AN EPIDEMIOLOGICAL ANALYSIS OF ~~PREDICTORS~~ THE DETERMINANTS OF CHILDHOOD MALNUTRITION AND MORTALITY IN SOUTHWEST UGANDA

by

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ABSTRACT

4320 children aged, 0-59 months, were measured (Weight, Height and Mid Upper Arm Circumference) in 31 villages in the district of Mbarara (Southwest Uganda) in March and April 1988. Socioeconomic and health characteristics of the families of the children were also collected.

The socioeconomic variables were analysed through Multiple Correspondence Analysis which produced 7 socioeconomic classes. These were reduced to 3 socioeconomic groups (SEGs) because of similarities between some of the classes. SEG I was the most advantaged group with a higher level of education, a high prevalence of Government workers and professionals who were able to hire labour. SEG II was mainly composed of cattle keepers and producers of export crops with only primary education, not hiring labour and not working on other people's land. SEG III was the most disadvantaged group with minimal or no education and mainly comprised of subsistence farmers frequently working on other people's land. SEG I was the best off in every socioeconomic, health and nutrition indicator, while SEG III was the worst off.

After 12 months, a follow-up survey was carried out in order to assess the number of children who had died.

Mortality rates were inversely proportional to anthropometric indices. There was no interaction between mortality associated with different anthropometric cut-off points and SEGs. Malnutrition produced similar mortality across the SEGs. The most sensitive predictor for mortality was Mid Upper Arm Circumference and the weakest was Weight for Height. Malnourished children

had a significantly higher risk of death from fever, measles, diarrhoea, acute respiratory infections and malnutrition while there was no evidence of a higher risk of death from other causes. Ownership of cattle, length of stay in the village, birth order, father's education and kind of lighting fuel were significantly associated with child mortality.

Nutritional status was influenced by socioeconomic variables directly related to the poverty conditions of the family, to morbidity (especially diarrhoea), and to hygienic conditions in the house.

Poverty was the main determinant of mortality and malnutrition, but even in the better off sector of the community, malnutrition per se put children at a higher risk of death.

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CHAPTER I

BACKGROUND

1.1 INTRODUCTION

In many developing countries, life expectancy at birth is less than 50 years[1] and malnutrition is the biggest contributor to child mortality[2]. However, malnourished children usually live in poor environments and this may itself increase their risk of mortality. It has been suggested[3] that malnutrition is directly or indirectly responsible for more than half of the deaths under 5 years of age and the majority of surviving children will suffer from diseases brought on or aggravated by malnutrition[2].

Low resistance caused by poor nutritional status may facilitate the occurrence of common diseases of childhood. A typical young child will be ill for 30% of the time[4] and the virulence of common diseases such as measles, diarrhoea and whooping cough would be enhanced, contributing to high infant and young child mortality. Severe malnutrition syndromes, such as kwashiorkor and marasmus, are only the tip of the iceberg whose submerged part constitutes the subclinical, moderate and invisible malnutrition present in the community and affects nearly half of the child population of developing countries[5]. Whereas high mortality rates are well recognized in these severe conditions, there is less information on the functional significance of marginal malnutrition.

The long-term consequences of malnutrition could include impairment of the mental and physical capability of many of the affected children who survive to adult life[6]. Brain development of the young child has been demonstrated to be affected by insufficient nutrient intake[7] and the negative effects on mental development may be irreversible[8-12]. This may influence the child's attention, curiosity, reaction and awareness to the surrounding environment; all these are necessary requirements for mental development. The learning capability and school performance of the child is likely to be further handicapped by the many days of school missed due to frequent illnesses. Such loss of opportunities contributes to the poverty of the future adult.

Retardation of physical growth in adults is often associated with iron deficiency and anemia, contributing to high rates of maternal mortality[13].

Blindness and immune suppression may be caused by vitamin A deficiency[14]. These coexisting micronutrient deficiencies may have additional effects on the mortality risk associated with growth faltering.

Widespread poor nutritional status, with resulting negative effect on health and productivity, is likely to be a serious constraint to the development of a country. Thus, investment of resources to combat malnutrition has not only ethical, but also economic justification. Low energy intake is often a cause of low productivity in quantity and quality because of illnesses and chronic debility associated with poor nutrition. If children are protected from malnutrition they will have a better opportunity to grow up healthy in body and mind, reaching their genetic physical and intellectual potential and contributing to higher productivity in the future.

Development is no longer considered as merely an increase in per capita income, but as a decrease in poverty, unemployement and inequality and an improvement in nutrition, health and other basic needs. Whether investing resources in packages of services such as integrated Primary Health Care programs will improve health and nutritional status is however, debatable. Considerable claims have been made for such programmes, but analyses of past interventions have rarely given a clear answer to this important question and for this reason it is essential that future programmes are soundly evaluated.

1.2 AIM OF THE STUDY AND MAIN HYPOTHESIS

Several studies have demonstrated that poor nutritional status puts children at a higher risk of death, though the relationship between malnutrition and mortality differs considerably between communities[15]. It is also true that higher levels of malnutrition and higher levels of mortality are more frequent in lower socioeconomic classes and it has been claimed that malnutrition is a 'proxy' of poverty rather than a true determinant of mortality because higher levels of mortality associated with malnutrition could be due to the confounding effect of social class. The main hypothesis of this study is that malnutrition is associated with higher mortality independently of social class and is directly responsible for death from specific nutritionally related diseases, such as measles and diarrhoea. In order to test this hypothesis, it was necessary to classify families into socioeconomic groups and to assess the mortality of children after anthropometric baseline measurements. An additional aim of this study was to assess the major determinants of child mortality and malnutrition in a specific area of Uganda.

1.3 CHOICE OF THE STUDY SITE

The study was conducted in the District of Mbarara, located in the Southwest of Uganda. This District was chosen because the Ugandan Government and UNICEF needed to carry out a baseline survey for planning, monitoring and evaluation purposes as part of an integrated water supply and Primary Health Care (PHC) project to be implemented in the area. As will be explained later, the baseline survey was the starting point of the study. This was completed by a follow-up survey on mortality of the children who were measured one year before in the baseline survey.

1.4 GENERAL INFORMATION ON UGANDA

1.4.1 Geography, agriculture and climate

The following information on Uganda is taken from the UNICEF Situation Analysis[16] in which the author participated. Uganda is a landlocked country of 241,139 sq km, of which 41,440 sq km consist of swamps and lakes. The country is surrounded by Sudan to the North, Kenya to the East, Zaire to the West and Rwanda, Tanzania and Lake Victoria to the South. Situated in the East African plateau, most of the country lies at an altitude of 900-1800 metres, with Mount Ruwenzori (around 5000 metres) to the West and Mount Elgon (around 4300 metres) to the East. The country is characterized by hills, tropical forests, game parks, fertile valleys and savannah. The most fertile land is in the Central part of the country surrounding Lake Victoria, while the North is more arid, especially Karamoja where pastoralism is widely practised.

The average family cultivates less than 3 hectares of land. However, average farm size increases to the north where the soil is drier and less fertile. There are only a few large scale farms (100-200 hectares) used for production of coffee, tea and sugarcane and these are usually run by parastatal or Government cooperatives.

There are 2 rainy seasons, in April-May and in November, with an average rainfall of 1000 mm per year, allowing two harvests per year in the centre and south.

The hungry seasons are usually in the dry months of January-February and June-July.

Uganda has a wide network of roads, mostly in disrepair due to lack of maintenance and the heavy traffic from Kenya to Sudan, Zaire, Rwanda and Tanzania.

1.4.2 Population

The population rose from 2.5 million in 1911 to 12.6 million in 1980. The estimated annual growth rate is 2.8%, but the rate is probably around 3%. According to the 1969 census, Uganda has a young population: 46% are under 15 years, 19% are below 5 years and only 10% are over 50 years.

The ethnic groups are Bantus, Nilotics, Nilo Hamitics and Sudanics; the Bantus live in the South and the others in the North.

1.4.3 Health situation

The Demographic and Health Survey estimated an infant mortality of 101 thousand live births and life expectancy is estimated to be 52 years.

The major causes of mortality among all age groups in 1981 were measles, acute respiratory infections, diarrhoea and malaria. The major causes of morbidity found among children under 5 in various surveys were malaria, diarrhoea, acute respiratory infections and measles. Malaria is the main cause of morbidity and mortality, being endemic throughout the country. Two species of anopheles mosquito (the Gambiae and the Funestus) act as vectors and the most common form of malaria is due to Plasmodium falciparum.

The second most common cause of morbidity and mortality is diarrhoea, where death is mainly due to dehydration. Intake of foods and fluids is customarily maintained during diarrhoea but there are few families who possess sugar in their households, thus treating diarrhoea with sugar-salt solution is difficult to implement. According to reports of the Uganda National Expanded Programme of Immunization the immunization coverage in 1988 was 77% for Bacille Calmette-Guerin (BCG), 41% for polio 3, 40% for diphtheria, pertussis and tetanus (DPT3) 49% for measles and 14% for Tetanus Toxoid (TT 2).

Although immunization may have reduced measles incidence in the country, case fatality rates remain high. Measles was found to account for 18% of deaths below 5 years in a survey in Arua.

According to a survey in Mbale District in 1984, neonatal tetanus accounted for 15 deaths per thousand live births. The incidence of polio was estimated to be 9-12 cases per 100,000 people in 1988.

1.4.4 Nutrition

As in other developing countries, nutritional status is often satisfactory during the first 6 months of life, deteriorating afterwards due to a combination of factors related to the weaning period. The situation improves in the third, fourth and fifth years. Available data indicate that stunting (below 90% median Height for Age) is around 30% and wasting (below 80% median Weight for Height) affects around 2% of the children under 5 years. In a study carried out in Kampala[17], the prevalence of children with Weight for Age (W/A) below 80% was 25%, while the prevalence for Height for Age (H/A) below 90% was 22% and for Weight for Height (W/H) below 80% was 2%. The prevalence of wasting in children whose parents were self employed or in business was less than half that of children whose parents had other occupations.

In a study carried out in Mbale District[18] in 1982, there was a prevalence of 29% below 90% H/A and 4% below 80% W/H. Foods were introduced between 3 and 6 months in the form of cow's milk, beans, groundnuts, maize porridge and matoke. Malnourished children were introduced to foods other than breastmilk at 6 months of age compared to an average of 4.5 months among better nourished children. In a survey carried out in Northeast Uganda in 1985[19], 16% of children under 5 years were below 80% of the median W/A, 13% were below 90% of the median H/A and 1% were below 80% of the median W/H.

Low W/A was significantly more prevalent in households with a low score (based on type of building materials of the house), owning less than 10 acres of land and having less than 3 people working the land. Low H/A was more prevalent in households with a low score; wasting was more prevalent among children who suffered from malaria in the previous 2 weeks and belonging to a family who had to rent some land. These findings indicated that low socioeconomic conditions affect nutritional status.

In a survey in Kawempe[20] subdistrict near Kampala in 1987, the mean W/A was above 100% below 1 year, falling to 90% in the second year and 85% afterwards. The mean length for age (L/A) was around 100% during the first year, falling afterwards to 93-94%, the mean Weight for Length (W/L) was above 100% below 6 months, declining to 98% in the second year and recovering afterwards. The median age for introduction of solid foods was 5 months and median age of cessation of breastfeeding was 15 months. Both L/A and W/L were significantly lower in children who had suffered from some illness in the previous month.

In a survey from Arua District in West Nile in 1987[21], the prevalence was, 29% below 80% W/A, 28% below 90% H/A and 2% below 80% W/H. Breastfeeding prevalence was 97% in the first year, 85% in the second year and 23% in the third year. Solid foods were introduced in 5% below 4 months, in 66% by 8 months and in 94% by the first year. The most common foods used during weaning were: bananas, beans, simsim (sesame seeds), eggs and pawpaw (papayas). The variables negatively influencing nutrition were prolonged breastfeeding; involvement of the father in activities such as alcohol distillation and tobacco growing and having been sick in the previous 2 weeks.

The majority of infants are breastfed until at least the end of the first year, the median cessation point being 9 months for urban children and 16 months for rural children[16]. A survey in 1988[22] in four Districts found that the majority of infants were started on supplementary feeding between four and six months. Common weaning foods included cow's milk, vegetable stew and porridge of millet, sorghum, maize and cassava. Sorghum was also found to be traditionally fermented into porridge and given to the children.

1.4.5 Maternal health

Based on hospital statistics, the maternal mortality rate is estimated to be around 2.65 per 1000 births. However, due to the fact that most mothers deliver at home, this is only an estimate. A more reasonable figure should be around 3 per 1000 births. The major causes of deaths in pregnancy are haemorrhage, infections, eclampsia, obstructed labour, abortion, malaria and anaemia. From hospital records, more than 1 in 5 pregnancies in Kampala end with self-induced or spontaneous abortion. From various surveys, the prevalence of deliveries in health institutions varies from 7% to 43%, depending on the district. The Demographic Health Surveys (DHS) reported that by the end of childbearing, women had an average 7.3 children. Of the women interviewed by the DHS, 23% did not want any more children and 33% wanted to wait at least two years before having another child. However, only 16% used family planning.

1.4.6 Health infrastructure

In 1987, there were 792 Government and 145 Non Government Organization (NGO) health units, but most of the Government facilities were in a state of disrepair. In response to the deterioration in quality of health services, many families reverted to self treatment and traditional healing, and when they choose modern medical treatment, a higher proportion chose the NGO health facilities.

27% of the population live within 5 km and 57% within 10 km from a health unit. While 91% of the population live in rural areas, only 10% of hospital beds and 24% of doctors are located in rural areas. Ministry field staff do not reach the village level but are concentrated at county or subcounty levels. Due to lack of transport and low wages, these field staff are generally inactive.

1.4.7 Occupation, religion, housing, education and sanitation

In 1987, 55% of the rural population depended on crop cultivation as their source of income, 19% depended on mixed farming, 3% on animal husbandry, 2% on fishing, and 22% on other work.

The main religions are Catholicism (49%), Protestantism (33%) and Islam (7%). Generally, the Protestants dominate senior offices and chieftainships. A 1987 survey found that less than 3% of households had been visited by a health worker. At village level, most houses are built with mud, the roofs are made of grass and the floor of earth. Most people still cultivate with handtools (usually in short supply), cook with firewood and use candles for lighting. Latrine coverage was between 65% and 89% in 1988. Access to safe water supply was 7% for rural areas and 90% for urban areas in 1987. Most households are within 2 km from a primary school. There were 7,955 primary schools in the whole country in 1987. The gross enrollment ratio in primary school was 56% in 1980. The principal reason for non attendance is economic (parents cannot afford school uniforms or books or children are needed on the farm). Girls are less likely to go to school and when they do they have a higher drop-out rate than boys.

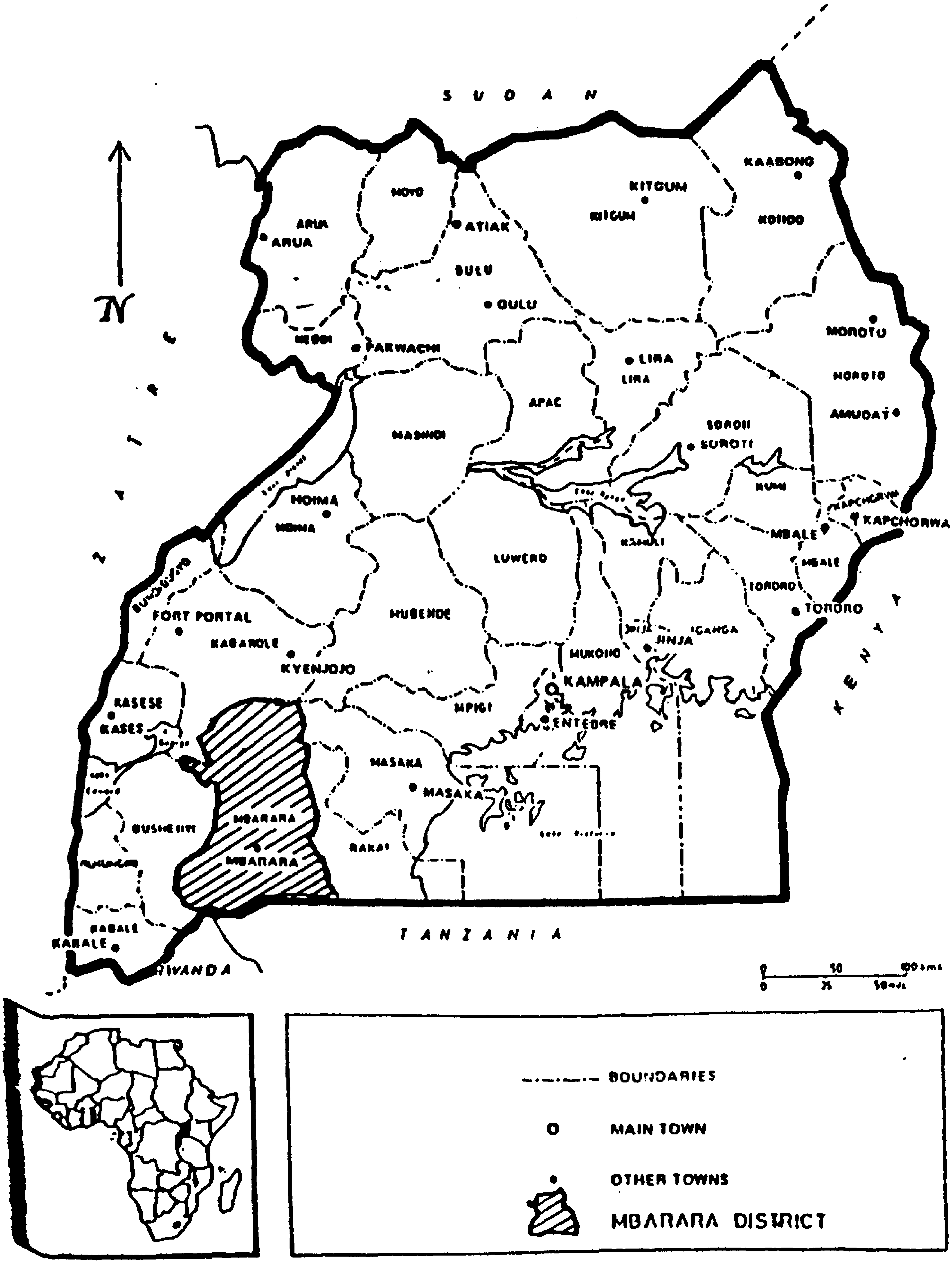
1.5 PROFILE OF THE STUDY AREA

Mbarara District is bordered by Kabarole District to the North, Rakai and Masaka Districts to the East, Bushenyi District to the West and Rwanda and Tanzania to the South. The physical features of the area are characterized by rounded hills and undulating grassy downland which extends westwards to the highlands of Kabale District; savannah vegetation predominates. The rainy seasons are in April-May and September-November; the dry seasons occur in

June-July and December-February. The District is historically part of the Kingdom of Ankole and is divided into 8 counties, 37 subcounties and 175 parishes. The new Government organization ensures a Resistance Committee (RC1) at village level; a higher Resistance Committee (RC2) at parish level (elected by all the villages in the parish), and so on up to Resistence Committee 5 (RC5) at the district level. Through these institutions the people are given an opportunity to make decisions affecting their immediate circumstances; to monitor the well-being of their areas; to assist Government officials to implement policies; to initiate and propose development policies; and to initiate and propose development changes in their own areas. The administrative structure is headed by a District Administrator who is the representative of the President and who works with the traditional local government civil servants within the district.

The population of Mbarara District is estimated to be 957,553, with a growth rate of 4.2% and an under-five population of 181,935. The people are traditional agriculturalists and pastoralists, but with a some tin-mining in Isingiro County. The majority of the population is rural and farming is still mostly at subsistence level. The town of Mbarara is mainly an administrative and trading centre, and the majority of the town dwellers also own land in the village which they farm. Cereals, plantain, millet, sorghum, beans and groundnuts are produced for home consumption and some for sale; in addition there is some cash cropping (coffee, tea or tobacco).

MAP OF UGANDA



CHAPTER II

METHODOLOGY AND DESCRIPTION OF THE POPULATION SAMPLED

2.1 STUDY DESIGN

The study consisted of a cross-sectional baseline survey carried out in March and April 1988, with a follow-up survey carried out 12 months later to record the mortality of the children measured at the baseline. This involved the recruitment of a cohort of 4,320 children age 0-60 months who were examined at the baseline and visited after 12 months. The cohort was sampled from 31 villages in the district of Mbarara, Southwest Uganda. Every child under 5 years present in the village on the day of the survey was enrolled. Different indicators were used to build up a socioeconomic classification in order to assess possible interactions between socioeconomic status and nutrition in causing mortality.

2.2 OBJECTIVES

The general objectives of the study were:

a) to have a baseline of the health situation in Mbarara District for planning and evaluation purposes of a Primary Heath Care (PHC) and water project;

b) to identify indicators to monitor the implementation of the project;

c) to identify groups at risk needing priority action;

d) to analyse risk factors influencing health and nutritional status;

e) to assess the status of health and community services, their accessibility and utilization.

The specific objectives were to estimate:

a) the sensitivity and specificity of anthropometric indicators in predicting child mortality;

b) the interrelationship between nutrition and socioeconomic status in causing deaths.

2.3 RELATIONSHIP BETWEEN THE RESEARCH AND THE PHC PROJECT

The UNICEF/Uganda Ministry of Health plan for the area included the following activities: community mobilization, immunization, health education, growth monitoring, diarrhoea disease control, sanitation and water supply.

At the time of the baseline survey there was no project activity in any of the 31 villages covered by the study. Unfortunately due to technical and administrative difficulties the 31 villages in this study were not covered by project activities by 12 months after the baseline.

2.4 SAMPLE SIZE

One anticipated effect of the integrated project was a reduction in stunting (% below -2 SD H/A). Although no data was available on stunting in the area, it was expected to be similar to other areas of Uganda i.e. around 30%. Assuming that the project would lead to a reduction of 20% of this prevalence (so that at the end of the project the prevalence would be 24%), and assuming we wish to detect this difference with beta=10%(90% power), and alpha=5%, the sample size was 1,144 children according to[23]:

$$n=\{[(p1x(100-p1)+p2x(100-p2)]/(p1-p2)^2\} \times F(alpha, beta)$$

$$n=\{[(30x70)+(24x76)]/36\} \times 10.5=1,144.$$

In order to assess the overall Government of Uganda/UNICEF project impact, it was necessary to compare the project area with a control area; we needed 1,144 children under five years in the project area and a further 1,144 in the control area, making a total of 2,288 children. Furthermore, because we were dealing with clusters (villages) there was a strong possibility of a distortion called the 'design effect' which is around 2.[24] Therefore 2,288 was multiplied by 2 to obtain the final sample of 4,576. Because it was estimated that in each village there were around 75 households and in each household it was supposed there would be around 2 children in the target age range, a total of 31 villages were selected. A household was defined as a group of people sharing a common cooking pot.

2.5 SAMPLING

To select the villages the Uganda census of 1980[186] was used to give the roster of parishes, which are the smallest units in the census. Each parish was composed of 1 to 5 villages. The 31 parishes were selected with systematic random sampling with probability proportional to size in order to give more weight to the bigger parishes. In this method the parish name is included in the first column, the second column includes the population of each parish. The third column shows the cumulative population.

The total population was divided by 31 giving the sampling interval. From this figure a random number between 1 and the maximum number in the sampling interval was drawn. This random number fell at a certain point within the cumulative population corresponding to the first parish to be selected. The sampling interval was added to the first random number and this second number fell at a separate point within the cumulative population corresponding to the second parish. The process was repeated till the 31st parish was selected.

The selected parishes were contacted in order to have the names of the villages included in each parish. For each parish one village was selected at random. In each village all the households were selected because the total sample size was almost equal to the population of the 31 villages. In each household the mother was interviewed or, in the absence of the mother, the closest person who was taking care of the child. The father of the child was interviewed for some questions concerning the household indices.

2.6 TIMETABLE OF THE RESEARCH PROJECT

The baseline survey was planned between September 1987 and January 1988 and the chiefs of the selected villages were contacted in order to explain the purpose of the survey, to have a roster of family names, to draw maps of the villages in order to locate the families and to organize calendars of local events to improve the accuracy of assessment of the age of the children.

A questionnaire was pretested in January 1988 and modified accordingly. Twenty medical assistant from Mbarara were recruited and trained in interviewing techniques, anthropometry and the use of local calendars of events for assessment of age. The training lasted one week; half of the time was spent practising in a village near Mbarara town. Each interviewer was trained during 5 sessions of anthropometric measurement of 10 children under 5 years at one local health centre. Accuracy was evaluated at each session against the measurements of the principal investigator according to the procedures described in the United Nations manual "How to Weigh and Measure Children"[25].

