by Riesman (1970) into:

- high growth potential/tradition-directed type-characterised by a tenacity of custom. Social changes take place by adaptation and not by innovation.
- transitional growth/inner-directed type. The imbalance of births and deaths puts pressure on the society's customary ways with disruption of traditional living patterns. There is increased personal mobility and an almost constant expansion. The inner-directed type has much in common with Weber's affectual mode of orientation.
- incipient population decline/other-directed type - with material abundance and leisure as well. Other-directed people are literate, educated and provided with the necessities of life by machine, industry and agriculture.

The coloured population of South Africa has moved demographically well into the transitional phase with the birth rate high, but showing signs of a fall and death rate declining. The figures for the coloured community of Cape Town (birth rate and death rate 25,35 and 5,95; 1980) would represent the late transitional phase. As regards social character the Theron Commission (1976) found a subgroup of approximately 20% in which the breadwinners were employers (farmers or businessmen), professional, or educated clerical workers. They manifested a 'middle class' lifestyle and outlook and would fall into the rational-purposive or other-directed category. The lowest subgroup comprising about 40% of the coloured population had, the Commission felt, a lifestyle and orientation indicating a condition of chronic poverty*.

* Footnote: A minority view of the Commission objected to the term 'chronic community poverty' as they claimed it implied a 'subculture of poverty'. They criticized the concept on philosophical and ideological grounds, saying that such ideas are put forward by radicals, largely under neo-Marxist influence, who direct their resentment against the environment (the 'system', the 'establishment'). This they felt was a one sided approach.

This subgroup had much in common with the Culture of Poverty of Lewis (1966). The members would then have their own structure, rationale, way of life, providing them with a design for living and a ready made set of solutions for human problems. The setting for such a culture is a Western cash economy with a high rate of unemployment and underemployment. The families are characterised by instability of consensual marriage; are mother centred and are tied closely to the mother's extended family. They would fall into Weber's affectual or Riesman's inner-directed groups. The remaining 40% represented a spectrum between the two which would roughly be divided in half. The uppermost section would, in the opinion of the Commission, advance within ten or more years to join the 'middle class' group.

The social characteristics of the families in this study will be described in Chapter V.

CHAPTER 3

REVIEW OF THE LITERATURE

A system, according to Scott (1979), is one of the most general scientific concepts, applying to both living and non-living phenomena. Growth, development and social milieu may each be seen as systems comprised of a number of sub-systems. A system may be defined as a group of interacting entities, with the following characteristics (Scott, 1979):

- reciprocal stimulation between units
- a tendency for organisation to change towards increasing complexity and, concurrently, stability
- differentiation of function between units
- a tendency for the interactions between the units to favour survival of the system; to be adaptive.

In this literature review growth, development and social milieu are dealt with separately, with attention being paid to definitions and terminology, theoretical background, methods of assessment and factors influencing outcome.

A. GROWTH

The literature is vast and only that which is specific for this study will be covered i.e. human, postnatal growth relating primarily to the pre-school period.

I. Definitions:

Growth refers to the process or manner of growing; to grow is to increase in size by natural development or to increase in magnitude, quantity or degree (Shorter Oxford Dictionary, 1970). By introducing the adjective somatic, physical or body growth is indicated which in turn depends on skeletal growth and maturation. Maturation is defined as the action of coming to full growth and development (Shorter Oxford Dictionary, 1970). Both development and maturation are also used in other contexts and will be defined in section B.

The comparative measurement of the human body and of its parts is termed anthropometry (Butterworths Medical Dictionary, 1978). Auxology refers to the scientific study of the growth of the organism (Butterworths Medical Dictionary, 1975). The concept of nutritional anthropometry was introduced in 1953 by Brozek as a synthesis of the methods of physical anthropometry and the theoretical aspects of nutrition.

Nutritional status is an operational term that implies measurement of the responses to nutrients or lack of them by an individual, a group or a community (Falkner and Roche, 1974).

Growth is a product of the interaction of heredity and environment (Tanner, 1978). An optimal environment will theoretically allow the inherited possibility to be fulfilled. One of the major environmental limiting factors is nutritional or limited food intake. Thus suboptimal nutrition (over or under) will lead to suboptimal growth. It must be stressed that other factors besides nutrition e.g. organic disease may also lead to suboptimal growth. Conversely there are other ways besides growth analysis by which nutritional status may be assessed.

II. Mechanisms of Growth Control:

Growth reflects a combination of cellular hyperplasia and hypertrophy under genetic control, modulated by environmental factors especially nutrition (Cheek et al, 1970). Widdowson and McCance, (1975) postulated on the basis of animal studies a 'critical period' depending on nutritional status which sets the appetite and determines future growth. A small size at this critical time, brought about by undernutrition, is not followed by 'catch-up' growth, however liberal the diet. A full diet produces catch-up only if malnutrition occurred after the critical period. A prolonged period of suboptimal nutrition has 3 effects - the young animal or child grows at a suboptimal rate- the time during which growth is possible is prolonged - the adult size is smaller. Ounsted and Sleigh (1975), by demonstrating a tendency in breastfed small for

gestational age and large for gestational age infants to revert to the mean, postulated a powerful self regulatory control of intake within infants. The same idea was referred to by Waddington (1957) as canalization. This meant that, should growth be pushed off course, there is a tendency for it to return to its original path or channel. The process of growth thus manifests a self-stabilizing or target seeking ability.

III. Factors Affecting Growth:

i. Genetics: Growth is one of the most heritable characteristics in man. Heritability refers to the proportion of the phenotypic variance due to additive genetic variance or stated differently, the regression of the additive genetic value on the phenotype value (Susanne, 1980). Estimations of heritability may be calculated from studies on twins, from parent child comparisons; analysis of data for siblings or other degree relatives can also be used (Susanne, 1980). Shields (1962) has demonstrated that monozygous twins reared apart were more different in adult stature than those reared together, but they were more similar than dizygous like-sexed twins. Regarding siblings (Garn et al, 1966) correlation co-efficients of body length measurements are generally 0,3 - 0,5 but may be higher in sister-sister than brother-brother comparisons (Garn et al, 1969). Between parent and child the relationships become closer from the age of 2 years suggesting a takeover of genetic influence from uterine environment. From 3 to 9 years parent offspring correlation co-efficients are in the order of 0,5 for height (Mather and Jinks, 1963). There is little evidence that one parent predominates in effect on size or that same sex plays a role (Tanner et al, 1970).

ii. Racial differences are studied in populations with a common gene pool and optimal environmental conditions. In 1976 Eveleth and Tanner (1976) summarised data

collected from 340 growth projects in 42 countries. This was done as part of the Human Adaptability Section of the International Biological Programme which extended from 1964 to 1974. The following is a summary of their findings:

The world populations were divided into:

- Europeans in Europe and their descendents
- Africans in Africa and their descendents in the America's
- Asiatics (including Chinese, Japanese, Southeast Asians, Amerindians and Eskimos)
- Indo-Mediterraneans of the Near East, Middle East and India
- Australians and the Pacific Island peoples

All European populations grow in a similar manner with slight local variations. Those of the North-west fringe of Europe (Norway, Sweden, North Germany and Holland) are the tallest, and those of North-central Europe (Czechoslovakia and Poland) are the heaviest both absolutely and relative to height.

Growth studies in Africa are hampered by the impact of undernutrition and disease. However, well-off groups of Africa are similar in height and weight to Europeans. In the U.S.A. children of African descent are taller and heavier at all ages than Americans of European descent, mainly because of faster skeletal maturation from birth onwards. In addition Africans have longer legs relative to trunk length, narrower hips relative to shoulder width and possibly less subcutaneous fat over the arms relative to fat over the trunk.

Asiatics are less tall at all ages than Europeans and Africans despite early skeletal maturation. Their leg lengths, although initially similar to Europeans, diminish relative to trunk length so that adults have

shorter legs.

Indo-Mediterraneans resemble Europeans in growth and body proportions.

Australian Aborigines are characterised by excessive leg length relative to trunk length. Data on other peoples in this group was lacking.

There have been a number of anthropometric studies carried out in South Africa. In 1967 Smit et al found White children in Pretoria to be as tall a their US counterparts and their weight-height ratios fell within the range of European children. Their shoulder tip and hip width measurements, together with those from the US, were at the top of the European range. Skinfold thicknesses were identical to London findings.

Urban Black children in Pretoria (Smith, 1967) and rural Pedi (Leary, 1968) were lighter and shorter than European children. In addition, their weight-height ratios and shoulder and hip widths were below European values. Arm circumferences in both urban and rural samples fell within the European ranges, whereas skinfold thicknesses were below European norms.

Children from reasonably affluent Pretoria Indian familes (Smit et al, 1967) were marginally below well-off children in India as far as weight and height was concerned. Although the Pretoria children were smaller than those in Europe, their weight-height ratios fell on the regression line. Shoulder and hip width and skinfold thickness were all below European values.

Coloured children in Pretoria (Smit et al, 1967) were smaller and lighter than Ashcroft and Lovell's (1964) privileged children of 'mixed descent', in Jamaica.

Taking the four groups together, between the ages of seven and eleven years (Smit et al, 1967), the Whites were significantly bigger than tbe Black, Indian and Coloured children, but there were no differences between the latter three groups. Regarding intercristal and biocromial distances, there was a gradient from White to Indian to Coloured to Black, with the largest measurements found in White children. The skinfold thicknesses of White and Indian were significantly greater than Coloured and Black children. The White children grew faster than those in the other groups. A Pretoria dietary survey (Lubbe, 1973) showed that the intakes of all nutrients were lowest among the Coloured group. Black children had the highest intakes of carbohydrate and iron, while White children had the highest intake of all other nutrients.

A study by Singer and Kimura (1981) investigated body growth and skeletal maturation in the related populations of Namibian Basters, Namibian Hottentots and Cape Coloureds. Unfortunately the Coloured sample consisted of 41 children from Bonnytoun 'School'. This institution is, in fact, a place of safety, for children in need of care and cannot be considered to be representative of Coloured children in Cape Town.

A large study on when Black children in Durban (Coovadia et al, 1978) reported that median weights of the youngest were similar or heavier than the Harvard standards, whereas their older children were generally lighter. Similarly lengths up to 24 months were the same, while older children were shorter. The authors concluded that this decrease in height and weight probably reflected the damaging effects of an impoverished socio-economic environment on growth and that standards established in the 'developed world' were appropriate for South African Blacks. A recent study in a rural Tswana community (Richardson and Sinwel, 1984) reported weights on the NCHS standards

for the first seven months but thereafter faltering. Stature remained below the 50th centile but head circumferences followed the standard curve.

Power (1982) assessed the growth achievements of Coloured entrants in Cape Town in 1979 and concluded that, although some children had grown suboptimally during the preschool period, there was a relatively favourable picture when compared to previous studies.

In all these studies only the White and Indian children could be considered to be adequately nourished. The findings of these two groups bear out the conclusions of Eveleth and Tanner, that the descendants of European populations are taller, broader and heavier than those of Asian origin. Thje studies on Black and Coloured populations reflect the effects of undernutrition on growth. There is a trend towards improved nutrition and the suggestion that during infancy amongst Black children normal growth centiles can be maintained, but at this stage there are no data to confirm the postulation that South African Blacks have the same growth potential as children of European origin. Similarly the growth potential of the Coloured population remains to be evaluated.

iii. Nutrition: That nutrition has an important influence on growth is beyond dispute. Waterlow and Payne (1975) have expressed the relative amount of energy required for maintenance to that required for growth at different ages. In the first 3 postnatal months 23% of the energy cost is for growth, relative to maintenance. This has obvious implications for growth if energy intake is deficient. In later years the proportion required for growth relative to that for maintenance diminishes, but if a chronic energy deficit occurs, the cumulative effect on growth can be significant. Waterlow and Payne (1975) estimated the

energy requirements for daily physical activity to be in the region of 80 KJ/kg/day and for growth 20 KJ/kg/day. When daily intake falls physical activity diminishes with concomitant deleterious effects on play and social interaction. A further decrease in calorie intake (below 330 KJ/kg/day) results in growth failure. Protein is perhaps less important than previously thought. Of the daily intake 7/8 is used for maintenance and 1/8 for growth. An intake below 1,3 g milk protein per kilogram in an infant causes growth to cease within 2 days.

The role of the genotype in determining differential response to nutrient intake has been established in experimental animals. In humans, however, Johnston (1984) maintains that there is no solid evidence of differential responses to the same level of nutrient as a factor contributing to inter-population variability in growth.

Many reports are to be found in the literature documenting poor growth in disadvantaged societies throughout the world. Attention has been given particularly to the timing of the onset of malnutrition as well as to the prospects of growth catch up on return to adequate nutrition. Thomson (1970) suggested 3 phases - firstly from birth to 3 or 6 months when growth was optimal; secondly a period from 6 to 18 months when disease or other adverse circumstances cause setback and thirdly, from 18 months to 5 years, when growth 'maintains station' but fails to achieve full recovery from previous set-back.

The question of catch-up growth has generated considerable debate in recent years. Forbes (1974) described it in mathematical terms, stating that it is complete only when the integrated velocity excess during recovery matches the previous deficit. Prader (1978) showed that there is a sharp increase in growth

velocity followed by a progressive deceleration until the original 'growth channel' is reached. Tanner (1978) distinguished between 'true catch-up' consisting of a considerable increase in growth velocity until the original curve or pattern is reached and a delayed maturation and prolonged growth period without an abnormal increase in velocity. Hansen et al (1971) claimed a good prognosis, given proper treatment and a continued improved environment. Graham and Adrianzen (1971) speculated that adverse environmental influences affecting nutrition over the entire growth period are probably as important as inheritance in determining eventual stature. Catch-up growth both in height and head circumference can go on for many years. Head circumference and presumably brain mass may not be selectively affected by severe malnutrition and may remain a function of body mass. Graham et al (1981a) found children of better off families to be taller and heavier but no different in weight/height. Graham et al (1981b) pointed out that it is possible that taller and heavier children whose families can spend more on food also had a greater genetic potential for growth or were living in slightly healthier environments with less constraints to the most efficient utilization of food. Studies from Jamaica (Granthan McGregor et al, 1972), Nigeria (Jane, 1974), Egypt (El-Nofely, 1978), Durban (Coovadia et al, 1978), Australia (Cox, 1979) show growth failure in disadvantaged populations or sections of a community. In Third World societies, however, the elite sections attain growth standards similar to children in developed societies (Graitcer and Gentry, 1981).

Habicht et al (1974) maintain that ethnic differences in height and weight in well nourished children are small (3% for height and 6% for weight). In contrast, among poor, urban and rural regions differences approach 12% in height and 30% in weight.

Regarding the role of growth as an indicator of malnutrition, Margen (1983) described the following theoretical models: deprivational theory of growth based on the definition of malnutrition as the undersupply of nutrients necessary for the individual to reach his full genetic growth potential. By implication failure to reach this potential will result in functional impairment in addition to a decreased size. In contrast, the homeostatic theory of growth maintains that the function of the genetic mechanism is to provide a potential for growth within the bounds of the nutritional and environmental experiences of the child. According to this theory the optimal growth curve is replaced by a broad spectrum of potential growth curves. A third possibility is that the genetic determinant regulates the maximum growth potential of the individual and any growth beyond this would be detrimental. This would query the supposition that maximal growth should be equated with optimal growth.

Another question arising is that if growth is an indication of malnutrition, would the relationship and functional impairment be linear or curvilinear thus demonstrating an area of adaptation and a threshold effect? At present Margen claims the answer remains inconclusive.

iv. Social Class: In countries where conditions of adequate nutrition prevail, differences in height are found in children of different socio-economic status. The children from better-off homes are taller and mature earlier. A number of large studies in the UK (Acheson and Hewitt, 1954; Goldstein, 1971; Douglas and Blomfield, 1958; Miller, 1972;) have borne this out although in Sweden (Lindgren, 1976) no such differences were found. The causes for social class difference in growth patterns are complex and cannot be fully explained in terms of nutrition. It has been

shown that in Britain women who are taller than average for their class tend to marry 'up' and vice versa (Illsley, 1955).

v. Migration and urban rural differences: Many studies in various parts of the world have shown that children of immigrants become taller than their parents (Tanner, 1978). This trend is also evident with migration from a rural to an urban environment within the same country (Panek and Piasecki, 1971).

There has been a change in growth pattern over the last hundred years which is referred to as the secular trend (Meredith 1976). Children have matured faster with greater increments of growth resulting in a larger size for age during childhood and in an earlier advent of adolescence and final height attainment.

vi. Disease: Acute illnesses do not usually cause a discernable retardation in growth. Chronic or repeated minor ailments affect growth especially in children who are suboptimally nourished. Martorell (1980) has reviewed a number of studies on the relationship between illness and physical growth. Separation of country of origin revealed contrasting results. In developed countries no association was found, whereas in developing countries, even common childhood ailments, in particular diarrhoeal disease, were clearly associated with poor growth (Rowland et al, 1977; Chandra, 1979). It is, however, difficult to distinguish the importance of disease from other adverse factors in the environment which are often present. The exact causes of growth retardation in serious and prolonged illness probably vary from one disease to another. Possible mechanisms include reduced availability of nutrients to the growing tissues, action of toxic substances on the growing cells and increased production of cortisol. Cure of the disease, however, is followed by partial or

complete catch-up growth.

vii. Psychological Stress: The classical study of Widdowson (1951) demonstrated that subjecting children to emotional stress was more effective in inhibiting growth than increased rations were in accelerating it. There are a number of reported studies on children admitted to hospital for investigation of failure to thrive in whom a significant number had no primary organic illness. These children came from emotionally disturbed families with a high prevalence of psychological stress and abnormal maternal or environmental relationships or a history of family disruption (Bullard et al, 1967; Shaheen et al, 1968; Hannaway, 1970; Oates et al, 1971; Sills, 1978). The condition of deprivation dwarfism has also been related to the association between lack of sleep and decreased secretion of HGH (Gardner, 1972).

viii. Seasonal and Climatic Factors: It has been suggested that growth is faster in midwinter and early spring, whereas weight gain is fastest in autumn. However, Marshall (1965) has shown that only about 30% of children manifested seasonal growth cycles and concluded that seasonal variations in light and temperature exert at most only a small effect on growth rate and perhaps none at all.

ix. Assessment of Growth requires the following procedures

- correct recording of the age
- accurate measurements
- selection of important anthropometric indices
- comparison of results with appropriate standards

The chronological age is recorded in terms of years and months calculated from the birth date of the individual. For evaluating changes in measurements and growth velocities, the decimal age is required. Here the year is divided into tenths and each day of

the year is ascribed a value - in terms of thousanths of a year. The decimal age is calculated by subtraction of the decimal birth date from the decimal date of examination.

The methods for obtaining accurate readings have been described by Falkner (1961), Owen (1973), Zerfas (1977) and Cameron (1984). In August 1976 a review based on results of the WHO Collaborative Study on Nutrition (Keller et al, 1976) was published. In the selection of anthropometric measurements and indices the following were found:

Arm circumference, first introduced by Jelliffe (Jelliffe and Jelliffe, 1969), has been criticised because of its lack of inter- and intra- personal reliability as well as the sensitivity as an indicator of recent nutritional change. The arm circumference related to height (Quac stick) (United Nations Relief Operation, 1972)is generally unsuited for clinical use but helpful in emergencies. The ratio of arm circumference to head circumference which should be independent of age has no particular advantage. Similarly the difference between chest circumference and head circumference may indicate chronic rather than acute malnutrition but does not appear to be suitable for wide use because of the difficulty in measuring chest circumference accurately.

Weight-for-age is a simple measure but may create inaccuracies in the presence of oedema and because the major part of the deviation of the body weight from the mean is due to differences in height.

Height-for-age will estimate past and chronic malnutrition but not necessarily the present status. In addition, the disadvantage of using the height only relates to the narrow distribution of values, making grading difficult or to the fact that a height deficit

takes a long time to develop. Finally height differences are often a reflection of genetically determined factors.

An indicator of leanness or thinness and fullness is obtained by the weight-for-height. This measure is age independent and is expressed proportional to height. Obviously there is advantage to be gained by quoting weight-for-height plus height-for-age (i.e. information on both past and present nutritional status). There is in fact little correlation between these 2 indicators, in contrast to the weight-for-age and height-for-age. The weight/height and weight-for-age have been combined in Waterlow's classification of malnutrition. It is important to realise that the significance of stunting is related to age if it is expressed as a percentage of a reference height because of the influence of growth velocity. A number of indices using weight and height have been proposed, many in an attempt to obtain age independence e.g. Quetelet (weight/height), Kaup (weight/height^2); Rohrer (100 weight height^3), Livi (^{3} Wt/length); Dugdale weight/height^{1,6}; Wetzel etc (Waterlow and Rutishauser, 1974). These appear to have little advantage over the simpler methods.

According to Waterlow (1984) a deficit in weight-for-age include deficits in both weight-for-height and height-for-age and, with the usual cut-off points gives a higher prevalence of malnutrition than other indices. A deficit in weight-for-age (wasting) may develop and be restored quickly and is therefore the index of choice for assessing the impact over a short period of acute malnutrition or the effects of a feeding programme. Deficits in height-for-age (stunting) are more difficult to assess. Height-for-age falls off fairly early with limitation of almost any nutrient and may be restored to normal in favourable circumstances by two to three years.

Nevertheless in many countries a large proportion of pre-school children remain stunted by the conventional criterion of 90% of reference height-for-age. Waterlow questioned whether such children should be called malnourished or should be considered to have a healed scar which is of no importance provided that the patient has survived. The answer depends on whether or not stunting produces handicap, impairment or extra risk for the child.

Hansen (1984) felt that age, weight and length or height were essential measurements. Skin folds and arm circumferences were of value when weight and height could not be measured. He favoured using weight-for-age as an overall indicator because it was traditional and had stood the test of time, it included weight-for-height and height-for-age; it correlated well with other social and economic indicators; and was a simple procedure providing there was a good weighing scale available.

Apart from the allometric relationships between weight and height mentioned above, a number of anthropometric indices have been devised for classifying nutritional status e.g. Gomez et al (1956), Jelliffe (1966) based on weight as a percentage of that expected for age, the Wellcome working party classification (1970) using weight-for-age and whether or not oedema is present, Waterlow (1972) based on the concepts of height-for-age and weight-for-height and McLaren and Read (1972; 1975) using weight/height ratio as a percentage of that expected for age.

Standards of Reference: There has been debate in the past as to whether international or local standards based on well-to-do and presumably wellfed children living in the same area should be used. This depends on whether genetic or ethnic differences in growth potential are significant in determining growth of

children in different populations or whether ethnic differences play a minor role compared to the overwhelming influence of nutrition and disease, thus favouring international standards. The most commonly used reference data originate from the U.S.A. (Hamill et al, 1976) and Britain (Tanner and Whitehouse 1976). The wisdom of using such figures has been questioned because of the secular trends in growth, because of the possibility of the undesirable presence of obesity in these populations and also because there may still be undernourished individuals in these populations. An important recent review by Goldstein and Tanner (1980) has clarified the issue. There are 2 distinct uses of growth measurement - firstly, to assess health and nutrition between groups and to monitor change in such groups and secondly, as a screening device for individual children. In the latter case standards should be derived from the population or subpopulation to which the child belongs. Based on the 1971 committee of the International Union of Nutritional Sciences, recommendations are that each country should establish its own standards derived from carefully selected samples representing an optimal environment. This would give rise to a 'modern elite' reference group. An opposing view is posed by Graitcer and Gentry who, on the basis that children of privileged groups in developing countries do not differ in growth from those in developed countries, advocate one reference for all. Goldstein and Tanner caution against the use of optimal or best off in view of the fact that this may be equated with most food i.e. too much may be as harmful as too little. A better definition would embrance the association of greatest amount of health. In the absence of a definition of positive health, lowest mortality and morbidity rates should be used.

x. <u>Implications and Consequences of Growth Failure</u>: There would appear to be 3 main issues relevant to

growth failure - what is the prognosis, with and without reversal of the causative factor(s)?

- what is optimal growth in childhood?
- what effect will growth failure have on child development?

Growth is a function of nutrition; undernutrition results in growth failure and improvements in nutrition have led to a long-term increase in the mean height-for-age of children in most parts of the world (Brozek, 1970). Animal studies have shown that if a period of malnutrition is severe or prolonged, or if it occurs at a 'critical' period of growth, catch-up is not complete (Dobbing and Smart, 1972). Children in Jamaica recovering from malnutrition gained weight rapidly until the expected weight-for-height was reached but they remained lower in terms of weight-for-age (Ashworth, 1969). Hansen (1971) and Tanner (1978) believe that complete catch-up is possible given optimal circumstances. Malcolm (1970) argues that because growth is slower in regions of suboptimal nutrition this may confer an advantage to these populations in terms of survival.

Turning to the question of optimal growth in childhood, the answer must lie in terms of mortality and morbidity. Keilmann and McCord (1978) showed that in the Punjab between 1-36 months mortality doubled for each 10% decline below 80% of the Harvard weight mean. Similarly Chen et al (1980) have worked out the risk of mortality among preschool children based on anthropometric measurements. No-one has yet been able to give risk figures in the longterm for overnutrition. Waterlow (1979) concluded that normality must be based on risk which takes age into account. Where data are lacking value judgements are substituted.

The relationship between physical growth and development is complex. The brain has a single growth spurt which is age related - in man this occurs at the end of pregnancy and first few months of life (Dobbing and Smart, 1974). Studies in animals (and some human autopsy material) (Tizard, 1972) indicate that even minor malnutrition, if prolonged over the full period of the growth spurt, affects brain growth. However, there is, within species, including man, little relation between brain size and intelligence (Tizard, 1972). In addition, although brain growth stops in all species when animals are still young, intelligence goes on developing through adolescence and even later (Tizard, 1972). Thus in man Mental Age depends on physical age (i.e. experience) as well as upon crude brain weight or cell number (Tizard, 1972). Some brain functions (e.g. vision, speech) are localized i.e. dependent upon the integrity of specific areas of the brain. Most higher nervous processes, however, are not localised, so that the brain functions 'as a whole' in its problem-solving capacity. Moreover, it is well established that destruction of even large amounts of cortical tissue in man may result in only minor demonstrable changes in behaviour and competence (Tizard, 1972).

CONCLUSION:

Growth involves changes in an enormously complex set of physiological subsystems. It is an integrative process in that units become increasingly related to each other. It is a process of specialisation of function. Thus growth involves organisation which takes place within subsystems of an organism. Moreover, it is cumulative, involving an increase in somatic size (Scott, 1979).

Four practical issues relating to this thesis arise from the review of the literature:

- which growth indices should be used?

- which reference values are most suitable?
- it is appropriate in the Cape Town preschool coloured population to use growth as an indicator of nutritional status?
- can the study throw light on the question of theoretical growth models?

There is no consensus over the most suitable anthropometric indices. It was therefore decided for this thesis to use weight-for-age as a global indicator, height-for-age as a measure of stunting, weight-for-height to indicate wasting, head circumference as an indication of brain size and growth velocity.

The question of whether to use local or international reference values may be placed within the framework of a thesis, antithesis and synthesis. The statement of Goldstein and Tanner (1980) serves as a thesis, 'There is no proper substitute for a country, especially a developing country, having its own child growth standards or norms for clinical use, based on a representative sample of the population'. As corresponding antithesis, Graitcer and Gentry's (1981) conclusion from data collected among privileged groups of children in developing countries, that child growth is mainly influenced by socio-economic status and not by race or ethnicity, supports the call for one reference standard for all. The synthesis comes from Habicht et al (1974) who showed that slow physical growth and small body size in developing countries are more the reflection of environmental influences than of genetic endowment. Thus, although there are racial influences, for practical purposes, they are overshadowed by the environment. Local growth standards were used in Cape Town in the 1950's and formed the basis for patient selection in the follow-up study on marasmic children of Stoch and Smythe. Subsequently international standard were employed in all nutrition studies. At a symposium on growth and development at the University of Cape Town, Institute of Child Health in November 1979 (Mcdonald, 1979) consensus was reached that the NCHS standards be used in South Africa. The

recommendation of Waterlow (1980) that the word 'reference' be used instead of standard because it is neutral, whereas 'standard' implies a norm or often a target or ideal, is relevant. In this study the NCHS 'reference' values have been used.

The rationale for nutritional anthopometry is based on the assumption that the growth of an individual is an appropriate indication of the adequacy of intake of essential nutrients. This assumption stems from a number of studies reporting deviations from normal growth associated with nutritional deficiencies and reinforced by the work of experimental nutritionists studying the growth of animals (Johnson and Lampl, 1984). But there are many other factors influencing individual growth. The application of nutritional anthropometry therefore depends on circumstantial evidence of nundernutrition plus the finding of growth parameters below the reference values. If poor social circumstances in the families in Cape Town are found, this will indicate a setting for undernutrition. In addition, if the weights- and heights-for-age are below the NCHS reference values and there is a stepwise gradient in growth by social class categories, then the assumption of growth as a nutritional indicator will be acceptable.

If the children in the study are found to be small, some genetic influence would be implicated. The review of Eveleth and Tanner (1976) suggested that Asiatics are less tall at all ages than Europeans and Africans. Based on historical origin and gene frequenceis (Chapter 2) there is significant Asian origin in the Cape Coloured population. This influence would be small, as there is also a considerable European and African genetic input which would dilute the effect of the Asian component.

Finally there is the theoretical concept of optimal growth. This study could support either the deprivational or homeostatic theory of growth, by determining whether or not growth as an index of nutrition relates to development

independently of social environment. According to the deprivational theory, poor growth per se, due to undernutrition, will be detrimental to the child's development. The homeostatic theory, on the other hand, claims that poor growth due to undernutrition will not, unless extreme, adversely affect child development. Developmental retardation, if present in children who are not grossly malnourished, would then be due to social deprivation.

DEVELOPMENT

Definitions:

Development is defined by Hurlock (1972) as a progressive series of changes in an orderly coherent pattern. Prechtl and Connolly (1981) define the term as a process or processes of more or less continuous changes within the life history of an organism. But, they claim, not all changes are developmental, as they may also be cyclical or random. Developmental changes persist for only one generation. This distinguishes them from evolutionary and ecological changes which both persist over more than the lifetime of the individual (Scott, 1978). Developmental changes are sequential, usually progressive and irreversible, irrespective of whether they are molecular, physiological or behavioural. They consist of transformations in structure and function of an organism and its constituent systems according to a sequence or timetable, which often enables one to identify separate stages. Development generally involves increasing complexity; a process of differentiation which includes gaining special properties, but this may occur at the price of lost competence and a reduction in other degrees of freedom (Prechtl and Connolly, 1981). Development may apply to both structural differentiation and to behavioural changes. In this study the term will refer only to behavioural development.

Development is a superordinate concept which subsumes growth and maturation (Prechtl and Connolly, 1981). Growth has been defined in the previous section, but in the context of development, it is used metaphorically to include mental (cognitive) and behavioural aspects (Prechtl and Connolly, 1981). Maturation has also been defined with growth. It is a process leading to a condition of ripeness or maturity, usually with the emphasis on unfolding (Prechtl and Connolly, 1981). Gesell (1945) tended to emphasise the genetic aspect of maturation and talked of 'the net sum of gene effects operating in a self limiting time-cycle' and 'the hereditary ballast that conserves and stabilizes the growth of each individual infant' (Gesell, 1941). Paul Weiss (1934) defined it as 'that inherent process of progressive organisation of functions and their morphological substrates which is directional in character, goes on through the lifespan and is never independent of experience'.

Developmental Theory

The origins of developmental theory may be traced back to Greek antiquity. Plato in this Republic recognised inherent individual differences among children and recommended that aptitudes should be sought and education and training tailored to their particular talents. The British philosopher John Locke (1632 - 1704) on the other hand, described the infant's mind as a tabula rasa - a blank state which was receptive to all kinds of learning. Jean Jacques Rousseau in the latter half of the 18th century believed that the child was endowed with an innate moral sense; a 'noble savage' with intuitive knowledge of right and wrong which is thwarted by restrictions imposed on him by society. Already we find the beginnings of a dichotomy between the protagonists of the innate forces and those who emphasise the external environmental forces.

Charles Darwin's (1877) publication in 1877 of his observations of his first child's early infancy 'A Biographical Sketch of an Infant' in Mind, was an important milestone. About the same time Haeckel (1874) proposed his famous dictum that ontogeny recapitulates phylogeny. This was followed by a line of investigation based on the child-animal anology. The orgins of 'learning theory' also go back to the last century with Herbert Spencer's (1891) idea that human behaviour was selected by the action of the environment. Interest in human variation was sustained by Galton (1889) who attempted to demonstrate the genetic superiority of the English ruling classes. Such endeavours led to the early measurement of development and intelligence. This was carried on by Binet (1916) in France and Terman (1916) in the USA, who set in motion a body of research (Gessel, 1947) which has gained momentum and persists to the present time.

To focus attention on the protagonists of the innate forces, the psychoanalysis of Freud (1949) provides a starting point. His theory based on instincts and drives with mechanisms of drive reduction is well known. His ideas were perpetuated and developed by his daughter Anna (1966). A large number of neo-Freudians have provided radical revisions e.g. Erikson (1963) extended the developmental stages and introduced a significant shift of emphasis to include psychosocial aspects; Jung (1953) substituted mystical concepts. Other neo-Freudians Adler (1948),

Sullivan (1953), Horney (1939) and Fromm (1941) pursued the social aspects of psychoanalysis.

The theory of cognitive development has been dominated by Piaget (1953) who proposed an evolutionary model of development focusing on intellect and rationality. The constitution of new thought results from the interaction of organism and environment according to set rules. Thus he postulated sequential periods of cognitive growth which follow each other in an invariant order. The age-periods are not fixed but the sequences are; i.e. a linear sequential, unidirectional conception of cognition. Piaget (1971) was interested in the nature of knowledge and how it is acquired - epistemology (the study of knowledge). Flavell (1972) however, has questioned Piaget's formulation of linear, sequential and unidirectional development and proposed that cognitive activity is often tortuous and spiral-like, cyclical and recursive, sequence-violating and sequence-transforming.

Animal models of behaviour have featured prominently in developmental theory. The discipline of comparative ethology has formulated hypotheses such as 'fixed action patterns', ' innate releasing mechanisms' and 'action specific energy' which correspond to the theory of instinct (as proposed by the psychoanalysts). Other issues which have gained prominence by the ethologists such as Lorenz (1952) and Tinbergen (1968) are 'imprinting', the concept of 'critical periods' and also aggression.

More recently the innatist argument has been supported by the discipline of sociobiology as proposed by Wilson (1965). He claimed that aspects of social behaviour are genetically rather than culturally transmitted. By natural selection genetic transmission of randomly produced variants in social behaviour e.g. altruism, incest taboo have superior adaptive value. Sociobiology has been severely attacked by certain social scientists who see it as an attempt to promote the concept of biological determinism of human culture (Ellis, 1977).

The conceptual framework of behaviourism based on learning theory contrasts that of the psychoanalytical approach. The work of Pavlov (1928), a research physiologist, who discovered a basic neurophysiological mechanism, the conditioned reflex through which

learning takes place is well known. He also proposed the existence of a special additional system of conditioned reflexes in humans, which he called the secondary signalling system. This system is the basis of language and thought and enables man to substitute a word or other abstract symbol for the concrete environmental stimulus. Watson (1928) is generally regarded as the founder of behaviourism, but he based his stimulus-response psychology on the work of Pavlov. Dollard and Miller (1950) developed the stimulus-response approach and stressed the role of reinforcement. They extended the concept by proposing hypothetical, non-observable or implicit events (intervening variables) between the stimulus and response. Another group led by Skinner (1974) has developed the concept of operant conditioning. Here, in contrast to classical conditioning, a reinforcer, contingent on the response having being made occurs. The response is instrumental in producing the reinforcing event, therefore it is known as instrumental or operant conditioning. Bandura (1977) and other 'radical behaviourists' have focused on social and psychological factors in learning. Studies by the 'social learning theory' group have demonstrated the significance of 'imitation' and 'vicarious reinforcement'.

In recent years there has been dissatisfaction in a framework for developmental theory in which a linear, static model is used with a dichotomy between biology and culture (Thomas, 1981). The issue has been resolved by the proposition of an interactional (or transactional) model. The beginnings of such an approach stem from both Freud and Pavlov. However, the conceptualizations of psychologists such as Lewin, Murphy, Sears and Stern were necessary to develop the logic of a dynamics of interactionism (Thomas, 1981). The interactional concept embodies a reciprocal relationship with the characteristics of the organism and their interaction with environmental opportunities, demands and stresses (Chess, 1979). It involves a complex dialectical process, intertwining the external and internal factors in an adaptive process which overcomes inpediments that the child encounters (Vygotsky, 1978). Central to the interactionist formulation is the thesis that the human infant is an active agent from the moment of birth in the organiser environment interactional process (Thomas, 1981). Moreover, this process is irretrievably anchored in its social context (Lamb, 1978). The model has been further developed by Thomas et al (1981) by the concept of 'goodness of fit' and the related ideas of consonance and dissonance.

Goodness of fit occurs when there is consonance between organism and environment, which allows optimal development in a progressive direction. Conversely dissonance between environmental opportunities and demands on the organism leads to distorted development and maladaptive functioning. Thomas emphasizes that goodness of fit does not imply an absence of stress. Stress is an inevitable concomitant of the developmental process.

A related concept which also attempts to resolve the biology/culture or nature/nurture issue is that of Waddington's (1957) rheostasis. This refers to a guided flow of developmental changes, restricted within genetically prescribed limits, but variable and probabilistic within buffered pathways. These he refers to as 'chreods'.

There are a number of practical issues which are closely related to developmental theory. Limitations on space allow only for comment on these topics rather than full discussion:

- importance of the neonatal period; to quote from Thomas (1981) 'Research studies of the last 20 years have dramatically changed the view of the neonate's functioning. Careful, detailed, naturalistic observations and inclusive content data analysis, combined with the use of new experimental techniques, have by now provided convincing evidence of the neonate's capacities'. He is capable of perception and discrimination of visual patterns and sounds; of learning and of active social communication. The mother, at the same time, has finely tuned behaviour patterns. These ingredients result in the development of the human infant from a biological to a psychobiological organism and then, with his mother, to a dyad capable of complex interactional synchrony.

- Critical phases: This concept was developed from observations of imprinting in birds and came to suggest a developmental fixity, restricted to a narrow period with a high degree of specificity and of permanent irreversible effects (Rutter, 1980). However, there would appear to be too many exceptions and qualifications and it has been proposed that the idea should be dropped from human psychosocial development (Rutter, 1980). In its place the broader concept of 'sensitive periods', which represent a phase of

heightened responsiveness to certain kinds of stimuli, has been suggested (Oyama, 1979).

- Longterm effects of early experience; Freudian psychoanalysis stressed the importance of the first 5 years of life. The tragic and dramatic experiences of the twins described by Koluchova (1972) and of Genie (Curtiss, 1977) who spent their early years in extreme environmental deprivation illustrate however that a good environment throughout the rest of childhood can compensate in the longterm. Clarke and Clarke (1976) have reviewed a number of reports showing that bad care in early life does not necessarily cause permanent, irretrievable damage. Rutter and Madge (1976) do warn that although the effects are greatly modified by later experience, some residual consequences may remain.

- Cultural deprivation and compensatory education: A great deal of money and attention has been devoted in recent years to the preschool education of socio-economically disadvantaged children. Evaluations of these efforts, however, have proved disappointing as the beneficial effects tend to disappear in 4-5 years (Horowitz and Paden, 1973; Bronfenbrenner, 1974)

  A more encouraging report has come from Dorrington et al (1980) who found that although the IQ of study children did not differ from controls, fewer of the experimental children were assigned to special class and fewer had to repeat a school year.

- Consistency over age and individual differences: This refers to the relative consistency (stability) of individual differences, or rank ordering of the individual within a group over a period of time. McCall (1981) proposed 2 seemingly contradictory statements as a theoretical viewpoint on the issue:
  a. during the first 18-24 months developmental function is largely maturational while individual differences are unstable and not highly correlated with either genetic or environmental factors
  b. thereafter individual differences correlate more strongly with both genetic and environmental factors.

Assessment of Development

The first intelligence test was published by Binet and Simon in France in 1907 (Anastasi, 1976). Binet had been asked by the French Government to devise a test for identifying retarded children. The Binet-Simon test was brought to the US and was subsequently revised by Terman (Terman, 1916) and his associates as the Stanford Binet Test. In 1912 Kuhlman extended the Binet Scales downwards to a 3 month level.

During the 1920's and 1930's Gesell and his colleagues (Gesell, 1946, Gesell, 1971) compiled narratives of motor and mental development. These early normative studies made an important contribution to 'development diagnosis' and The Gesell Developmental Schedules have represented a standard procedure for observing and evaluating the course of behavioural development in the child's daily life. Cattell in 1937 attempted to relate the work of Gesell to the earlier work of Binet and evolved the Cattell Infant Intelligence Scales, computed in the same manner as the original Stanford Binet IQ (Cattell, 1940). The Merril-Palmer Scale of Mental Tests introduced in 1931 (Stutsman), was primarily a performance test and was often supplemental to the highly verbal Stanford Binet Test.

Because many of the earlier tests relied heavily on verbal skills, tests were devised to measure certain abilities, without having to use verbal ability. Such 'performance' skills were included, for example, in the Wechsler Intelligence Scales for Children (WISC) (Wechsler, 1974). Subtests were grouped separately into verbal and performance sections. In 1967 the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) was published, designed for ages 4 to 6½ years.

The Griffiths Mental Developmental Scale for testing babies up until 2 years was published in 1954 (Griffiths, 1954). It was based on 250 items, evenly classified in 5 subscales - Locomotion, Personal-Social, Hearing and Speech, Eye and Hand Co-ordination and Performance. A "GQ" (general intellectual quotient) was obtained using the ratio method. Subsequent factor analysis of test-item variation questioned the 5-subscale structure and suggested that only 2-3 factors could be discerned in language and one or two motor factors (Munro, 1968). The test has been extended to cover an age range up to 6 years (Griffiths,

1970).

The Bayley Scales of Infant Development were produced as a culmination of 40 years of experience (Bayley, 1969). The scales have undergone a number of revisions and careful standardisation so that the mental and motor indices have, like an IQ, a mean of 100. More recently The McCarthy Scales of Children's Abilities covering an age range of 2½ to 8½ years have been introduced in America.

A number of scales, applicable to the first 2 years of life and based on Piaget's stage theory of cognitive development have been devised e.g. The Ordinal Scales of Psychological Development (Uzgiris and Hunt, 1975).

Because of the desire to develop a 'culture free' or 'culture fair' test, the Goodenough Draw-a-Man Test was introduced in 1926 (Goodenough and Harris, 1950) and revised as the Goodenough-Harris Drawing Test in 1963 (Harris, 1963). Unfortunately the hope that it would be culture free has not been fulfilled. Dennis (1966) found cross cultural associations depending on the amount of experience with representational art in each culture. In studies in Nigeria (Bakare, 1972) and Turkey (Ucman, 1972) an association with socio economic status (SES) was demonstrated.

A number of studies have looked at the relationship between assessments in early infancy and later mental functioning e.g.

- Cattell Infant Intelligence Scale at 3 months and Stanford-Binet IQ at 3 years, r = 0,10 (Cattel, 1940)
- Griffiths Mental Development Scales at 3 and 18 months, r = 0,46 (Hindley, 1960)
- Baley Scales of Infant Development at 3 and 12 months, r = 0,44 (Wilson, 1976)
- Bayley Scales of Infant Development at 8 months and Stanford-Binet IQ at 4 years, r = 0,28 for boys and 0,23 for girls (Ireton et al, 1970)
- Bayley Scales of Infant Development at 6 to 8 months and Stanford-Binet IQ at 36 months - Bayley Psychomotor Developmental Index (PDI), r = 0,43 and Mental Developmental Index (MDI), r = 0,90 (Ramey et al, 1973)

Because of the variable and generally weak correlations, Lewis and McGurk (1972) caution against generalising infant assessments beyond the particular set of abilities or factors sampled by items administered at the time of testing.

Developmental screening forms a particular aspect of appraisal. It has been defined by Holt (1967) as a procedure sensitive to and specific for a particular condition, capable of being performed quickly and cheaply and providing a fail/pass result. One of the oldest screening measures, the Revised Developmental Screening Inventory (RDSI) was developed by Knobloch et al (1966). The Denver Developmental Screening Test (Frankenburg and Dodds, 1967) is widely used in the USA and elsewhere. When applied in Britain, there appeared to be discrepancies regarding the age at which certain milestones were reached (Bryant et al, 1973). The Denver Developmental Test has been used in Japan (Ueda, 1978). The screening techniques advocated for use in Britain have been described by Egan et al (1969). Dubowitz et al (1977), found a good correlation between a screening test for 4-5 year old children which could be completed in 10 minutes and scores on the WPPSI.

Another approach to developmental assessment has been to look at developmental skills which the child has attained e.g. The Gunzberg Assessment (1966). This has particular application in the management of handicapped children.

Tests used during the preschool period for specific areas of development e.g. visual perception, sensory motor integration, language will not be discussed as they are beyond the scope of this review. So also are the assessments applied in the neonatal period and to the school aged child.

Tizard (1962) has expressed reservations about applying formal tests to children in different cultures as they tell us nothing about the 'true' abilities of the children in real-life situations, but only about their relative performances on a particular test. Yarbrough et al (1974) favour the use of special tests to measure specific functions in a manner which is valid for the population being studied. According to Vernon (1968) most Western type tests can give useful results in semi-accultured groups provided that regard is paid to the linguistic, motivational and other cultural factors that affect performance.

Ounsted et al (1979) have designed an assessment specifically for research purposes. It is applied at 4 years of age and gives a global score and also separate scores for each section of development.

FACTORS AFFECTING DEVELOPMENT:

In considering the influences on development, one must take both biological and psychosocial factors into account. Biological factors such as prematurity, reduced birth weight, infection, perinatal hypoxia etc may give rise to more marked developmental deviations often associated with brain damage, but they occur infrequently. Psychosocial influences are universal, although they are more subtle. For example twins, only children, firstborn and subsequent children all have differing relationships with their parents. Firstborn and only children enjoy a monopoly on relationships and resources. Later born, in contrast, share divided parental attentions and live in the company of their siblings. Twins can be considered as extreme cases of later borns since the spacing between them is zero.

This review of influences on development will not include brain damage. The effect of malnutrition on development will, however, be covered.

Genetic Influence:

Fulker (1981) advocates the biometrical approach. In animal studies, laboratory strains are used under experimental control. In human populations this is not possible and natural material such as data from pairs of MZ and DZ twins, siblings, nuclear families or parents and offspring, adopted and foster children are relied upon. The basic model used is $P = G + E$ where the phenotype (P) reflects both genetic (G) and environmental influences (E). Taking a particular trait, its variance V(P) (the full range of individual differences) is the mean of squared deviations from the overall mean and V (P) is made up of the variance of G and E i.e. $V(P) = V(G) + V(E)$. The environment is further divided into CE or common environment i.e. that which causes sibling similarity (shared home environment and the influence of parents) and SE or specific environment i.e. that which makes siblings different (unique life epxeriences). Studies have used the IQ obtained on the Stanford Binet or WISC. Data obtained from numerous studies compiled by

Erlenmeyer-Kimling and Jarnick (1963) and augmented and analysed by Fulker and Eysenck (1979) are applied to the equation. Their analysis suggests that the estimated effect of the genetic influence on intelligence V(G) amounts to 0,69 whereas the common environment V(CE) and specific environment V(SE) account for 0,18 and 0,13 respectively.

The IQ is known to remain stable from 6-7 years onwards but in younger children this is not the case. There is thus considerable fluctuation of cognitive performance during development. Two questions arise:

i. What part do genetic factors play in early IQ?
ii. Is the fluctuation in rate of development under genetic control?

Using the twin studies of Wilson (1977), Fulker (1981) concluded that the overall IQ in the preschool years is less influenced by genetic make-up and more by home environment, but the timing of the developmental processes appears to be under genetic control.

Gender:

The effects of gender on development have been reviewed by Hutt (1972); Buffery and Gray (1972) and Fairweather and Hutt (1972). The most striking differences between girls and boys are as follows: girls are superior as regards verbal ability, executive aspects of language e.g. reading, writing and spelling; rote memory and manual dexterity. Boys are better at spatial ability, comprehension of mechanical tasks and relationships, verbal reasoning, mathematical ability. Boys are superior at problem solving. They are able to break a set, restructure and reorganise their concepts. On the WISC, boys do better on subtests listing spatial skills - e.g. block design, picture completion and object assembly. In general the IQ means are similar between males and females, but males have a wider distribution. This is an expression of the law of greater variability in males which also applies to other human parameters.

Buffery and Gray (1972) suggest an innate neural mechanism for speech perception which is more developed in girls. This is related to the lateralization of linguistic function to the left hemisphere. Boys have a more bilateral representation accounting for their superior spatial ability. Conel (1963) at 4 years demonstrated a greater degree of

myelination and dendritic growth on the left in girls and the right in boys. Money and Ehrhardt (1968) have shown that females exposed to androgen early in development had significantly higher than average IQ's. Similarly Dalton (1968) found that mothers given progesterone in pregnancy resulted in increased IQ's in the offspring which persisted throughout childhood. Hutt (1972) suggested the possibility of steroid hormones with an androgenic action, by facilitating protein synthesis especially brain RNA, could enhance neural integration, thus promoting more 'intelligent' behaviour. However, if this were so, one might expect average IQ's to differ. Stafford (1961) has demonstrated that the genetically determined visuo-spatial ability is a recessive trait carried on the X chromosome. There is evidence that spatial ability develops under the control of sex hormones.

In conclusion Hutt (1972) maintains that there is a structural and functional difference in organisation of human male and female brains present from an early age, possibly from the time of sex differentiation. Ounsted (1972) drew attention to gender related developmental acceleration in girls, or delay in boys, which affords more opportunity to interact with the environment in a less mature state. This implies that more information may be derived from the genome, some of which may be disadvantageous.

Birth Order and Sibship Size:

Drillien (1964) found that between 6 months and 4 years the IQ of twins was lower than that of singletons. Wilson (1977) found twins to be relatively delayed at 18 months but they caught up by 6 years. Zazzo (1979) claimed that the overall curve of twins was within the normal range, but shifted to the left. Singletons were on average 7 points higher in IQ than their twin siblings. Husen (1961) maintained that the shift to the left applied throughout different socio-economic groups. Ernst and Angst (1983), in contrast claimed that only large birth weight differences in twins were related to deficits in IQ suggesting a biological effect. A part of the twin singleton difference in IQ is explained by a twin bias for lower social class and larger sibship size.

According to Ernst and Angst (1983) there is no consistent evidence that only children are either advantaged or disadvantaged intellectually.

Similarly they claim that there is no evidence that the wellknown negative correlation of IQ with sibship size is due to a less stimulating environment or diluting of adult contact. When social class is controlled, IQ differences by sibship size becomes negligible.

There is no evidence that a linguistic advantage in firstborns due to increased stimulation persist after infancy (Ernst and Angst, 1983).

Ethnicity:

Accelerated motor development in black infants has been described by Bayley (1965) and global precocity in Africans lasting until the third year by Geber and Dean (1957). Others have not been able to confirm these findings (Warren, 1972). Pollack and Mitchell (1974) found West Indian babies in London to have accelerated motor development when compared to English and Cypriot babies. This they put down to greater extension. At 9 months, however, English and Cypriot infants were advanced in adaptive language and personal/social development. There was no significant difference in age at walking. Super (1976) in Kenya found that the motor skills sitting and walking were acquired earlier than by American infants. The reasons given were that they were specifically taught these skills which were then practiced in the course of their daily routines. Middle class urban Kenyan childen of the same ethnic background were intermediate in both environmental encouragement and rate of advancement. Other reasons which have been given for motor precocity are more permissive attiude towards child rearing, traditional method of child care (including carrying babies on the mother's backs) (Walter and Parke, 1957); close physical contact (Ainsworth, 1967); social class (Geber and Dean, 1958; Leidermann et al, 1973); innate racial differences (Geber and Dean 1957; Jansen, 1973), environmental differences in opportunities and expectations (which explain relatively delayed language development at a later date) (Walter and Parke, 1965).

Social Class:

Several studies have shown no difference in infant development between various socio-economic groups (Bayley 1965; Goldon and Birns, 1968; Hindley, 1960). By the age of 4 and 5 years, however, children from higher socio-economic status are more advanced than those of lower SES

in language and adaptive development (Bayley, 1965; Caldwell and Richmond, 1967). By using the method of fitting linear curves to each child's DQ and IQ from 6 months to 5 years, in London, Hindley (1962) found significant tendencies for children in the upper class group to have rising regression lines with age and those of lower social class groups to have falling regression lines. the same tendency was found up to 3 years in Stockholm by Klackenberg-Larsson and Stenson (1964) and in Brussels by Sand (1064). Neligan et al (1974) found at 5 years intelligence measured by a non-verbal test was significantly influenced by social class and that the disparity increased markedly by 10 years. Frankenburg et al (1975) in Denver showed children of unskilled workers to be more advanced below 20 months than those of skilled workers. Beyond 2 years the situation was reversed particularly as regards language development.

Growth:

Husen (1951) found that the correlation between growth and intelligence were mostly around + 0,20 and did not exceed + 0,30. A similar correlation between IQ and height (r 0,25 - 0,30) was shown by Douglas et al (1965) in school children of the same social class family size and stage of sexual development. Wolf (1981) concluded that such data constitutes presumptive evidence for a causal relation between somatic growth and psychological function, but they do not clarify how the association is mediated. The correlations are small and useful only for the epidemiological study of large populations.

Nutrition:

Over the years a number of clinical studies have been carried out on malnourished children. Monckeberg (1968) showed that malnutrition tended to restrict expression of the genetic potential for development, both physical and psychological. Socio-economic factors also strongly affected mental development and could not easily be separated from nutritional influences. Birch and Lleford (1966) developed an intersensory integration test and showed that malnourished children performed poorly when compared to controls. Botha-Antoun (1968) demonstrated that children malnourished during the first 3 months, scored lower on both verbal and performance scores on the Stanford Binet

when tested at 4 to 5 years. Birch (1971) found that Jamaican children recovering from Kwashiorkor had lower full scale WISC scores than their siblings. Brockman and Ricciuti (1971) showed persisting behavioural differences in marasmic children after treatment. Evans et al (19871) failed to demonstrate a difference in intelligence between children who had suffered from Kwashiorkor and their siblings, but did find a discrepancy between intelligence and the drawing scores in late-onset cases. This could, however, have been due to affective factors. Acute episodes of malnutriton in the first 2 years of life, according to Richardson (1976) have little effect on intellectual development of children gowing up in a favourable environment. In contrast, in unfavourable circumstances, there is a marked effect on later mental attainments. Canosa et al (1973) showed differences between malnourished children and their siblings in short-term memory of digits, for sentences and intentional and in incidental learning. Herzig (1972) found that children scored lower than siblings on the WISC. Stoch and Smythe (1976) in a 15 year follow-up of marasmic children found that formerly malnourished subjects were considerably retarded in relation to their controls. Tizard (1974) showed that health, development, growth intelligence and educational attainment in boys after recovery from clinical malnutrition lagged behind their peers. Hoorweg and Stanfield (1976) demonstrated that at 11-17 years of age children with early protein energy malnutrition revealed a general deterioration of intellectual ability; reasoning and spatial perception were most affected, memory and rote learning to a moderate extent and speech very slightly if at all. Cravioto and Delicardie (1972) looked at malnourished children and their families in Mexico. The families of index children did not differ from controls in socio-economic characteristics nor in biological factors (parental height, weight, age, number of pregnancies, size of family, etc.) They did, however, differ in terms of home environment - poorer emotional climate, fewer play materials and attention to infant's needs. The index children did not differ somatically or behaviourally before they became ill. Their language development however, was delayed prior to the onset of illness. After recovery from malnutrition they were developmentally delayed.

Townsend et al (1982) have listed the problems associated with studying the relationship between chronic protein-energy malnutrition and cognitive development. Undernutrition is almost always accompanied by poverty and social deprivation. Experimental food deprivation is obviously precluded on ethical grounds. Thirdly chronic malnutrition tends to occur in rural semiliterate communities where available instruments for measuring mental development, which have originated in middle-class developed countries, are inappropriate.

Strategies designed for dealing with these obstacles are:

- longitudinal, prosepctive, nutrition intervention studies
- studying middle-class children who have suffered from illnesses associated with nutritional compromise
- studying children who have been brought up in favourable social circumstances following early malnutrition.

A number of intervention studies have shown positive results with nutritional supplementation (Chávez and Martinez, 1977; Klein et al, 1977, Evans et al, 1980) and with cognitive stimulation in addition to improved nutrition (McKay et al, 1978; Mora et al, 1977). Increased levels of activity and demand for attention, as well as improved caretaker-infant interaction, have been found with nutritional improvement (Mora et al, 1977). Babies with supplementation are less irritable and show higher levels of visual attention (Mora et al, 1977).