The baseline study was implemented in March-April 1988. A first cleaning of the questionnaires was done before leaving the village and if necessary families were revisited in order to correct mistakes and fill missing information. A second cleaning was done in Kampala and the data was coded in coding sheets. The coding sheets were checked with the questionnaires for any inconsistencies and then entered in Data Base III Plus on an Amstrad PC. The data entered was checked against the coding sheets. Anthropometry was transformed to Standard Deviation (SD) scores and 'percentage of the median NHCS(National Health Centre for Statistics)[26] standard' using the subroutines from CDC (Centre for Disease Control).[27] A few random transformations were

checked manually and all of them were found to be correct. Between June 1988 and September 1988 a first descriptive analysis was carried out using SPSS (Statistical Package for the Social Science)[29] on an Amstrad PC.
In October-November 1988 Multiple Correspondence Analysis was carried out at the University of Milan using the software programme SPAD (Systeme Portable Pour l'Analyse des Donnes).[30] In February 1988 two interviewers were trained on how to interview mothers who had lost a child and on how to assess causes of death. In March-April 1989, 12 months after the end of the baseline, the same families were revisited to assess the conditions of the 4,320 children measured in the baseline.

Of the initial 4,320 children, 3,814 (88%) were traced, 104 of whom died. There was no significant difference between those traced and those lost to follow-up in terms of prevalence of weight for height, height for age and weight for age below -2 SD and of MUAC below 12.5 cm (see Table 4.2).

The final analysis was carried out at the London School of Hygiene and Tropical Medicine starting in November 1989 on an Opus PCV using SPSS and EGRET(Epidemiological Graphics Estimation and Testing)[187], GLIM (Generalized Linear Interactive Modelling)[31] was used for analysis with the mainframe of the University of London.

2.7 QUESTIONNAIRE AND INSTRUMENTS

The questionnaire was 6 pages in length. The first section included questions on housing characteristics, such as number of people living in the household, number of rooms, source of water used, presence of a latrine, type of cooking and lighting fuel, ownership of a radio and distance from the nearest health unit.

Section 2 was related to each index child under five living in the household, and included the following variables: birth order, place of delivery, breastfeeding status, ethnicity, length of residence, education, occupation and religion of the father, marital status, education and pregnancy status of the mother.

Weaning is a widely used term to mean different things by different authors. It is helpful to distinguish "weaning on" from "weaning off". By "weaning on" is meant the introduction of solid foods to the purely breast fed infant. By "weaning off" is meant the cessation of breast feeding. For the study the term weaning is used to describe "weaning on" to solid.

Other questions were related to weaning practices, presence of the growth chart, weight, height, Mid Upper Arm Circumference (MUAC), vaccination status and food eaten in the previous 24 hours. To assess reading capability of the parents, written materials in the local language and English were used.

Section 3 dealt with sickness suffered by any family member, including the child, in the previous two weeks, duration, treatment and who provided treatment, if any. Each interviewer was trained in diagnosing disease on the basis of a checklist of symptoms. If more than one disease was present, the most relevant was recorded. For example, if the patient was affected by measles and at the same time by diarrhoea, measles was recorded. As far as vaccination is concerned, over 70% of children had the vaccination card. If the child did not have any card, he/she was considered not vaccinated. Only those vaccinations registered in the cards were considered, and only if they were given at the correct age and interval.

In section four of the questionnaire, mothers were randomly selected and asked about feeding and fluids practices during the child's last episode of diarrhoea. Their knowledge of sugar salt solution, the use of ORS packets and vaccinations were also assessed.

Section five included questions about land acreage, the kind of crops cultivated, livestock owned, goods bought and crops sold during the previous 6 months.

The height of each child between 2 and 5 years was measured, while length was measured in children below 2 years; measurements were taken to the nearest mm. Length boards were locally constructed according to instructions from the United Nations manual "How to Weigh and Measure Children'.[25] The weight was taken to the nearest 100 g with a Salter spring scale (model 235 PBW) which was checked with a 5 kg weight every day. MUAC was measured to the nearest mm with a standard tape provided by UNIPAC (UNICEF warehouse for packing supplies and equipment in Copenhagen).

If a birth or baptismal certificate was not available, the age of the child was assessed through a local calendar of events. Children who were ill on the day of the survey were treated accordingly or referred to the nearest health unit.

Each mother was left with an ORS packet and instructions on how to treat diarrhoea and malnutrition. To check the accuracy of the data collected, two households per village were randomly selected and cross-interviewed by the principal investigator, who found a 95% consistency of the answers.

2.8 DESCRIPTION OF THE POPULATION SAMPLED

2.8.1 Introduction

The total population was 17,134 living in 2,699 households. The 4,320 children under five accounted for 25% of the population with 1.6 children per household.

The most frequent occupation of the father was subsistence farmer, followed by cattle keeper, 23% had occupations outside agriculture such as traders, professionals, government officers, artisans, teachers, builders, butchers, policemen, armymen, church people, drivers and dependent workers of the private sector. 26% of the fathers and 49% of the mothers did not have any formal education. 55% of the fathers were Protestant, 36% Catholics, 8% Muslims and the rest made up of other religions. The major ethnic group was Banyankole followed by Bakiga, Baganda, Rwandese and others. 12% had been resident for less than 3 years and 71% for more than 10 years. 87% of the mothers were married and 17 % were pregnant at the time of the survey.

As far as socioeconomic variables are concerned, 22% of the households did not own a radio, 28% used candles for lighting and almost everybody used wood for cooking. 69% cultivated less than 3 acres of land, 78% of the households had a latrine and only 13% collected water from a protected source such as borehole, protected spring or protected well. The remainder collected water from rivers, streams, swamps and ponds.

2.8.2 Maternal and child health

More than 3/4 of the women received some form of antenatal care, but only 20% of deliveries had been conducted under trained supervision (e.g. nurse, midwife). The first born child was more frequently delivered in a health institution. This is probably due to the fact that primiparae are probably more keen to deliver with the assistance of a trained person, while multiparae are sufficiently confident to deliver with a Traditional Birth Attendant (TBA) or a relative.

Duration of residence of the family influenced where the delivery took place; those women who had arrived in the area recently delivered more frequently in a health institution. Place of delivery varied between ethnic groups, with nearly half of the Rwandese delivering in a health unit vs 7% of the Bakiga. This could reflect the fact that the Rwandese tend to live in settlements with easy access to such institutions.

Father's occupation was also important in influencing the choice of the place of delivery, with 35% of wives of Government employees delivering in health institutions, compared to 15% of wives of subsistence farmers. The level of education had a strong influence in the choice of the place of delivery; the percent of deliveries in health institutions was 11% among women with no education, 24% among those with primary education and 58% among those with secondary education. This difference remained significant even after controlling for distance of the house from a health institution. Distance from a health unit was important in influencing place of delivery. However, whatever the distance, the utilization of the TBA always remained around 33%, indicating that using TBAs is not influenced by availability of health services.

Those children who had been delivered in a health unit had a higher probability of receiving follow-up care in their first year of life with more records of weighing and recording of the growth pattern on a growth chart than those delivered at home. In general, growth monitoring was almost absent with one third of children possessing a growth chart; 12% of mothers knew how to interpret the growth curve, and 8% of children were weighed in the previous 3 months.

Among those children between 12-23 months who owned a vaccination card 17% were fully vaccinated (BCG, DPT 3, polio 3 and measles), 41% were partially vaccinated and 42% not vaccinated.

2.8.3 Morbidity in the previous 2 weeks

43% of children had been ill in the previous 2 weeks. The most prevalent diseases in order of frequency were acute respiratory infections (16%), diarrhoea (9%), fever (8%), skin infections (2%) and worm infestation (2%). 2% of children suffered from measles in the previous 3 months. The prevalence of some diseases were higher in certain age groups; in the first year, the most common illnesses were respiratory infections (17%). Diarrhoea reached its peak during the second year (16%) and then declined to only 2% in the fourth year. Worm infestation was absent in the first 6 months and remained around 2% after the first year. A quarter of the illnesses lasted for less than 1 week, and nearly half for more than 2 weeks. The most common form of treatment was tablets followed by injections, herbs and ointments. Tablets were the first choice when the disease lasted less than two weeks, while injections were used more for chronic diseases. Mothers with a higher level of education sought injections relatively frequently, while herbs were more commonly used by those mothers with low or no education. Treatment was given in a health institution in two thirds of

cases, the traditional healers were consulted rather infrequently (2%). The low rate of utilization of traditional healers may reflect the fact that the community did not want to prejudice the chance of obtaining medical help by admitting to the use of traditional healers.

2.8.4 Nutrition

2.8.4.1 Anthropometry

The Mean Z Score for Weight for Age (W/A) began to drop from 5 months of age, reaching -1.5 at around 12 months and thereafter remaining around -1. The Mean Z Score for Height for Age (H/A) was consistently below 0 and from 12 months onwards was always around -1.5. The Mean Z Score for Weight for Height (W/H) was positive up to 7 months of age, before falling to about -0.5 around 12 months and then varying around 0.

The prevalence of underweight (measured as below -2 SD W/A), increased from 11% in the first year to 20% in the second and third years. Stunting or shortness (measured as below -2 SD H/A) increased from 17% in the first year, to 38% in the second year and remained at that level in the following years. Thinness (measured as below -2 SD W/H) increased from 4.5% in the first year to 6% in the second year, 4% in the third and 2% in the fourth and fifth year. The overall proportion of children who were underweight, short or thin (below -2 SD W/A, H/A and W/H) was 18.5%, 32.5% and 3.8% respectively.

The prevalence of children below different cut off points of % from the median followed the same pattern of the SD scores, with increasing prevalence of children below 80% median W/A and below 80% median W/H during the second year, and a higher prevalence below 90% median H/A in the third and fourth years. The overall proportion of children who were below 80% W/A, 90% H/A and 80% W/H were 21.8%, 21.3% and 2.7% respectively.

These findings indicate that the critical period for thinness starts at the end of the first year. The prevalence of shortness steadily increases with age. Between 12 and 59 months the prevalence of MUAC below 12.5 cm was 3.2%, while 12.5% were below 13.5 cm.

2.8.4.2 <u>Diet in the previous 24 hours</u>

Breastfeeding was universal below 1 year, declined to 50% in the second year and 6% in the third year. Between 3 and 4 months 9% of children were introduced to beans, 3% to cassava, 5% to greens, 4% to groundnuts, 13% to matoke and 3% to millet. The percentage of children eating matoke increased to 40% between 5 and 6 months to 67% between 7 and 8 months and 84% between 9 and 10 months. The second most common food was beans, which increased with the same pattern to reach around 50% in the 10th month. After the first year matoke and beans remained the most common foods, followed by groundnuts, greens, meat, millet, cow's milk and potatoes, while cassava was present in only 4% of the diet.

In general, consumption of cereals was low; pulses were eaten by around 20%, groundnuts by 10%, meat was only consumed by a minority and sugar was consumed rarely. After the first few months of life the child's diet resembled the adult family diet with matoke, roots and tubers being the main staple foods.

2.8.4.3 Agriculture

Almost all the households cultivated beans, matoke and millet, and half of the population cultivated groundnuts, cassava, maize, potatoes and sorghum. 12% produced coffee, 10% produced peas, pineapple and pumpkins and 2% grew tobacco.

The most frequently stored crops were beans, groundnuts, maize, millet and sorghum, while matoke and cassava were rarely harvested but sold or eaten piecemeal.

The most resistant crops were cassava and matoke while all the rest were, to some extent, lost in storage. The main foods purchased in the previous 6 months were meat (32%), maize flour (29%), tomatoes (22%), beans (20%), onions (20%), matoke (18%), groundnuts (18%), sugar (12%), cassava (10%), peas (4%), oil (3%), rice (5%) and sorghum (3%). About 10% of those who sold their crops had to buy the same crops later in the year, probably at a higher price.

CHAPTER III

SOCIOECONOMIC CLASSIFICATION

3.1 INTRODUCTION

Good health is linked to cultural, social and economic conditions in every part of the world. The availability and impact of health technologies and structures depends on the organizational structure of the community.[32] Economic factors operate at individual and community levels. At a personal level, these determine whether or not individuals can use health services and health structures and therefore influence their health status. At the community level, the provision of health services and structures is determined by the overall contribution to this sector by the community, while access to them by a more or less wide section of the community depends on the degree of subsidy for needy individuals.

It is extremely useful to be able to summarise this type of information by means of quantitative indicators for the purpose of evaluation of health interventions.[33] Indeed, accurate targeting of health interventions in developing countries demands the use of socioeconomic indicators. These must be sensitive enough to detect vulnerable groups who have problems of accessibility to services.[34-37] In industrialized countries, socioeconomic classifications are based on income, occupation and education. For example, in Great Britain, the usual reference is the General Register of Occupations. In the United States, the classification of the Bureau of Census or the poverty index of the Social Security Administration is used.

The limitation of these socioeconomic classifications is that they are based on only one variable, usually the occupation of the father. Although occupation is often related to income, the same occupation could be associated with differences in socioeconomic conditions. For instance, a teacher might earn less than a manual worker. Therefore, it is necessary to rely on several socioeconomic indicators which need to be considered at the same time and whose interlinkage will allow more flexibility in assigning a family to a socioeconomic group.

To take a practical example, if the head of the household is a subsistence farmer this will not be enough to assign the family to the worst socioeconomic group. It will also be necessary to take into account variables such as husband's and wife's education, whether the family has goods such as a radio, if the members of the family hired labour or worked on other people's land, and so on.

The interlinkage of the different indicators may be drawn from information concerning the family profiles. It is possible to examine these interactions using an analysis called Multiple Correspondence. As this contributes to a major part of this thesis it will be described in greater detail in the methodology section.

The advantage of such an analysis in comparison with others lies in its capability of analysing a multitude of indicators without preconceived ideas, thereby identifying those who have certain socioeconomic characteristics.

Families may be clustered into classes according to their similarity in relation to these socioeconomic indicators. For developing countries, the administrative and organizational problems are such that attempts have not yet been made to compile national registers. Furthermore, because of the structural and economic heterogeneity of these poorer countries in comparison with industrialized ones, it is inappropriate to use the above mentioned indices.[38-40]

For health planning, indicators often used include women's literacy or housing conditions (size, crowding etc.) and, where possible, the availability of food items. In constructing a list of suitable indicators it is necessary to consider simplicity of construction, clear definition and specificity in relation to the phenomenon considered.[41-43]

3.2 MATERIALS

Of the data from 2,699 households 18 variables were chosen for the purpose of describing living conditions of the family in the study: crowding conditions, type of water supply, presence or absence of a latrine, type of cooking fuel, type of lighting fuel, ownership of a radio, number of years of residence in the village, ethnicity, religion and occupation of the father, marital status and fertility of the mother, years of schooling and reading capability of the mother and father, number of acres of land cultivated by the family, whether or not anybody in the family worked on other people's land in the previous 6 months and whether or not the family hired labour in the previous 6 months. It was noted that in Mbarara, as in other parts of Uganda, that everybody is involved in some agricultural activities even if they work in other sectors such as trading or Government. However, a Government worker with a plot of land usually has living conditions and other characterics which differ from those whose occupation is full-time farming. Therefore, if a person was a Government worker and had also a plot of land, he was coded as Government worker; the same applies for other non-agricultural categories such as policemen, artisans, butchers, professionals etc. Those who were involved in agriculture only were classified as: cattle keepers if they owned cattle, export crop farmers if they produced coffee, tea or tobacco; subsistence farmers if they were producing crops other than export crops. With few exceptions, subsistence farmers cultivated less than 2 acres of land and had little or nothing left in the granaries at the time of the survey which was conducted in pre-harvest.

Of the 2,699 households, 350 were missing 1 or more variables. A first analysis showed a substantial homogeneity between the sample of households with complete information and the total sample (table 3.1), and therefore the exclusion from the analysis of households with at least one missing data should not affect the explanation of the relationships existing between the different categories.

3.3 METHODOLOGY

3.3.1 Objectives of the Multiple Correspondence Analysis

When there is a mass of statistical data with thousands of subjects and tens of variables and it is needed to describe them it will be necessary to deal with points in a multidimensional space which is impossible to visualize geometrically beyond the third dimension. It is therefore useful to imagine in some way a cloud in which each subject is like a droplet or point in this cloud. The dimensions of the cloud are given by the categories of the variables. It is difficult to interpret the data in this form; therefore it is necessary to project the droplets or points of the cloud in a subspace of less dimension which is usually a plane (see graph 3.1).

3.3.2 Introduction

Multiple Correspondence Analysis (MCA)[44-46] attempts to find the associative structure between variables and the similarities between subjects in a descriptive way. MCA deals with categorical data starting from a representation in a multidimensional space where each dimension represents a category of each variable, and each household is represented in the space by a point whose position is determined by the categories of the variables which characterize the household. Such a multidimensional space however, is difficult to analyse. It is therefore advantageous to represent these data in a space with less dimensions in order to extract and interpret the data optimally.

TABLE 3.1

Comparison between the sample with complete data (2,349), where there were no missing values, and the entire sample (2,699). None of the difference between the two groups were substantial

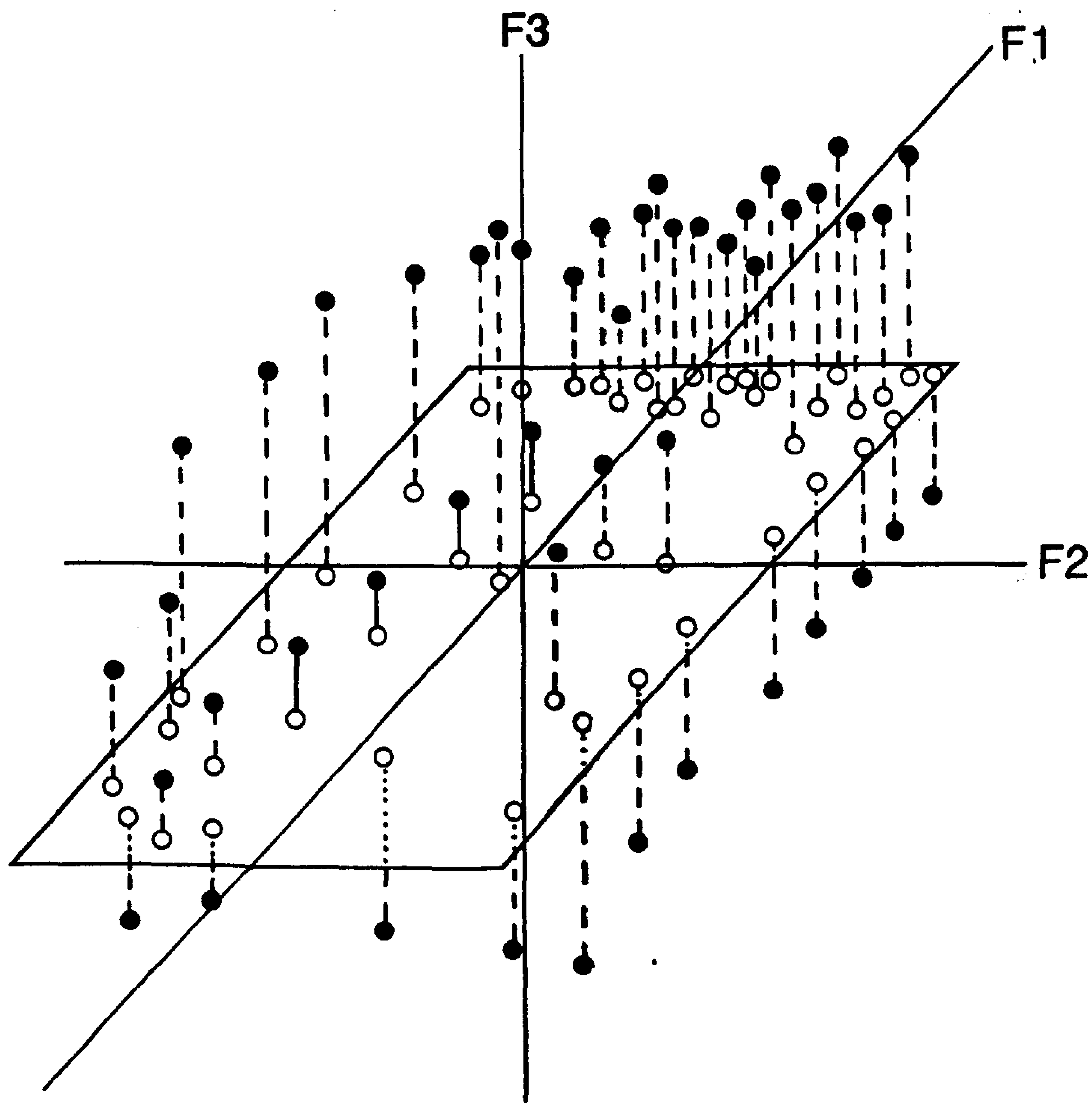
VARIABLES	Sample with no missing values	Entire sample
FATHER'S EDUCATION		
0 years	26%	26%
1-3 years	16%	16%
4-7 years	46%	46%
8-12 years	10%	10%
>12 years	2%	2%
PROFESSIONAL POSITION		
Hiring	11%	11%
Hiring and working	1%	1%
Not hiring and not working	73%	73%
Working	15%	15%
OWNERSHIP OF RADIO	22%	22%
FATHER'S RELIGION		
Protestant	56%	56%
Catholic	36%	36%
Muslim	8%	8%
Others	1%	1%
ETHNICITY		
Banyankole	81%	81%
Baganda	5%	5%
Rwandese	2%	2%
Bakiga	10%	10%
Other	2%	2%
ACREAGE		
<1 acres	13%	13%
1 acres	31%	31%
2 acres	25%	25%
>2 acres	31%	31%
WOOD AS COOKING FUEL	97%	96%
LIGHTING		
Candle	28%	28%
Kerosine	69%	69%
Electricity	1%	1%
Other	2%	2%
MOTHER'S EDUCATION		
0 years	48%	49%
1-3 years	18%	18%
4-7 years	30%	29%
8-12 years	4%	4%
>12 years	0%	0%

(Cont. TABLE 3.1)

LENGTH OF STAY		
0-2 years	11%	12%
3-5 years	9%	10%
6-9 years	7%	7%
>9 years	73%	71%
NO LATRINE	22%	22%
PEOPLE PER ROOM		
<2	13%	13%
2-4	74%	74%
5-6	10%	10%
>6	3%	3%
USING PROTECTED WATER	13%	13%
FATHER'S LITERACY		
English	32%	32%
Vernacular	42%	42%
None	26%	26%
MOTHER'S LITERACY		
English	14%	14%
Vernacular	37%	37%
None	49%	49%
MOTHER'S MARITAL STATUS		
Married	90%	87%
Single	6%	7%
Widow	1%	2%
Divorced	3%	4%
MOTHER'S STATUS		
Lactating	52%	52%
Pregnant	17%	17%
Not pregnant nor lactating	31%	31%
FATHER'S OCCUPATION		
Professional	14%	14%
Government	7%	7%
Dependent	2%	2%
Cattle keeper	19%	19%
Subsistence with animals	26%	26%
Export crop growers	12%	12%
Subsistence	20%	20%

GRAPH 3.1

MULTIDIMENSIONAL SPACE OF THE
MULTIPLE CORRESPONDENCE ANALYSIS



The analysis searches for relationships between the categories of these variables which will allow, with the least loss of information, a description of the original data in a lower dimensional space. Through a projection of the points of the multidimensional space onto the plane formed by the first two factorial axes (graph 3.2), bidimensional graphic representations are obtained which give a more comprehensive and understandable view of the relationships involved. MCA does not try to find inferential relationships between a dependent and independent variable such as regression techniques.

3.3.3 Methods

3.3.3.1 Multiple Correspondence Analysis

MCA[44-46] was applied to the 18 variables considered, which were categorical. At the beginning there is the data matrix consisting of 2,349 households which form the rows, and the 69 sociodemographic categories which form the columns. The individual household data (profiles) can then be plotted as dots in a 69 dimensional space. The coordinate system of 69 category axes gives the position of the household profiles. Similarly, the 69 categories (as coded in the dummy variables) can be represented as 69 points in a 2,349-dimensional space (number of households). The distance between points, defined according to a chi-square metric, expresses the similarities between household-profiles (in the 69-dimensional space) or between the categories (in the 2,349-dimensional space). A chi-square metric defines the distance between family i and family i' as:

$$d(i,i')=\sum_{j=1}^{J}\frac{(f_{ij}/f_{i+}-f_{i'j}/f_{i'+})^2}{f_{+j}/n}$$

where j indicates the columns (the dummy variables)

fij = the value of dummy variable of j for family i

fi+ = the total of all dummy variable values for family i

f+j = the total of all values of dummy variable j (i.e. across all families)

n = the grand total of all values.