Klein et al (1975) looked at the effects of starvation in infancy (due to pyloric stenosis) and found that learning ability was negatively correlated with degree of severity of the starvation especially as regards short-term memory and attention. In contrast Valman et al (1976) failed to show any difference in intelligence or school performance in children malnourished due to neonatal resection of the ileum or those with cystic fibrosis. Similarly, Lloyd-Still et al (1974) showed no cognitive defects in later childhood in middle-class children who were malnourished during the first 6 months of life due to cystic fibrosis, bowel obstruction or protracted diarrhoea.

Some studies threw light on the effects of a favourable social environment after early malnutrition. The circumstances of the Hogerwinter in the Netherlands in 1944-1945 enabled Stein and Susser

(1972) to isolate the experience of famine from other elements of the social environment. By analysing the military records of entrants into the Dutch army 19 years later, they found no differences between those born in affected areas and successive birth cohorts in terms of height, IQ or prevalence of mental retardation. Tizard pointed out, however, that during the period of starvation the birth rate dropped markedly but the mean birth weights were consistent with international standards. Furthermore about 5% of the records were not available. The others looked at environmental enrichment by early adoption. Winick et al (1975) found no significant differences between Korean orphans adopted in the USA and the normal population at follow-up. They did, however, find an inverse relationship between the time of adoption and ultimate IQ and school performance; the earlier the adoption, the higher the IQ and the better the performance. In a study on black foster children in New York, Winick et al (1978) found that those who grew up in a single foster home had significantly higher IQ's than those shunted from one foster home to another. Moreover they showed a significant correlation between height and IQ in the latter group only. They therefore postulated that early malnutrition interacted with poor early environment and resulted in retarded development. There is, in addition, some experimental work in rats reported by Winick to support this interaction. The ganglioside N-acetylneuraminic acid (NANA) falls in malnourished animals, but then rises with appropriate environmental stimulation. In addition injection of NANA will protect malnourished animals from expected behavioural abnormalities. Winick, therefore, suggests that NANA may be involved in a final common pathway through which both early malnutrition and early environmental deprivation produce their behaivoural effects.

Conclusions

Development involves internal physiological processes which become integrated into systems and sub-systems of behaviour. It is cumulative in that more and more behaviours are added. Development is primarily a process of organising the organismic system as a whole with respect to the external world (Scott, 1979).

Development is influenced by a complex set of interacting biological and social factors. These may be understood against a background of

developmental theory. Assessment is based on the evaluation of skills and behaviours which emerge in a uniform sequence but with individual variations in timing.

It was decided for this study to use basic milestones to assess progress during the first 18 months of life. The criteria for achieving the milestones were similar to those used in the study in Newcastle-upon-Tyne by Neligan et al (1974). Language was assessed formally on the Reynell Language Scales (1969) which were selected because they are routinely used in Cape Town and have been translated into Afrikaans. For the final assessment at 5 years a specific test was developed to suit the study. Ths use of the Griffiths Mental Development Scales (1979) was considered but decided against as it would have taken too long to assess each individual child. The test was similar in design to the assessment of Ounsted et al (1979) in that a global score and separate scores for each sector of development could be obtained. It was devised so that it could be completed in the child's home and take no more than 20 minutes. By assessing all of the children at exactly 5 years of age the number of items could be limited but still cover a wide range of developmental skills including the Draw-A-Man test. It was possible to select items with which the children were familiar and therefore valid for the population being studied.

SOCIAL MILIEU

INTRODUCTION:

Social milieu refers to the environment (milieu) referable to a particular socity or aggregate of persons living together in a more or less ordered community. An important component of this environment is social action, which was defined by Weber (Hagerdorn and Labowitz, 1973) as behaviour motivated toward specific goals and satisfying human wishes, attitudes and dispositions. Action is social only when subjective meanings are attached to the behaviour of individuals and the individual is the sole carrier of meaningful conduct. The child is not born with the ability to attach subjective meaning. This is learnt during socialisation which refers to the process through which an individual learns to be a member of society. The locale for socialization is provided by the family (Berger and Berger, 1972). The family constitutes the basic social institution (Horton and Hunt, 1968); it is the most permanent and pervasive of institutions and the most pre-eminent of all primary groups. According to Hodges (1971) it is the indisputable sine qua non of human social life, with 3 basic human activities - sexuality, procreation and socialization (Berger and Berger, 1972). Families may be conjugal nuclear, extended or single parent (Berger and Berger, 1972); They are adult- or child-centred (Berger and Berger, 1972); authoritarian or democratic (Berger and Berger, 1972); functional or subject to dysfunction in the form of violence or neglect (Snyder et al, 1983). The family therefore has the vast potential for shaping or misshaping the developmental outcome of the child.

At birth the infant is introduced into a social world. The behaviour repertoire of the newborn infant and the contingent responses of the mother are fairly narrow and predictable and have been well described by Klaus and Kennel (1970). During the first year of life, however, discontinuities of interaction patterns and varying rates of development occur and these present difficulties for those looking for stable patterns of individual differences in child development (Dunn, 1979). The child then continues to grow into a steadily expanding circle of social and institutional relationships i.e. he develops a social biography (Berger and Berger, 1972). Moreover, the child inhabits a

micro-world (of face to face relations) and beyond that, with varying degrees of significance and continuity, a macro-world. The micro-environment is understood only against the background of the macro-environment which envelopes it (Berger and Berger, 1972).

Both the micro- and macro-environments exist within a cultural context. Culture is defined as an historically derived system of explicit and implicit designs for living shared by members of a group or society (Kluckhohn and Kelly, 1945), or the complex whole which includes knowledge, belief, art, morals, law, custom and any other capabilities or habits acquired by man as a member of society (Tylor, 1897). Ethnicity is defined by Isajiw (1974) refers to an involuntary group of people who share the same culture and have a common ancestral origin. Ethnicity is not synonymous with race which is used in a biological context to indicate membership of a group that draws from the same gene pool (Isajiw, 1974).

Lewis (1966) distinguished between poverty, defined in relation to a 'poverty line' and the culture of poverty. Culture of poverty is characterized by chronic unemployment and underemployment, low wages, lack of savings, poor housing and overcrowding, a family which does not cherish childhood as a specially prolonged and protected stage in the life cycle and an individual who grows up with a strong feeling of fatalism, helplessness, dependence and inferiority. Such a subculture develops its own structure and rationale, a way of life handed on from generation to generation along family lines. It provides human beings with a design for living, with a ready-made set of solutions for human problems, and so serves a significant adaptive function. Related terms are cultural deprivation and disadvantage. Birch and Gussow (1970) stress the link between poverty and education and draw attention to role played by disadvantage in poor school performance.

Social class is a term and concept which is encountered frequently in social research. It is defined as that form of social stratification based on wealth or economic resources (relation to the means of production). Because it is based on an acquired characteristic a class system typically allows for some vertical mobility - movement up or down in the social structure. In industrialized societies, class is apt to be pervasive and affect almost every area of social behaviour (McGee,

1972). It is often used, according to Davie and Butler (1972), as an evocative term with undertones of social prejudice. It carries some implication of a person's standing or even 'worth' within a hierarchical society, thus adding to emotive flavour. Davie and Butler (1972) advocate its use exclusively to describe the occupational group of the child's father. Inevitably, any such grouping will be hierarchical in so far as it relates to the level of skill or training required. The term socio-economic status (SES) is used almost synonymously with social class. Because of the importance placed on education, occupation and income, SES expresses these factors as an index which places individuals, families or neighbourhoods on a hierarchy according to their social status relative to others in the same community (Green 1970).

Assessment of the Social Milieu:

The work of Bloom at the University of Chicago, according to Bradley and Caldwell (1978) was a watershed in the history of environmental measurement. Bloom's (1964) 'Stability and Change in Human Characteristics' offered both a theoretical and empirical basis for the development of a measure of the environment. The actual schedule was worked out by two of his students, Davē and Wolf (1964). Majoribanks (1972) using a similar approach devised a measure of the home learning environment. Other workers to employ the Chicago approach have been Radin (1971), Keeves (1972) and Henderson et al (1972). Henderson and his colleagues at the University of Arizona produced the HELPS (Henderson Environmental Learning Process Scale).

Barker and Wright (1954) attempted to qualify human ecology so that minute details of life events could be reconstructed for the purposes of analysis. This method influenced the coding systems developed by White Carew et al (Watts et al, 1974), of the Harvard Preschool Project. Carew, distinguished for analysis the role played by the person interacting with the child (Human Interaction Scale) and the child's involvement with objects in the environment (Object Interaction Scale). The Deprivation Index developed by the New York University Institute of Developmental Study by Deutsch et al (1968) had its roots in sociological and social psychological theory and research. At the National Institute of Child Health and Human Development Yarrow et al

(1972), devised their own system for environmental measurement. Perhaps the most widely used measure in the USA is Caldwell's HOME (Home Observation for Measurement of the Environment) (Caldwell et al, 1966).

This is composed of 6 sub-scales: emotional and verbal responsiveness of the mother, avoidance of restriction and punishment, organization of physical and temporal environment, provision of appropriate play materials, maternal involvement with children and opportunities for variety and daily stimulation.

Grantham-McGregor (1984) recommended considering national, regional, local and family characteristics. The latter should include physical and economic resources, family size and structure, biological characteristics of the family, socio-cultural characteristics, child feeding practices, maternal behaviour and stimulation in the home. The list of variables is, she claimed, large, diverse and dismal. Many of the variables are interrelated and associations reported are not causal. For these reasons she advocated a nultivariate approach to determine the relative contributions of each variable.

The methods mentioned above allow for the recording of variables referable to both macro- and micro-environments and in some cases enable the recording of individual social biographies. Such measures are only possible in intensive studies on relatively small groups of children. Many developmental studies, however, rely on the use of social indicators.

A social indicator is defined as a statistic of direct normative interest which facilities concise, comprehensive and balanced judgements about the condition of major aspects of a society (US Department of Health, 1969).

Occupational status represents the single best indicator of SES (Mueller and Parcel, 1981). Edwards in 1983 developed a ranking system for the U.S. Bureau of the Census utilising information on the educational requirements and monetary rewards of the occupation. A similar class scheme was provided by the U.S. Department of Labor in 1977.

The Hollingshead Two-factor Index of Social Position (1957) has been widely used in the past, but has fallen into relative disuse (Haug, 1977). Green (1970) devised a scoring procedure for public health research based on the presumption that health behaviour is more highly correlated with income, education and occupation than with other personal attributes. Recently Mueller and Parcel (1981) advocated a single occupation-based scale, such as the Duncan SEI (1961) or Siegel Prestige Scale (1971) which have been validated in terms of their relationship to commonly accepted stratification dimensions. Here the occupations are socially defined i.e. the general public's estimate of social standing or prestige is used in ranking. A major concern in evaluating family social standing is how to incorporate both the husband's and wife's work status when both spouses are employed. Rossi et al (1974) have developed a method for providing a multidimensional measure of SES. Another strategy for dealing with this problem was developed by Jôreskog (1973) using principles of analysis of co-variance.

In the UK Stevenson as Superintendent of the General Register Office originated the social class classification in 1911 (Registrar General 1913). Since then there have been revisions in 1921 and 1931, when various occupation groups were moved up or down. Generally there has been a profound change affecting the whole structure of the working class, resulting in a much smaller section of the relatively underprivileged (DHSS 1980). The Registrar General's social class classification has recently been criticised by Jones and Cameron (1984) as 'an empiricist methodology, engineered to conform to the prejudices of narrow minded professionals'. They argued that it was not based on any theory or principle of social class and, when applied to health statistics, it was a 'massive tautology'. Nevertheless, it remains the best known and most widely used social indicator in the UK.

Conclusion:

The family forms the locus for the micro-environment of the developing child. The family, consisting of various individuals or groups of individuals, functions as a system (Barker, 1983). Families in turn belong to extended families, neighbourhoods, communities etc. Ramey (1983) recommended incorporating all these elements in an hierarchical

systems theoretical framework for evaluating the environment. Alternatively, social indicators based on occupational status may be used in assessing the environment in child developmental research.

In the context of the present study, no indicator has been developed for use in the Coloured population of Cape Town. In addition global indictors are not always useful in pinpointing areas of priority for intervention. It was therefore decided to combine a social class grading by occupation based on the U.K. Registrar General's social class classification and an approach similar to that of Grantham-McGregor. Broad aspects of the child's socio-cultural environment were considered e.g. family structure and function, physical and economic resources as well as more subtle characteristics of the social milieu including maternal personality and stimulation within the home. Because many of the variables are interrelated a multivariate approach was used in analysis.

CHAPTER 4

METHODOLOGY

A. INTRODUCTION

The study design was that of an analytical survey. The word 'survey' is derived from the Latin and means 'to look over or beyond'. The purpose of an analytical survey is to analyse by means of appropriate statistical tools, so that meanings which lie hidden within them can be inferred or the presence of potential and dynamic force may be discerned (Leedy, 1974).

B. SAMPLING PROCEDURE:

i. Pilot Study:

This was conducted to establish the feasibility of obtaining information about the factors to be included in the study. One hundred consecutive infants notified to the Cape Town City Council were visited by one of the research social workers and certain social data were recorded. It was also necessary to determine whether a stratified sampling technique should be used. Although it was thought that the contrast between extreme social groups could justify stratified sampling, only 3 cases out of 100 fell in categories I and II (using the social class classification of the British Registrar General, 1960). Hence classes I, II and III were combined. Since the distribution of cases in each of the 3 groups (using I, II and III as one group) were roughly uniform, stratified sampling was not considered necessary.

ii. The Cohort and Sample:

A cohort of 1000 consecutive Coloured infants born in the Cape Town Municipal area and notified to the City Council were chosen. From the cohort 187 randomly selected infants made up the study sample. The sample was compared with the remainder of the cohort on all of the following variables:

- Place of birth
- Birth weight, length, head circumference

- Gestational age - complications during pregnancy
- Method of delivery
- Method of resuscitation, if necessary
- Apgar score at 1 and 5 minutes
- Maternal age, height, weight gain during pregnancy
- Parity
- Gravida
- Foetal distress
- Congenital abnormalities
- Perinatal complications

There was no significant difference at the 5% level on any variable except for perinatal complications i.e. 'at risk' factors. The sample had 0,6% (1 baby) at risk while the remainder had 3,9% (28 babies) ($p = 0,01$). With 18 variables compared, it is not unexpected to have one significant difference at the 5% level. This would not indicate that the sample was unrepresentative of the cohort. The fact that there was only one infant at risk in the sample is inexplicable, but it does reduce the impact of an important compounding variable in a developmental study i.e. the possibility of perinatal brain damage.

iii. Evaluation of the sample:

Precision: The population was precise in terms of the population group (i.e. Coloured) to which the subjects belonged.

Completeness - was ensured by considering consecutive births in the Cape Town Municipal area. Notification of all births is compulsory by law.

Heterogeneity - was considered and planned for as a result of the pilot study.

Adequacy and representativeness: By considering a cohort of 1000 and randomly selecting 187 infants, the sample should be considered adequate and representative. A sample of 187 was decided upon as this was the maximum number of families which could satisfactorily be visited in the time available.

iv. Outcome of the Sample:

It was decided that should a family move from the area, the child would be excluded from the study.

Summary of exclusions

Deaths	2
Moved from the area	11
Lost to follow-up	1
Total	14

One hundred and seventy three children were therefore followed for 5 years.

C. MEASUREMENT OF GROWTH:

i. Birth - The measurement of weight, length and head circumference were obtained from the birth records.

ii. Twelve months

- Weight - all infants were weighed naked on a beam scale with readings taken to the nearest 10 g.
- Length - was measured on a horizontal board with a fixed vertical headpiece, a sliding vertical footpiece and a scale fixed along the length of the board. The infant was measured supine with the ankles gently pulled to stretch the infant, the knees flat, the head against the headpiece and the sliding footpiece in firm contact with the soles of the feet held vertically. The head was held firmly in line with the body and with the lower orbital border in the same vertical plane as the external auditory canal. An observer and assistant were required and the distance between headpiece and footpiece was recorded, to the nearest 0,1 cm.
- Head circumference was taken as the maximum measurement around the head in the horizontal plane. it was measured

with a non-stretchable tape at the maximum point of occipital protruberance posteriorly and above the eyebrows anteriorly.

iii. 30 Months to 5 Years:

- Weight was measured on a Seca scale with the children stripped to their underclothes. Readings were taken to the nearest 250 g.
- Height was measured on a specifically constructed apparatus. The child was positioned, feet together without shoes, back straight with the occiput, buttocks and heels lightly touching the measuring rod, head aligned so that the lower rim of the orbit and the auditory canal were in a horizontal plane. The child was told to make himself tall, was stretched gently upward by pressure under the mastoid process and instructed to relax the shoulders so that these were not shrugged. Care was taken that the heels were not lifted from the floor. The sliding headpiece was lowered to rest firmly on the head. The distance from the floor to the lower border of the headpiece was measured.
- Head circumference was measured as at 12 months.

All measurements after birth were taken by the author and assistants. The readings were compared to the National Centre for Health Statistics percentiles (Hamil et al 1979) and expressed as percentage of expected value for age.

D. ASSESSMENT OF DEVELOPMENT:

i. Milestones:

Three milestones were selected - sitting unsupported, walking unaided and saying single words. At the visit by the social worker prior to the expected emergence of the particular milestone, the mother or caretaker was asked to look for and record the date on which it was reached. On the subsequent visit the social worker enquired about the acquisition of the

milestones and checked the accuracy, where possible, with direct observation. The criteria for the milestones were as follows; sitting unsupported - able to sit for at least a minute on the floor or a table without using his arms for support. Walking unaided - able to take ten steps alone. Single words with meaning - able to use two words other than 'mama' or 'dada' correctly. The words could refer to objects or people.

ii. Language at 30 Months: All the children were assessed at the Logopaedic Department of the University of Cape Town, on the Reynell Scales of Language Development (Reynell, 1969). In each case the home language of the child was used. The scales have been translated into Afrikaans and are currently in routine use.

iii. Development at Five Years: A specific test was designed for use in this study. The aim was to assess basic developmental skills in children aged exactly 5 years. The content of the assessment included gross motor function, fine motor development including visuo motor skills and language, both comprehensive and expression as well as basic colour and number concepts. The responses were measured in terms of behaviour, pencil and paper and verbal expression. In addition a measure of general intelligence was included in the form of the Draw-A-Man. Items were grouped in such a way that different categories of development could be tested separately.

The following considerations were taken into account:

- the assessment should not take longer than 20 minutes.
- it could be carried out by the author in the child's home
- the equipment used should be standard, simple and culturally appropriate

Item selection: Items as in the test of Ounsted et al (1979) were drawn from well known sources e.g. Gesell (1942) DDST (Frankenburg and Dodds, 1967), Sheridan (1960) and selected so that they would be easily understood by children of differing

levels of sophistication. The items were grouped into Gross motor; Fine motor; and Language categories and criteria for a pass were established (Appendix 2). The test was highly structured and responses were limited to correct/incorrect according to the prejudged criteria. All assessments were carried out by the author and the child had to be co-operative.

Preliminary application: An unselected sample of 30, five year old Coloured nursery school children were tested by the author in their respective nursery schools.

Item analysis: On completion of the preliminary application, the items of each sub-test were subjected to item analysis. The reliability index of each item was determined (Appendix 3). It was decided prior to testing that a reliability index of 0,2 or 0,3 would be considered good, of 0,1 to contribute to the reliability of the test and 0,1 to be unacceptable (Plug et al, 1973). Only one of the 25 items were found to be unacceptable and the criterion for a pass on that item was altered for the final test (Appendix 2).

Subtests:

		Mean	S.D.
I	Gross Motor	6,10	2,26
II	Fine Motor	5,13	2,22
III	Language	3,03	1,35

Cross correlation of sub-tests: The 4 sub-tests - fine motor, language, gross motor and D-A-M were cross correlated as follows:

	Language	Gross Motor	Draw-A-Man
Fine Motor	r = 0,664	r = o,684	r = 0,481
Language		r = 0,383	r = 0,317
Gross Motor			r = 0,190 NS

The cross correlations were significant except for gross motor function and the D-A-M. The best correlations were

between fine and gross motor function and fine motor and language development.

Reliability of the test:

i. Test-retest: Ten children repeated the identical assessment 2 weeks after the original performance. The correlation coefficient was r = 0,919, p. < 0,001.

ii. Internal stability: For each section, the split-half reliability coefficient, corrected for the full length of the subtest using the Spearman Brown formula was calculated (Appendix 4).

The coefficient of internal consistency was also determined by means of the Kuder Richardson formula no 20 (Appendix 4).

The reliability coefficients and SEM for the sub-tests were as follows:

	SPLIT HALF	
Fine Motor	r_{tt} = 0,84	SEM = 1,06
Language	r_{tt} = 0,57	SEM = 1,22
Gross Motor	r_{tt} = 0,49	SEM = 0.97
	KUDER RICHARDSON	
Fine Motor	r_{tt} = 0,77	SEM = 1,20
Language	r_{tt} = 0,63	SEM = 1,13
Gross Motor	r_{tt} = 0,89	SEM = 0.45

A low split half r_{tt} on gross motor development could be explained by the fact that there were only 5 items in the sub-test. The r_{tt} on the Kuder Richardson 20 of 0,89 for gross motor function was good. A weaker reliability for language than for fine motor may be explained by the inclusion of number and colour concept in this sub-test. Different skills are therefore included in this section. Their inclusion is justified by the fact that verbal communication is used in the question and response.

Validity of the Test: All items were similar to those used in standard developmental tests.

E. ASSESSMENT OF SOCIAL MILIEU

Data were collected by 2 experienced, full-time research social workers, JH and AM. They were both integrally involved in the planning of the study. Frequent staff meetings were convened to discuss concepts and terminology to be used in the schedules. The schedules were drawn up paying attention to items to be included i.e. identifying data, data on the social, economic and physical aspects of the environment. From the time at which the children were 2½ years old AM retired and JH visited and collected data on the whole sample.

The details of data collected appear in Appendix 5 and included:

Social background

- Social class by occupation grading of the breadwinner
- Maternal age at the child's birth
- Maternal education - recording actual standards passed and any post school education or training
- Maternal personality as assessed over a 5 year period and designated 1) mature/calm/warm/consistent; 2) excitable/tense/inconsistent; 3) immature/ignorant/apathetic/resigned; 4) repressive/rough/quick tempered; and 5) Other (state)
- Paternal education
- Paternal occupation
- Marital state at the time of the child's birth
- Was the baby planned? - yes or no
- Family unit - whether the child was living with both parents, one parent or neither parents
- Family setting - whether the family was living alone in their house or flat, or sharing with extended family or sharing with others
- Family social stability - assessed over the 5 year period as 1) overtly very stable; 2) moderately stable; 3) doubtful; 4) somewhat unstable; and 5) marked problems (excluding non-support)

Economic status of the family

- Available income ratio (AIR) expressed as a percentage of the household subsistance level based on the Primary Household Subsistence Level of Potgieter (1976)
- Father supporting

Physical environment

- External environment
- Housing
- Occupation density measured on the Batson scale (Batson, 1944)

The social milieu was reassessed periodically over the 5 years.

F. STATISTICAL ANALYSIS

The study was planned in collaboration with and data analysed by the National Biostatistical Research Centre of the South African Medical Research Council. The data were coded and entered into the computer at the Centre. The majority of the variables were categorical. In the case of continuous variables, the data were tabulated by choosing suitable groups. The maximum likelihood χ^2 goodness of fit test was used for analysis (Bishop, 1975).

The independent contributions of growth and social milieu to developmental outcome were assessed by multiple regression analysis. A linear regression model was used to determine the effect of predictor variables on a dependent variable. The total developmental score at five years was found to correlate with and therefore summarise the developmental data and served as the dependent variable in the regression model. The predictor or explanatory variables were selected from the mass data on the basis of their correlation or lack of correlation with each other. (The growth and social data were considered separately). A stepwise procedure was used to select the variables to be included in the model. The partial regression coefficients were then calculated.

CHAPTER 5

RESULTS

A. GROWTH

The data were compared to the NCHS centiles and expressed as percentages of expected weight, height and head circumference for age. The weights for given heights were also expressed as a percentage of expected value for age.

The birth weights were significantly lower than the NCHS reference figures (average of 92,5%). However, by 3 months, the weights were higher than expected. There then followed a relative decline in expected weight-for-age, so that at 6 and 9 months they did not differ from the NCHS figures. At 12 months they were again below the NCHS expected weights. Thereafter they continued at 95% of the expected values significantly below the reference values (Figure 1).

At birth the babies were significantly shorter than the NCHS reference values. The lengths relative to the standards declined further until 30 months when they were 95% of the expected value. They then improved slightly until 60 months, when they were 96,5% of expected height (Figure 1).

The NCHS weight-for-height figures are not given for infants shorter than 49 cms. As these babies were excluded, the average of the relative weights at birth was based on a selected sample. However, the infants still weighed less than expected for a given length. At 6 months they were significantly heavier than expected for their lengths. At 12 months they were similar to the NCHS reference values, but at 30 and 48 months they were significantly heavier than expected although by 5 years they were once again equal to the NCHS values.

The head circumference at birth were significantly lower than the NCHS reference values (average of 98,2%). At 6 months they were similar, but by 12 months they were again significantly below expected values (average of 98,9%).

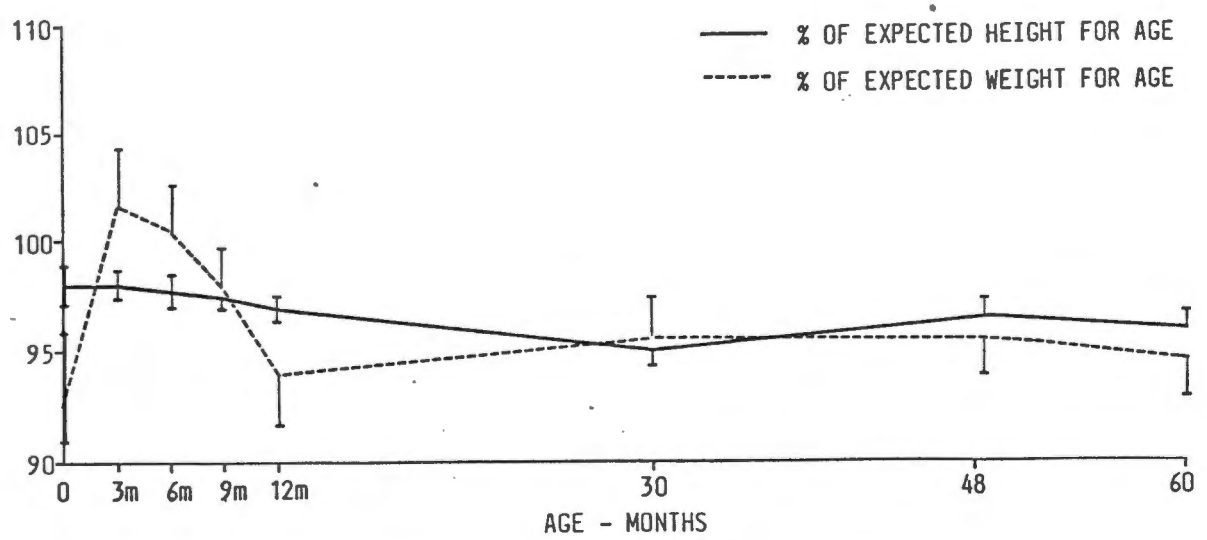

FIGURE 1: Growth 0.5 years (mean and 95% confidence limits).

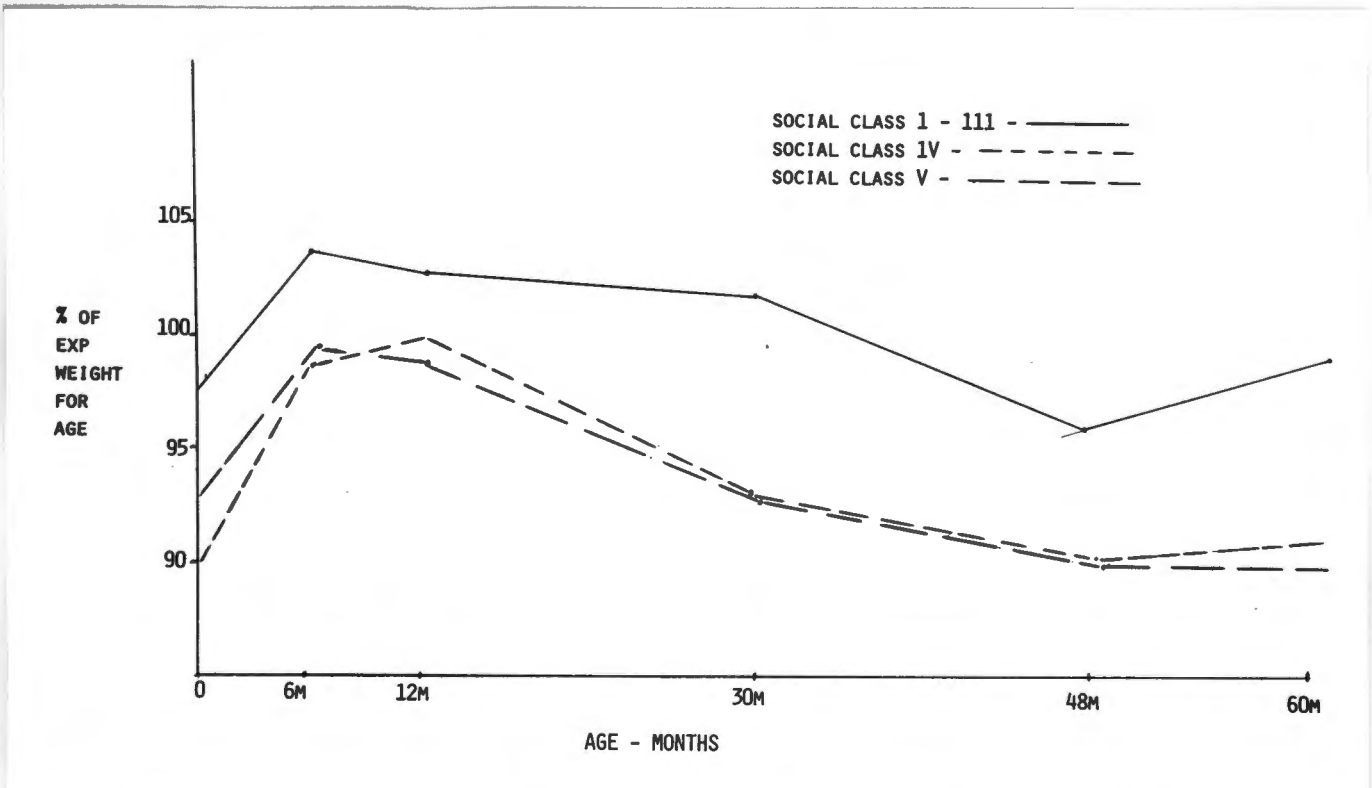

FIGURE 2: Mean percentages of expected weight-for-age by social class category (calculated from NCHS values).

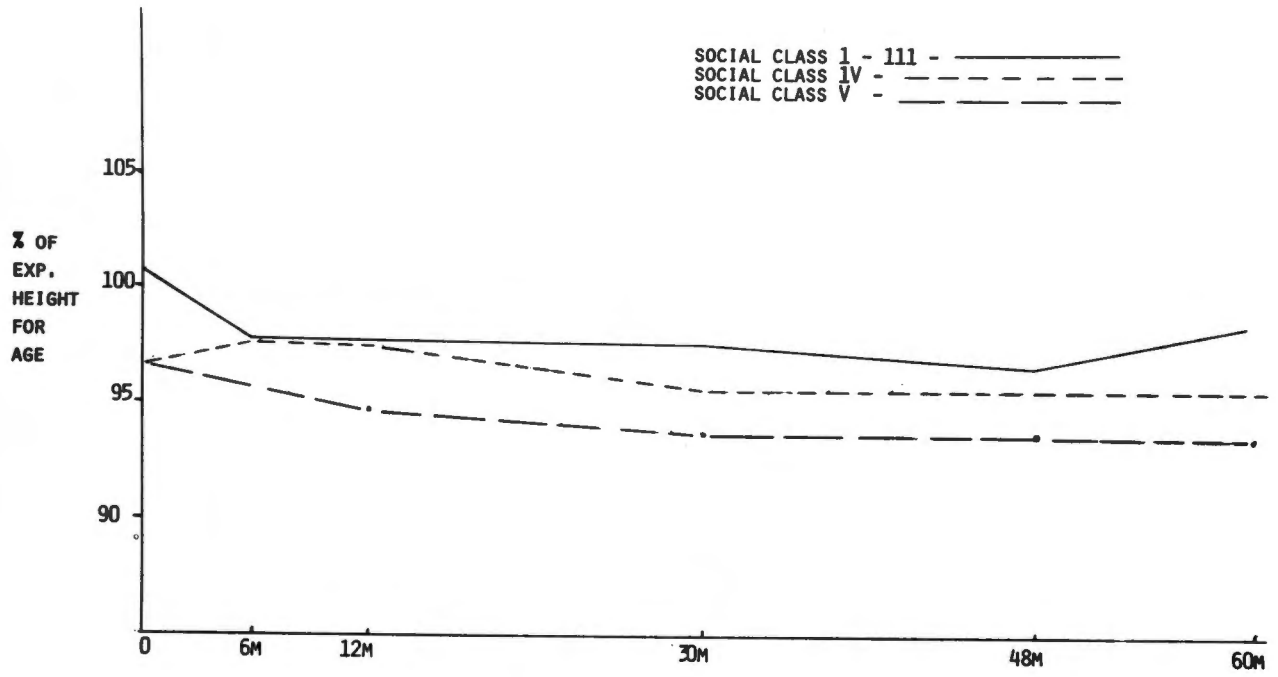

FIGURE 3: Mean percentage of expected height-for-age by social class category (calculated from NCHS values).

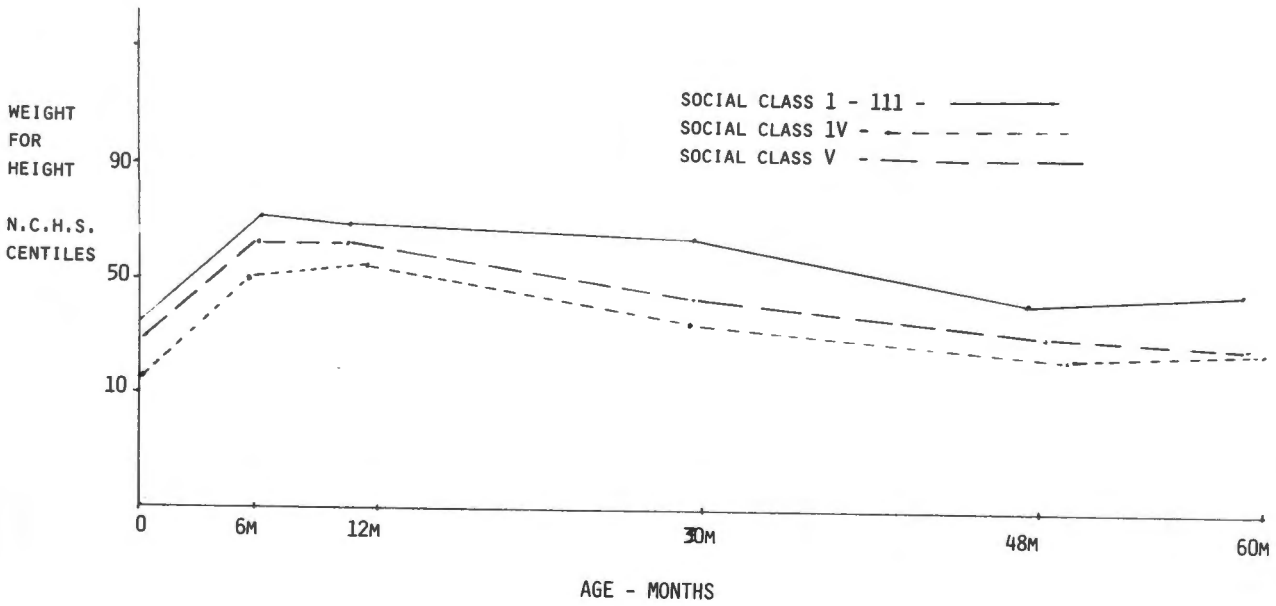

FIGURE 4: Means of weight-for-height by social class category.

The correlations with parental growth are given in Table I. The mother's weight correlated significantly with the growth of the child, but not with growth velocity. Mother's height, however, was not associated with growth except for the length of the child at 2½ years. Father's height correlated with length at 12 and 30 months and with head circumference at birth and at one year. Neither mother's nor father's heights were associated with growth velocity.

B. DEVELOPMENT

Milestones: The distribution of the ages of attaining the 3 milestones are given in Figures 5 - 7. The median value for sitting was 6,0 months, for walking unaided 12,5 months and for saying 4 words with meaning 13 months. In all 3 distribution curves there was a skewing of the upper tail. There were no significant differences in any of the milestones as regards sex.

Language assessed at 2½ years: The median age equivalent for expressive language on the Reynell Language Scales was 2,21 years and for receptive language 2,00 years. Although girls had a slightly higher expressive age equivalent, it did not reach statistical significance.

Development assessment at 5 years: This was expressed as raw score data for the total test and for the subtests - fine motor, language and gross motor. The distribution of age equivalent scores for the D-A-M is given in Figure 8. There were no significant sex differences except for the D-A-M where the girls obtained higher scores ($p = 0,0076$).

C. SOCIAL MILIEU

Social class was categorized according to the occupation of the breadwinner. From the pilot study it was apparent that three divisions were appropriate. The percentage distribution of the three classes was as follows: 1 to III - 36%; IV - 27% and V - 36%. These figures relate to the sample, but were similar to those in the pilot study and cohort (Chapter IV). The marital status is

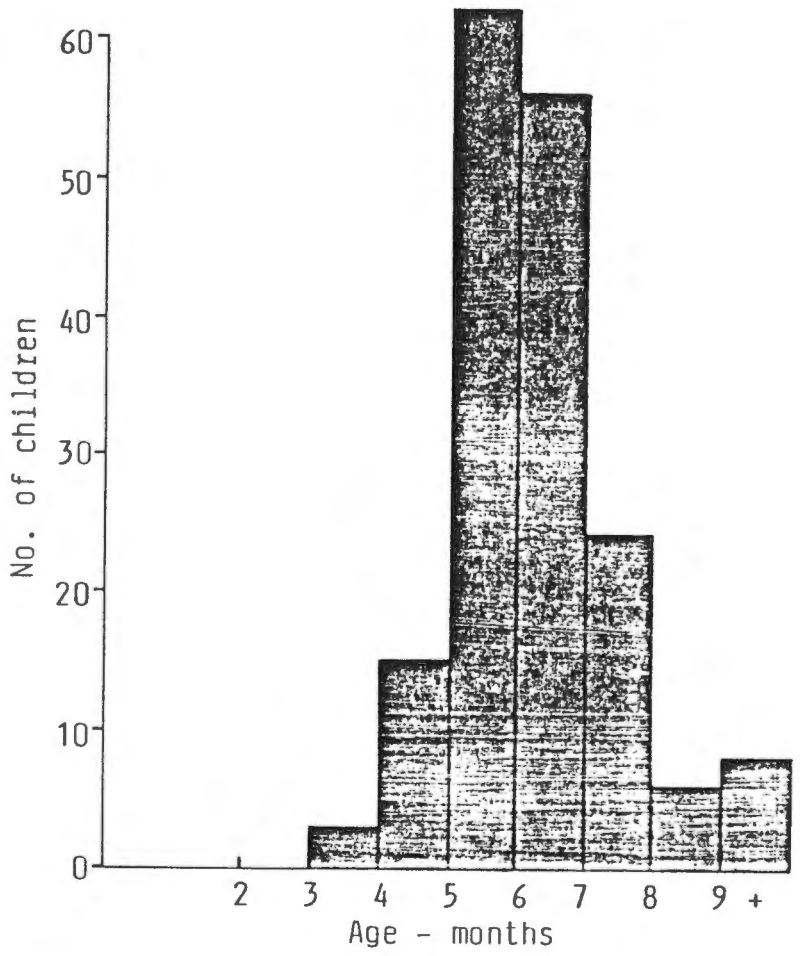

FIGURE 5: Age at which the infants first sat unsupported.

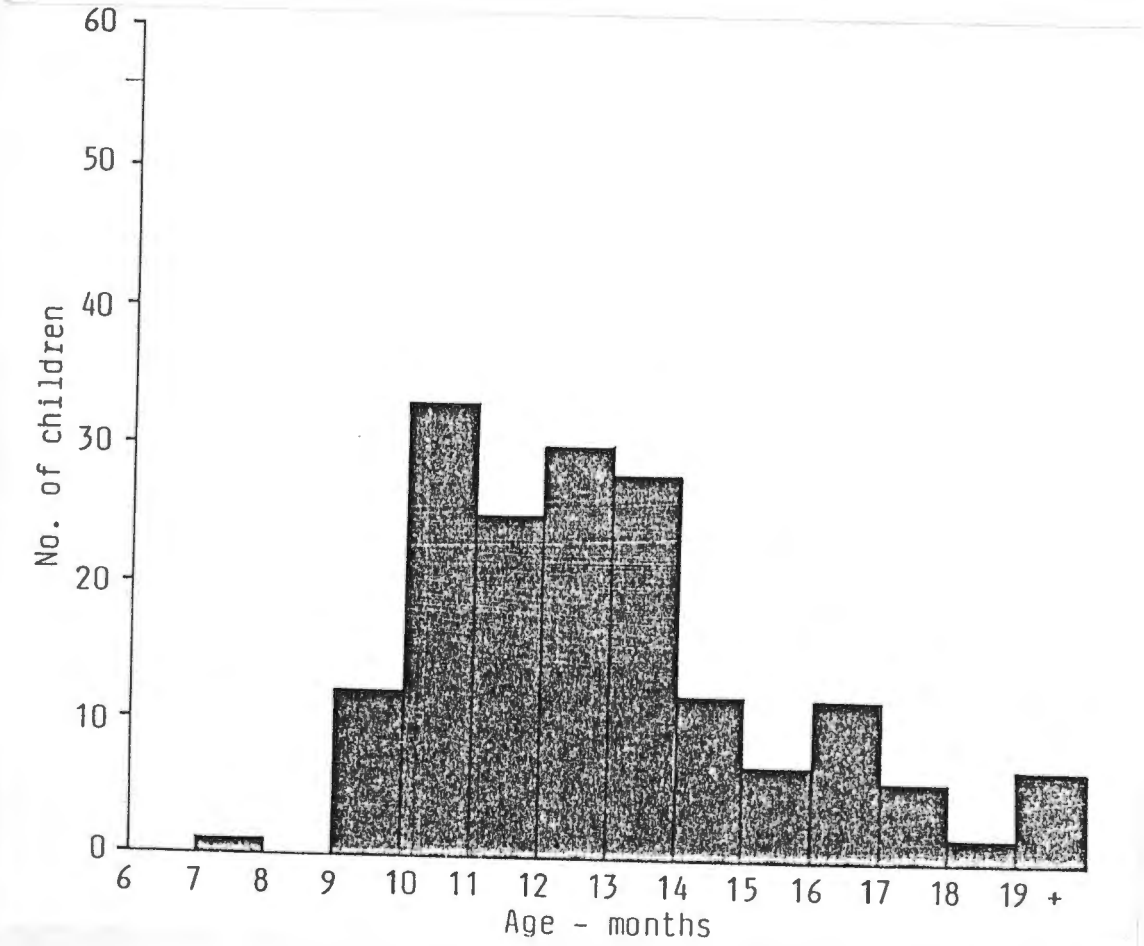

FIGURE 6: Age at which the children walked unaided.

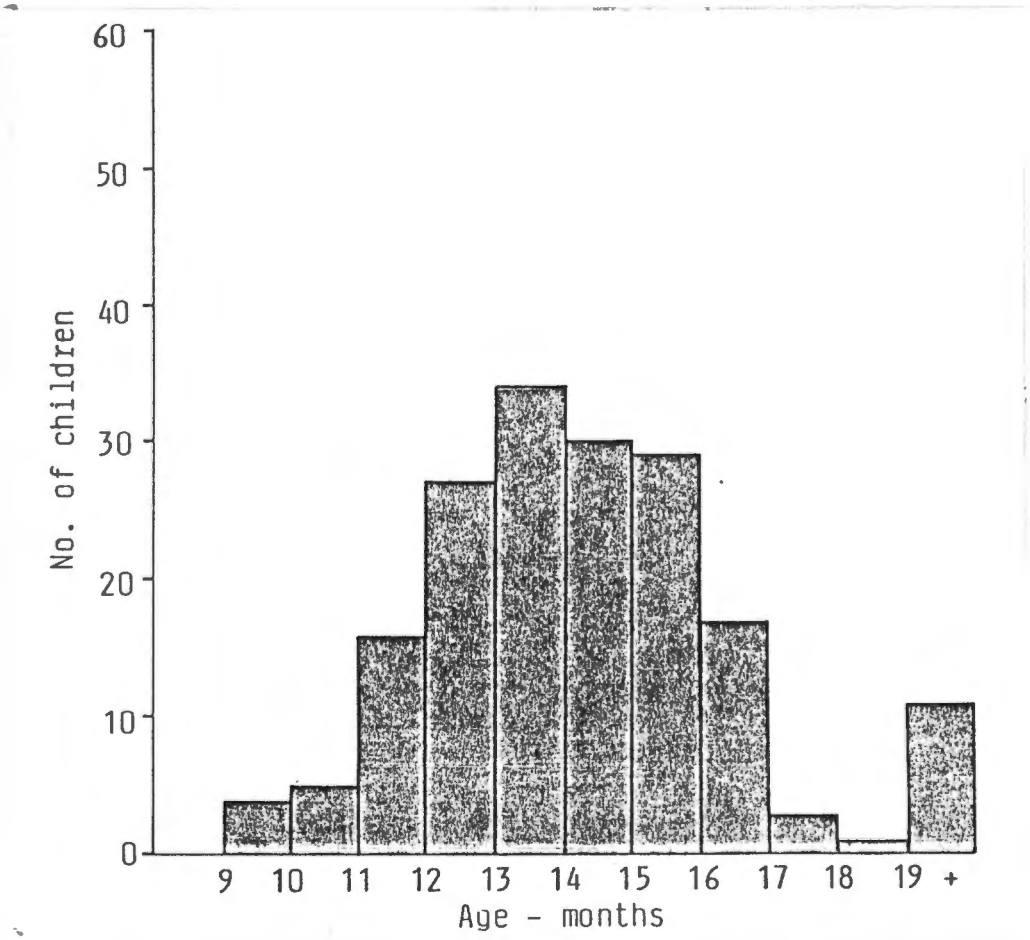

FIGURE 7: Age at which the children could say four words with meaning.

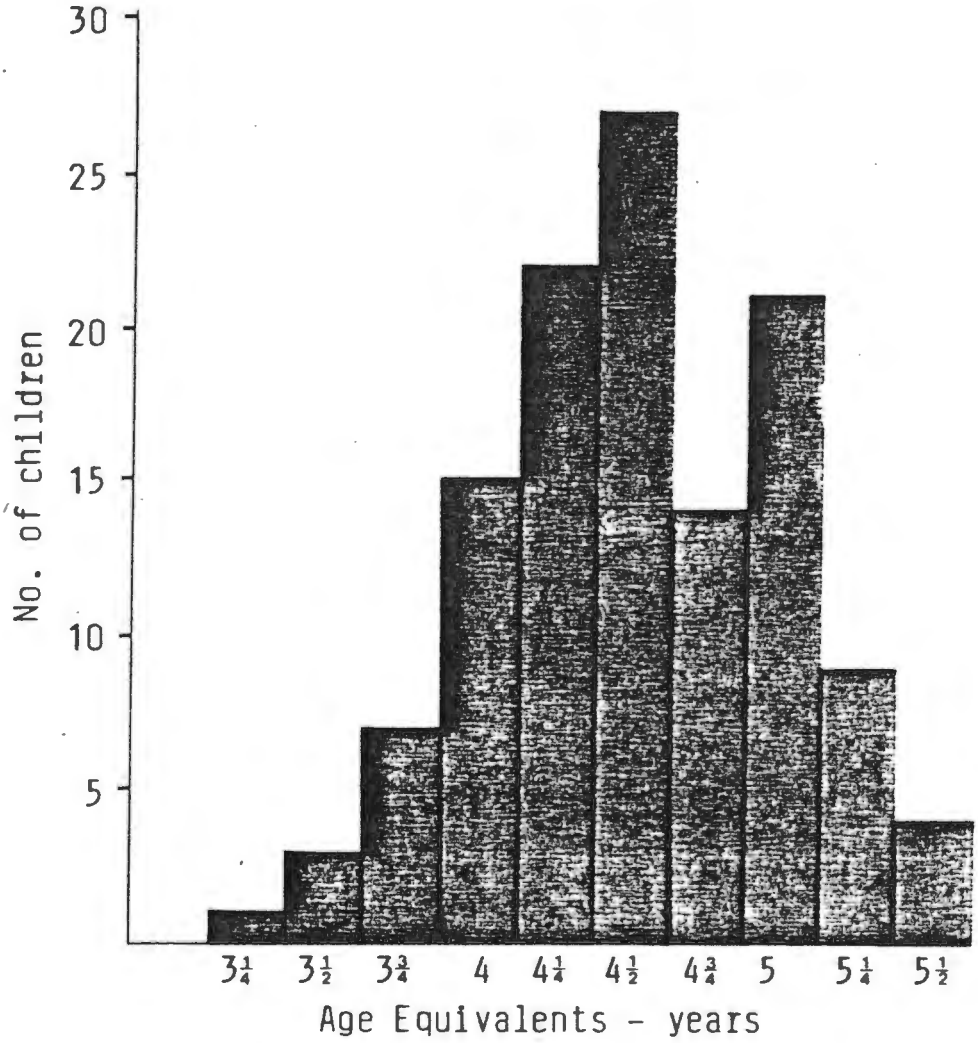

FIGURE 8: Distribution of scores on Draw-A-Man at 5 years of age.

given in Table 2, and educational achievements of the parents are listed in Table 3.

Income was calculated by expressing as a percentage what was earned against what each individual in the household required, according to the Primary Household Subsistence Level of Potgieter (1976). Approximately 24% were below 100 (i.e. below the poverty datum line) and 30% between 100 and 149 (a figure of 150 is generally considered to be an effective minimum level); 22% fell between 150 and 199, and 25% were over 200 (Table 4).

Of the sample, 17% of the families owned their own homes and 56% lived in Council houses or rented adequate accommodation. The rest were considered to be inadequately housed, of whom 6% lived in very squalid conditions. Occupational density was calculated according to the Batson Scale (1944). Fifty percent of the families had a figure above 150, representing gross overcrowding. Table 4 gives the means and ranges of occupational density.

The occupation grading was measured by a number of different criteria. There was a strong association between the father's occupation and that of the breadwinner ($p = 0{,}000$). The breadwinner in some cases was the grandfather, a grandmother, mother or other relative. The breadwinner's occupation was significantly higher than that of the maternal grandfather ($p = 0{,}0350$). The breadwinner's occupation at birth and at 5 years were strongly associated ($p = 0{,}000$). The breadwinner's occupation at 5 years was associated with that of the maternal grandfather ($p = 0{,}0000$) but was significantly higher ($p = 0{,}0072$). In summary, the occupations by different criteria were significantly related to each other. In addition, the breadwinner at birth and 5 years had a significantly higher occupation category than the maternal grandfather, suggesting a trend towards upward mobility over the generations.

Social class is traditionally measured in terms of occupation grading. The question arises, however, as to how well occupation grading reflects the general socio-economic status. The social class measured by breadwinner's occupation was correlated with a

number of other social variables (Table 5). There was a positive correlation with parental education, marital state, income, occupational density, standard of care given to the child, mother's personality and whether or not the father supported the family. There was no correlation with maternal age, mother's return to work, family unit, family planning or children born to the mother. There was also no correlation with nursery school attendance. This could be explained by the allocation of places in the municipal nursery schools to children whose mothers need to work and to families with social problems.

There was generally a good correlation between the various social variables (Table 6),

As stated above, social class by occupation of the breadwinner at birth was strongly associated with that at 5 years suggesting stability of social status during the study period. This was supported by the income, occupational density and marital status over the 5 years (Tables 2 and 4). There was, however, a general improvement in AIR and a slight reduction in the degree of overcrowding. The number of single mothers declined because of subsequent marriages to either the father or a stepfather (Table 2).

D. RELATIONSHIPS BETWEEN GROWTH, DEVELOPMENT AND SOCIAL MILIEU

Growth and Development - Table 7 summarises the associations between growth and development. There was a strong relationship between growth parameters at 12 months and motor development. At 2½ years growth correlated with language comprehension but not expression. At 5 years development (total score) correlated with all growth parameters. Weight and head circumference were associated with all aspects of development except gross motor. Height correlated with the total score and fine motor only. Head circumference had the highest p values followed by weight-for-age and then height-for-age. Gross motor development did not relate to growth.

Growth and Social Milieu - The birth weight was related to the occupation of the breadwinner and O.D. There were no other significant correlations of birth. By 12 months, however, growth correlated well with social variables. This also applied at 30 months (Table 8). Maternal personality was related to length at 2½ years only. There were no significant correlations with growth velocity.

Growth, generally correlated poorly with childhood illnesses (Table 9). There was a negation correlation between gastro-enteritis and length at 12 and 30 months and a positive correlation between other illnesses and weight at a year and growth velocity over 2½ years. Clinic attendance had no influence over growth, and the duration of breast feeding correlated only with growth velocity over 2½ years.

There was a strong correlation between height, weight and head circumference and social class AIR, O.D. and family stability at 5 years. Weight height ratio however was only related to O.D. and there was no relationship between growth velocity and social variables.

There was a stepwise improvement in nutritional status by social class based on the occupational grading of the breadwinner (Figures 2, 3 and 4). Social class V at 5 years had 18,5% of children underweight (below 80% of expected weight for age) and the same number stunded (below 90% of expected height for age). In social class IV the figures were 11, 1% and 4,4% respectively and in social class I-III 4,9% and 1,6%.

Development and Social Milieu - Early motor development correlated significantly with father's education, mother's personality and family stability but not with occupation of the breadwinner. AIR, O.D., mother's education, marital status etc. Early language development was related to mother's age, marital status, family unit, setting and stability (Table 10).

Comprehension at 2½ years was associated with parental education, family stability and occupational density but not social class

(Table 11). Expression was related to mother's education, family stability and mother's return to work, but not with social class (Table 11).

At 5 years there was a good correlation between social class, AIR, O.D., family stability and mother's education and all aspects of development except gross motor. Father's education, however, was only related to gross motor and the D-A-M score and mother's personality to the D-A-M and the total scores (Table 12).

Growth, Development and Social Milieu

Multiple regression analysis was used to determine the independent contributions of growth and social milieu to developmental outcome. Certain variables were selected from the mass data as being representative, with growth, development and social milieu considered separately. Weight-for-age, height-for-age and head circumference for age were representative if growth of the values after 6 months were used. Head circumference was selected as it had been shown to correlate best with development. Birth data did not correlate with other growth indices and therefore had to be included separately in the linear regression model. Income (AIR) best summarised the social milieu. (Income was preferred to social class by occupation grading of the breadwinner as the latter was categorial and comprised only 3 groups, whereas AIR was a continuous variable). Variables which lacked correlation and therefore had to be included separately in the model were maternal age, family setting, family planning, O.D. and attendance at nursery school. The total developmental score at 5 years was representative of the developmental variables and served as the dependent variable.

A stepwise procedure was used to select variables to be included in the regression model. By means of partial correlation it was found that 43% of the developmental variation could be accounted for by the following:

- social milieu (AIR), partial correlation 0,529 - 28%
- growth (head circumference) partial correlation 0,291 - 8%
- mothers age, partial correlation -0,251 - 6%
- family setting.

TABLE I

GROWTH

INFANT vs PARENT

% OF EXP NCH	p values		
	MOTHER'S WEIGHT	MOTHER'S HEIGHT	FATHER'S HEIGHT
Birth - Weight	0,0005*	0,5137	0,3861
Birth - Length	0,2123	0,4412	0,4784
Birth - Head Circumference	0,0381*	0,1230	0,0277*
12 month - Weight	0,0217*	0,6162	0,3215
12 month - Length	0,0000*	0,1815	0,0005*
12 month - Head Circumference	0,0020*	0,5716	0,0413*
Velocity: Birth - 12 months			
Weight	0,3323	0,5650	0,8846
Length	0,5630	0,2986	0,4339
Head Circumference	0,1991	0,3694	0,6283
30 month - Weight	0,0093*	0,1709	0,3392
30 month - Length	0,0579	0,0200*	0,000*

TABLE I (continued)

% OF EXP NCH	p values		
	MOTHER'S WEIGHT	MOTHER'S HEIGHT	FATHER'S HEIGHT
Velocity: Birth - 30 month			
Weight	0,5462	0,5253	0,9362
Length	0,4313	0,3146	0,7653
Velocity: 12 - 30 month			
Weight	0,4986	0,1287	0,8178
Length	0,7990	0,8515	0,3456

TABLE II

MARITAL STATUS

At Birth

	Frequency	%
Married	107	57,2
Living together	20	10,7
Widowed	1	0,5
Divorced / separated	1	0,5
Single	58	31,0
TOTAL	187	99,9

At 5 Years

Married to father before birth	93	55
Married to father after birth	15	9
Married to stepfather	10	6
Living together	15	6
Single	36	21
TOTAL	169	

TABLE III

FREQUENCY DISTRIBUTION OF PARENTAL EDUCATION

	MOTHER		FATHER	
SCHOOL LEVEL	FREQUENCY	%	FREQUENCY	%
Nil	9	4,9	5	3,2
Std IV	30	16,2	19	12,2
Std IV - V	75	40,5	36	23,1
Std VI	36	19,5	37	23,7
Std VII - X	35	18,9	59	37,8
TOTAL	185	100,0	156	100,0
Advanced Education or training	11	5,9	38	24,4

Values for 1,1% of mothers and 16,6% of fathers are unknown. The advanced education is irrespective of the school level achieved.