Categories of variables

		A_1	A_2	A_3	....	A_j	.....	A_J	
	B_1	f_{11}	f_{12}	f_{13}	......	f_{1j}	......	f_{1J}	f_{1+}
	....	....	....	...	.....	....	.....	....	....
Households	B_i	f_{i1}	f_{i2}	f_{i3}	......	f_{ij}	......	f_{iJ}	f_{i+}
	....	....	....	...	.....	....	.....	....	....
	B_I	f_{I1}	f_{I2}	f_{I3}	......	f_{Ij}	......	f_{IJ}	f_{I+}
		f_{+1}	f_{+2}	f_{+3}	......	f_{+j}	......	f_{+J}	n

The MCA aims at supplying a low-dimensional image approximating the structure of the cloud of points in a subspace identified by the factorial axes that carry most of the variation from point to point. These are the axes of maximum dispersion (or inertia) of the cloud of points. The first axis is chosen so that the variation between the points in its direction is as large as possible. The second axis is made perpendicular to the first and is chosen so that variation between the points in its direction is as large as possible, subject to the perpendicular requirement; subsequent axes are defined by continuing this process. Variation corresponds to the amount of information explained by the axis.

3.3.3.2 Partition of the sample into socioeconomic classes

In the second part of the analysis, clustering of the households into social classes was carried out by the following two-stage procedure called dynamic cluster method:[47] in the first stage, the population was divided into many more clusters than any actual number of social classes. In the second stage a hierarchical clustering procedure was used to combine these clusters into a smaller number, which are taken as the social classes.

In more detail:

1) Three households were selected at random.
2) The other households were collected into 3 groups on the basis of closeness to the initially sampled households.

3) The "centres of gravity" (barycentres) of these groups were determined, and the population re-allocated around the barycentres.

4) Steps 1-3 were repeated 5 times.

5) The households that were always in the same group formed the first three most stable clusters. The households that only appeared one time in different groups formed the next less stables clusters. The households that appeared twice in different groups formed the next clusters, and so on until 30 clusters were obtained.

6) Hierarchical clustering was applied to the barycentres of the cluster resulting from step 5 to combine the 30 clusters into a smaller number (7 clusters) which constituted the final classes.

MCA and cluster analyses were carried out using the computer programme SPAD (Systeme Portable Pour l'Analise des Donnes).[30] The new socio-economic level was plotted as an illustrative variable on the factorial plane F1-F2.

3.4 RESULTS

3.4.1 Introduction.

Table 3.2 sets out the categories of the household's variables considered in the analysis. It also shows the abbreviations used for each variable in the subsequent graphs. The variables "hired" and "worked" were combined into a single variable "professional position".

The MCA has allowed the selection of 11 variables for a total of 45 categories which contributed more strongly than the others to the explanation of the first 3 factorial axes. 11 variables were found to contribute significantly to the variance of the first 3 factorial axes.

The results of the MCA using these 11 selected variables are shown in table 3.3 and in graph 3.2. Table 3.3 shows the contributions (in %) of each variable to the explanation of the total variability of the first 3 axes. Graph 3.2 shows the projections of the categories of the variables on the first factorial plane (formed by F1 and F2), which explain around 80% of the total variability of the data.

3.4.2 Variables more associated to the axis

The variables most closely associated with the first factorial axes were education of the parents and father's occupation. The latter variable has a special importance because it is the most closely associated with the factorial plane F1 and F2, and therefore the projections of the barycentres of the categories are particularly significant.

It can be inferred from graph 3.2 that the agricultural occupations dispose themselves on a straight line, contrasting with the other occupations. Agricultural occupations include cattle-keepers (CATTLE), farmers cultivating export crops (EXPORT) and subsistence farmers (SUBST + ANML, SUBSIST). The other occupations with a better socioeconomic situation (GOVERN, PROFESS, DEPEND) are not so alligned. However, it is evident that the different types of occupation of the father assume (with respect to F1) ranks to which a coherent meaning can be assigned: from more advantaged occupations (towards the left of Graph 3.2) to those disadvantaged socially and economically (towards the right of the Graph).

It has to be noted that 3/4 of the families in the sample have agricultural occupations and the remaining occupations form an elite, or a leading group. This observation corresponds to the fact that the occupations of the private and public sectors are strongly linked to a high level of education, hiring labour, ownership of a radio and therefore are the wealthiest socioeconomic cluster. In contrast to this situation are the agricultural occupations of subsistence with a low level of education, usually with disadvantaged living

Table 3.2

Codes and meaning of each category of the variables considered in the MCA

CODE	CATEGORIES
YEARS OF SCHOOLING FATHER'S	
fILLIT	0 years
fJP	1-3 years
fSP	4-7 years
fSEC	8-12 years
fPOSTSEC	>12 years
PROFESSIONAL POSITION FATHER'S	
HIRING	hiring and no work
H&W	hiring and working
no H&W	no hire and no work
WORKING	working and no hiring
OWNERSHIP OF RADIO	
radio	with radio
no radio	no radio
RELIGION FATHER'S	
protst	Protestants
cathol	Catholics
muslm	Muslims
oth-rel	other
ETHNIC GROUP	
BANYNK	Banyankole
BAGANDA	Baganda
RWAND	Rwandese
BAKIGA	Bakiga
OTH-ETH	other
ACRES CULTIVATED	
0acr	0 ACRES
1acr	1 ACRES
2acr	2 ACRES
3acr	3 ACRES
4acr	4 ACRES
>5acr	>4 ACRES
COOKING FUEL	
wood	wood
no wood	other

CODE	CATEGORIES
MOTHER'S YEARS OF SCHOOLING	
mILLIT	0 years
mJP	1-3 years
mSP	4-7 years
mSEC	8-12 years
m12M	>12 years
YEARS OF RESIDENCE	
0-2 yr	0-2 years
3-5 yr	3-5 years
6-9 yr	6-9 years
>10 yr	>9 years
LATRINE	
no latr	no latrine
latr	with latrine
CROWDING (people per room)	
<2pp	<2 people
24pp	2-4 people
46pp	5-6 people
>6pp	>6 people
WATER SUPPLY	
SI-W	protected water
NO-W	unprotected water
FATHER'S READING CAPABILITY	
ENGP	English
VERP	Vernaculr
ILLP	illiterate
MARITAL STATUS	
1-MR	married
2-MR	single
3-MR	widow
4-MR	divorced
5-MR	other
MOTHER'S READING CAPABILITY	
ENGM	English
VERM	Vernacular
ILLM	illiterate

(Cont Table 3.2)

LIGHTING FUEL		
	candle	candle
	ker	kerosene
	electr	electricity

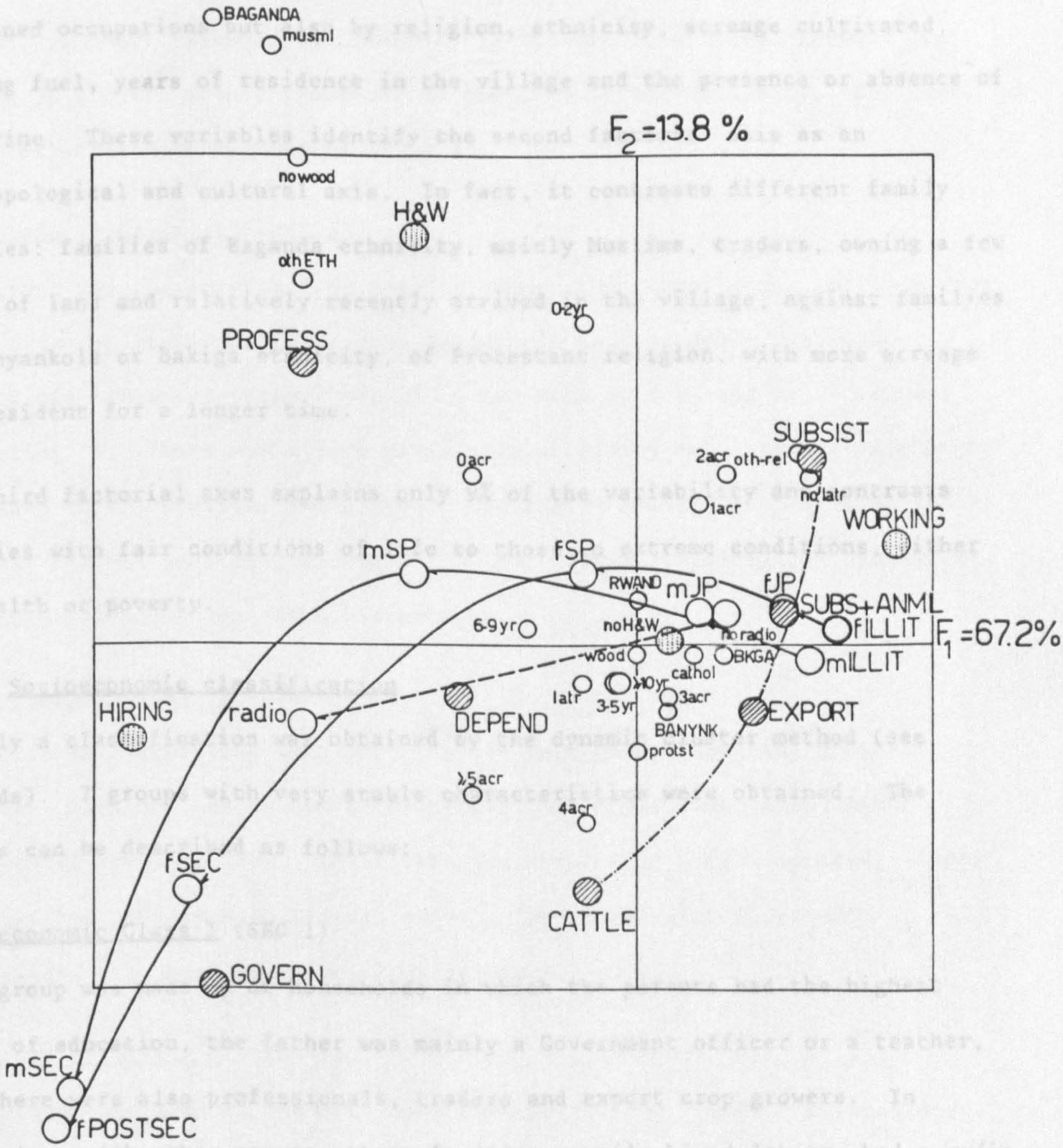
MOTHER'S CONDITION		
	1-ST	lactating
	2-ST	pregnant
	3-ST	not pregnant nor lactating

FATHER'S OCCUPATION		
	PROFESS	professionals, constructors (builders), traders, artisans, butchers, religious workers, leaders, drivers
	GOVERN	government workers, administrators, teachers
	DEPEND	police, army, vendours, dependent workers
	CATTLE	nomads/pastoralists mixed crop farmers with cows, mainly cattle keepers
	SUBSIST	subsistence farmers
	EXPORT	export crop farmers
	SUBS+ANML	subsistence farmers with poultry, goats, sheep

Table 3.3
Contribution to the explanation of the first three factorial axes and number of categories for each variable. In brackets is reported the percentage of the total variability explained by each factorial axis

	F1 (67.2%)	F2 (13.8%)	F3 (9.3%)	NUMBER OF CATEGORIES
FATHER'S OCCUPATION	16.7	15.7	19.2	7
FATHER'S EDUCATION	17.3	6.5	19.9	5
MOTHER'S EDUCATION	17.7	5.3	11.1	4
PROFESSIONAL POSITION	15.7	1.4	2.2	4
OWNERSHIP OF RADIO	12.0	0.8	2.6	2
FATHER'S RELIGION	6.4	27.5	2.1	4
ETHNIC GROUP	6.0	24.2	4.9	5
ACRES CULTIVATED	3.6	8.3	15.6	6
COOKING FUEL	1.2	3.0	2.5	2
YEARS OF RESIDENCE	0.4	4.4	16.4	4
LATRINE	2.9	3.0	3.5	2

GRAPH 3.2
Projections of the categories of the variables on the plane formed by the axes F1 and F2



conditions, working on other people's land and not owning a radio. Therefore, the first factorial axis is characterized as the socioeconomic axis.

The second factorial axis is characterized not only by the previously mentioned occupations but also by religion, ethnicity, acreage cultivated, cooking fuel, years of residence in the village and the presence or absence of a latrine. These variables identify the second factorial axis as an anthropological and cultural axis. In fact, it contrasts different family profiles: families of Baganda ethnicity, mainly Muslims, traders, owning a few acres of land and relatively recently arrived in the village, against families of Banyankole or Bakiga ethnicity, of Protestant religion, with more acreage and resident for a longer time.

The third factorial axes explains only 9% of the variability and contrasts families with fair conditions of life to those in extreme conditions, either of wealth or poverty.

3.4.3 Socioeconomic classification

Finally a classification was obtained by the dynamic cluster method (see methods). 7 groups with very stable characteristics were obtained. The groups can be described as follows:

Socioeconomic Class I (SEC 1)

This group was made up of households in which the parents had the highest level of education, the father was mainly a Government officer or a teacher, but there were also professionals, traders and export crop growers. In comparison with other groups, these families usually hired labour, had a radio and a latrine. There were more Muslims in this than in other groups, and they arrived in the village relatively recently.

Socioeconomic Class II (SEC 2)

In this group parents had a relatively high level of education; the most frequent occupations were those dealing with the tertiary (public and private) sector; there were also dependent workers of the private sector, policemen, armymen, vendours (grouped as DEPEND). There were also cattle-keepers and mixed-crop growers with a professional position of hiring labour. The other characteristics were similar to GROUP I.

Socioeconomic Class III (SEC 3)

This group was characterized by families where the father was a cattle-keeper or export-crop grower in relatively favourable socioeconomic conditions. Parents had completed primary school or followed it for some years without completing it. There was a high prevalence of radios and latrines, although less than in the previous two groups. The family members did not hire labour, but they did not work on other people's land either. Muslims and Protestants were more prevalent than in other groups.

Socioeconomic Class IV (SEC 4)

Agricultural occupations were prevalent in this group, especially cattle keepers. Although the economic conditions were still favourable, the educational level was low. There were few radio owners and latrines. These families had usually been residents for a long time. Catholics and Banyankoles were more prevalent than in other groups.

Socioeconomic Class V (SEC 5)

This group consisted of the most disadvantaged of the "PROFES" occupations; they were export crop growers and cattle-keepers. Parents had primary education only, and ownership of radios was low. Together with GROUP III and GROUP IV they formed a sort of wide middle class between the better-off and the worst-off, characterized by a mixture of conditions such as families with a good economic status and low educational level vs families with less good economic conditions but, with relatively high levels of education.

Socioeconomic Class VI (SEC 6)

This group contained those with disadvantaged conditions; there were few cattle-keepers and export crop growers, and many subsistence farmers with small livestock (poultry, sheep, goats etc). These families had been resident for a long time, their educational level was low, and very few owned a radio, but latrines were relatively frequent.

Socioeconomic Class VII (SEC 7)

This was the most disadvanged group, mainly composed of subsistence farmers frequently working on other people's land, with no education and almost no ownership of radios.

The frequency distribution of each variable within the different groups is reported in figures 3.1a and 3.1b.

3.4.4 The most important socioeconomic variables

The first factorial axis, which has a socioeconomic meaning, explains 2/3 of the information of the data collected in the survey. 5 of the 11 variables considered are related to this axis, and the first axis is the factor which contributes most to their explanation (highest relative contribution in the MCA).

As an overall consideration of the results of the MCA, the 5 variables (father's occupation, father's education, mother's education, professional position and radio ownership) can be considered in order of importance in relationship to their absolute contribution given to the explanation of the first 3 factorial axes.

FIGURE 3.1a

Frequency distribution of variables used in the MCA among SECs

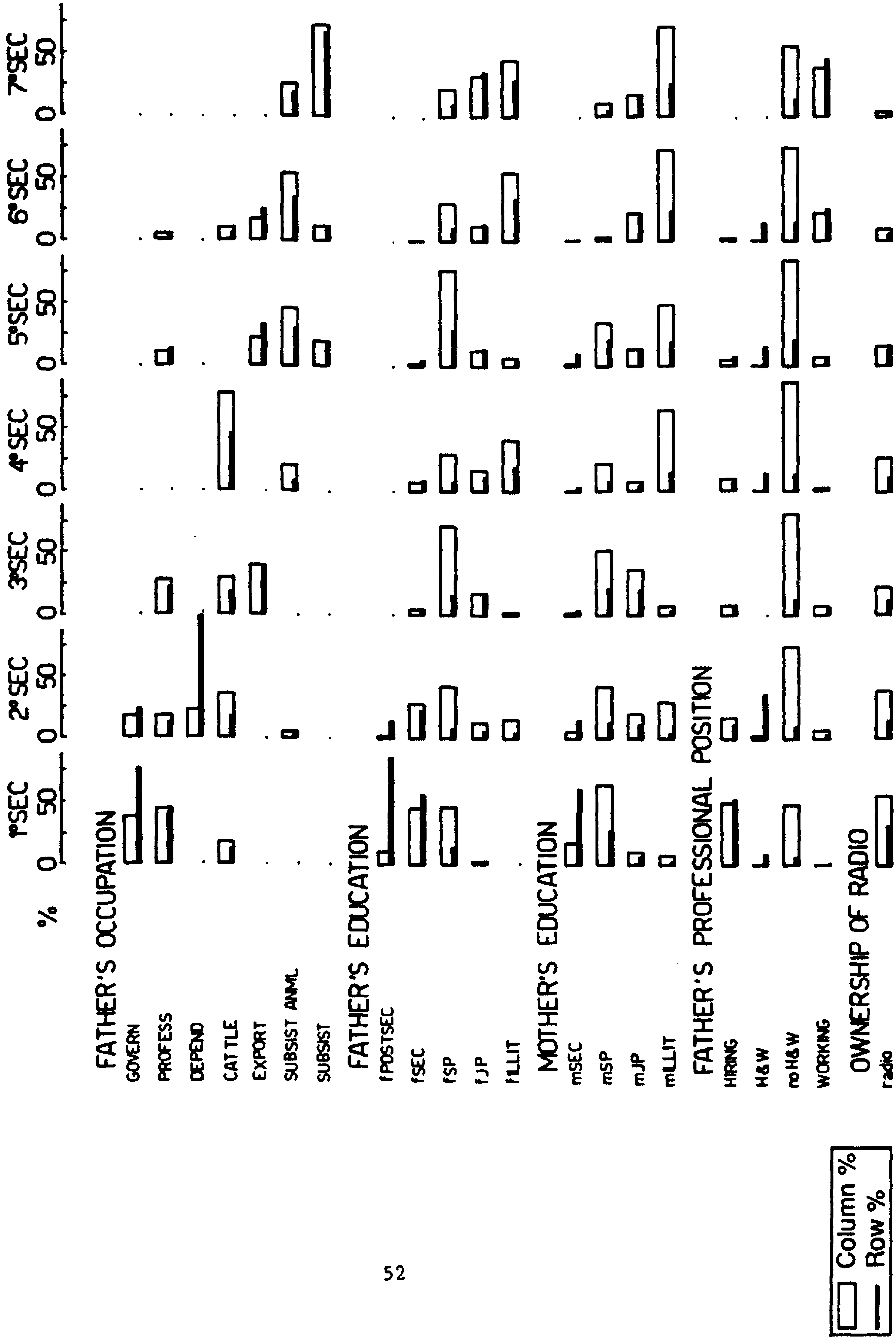
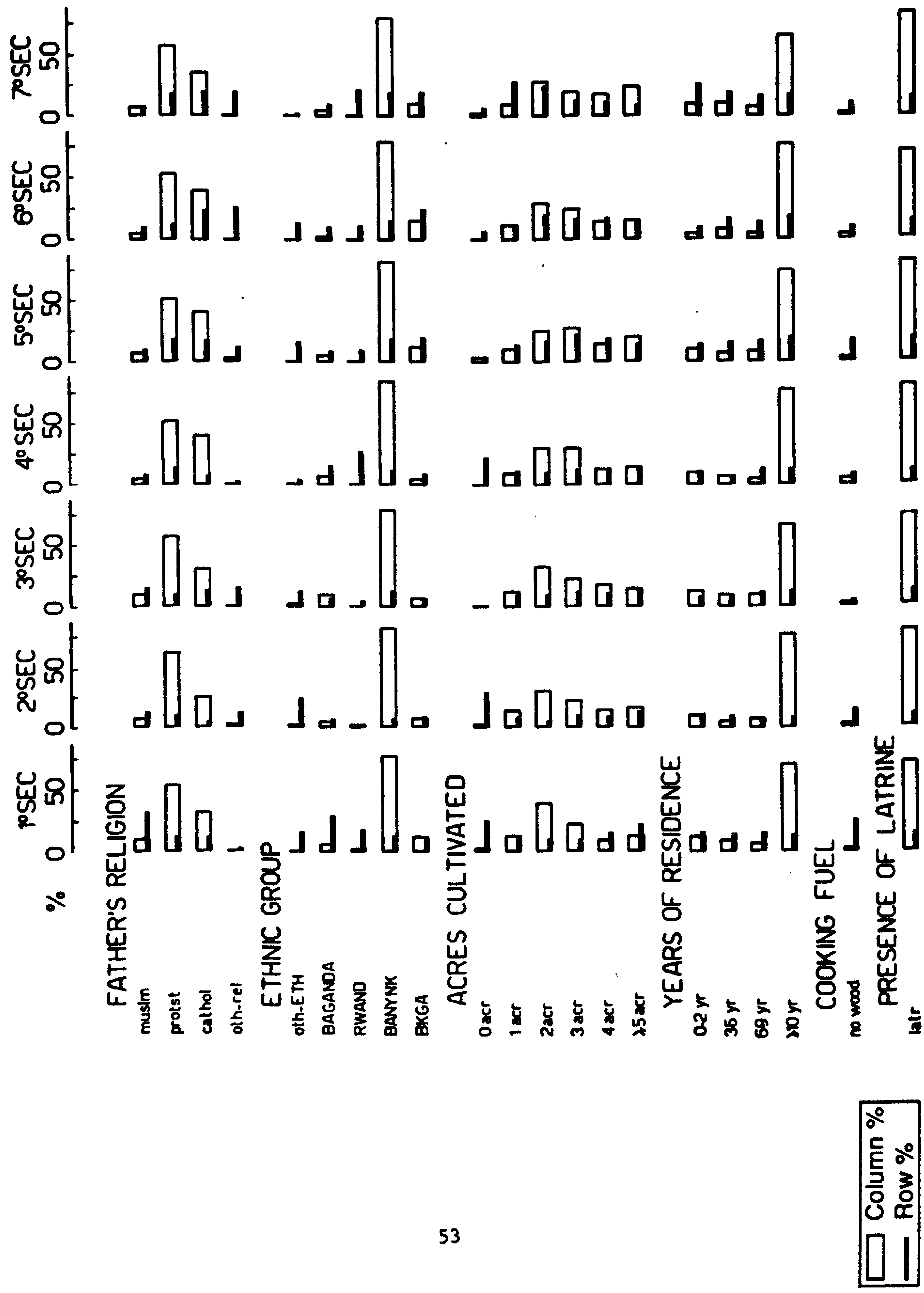


FIGURE 3.1b

Frequency distribution of variables used in the MCA among SECs



3.4.5 Flowchart to identify to which class a household belong

The classification worked out by the cluster analysis takes into account all these points. Therefore, from a detailed description of the households forming the various clusters, it has been possible to identify the sequence of categories specific to each one in relationship to the 5 variables associated to the first factorial axis. The list of profiles of the families (with the first 5 variables) is set out in table 3.4. The hierarchic order of the variables in explaining the relationships existing in all the households studied, and the identification of category profiles which classify unequivocally each household, have allowed the flowcharts 3.1-3.6.

This outline makes it possible to identify the socioeconomic group of each family on the basis of easily collectable data. In fact, it is sufficient to start with the occupation of the father, progressing through successive items of information (following the route indicated by the arrows) to determine the socioeconomic group of the index family. To facilitate the identification of the 7th group (the most deprived), a questionnaire to be utilized by the health worker has been developed.

Whenever an easily-determined socioeconomic index is required, the questionnaire derived from the "flow charts" may be a valid tool.

It is not enough to be a subsistence farmer to be placed in the poorest SEC (Socioeconomic Class); other variables such as education of the parents, hiring labour, working on other people's land or ownership of a radio are necessary before deciding to which SEC the household belongs. This indicates the flexibility of this socioeconomic classification, which allows more freedom of choice before assigning a family to a particular SEC. In Graph 3.3, the projections of the categories of the variable "SEC" on the factorial plane F1 and F2 of the MCA are shown.

Table 3.4

Profiles of the variables associated to the families within each of the 7 SECs (socioeconomic classes). For reasons of space only the most frequent profiles are listed.

FATHER'S OCCUPATION	FATHER'S EDUCATION	MOTHER'S EDUCATION	PROFESS. POSITION	OWNERSHIP OF RADIO
SEC 1				
PROFESS	fJP	mSP	WORKING	radio
PROFESS	fSP	mSEC	HIRING	no radio
PROFESS	fSEC	mSP	HIRING	no radio
PROFESS	fSEC	mSEC	WORKING	radio
GOVERN	fSP	mJP	WORKING	radio
GOVERN	fSEC	mJP	WORKING	no radio
CATTLE	fSP	mJP	HIRING	radio
CATTLE	fSP	mJP	HIRING	no radio
PROFESS	fSP	mILLIT	HIRING	radio
PROFESS	fSP	mJP	HIRING	radio
PROFESS	fSEC	mSEC	HIRING	radio
GOVERN	fSEC	mSEC	WORKING	radio
PROFESS	fSP	mJP	HIRING	no radio
PROFESS	fSEC	mSP	HIRING	radio
GOVERN	fSEC	mSP	HIRING	radio
GOVERN	fPOSTSEC	mSEC	WORKING	no radio
CATTLE	fSEC	mSP	HIRING	no radio
GOVERN	fSEC	mSEC	HIRING	radio
GOVERN	fSEC	mSEC	WORKING	no radio
CATTLE	fSEC	mSP	HIRING	radio
PROFESS	fSEC	mSP	WORKING	radio
GOVERN	fSP	mSP	WORKING	radio
CATTLE	fSEC	mSEC	HIRING	radio
GOVERN	fSEC	mILLIT	WORKING	no radio
GOVERN	fSEC	mSP	WORKING	radio
PROFESS	fSEC	mSP	WORKING	no radio
GOVERN	fSP	mSP	WORKING	no radio
CATTLE	fSP	mSP	HIRING	no radio
PROFESS	fSP	mSP	HIRING	no radio
CATTLE	fSP	mSP	HIRING	radio
PROFESS	fSP	mSP	HIRING	radio
GOVERN	fSEC	mSP	WORKING	no radio
PROFESS	fSP	mSP	WORKING	radio

(Cont Table 3.4)

SEC 2

PROFESS	fILLIT	mSP	WORKING	radio
GOVERN	fJP	mILLIT	WORKING	no radio
GOVERN	fSP	mJP	no H&W	no radio
DEPEND	fSP	mILLIT	WORKING	radio
CATTLE	fJP	mJP	HIRING	no radio
SUBS+ANML	fSEC	mSEC	WORKING	no radio
PROFESS	fSP	mILLIT	WORKING	no radio
PROFESS	fSEC	mILLIT	WORKING	no radio
DEPEND	fILLIT	mILLIT	no H&W	no radio
CATTLE	fSP	mILLIT	HIRING	radio
CATTLE	fSP	mILLIT	HIRING	no radio
PROFESS	fJP	mSP	WORKING	no radio
DEPEND	fILLIT	mILLIT	WORKING	no radio
DEPEND	fSEC	mSP	WORKING	no radio
PROFESS	fSP	mSP	WORKING	no radio
DEPEND	fSP	mSP	WORKING	no radio
PROFESS	fSP	mJP	WORKING	radio
CATTLE	fSEC	mILLIT	WORKING	no radio
CATTLE	fSEC	mSP	WORKING	radio
GOVERN	fSP	mILLIT	WORKING	no radio
CATTLE	fSEC	mSP	WORKING	no radio
CATTLE	fSP	mJP	WORKING	radio
CATTLE	fSP	mSP	WORKING	radio

SEC 3

PROFESS	fJP	mJP	WORKING	no radio
CATTLE	fJP	mJP	WORKING	radio
CATTLE	fSP	mJP	no H&W	no radio
CATTLE	fSP	mSP	no H&W	no radio
EXPORT	fSP	mSP	HIRING	radio
EXPORT	fSEC	mSP	HIRING	no radio
EXPORT	fJP	mSP	WORKING	no radio
EXPORT	fSP	mJP	no H&W	no radio
EXPORT	fSEC	mSP	WORKING	no radio
PROFESS	fJP	mJP	WORKING	radio
EXPORT	fSP	mJP	WORKING	radio
EXPORT	fSP	mSP	HIRING	no radio
CATTLE	fILLIT	mSP	WORKING	radio
EXPORT	fJP	mJP	WORKING	no radio
EXPORT	fSP	mILLIT	WORKING	radio
EXPORT	fSP	mSP	WORKING	radio
CATTLE	fJP	mJP	WORKING	no radio
CATTLE	fJP	mSP	WORKING	no radio
PROFESS	fSP	mILLIT	WORKING	radio
PROFESS	fSP	mJP	WORKING	no radio
EXPORT	fSP	mJP	WORKING	no radio
EXPORT	fSP	mSP	WORKING	no radio
CATTLE	fSP	mJP	WORKING	no radio
CATTLE	fSP	mSP	WORKING	no radio
PROFESS	fSP	mSP	WORKING	no radio

(Cont Table 3.4)

SEC 4

SUBS+ANML	fSP	mSP	HIRING	radio
CATTLE	fJP	mILLIT	WORKING	radio
SUBS+ANML	fJP	mSP	WORKING	radio
SUBS+ANML	fSEC	mJP	WORKING	radio
SUBS+ANML	fSEC	mSP	WORKING	radio
SUBS+ANML	fSEC	mSP	WORKING	no radio
SUBS+ANML	fSP	mSP	HIRING	no radio
CATTLE	fILLIT	mILLIT	HIRING	no radio
CATTLE	fILLIT	mJP	WORKING	no radio
SUBS+ANML	fSP	mSP	WORKING	radio
CATTLE	fILLIT	mILLIT	WORKING	radio
CATTLE	fILLIT	mSP	WORKING	no radio
CATTLE	fSP	mILLIT	WORKING	radio
CATTLE	fSP	mILLIT	WORKING	no radio
CATTLE	fJP	mILLIT	WORKING	no radio
CATTLE	fILLIT	mILLIT	WORKING	no radio

SEC 5

SUBSIST	fSEC	mILLIT	WORKING	no radio
EXPORT	fJP	mJP	no H&W	no radio
EXPORT	fSP	mILLIT	no H&W	radio
SUBS+ANML	fILLIT	mSP	WORKING	radio
SUBS+ANML	fSP	mILLIT	HIRING	no radio
PROFESS	fJP	mILLIT	no H&W	no radio
SUBSIST	fSP	mILLIT	WORKING	radio
SUBSIST	fSP	mSEC	WORKING	no radio
PROFESS	fJP	mILLIT	WORKING	no radio
SUBSIST	fSEC	mSP	WORKING	no radio
EXPORT	fILLIT	mSP	WORKING	no radio
SUBS+ANML	fSP	mJP	WORKING	radio
SUBS+ANML	fILLIT	mSP	WORKING	no radio
SUBS+ANML	fSP	mSP	no H&W	no radio
SUBSIST	fSP	mSP	WORKING	radio
EXPORT	fJP	mILLIT	WORKING	radio
EXPORT	fSP	mILLIT	no H&W	no radio
SUBS+ANML	fJP	mSP	WORKING	no radio
SUBS+ANML	fSP	mILLIT	WORKING	radio
EXPORT	fJP	mILLIT	WORKING	no radio
PROFESS	fSP	mILLIT	WORKING	no radio
SUBS+ANML	fSP	mJP	WORKING	no radio
SUBSIST	fSP	mSP	WORKING	no radio
SUBS+ANML	fSP	mILLIT	WORKING	no radio
EXPORT	fSP	mILLIT	WORKING	no radio
SUBS+ANML	fSP	mSP	WORKING	no radio

(Cont Table 3.4)

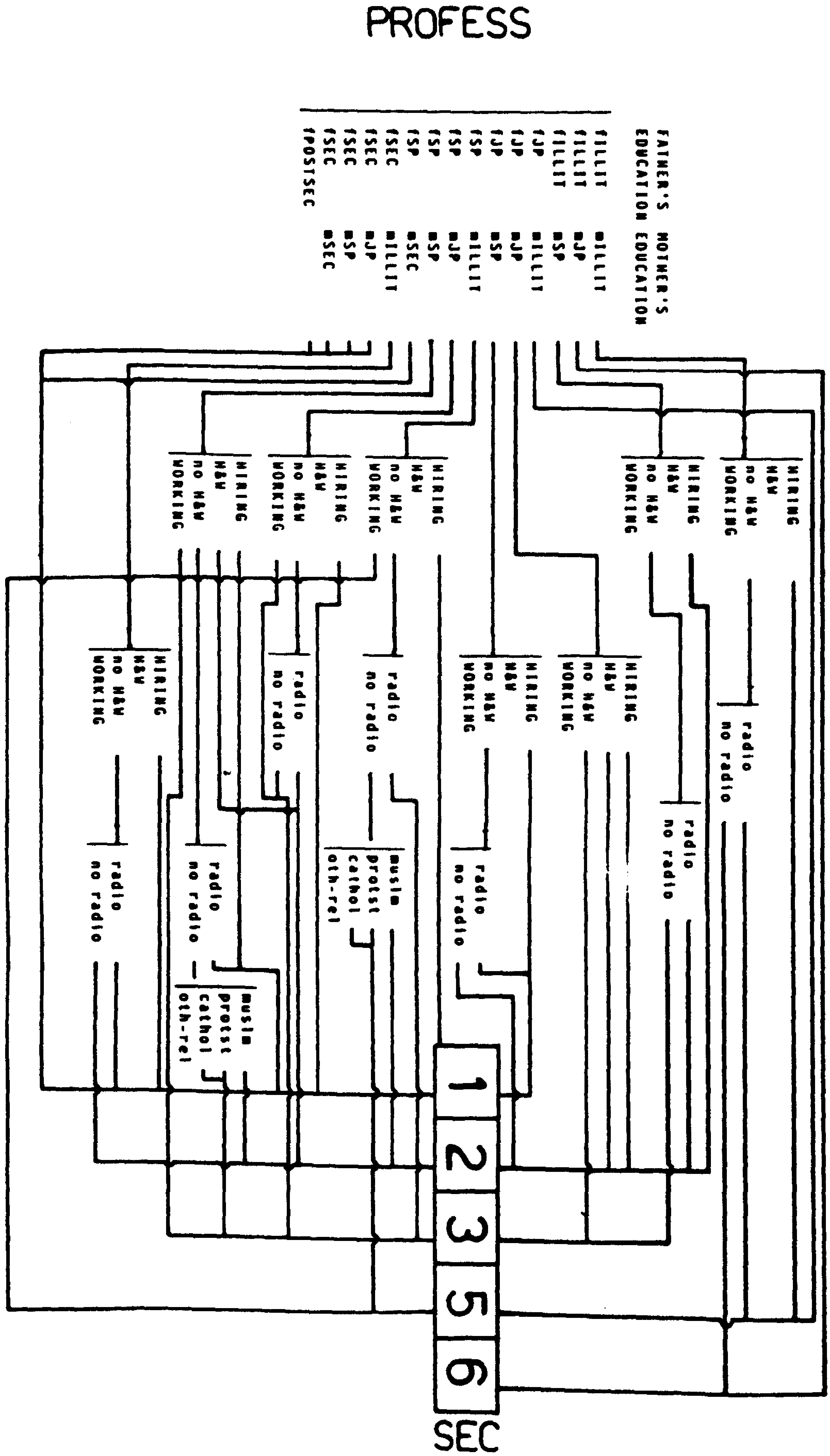
SEC 6

SUBS+ANML	fILLIT	mILLIT	HIRING	no radio
SUBS+ANML	fILLIT	mSP	no H&W	no radio
PROFESS	fILLIT	mJP	WORKING	no radio
EXPORT	fILLIT	mILLIT	WORKING	radio
EXPORT	fILLIT	mJP	WORKING	no radio
SUBS+ANML	fILLIT	mJP	WORKING	radio
SUBS+ANML	fJP	mSP	no H&W	no radio
CATTLE	fILLIT	mILLIT	no H&W	no radio
EXPORT	fJP	mILLIT	no H&W	no radio
SUBS+ANML	fJP	mILLIT	WORKING	radio
SUBS+ANML	fILLIT	mILLIT	WORKING	radio
CATTLE	fSP	mILLIT	no H&W	no radio
EXPORT	fILLIT	mILLIT	no H&W	no radio
SUBS+ANML	fSP	mJP	no H&W	no radio
SUBS+ANML	fSP	mILLIT	no H&W	no radio
PROFESS	fILLIT	mILLIT	WORKING	no radio
CATTLE	fILLIT	mILLIT	WORKING	no radio
SUBS+ANML	fJP	mJP	WORKING	no radio
SUBSIST	fSP	mJP	WORKING	no radio
EXPORT	fILLIT	mILLIT	WORKING	no radio
SUBS+ANML	fSP	mILLIT	WORKING	no radio
SUBS+ANML	fILLIT	mILLIT	WORKING	no radio

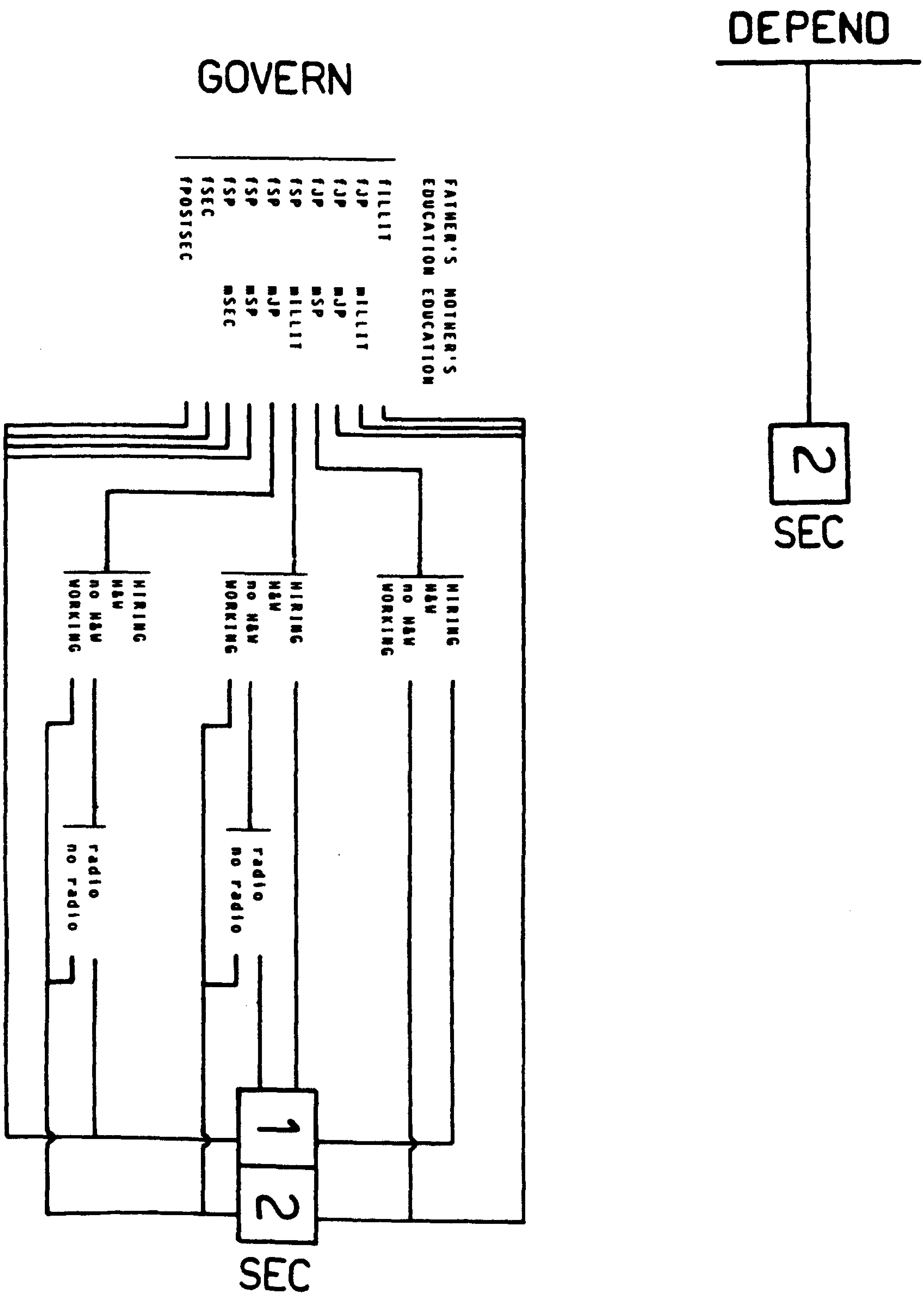
SEC 7

SUBSIST	fSP	mSP	no H&W	radio
SUBS+ANML	fJP	mILLIT	no H&W	radio
SUBSIST	fJP	mSP	no H&W	no radio
SUBS+ANML	fJP	mJP	no H&W	no radio
SUBSIST	fILLIT	mJP	no H&W	no radio
SUBSIST	fJP	mJP	no H&W	no radio
SUBSIST	fILLIT	mILLIT	WORKING	radio
SUBSIST	fSP	mSP	no H&W	no radio
SUBSIST	fJP	mSP	WORKING	no radio
SUBSIST	fJP	mJP	WORKING	no radio
SUBSIST	fILLIT	mSP	WORKING	no radio
SUBS+ANML	fILLIT	mJP	WORKING	no radio
SUBSIST	fILLIT	mJP	WORKING	no radio
SUBS+ANML	fJP	mILLIT	no H&W	no radio
SUBSIST	fSP	mJP	no H&W	no radio
SUBSIST	fJP	mILLIT	no H&W	no radio
SUBSIST	fSP	mILLIT	no H&W	no radio
SUBSIST	fJP	mILLIT	WORKING	no radio
SUBSIST	fILLIT	mILLIT	no H&W	no radio
SUBS+ANML	fILLIT	mILLIT	no H&W	no radio
SUBS+ANML	fJP	mILLIT	WORKING	no radio
SUBSIST	fSP	mILLIT	WORKING	no radio
SUBSIST	fILLIT	mILLIT	WORKING	no radio

FLOWCHART 3.1
Father's occupation:professional.

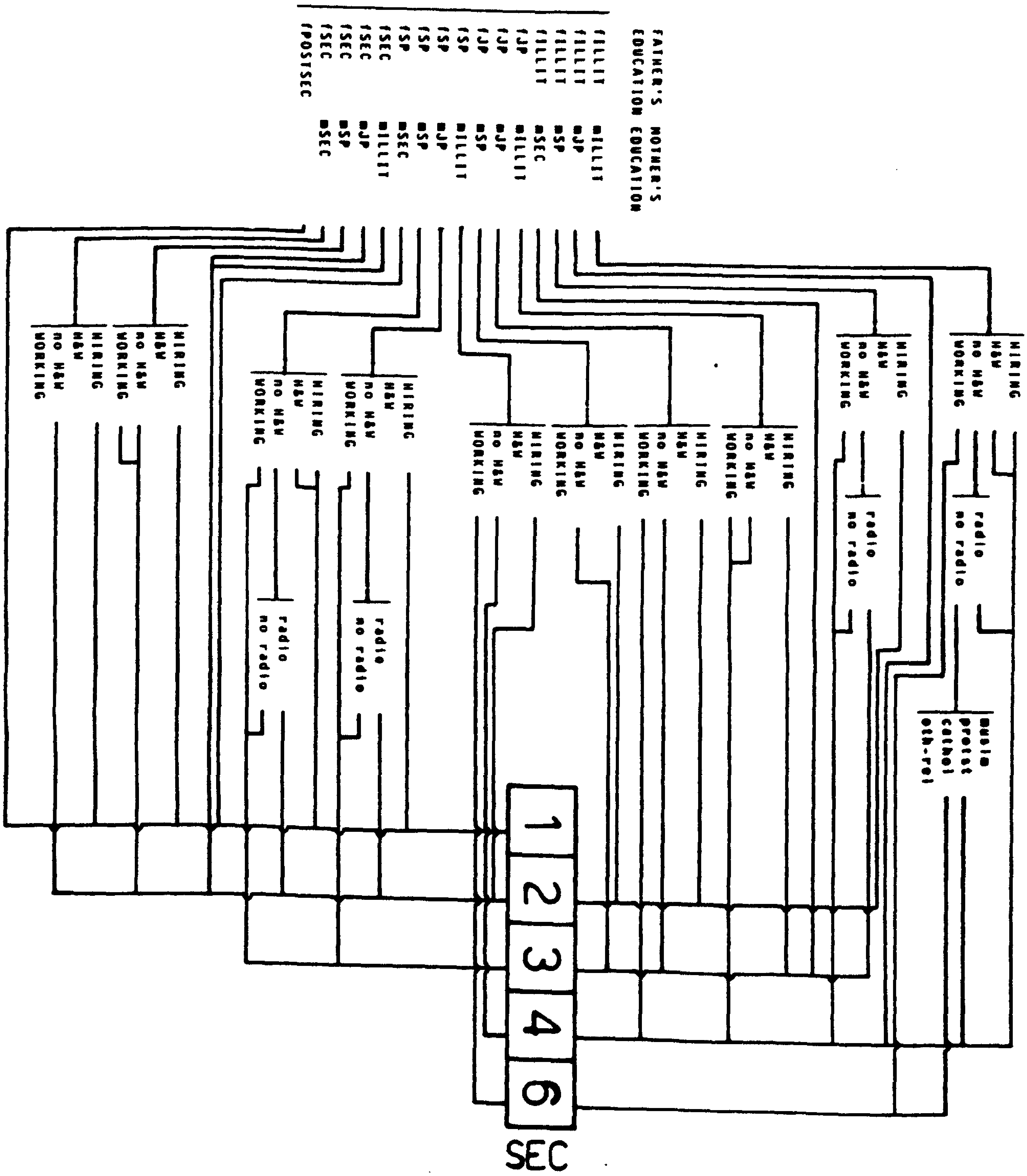


FLOWCHART 3.2
Father's occupation:Government or dependent worker .

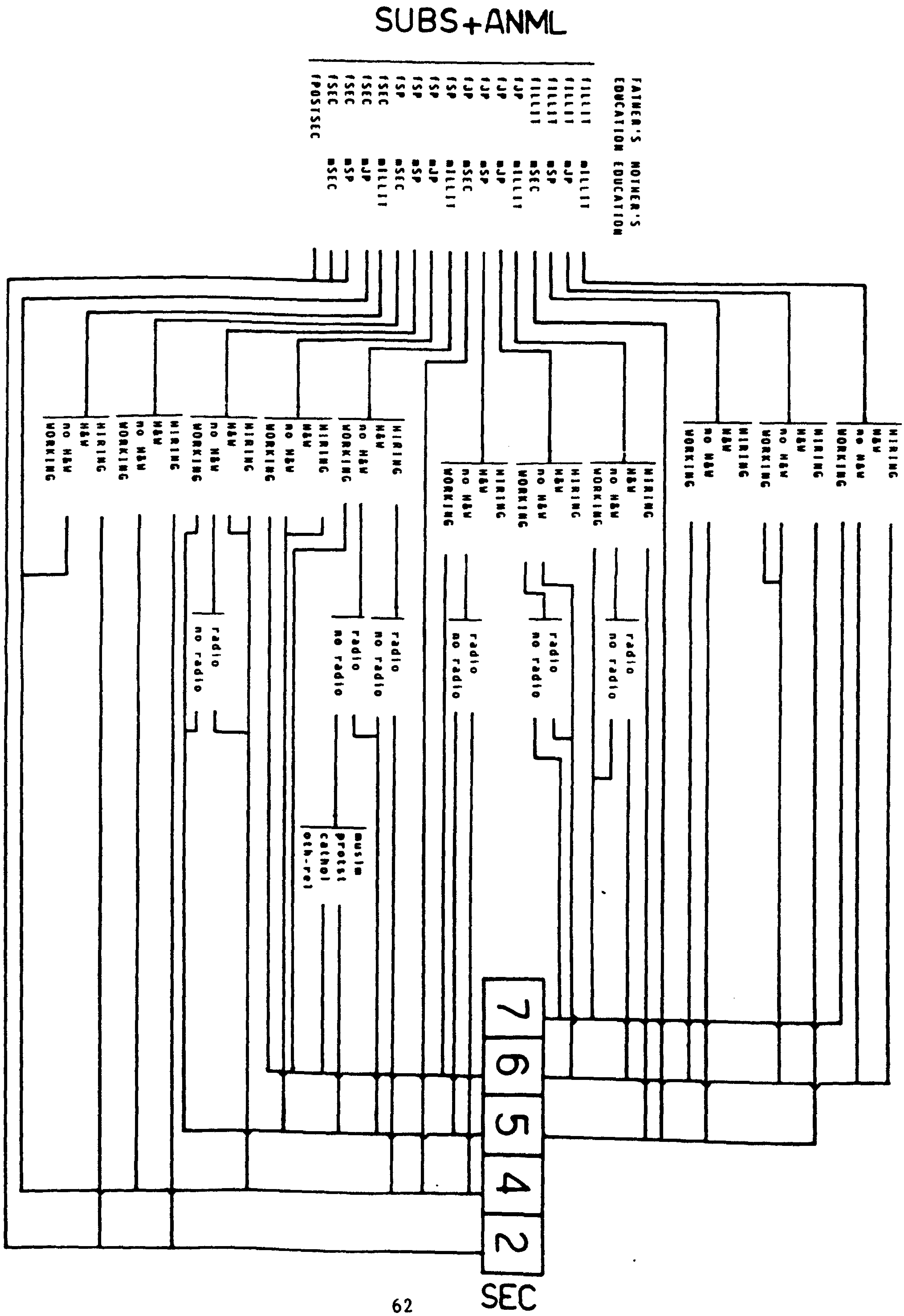


FLOWCHART 3.3
Father's occupation: cattle keeper.