TABLE IV

AVAILABLE INCOME RATIO (AIR)

	X	Range
At Birth	165,75	30 - 567
At 1 year	183,5	20 - 765
At 2 years	186,26	18 - 605
At 5 years	245,81	57 - 1198

HOUSEHOLD OCCUPATION DENSITY (O.D.)

	X	Range
At Birth	165,43	60 - 471
At 1 year	162,58	60 - 420
At 2 years	161,54	50 - 380
At 5 years	141,16	60 - 314

TABLE V

OCCUPATION GRADING OF BREADWINNER vs OTHER SOCIAL VARIABLES

p - values

Significant Variables		Variables not significant
Father's schooling	0,0000	Mother's age
Mother's schooling	0,0001	Family unit, setting
Marital state	0,0002	Who plays with child at 3 m
Mother's siblings	0,0077	Who is mainly in charge at 6 m
Father supporting	0,0075	Who is mainly in charge at 1 yr
Mother's personality	0,0035	Mother working at 1 yr
Standard of care (3 m)	0,0000	Mother working at 2 yrs
Standard of care (6 m)	0,0000	Siblings by 15 m
Standard of care (9 m)	0,0000	Siblings by 18 m
Standard of care (1 yr)	0,0000	Siblings by 48 m
Ownership of house	0,0000	Family planning before birth
Income	0,0000	Family planning at 48 m
Occupational density	0,0000	Attending nursery school at 4 yrs

TABLE VI

CROSS CORRELATION OF SELECTED SOCIAL VARIABLES

	MAT ED	MAT OCC	PAT ED	PAT OCC	MARITAL STATE	FAM UNIT	FAM SETTING	AIR	EXT ENV	HOUSING	O.D.
Mat Age	,327	,016*	,938	,949	,000*	,000*	,000*	,536	,016*	,162	,827
Mat Ed	.	,000*	,03*	,000*	,368	,465	,953	,002*	,000*	,000*	,008*
Mat Occ		.	,000*	,000*	,000*	,001*	0,24*	,000*	,000*	,000*	,001*
Pat Ed			.	,000*	,026*	,553	,881	,000*	,001*	,009*	,383
Pat Occ				.	,000*	,332	,337	,000*	,000*	,000*	,036*
Marital Status					.	,000*	,000*	,043*	,003*	,032*	,000*
Fam Unit						.	,000*	,027*	,070	,038*	,000*
Fam Setting							.	,131	,148	,622	,003*
AIR								.	,000*	,000*	,000*
Ext env									.	,000*	0,00*
Housing										.	0,04*

TABLE VII

GROWTH vs DEVELOPMENT

p - value

% OF EXP HCHS	MOTOR DEVELOPMENT (Milestones)
Weight at 1 yr	0,0015*
Height at 1 yr	0,0013*
Head Circumference at 1 yr	0,0055*

	LANGUAGE DEVELOPMENT AT 2½ YEARS	
	COMPREHENSION	EXPRESSION
Weight	0,0066*	0,4758
Height	0,0206*	0,1519

	DEVELOPMENT AT 5 YEARS				
	TOTAL	FINE MOTOR	GROSS MOTOR	LANGUAGE	DRAW-A-MAN
Weight	0,0020*	0,0135*	0,8457	0,0010**	0,0171*
Height	0,0061*	0,0304*	0,8144	0,1063	0,0893*
Head Circumference	0,0001*	0m0001*	0,2519	0,0001*	0,0497*

TABLE VIII

GROWTH vs SELECTED SOCIAL VARIABLES

% OF EXP NCHS	p - values				
	SOCIAL CLASS	AIR	OD	MAT PERSONALITY	SOCIAL STABILITY
Birth - Weight	0,024*	0,3525	0,0126*		
Birth - Length	0,1225	0,1497	0,1752		
Birth - Head Circumference	0,4094	0,7329	0,8220		
12 month - Weight	0,0056*	0,0025*	0,1155	0,1139	0,0002*
12 month - Length	0,0227*	0,0007*	0,0308*	0,2097	0,0003*
12 month - Head Circumference	0,0012*	0,0006*	0,2360	0,1629	0,0080*
Velocity: Birth - 12 month					
Weight	0,6413	0,1219	0,7626	0,8877	0,4173
Length	0,1094	0,7973	0,6187	0,2935	0,2768
Head Circumference	0,5159	0,6736	0,2791	0,0635	0,0971
30 month - Weight	0,0002*	0,0059*	0,0222*	0,0800	0,0075*
30 month - Length	0,0019*	0,0000*	0,0096*	0,0000*	0,0000*

TABLE VIII (continued)

% OF EXP NCHS	P - VALUES				
	SOCIAL CLASS	AIR	OD	MAT PERSONALITY	SOCIAL STABILITY
Velocity: Birth - 30 month					
Weight	0,6340	0,2766	0,6651	0,5397	0,2115
Length	0,5176	0,2980	0,0374	0,3337	0,9133
Velocity: 12 - 30 month					
Weight	0,6214	0,7356	0,6881	0,6730	0,5185
Length	0,2216	0,0726	0,7443	0,0943	0,0331*
60 - month					
Weight	0,0002*	0,0023*	0,0024	0,6840	0,0147*
Height	0,0021*	0,0037*	0,339*	0,5439	0,0006*
Head Circumference	0,0054*	0,0002*	0,0157*	0,3860	0,0015*
Weight for Height	0,0552	0,2763	0,0156*	0,5360	0,0912
Velocity: Birth - 60 months					
Weight	0,7895	0,6435	0,6661	0,6785	0,5837
Height	0,6514	0,1005	0,0734	0,6480	0,0678
Weight for Height	0,2712	0,7001	0,5661	0,7360	0,5060

TABLE IX

GROWTH vs ILLNESS, BREAST FEEDING AND CLINIC ATTENDANCE

% OF EXP NCHS	p - values				
	GASTRO	RESPIRATORY	OTHER	CLINIC ATTENDED	DURATION OF BREAST FEEDING
12 month - Weight	0,0718	0,7529	0,000*	0,1613	0,5583
12 month - Length	0,0464*	0,7261	0,0928	0,1295	0,5253
12 month - Head Circumference	0,6611	0,5718	0,9942	0,3609	0,8015
Velocity: Birth - 12 month					
Weight	0,4177	0,3345	0,1368	0,8031	
Length	0,4405	0,4984	0,3050	0,6935	0,4097
Head Circumference	0,1298	0,8720	0,5332	0,9823	0,9097
30 month - Weight	0,5370	0,3538	0,4118	0,4280	0,1421
30 month - Length	0,0262*	0,7912	0,1672	0,3731	0,6586

TABLE IX

% OF EXP NCHS	p -values				
	GASTRO	RESPIRATORY	OTHER	CLINIC ATTENDED	DURATION OF BREAST FEEDING
Velocity: Birth - 3 month					
Weight	0,5543	0,1060	0,0251*	0,9091	0,0306*
Length	0,2387	0,3807	0,3590	0,7665	0,6735
Velocity: 12 - 30 month					
Weight	0,2751	0,3501	0,7498	0,7332	0,6652
Length	0,6066	0,7984	0,7234	0,0920	0,3364

TABLE X

DEVELOPMENTAL MILESTONES vs SELECTED SOCIAL VARIABLES

p - values

VARIABLE	MOTOR	LANGUAGE
Social class	0,2163	0,4528
Mother's age	0,2412	0,0012*
Mother's education	0,2402	0,2016
Father's education	0,0066*	0,4839
Marital status	0,1641	0,0009*
Family unit	0,2882	0,0021*
Family setting	0,3294	0,0007*
Pregnancy planned ?	0,8122	0,6360
Father's support	0,1101	0,2865
Mother's personality	0,099*	0,7664
Family stability	0,0000*	0,0034*
AIR	0,0256	0,4065
OD	0,0502	0,0617
Mainly-in-Charge	0,0772	0,2190

TABLE XI

LABGUAGE DEVELOPMENT AT 30 MONTHS vs SELECTED SOCIAL VARIABLES

p - values

	REYNELL LANGUAGE SCALE	
	COMPREHENSION	EXPRESSION
Social class	0,2426	0,2636
Mother's age	0,6179	0,7911
Mother's education	0,0012*	0,0427*
Father's education	0,0353*	0,6288
Marital status	0,0566	0,0014
Mother working	0,7547	0,0492*
Father supporting	0,0696	0,0703
Maining in charge	0,8110	0,3846
Mother's personality	0,2183	0,1221
Family stability	0,0237*	0,0007*
AIR	0,7750	0,6716
OD	0,0095*	0,3179
Apgar score 5 mins	0,6392	0,7638
Siblings born	0,7513	0,8622

TABLE XII

DEVELOPMENT AT 5 YEARS vs SELECTED SOCIAL VARIABLES

p - values

	TOTAL	FINE MOTOR	GROSS MOTOR	LANGUAGE	DRAW-A-MAN
Social Class	0,0002*	0,0001*	0,4554	0,0001*	0,0001*
Mother's education	0,0001*	0,0001*	0,9091	0,0001*	0,0237*
Father's education	0,3951	0,6035	0,0161	0,0997	0,0223*
Mother's personality	0,0143*	0,1857	0,4791	0,1171	0,0045*
Family stability	0,0044*	0,0002*	0,5384	0,0017*	0,0284*
AIR	0,0002*	0,0007*	0,1793	0,0005*	0,0024*
OD	0,ooo2*	0,0002*	0,1946	0,0001*	0,0356*

CHAPTER 6

DISCUSSION

In comparison with the NCHs growth figures the study children at birth were well below expected weight, length and head circumference. Thus the Coloured children in Cape Town weigh less, are shorter and are lighter for length than the American infants on whom the NCH figures were based. This finding has been reported by Woods et al (1979). Regarding birth weight in the UK, Baird (1969) has shown that women in social classes IV and V were relatively undernourished and tended to produce poorly grown fetuses. A number of comparative studies on birth weight and social class in 3rd world countries have been reviewed by Ross and Turshen (1970). They found a consistent relationship between mean birth weight and socio-economic status within a community. Ounsted and Ounsted (1973), however, have questioned the value of using social class of an infant's parents when examining aspects of human biology. They argued that social class tended to be variable within a family and markedly unstable over generations. The present study showed a strong correlation between birth weight and social class by occupation of the breadwinner and many other variables. There was also a good correlation between occupation of the breadwinner and that of the maternal grandfather, suggesting consistency over generations.

There was a rapid postnatal weight gain but not an increase in length, so that between three and six months, they were heavier than the NCHs reference values. By a year, however, they were once again below the values in weight and length and this persisted throughout the pre-school period. Thomson (1970) has described three phases in early childhood growth. During the first six months there is a period of optimal growth. From six to 18 months, disease and other adverse circumstances cause a setback and from then until five years growth 'maintains station', but fails to achieve full recovery from the set-back. These trends correspond to the patterns seen in this study.

Because the infants were all born within one month, the possibility of a seasonal influence on growth arises, particularly with regard to the rapid but transient weight gain during the first six months of life. Marshall (1975) has studied the relationship between growth rate and

seasonal climatic variations, and concluded that they exert at most a small effect on growth rate and perhaps none at all. Excessive calorie intake was probably responsible for the weight gain as it was not accompanied by an increase in length. Eighty-one percent of the infants were initially breast fed, but this figure dropped rapidly, so that by four months only 30% were fully breast fed. Thus 70% of the infants were partially or totally bottle-fed, many receiving added energy in the form of solids. Whitehead and Paul (1984) have drawn attention to the trend in developed countries towards reduced energy intake associated with increased breast feeding and also in those infants bottle fed on modified milks. This has led to anthropometric measurements falling well below the reference figures based on children who were predominantly bottle fed prior to 1970.

The weights were not affected by gastroenteritis or respiratory infections. In relation to Martorell's review (1980), therefore, Cape Town would qualify as a developed country, because of the poor relationship between illness and growth. However, the infants with 'other illnesses' weighed less at 12 months than those who had no such illnesses. The commonest 'other' illness was skin infection, which related to social class and standard of hygiene.

Development was assessed by recording basic milestones in infancy, by the Reynel Language Scales at 30 months and on a general assessment designed for the study at five years. According to Vernon (1968) most Western type tests can give useful results in semi-accultured groups provided that regard is paid to the linguistic, motivational and other cultural factors that affect performance. The Coloured population of Cape Town is a Western orientated group in whom language and cultural factors should not affect developmental performance. The test, based on one described by Ounsted et al (1979) was devised so that it could be administrated in the child's home, could be completed in 20 minutes and would test global development as well as different aspects of development important in the preschool period. Seven of the children were unco-operative on testing. In the preschool period there are always some children who refuse certain items or the whole test. Ounsted et al (1979) found 11,5% of their children refused two or more items at four years.

The developmental milestones were very similar to those reported in the literature. The median age of walking at 12,5 months compared with United States Heterogenous (white) of 12,4 months (Bayley, 1965) and Newcastle 12,8 months (Neligan and Prudham, 1969) (Table 1). The median age for saying first words with meaning was 13 months compared to 12,4 months in the Newcastle study (Neligan and Prudham, 1969). The slight delay in the study could be explained by the fact that the Cape Town milestone stated that the children had to say 2 words in addition to mommy and daddy, as opposed to 3 or 4 words correctly used in Newcastle. The skewing of the upper tail in the distribution of milestones has been reported by Neligan and Prudham (1969); Frankenburg and Dodds (1967); Hindley et al (1966) and by Miller et al (1960). The practical significance of this phenomenon lies in the need for reporting milestones in terms of percentiles rather than means and standard deviations.

The Reynell Language Scales have been translated into Afrikaans and are routinely used in Cape Town. The language delay in this study must therefore be considered significant as such a marked delay cannot be explained by cultural unfamiliarity with test items. Many of the children were reared in bilingual environments. It has been well documented that children from bilingual homes develop their skills in one language at a slower rate than those who are primarily reared in monolingual homes (Frankenburg, 1975). It has also been shown, that more bilingual children come from lower SES families than the monolingual ones (Darcy, 1953). The D-A-M as developed by Goodenough was originally held to be 'culture free'. However, this has been shown not to be so and the test outcome has been related to SES (Bakare, 1972; Ucman, 1972). The children in this study scored below the expected levels.

In the follow-up study on children with kwashiorkor, Evans et al (1971) found that at 10 years the D-A-M scores were significantly lower than the sibling controls, despite no differences in IQ or head circumference. They concluded that this could be the result of emotional or affective influences. In the present study the D-A-M scores correlated with social variables as well as with growth including the head circumference. Stoch and Smythe (1976) mentioned visuo-motor perception defects together with a reduction in head circumference as

reflecting evidence of organic brain dysfunction in their study on marasmic children. Visuo-motor difficulties would probably also contribute to poor drawing ability. there was a good correlation between the Fine Motor subtest and D-A-M (Chapter 5). In the present study both nutritional and social/affective effects could have been operative in the outcome of the D-A-M test.

Social class by occupation grading of the breadwinner appeared to reflect the general socio-economic status, but as only 3 classes were distinguished, other measures of social milieu were included. There was a reasonably good cross correlation of social variables.

Approximately a third of the sample families fitted into the U.K. Registrar General's social classes I - III. This group corresponded to the upper stratum described in the report of the Theron Commission. The

TABLE I

AGE OF INDEPENDENT WALKING (SEXES COMBINED)

STUDY	MEDIAN OR MEAN AGE MONTHS	REFERENCE
Cape Town	12,50	Present study
Europe:		
Brussels	12,48	Hindley et al (1966)
London	13,23	Hindley et al (1966)
Paris	13,58	Hindley et al (1966)
Stockholm	12,44	Hindley et al (1966)
Zurich	13,63	Hindley et al (1966)
Newcastle	12,80	Neligan and Prudham (1969)
London - English	12,80	Pollak and Mitchell (1974)
- West Indian	12,70	Pollak and Mitchell (1974)
- Cypriot	12,90	Pollak and Mitchell (1974)
United States		
Iowa- White	13,54	Smith et al (1930)
California	13,00	Bayley (1935)
New York	13,30	Peatman and Higgons (1940)
Philadelphia - white	13,30	Rhoads et al (1945)
- negro	13,30	Rhoads et al (1945)
Heterogenous - white	12,40	Bayley (1965)
- negro	11,40	Bayley (1965)
Denver	12,10	Frankenburg and Dodds (1967)
Stratified U.S. sample	11,70	Bayley (1969)
Africa		
Uganda, Baganda, rural	11,70	Kilbride et al (1970)

fathers of the children were generally better educated than the mothers. However, 3,2% of the fathers and 5,2% of mothers had no formal education, and a further 35% of fathers and 60% of mothers were not educated further than standard V. Regarding income, a quarter of the families were below the poverty datum line and over half below an effective minimum level. The Theron Commission estimated that in 1975, 38,3% were below a supplemental living level. Over half of the families in the sample lived in overcrowded conditions (occupational density over 150) and more than a quarter lived in unsatisfactory accommodation. This agrees with the finding in the Theron Commission Report that in a survey of attitudes among urban Coloured people, they perceived housing shortage to head the list of problems.

Growth is determined by a continuous interaction between genetic and environmental forces. Support for the genetic influence in this study comes from the correlation of paternal height with length at 12 and 30 months and maternal height with length at 30 months. It is interesting to note that neither parent's height correlated with growth parameters at birth. The genetic influence would therefore appear to affect length rather than weight and to be operative from one year onwards.

Mother's weight correlated with weight throughout and with head circumference at birth and length and head circumference at a year. This suggests the possibility of the early influence on intrauterine nutrition. Low birth weight for gestational age is generally accepted as being due to maternal and fetal malnutrition. Ounsted and Ounsted (1973) on the other hand, have postulated a theory of maternal constraint on fetal growth, which is determined by the degree of constraint imposed on the mother during her fetal existence and operates in ethnic groups to draw mean growth rate towards that which is most adaptive for the particular gene pool.

Environmental influences are undoubtedly important. It is interesting to note that AIR did not correlate with size at birth, but did so with all growth parameters at 12 and 30 months and at five years. Social class was related to birth weight, but not length nor head circumference. From 12 months onwards it correlated with all measurements. Growth velocity, however, did not correlate with any of the social variables.

There was a strong correlation between growth and motor development. This is consistent with other studies which have shown a relationship between motor development in infancy and measures of size, build and body composition (Bayley, 1935; Norval, 1947; Peatman and Higgons, 1942; Shirley, 1931). The relationship is most apparent at the extremes of the physique continuum (Malina, 1980). Laskey et al (1981) found a relationship between physical growth and infant development in rural Guatemala. They were unable to explain this relationship by a number of variables including gestational age, nutrient intake, prevalence of disease or familial characteristics.

Of all the growth indices the head circumference was found to correlate best with development. The relationship between head circumference and cognitive development remains controversial. Sells (1977) found no significant reduction in the IQ's of children attending regular classes who had a head circumference greater than two standard deviations below the mean although their academic achievements were lower than children with normal head circumferences. Stoch et al (1982) reported decreased head circumference and IQ in marasmic children at follow-up but no attempt was made to correlate this parameter with outcome. Klein et al (1972) in rural Guatemalan children found that head circumference accounted for more of the variance in mental development than height. This they suggested may be a product of the changing relation of height and head circumference over age.

In the present study there was no correlation between social class and head circumference at birth. By a year there were significant differences in head circumferences between the social classes although they still fell within the normal range and these differences persisted throughout the study period, indicating a nutritional effect on early brain growth. Taking the above studies together the conclusion can be reached that in well nourished children, head size does not correlate with cognitive development. With early malnutrition there is an effect on brain size and intellect (Stoch et al, 1982). Even in milder forms of malnutrition (Klein et al, 1972) and in the present study, a relationship between brain growth and development is demonstrable.

Several studies have examined early motor development in relation to social class. Bayley and Jones (1937) reported no relationship between

socio-economic variables and the age of first walking independently but there was a tendency for an increased number of negative correlations between motor scores and socio-economic variables. Neligan and Prudham (1969) reported a social class difference in the age of independent walking in Newcastle Upon Tyne, the social class differences favouring the lower class children. They postulated a 'deprivation of the opportunity to learn resulting from over protection', as the reason for this. Hindley et al (1966), on the other hand, found no social class differences in the age of walking among five European longitudinal samples. Social class did not affect the age of walking in this study, but there was a correlation with father's education, mother's personality and family stability.

No significant social class differences in early language development were formed by Miller (1960). Frankenburg and Dodds (1967) and Prudham and Neligan (1969). In this study there was no associated between social class by occupation of the breadwinner, and early language milestones, but there was a relationship with marital status and family unit, setting and stability. This emphasizes the importance of the micro-environment in early language development.

From the age of two years advancement occurs due to the greater amount of verbal dialogue and general intellectual stimulation received by middle class children (Frankenburg et al, 1975). A study in the U.K. demonstrated after six months a progressive deceleration in the development of lower class children in contrast to higher class children (Hindley, 1961). Although there was no direct relationship to social class at 30 months, there was a strong association with parental education and family stability.

At five years language correlated with social class maternal education income, occupational density and family stability.

The gender difference favouring girls in all major sections of development as reported by Ounsted et al (1979) were not as marked in this study. There was no significant difference in language acquisition between boys and girls but on the D-A-M girls did obtain higher scores.

Nursery school attendance did not advance the developmental performance of the children. This is contrary to the finding of Ounsted et al (1979). In the Coloured community of Cape Town nursery school attendance is usually confined to the more affluent well motivated families and to the poor and problem families where preference for placement is given to children whose mothers need to work to supplement the family income. This probably accounts for the lack of correlation with development and also for the fact that nursery school attendance was one of the variables which lacked correlation with AIR and the majority of the other social variables.

Ireton et al (1970) found no correlation between SES and infant development assesed by the Bayley Scales. At four years, however, there was a significant correlation between SES and intelligence. The present study supports these findings in that social class did not correlate with development during infancy, but at five years there was a strong association between development and social class by occupation of the breadwinner, income, occupation density and family stability. Infant motor development did relate to father's eduction, mother's personality and family stability. Language development in infancy related to mother's age, marital status, family unit, setting and stability. Relating these findings to McCall's conceptual scheme on early development (1981) i.e. that early development is largely maturational, while individual differences are unstable and not highly correlated with genetic or environmental factors, whereas later on nature's hold on development declines and individual differences correlate more strongly with both genetic and environmental factors, the following facts are relevant:

- infant development in Cape Town's Coloured children as assessed by milestones was very similar to that reported from Europe and America

- infant development was not associated with social class by occupation of the breadwinnder. It was, however, associated with growth and some social variables i.e. genetic/environmental influences

- at 30 months language was relatively delayed when assessed on the Reynell Scales and comprehension especially was associated with growth, parental education and family stability, but not with social class

- at five years there was a very strong correlation between growth, development and social milieu.

There is therefore some agreement with McCall's conceptual scheme although in infancy genetic and environmental factors did play a limited role.

Social stability was the social variable most consistently related to development (in infancy, at five years and language at 30 months). It was a composite assessment based on income, housing, family cohesion and child centredness as well as the presence or absence of social pathology. A significant proportion of the Coloured population of Cape Town have low incomes, poor housing, and manifest social disorganisation. The implications for intervention are that this would need to be broad based and particular emphasis placed on these aspects. This is important for administrators, community workers and health professionals. In addition to general measures, specific intervention strategies should be implement. For those children who are underweight (approximately 12% of the population) nutrition clinics run by the local health authorities should be provided. In view of the correlation between income and nutrition and the significant number of households with inadequate incomes, consideration should be given to some form of state funded financial supplementation programme for low income families.

The cluster of social variables were best summarised by the AIR. Social variables not fitting into this cluster were maternal age, family setting, the practice of family planning, O.D, and attendance at nursery school. Social milieu as indicated by income accounted for 28% of the variation in development at five years. Growth, with a partial correlation coefficient of 0,291, accounted for 8% of the variation. Studies in well nourished populations report correlations between growth and development of 0,2-0,3 (Husen, 1951; Douglas et al, 1965). The

figure in this study falls within the upper limits of this range. Nutritional deficit, therefore, has a very limited contribution to developmental outcome within the range of this study.

Finally there is the question of theoretical models and whether or not growth could be considered an indicator of nutritional status among the children of the study. The families showed a wide range of socio economic circumstances. A quarter of them were below the poverty datum line and half an effective minimum level. This would provide a setting for undernutrition. The growth parameters were all below the expected NCHS values for age. There was a strong correlation between weight, height and head circumference, from one to five years and social class by occupational grading of the breadwinner and AIR. The social classes I - III, with approximately 5% of children below the third percentile, could be considered to be well nourished, whereas in social class IV 11,1% and V 18,5% of the children were underweight. Taking the social setting and the anthropometric findings together, there is good evidence to support this supposition of nutritional growth failure in children from poorer families in the study.

Regarding the issue of theoretical models (Margen, 1984) the optimal nutritional theory implies that an undersupply of those quantities of nutrients necessary for an individual to reach full growth potential will result, in addition to growth failure, to some functional developmental impairment. One would expect the correlation between growth and development to be greater than 0,3, the upper limit of the correlations applying to well nourished, optimally grown populations. This was not the case in this study. The alternative model, the homeostatic theory of growth postulates a broad spectrum of growth curves, the one actually followed being determined by the nutritional and environmental experiences of the child. The findings of this study would support this theory in that the correlation between growth and development was within the range expected from well grown children, whereas the social factors accounted for far more of the developmental variability than did growth. One must add that, if this is accepted, the relationship of nutrition to development could be curvilinear rather than linear and that developmental fall off would occur beyond an area of adaptation or threshold and that such a threshold is below the nutritional levels found in the children of this study.

In conclusion, this thesis has addressed the issue of the impact of mild malnutrition on development in a society in transition. It has sought to find both the biological (anthropometric) and social correlates of development in preschool children. Within the study population, where approximately 12% of the children were underweight and 9% were stunted, social milieu accounted for far more of the variation in development than did growth. The correlation between growth and development fell within the upper limits of the range reported for optimally nourished populations. The study therefore supports a homeostatic theory of growth and the concept of severe developmental fall of occurring only below a certain nutritional threshold. Nevertheless, the finding of a strong correlation between head circumference and development pointed to the importance of ensuring adequate nutrition during infancy.

CHAPTER 7

SUMMARY AND CONCLUSIONS

The aim of the study was to document growth trends, developmental progress and social milieu in preschool coloured children in Cape Town and to investigate the relationship between these factors particularly as to whether growth as an index of nutritional history, could be related to development independent of social environment.

At birth infants were relatively light and short for gestational age. Size at birth correlated with social class. A rapid post-natal weight gain rendered them relatively overweight between 3 and 6 months. Thereafter they again became lighter and shorter than the NCHS reference values and this persisted during the pre-school period. Mother's weight was related to weight at birth, 12 months and 30 months. The genetic influence on growth was reflected in a correlation between parental height and child's length from 12 months onwards.

Environmental influences as assessed by social class by occupational grading of the breadwinner, income and family stability were also correlated with growth from 12 months onwards.

Infant development as indicated by milestones was very similar to internationally reported studies. Motor development was not associated with social class by occupational grading of the breadwinner but with father's education, mother's personality and family stability. It was also highly correlated with growth during infancy. Early language milestones were associated with the child's micro-environment as indicated by marital status, family unit, setting and stability. Language development at 30 months reflected a general lag in verbal skills and was correlated with parental education and family stability. At five years there was a good correlation between growth, development and social milieu, although the social variables accounted for far more of the variation in development than did growth.

It was concluded that growth could be considered an indicator of nutritional status among the children of the study. Because growth contributed relatively little to the developmental variability as

compared to social milieu, there was more support for the homeostatic theory than for the deprivational theory of growth.

Social class by occupation grading of the breadwinner and income reflected the general socio-economic status and there was a good cross-correlation between the social variables. Approximately one third of the families lived in a middle class environment. However, poor maternal education, low incomes and over-crowding were prevalent and must constitute risk factors in child rearing. Sixty five percent of the mothers were not educated further than primary school level and over half of the families were living below an effective minimum level of income. Similarly over half the families lived in grossly overcrowded conditions.

In conclusion, therefore, during infancy developmental milestones were similar to those reported in the literature. Later, however, there was a fall off in development and this coincided with a greater association with social circumstances. Just prior to school entry social factors far outweighed growth indices as predictors of developmental variation. Social stability of the family, a composite evaluation based on a number of social characteristics,was most consistently associated with development. The implications for intervention are that this would need to be broad based and aimed at improving incomes, housing, family cohesion and child centredness and eliminating social pathology. Such intervention would require a concerted effort from a variety of sources which should include administrators, community workers and health professionals.

REFERENCES:

Acheson RM, Hewitt D. The Oxford Child Health Survey: stature and skeletal maturation in the preschool child. Brit J Prev Soc Med 1954; 8:59.

Adler, G. Studies in analytical psychology. Norton: New York 1984.

Ainsworth MDS. Infancy in Uganda. Baltimore: Johns Hopkins, University Press. 1967.

Anastasi, A. Psychological testing. 4th Ed. Macmillan Publishing Co Ltd, New York. 1976.

Ascroft MT, Lovell HA. Heights and weights of Jamaican children of various racial groups. Trop Georg Med 1964; 4:346.

Ashworth A. Growth rates in children recovering from protein-calorie malnutrition. Brit J Nutr 1969; 23:835.

Baird D. The contribution of opertive obstetrics to the prevention of perinatal death. J of Obstet Gynaecol of the British Commonwealth. 1963; 70:204.

Bakare CGM. Social Class Difference in the Performance of Nigerian Children on the Draw-A-Man Test. In: LJ Cronbache, OJD Drenth (Eds). Mental tests and cultural adaptation. Mouton: The Hague: pp.355-363. 1972.

Bandura A. Social Learning Theory. Englewood Cliffs, NJ Prentice-Hall. 1977.

Batson E. Notes on the Concept of Measurement of Overcrowding (Report SS27). Cape Town: University of Cape Town. 1944.

Barker, P. Basic Family Therapy. Granada Publishing Ltd. 1983.

Barker R, Wright A. Midwest and its children. Row, Peterson and Co. Evanston: Illinois. 1954.

Bayley N. The development of motor abilities during the first three years. Monographs of the Society of Research in Child Development. No. 1. 1935.

Bayley N. Comparison of mental and motor test scores for ages 1-15 months by sex, birth order, race, geographical location and education of the parents. Child Dev 1965; 36:379.

Bayley N. Bayley Scales of Infant Dev. New York: Psychological Corporation. 1969.

Bayley N, Jones HE. Environmental correlates of mental and motor development: A cumulative study from infancy to six years. Child Dev 1937; 8:329.

Berger PL, Berger B. Sociology - a Biographical Approach. Basic Books, Inc. New York. 1972.

Beshers JM. Population Processes in Social Systems. Free Press: New York: 1967.

Binet A, Simon T. The Development of Intelligence in Children. (Translation of papers in L'Anée Psychologique, 1905-1911). Williams and Wilkins: Baltimore. 1916.

Birch HG. Relation of kwashiorkor in early childhood and intelligence at school age. Pediat Res 1971; 12:579.

Birch HG, Gussow JD. Disadvantaged Children - Health Nutrition and School Failure. Grune and Stratton, Inc: New York. 1970.

Birch HG, Lefford A. Visual differentiation, intersensory integration, and voluntary motor control. Monogr Soc Res Child Dev 1967; 32:2.

Bishop YMM, Fienberg SE, Holland PW. Discrete Multivariate: Theory and Practice. The MIT Press. 1975.

Blommaert W. Agrief Jaarboek vir Suid-Afrikaanse Geskiedenis. Vol. 1. pp.1-24. 1938.

Bloom B. Stability and Change in Human Characteristics. John Wiley: New York. 1964.

Böeseken AJ. Slaves and Free Blacks at the Cape 1658-1700. Tafelberg: Cape Town. 1977.

Botha-Antoun E. Intellectual development relating to nutritional status. J Trop Pediat 1968; 14:112.

Botha MC, Pritchard J. Blood group gene frequencies. An indication of the genetic constitution of population samples in Cape Town. Suppl. S Afr Med J 1972.

Bradley RH, Caldwell BM. Screening the Environment. Amer J Orthopsychiat 1978; 48:114.

Brockman LM, Ricciuti HN. Severe PCM in infancy and childhood. Dev Psychol 1971; 4:312.

Bronfenbrenner U. Is Early Intervention Effective? A Report on the Longitudinal Evaluation of Pre-school Programs. Bethesda, Md: Office of Child Development, U.S. Department of Health, Education and Welfare.

Brozek J. Measuring nutriture. Amer J Phys Anthr 1953; 11:147.

Brozek J. Ed. Monogr Soc Res Child Dev vol 35, No 7. 1970.

Bryant GM, Davies KJ, Richards FM Voorhees S. A Primary Study of the Use of the Denver Developmental Screening Test in a Health Department. Dev Med Child Neurol 1973; 15:33.

Buettner-Janish, J. Physical Anthropology. John Wiley: New York. 1973

Buffery AWH, Gray JA. Sex Differences in the Development of Spatial and Linguistic Skills. In: Ounsted C, Taylor DC. eds: Gender Differences. Their Ontogeny and Siginificance. Churchill Livingstone: London. 1972

Bullard DM, Glaser HH, Heagarty MC, Pivchik EC. Failure to thrive in the 'neglected' child. Amer J Orthopsychiat 1967; 37:680.

Butterworths Medical Dictionary 2nd Ed. ed-in-Chief Macdonald Critchley, Butterworth and Co Ltd: London. 1978

Caldwell B, Heider J, Kaplan B. The inventory of home stimulation. Presented to the Americal Psychological Association, New York. 1966.

Caldwell BM, Richmond JB. Social class level and stimulation potential of the home. Exceptional infant - The normal infant. Seattle: Special Child Publications. 1967.

Cameron N. The Measurement of Human Growth. Croom Helm: London. 1984.

Canosa CA, Solomon RL and Klein RE. The Intervention Approach: The Guatemala Study. In: Moore WM, Silverberg MM, Read MS eds. Nutrition, Growth and Development of North American Indian children. DHEW Publication No. (NIH) 72-76. Washington D.C.: 1973.

Cape Archives: Slave Office Lists 7/34.

Cattell, P. The Measurement of Intilligence of Infants and Young Children. New York Psychological Corp. 1940.

Catell RB. Personality. A Systematic, Theoretical and Factual Study. McGraw-Hill Book Co: New York. 1979.

Chandra RK. Interactions of nutrition, infection and immune response. Acta Paed Scand 1979; 68:137.

Chávez A, Martinez C. Effects of Nutrition on Child Behaviour. In: Brozek, J (ed) Behavioural Effects of Energy and Protein Deficits. International Conference, Washington, DC, November 30 - December 2, 1977.

Cheek DB, Graystone JE, Read MS. Cellular growth, nutrition and development. Pediatr 1970; 45:315.

Chen LC, Chowdhury A, Huffman SL. Anthropometric assessment of PEM and subsequent risk of mortality among preschool aged children. Amer J Clin Nutr 33:1836.

Chess S. Developmental theory revisited. Findings of longitudinal study. Canad J Psychiat 1979; 24:101.

Cilliers SP. The Coloureds of South Africa. Banier Publishers: Cape Town. 1963.

City of Cape Town - Annual report of the Medical Officer of Health. 1980.

Clarke AM, Clarke ADB. Early Experience: Myth and Evidence. Open Books: London. 1976.

Conel JL. The Postnatal Development of Human Cerebral Cortex. Vol 7. Harvard University Press: Cambridge, Mass. 1963.

Coovadia M, Adhikari M Mthethwa D. Physical growth of Negro children in Durban. Trop Geogr Med 1978; 30:373.

Cox JW. Growth characteristics of preschool Aborigines. Austr Paed 1979; 15:10.

Cravioto J, De Licardie ER, Birch HG. Nutrition, Growth and Neurointegrative Development. Pediatrics 1966; 38:319.

Curtiss S. Genie, A Psycholinguistic Study of a Modern-Day 'Wild Child'. Acadmic Press: New York. 1977.

Dalton K. Ante-natal progesterone and intelligence. Brit J Psychiat 1968; 114:1377.

Darcy NT. A review of the literature on the effects of biligualism upon the measurement of intelligence. J Genet Psychol 1953; 83:21.

Darlington RB, Royce JM, Snipper As, Murray HW, Lazar, I. Preschool programs and later school competence of children from low income families. Science 1980; 208:202.

Darwin CR. A biographical sketch of an infant. Mind 1877; 2:286.

Davé R, Wolf R. In: Screening the Environment. Bradley and Caldwell. 1964.

Davie R, Butler R, Goldstein H. From Birth to Seven. A report of the National Child Development study. Longman p.2. 1972.

Dennis W. Goodenough scores, art experience and modernization. J of Social Psychology 1966; 68:211.

Department of Statistics. Report on Deaths 1968-71, South Africa. (Report No 07-0303). Pretoria : Government Printer. 1974.

Deutsch M, Katz I, Jensen A. Social Class, Race and Psychological Development. Holt, Rinehart and Winston: New York. 1968.

D.H.S.S. Inequalities in health. London. 1980.

Dobbing J, Smart JL. Vulnerability of developing brain and behaviour. Brit Med Bul 1974; 30:164.

Dollard J, Miller NE. Personality and Psychotherapy. McGraw-Hill Book Co: New York. 1950.

Douglas JWB, Blomfield JM. 'Children Under Five'. Allen and Unwin: London. 1958.

Douglas JWB, Ross JM, Simpson HR. The relationship between height and measured educational ability in school children of the same social class, family size and stage of sexual development. Human Biol 1965; 37:178.

Downie NM, Heath RW. Basic Statistical Methods. Harper and Row: New York. 1965.

Drillien CM. The Growth and Development of Premature Infants. Livingstone: Edinburg. 1964.

Dubowitz LMS, Leibowitz D, Goldberg C. A Clinical Screening Test for Assessment of Intellectual Development of 4 and 5 year old children. Develop Med Child Neurol 1977; 19:776.

Dugdale AE. An age-independent anthropometric index of nutritonal status. Am J Clin Nutr 1971; 24:174.

Duncan OD. A Socioeconomic Index for all Occupations. In: AJ Reiss Jr (Ed) Occupations and Social Status. Free Press: New York. 1961.

Dunn J. The First Year of Life: Continuities in Individual Differences. In: The First Year of Life - Psychological and Medical Implications of Early Experience. eds. Shaffer D, Dunn J. John Wiley and sons Ltd: Chichester. 1979

Editorial: Classification of Infantile Malnutrition. Lancet 1970; 2:302.

Edwards AM. A social-economic grouping of gainful workers of the United States. J of the Amer Statistical Assoc 1933; 28:377.

Egan D, Illingworth RS, Sheridan M. Developmental screening 0-5 yers. Heinemann: London. 1964.

Ellis L. the decline and fall of sociology 1975 - 2000. American Sociologist 1977; 12:56.

el-Nofely AA. Antropometric study of growth of Egyptian Nubian children. Human Biol 1978; 50:183.

Erikson EH. Childhood and Society. Norton: New York. 1963.

Erlenmeyer-Kimling L, Jarvik LF. Genetics and intelligence: a review. Science 1963; 142:1477.

Ernst C, Angst J. Birth Order - its Influence on Personality. Springer-Verlag: Berlin. 1983.

Evans D, Bowie MD, Hansen JDL, Moodie AD and Van der Spuy HIJ. Intellectual development and nutrition. J Pediatr 1980; 97:358.

Evans DW, Moodie AD, Hansen JDL. Kwashiorkor and intellectual development. S Afr Med J 1971; 45:1413.

Eveleth PB, Tanner JM. Worldwide Variations in Human Growth. Cambridge University Press: Cambridge. 1976.

Fairweather H, Hutt SJ. Gender Differences in a Perceptual Motor Skill in Children. In: Ounsted C, Taylor DC. eds. Gender Differences: Their Ontogeny and Significance. Churchill Livingstone: London. 1972.

Falkner F. Office measurement of physical growth. Pediat Clin N Amer 1961; 8:13.

Falkner F, Roche AF. Measurement of nutritional status. Amer J Clin Nutr 1974; 27:1259.

Flavell JH. An analysis of cognitive developmental sequences. Genet Psychol Monogr 1972; 86:279.

Forbes GB. A note on the mathematics of 'catch-up' growth. Pediatr Res 1974; 8:929.

Frankenburg WK, Dick NP, Carland J. Development of preschool-aged children of different social and ethnic groups: Implications for developmental screening. Pediatrics 1975; 87:125.

Frakenburg WK, Dodds JB. The Denver developmental screening test. J Pediat 1967; 71:181.

Freud A. Normality and Pathology in Childhood. Hogarth Press: London. 1966.

Freud S. An Outline of Psychoanalysis. WW Norton: New York. 1949.

Fromm E. Escape from Freedom. Rinehart: New York. 1941.

Fulker DW. Genetics and Behavioural Development in Maturation and Development: Biological and Psychological Perspectives. p.32 eds: Connolly, KJ, Prechtl HFR. In: Clinics in Dev Medicine No 77/78. William Heinemann: London. 1981.

Fulker DW, Eysenck HJ. Heredity and Intelligence. In: The Structure and Measurement of Intelligence. Eysenck HJ Fulker DW (Eds). Springer-Verlag: Berlin. 1979.

Galton F. Natural Inheritance. The Macmillan Co: New York. 1889.

Gardner LI. Deprivation dwarfism. Scientific American 1972; 227:76.

Garn SM, Hertzog KP, Rohmann CG. Evidence for X-linkage of tibial length and body height. Amer J Phys Anthrop 1969; 31:187.

Garn SM, Rohmann CG. Interaction of nutrition and genetics in the timing of growth and development. Pediat Clin N America 1966; 13:353.

Geber M, Dean RFA. The state of development of new-born African children. Lancet 1957; 1:1216.

Geber M, Dean RFA. Gesell tests on African Children. Pediatrics 1957; 20:1055.

Geber M, Dean RFA. Psychomotor development in African children: the effects of social class and the need for improved tests. Bulletin of the WHO 1958; 18:471.

Gesell A. The genesis of behaviour forms in fetus and infant. The growth of the mind from the standpoint of developmental morphology. Proc N Amer Philosophical Soc 1941; 84:471.

Gesell A. The First Five Years of Life. Metheun: London. 1942.

Gesell A. The Embryology of Behaviour. Harper: New York. 1945.

Gesell A. The First five years of life. A guide to the study of the Pre-School child. University Paperback ed. Metheun and Co Ltd: London: 1971.

Gesell A, Amatruda CS. Developmental Diagnosis: Normal and Abnormal Child Development. 2nd ed. Hoeber: New York. 1947.

Gesell A, Ilg FL. The Child from Five to Ten. Harper Brothers: New York. 1946

Golden M, Birns, B. Social class and cognitive development in infancy. Merrill-Palmer Quart 1968; 14:139.

Goldstein M. Factors influencing the height of sever year old children. Results from the National Child Development Study. Human Biol 1971; 43:92.

Goldstein H, Tanner JM. Ecological Considerations in the Creation and the use of Child Growth Standards. Lancet 1980; 1:582.

Gomez F, Galvan RR, Fenk S, Munoz JC, Chavez R, Vazquez J. Mortality in second and third degree malnutrition. J Tropical Pediatr 1956; 2:77.

Goodenough P, Harris DB. Studies in the psychology of children's drawings II 1928 . 1949. Psychol Bulletin 1950; 47:369.

Graham G, Adrianzen B. Growth, inheritance and environment. Pediatr Res 1971; 5:691.

Graham GG, Creed HM, MacLean WC, Rabold J, Kallman CH, Mellitis ED. Determinants of growth among poor children - relationship of nutrient intakes to expenditure for food. Amer J Clin Nutr 1981; 34:555.

Graham GG, Creed HM, MacLean WC. Kallman CH, Rabold J, Mellitis ED. Determinants of growth among poor children nutrient intakes - achieved growth relationships. Amer J Clin Nutr 1981; 34:539.

Graitcer PL, Gentry EM. Measuring children: one reference for all. Lancet 1981; 2:297.

Grantham-McGregor SM, Desai P, Back EN. A longitudinal study of infant growth in Kingston, Jamaica. Human Biol 1972; 44:549.

Green LW. Manual for scoring socio-economic status for research and health behaviour. Public Health Reports 1970; 85:815.

Griffiths R. The Ability of Babies. A Study of Mental Measurement. McGraw-Hill Book Co: New York. 1954.

Griffiths R. The Abilities of Young Children. Young and Son: Somerset. 1974.

Gunzberg H. Social Progress Assessment Charts. 6th Ed. National Association for Mental Health: London. 1966.

Habicht JP, Martorell R, Yarborough C, Malina RM, Klein RE. Height-weight standards for preschool children - How relevant are ethnic differences in growth potential? Lancet 1974; 1:611.

Haeckel E. Anthropogenie order Entwicklungs-Geschichte des Menschens. Engelmann: Leipzig. 1874.

Hagedorn R, Labovitz S. An Introduction into Sciological Orientations. John Wiley and Sons, Inc: New York. 1973.

Hamill PVV, Drizd TA, Johnson CL, Reed RB, Roche AF, Moore WM. Physical growth: National Centre of Health Statistics Percentile. Amer J Clin Nutr 1979; 32:607.

Hannaway PJ. Failure to thrive - A study of 100 infants and children. Clin Pediatr 1970; 9:96.

Hansen JDL, Freesemann AD, Moodie AD, Evans DE. What does nutritional growth retardation mean?. Pediatrics 1971; 47:299.

Harris DB. Children's Drawings as Measures of Intellectual Maturity. A Revision and Extension of the Goodenough Draw-A-Man Test. Harcourt, Brace and World: New York. 1963.

Haug MR. Measurement in social stratification. Annual Review of Scoiology 1977; 5:51.

Heese JA. Die Herkoms van die Afrikaner 1657-1867. Balkema, Cape Town. 1971.

Henderson R, Bergan J, Hurt M. Development and validation of the Henderson Environmental Learning Process Scale. J Soc Psychol 1971; 88:185.

Hertzig ME. Intellectual levels of school children severely malnourished during the first 2 years of life. Pediatrics 1972; 49:814.

Hindley CB. The Griffiths Scale of infant Development: Scores and prediction from 3-18 months. Child Psychol Psychiatr 1960; 1:99.

Hindley CB. Social Class Influences on the Development of Ability in the First Five Years. Proceedings of the XIV International Congress of Applied Psychology. Eginar Munkgaards Forlag: Copenhagen. 1961.

Hindley CB. Social class influences on the development of ability in the first five years. In: Proceedings of the 14th International Congress of Applied Psychology. Vol 3. The Child and Education. Munksgaard: Copenhagen. 1962.

Hindley CB, Filliozat AM, Klackenberg G. Nicolet-Meister D, Sand EA. Difference in age of walking in five European longitudinal samples. Human Biology 1966; 38:363.

Hockley EE. The Story of the British Settlers of 1820 in South Africa. pp.17-35. Juta: Cape Town. 1948.

Hodges HM. Conflict and Consensus: an Introduction to Sociology. Harper and Row: New York. 1971.

Hollingshead AB. The two-factor index of social position. Privately published - Yale University; New Haven, Conn 1957. Quoted by Mueller and Parcel 1981.

Holt KS. Functional Assessment of Handicapped children: An Assessment. Proc Roy Soc Med 1973; 66:611.

Hoorweg JC, Stanfield P. The effects of PEM in early childhood on intellectual and motor abilities in later childhood and adolescence. Devlop Med Child Neurol 1976; 18:330.

Horney K. New Ways in Psychoanalysis. Norton: New York. 1939.

Horowitz FD, Paden LY. The Effectiveness of Environmental Intervention Programes. In: Caldwell BM and Ricciuti HN. (eds) Review of Child Development Research. Vol 3. University of Chicago Press; Chicago. 1973.

Horton PB, Hunt CL. Sociology (second edition). McGraw-Hill: New York. 1968.

Hurlock EB. Child Development. 5th ed. McGraw-Hill, Kogakusha Ltd. International Student Edition: Tokyo. 1972.

Husén T. Undersökningar rörande sambanden mellan somastika för hallenden och intellecktuell presentationsförmaga . T Militär Hälsovard 1951; 76:41.

Hutt C. Neuroendocrinological Behavioural and Intellectual Aspects of Sexual Differentiation in Human Development. In: Gender Differences; Their Ontogeny and Significance. Ounsted C, Taylor DC (eds). Churchill Livingstone: London. 1972.

Huysamen GK. Introductory Statistics and Research Design for the Behavioural Sciences. Varsity Press:Johannesburg. 1976.

Illsley R. Social class selection and class differentiation in relation to stillbirths and infant deaths. Brit Med J 1955; 2:1520.

Ireton H, Thwing E, Gravem H. Infant mental development and neurological status, family SES and intelligence at 4 years. Child Dev 1970; 41:937.

Isajiw WW. Definitions of Ethnicity. Ethnicity 1974; 1:111.

James MD. Physical Growth of Nigerian Yoruba Children. Trop Geogr Med 1974; 26:389.

Jelliffe DB. Assessment of the nutritional status of the community. Geneva: WHO, WHO monogr series N 53, 1966.

Jelliffe EFP, Jelliffe DB. The arm circumference as a public health index of protein - calorie malnutrition of early childhood. J Trop Pediat 1969; 15:177.

Jensen A. Educability and Group Differences. Methuen: London. 1973.

Johnston FE. Nutrition and Growth. In: Human Physical Growth and Maturation - Methodologies and Factors. Johnston FE, Roche AF, Susanne C (eds). Plenuim Press: New York. 1984.

Johnston EF, Lampl M. Anthropometric Assessment. In: Malnutrition and Behavior: Critical Assessment of Key Issues. Brozek J, Schürch B (eds). Nestlé Foundation Publication Series Vol 4. Lousanne: Switzerland.

Jones IG, Cameron D. Social class analysis - an embarrassment to epidemiology. Community Medicine 1984; 6:37.

Jöreskog KG. A General Method of Estimating a Linear Structural Equation System. In: Structural Equation Module in the Social Sciences. Goldberger AS, Duncan OD (eds). Seminar Press: New York. 1973

Jung CG. Collected Works. Read H, Fordham M, Adler G (eds). Princeton University Press: Princeton. 1953.

Keet MP, Moodie AD, Wittmann W, Hansen JDL. Kwashiorkor: a perspective ten-year follow-up study. S Afr Med J 1971; 45:1427.

Keeves J. Educational Environment and Student Achievement. Malmquist and Wicksell: Stockholm. 1972.

Keilmann AA, McCord C. Weight for age as an index of risk of death in childhood. Lancet 1978; 1:1247.

Keller W, Donoso G, De Maeyer EM. Anthropometry in nutritional surveillance - a review based on results of the WHO collaborative study on nutritional anthropometry. Nutr Abstr Rev 1976; 46:591.

Kilbride JE, Robbins MC, Kilbride PL. The comparative motor development of Baganda, American white, and Americal black infants. American Antropologist 1970; 72:1422.

Klackerberg-Larsson I, Stenson J. The course of mental development in children from 3 months to 3 years and its relation with 9 different variables quoted by Hindley, CB. Develop Med Child Neurol 1968; 10:715.

Klaus M, Kennell JH. Mothers separated from their infants. Pediatric Clinics of N Amer 1970; 17:1015.

Klein P. Effects of starvation in infancy (pyloric stenosis) on subsequent learning abilities. J Pediat 1975; 87:8.

Klein RE, Freeman HE, Kagan J, Yarbrough C, Habicht JP. Is big smart? The relation of growth to cognition. Journal of Health & Social Behaviour 1972; 13:219.

Klein RE, Irwin M, Engle PL, Yarbrough C. Malnutrition and Mental Development in Rural Guatemala. In: Advances in Cross-Cultural Psychology. Warren N (ed). Academic Press: New York. 1977.

Kluckhohn C, Kelly W. The Concept of Culture. The Science of Man in the World Crisis. Ralph Linton (ed). Columbia University Press: New York. 1945.

Knobloch H, Pasamanick B, Sharard EG. A Developmental Screening Inventory for Infants. Pediatrics Suppl 1966; 38:1095.

Koluchova J. Severe deprivation in twins - a case study. J Child Psychol & Psychiat 1972; 13:107.

Kuhlman F. A revision of the Binet-Simon System for measuring the intelligence of children. J Psycho-Asthenics, Monograph Supplement 1912; 1:1-41.

Lamb M. Influence of the Child on Mental Quality and Family Interaction During Prenatal, Perinatal and Infancy Periods. In: Child Influences of Marital and Family Interaction. Lerner R and Spanier G (eds). Academic Press: New York. 1978.

Lasky RE, Klein RE, Yarbrough C, Engle PL, Lechtig A and Martorell R. The relationship between physical growth and infant behavioural development in rural Guatemala. Child Dev 981; 52:219.

Leary PM. The body measurements of Pedi school children. S Afr Med J 1968; 42:1314

Leedy PD. Practical Research Planning and Design. Macmillan Publishing Co Inc: New York. 1974.

Leibbrant HCV. Precis of the Archives of the Cape of Good Hope: Requesten or Memoriate, 1715-1806, Vol 1, 2 and 3. Richards: Cape Town 1905-1906.

Leiderman PH, Babu B, Kagia J, Kraemer HC, Leiderman GF. African infant precocity and some social influences in the first year. Nature (London) 1973 242:247.

Lewis O. The Culture of Poverty. Scientific American 1966; 215:19.

Lewis M, McGurk H. Evaluation of infant intelligence. Infant intelligence scores true or false? Science 1972; 178:1174.

Lindgren G. Height, weight and memarche in Swedish urban school children in relation to SE and regional factors. Annals of Human Biol 1976;3:501.

Lloyd-Still MB, Hurwitz I, Wolff PH and Schwachman H. Intellectual development after severe malnutrition in infancy. Pediatrics 1974; 54:306.

Lorenz K. King Solomon's Ring: New Light on Animal Ways. Thomas Y Crowell: New York. 1952.

Lubbe AM. Nutritional status survey of Pretoria school children from four racial groups: dietary aspects. S Afr Med J 1973; 47:679.

MacMillan WH. The colour question at the Cape. Reprinted by AA Balkema: Cape Town. 1968.

Majoribanks K. Environment, social class and mental abilities. J Ed Psychol 1972; 43:103.

Malcolm LA. Growth and development of the Bundi child in New Guinea. Human Biol 1970; 42:293.

Malina RM. Biosocial Correlates of Motor Development During Infancy and Early Childhood. In: Social and Biological Predictors of Nutritional Status, Physical Growth and Neurological Development. Academic Press Inc: 1980.

Marais JS. The Cape Coloured People. Longmans, Green: London: 1939.

Margen S. Energy-Protein Malnutrition: The Web of Causes and Consequences. In: Malnutrition and Behaviour: Critical Assessment of Key Issues. Brozek J, Schürch B (eds). Nestlé Foundation: Lausanne. 1984.

Marshall WA. Seasonal effect on growth. Ann Human Biol 1975; 2:243.

Martorell R. Interrelationships between Diet, Infectious Disease, and Nutritional Status. In: Social and Biological Predictors of Nutritional Status, Physical Growth, and Neurological Development. Green LS, Johnston FE (eds). Academic Press: New York. 1980.

Mather K, Jinks JL. Correlations between relatives arising from sex-linked genes. Nature (London) 1963; 198:314.

McCall RB. Nature-nurture and the two realms of development: a proposed integration with respect to mental development. Child Dev 1981; 51:1.

McDonald R. Growth and Development - a Symposium. Institute of Child health, University of Cape Town. 1979.

McCarthy D. McCarthy Scales for Children's Abilities. Psychological Corporation: New York. 1970.

McKay H, Sinisterra L, McKay A, Gõmez H, Lloreda P. Improving cognitive ability in chronically deprived children. Science 1978; 200:270.

McGee R. Points of Departure. Basic Concepts in Sociology. The Dryden Press Inc: Hinsdale, Illinois. 1972.

McLaren DG, Read WWC. Classification of nutritional status in early childhood. Lancet 1972; 2:146.

McLaren DS, Read WWC. Weight/length classification of nutritional status. Lancet 1975; 2:219.