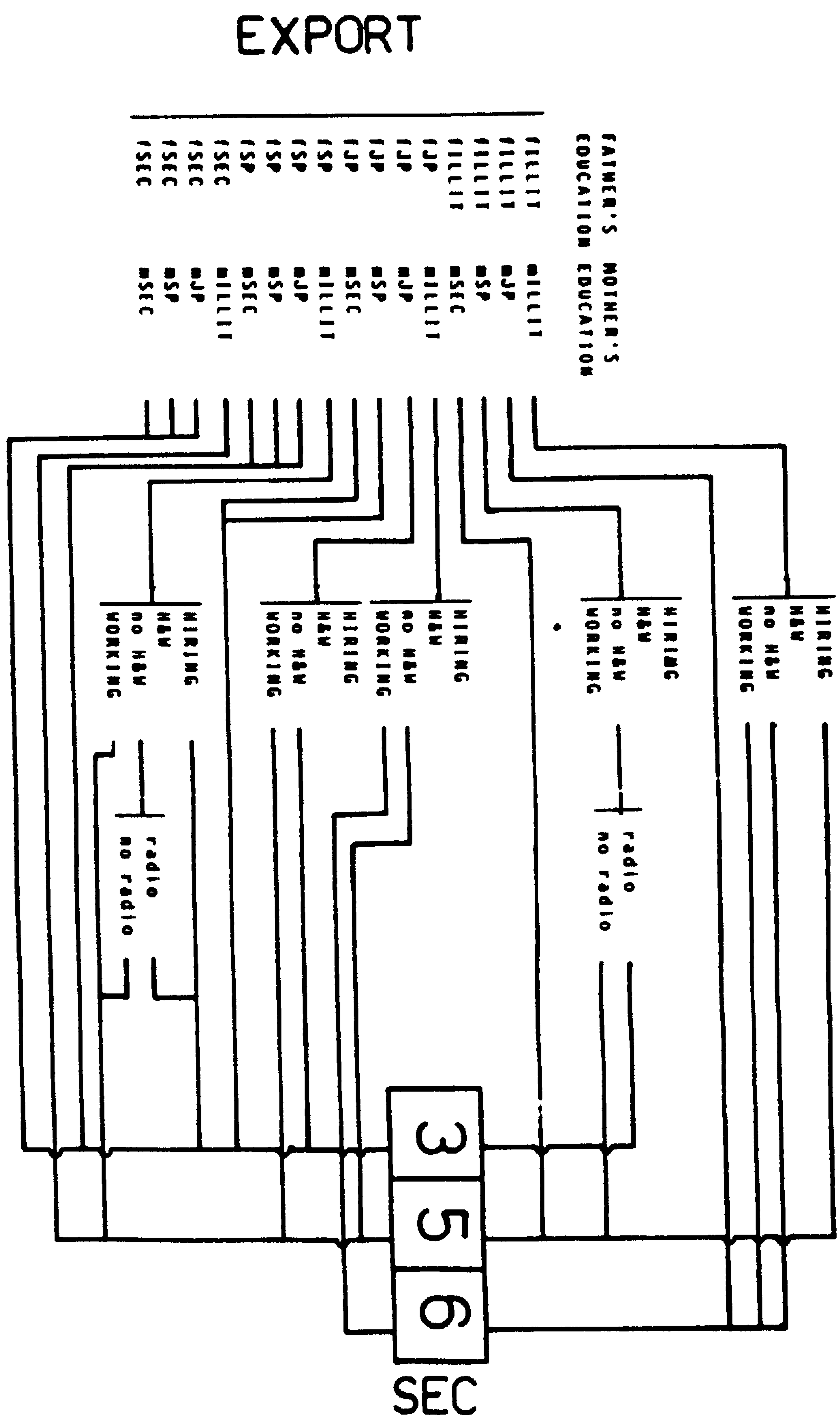
CATTLE



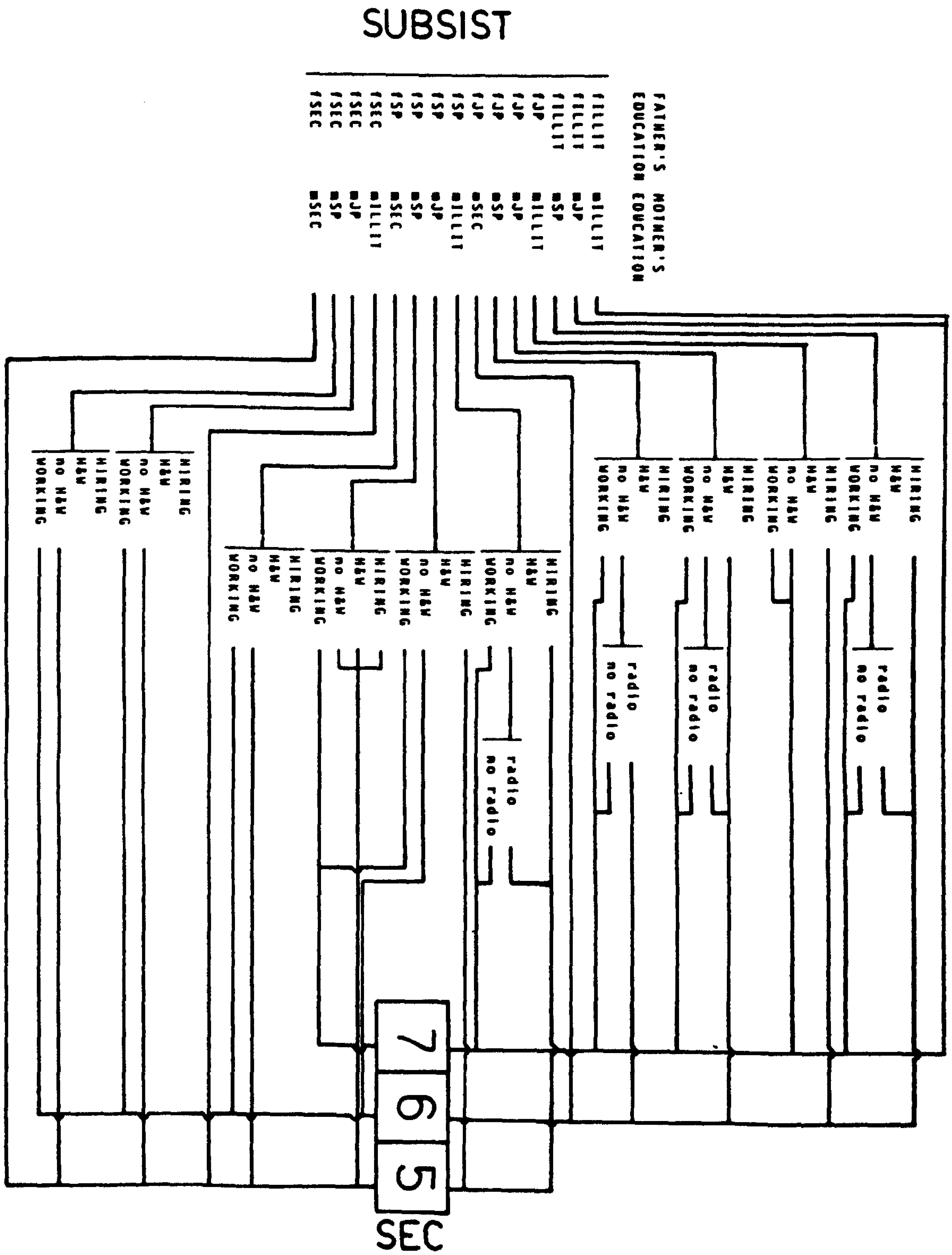
FLOWCHART 3.4
Father's occupation:subsistence farmer with small livestock (sheep,goats,poultry).



FLOWCHART 3.5
Father's occupation: export crop grower



FLOWCHART 3.6
Father's occupation: subsistence farmer with no small livestock.



3.4.6 Validation of the socioeconomic classification

Finally, the frequency in each SEC of variables other than those ones used in the MCA is shown in tables 3.5 to 3.9. It may be noticed that even for variables not used in the MCA, the most deprived classes are characterized by the worst socioeconomic, health and environmental conditions (Tables 3.5-3.6).

Prevalence of malnutrition increased steadily from the better-off to the worst-off SECs (Figure 3.2, 3.3). Child mortality during the year following the baseline was significantly higher in SEC 7 compared to the other SECs (Table 3.7).

QUESTIONNAIRE TO IDENTIFY FAMILIES AT RISK (SEC 7)

If the father of the child is a PROFESSIONAL, CONSTRUCTOR, TRADER, SHOPKEEPER, ARTISAN, BUTCHER, RELIGIOUS WORKER, DRIVER, BUSINESSMAN, GOVERNMENT EMPLOYEE, TEACHER, ADMINISTRATOR, POLICEMAN, ARMYMAN, HAWKER/VENDOUR, FARMER WITH ONE OR MORE COWS,FARMER CULTIVATING EXPORT CROPS(tea,coffee,tobacco,cotton)stop,because your family is not at risk,otherwise proceed to the next SECTION ONE.

N.B.
The term household indicates the extended family(father,mother and relatives of the child) sharing a common cooking pot.
The term worked means that at least one member of the household worked in the previous 6 months on other's people land.

SECTION ONE

ASK THE HEAD OF THE HOUSEHOLD IF HE HIRED ANYBODY TO WORK THE LAND IN THE PREVIOUS 6 MONTHS. IF THE ANSWER IS YES STOP BECAUSE THE CHILD IS NOT AT RISK. OTHERWISE PROCEED TO SECTION TWO

SECTION TWO

THE CHILD IS AT RISK ONLY IF HE/SHE FALLS IN THE FOLLOWING CATEGORIES:

1) The father has NO OTHER OCCUPATIONS BESIDES FARMING AND DOES NOT HAVE A COW, BUT ONLY SMALL ANIMALS(goats,sheep,pigs etc)

PLUS ANY OF THE FOLLOWING IS TRUE

a) Father and mother have never gone to school and the household worked on others land.
a) Father attended less than Primary 4 and mother has no education and the household did not worked on others land but does not have a radio.
b) Parent's education as above and the household worked on others land
b) Father and mother attended less than Primary 4 and the household did not work on others land and does not have a radio.

2) The father has NO OTHER OCCUPATIONS BESIDES FARMING AND THE HOUSEHOLD DOES NOT HAVE SMALL ANIMALS BUT ONLY POULTRY

PLUS ANY OF THE FOLLOWING IS TRUE

a) Father has no education and mother attended less than Primary 4.
b) Father attended less than Primary 4 and mother has no education.
c) Father has no education and mother attended Primary 4,5,6 or 7 and the household did not work on others land but does not have a radio.
d) Parent's education as above and the household worked on others land.
e) Father and mother attended Primary 1,2 or 3 and the household did not work on others land but does not have a radio.
f) Parent's education as above and the household worked on others land.
g) Father attended Primary 1,2 or 3 and mother Primary 4,5,6 or 7 and the household did not work on others land but does not have a radio.
h) Parent's education as above and the household worked on others land.
i) Father attended Primary 1,2 or 3 and mother has no education and the household did not work on others land but does not have a radio.
l) Parent's education as above and the household worked on others land
m) Father attended Primary 4,5,6 or 7 and mother Primary 1,2 or 3 and household worked.

GRAPH 3.3
Projections of the socioeconomic classes on the factorial plane formed by F1 and F2.

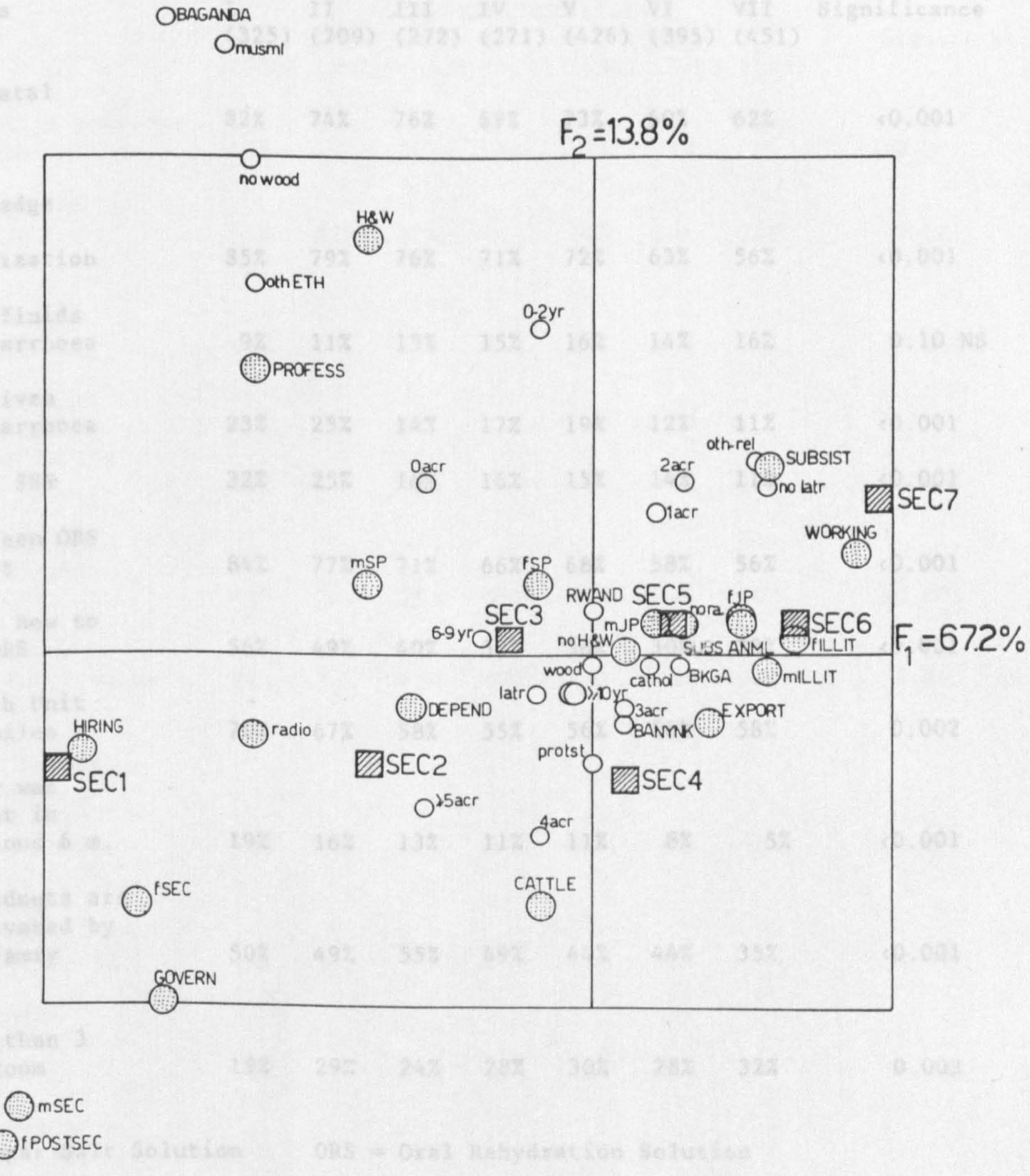


TABLE 3.5
DISTRIBUTION OF HOUSEHOLD VARIABLES NOT USED IN THE MCA AMONG SOCIOECONOMIC CLASSES

The number of households in each group are in brackets

Variables	SOCIOECONOMIC CLASSES							
	I (325)	II (209)	III (272)	IV (271)	V (426)	VI (395)	VII (451)	Significance
1) Antenatal care	82%	74%	76%	69%	73%	60%	62%	<0.001
2) Some knowledge about immunization	85%	79%	76%	71%	72%	63%	56%	<0.001
3) Less fluids in diarrhoea	9%	11%	15%	15%	16%	14%	16%	0.10 NS
4) ORS given in diarrhoea	23%	25%	14%	17%	19%	12%	11%	<0.001
5) Knows SSS	32%	25%	16%	16%	15%	14%	11%	<0.001
6) Has seen ORS packet	84%	77%	71%	66%	68%	58%	56%	<0.001
7) Knows how to mix ORS	56%	49%	40%	38%	36%	30%	28%	<0.001
8) Health Unit < 5 miles	70%	67%	58%	55%	56%	56%	58%	0.002
9) Sugar was bought in previous 6 m.	19%	16%	13%	11%	11%	8%	5%	<0.001
10)Groundnuts are cultivated by the famiy	50%	49%	55%	49%	44%	44%	35%	<0.001
11)Less than 3 per room	19%	29%	24%	28%	30%	28%	32%	0.003

SSS = Sugar Salt Solution ORS = Oral Rehydration Solution

Table 3.6

DISTRIBUTION OF CHILD VARIABLES NOT USED IN THE MCA AMONG SOCIOECONOMIC CLASSES

The number of children in each group are in brackets.

Variable	SOCIOECONOMIC CLASSES I (550)	II (342)	III (453)	IV (471)	V (694)	VI (616)	VII (693)	Significance
1)weighed in previous 3 months	12%	12%	10%	8%	7%	4%	4%	<0.001
2) with growth chart(g.c.)	49%	43%	43%	34%	34%	29%	25%	<0.001
3) % of g.c. with weight plotted	69%	67%	67%	64%	64%	60%	60%	0.362 NS
4) % of mothers interpreting correctly the g.c.	51%	39%	33%	24%	19%	12%	12%	<0.001
5) % delivered in a health facility	40%	24%	20%	15%	17%	13%	10%	<0.001
6) Ill in the previous 2 weeks	42%	41%	40%	42%	45%	42%	47%	0.225 NS
7) If the child was ill, the illness lasted more than 2 weeks	35%	39%	45%	37%	36%	42%	49%	0.006
8) Received treatment from a health facility	75%	69%	58%	55%	62%	60%	48%	<0.001
9) Breastfed between 18-35 m.	8%	15%	5%	11%	14%	24%	19%	0.002
10)Consumed meat fish or eggs in previous 24 hours	14%	9%	10%	8%	10%	11%	8%	0.03
11)consumed milk in previous 24 hours	24%	21%	14%	20%	9%	6%	6%	<0.001

Figure 3.2 W/A, H/A and W/H by Socioeconomic Classes

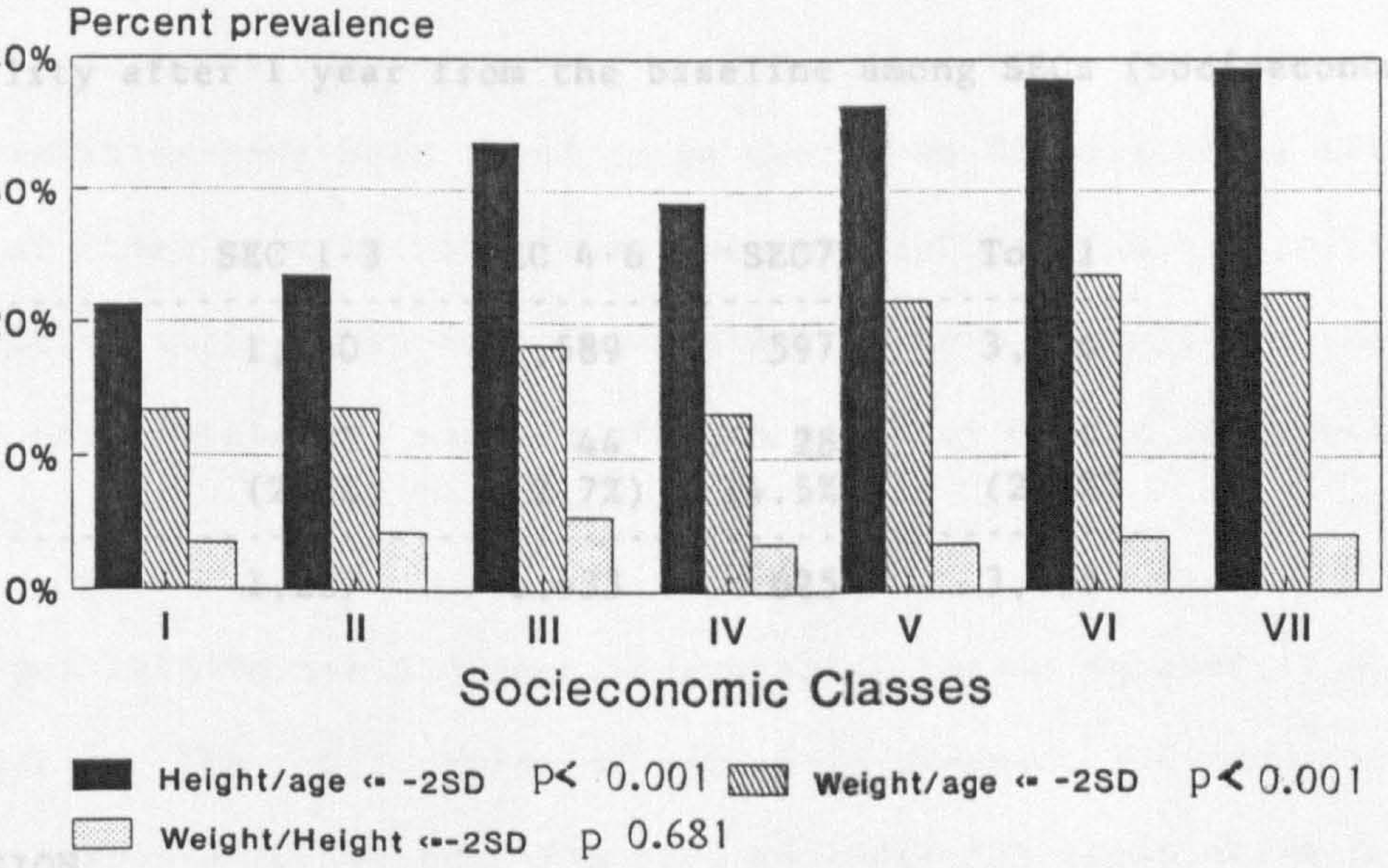


Figure 3.3 MUAC <13.5 cm by Socioeconomic classes

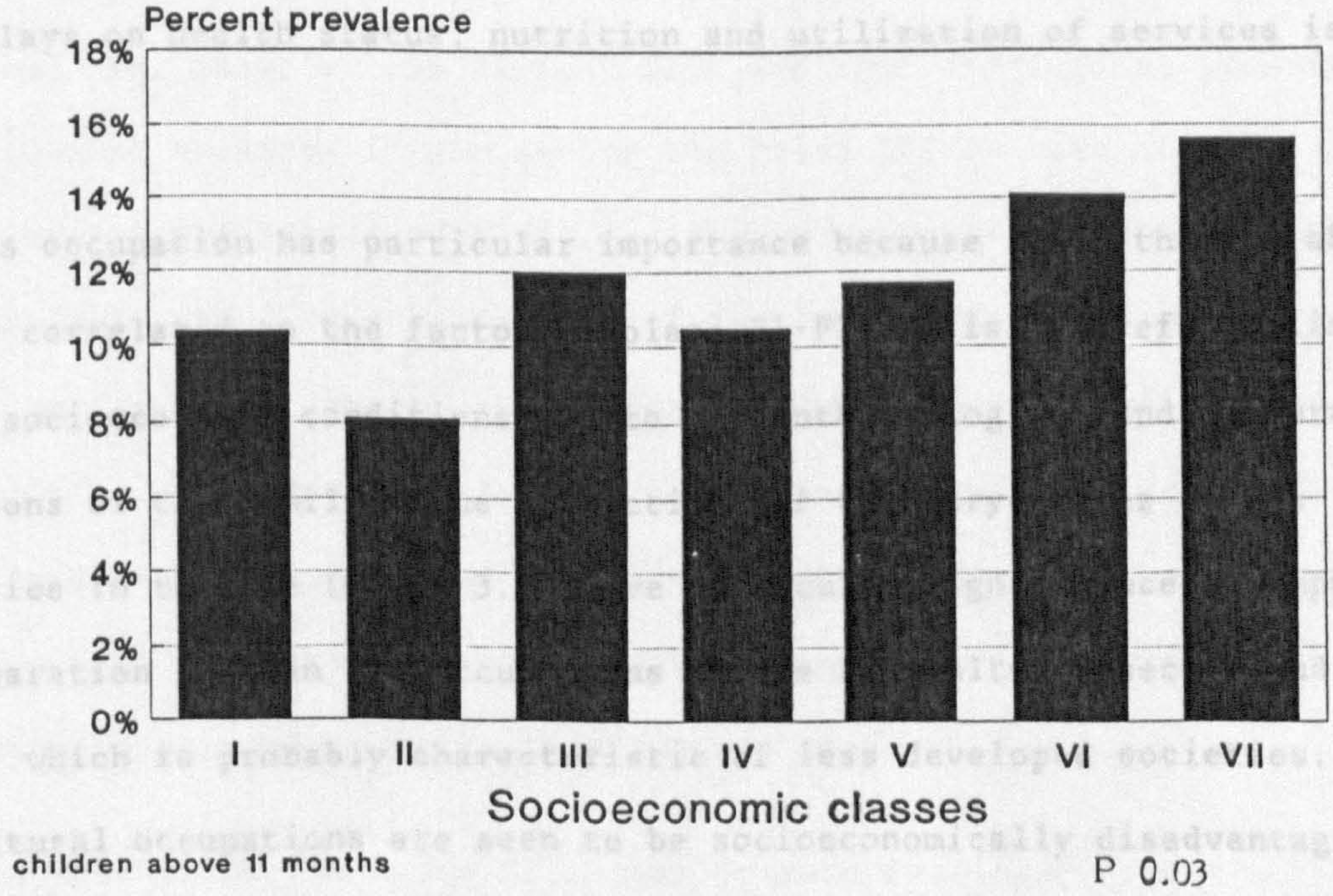


Table 3.7

Child mortality after 1 year from the baseline among SECs (Socioeconomic Classes).