Mentzel OF. Descriptions of the Cape. p. 126. Van Riebeeck Society 6: Cape Town. 1785.

Meredith HV. Secular changes. Amer J Phys Anthrop 1976; 44:315.

Miller FJW, Billewicz WZ, Thomson AM. Growth from birth to adult life of 442 Newcastle-Upon-Tyne children. Brit J Prev and Soc Med 1972 26:224.

Miller FJW, Court SDM, Walton WS, Knox EG. Growing Up in Newcastle-Upon-Tyne. Oxford University Press: London. 1960.

Monckeberg F. Effect of Early Marasmic Malnutrition on Subsequent Physical and Psychological Development. In: Malnutrition, Learning and Behaviour. Scrimshaw NS, Gordon JE (eds) pp.269-278. M.I.T. Press: Cambridge, Mass. 1968.

Money J, Ehrhardt AA. Prenatal Hormone Exposure: Possible Effects on Behaviour in Man. In: Endocrinology and Human Behaviour. Michael RP (ed) Oxford University Press: London. 1968.

Moodie AD, Hansen JDL, Jordaan HVF, Malan AF, Davey D. Low-weight coloured mothers and their infants. S Afr Med J 1970; 44:1400.

Moodie D. The Record. Part I, p.317-319. (Reprinted 1960) Balkema: Cape Town. 1838-1842.

Mora JO, Clement J, Christiansen N, Ortiz N, Vuori L, Wagner M, Herrera MG. Nutritional Supplementation, Early Home Stimulation and Child Development. In: Behavioural Effects of Energy and Protein Deficits. Brozek J (ed). International Conference, Washington DC: November 30 - December 2, 1977.

Mueller CW, Parcel TL. Measures of Socioeconomic Status Alternatives and Recommendations. Child Dev 1981; 52:13.

Munro, 1968 - quoted by Kessen W, Scott D. The Development of Behaviour: Problems, Theories and Findings. In: Developmental Behavioural Paediatrics. Levine MD, Carey WB, Crocker AC, Gross RT (eds). W.B. Saunders Co: Philadelphia. 1983.

Neligan G, Prudham D. Norms for four standard developmental milestones by sex, social class and place in family. Develop Med Child Neurol 1969; 11:413.

Neligan D, Prudham D, Steiner H. The Formative Years - Birth Family and Development in Newcastle-Upon-Tyne. Oxford University Press: London. 1974.

Norval MA. A relationship of weight and length of infants at birth to the age at which they begin to walk alone. J Pediat 1947; 30:676.

Oates RK, Yu JS. Children with non-organic failure to thrive: A community problem. Med J Aust 1971; 2:199.

Ounsted M, Ounsted C. On Fetal Growth Rate. Clinics in Developmental Medicine No. 46. William Heinemann Books: London. 1973.

Ounsted MK, Osborn ML, Good FJ. A method of developmental assessment at four years and some associated findings. Early Human Dev 1979; 3:1.

Ounsted M, Sleigh G. The infant's self-regulation of food intake and weight gain. Lancet 1975; i:1393.

Ounsted C, Taylor DC. The Y Chromosome Message: A Point of View. In: Gender Differences: Their Ontogeny and Significance. Ounsted C, Taylor DC (eds). Churchill Livingstone: London. 1972.

Owen GM. The assessment and recording of measurements of growth in children: report of a small conference. Pediatrics 1973; 51:461.

Oyama S. The concept of the sensitive period in developmental studies. Merrill-Palmer, Quarterly 1979; 25:83.

Panek S, Piasecki E. Nowa Huta: integration of the population in the light of antropological data. Materialy i Prace Antropologiczne 1971; ii:189.

Pavlov I. Lectures on Conditional Reflexes. Vol 1. International Publishers: New York. 1928.

Peatman JG, Higgons RA. Development of sitting, standing and walking of children reared with optimal pediatric care. Amer J Orthopsychiat 1940; 10:88.

Peatman JG, Higgons RA. Relation of infants weight and body build to locomotor development. Amer J Orthopsychiatry 1942; 12:234.

Piaget J. Biology and Knowledge. University of Chicago Press: Chicago. 1971.

Piaget J. The Origins of Intelligence in Children. International Universities Press: New York. 1952.

Plug C, Durrheim DM, Visser JD. Measurement in Psychology. UNISA-publication: Pretoria. 1973.

Pollack M, Mitchell S. Early development of Negro and White babies. Archives Dis Child 1974; 49:40.

Power DJ. An anthropometric study of young school children in an area of Cape Town. S Afr Med J 1982; 61:303.

Potgieter JF. The Household Subsistence Level in the Major Urban Centres of the RSA (Fact Paper No, 16). University of Port Elizabeth: Port Elizabeth. 1976.

Prader A. Catch-up growth. In: Paediatrics and Growth. Barltrop D, (ed) Fellowship of Postgraduate Medicine: London. 1978.

Prechtl HFR, Connolly KJ. Maturation and Development: an Introduction. In: Maturation and Development: Biological and Psychological Perspectives. Pechtl HFR, Connoly KJ. (eds). Clinics in Dev Med No 77/78. Willaim Heinemann, Medical Books: London. 1981.

Radin N. Maternal warmth, achievement, motivation and cognitive functioning in lower class preschool children. Child Dev 1971; 42:1560.

Ramey CT, Campbell FA, Nicholson JT. The predictive power of the Bayley Scales of infant development and the Stanford-Binet IQ test. Child Dev 1973; 44:790.

Ramey CT. The 2nd International Workshop on the 'at risk' infant. Jerusalem May 1983.

Registrar General. Seventy-fourth Annual Report of the Registrar General of births, deaths and marriages in England and Wales (1911). HMSO: London. 1913.

Registrar General. The Registrar General's Decennial Supplement. England and Wales. HMSO: London. 1927 and 1938.

Registrar General Classification of Occupations. HMSO: London. 1960.

Reynell J. Developmental Language Scales, Slough: National Foundation for Educational Research. 1969.

Richardson BD. Underweight - a nutritional risk. S Afr Med J 1977; 51:42.

Richardson BD, Sinwel R. Infant growth in a rural Tswana community. S Afr Med J 1984; 65:775.

Richardson SA. The relationship of severe malnutrition in infancy to the IQ of school children with differing life histories. Pediat Res 1976; 10:57.

Riesman D. The Lonely Crowd. Yale University Press. New Haven. 1970.

Rhoads TF, Rapoport I, Kennedy R, Stokes J. Studies on the growth and development of male children receiving evaporated milk II. Physical growth, dentition, and intelligence of white and negro children through the first four years as influenced by vitamin supplements. J Pediat 1945; 26:415.

Rowland MG, Cole TJ, Whitehead RG. A quantitative study into the role of infection in determining nutritional status in Gambian village children. Brit J Nutr 1977; 37:441.

Rosa FW, Turshen M. Fetal nutrition. Bulletin of the World Health Organisation. Bull of the WHO 1970; 43:785.

Rossi PH, Sampson WA, Base CE, Jasso G, Passel J. Measuring household social standing. Social Science Research 1974; 3:169.

Rutter M. The Long-term Effects of Early Experience.. Develop Med Child Neurol 1980; 22:800.

Rutter M, Madge N. Cycles of Disadvantage: A Review of Research. Heinemann Educational: London. 1976.

Sand EA. quoted by: Hindley CB. Develop Med Child Neurol 1968; 10:715.

Schapera I. The Khoisan Peoples of South Africa. Routledge and Kegan Paul: London. 1930.

Scott JP. Critical Periods in Organisational Processes. In: Human Growth 3, Neurobiology and Nutrition. Falkner F, Tanner JM (eds). Plenuim Press: New York. 1979.

Sells CJ. Microcephaly in a normal school population. Pediatrics 1977; 59:262.

Shaheen E, Alexander D, Truskowsky M, Barbero GJ. Failure to thrive - a retrospective profile. Clin Pediatr 1968; 7:255.

Sheridan M. Developmental Progress of Infants and Young Children. HM Stationery Office: London. 1960.

Shields J. Monozygotic Twins. Oxford University Press: London. 1962.

Shirley MM. The First Two Years. A Study of Twenty Five Babies (Vol 1): Postural and Locomotor Development. University of Minnesota Press: Minneapolis. 1931.

Shorter Oxford Dictionary. Oxford University Press: London. 1970.

Siegel PM. Prestige in the American Occupational Structure. Unpublished doctoral dissertation, University of Chicago, 1971. Quoted by Mueller and Parcel 1981.

Sills RH. Failure to thrive - The role of clinical and laboratory evaluation. Amer J Dis Child 1978; 132:967.

Singer R, Kimura K. Body height, weight and skeletal maturation in Hottentot children. Amer J Phys Antrhopol 1981; 54:401.

Skinner BF. About Behaviourism. Jonathan Cape: London. 1974.

Smit PJ, Potgieter JF, Neser ML, Fellingham SA. Sex, age and race variations in the body measurements of White, Bantu, Coloured and Indian children aged 7-15 years. S Afr Med J 1967; 41:422.

Smith ME, Lecker G, Dunlap JW, Cureton EE. The effects of race, sex and environment on the age at which children walk. J of Genetic Psychology 1938; 38:489.

Spencer H. The Study of Sociology. D Appleton: New York. 1891.

Snyder JC, Hampton R, Newberger Eh. Family Dysfunction: Violence, Neglect and Sexual Misuse. In: Developmental-Behavioral Paediatrics. Levine M, Carey WB, Crocker AC, Gross RT (eds). W.B. Saunders Co: Philadelphia. 1983.

Stafford RE. Sex differences in spatial visualisation as evidence of sex linked inheritance. Percept Mot Skills 1961; 13:428.

Stein Z, Susser M. Nutrition and mental performance. Science 1972; 178:708.

Stein Z, Susser M. The Epidemiology of Mental Retardation. In: Stress and Disability in Childhood. Butler NR, Corner BD (eds). John Wright and Sons Ltd: Bristol. 1984.

Stoch MB, Smythe PM. Does undernutrition during infancy inhibit brain growth and subsequent intellectual development? Arch Dis Child 1963; 38:546.

Stoch MB, Smythe PM. The effect of undernutrition during infance on subsequent brain growth on intellectual development. S Afr Med J 1967; 41:1027.

Stoch MB, Smythe PM. 15-year developmental study on effects of severe undernutrition during infancy on subsequent physical growth and intellectual functioning. Arch Dis Child 1976; 51:327.

Stoch MB, Smythe PM, Moodie AD, Bradshaw D. Psychosocial outcome of CT findings after gross undernourishment during infancy: 20-year developmental study. Develop Med Child Neurol 1982; 24:419.

Stutsman R. Mental Measurement of Pre-School Children. Harcourt, Brace and World: New York. 1931.

Sullivan HS. The Interpersonal Theory of Psychiatry. Nerton: New York. 1953.

Super CM. Environmental effects on motor development: the case of 'African infant precosity'. Develop Med Child Neurol 1976; 18:561.

Susanne C. Developmental Genetics of Man. In: Human Physical Growth and Maturation, Methodologies and Factors. Johnston FE, Roche AF, Susanne C (eds). Plenum Press: New York. 1980.

Tanner JM. Education and Physical Growth. Hodder and Stoughton: London. 1978.

Tanner JM. Foetus into Man. Secular trend. pp.150-3. Open Books: London. 1978.

Tanner JM, Goldstein H, Whitehouse RH. Standards for children's height at ages 2-9 yrs allowing for height of parents. Archives Dis Child 1970; 45:755.

Tanner JM, Whitehouse RM. Clinical longitudinal standards for height, weight, height velocity, weight velocity, and the stages of puberty. Arch Dis Child 1976; 51:170.

Terman LM. The Measurement of Intelligence. Houghton Mifflin: Boston. 1916.

Thomas A. Current trends in Developmental Theory. Amer J Orthopsychiat 1981; 51:580.

Theal GMcC. History of Ethnography of South Africa. Vol 2, p.184. Swan Sonnenschien: London. 1909.

Theron E (Chairman). Commission of Inquiry into Matters Relating to the Coloured Population Group (RP38/1976). Government Printer: Pretoria. 1976.

Thom HB. Journal of Jan van Riebeeck (1651-1662). Vols 1,2 and 3. Balkema: Cape Town. 1952.

Thunberg CP. Travels in Europe, Asia and Africa Made Between Years 1770 and 1779. Part I, p.120. Rivington: London. 1975.

Timasheff NS, Theodorson GA. Sociological Theory - Iits Nature and Growth. Random House: New York. 1976.

Tinbergen N. On war and peace in animals and man. Science 1968; 160:1411.

Tizard J. Early malnutrition, growth and mental development in man. Brit Med Bull 1974; 30:169.

Tizard J. Nutrition, growth and development. Psychol Med 1976; 6:1.

Thomson AM. Evaluation of human growth patterns. Amer J Dis Child 1970; 120:398.

Tobias PV. Standard Encyclopaedia of Southern Africa. Vol 1. p.460. Nasau: Cape Town. 1972.

Townsend JW, Klein RE, Irwin MH, Owens W, Yarbrough C, Engle PL. Nutrition and Preschool Mental Development. In: Cultural Perspectives on Child Development. Wagner DA, Stevenson HW (eds). WH Freeman and Co: San Fransisco. 1982.

Tylor EB. Primitive Culture: Researches into the Development of Mythology, Religion, Language, Art and Custom. Vol 1, 3rd ed. John Murray: London. 1897.

Ucman PA. A Normative Study of the Goodenough-Harris Drawing Test on a Turkish Sample. In: Mental Tests and Cultural Adaptation. pp. 365-370. LJ Cronbach, Drenth OJD (eds). Mouton: The Hague. 1972

Ueda R. Child development in Okinawa compared with Tokyo and Denver, and the implications for developmental screening. Develop Med Child Neurol 1978; 20:657.

Union of South Africa. Report of the Commission in Mixed Marriages in South Africa. p.4. Government Printer: Pretoria. 1939.

United Nations Relief Operation Dacea. Quac stick. 2nd Bangladesh National Nutr Assessment, Information. Paper No. 21. 1972.

U.S. Department of Labor. Dictionary of Occupational Titles (4th ed). Government Printing Office: Washington, DC. 1977.

U.S. Department of Health, Education and Welfare 1969, p.97. Publication - Toward a Social Report.

Uzgiris IC, Hunt JM. Assessment in Infancy: Ordinal Scales of Psychological Development. University of Illinois Press: Urbana. 1975.

Valman HB. Intelligence after malnutrition due to neonatal resection of the ileum. Lancet 1974; 1:425.

Van der Ross RE. Myths and Attiudes - An Inside Look at the Coloured People. Tafelberg: Cape Town. 1979.

Venter AL. Coloured - A profile of Two Million South Africans. Human and Rousseau: Cape Town. 1974.

Vernon PE. Measurement of Learning. In: Malnutriton Learning and Behaviour. Scrimshaw NE (eds). MIT Press: Cambridge MA. 1968.

Vygotsky L. Mind in Society. Cole M et al (eds). Harvard University Press: Cambridge, Mass. 1978,

Waddington CH. The Strategy of the Genes. Allen and Unwin: London. 1957.

Walker ARP, Walker BF. Studies on increased growth rate of South African Black school children and their significane to health. S Afr med J 1977; 51:707.

Walters RH, Parke RD. Advances in Child Development and Behaviour. 1965; 2:59.

Warren N. African infant precocity. Psychol Bull 1972; 78:353.

Waterlow JC. Classification and definition of protein-calorie malnutrition. Brit Med J 1972; 3:566.

Waterlow JC. Anthropometric assessment of malnutrition in children. Lancet 1979; 2:250.

Waterlow JC. Child growth standards. Lancet 1980; 1:717.

Waterlow JC, Payne PR. The protein gap. Nature (London) 1975; 258:113.

Waterlow JC, Rutishauser IHE. Malnutrition in Man. In: Early Malnutrition and Mental Development. Symposia of the Swedish Nutrition Foundation XII. 13-26. Almquist and Wiksell: Uppsala, Sweden. 1974.

Watson JB. Psychological Care of Infant and Child. WW Norton: New York. 1928.

Watts J, Halfar C, Chan I. Environment, experience and intellectual development of young children in home care. Amer J Orthopsychiat 1974; 44:773.

Weber M. The Theory of Social and Economical Organisation. Trans Talcott Parsons. Free Press: New York. 1947.

Weber M. Economy and Society. Edited and translated by Roth G and Wittich C. Bedminster: Totowa NJ. 1968.

Weber M. In: An Introduction into Sociological Orientations. Hagedorn R, Labovits S (eds). John Wiley and Sons, Inc.: New York. 1973.

Wechsler D. Wechsler Pre-School and Primary Scale of Intelligence. WP and PSI. Psychological Corporation: New York. 1967.

Wechsler D. Manual: Wechsler Intelligence Scale for Children: Revision. Psychological Corporation. New York. 1974.

Weiss P. Principles of Development. Holt: New York. 1939.

Whitehead RG, Paul AA. Growth charts and the assessment of infant feeding practices in the Western World and in developing countries. Early Human Dev 1984; 9:187.

Widdowson EM. Mental contentment and physical growth. Lancet 1951; 1:1316.

Widdowson EM, McCance RA. A Review. New Thoughts on Growth. Pediat Res 1975; 9:154.

Wilson E. Sociobiology. The New Synthesis. Harvard University Press: Cambridge, Mass. 1975.

Wilson. Paper presented at the Conference on Early Behavioral Assessment. Seattle: Washington. 1976.

Wilson RS. Mental Development in Twins. In: Genetics, Environment and Intelligence. Oliverio A (ed). Elsevier/North Holland: Amsterdam. 1977.

Winick M. The Fetal Brain 63-72. In: Fetal Growth Retardation. Van Assche FA, Robertson WB (eds). Churchill Livingstone: Edinburgh. 1981.

Winick M, Jaroslow A, Winer E. Foster placement, malnutrition and environment. Growth 1978; 42:391.

Winick M, Meyer KK, Harris RC. Malnutrition and environmental enrichment by early adoption. Science 1975; 190:1173.

Wittmann W, Moodie AD, Fellingham SA, Hansen JDL. An evaluation of the relationship between nutritional status and infection by means of a field study. S Afr Med J 1967; 41:664.

Wolff H. Normal Variation in Human Maturation. In: Maturation and Development: Biological and Psychological Perspectives. Connolly KG, Prechtl HFR (eds). Clinics in Dev Medicine No.77/78. Wiliam Heinemann: London. 1981.

Woods DL, Malan AF, Heese HdeV, van Schalkwyk DJ. Maternal size and fetal growth. S Afr Med J 1979; 56:562.

Yarbrough C, Lasky RE. Habicht JP, Klein RE. In: Early Malnutrition and Mental Development (Symposia of the Swedish Nutrition Foundation No. XII). Cravioto J, Hambraeus L, Vahlquist B (eds). Almqvist and Wiksell: Stockholm. 1974.

Yarrow L, Rubenstein J, Pederson F. Infant and Environment. Hemisphere Publishing Corp.: Washington, DC. 1975.

Zazzo R. The twin condition and the couple effect on personality development. Acta Genet Med Gemellol (Roma) 1979; 25:343.

Zerfas AJ. Shorr IJ, Neumann CG. Office assessment of nutritional status. Pediat Clin N Amer 1977; 25:253.

APPENDIX 1

THE SAMPLE

							COMMENTS
1	LC	F	1	168	95,87	20	
3	NvdR	F	2	178	91,05	17	
16	RC	M	1	308	118,65		Uncooperative
27	NvG	F	1	316	89,86	18	
31	NM	F	1	518	104,85	19	
41	EO	M	1	650	95,87	28	
47	AG	M	2	352	98,86	18	
55	CO	M	3	98	97,88	12	
67	LP	F	1	888	111,97	27	
68	RR	M	1	358	109,75	12	
73	GS	M	3	211	86,02	9	
75	DP	F	3	134	100,85	28	
76	RD	M	3	202	100,85	16	
81	KZ	M	1	659	103,82	25	
90	JJ	M	3	73	94,90	11	
92	TB	M	2	298	88,49	14	
100	QH	M	1	217	118,03	8	Conradie Syndrome
110	AS	F	2	212	80,09	21	
116	DP	M	2	254	92,87	22	
118	EP	M	3	101	72,72		Uncooperative
131	MF	F	3	82	95,87		Uncooperative
136	GB	F	3	97	74,15	13	
140	OJ	M	1	213	94,92	13	
141	EF	F	3	266	107,85	22	
152	RvA	F	1	483	121,61	25	
168	RJ	F	1	490	94,92	22	
169	LvR	M	3	340	100,85	16	

* Social class 1 corresponds to U.K. Registrar General's classes I, II and III; social class 2 to IV and social class 3 to V (Chapter 4).

							COMMENTS
172	MR	M	3	193	92,87	21	
174	AduP	F	3				Mentally retarded - post meningitis
185	TK	M	2	150	87,37	15	
188	JG	F	3	81	88,99	17	
194	VF	M	3	68	106,78		Deaf
197	AW	F	2				Moved from Cape Town
202	FH	F	3	107	100,85	13	
206	RdW	M	3	90	74,90	17	
208	RA	M	3	154	91,95	16	
225	CL	M	1	350	103,82	21	
227	JC	M	3	94	94,92		Uncooperative
239	JN	M	3	299	91,95	15	
243	MF	F	2	222	97,88	19	
248	AJ	F	2	254	94,92	10	
252	EM	F	3	100	97,88	7	
255	MS	F	1	1198	98,86	26	
261	BF	F	2	119	103,82	12	
264	LP	F	1	632	98,86	28	
273	CD	M	1	239	86,88	15	
279	RS	M	3	226	80,09	12	
283	BA	F	2	229	89,87	14	
285	RH	M	2	416	109,75	23	
289	JJ	F	1	541	100,85	20	
290	CM	F	2	109	88,99	13	
291	DD	M	1	319	101,86	21	
293	JD	F	1	179	80,09	16	
313	JK	F	3	158	119,83	23	

							COMMENTS
323	McK	M	1	587	86,02		50% hearing loss due to serous otitis media
337	SR	F	3	189	83,05	11	
343	EJ	F	3	157	80.09	7	
347	NL	F	2	93	77,89	15	
354	PG	F	1	241	91,95	19	
358	DS	F	1	272	86,88	27	
359	MJ	M	3	61	62,91	9	
364	PA	M	1				Moved from Cape Town
365	RI	F	3	393	104,85	22	
366	TM	M	2	162	98,86	17	
382	RA	M	3				Moved from Cape Town
383	GP	F	1	282	97,88	21	
389	JS	M	1	331	89,87	16	
392	IJ	M	2	87	94,92	5	
398	GF	F	1	227	115,00	28	
407	FE	F	3	53	71,90	19	
420	SS	F	1	178	97,88	8	
430	FV	F	2	343	104,85	15	
431	FS	F	2	125	83,88	15	
440	FP	M	2	92	89,87	16	
441	LJ	F	3	186	77,89	15	
445	NA	M	2	107	104,85	15	
449	RS	F	1	680	95,87	27	
453	WM	M	2	126	89,87	10	
458	RW	M	3	109	77,89	17	
464	LR	F	3				Moved from Cape Town

							COMMENTS
465	BMcK	F	1	167	72,63	24	
472	JMcK	M	1	273	88,99	20	
482	SL	M	2				Moved from Cape Town
487	JdV	M	2				Died at 3 months
490	ZW	F	3	126	80,09	17	
491	GA	F	3	467	77,89	15	
493	DJ	M	2	203	87,76	18	
497	BM	M	2	254	77,89	20	
508	HS	F	3	144	89,87	20	
513	DC	F	1	151	80.09	9	
534	BS	M	3	150	107,85	18	
535	AG	M	2	140	89,87	11	
536	MvdR	M	3	149	89,87	15	
538	CW	M	1	359	94,32	24	
545	IM	M	2	298	89,87	22	
552	PB	F	3	89	91,95	5	
559	RH	M	1	331	91,95	15	
568	NC	F	3	284	113,84	23	
569	MM	M	1	184	113,84	11	
572	TD	M	2	134	74,90	7	
579	SM	F	3	201	77,12	6	
580	CH	M	1	262	71,90	26	
588	BS	M	1	408	107,85	22	
593	EdP	M	3	65	89,87	20	
594	TG	F	1	255	97,88	25	
595	JP	M	3	164	98,86	16	
603	RA	F	2	168	97,88	15	
604	RH	M	2	399	89,87	18	
610	CH	M	1	482	95,87	20	
614	FA	M	3	149	92,87	12	

							COMMENTS
619	TI	F	1	247	89,87	17	
622	HB	M	3	211	104,85	17	
633	NT	M	3	224	84,74	19	
646	FA	M	3	141	91,95	11	
647	GH	M	1	111	103,82	16	
672	RK	F	2	89	89,87	14	
675	LG	F	2				Moved from Cape Town
688	BW	M	1				Moved from Cape Town
700	SS	F	1	373	97,88	22	
701	LW	F	2	126	86,88	8	
702	SB	F	2	108	86,88	16	
709	RvG	M	1	343	98,86	25	
719	CO	F	1	278	98,86	16	
728	FI	M	1	661	95,87	21	
730	DV	M	3	73	94,92	9	
737	NS	M	3	162	71,90	22	
738	AJ	M	2	141	98,86	14	
752	AK	M	3	152	76,37	13	
753	RC	F	3	94	80.09	7	
758	JR	F	1	519	101,86	22	
759	MA	F	1	380	88,99	14	
765	EE	M	2	157	95,87	10	
774	MwW	M	1	279	101,86	16	
783	AvdW	M	2	57	74,90	8	
788	CP	F	3	248	89,87	18	
792	IJ	M	1	280	94,92	14	
793	AL	M	1	241	86,88	24	
795	HA	F	1	512	110,84	24	
798	RW	M	1	276	92,87	14	

							COMMENTS
801	DC	M	3				Moved from Cape Town
803	RS	M	1				Moved from Cape Town
808	PJ	F	2	376	79,80		Uncooperative
811	DW	M	1	651	107,85	28	
812	LM	F	3	84	80.89	8	
814	JH	F	1	292	79,30	12	
815	EM	M	1	125	86,88		Uncooperative
819	CP	M	2	97	88,88	23	
820	AA	M	2	205	115,00	24	
845	RH	M	3				Moved from Cape Town
853	TB	F	1	196	103,82	15	
854	CM	F	3	119	100,85	29	
857	LE	F	1	538	90,79	19	
859	GM	F	3	96	84,74	23	
865	SE	M	3	261	103,82	23	
870	RC	M	2	207	94,92	19	
876	MS	M	1				Moved from Cape Town
877	NF	F	2	236	83,88	15	
883	NMcB	F	1	275	92,87	24	
885	BM	M	1	340	87,76	20	
893	AV	M	3	117	74,90	11	
897	ZJ	M	2	137	86,88	12	
899	DW	M	3	192	102,90	11	
901	LV	F	2	217	90,79	16	
904	HT	F	1	704	101,86	26	
909	AH	F	1	125	90,79	16	
913	GS	M	2	201	95,87	13	
921	LE	F	3	89	88,99		Uncooperative

							COMMENTS
923	NW	F	2	521	98,86	14	
924	EG	M	3	119	90,79	20	
926	RI	F	3	196	113,34	17	
928	AV	M	2	399	84,74	13	
933	PM	M	3	139	84,74	15	
934	BA	M	3	104	95,37	12	
942	LC	M	3	288	89,87	7	
948	NT	F	2	149	80,09	7	
950	SS	M	3	186	110,84	16	
953	JH	F	1				Moved from Cape Town
959	RW	M	1	343	92,87	11	
975	ZJ	F	3	90	94,92	15	
978	AA	F	2				Moved from Cape Town
986	AG	F	2	188	102,90	14	
990	CW	M	2	113	90,79	8	
993	JC	M	2	193	80,89	20	
994	SS	F	1	273	83,88	19	
995	S	M	3				Died at 3 months
1000	CB	F	3	234	107,35	26	

APPENDIX 2

DEVELOPMENTAL ASSESSMENT AT FIVE YEARS

This was carried out in the child's home with the mother not present, but available. The child was seated at a table opposite the tester. There was no time limit for the test and it was conducted in the child's home language.

EQUIPMENT:
Twelve cubes (2 cms^3) comprising the colours red, yellow, green and blue. One smaller green cube (1½ cms^3).

Separate sheets of paper with a circle, square and triangle drawn on one half. A sheet of paper with two vertical lines 10 cms apart. A sharp pencil and a blank sheet of paper.

The Ladybird Book Learning with Mother Book 4.

A tennis ball.
PROCEDURE:

1. FINE MOTOR DEVELOPMENT

   i. Give the child 10 cubes and ask him to build the highest tower he can. Allow him two attempts.