	SEC 1-3	SEC 4-6	SEC7	Total
Survived	1,200	1,589	597	3,386
Died	27 (2.2%)	44 (2.7%)	28 (4.5%)	99 (2.8%)
Total	1,227	1,633	625	3,485

P 0.01

3.5 DISCUSSION

3.5.1 Introduction

The MCA has identified a first factorial axis which explains over 60% of the variability. This axis is characterized by the socioeconomic conditions of the families. Education of the parents of the sampled children is highly correlated with this first axis, and the marked influence that educational level plays on health status, nutrition and utilization of services is evident.

Father's occupation has particular importance because it is the variable most closely correlated to the factorial plane F1-F2 and is, therefore, linked both to the socioeconomic conditions and to the anthropological and cultural conditions of the family. The projections of the barycentres of the modalities in the MCA (Graph 3.2) have particular significance in emphasizing the separation between the occupations in the agricultural sector and the others, which is probably characteristic of less developed societies. The agricultural occupations are seen to be socioeconomically disadvantaged by comparison with others.

The second factorial axis is explained by anthropological-cultural conditions reflected in particular by the variables "religion" and "ethnicity". The remaining variables have been found to be useful in formulating a better definition of these aspects, improving the description of the identified groups, differentiating them more favourably for some aspects and therefore defining in more detail the aspects of each modality of the constructed variable "SEC".

It was not possible to use a direct indicator of income because it would have been unreliable. The construction of our socio-economic indicator is, moreover, a response to the need for such an indicator whose characteristics are appropriate to studies in health, rather than in the economic field.

3.5.2 Comparison with other classification

The 7 SECs obtained by means of the MCA bear some similarities to the socioeconomic classes as usually described in more developed countries, although they reflect the different social conditions of less developed countries. For example, the first 2 SECs are characterized as professionals and Government workers, in the second and third SEC we have at the same time occupations of the tertiary/public and the agricultural sectors. The third SEC represents the living conditions of the less advantaged members of the private/public sector together with the better-off members of the agricultural sector; it is, therefore, a class of transition between the private/public and agricultural occupations. The remaining 4 SECs of the index typify the situation usual in less developed countries, where the majority of the population is engaged in agricultural occupations.

A common feature of the classifications in more developed countries is that the unemployed are included in the lowest socioeconomic class; these are not present in this study. By contrast, in the rural areas of developing countries, those not formally employed in the private or public sectors are active in agriculture. There are very few families who are entirely landless, because almost everyone in this district has a small plot of land with the exception of the traders who, however, enjoy a relatively good standard of living by comparison with those living on the land.

3.5.3 Usefulness of the socioeconomic classification

The women and children in the poorest sectors of the population are usually the most at risk because they are more threatened by the disadvantaged socioeconomic conditions. Any project which aims to improve the overall health and hygienic conditions of the population effectively needs to deal with the problems of these most vulnerable groups. When programmes are too general in nature and not targeted specifically, they are unlikely to reach the most needy, and the efforts will be in vain.

The socioeconomic index developed by this study is based on easily collectable information and could be effectively used to identify vulnerable groups in planning health and social interventions and in monitoring health programmes.

3.5.4 benefits of the mca

The Multiple Correspondence Analysis (MCA) allowed the combination of the complex of the 18 variables substituting them into two factors which summarize more than 80% of the information contained in the variables. It allowed us to concentrate attention on two new variables (factor 1 and 2) which are like indices (socioeconomic, cultural) which can be explained and interpreted through the absolute contributes or the % of information given by each variable in defining the 2 factors.

In the MCA it is neither necessary to define the dependent and independent

variables nor to presume the type of relationship existing between variables (e.g. linear as in the regression or logistic as in the logistic model).
The MCA allows the summary of the relationships between variables and to explain the information of the household through a graphic representation like that one reported in graph 3.2.

The cluster analysis (CA) has allowed to divide the families in classes or groups which are socioeconomically homogeneous. This subdivision of families into classes could be used in socioeconomic and health interventions to target the most deprived groups or to monitor that the most at risk groups are receiving project inputs and are covered by health services. In fact it is the frequent bypassing of the most deprived families which is the reason of the lack of impact of many programmes.
The use of MCA and CA is a relatively novel approach for the production of a socioeconomic index to be utilized in studies on human nutrition. Such methodologies are however extensively applied in the field of social science with very good results. Very often also in the field of nutrition a priori models are not known and in such a case the MCA and CA can be very good tools of analysis for descriptive purposes.
The complex analytical work is done by computer packages which have standard routines to be utilized. To the non specialist it is not necessary to know the statistical techniques of the MCA but is is enough to know how to interpret the MCA graphs which give a visual representation of the relationships between the variables involved.
The value of the MCA appears considerable and it should be used whenever the development of a socioeconomic index is needed.

CHAPTER IV

ANTHROPOMETRY AS A PREDICTOR OF MORTALITY

4.1 INTRODUCTION

4.1.1 Background

Overall malnutrition weakens immunological defences (see chapter VI 6.4.6.2) which increases the severity of infections, and increases mortality rates. However, there are considerable differences in the strength of relationship between malnutrition and a higher risk of death among children. These differ in part according to the cut-off point and to the anthropometric parameter used.

In addition it seems likely that the social, physical and economic environment may be very important in determining the mortality risk associated with malnutrition.

4.1.2 Relationship between malnutrition and mortality

Sommers and Lowenstain[48] assessed mortality in relationship to the Quac stick method. The term Quack stick[187] is used to describe the Quacker Arm Circumference measuring stick and relates Mid Upper Arm Circumference (MUAC) to height. The QUAC stick is a height measuring stick which is marked in MUAC measurements instead of height. The values for 85% or 80% of the expected MUAC for a specific height are marked on the stick at the corresponding height level. If the child's height is greater than the height corresponding to his MUAC, the child is considered lower than 85% of the MUAC of an average child of his height and therefore malnourished. MUAC is strongly correlated with weight and the QUAC stick method is therefore similar to measurements of weight for height or the degree of wasting.
MUAC is strongly correlated with weight and the Quac stick method measures the degree of wasting. Among Bangladeshi children Sommers and Lowestain

showed, during the 18 months following the anthropometric measurement, a relative risk of 3.4 for those below the 10th percentile of arm circumference for height compared with those above the 50th percentile. Kielman and McCord[49] found that among Indian children mortality, during the 12 months following anthropometry, decreased exponentially with each 10% rise in % median weight for age (W/A). Chen[50] et al followed 2,019 children for 24 months after anthropometry and found a relative risk of around 3 among severely malnourished children (<60% W/A) in Bangladesh, with Mid Upper Arm Circumference (MUAC) and W/A being the best predictors for mortality, and weight for height (W/H) being the weakest. Briend et al[51] followed up about 5000 children monthly with anthropometric measurement. They showed a sensitivity of MUAC of 56% at a specificity of 94% in predicting death after one month from the measurement. Specificity was improved if breastfeeding was absent and chronic diarrhoea, acute respiratory infections and oedema were present.

In a longitudinal study in Guinea Bissau[52] it was found that height for age, but not weight for height, was positively correlated with survival. This study plus the other performed in Kasongo (Zaire)[53] which also showed a poor discriminatory power of anthropometry might at first sight suggest that in Africa (in contrast to Asia) anthropometry plays a relatively minor role in predicting child mortality. This could be due in part to the lower prevalence of wasting in Africa associated with a lesser variability of socioeconomic structure when compared to Asia.

TABLE 4.1

Mortality associated with anthropometry

a) Sommers and Lowenstain (3,757 children 1-4 years old followed for 18 months)

MUAC/Height	<10 %tile	10-50%tile	>50%tile
%mortality	12.3%	4.5%	2.7%
Relative Risk (RR)	4.5	1.6	1

b) Kielmann/Mc Cord (2,808 children 1-35 months followed for 12 months)

% W/A	<60	60-69	70-79	>79
% mortality rate	12	6	4.5	1.2

c) Alam et al (2,449 children 12-59 months old followed for 6 months)

MUAC in mm	<121	121-130	131-140	>140
% Mortality rate	36.7	6.9	3.9	3,1
RR	11.8	2.2	1.3	1
% W/A	<60	60-69	70-79	>79
% Mortality rate	31.6	6.6	5.3	1.6
RR	19.8	4.1	3.3	1
% H/A	<85	85-89	>89	
% Mortality rate	15.4	5.2	3.6	
RR	4.3	1.4	1	
% W/H	<80	80-89	>89	
% mortality rate	15	5.3	5.4	
RR	2.8	1	1	

d) Briend (5000 children 6-36 months followed for 6 months)

MUAC in mm	<100	<110	<120	<130
RR	48	20.1	11.1	6.3

e) Chen (2,019 children 13-23 months old followed for 24 months)

% W/A	<60	60-74	≥75	
% mortality rate	11.2	4.2	3.6	
% H/A	<85	85-89	90-94	≥95
% mortality rate	11.3	3.7	3.9	3.3
% W/H	<70	70-79	80-89	≥90
% mortality rate	14.6	4.9	5.3	5.2

4.1.3 Possible reasons behind the differences found in some studies

Mortality associated with anthropometric indicators varies between countries.[54] According to Bairagi this could be due to the fact that food intake by children depends on socioeconomic status in some populations, whereas it may not be so strongly determined in others[55]. There are two possible scenarios; in the first case, anthropometry is an indicator of nutrition and socioeconomic status; in the second case, it is only an indicator of nutrition. In the first case the distribution of anthropometric values should be more heterogeneous because it has more sources of variation and the discriminating power should be greater. In the first case low anthropometric values will carry high risk of mortality because they will reflect the damaging effect of low socioeconomic status besides low nutritional status. In the second case however the socioeconomic source of mortality will not be reflected in anthropometry whose predictive power will therefore be low. Food intake in Kasongo was reported to be independent from income and therefore suggests the second type of case where anthropometry lacks the source of variation from socioeconomic status. Another possible explanation of the low predictive power of anthropometry in Kasango was that 56% of deaths were due to measles which has high fatality rates across a wide range of nutritional status. A problem with many of the available studies is that causes of death are not reported. It might be that if more deaths were attributable to diarrhoea and less to measles at Kasongo that mortality would be more strongly related to nutrition.

Another possible reason for the different predictive power of anthropometry among studies could be related to differences in the prevalence of vitamin A deficiency. This may cause high mortality among children with normal anthropometric parameters[56]. Poor quality of measurements could have also affected the different discriminatory power of anthropometry found in some studies.

4.1.4 Using more than one parameter to predict mortality

Different indicators may also represent different types of malnutrition so some researchers have suggested the use of more than one parameter at a time.

After taking 10,037 measurements from 2,625 Bangladeshi children, 12-59 months old, Alam et al[57] found that for mortality in the first 3 months the highest sensitivity was for MUAC and MUAC/age, and the lowest was for W/H but the predictive power of W/A and H/A improved when combined with MUAC, while the power of MUAC did not improve after adding H/A or W/A.

These studies show how different anthropometric parameters assess different aspects of malnutrition such as W/H which assesses wasting, W/A which assesses undernutrition, H/A which assesses stunting and MUAC which assesses muscle mass. These different aspects of malnutrition appear to be differently related to mortality.

The potential importance of these studies is the identification of anthropometric parameters and cut-off points which can identify children at higher risk of mortality.

4.1.5 Sensitivity and specifity

To assess the goodness of a test, sensitivity (% of diseased identified) and specificity (% of non diseased correctly identified) is commonly used. In anthropometry, sensitivity is identified with % of all children who died who were below a certain cut-off point and specificity with % of all children who survived and who were above the cut-off point.

An ideal test would have 100% sensitivity and 100% specificity identifying all children who will die and those who will survive. However, at each cut-off point some children will die and some will survive. Mortality by specific cause of death should aim at identifying the relative importance of malnutrition as directly related to mortality. For this reason, we report the specific mortality due to different diseases associated with various anthropometric parameters.

4.1.6 Anthropometry as a screening device

It is necessary to assess the risk of mortality associated with anthropometry in order to evaluate these parameters in their ability to identify children at higher risk of death. The importance of measuring nutritional status depends on the assumption that it can predict which children are more at risk of death and, through proper cut-off points, decide which child is at higher risk for screening purposes in order to increase the cost effectiveness of interventions.

4.1.7 Socioeconomic class as possible confounding factor

Another important point to take into account when comparing anthropometry with risk of death is the socioeconomic group. This is often related to both malnutrition and mortality and therefore could act as a confounder. For this reason, we put into the regression model of mortality and anthropometry the socioeconomic groups built up in chapter III in order to discern if they play an important confounding role in the association between malnutrition and mortality.

4.2 METHODOLOGY.

The analysis was carried out through cross-tabulations using Chi Square, Mantel-Haenszel and the Fisher's exact test. Logistic regression, using the GLIM statistical package, was applied to discriminate the effect of social class on mortality.

4.3 RESULTS

4.3.1 Introduction

Of the initial 4,320 children measured in March-April 1988, 506 (11.7%) were lost to follow-up mainly because of migration. Those lost to follow-up did not differ significantly from those who remained for all the anthropometric parameters used (table 4.2).

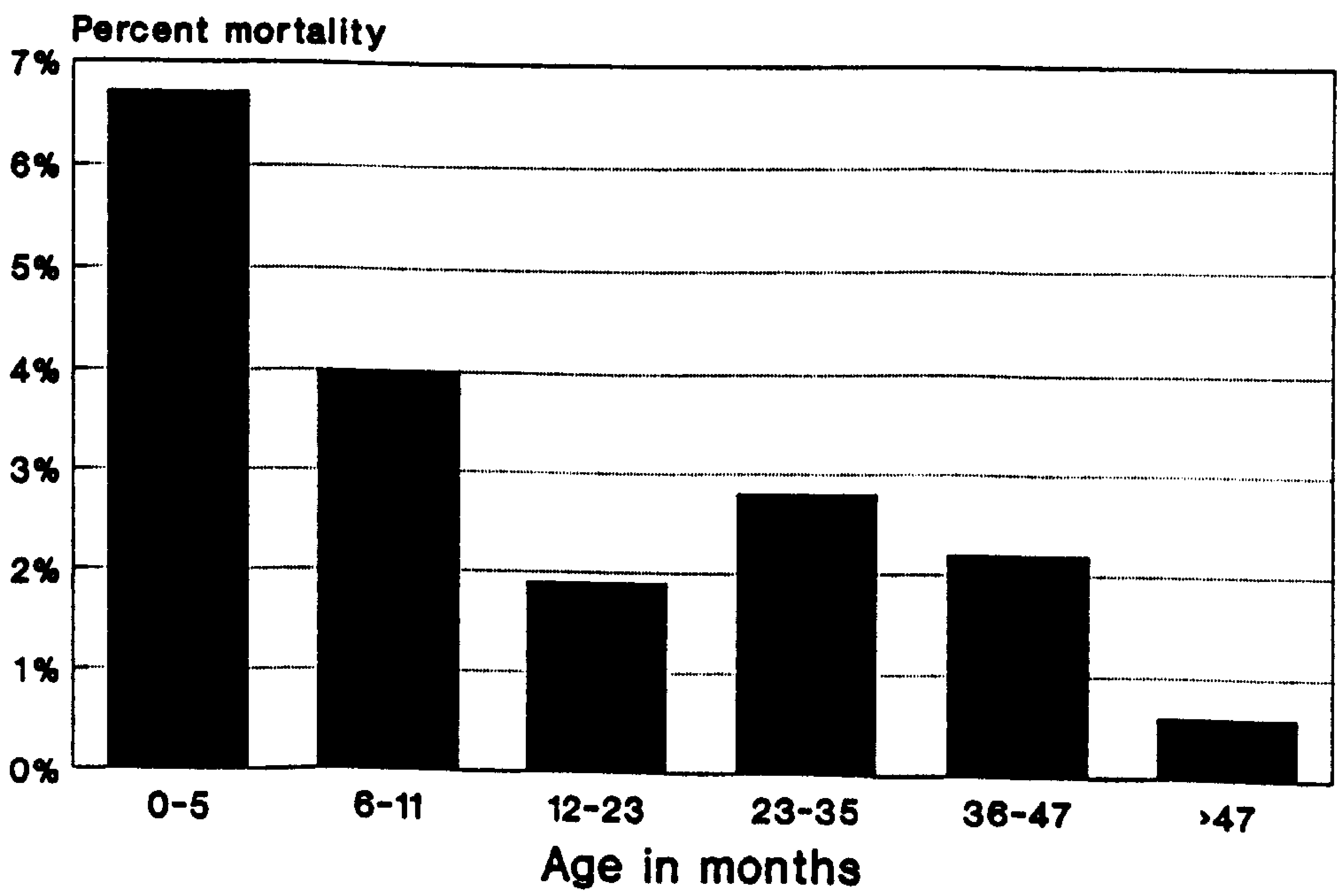
Table 4.2

Prevalence of malnutrition at the baseline (1988) between those traced and those lost to follow up after one year

	<-2 SD W/A	<-2 SD H/A	<-2 SD W/H	<12.5 cm M
traced (3,768)	18.3%	32.6%	3.8%	6.1%
lost (376)	17.8%	31.4%	4.0%	5.4%

Among the remaining children who were traced, there were 104 deaths which accounted for 2.7% of the whole sample traced. Of these 104 children who died, anthropometry was missing for 8 of them and they were therefore excluded from the analysis. Among those traced (3,814), 46 did not have valid anthropometric measurements and they were also excluded from the analysis. As shown in figure 4.1 mortality was higher below 12 months and thereafter remained around 2% declining to 0.6% above 47 months.

Figure 4.1
Mortality by age



4.3.2 Anthropometry and mortality

As shown by Tables 4.3 and 4.4, mortality increased as the anthropometric levels decreased.

TABLE 4.3

Percentage mortality according to different cut-offs in Standard Deviations(SD) of Weight for Age (W/A), Height for Age (H/A) and Weight for Height (W/H). From a total of 3,768 children with anthropometric measurements there were 96 (2.5%) deaths

SD	< -3	-3.00 -2.51	-2.50 -2.01	-2.00 -1.51	-1.50 -1.01	> -1
W/A	12/132 9.1%	14/212 6.6%	11/343 3.2%	11/516 2.1%	9/609 1.5%	39/1956 2%
H/A	23/502 4.6%	8/321 2.5%	9/400 2.3%	14/501 2.8%	8/478 1.7%	34/1566 2.2%
W/H	4/34 11.8%	3/28 10.7%	5/80 6.3%	13/210 6.2%	10/365 2.7%	61/3051 2%

Table 4.4

Percentage mortality according to different cut-offs in cm of MUAC

Cm	< 10.5	10.5 11.4	11.5 12.4	12.5 13.4	13.5 14.4	>14.5
	15/41 36.6%	3/55 5.5%	7/133 5.3%	17/395 4.3%	18/863 2.1%	36/2261 1.6%

The predictive value (% of children under a cut-off who died) was higher for MUAC followed by W/H, W/A and H/A. As can be seen from Table 4.4, there were 41 children below 10.5 cm for MUAC, of whom almost 1/3 died.
While there were 34 children below -3 Standard Deviations W/H, of whom 12% died.

Compared to a baseline of above or equal to -1 SD, the Relative Risk (RR) started increasing significantly (Tables 4.5 and 4.6) below -2.50 SD for W/A and below -1.50 SD for W/H while it rose significantly below -3 SD for H/A and below 13.5 cm for MUAC. If we compare the RR in the groups below -3 and above or equal to -1 SD, it increased 4.5 times for W/A and almost 6 times for W/H while the increase was twice for H/A. The RR increased 23 times if we compare the group below 10.5 cm of MUAC with the group above 14.5 cm. Although the relative risk is so high below 10.5 we must take into consideration that the sample size is small.

TABLE 4.5

Relative Risks according to different cut offs for W/A ,H/A and W/H with 95% Confidence Intervals in brackets

SD	< -3	-3.00 -2.51	-2.50 -2.01	-2.00 -1.51	-1.50 -1.01	> -1
W/A	4.5*** (2.4-8.5)	3.3*** (1.8-6)	1.6 (0.8-3.1)	1.1 (0.5-2.1)	0.7 (0.3-1.5)	1
H/A	2.1** (1.2-3.5)	1.1 (0.5-2.4)	1 (0.5-2.1)	1.3 (0.7-2.3)	0.7 (0.3-1.6)	1
W/H	5.8** (2.3-15)	5.3* (1.8-16)	3.1* (1.3-7)	3.1*** (1.7-5.5)	1.3 (0.7-2.6)	1

* $p<0.05$ ** $p<0.01$ *** $p<0.001$

TABLE 4.6

Relative Risks according to different cut-offs for MUAC

Cm	< 10.5	10.5 11.4	11.5 12.4	12.5 13.4	13.5 14.4	>14.5
	23*** (13.7-38)	3.4 (1-10)	3.3** (1.5-7)	2.7*** (1.5-4.7)	1.3 (0.7-2.3)	1

* $p<0.05$ ** $p<0.01$ *** $p<0.001$

Death rates varied with age, being 9% below 3 months, 5.6% between 3 and 8 months and maintaining itself around 2% afterwards.

4.3.3 <u>Mortality by age by anthropometry</u>

When the mortality by anthropometric intervals was crosstabulated by age groups (table 4.7), it was found that mortality was significantly higher below 6 months of age for all anthropometric parameters with the exception of MUAC.

TABLE 4.7

Percentage mortality by anthropometric intervals by age groups in months, the total number in each age group is in brackets

	0-5 m.	6-11 m.	12-23 m.	>24 m.	Total	Chi square
<-3 SD WA	(3) 33.3%	(14) 21.4%	(31) 6.5%	(84) 7.1%	(132) 9.1%	p 0.14 NS
-3 -2.01 SD WA	(12) 33.3%	(63) 5%	(145) 4%	(335) 3.6%	(555) 4.5%	p<0.001
>-2.01 SD WA	(336) 5.1%	(335) 3%	(642) 1.2%	(1,768) 1.4%	(3,081) 1.9%	p<0.001
<-3 SD H/A	(10) 30%	(27) 7.4%	(120) 4.2%	(345) 3.8%	(502) 4.6%	p 0.001
-3 -2.01 SD H/A	(28) 14.3%	(74) 4.1%	(187) 2.1%	(432) 1.4%	(721) 2.4%	p<0.001
>-2.01 SD H/A	(313) 4.8%	(311) 3.5%	(511) 1.4%	(1,410) 1.6%	(2,545) 2.2%	p 0.001
<-2 SD W/H	(8) 25%	(26) 7.7%	(49) 8.2%	(59) 6.8%	(142) 8.5%	p 0.38 NS
>-2.01 SD W/H	(343) 5.8%	(386) 3.6%	(769) 1.6%	(2,128) 1.8%	(3,626) 2.3%	p<0.001
<12.5 cm MUAC	(113) 10.6%	(44) 9.1%	(42) 7.1%	(30) 20%	(229) 10.9%	p 0.34 NS
12.5 13.4 MUAC	(100) 4%	(88) 5.7%	(124) 3.2%	(83) 4.8%	(395) 4.3%	p 0.84 NS
>13.5 MUAC	(135) 4.4%	(277) 2.5%	(646) 1.4%	(2,066) 1.5%	(3,124) 1.7%	p 0.06 NS

NS = Statistically Not Significant

The improvement of the predictive power of all the parameters (except for MUAC) by inclusion of age indicates that it is more serious to be underweight, short or thin if the child is young. For the same cut-off point, death rates were higher below 6 months for all the anthropometric parameters except for MUAC. When there is a logistic model, with an anthropometric parameter (eg W/A alone) and age is added into the model it results in a significant improvement of death prediction. However, when age was added to the MUAC logistic model, the deviance showed very little change (Table 4.8). This confirms that inclusion of age does not improve the predictive power of MUAC.

TABLE 4.8

Differences in deviance after adding age to the logistic model containing anthropometric parameters

Parameter	Coefficient	Standard Error	Change in Deviance	Significance
MUAC alone	-0.4687	0.05444	not applicable	
MUAC plus Age	-0.4260 -0.01032	0.06296 0.00746	-2	p>0.10 NS
W/A alone	-0.3480	0.08521	not applicable	
W/A plus Age	-0.4035 -0.0400	0.08438 0.00727	-34.5	p<0.001
H/A alone	-0.1025	0.06358	not applicable	
H/A plus Age	-0.1734 -0.0380	0.06746 0.00717	-31.9	p<0.001
W/H alone	-0.3304	0.08683	not applicable	
W/H plus Age	-0.3310 -0.0358	0.08374 0.00702	-29.1	p<0.001

Anthropometric parameters and age had a negative coefficient which means that for a given parameter, older children had a greater probability of survival.

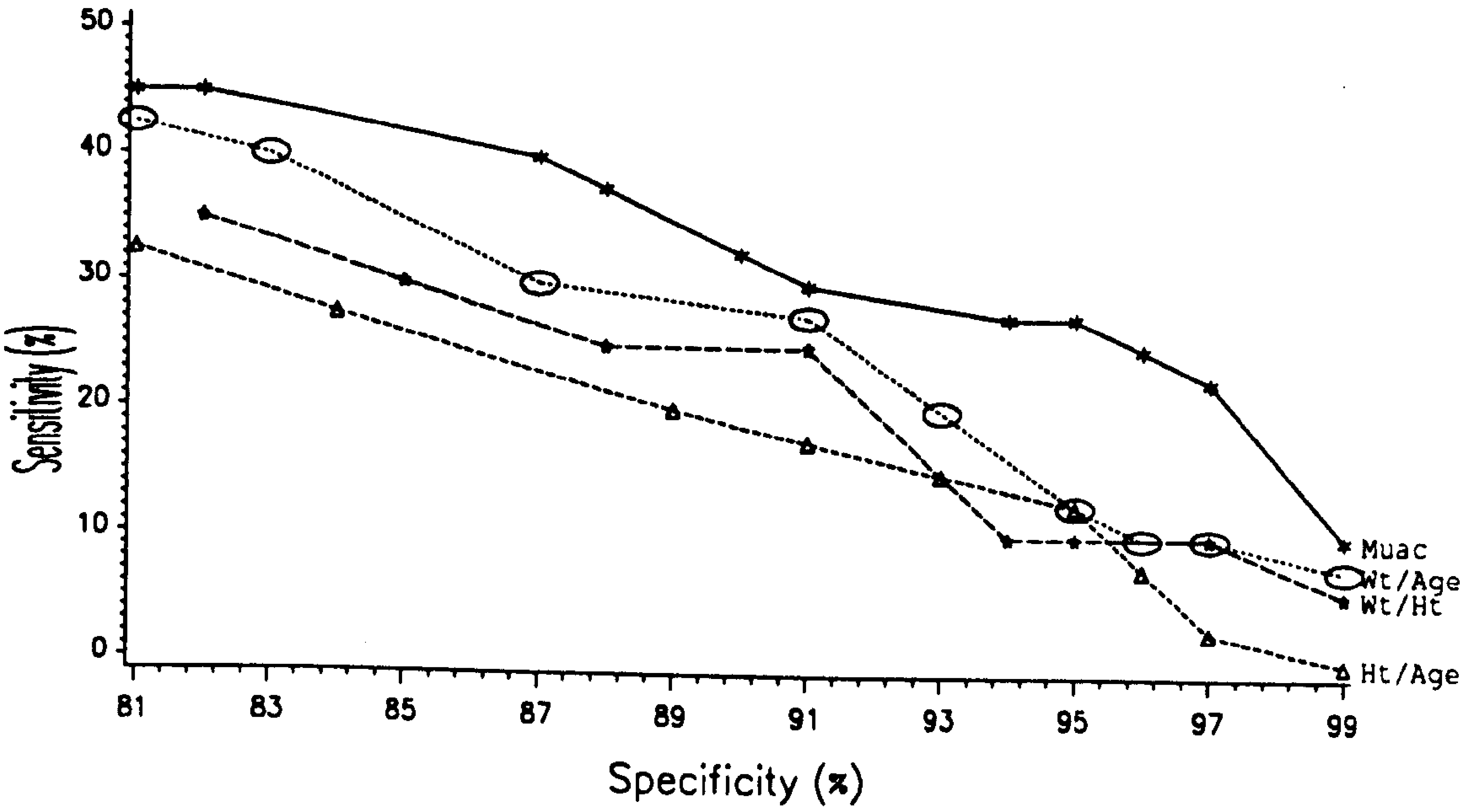
4.3.4 Sensitivity and specificity

Sensitivity and specificity for the various anthropometric parameters are shown in Graphs 4.1 and 4.2 which show that at same levels of specificity,

GRAPH 4.1

Sensitivity vs Specificity

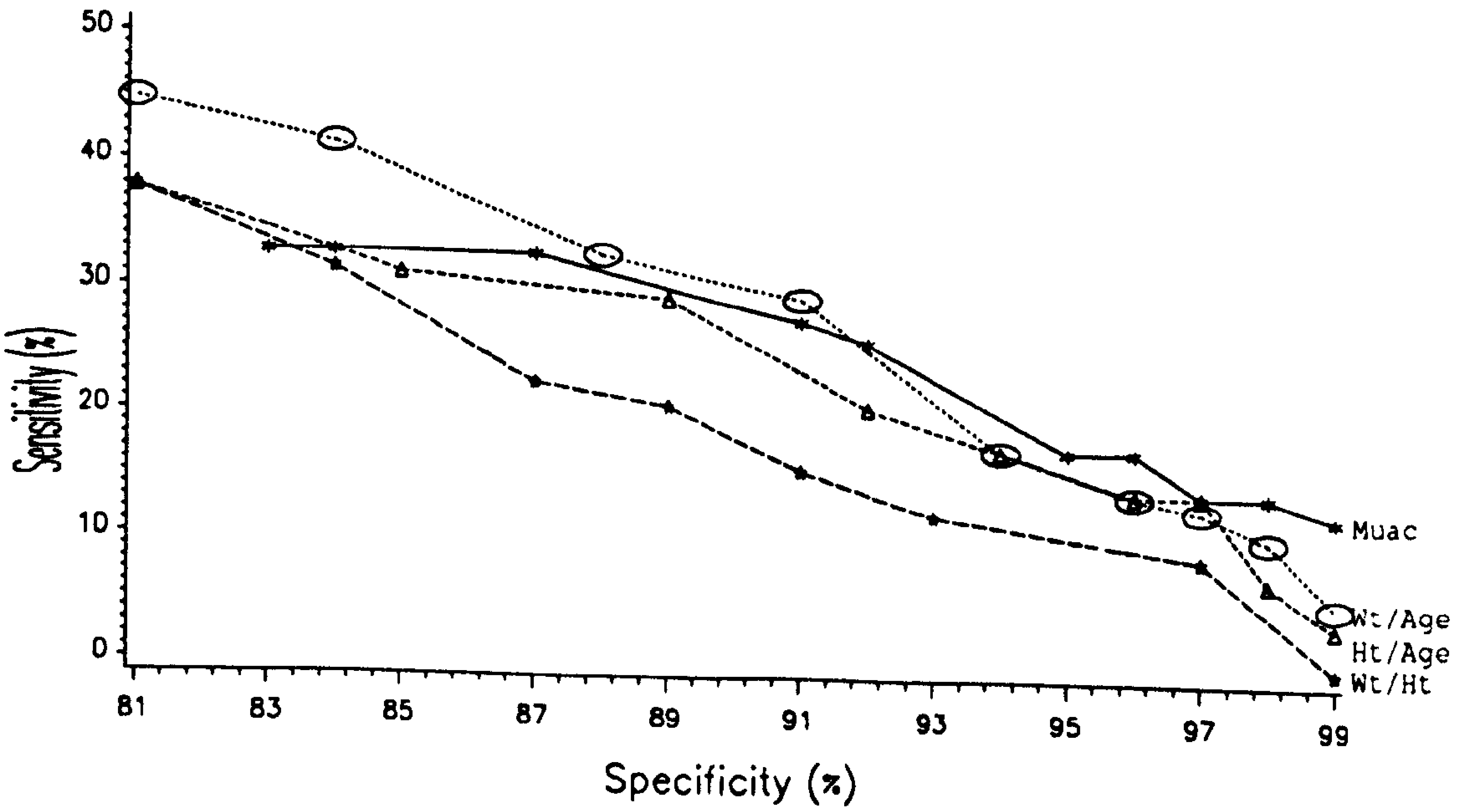
below 1 year in predicting mortality



GRAPH 4.2

Sensitivity vs Specificity

above 11 months in predicting mortality



MUAC had the highest sensitivity in comparison with other parameters. Whereas the sensitivity of MUAC by predicting death among infants less than 11 months was the best at every point of specificity higher than 80%, among children above 11 months the most sensitive indicators was W/A below 92% specificity, while MUAC was the most sensitive above 92% specificity. In general, we are interested in specificity beyond 95% for targeting purposes in a cost effective way.

This means that in our group 95% of the children who are going to survive will be correctly identified and there will be only 5% of false positives. If we look at Graph 4.1 and we take 95% specificity, with MUAC 28% of children who are going to die will be correctly identified, while utilizing W/A or H/A only 13% of children who are at risk will be identified, and with W/H only 10% will be identified. Above 11 months, the percentage of children at risk of death correctly identified at 95% specificity will be 17% with MUAC, 15% with W/A or H/A and 10% with W/H. As can be seen, the levels of sensitivity vary with age, with the parameters and with the specificity to be considered. However, in general, at the same level of specificity, MUAC will have the highest sensitivity followed by W/A, H/A and W/H.

4.3.5 Using more than one parameter at the same time

Table 4.9 shows how the goodness of fit of a logistic model containing a single parameter varies by adding other parameters. It can be seen that when MUAC alone is in the model and we add the other parameters, the change of deviance is not significant, meaning that the parameters added do not significantly improve the model. In other words, we are already better off with MUAC alone without the need to use other indicators in order to predict mortality. In contrast, when MUAC was added into the logistic models containing W/A, H/A or W/H there was a significant change in deviance, meaning that by adding MUAC to other parameters, the goodness of the model was significantly improved.

TABLE 4.9

Change in deviance with addition of other parameters to MUAC and of MUAC to other parameters

Parameter	Coefficient	Standard Error	Change in Deviance	Significance
MUAC	-0.4687	0.0544		
Muac plus	-0.4461	0.0576		
W/A	-0.1051	0.0840	-1.6	p 0.21 NS
Muac plus	-0.4414	0.0581		
W/A plus	-0.1589	0.1174		
H/A	0.0579	0.0876	-0.4	p 0.53 NS
Muac plus	-0.4428	0.0584		
W/A plus	-0.0610	0.4387		
H/A plus	0.0005	0.2631		
W/H	-0.0781	0.3376	-0.1	p 0.75 NS
W/A	-0.3469	0.0851		
W/A plus	-0.4793	0.1136		
H/A	0.1460	0.0833	-2.9	p 0.09 NS
W/A plus	-0.7487	0.4844		
H/A plus	0.2985	0.2794		
W/H	0.2153	0.3768	-0.3	p 0.58 NS
W/A plus	-0.0610	0.4387		
H/A plus	0.0005	0.2631		
W/H plus	-0.0781	0.3376		
MUAC	-0.4428	0.0584	-49.1	p<0.001

4.3.6 Influence of socioeconomic factors

As discussed in Chapter III, both mortality and malnutrition were higher in the poorest socioeconomic group. Therefore the highest death rate associated with low cut-offs of anthropometric parameters could be due to the association between malnutrition and low socioeconomic status.

To examine the role played by socioeconomic factors in the association between malnutrition and mortality, the relationship between anthropometry and mortality controlling for socioeconomic group (SEG) was analysed using logistic regression. Because of some similarities existing between some SECs, classes 1, 2 and 3 were united forming SEG I; and classes 4,5 and 6 were united forming SEG II while class 7 formed the third group. It can be noted from Table 4.10 that the mortality rates associated with different cut-offs were not significantly different among SEGs. From table 4.11 to table 4.18 it can be seen that the effect of socioeconomic status on mortality disappears after controlling for anthropometry except for W/H where the coefficient for SEG III remains more than twice the standard error. As can be seen in Table 4.19 there was no interaction between predicting power of anthropometric indicators and SEGs, and as shown in graphs 4.3 to 4.6 the mortality trend was the same in all 3 groups. This means that in each socioeconomic group the risk of mortality rises as anthropometric values become lower. This does not mean that socioeconomic indicators should be abandoned in favour of anthropometric ones, because each of them are good predictors of mortality. However it can be concluded that nutrition *per se* has an influence on mortality which is independent from socioeconomic status.

TABLE 4.10
Mortality associated with different cut-offs in various SEGs

	SEG I	SEG II	SEG III	Significance
<-3 SD W/A	(38) 10.5%	(47) 8.5%	(36) 8.3%	p 0.93
-3 -2.01 SD W/A	(133) 4.5%	(270) 4.8%	(93) 5.4%	p 0.95
>-2.01 SD W/A	(1016) 1.7%	(1259) 1.9%	(466) 3.2%	p 0.13
<-3 SD H/A	(109) 4.6%	(230) 3%	(111) 9%	p 0.05
-3 -2.01 SD H/A	(196) 2.6%	(321) 2.5%	(126) 1.6%	p 0.82
>-2.01 SD H/A	(882) 1.9%	(1025) 2.5%	(358) 3.1%	p 0.44
<-2 SD W/H	(46) 6.5%	(57) 14%	(24) 4.2%	p 0.26
>-2.01 SD W/H	(1141) 2.1%	(1519) 2.2%	(571) 3.9%	p 0.06
<12.5 cm MUAC	(56) 10.7%	(95) 9.5%	(55) 16.4%	p 0.43
12.5-13.4 cm MUAC	(107) 5.6%	(182) 4.9%	(81) 2.5%	p 0.56
>13.5 cm MUAC	(1,019) 1.5%	(1294) 1.8%	(452) 2.7%	p 0.28

TABLE 4.11
Logistic model with MUAC and age (the baseline is MUAC>14.4 and age>11 months)

Parameter	Coefficient	Standard error
MUAC 14.4-13.5 cm	0.392	0.293
MUAC 13.4-12.5 cm	0.966	0.309
MUAC 12.4-11.5 cm	0.742	0.481
MUAC 11.4-10.5 cm	1.702	0.506
MUAC <10.5 cm	3.239	0.403
Age 11-6 months	0.245	0.310
Age <6 months	0.281	0.317

TABLE 4.12
Addition of the variable SEG to the model in table 4.11 (the change in deviance was -2.2 with 2 degrees of freedom which is not statistically significant)

Parameter	Coefficient	Standard Error
MUAC 14.4-13.5 cm	0.327	0.307
MUAC 13.4-12.5 cm	0.945	0.316
MUAC 12.4-11.5 cm	0.695	0.487
MUAC 11.4-10.5 cm	1.687	0.514
MUAC <10.5 cm	3.148	0.425
Age 11-6 months	0.261	0.321
Age <6 months	0.373	0.323
SEG II	0.250	0.249
SEG III	0.403	0.284

TABLE 4.13
Logistic model with W/A and age (the baseline is W/A>-1 SD and age>11 months)

Parameter	Coefficient	Standard Error
W/A -1 to -1.5 SD	-0.182	0.389
W/A -1.51 to -2 SD	0.180	0.380
W/A -2.01 to -2.5 SD	0.828	0.360
W/A -2.51 to -3 SD	1.526	0.344
W/A <-3 SD	1.914	0.360
Age 11-6 months	0.770	0.299
Age <-6 months	1.638	0.281

TABLE 4.14
Addition of the variable SEG to the model in table 4.13 (the change in deviance was -2.5 with 2 degree of freedom which is not statistically significant)

Parameter	Coefficient	Standard Error
W/A -1 to -1.5 SD	-0.225	0.389
W/A -1.51 to -2 SD	0.147	0.381
W/A -2.01 to -2.5 SD	0.769	0.362
W/A -2.51 to -3 SD	1.460	0.347
W/A <-3 SD	1.838	0.363
Age 11 to 6 months	0.766	0.299
Age <6 months	1.611	0.281
SEG I	0.239	0.248
SEG II	0.439	0.279

TABLE 4.15
Logistic model with H/A and age (the baseline is H/A>-1 and age>11 months)

Parameter	Coefficient	Standard Error
H/A -1 to -1.5 SD	0.001	0.400
H/A -1.51 to -2 SD	0.537	0.332
H/A -2.01 to -2.5 SD	0.371	0.388
H/A -2.51 to -3 SD	0.088	0.488
H/A <-3 SD	1.257	0.299
Age 11-6 months	0.860	0.301
Age <6 months	1.599	0.280

TABLE 4.16
Addition of the variable SEG to the model in table 4.15 (the change in deviance was -3 with 2 degree of freedom which is not statistically significant)

Parameter	Coefficient	Standard Error
H/A -1 to -1.5 SD	-0.025	0.399
H/A -1.51 to -2 SD	0.494	0.333
H/A -2.01 to -2.5 SD	0.313	0.389
H/A -2.51 to -3 SD	0.005	0.489
H/A <-3 SD	1.169	0.302
Age 11-6 months	0.848	0.301
Age <6 months	1.564	0.280
SEG II	0.271	0.247
SEG III	0.477	0.278

TABLE 4.17
Logistic model with W/H and age (the baseline is W/H>-1 and age>11 months)

Parameter	Coefficient	Standard Error
W/H -1 to -1.5 SD	0.510	0.349
W/H -1.51 to -2 SD	1.233	0.331
W/H -2.01 to -2.5 SD	1.318	0.489
W/H -2.51 to -3 SD	1.942	0.636
W/H <-3 SD	1.972	0.562
Age 11-6 months	0.642	0.300
Age <6 months	1.423	0.265

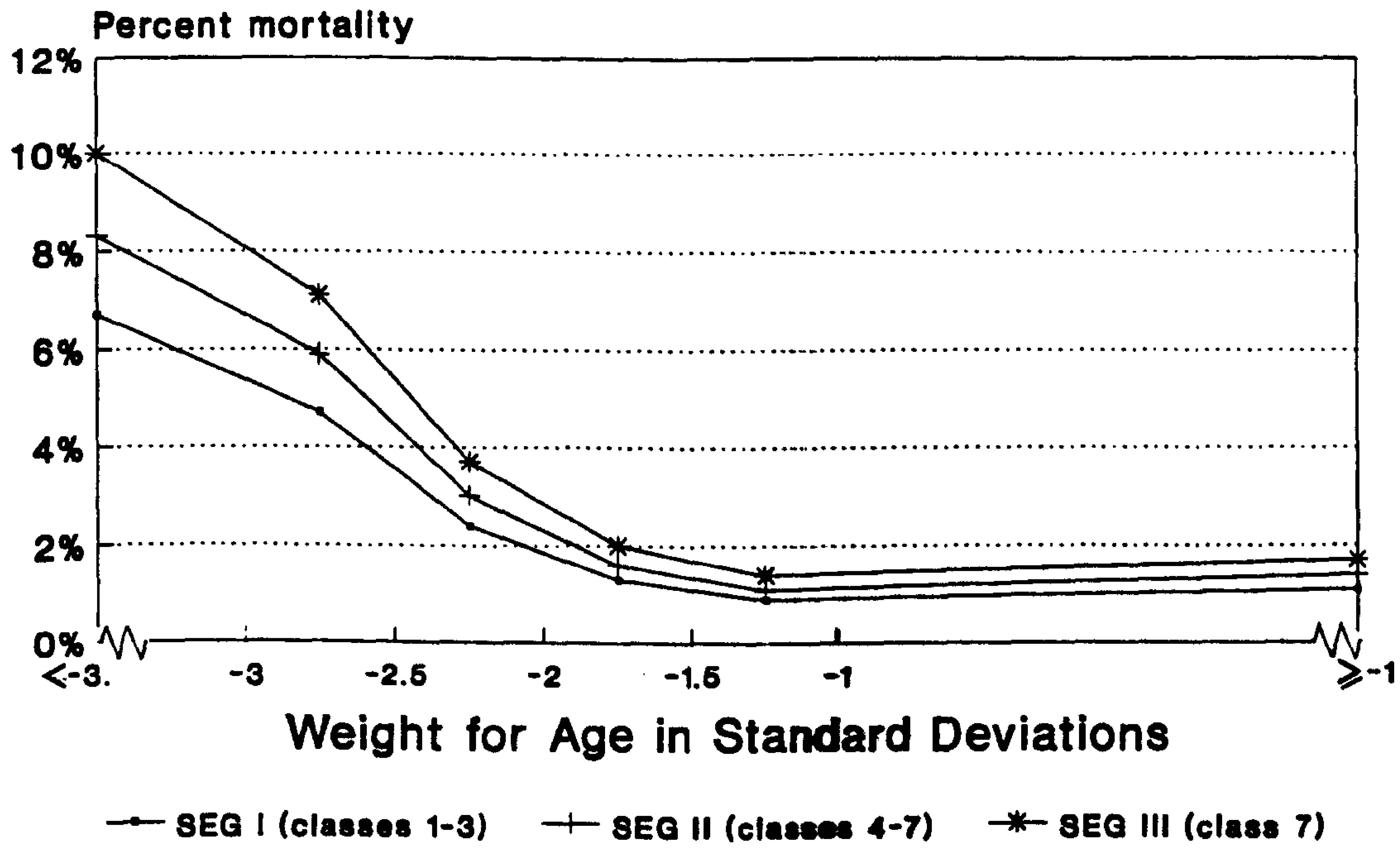
TABLE 4.18
Addition of the variable SEG to the model in table 4.17 (the change in deviance was -4.8 with 2 degrees of freedom which is not statistically significant)

Parameter	Coefficient	Standard Error
W/H -1 to -1.5 SD	0.505	0.350
W/H -1.51 to -2 SD	1.234	0.331
W/H -2.01 to -2.5 SD	1.350	0.490
W/H -2.51 to -3 SD	1.895	0.640
W/H <-3 SD	1.941	0.562
Age 11-6 months	0.652	0.300
Age <6 months	1.419	0.265
SEG II	0.326	0.247
SEG III	0.607	0.276

Table 4.19
Test for evaluating interaction between anthropometry and SEGs in their predictive power of mortality