      Passes if he builds 10 cubes.

   ii. Construct a model gate with cubes, out of sight of the child. Show him the finished model; give him five bricks and ask him to make one the same.

      Passes if correct.

   iii. Construct a staircase of six cubes, out of sight of the child. Show him the finished model; give him six cubes and ask him to make one the same.

      Passes if correct.

iv. Produce the sheet of paper with two vertical parallel lines 10 cms apart. Give the child a pencil and ask him to draw a straight line between them, starting on the first and ending at the second line.

Passes if he draw a single line from the one vertical line to the other.

v. Produce the sheet of paper with a circle drawn on it and ask him to copy it.

Passes if he draws an enclosed form, with one circular motion only.

vi. Produce the sheet of paper with a square drawn in on it and ask him to copy it.

Passes if he draws a figure with four sides and four corners (the lines may intersect and must join).

vii. Produce the sheet of paper with a triangle drawn on it and ask him to copy it.

Passes if he draws a figure with three sides and three angles (the lines may intersect and must join).

viii. Pencil hold - observe

Passes if he ues a dynamic tripod.

ix. Hand movements - with the child facing you, tell him to copy what you do with his hands.

a. both hands fisted
b. make a diamond with index fingers and thumbs keeping the other fingers fisted.
c. both fisted again

d. raise the index finger of one hand and little finger of the other, keeping the other fingers fisted.

Passes if correct.

x. Stand one and a half meters away from the child and bounce the ball towards him. At the top of the bounce the ball should be at the level of the child's waist.

Passes if he catches two out of three trials.

II. LANGUAGE

i. Put out a pile of cubes consisting of four different colours. Ask him to point to a red, blue, green and yellow cube.

Passes if all correct.

ii. Put 10 cubes in a row and ask him to count them while pointing to each in turn - one for one.

Passes if correct

iii. Ask him to define a ball, house, desk, banana, curtain ceiling.

Passes if he achieves five or six (the answers may be in terms of shape, composition or use, but pointing to the object is not sufficient).

iv. Make sure you have his attention and then say 'listen to what I say, then when I have finished, I want you to say exactly the same as I said'.

Give the sentence - Mommy goes to the shop to buy milk and bread - Mammie gaan winkel toe om melk en brood te koop. (The sentence may be repeated once).

Passes if given correctly.

v. Show the child the picture from the Ladybird book of a family in a boat on a lake and ask him to tell you about it. You may say 'anything else' or 'tell me more about it' but not ask what they are doing.

Passes if he gives two sentences describing the picture.

vi. Show the child the picture of children playing in a cardboard box, using it as a boat.

Passes if he indicates that they are playing in a boat i.e. a link between this and the previous picture.

vii. Place on the table in front of the child a standard cube and the smaller next to the closed book. Ask him to listen carefully, and then give the command to put the small cube on the book and give me the big one.

Passes if correct

NOTE:
As the reliability index was not sufficiently high on the preliminary application, it was decided to add an extra element to the command. In the final assessment the child was asked to turn over the book and then put the small cube on the book and give me the big one.

viii. Ask the child what he would do if he were:
a. tired
b. cold
c. hungry

Passes if he gives three logical answers.

ix. Make sure the child is listening and then say:
a. Mommy is a lady, daddy is a .....
Mammie is 'n vrou, 'deddie' is 'n .....

b. A horse is big, a mouse is ....
'n Perd is groot, 'n muis is ....

c. Fire is hot, ice is .....
Vuur is warm, ys is .....

Passes if he gives three appropriate opposite words.

x. Make sure the child is listening and then ask:

a. What is a shoe made of?
Van wat is 'n skoen gemaak?

b. What is a door made of?
Van wat is 'n deur gemaak?

c. What is a spoon made of?
Van wat is 'n lepel gemaak?

Passes - if he gives three appropriate responses.

III. GROSS MOTOR DEVELOPMENT

i. Ask the child to stand on one foot (either foot) in front of you (demonstrate). Time accurately. Allow two trials.

Passes if he stands for 20 seconds.

ii. Ask the child to hop on one (either) foot in front of you - demonstrate.

Passes if he hops 20 times.

iii. Show the child how to tandemwalk 10 paces along a straight line. Ask him to do it.

Passes if he walks 10 paces.

iv. Demonstrate backward heel toe walk along a straight line. Ask him to do it.

Passes if he walks 10 paces.

v. Demonstrate walking on heels over a distance of three metres. Ask the child to do it and observe for associated movements of the hands (flexion of elbows and hyperextension of wrists).

Passes if no associated movements occur.

IV. DRAW-A-MAN

Give the child a pencil and sheet of paper and ask him to draw a man, the best man he can. When he appears to have finished, ask him if he has. If he says 'yes', the score the drawing.

Score-one point for each body part that is not a pair e.g. head and one part for each pair.

APPENDIX 3

RELIABILITY OF THE ITEMS

The reliability index of each item was determined by item analysis as follows:

(reliability index = $r_{xg}\ S_g$ of item g in test x)

r_{xg} is the point biserial correlation of the item with the test
S_g is the standard deviation of the item

$$r_{xg} = \frac{\bar{x}_o - \bar{x}_1}{S_x} \qquad \frac{fo\ fi}{N(N-1)}$$

where
- $\bar{x}_o$ = mean score of those who passed the item
- $\bar{x}_1$ = mean score of those who did not pass the item
- S_x = mean standard deviation of all scores
- fo = number who passed the item
- fi = number who did not pass the item
- N = fo and fi

Method
- calculate $\bar{x}_o$
- calculate $\bar{x}_1$
- calculate S_x
- calculate r_{xg}

$S_g = p\ (1-p)$ where p is the difficulty level (p = +/N)

- calculate $r_{xg}\ S_g$ (Huysmen, 1976)

$r_{xg}\ S_g$ calculated for items of each subtests were as follows.

I FINE MOTOR DEVELOPMENT

i.	0,281
ii.	0,192
iii.	0,193
iv.	0,214
v.	0,069
vi.	0,139
vii.	0,143
viii.	0,315
ix.	0,167
x.	0,219

II LANGUAGE

i.	0,180
ii.	0,274
iii.	0,272
iv.	0,236
v.	0,123
vi.	0,172
vii.	0,259
viii.	0,239
ix.	0,211
x.	0,261

III. GROSS MOTOR DEVELOPMENT

i.	0,288
ii.	0,117
iii.	0,233
iv.	0,342
v.	0,293

APPENDIX 4

RELIABILITY OF THE TEST

Test-retest: the coefficient of stability was obtained by calculating the correlation coefficient using the Pearson product moment correlation on the test and the retest scores with the same form on different occasions.

Internal stability: For each subtest, the split-half reliability coefficient, corrected for the full length of the subtest using the Spearman Brown formula was calculated as follows:

Count the number of odd-numbered items correct and the number of even-numbered items correct. Each individual has an odd and an even score. Using the Pearson product moment correlate the two sets of scores. The Spearman Brown formla is applied:

$$r_{tt} = \frac{2\, r_{oe}}{1 + r_{oe}}$$

where r_{tt} = reliability of the test

r_{oe} = reliability coefficient obtained by correlating scores on the odd items with those on the even items

The Kuder Richardson formula No 20 was applied as follows:
Draw up the following colums:

1	2	3	4
Item	p	q = (1-p)	pq

$$r_{tt} = \frac{K}{K-1}\left[1 - \frac{pq}{S^2}\right]$$

where K = number of items

S^2 = variance of the test

(Downie and Heath, 1965)

APPENDIX 5

CHILD DEVELOPMENT STUDY No.

Child's Surname First Name

Father's Surname First Name

Mother's Surname First Name

Child's Address: 1. Home

2. Other

Date of Birth Birth Weight

Occupation of breadwinner Classif. 0 1 2 3

---

1. Genetic Inheritance: Familial physique & Intellect.

Father of Child

Height (as reported) 1. 'Tall 2. 'Medium 3. 'Short' 4. N

Education Std.

Occupation

Occupation Classification 0. 1. 2. 3. N.

Mother of Child

Height (as recorded)

Education Std.

Previous Occupation

Occupation Classification 0. 1. 2. 3. 4. N

11. Cultural endowment: Standards and Practices.

Civil State of mother 1.M. 2. L.T. 3. M. to infant's father during first year. 4. W 5. D or S 6. S 7. N.

Occupation of mother's father (state)

Occupation Classification 1. 2. 3. 4. N

No. of mother's own siblings No. died in childhood. N.

111. Environmental Conditions: Protection & Nurture.

1. Provision for social & emotional needs: Family functioning

(1) Unit: 1. Child living with both parents 2. One parent 3. Neither parent

(2) Setting: 1. Family alone in house or flat. 2. Sharing with grandparents only 3. Sharing with others

(3) Assumption of responsibility by parents:

Family planning 1. Yes 2. Doubtful or sometimes 3. No 4. N

Was this a planned pregnancy? 1. Yes 2. No. 3. N

Father 1. Supports family 2. Gives some regular support
3. Gives irregularly/seldom/never 4. N/A 5. N.

Mother 1. Plans to remain with child 2. To work later on
3. To work in 3 months 4. N.A. 5. N.

(4) Personality of mother or main caretaker. (As observed over a prolonged period.)
1. Mature/calm/warm/consistent 2. Excitable/tense/inconsistent
3. Immature/ignorant/apathetic/resigned 4. Repressive/rough/quick-tempered 5. Other (state) 6. N. 7. N.A.

(5) Assessment of social stability. (as observed over a prolonged period.)
1. Overtly very stable 2. Moderately stable 3. Doubtful
4. Somewhat unstable 5. Marked problems (excluding non-support.)

2. Provision for economic needs. Available Income Ratio (A.I.R.)
Household Composition & Family Income.

Relationship Sex. Age. Income p.wk Relationship Sex. Age. Income p.wk

3. Provision for Protection: Physical Surroundings & Occupation Density Ratio (O.D.R

(1) External environment: 1. Very good 2. Fairly good
3. Somewhat poor 4. Poor

(2) Housing: 1. Owned by parents or family (excl. shack)
2. Council house or adequate rented house.
3. Poor standard 4. Very poor standard"

(3) Occupation Density:

No. of Rooms used for sleeping

CHILD DEVELOPMENT STUDY No. [redacted]

OBSTETRICAL DATA

MOTHER

Surname CROESER First Name Susan.

Where delivered (1) Hospital (state) P.M.H. 2. Clinic
3. At Home 4. Other

Grav. 3 Para 3.

Age at delivery 24 Wt Ht.

W.R. (1) Neg. 2. Pos.treated. 3. Pos. 4. N

Pregnancy (1) Normal 2. P.E.T. 3. Diabetic 4. A.P.H. 5. N

INFANT

First Name Date of Birth 1.5.76.

1. Birth Wt 2900 g 2. Length 47 cms 3. Hd. Circ 34. cms

Gestation Age 39. wks

Abnormalities (state) O. N.

Delivery (1) S.V.D. 2. Breech 3. Forceps 4. Vacuum extr.
5. Caesarean 6. Other 7. N

Resuscitation (1) Spont.resp. 2. O_2 3. Cath.mask 4. I.P.P.R. 5. N

APGAR 1 min 10. 3 mins 5 mins 10.

HIGH RISK FACTORS

(1) Nil
2. Asphyxia neonatorum - intubation
3. Respiratory distress syndrome
4. Neonatal convulsions
5. Exchange transfusion
6. Birthweight less than 1500 g

≠ Obtain 6 months after delivery.

Name No.

3 MONTH VISIT

Date Age

GROWTH & DEVELOPMENT; GENERAL PROGRESS

Weight at 3 months

Sleep 1. Sleeps well & cries little. 2. Becoming more settled
3. Early pattern of crying & wakefulness persists 4. N

Illness Nature 1. Gastrointestinal 2. Respiratory 3. Other (state)
4. Nil 5. N

Treatment 1. At home 2. C.W.C. 3. Dr. or Day Hospital or O.P.D.
4. In hospital 5. N/A 6. N.

CARE.

In charge 1. Mother 2. Grandmother 3. Other adult 4. Child
5. Institution 6. N.

Feeding 1. Fully breast-fed 2. Partly or wholly bottle fed with bottle held. 3. Bottle propped 4 N.

C.W.C. Attendance 1. At least monthly 2. Irregularly or for immunisation only 3. Seldom/never 4. N.

Stimulation Who plays with infant? 1. Mother 2. Father.
3. Other adult 4. Child 5. Various people 6. Seldom anyone 7. N

Standard of Physical Care & Cleanliness 1. Very good 2. Probably adequate
3. Doubtful 4. Poor 5. N

Any comment by mother (or substitute) on infant's individuality or characteristics (state)

N.B. Ask mother to note date :-

1. When bottle-feeding starts if child is still fully breast-fed
2. When child is first able to sit for one minute on table or floor, unsupported by his arms.

Name No.

6 MONTH VISIT

Date Age

GROWTH & DEVELOPMENT: GENERAL PROGRESS

Weight at 6 months g N

Length at visit cms

Head Circumference at visit cms

VISION 1. Normal 2. Abnormal 3 N

Age at sitting unsupported N/A N.

Illnesses since last visit

Nature 1. Gastrointestinal 2. Respiratory 3. Other (state)
4. Nil 5. N

Treatment 1. At home 2. C.W.C. 3. Dr. Day Hosp. or O.P.D.
4. In hospital 5. N/A 6. N.

CARE

In charge 1. Mother 2. Grandparent 3. Other adult 4. Child
5. Institution 6. N.

Breast-feeding 1. Still fully 2. Till 5 mths 3. Till 4 mths
4. Till 3 mths 5. Till 2 mths 6. Till 1 mth.
7. < 1 mth 8. 0 9. N.

Reason for weaning 1. 'Old enough' 2. 'Insufficient milk'
3. 'Refused' 4. Advised to or mother ill 5. Work
6. Other (state) 7. N. (8) N/A

Milk intake 1. g. per wk. 2. Breast-milk only 3. Both 4. N.

C.W.C. Attendance 1. At least monthly 2. Irregular 3. Seldom/never
4. For immunisation only 5. N.

Reasons for poor attendance 1. N/A 2. Own Dr. 3. Mother works
4. Distance 5. Unable to leave home 6. Ignorance
7. Indifference 8. Other (state) 9. N

Out of doors. 1. Daily 2. Sometimes 3. Seldom/Never 4. N.

Stimulation/....

No"

Stimulation Who plays with infant? 1. Mother 2. Father
3. Other adult 4. Child 5. Various people 6. Seldom anyone 7. N.

Toys Does child take some object to sleep with him? 1. Yes 2. No 3. N

Standard of Physical Care 1. very good 2. probably adequate
3. Doubtful 4. poor 5. N.

Any comment by mother (or substitute) on infants individuality or characteristics (state)"

WEIGHT OF MOTHER (State)

N.B. Ask mother to note age when child sits if not yet.
Reconsider assessment of maternal personality and family stability.

Name No.

9 MONTH VISIT

Date Age

GROWTH & DEVELOPMENT: GENERAL PROGRESS

Weight at 9 months g N

HEARING 1. Normal 2. Abnormal 3. N

SITS UNSUPPORTED by his hands 1. Yes 2. No. 3. N

Age at sitting unsupported (state)

Illnesses since last visit 1. Gastrointestinal 2. Respiratory
3. Other (state) 4. Nil 5. N

Treatment 1. At home 2. C.W.C. 3. Dr. Day Hospital, O.P.D.
4. In hospital 5. N/A 6. N.

CARE

In charge 1. Mother 2. Grandparent 3. Other adult 4. Child
5. Institution 6. N.

Milk Intake 1. g. per wk 2. Breast-milk only 3. Both 4. N.

C.W.C. Attendance 1. At least monthly 2. Irregular 3. Seldom/never
4. N.

Stimulation Who plays with child most? 1. Mother 2. Father
3. Other adult 4. Child 5. Various people 6. Seldom anyone 7. N.

Playthings What objects does child play with 1. State
2. Nil 3. N.K.

Standard of Physical Care 1. Very good 2. Probably adequate
3. Doubtful 4. Poor 5. N

Any comment by mother (or substitute) on infant's individuality or characteristics (State)

N.B. Ask mother to note dates when child first takes 10 steps unaided and can use 4 words appropriately.

Reconsider assessment of maternal personality and family stability.

Name No.

1 YEAR VISIT

Date Age

GROWTH & DEVELOPMENT: GENERAL PROGRESS

Weight at 1 year g N

Length at visit cms N

Head Circumference at visit cms N

Age at walking 10 steps unaided 1. 10 mths 2. 11 mths 3. 12 mths 4. No yet 5. N.

Physically Acive 1. Yes 2. Moderate 3. No 4. N.

Co-operates in dressing 1. Yes 2. No 3. N

Sleep 1. Sleeps well & cries little at night 2. Becoming more restless 3. Having one-year-old sleep difficulties 4. N

Thumb-sucking (or other similar activity) 1. Has stopped 2. Is diminishing 3. Is still frequent 4. N/A 5. N.

Temper tantrums 1. No 2. Uncertain 3. Yes 4.N

Illnesses since last visit 1. Gastrointestinal 2. Respiratory 3. Other state) 4. Nil 5. N.

Treatment 1. At home 2. C.W.C. 3 Dr. Day Hosp or O.P.D. 4. In hospital 5. N/A (6) N.

CARE

In charge of child 1. Mother 2. Grandparent 3. Other adult 4. Child 5. Institution 6. N

Milk Intake 1. per wk 2. Nil 3. N.

C.W.C. Attendance 1. At least monthly 2. Irregularly 3. Seldom/Never 4. N

Stimulation Who plays with child or takes special interest? 1. Mother 2. Father 3. Other adult 4. Child 5. Various people 6. Seldom anyone 7. N.

Playthings What objects does child play with? 1.State 2. Nil 3. N.

Standard of physical care/.....

No

Standard of Physical Care 1. Very good 2. Probably adequate
3. Doubtful 4. Poor 5. N

Any comment by mother (or substitute) on infant's individuality or characteristics (state)

Has a Sibling been born? 1. No 2. Yes 3. Age Difference

Assumption of responsibility by parents

Family Planning 1. Yes 2. Doubtful or sometimes 3. No 4. N. 5. N/A

Father 1. Supports family 2. Gives some regular support
3. Gives irregularly/seldom/never 4. N. 5. N/A

Mother 1. Not working 2. Planning to work 3. Working part-time
4. Working full-time 5. N. 6. N/A

Household Composition & Income

Relationship. Sex. Age. Income. Relationship. Sex. Age. Income.

Physical Surroundings & Occupation Density

External environment 1. Very good 2. Fairly good 3. Somewhat poor
4. Poor 5. N.

Housing 1. Owned by parents or family (excl. shack.)
2. Council house or adequate rented house
3. Poor standard 4. Very poor standard 5. N

Occupation Density.

No of rooms sued for sleeping?

N.B. Check assessment made of mother's personality and family's social stability on first schedule. Amend mother's civil state on first page if necessary.

Name No

15 MONTHS VISIT

Date Age

GROWTH & DEVELOPMENT: GENERAL PROGRESS

Weight at 15 mths g N.

WALKS 10 STEPS UNAIDED 1. Yes 2. No 3. N

Age at Walking 10 steps unaided 1. 13 mths 2. 14 mths 3. 15 mths
4. Not yet 5. N. 6. N/A

Age when able to use 4 words appropriately. 1. 13 mths 2. 14 mths
3. 15 mths 4. Not yet 5. N.

Sleep Problems 1. No 2. Uncertain 3. Yes 4. N.

Eating using a spoon to feed himself 1. Yes 2. Uncertain
3. No 4. N.

Drinking using a cup successfully 1. Yes 2. Uncertain
3. No 4. N

Still persists in putting objects in mouth 1. No 2. Uncertain
3. Yes 4. N

Temper Tantrums 1. No 2. Uncertain 3. Yes 4. N

Physically active 1. Yes 2. Moderately 3. No 4. N

Sibling rivalry 1. No 2. Uncertain 3. Yes 4. N 5. N/A

Illnesses since last visit 1. Gastrointestinal 2. Respiratory
3. Other (state) 4. Nil 5. N

Treatment 1. At home 2. C.W.C. 3. Dr. Day Hosp. O.P.D.
4. In Hospital 5. N/A 6. N.

CARE

In charge of child 1. Mother 2. Grandparent 3. Other adult
4. Child 5. Institution 6. N

Milk Intake 1. per wk 2. Nil 3. N

C.W.C. Attendance 1. At least 2 monthly 2. Irregular 3. Seldom/never
4. N

Stimulation/....

Stimulation Who plays with Child or takes special interest?

1. Mother 2. Father 3. Other adult 4. Child

5. Various people 6. Seldom anyone 7. N.

Playthings what objects does child play with? (state)

2. Nil 3. N.

Has a sibling been born? 1. No 2. Yes 3. Age difference 4. N

Any comment by mother (or substitute) on child's individuality or characteristics (state)

N.B. If not accomplished ask mother to note dates when child takes 10 steps unaided or uses 4 words correctly.

Maintain constant assessment of maternal personality and social stability of family.

Name No.

18 MONTHS VISIT

GROWTH & DEVELOPMENT : GENERAL PROGRESS

Weight at 18 months g N

Height at visit cms N

Head Circumference at visit cms N

ABLE TO USE 4 WORDS CORRECTLY: 1. Yes 2. No 3. N

Age when able to use 4 words correctly 1. 16 mths 2. 17 mths 3. 18 mths 4. Not yet 5. N 6. N/A

Age at Walking 10 steps unaided 1. 16 mths 2. 17 mths 3. 18 mths 4. Not yet 5. N. 6. N/A

Sleep Problems 1. No 2. Yes 3. N

Feeding Problems 1. No 2. Yes 3. N

Domestic mimicry 1. Yes 2. Uncertain 3. No 4. N

Casting: Still deliberate 1. No 2. Uncertain 3. Yes 4. N

Still persists in putting objects in mouth 1. N 2. Uncertain 3. Yes 4. N

Sibling rivalry 1. No 2. Uncertain 3. Yes 4. N. 5. N/A

Temper Tantrums 1. No 2. Uncertain 3. Yes 4. N.

Physically active and mischievous? 1. Yes 2. Moderately 3. No 4. N

Illnesses since last visit 1. Nil 2. Gastrointestinal 3. Respiratory 3. Other (state) 4. N.

Treatment 1. At home 2. C.W.C. 3. Dr. Day Hosp. O.P.D. 4. In hospital 5. N/A 6. N

CARE

In charge of child 1. Mother 2. Grandparent 3. Adult 4. Child 5. Institution 6. N.

Milk Intake 1. p.wk 2. Nil 3. N

C.W.C. Attendance 1. At least 2 monthly 2. Irregular 3. Seldom/never 4. N.

Stimulation/....

No

Stimulation Who plays with child or takes special interest?

1. Mother 2. Father 3. Other adult 4. Child or children
5. Seldom anyone 6. N

Playthings What objects does child play with? (state)

2. Nil special 3. N.

Standard of physical care 1. Very good 2. Probably adequate

3. Doubtful 4. Poor 5. N.

Has a sibling been born? 1. No. 2. Yes 3. Age interval 4. N

Any comment by mother (or substitute) on child's individuality or characteristics (state)

Name No.

21 MONTHS VISIT

Date Age

GROWTH & DEVELOPMENT: GENERAL PROGRESS

Weight at 21 mths g N

Joins 2 or more words together 1. Yes 2. No 3. N

Age at walking 10 steps unaided 1. 19 mths 2. 20 mths 3. 21 mths
4. Not yet 5. N/A 6. N

Sleep Problems 1. No 2. Yes 3. N

Feeding Problems 1. No 2. Yes 3. N

Sibling rivalry 1. No 2. Mild 3. Yes 4. N. 5. N/A

Temper Tantrums 1. No 2. Yes 3. N.

Physically active 1. Yes 2. Moderately 3. No 4. N.

Asks for food, drink or 'pottie' 1. Yes 2. No 3. N

Illnesses since last visit 1. Gastrointestinal 2. Respiratory
3. Other (state) 4. Nil 5. N.

Treatment 1. At home 2. C.W.C. 3. Dr. Day Hosp. O.P.D
4. In hospital 5. N/A 6. N

CARE

In charge of child 1. Mother 2. Grandparent 3. Adult 4. Child
5. Institution 6. N.

Milk Intake 1. g per wk 2. Nil 3. N.

C.W.C. Attendance 1. At least 2 monthly 2. Irregular 3. Seldom/never
4. N.

Stimulation Who plays with child or takes special interest?
1. Mother 2. Father 3. Other adult 4. Child or children
5. Various people 6. Seldom anyone 7. N.

Playthings What does child play with? (state)
2. Nil 3. N

Standard of physical care/....

No

Standard of Physical Care 1. Very good 2. Probably adequate
3. Doubtful 4. Poor 5. N.

Has a sibling been born? 1. No 2. Yes 3. Age difference

Any comment by mother (or substitute) on child's individuality or characteristics (state)

Name No.

24 MONTHS VISIT

Date Age

GROWTH & DEVELOPMENT: GENERAL PROGRESS

Weight at 24 mths g N

Length at visit cms N

Head circumference at visit cms N

Language 2 to 3 word sentences 1. Yes 2. No 3. N.

Age at walking 10 steps unaided 1. 22 mths 2. 23 mths
3. 24 mths 4. No yet 5. N/A 6. N

Able to run 1. Yes 2. A little 3. No 4. N.

Sleep Problems 1. No 2. Yes 3. N.

Feeding problems 1. No. 2. Yes 3. N

Does he feed himself without help? 1. Yes 2. No 3. N

Sibling rivalry 1. No 2. Mild 3. Yes 4. N. 5. N/A

Is child now dry by day? 1. Yes 2. No 3. N.

CARE

In charge of child 1. Mother 2. Grandparent 3. Adult 4. Child
5. Institution 6. N

Milk Intake 1. g per wk 2. Nil 3. N.

C.W.C. Attendance 1. At least 3 monthly 2. Irregular
3. Seldom/never 4. N.

Stimulation Who plays with child or takes a special interest?
1. Mother 2. Father 3. Other adult 4. Child or children
5. Various people 6. Seldom anyone 7. N.

Playthings 1. What does he play with? (state)
2. Nil 3. N.

Standard of Physical Care 1. very good 2. Probably adequate
3. Doubtful 4. Poor 5. N.

Has a Sibling been born/....

No.

Has a Sibling been born? 1. No 2. Yes 3. Age difference

Any comment by mother(or substitute) on child's individuality or characteristics (state)

Assumption of responsibility by parents:-

Family planning 1. Yes 2. Doubtful or sometimes 3. N 4. N/A

Father 1. Supports family 2. Gives some regular support.
3. Gives irregularly/seldom/never 4.N 5. N/A

Mother 1. Not working 2. Planning to work 3. Working part-time
4. Working full time 5. N. 6. N/A

Household Composition and Income

Available Income

Household Composition & Family Income

Relationship Sex Age Relationship Sex Age

Physical surroundings and Occupation Density

1. External environment 1. Very good 2. Fairly good 3. Somewhat poor
4. Poor.

2. Housing 1. Owned by parents or family (excl. shack)
2. Council house or adequate rented house
3. Poor standard 4. Very poor standard

3. Occupation Density

No of rooms used for sleeping?

N.B. Final Assessment of maternal personality and family social stability.

Name No.

36 MONTHS VISIT

Date :

Weight at Visit

Height at Visit

Health

Sociability

Siblings

Family Planning

Employment

NAME :

NO.

48 MONTHS VISIT

DATE :

WEIGHT AT VISIT :

HEIGHT AT VISIT :

INTERVIEWEE :

5 YEAR VISIT

Name No.

Date Interviewee

Weight: Height: Head Circumference:

General Health: (check teeth, eating, sleeping, continence)

Care of Child: By day
(Name & relationship) : At night/weekends

Standard of physical care: 1 = V.G., 2 = Adequate 3 = Doubtful 4 = Poor

Family Circumstances:

Name	Relationship	Sex	Age	Occupation	Income

Rooms used for sleeping:

Housing: 1 = Own 2 = Council 3 = Poor 4 = Very poor

Environment: 1 = V.G. 2 = Fairly good 3 = Somewhat poor 4 = Poor

Maternal Personality: 1 = Consistent 2 = Tense 3 = Resigned 4 = Rough

Family Planning:

Social Stability: 1 = Very stable 2 = Moderately stable 3 = Doubtful
4 = Unstable 5 = Problems

Comments:

CHILD DEVELOPMENT STUDY

5-YEAR ASSESSMENT

NAME: _____ NO: _____

DATE: _____

FINE MOTOR DEVELOPMENT SCORES	LANGUAGE DEVELOPMENT SCORES
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.

GROSS MOTOR DEVELOPMENT SCORES

1.

2.

3.

4.

5.

DRAW-A-MAN TEST SCORE