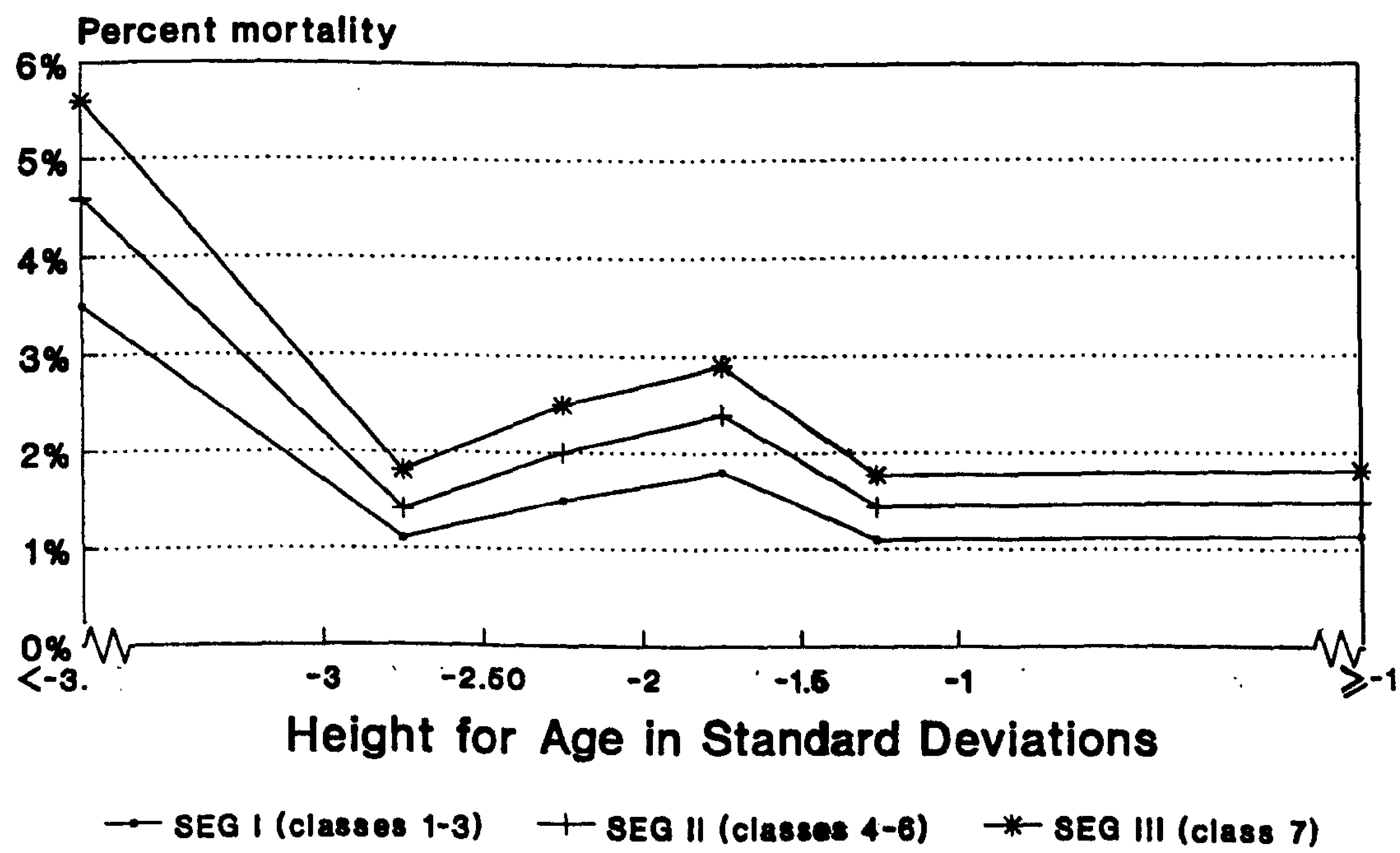
Parameters Interacting	Change of Deviance	Degrees of Freedom	Significance
MUAC * SEGs	-9.8	10	p> 0.50 NS
W/A * SEGs	-7.5	10	p> 0.50 NS
H/A * SEGs	-10.5	10	p> 0.25 NS
W/H * SEGs	-14.8	10	p> 0.10 NS

Graph 4.3 Mortality by Weight for Age by SEGs (socioeconomic groups)



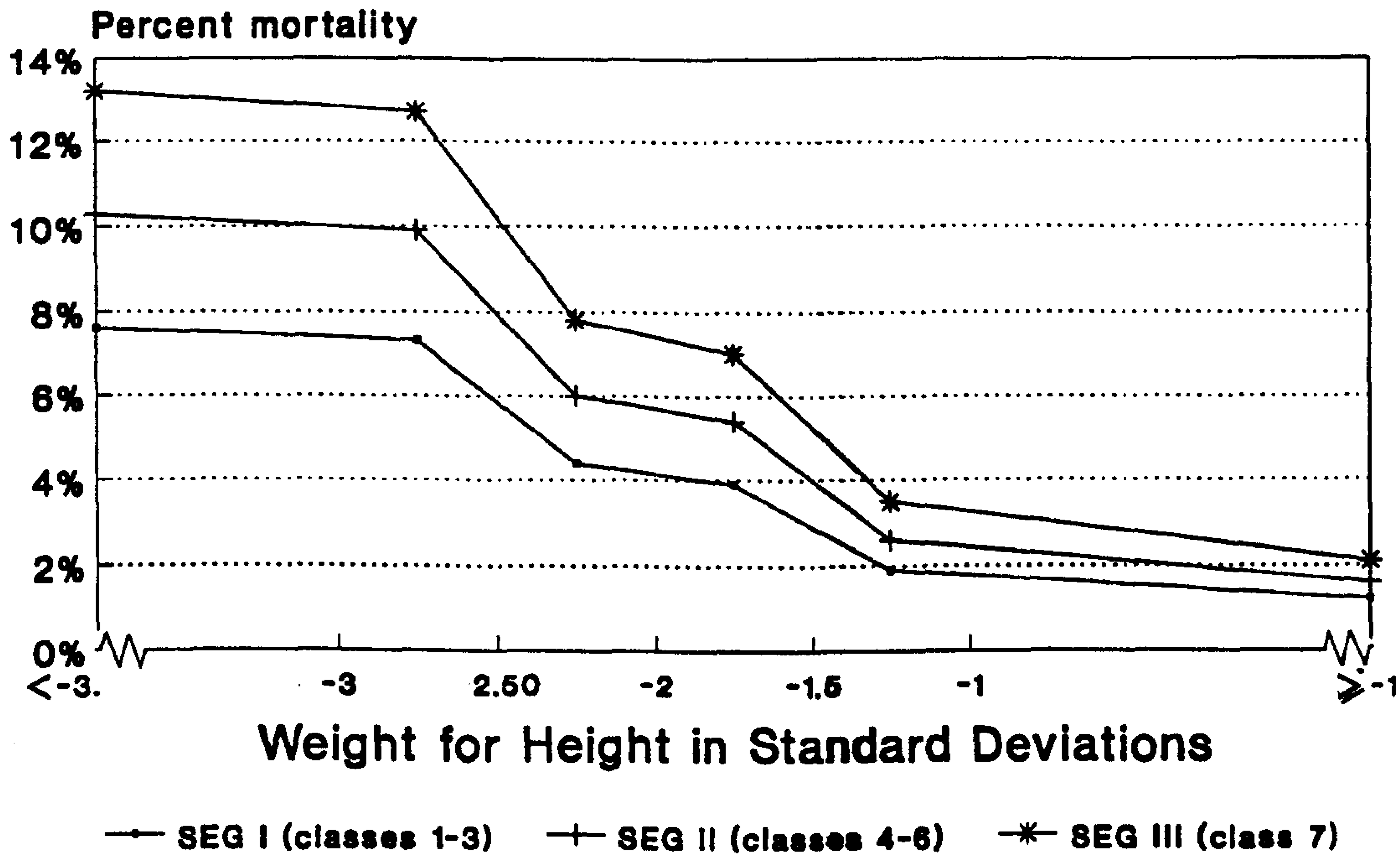
Rates predicted by logistic model

Graph 4.4 Mortality by Height for Age by SEGs (socioeconomic groups)



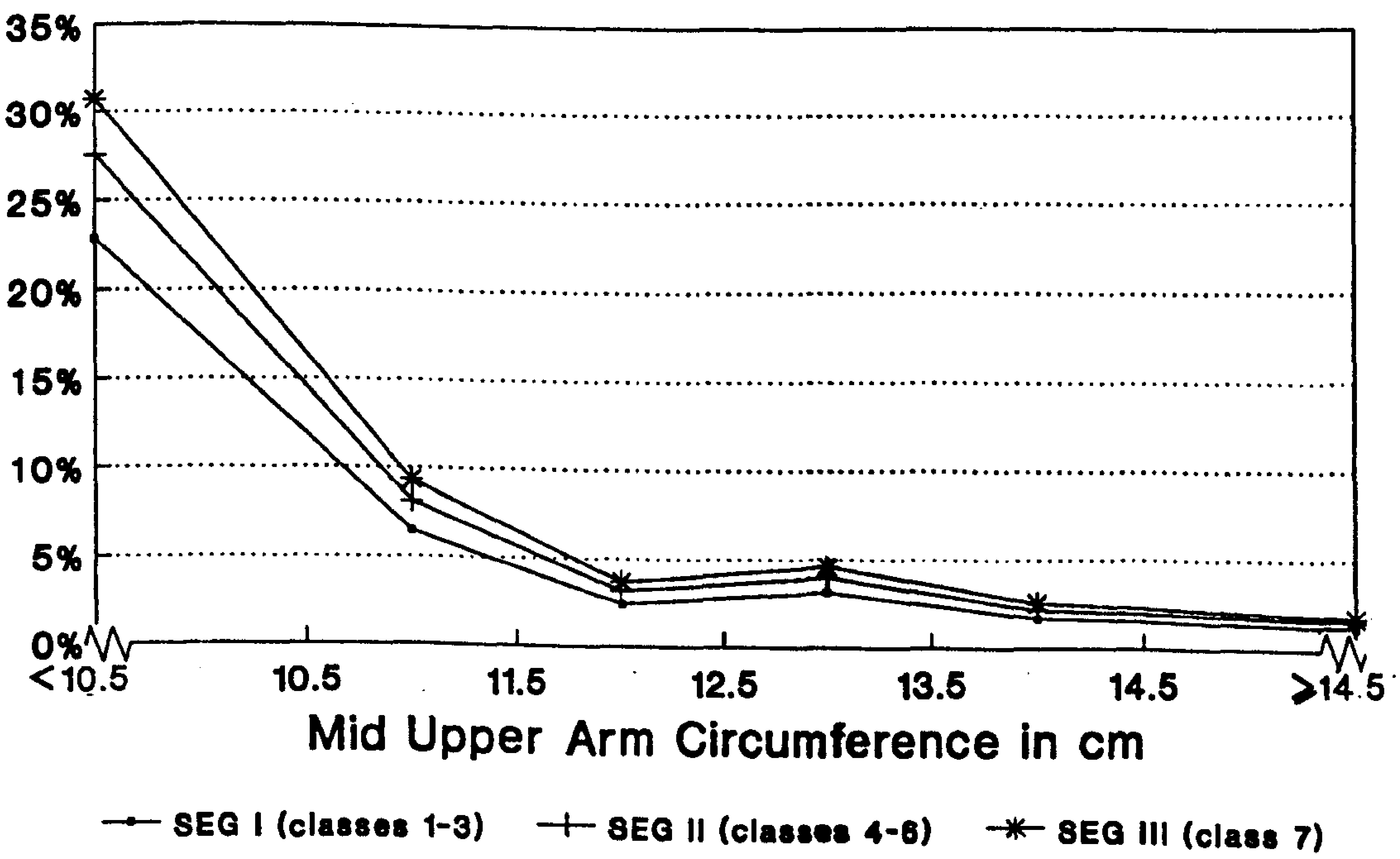
Rates predicted by logistic model

Graph 4.5 Mortality by Weight for Height by SEGs (Socioeconomic Groups)



Rates predicted by logistic model

Graph 4.6 Mortality by MUAC by SEGs (Socioeconomic Groups)



Rates predicted by logistic model

4.3.7 Comparison of the SEG variable with other variables in influencing the anthropometry/mortality relationship

The issue of whether the anthropometry/mortality relationship remains after controlling for socioeconomic status was analysed through logistic regression. MUAC as the most sensitive indicator was entered as a factor with age alone first, then single socioeconomic variables were added into the model separately. The change of deviance was significant for only three variables namely lack of ownership of a cow, father education below 8 years of schooling and if candles were used for lighting. Those variables which were more related to mortality (those with a coefficient whose level of significance was below 0.10) were included together in a final model whose change in deviance was significant. The changes that occur in the coefficient of MUAC on adding the variable SEG were not very different when compared to the effect on the coefficient of MUAC of adding the other socioeconomic variables singly or in the complex model containing several variables (lack of ownership of a cow, length of residence, birth order, father's education and candles used for lighting).

As can be seen from tables 4.20 the coefficients for MUAC between 13.4-12.5, 11.4-10.5 and below 10.5 remained more than twice their standard error whatever variable was added into the model; the coefficients changed relatively little.

It can be concluded that the corrected effect of MUAC using various socioeconomic variables is similar to the corrected effect using the SEG index derived from the MCA analysis.

TABLE 4.20

Effect of socioeconomic variables on the MUAC coefficient
(Age is always included in the model, the baseline for MUAC is >14.4 cm.
The variables are coded as in table 5.2 page 120)

VARIABLE ADDED	MUAC 14.4 13.5	MUAC 13.4 12.5	MUAC 12.4 11.5	MUAC 11.4 10.5	MUAC<10.5
No variable except age					
Coefficient	0.355	1.036	0.716	1.973	3.232
S.E.	0.325	0.329	0.529	0.522	0.457
SEGs					
Coefficient	0.348	1.023	0.700	1.945	3.193
S.E.	0.325	0.330	0.529	0.523	0.461
<2 acres of land					
Coefficient	0.355	1.032	0.717	1.986	3.230
S.E.	0.325	0.330	0.529	0.522	0.457
>3 people per room					
Coefficient	0.357	1.038	0.713	1.977	3.235
S.E.	0.325	0.330	0.529	0.522	0.457
Working on other people's land					
Coefficient	0.355	1.034	0.713	1.970	3.232
S.E.	0.325	0.330	0.529	0.521	0.457
Radio is not owned					
Coefficient	0.358	1.054	0.727	1.993	3.271
S.E.	0.325	0.331	0.529	0.522	0.461
Not hiring labour					
Coefficient	0.326	1.023	0.670	1.913	3.232
S.E.	0.325	0.329	0.529	0.523	0.459
Mother divorced					
Coefficient	0.361	1.036	0.730	1.981	3.265
S.E.	0.325	0.330	0.529	0.523	0.458
Fluids are withdrawn during diarrhoea					
Coefficient	0.354	1.033	0.714	1.969	3.202
S.E.	0.325	0.330	0.528	0.522	0.461
Cows are not owned					
Coefficient	0.327	0.985	0.697	1.904	3.094
S.E.	0.328	0.333	0.531	0.527	0.462
Length of residence					
Coefficient	0.352	1.029	0.697	1.933	3.232
S.E.	0.325	0.328	0.530	0.522	0.458

continued overleaf

(cont. TABLE 4.20)

VARIABLE ADDED	MUAC 14.4 13.5	MUAC 13.4 12.5	MUAC 12.4 11.5	MUAC 11.4 10.5	MUAC<10.5
Birth order					
Coefficient	0.352	1.046	0.693	1.952	3.214
S.E.	0.325	0.329	0.529	0.524	0.459
Candles are used for lighting					
Coefficient	0.360	1.064	0.728	2.049	3.179
S.E.	0.325	0.330	0.528	0.524	0.457
Father's Occupation					
Coefficient	0.331	0.997	0.713	1.987	3.152
S.E.	0.329	0.333	0.531	0.527	0.463
Father's education					
Coefficient	0.336	1.001	0.637	1.896	3.216
S.E.	0.328	0.333	0.532	0.525	0.459
Mother's education					
Coefficient	0.355	1.023	0.700	1.953	3.211
S.E.	0.325	0.330	0.529	0.521	0.457
Cows are not owned + Length of residence + birth order + Father's education + Candles are used for lighting					
Coefficient	0.305	0.997	0.569	1.842	3.032
S.E.	0.330	0.335	0.539	0.536	0.466

4.3.8 Cause specific mortality

One way to ascertain the causal link between malnutrition and mortality is to examine the causes of death associated with malnutrition.

As can be seen in Table 4.21, those children below a certain cut-off for various anthropometric parameters had a higher significant RR of dying from fever, diarrhoea, acute respiratory infections (ARI), measles and malnutrition if compared with children above the cut-off, while no difference in RR was registered for other causes of death. W/A below -2.5 SD was associated with a higher RR for death from fever, diarrhoea and measles; being below -3 SD H/A was associated with a higher risk of death from fever; and W/H below -1.5 SD was associated with a higher risk of death from diarrhoea measles and malnutrition. MUAC below 12.5 cm was strongly associated with deaths from fever, diarrhoea ARI, measles and malnutrition.

Malnourished children therefore had a higher risk of death from ARI, fever, diarrhoea, measles and malnutrition. They did not have a higher risk for other causes of death.

The relationship between nutritional status and measles, diarrhoea and ARI is known and thus, the fact that malnourished children died more frequently from these specific diseases added some evidence to the specific link between these two events.

TABLE 4.21

Relative Risks of causes of deaths according to different cut-offs of various anthropometric parameters. In brackets are the 95% Confidence Intervals

	Fever	Diarrhoea	A.R.I.	Measles	P.E.M.	Others
<-3 W/A SD	5.9* (1.3-26)	4.6* (1.4-15)	3.4 (0.8-14)	8.7** (2.4-31)	4.2 (0.5-34)	1.3 (0.2-9)
<-3 H/A SD	4.7** (1.5-14)	1.4 (0.5-4.3)	2.3 (0.8-6.5)	1.2 (0.3-5.4)	2.2 (0.4-11)	1.7 (0.6-4.6)
<-2 W/H SD	2.4 (0.3-19)	5.8** (2-17)	1.5 (0.2-11)	4.8* (1.1-21)	26*** (6-103)	0.4 (0.2-5)
<12.5 cm MUAC	8.2** (2.5-27)	7.5*** (3.1-18)	9.4*** (3.7-23)	4.9* (1.4-17)	27*** (6.5-113)	0.7 (0.1-5)

A.R.I. Acute Respiratory Infections P.E.M. Protein Energy Malnutrition

* $p<0.05$ ** $p<0.01$ *** $p<0.001$

It can be concluded that anthropometric indicators are important as risk factors for specific mortality, the best predictor being MUAC and the weakest

H/A. Diseases which are influenced by nutritional status have a higher fatality rate among malnourished children in this community. This is probably due to the fact that malnutrition weakens the immunological defences (see chapter VI) which will increase the incidence and severity of fever, diarrhoea, ARI and measles. Socioeconomic factors like crowding, which is associated with ARI, could also explain why malnourished children have a higher mortality for these diseases. The higher severity for these infectious diseases caused by lower immunological defences and possible lack of prompt therapy due to low socioeconomic conditions are probably the reasons for higher mortality from infectious diseases among malnourished children.

AIDS could have contributed to the high mortality rates from infectious diseases. This seems unlikely however, because the prevalence of wasting was low (less than 4%). In the event, no firm conclusion can be made because the study design did not include any assessment of the epidemiology of AIDS in the district.

4.4 DISCUSSION

4.4.1 Predictive power

As in previous studies[48-52], mortality was found to be associated with various cut-offs of different anthropometric indicators.

Under 10.5 cm of MUAC there was a big jump in mortality (36.6%) while at the lowest cut-offs for the other parameters (<-3 SD) mortality reached 11.8% with W/H, 9.1% with W/A and 4.6% with H/A.

The RR, taking as a baseline >-1 SD, started to become significant at below -3 SD H/A, -2.5 SD W/A and -1.5 SD W/H. Therefore, we assume that these should be the cut-offs to be taken into account in this population to define malnutrition. For MUAC, if we take as a baseline >14.5 cm, the RR started to become significant between 12.5 and 13.4 cm. Therefore, it is probably preferable to utilise the conventional use of < 12.5 cm for severe malnutrition, and 12.6 to 13.4 for moderate malnutrition.

4.4.2 Mortality and age

Mortality was highest below 6 months and above the first year it remained around 2%. Looking at the relationship between cut-offs and mortality according to age groups for all the parameters used except for MUAC, mortality was significantly higher below 6 months. MUAC had a peculiar behaviour in relation to age at least; below 12.5 cm it had a mortality rate around 11% below 6 months and decreased during the second year and then started rising to 20% after the second year. These changes were not significant and we can conclude that they were due to sampling variation.

In all the other anthropometric parameters, mortality went down with age, reaching a plateau after 12 months. That MUAC was more independent from age than other parameters was proven by the logistic regression in which, contrary to other parameters, the addition of age to MUAC only slightly changed the deviance. In contrast, for the other parameters the addition of age to the logistic model changed the deviance considerably, indicating their dependency on age to improve the model.

4.4.3 Sensitivity and specificity

As for any diagnostic test, sensitivity and specificity characterize the predictive power of anthropometry. There was a difference in sensitivity and specificity below and above 1 year but, in general, MUAC represented the most sensitive indicator, followed by W/A, H/A and W/H. This finding should be taken into consideration by any programme manager or health worker especially when, with scarce resources, there is a need to be selective and target those children who are more at risk. It is with a sensitive indicator at a high level of specificity that health workers could concentrate their attention on the most needy children, especially to assess mortality risk over a short period of time, leading to a more cost effective use of resources.

4.4.4 Using more than one parameter at the same time

Sometimes adding other variables increases the predictive power of MUAC. Briend[51] found that a MUAC of less than 110 mm plus the presence of oedema, bloody diarrhoea, ARI and absence of breastfeeding were associated with a higher Relative Risk (RR) than MUAC alone with subsequent raised sensitivity.

With MUAC alone and a specificity of 95% we have been able to identify 28% of children below 1 year and 17% above 1 year who died. This is lower than that reported by Briend, but it is better than that reported by previous studies in Africa.[52,53] The better results by Briend are probably due in part to the short period of follow-up which was one month.

Adding other parameters did not improve the predictive power of MUAC, while adding MUAC to other parameters improved their predictive power. This confirms that a combination of indices did not improve the prediction of death by MUAC alone. One reason for this better performance by MUAC could lie in the fact that MUAC is more related to direct muscle mass while the others such as W/A and W/H are related not only to muscle mass but also to water mass. It is to be noted that when MUAC was taken into account (Table 4.8), the other parameters were not significantly related to the risk of death. In conclusion, MUAC can be considered the best predictor of death.

4.4.5 Specific cause of death

Anthropometry was related to specific causes of death which are influenced by nutritional status such as diarrhoea, ARI and measles, suggesting a specific link between low level of anthropometry and risk of dying from diseases related to malnutrition. This is in contrast to what was found by Aaby et al in Guinea Bissau[58] where it was found that previous nutritional status (measured 1 year before the measles epidemic) among those who died from measles did not differ from the level of the general population which had relatively good nutritional status. This could be due to the fact that, being in a better-off community, the nutritional status is so satisfactory that it does not allow enough sources of variation. In Kasongo[53] also, mortality was not found to be associated with low anthropometry and the authors suggested that this lack of association was due to the good nutritional status of the community which did not allow enough variation. However, some studies indicate that malnutrition produces a higher risk of mortality from measles such as the study in Kenya[59] where there was a statistically significant difference of 6 mm of MUAC between those who had died from measles and those who survived. A study in Bangladesh,[50] showed a higher risk of measles-related mortality for children below 65% W/A.

Kielman[49] found in India that during harvest time when the temperature is high and diarrhoea prevalence is at its peak there is a higher mortality among the malnourished while the normally nourished do not experience seasonal variations in mortality. This suggests that good nutritional status may give protection from particularly severe attacks of diarrhoea and other infections.

4.4.6 Socioeconomic status as a possible confounder of the association between malnutrition and mortality.

None of the previous studies examined carefully the possibility that socioeconomic factors coexist with malnutrition producing a higher mortality among the malnourished. The possible confounding effect of socioeconomic status has been controlled in this study. When the variable SEG is included in a logistic model predicting mortality with anthropometry, there was no indication of interaction of SEG with anthropometric parameters. Even when analysing in simple cross-tabulation, mortality rates at various anthropometric cut-offs did not differ significantly between one SEG and another.

Bairagi[55] classifies the determinants of anthropometry in social and biological terms. In this study it is possible to separate the two determinants so that in SEG III, anthropometry is an indicator not only of nutritional status but also of socioeconomic deprivation. In SEG I anthropometry should be an indicator of poor nutritional status alone. Children in SEG III, are under the simultaneous threat from low socioeconomic status plus low nutritional status. Among children in SEG I the mortality associated with low anthropometry should be the consequence solely of nutritional status. According to Bairagi's hypothesis, the discriminatory power of anthropometry for mortality in the poorest group is likely to be much greater than in the better off. However there is no evidence for such an interaction in the present data where the discriminatory power of anthropometry remained good across different SEGs. Therefore, anthropometric parameters seem to have discriminatory power even in groups which are socioeconomically better-off.

Mortality under certain cut-offs was due to specific diseases, indicating a causal relationship between malnutrition and mortality.

4.4.7 MUAC vs H/A

Taking MUAC as the most sensitive predictor and 12.5 cm as the cut-off point for malnutrition there is (229/3748 in table 4.4) a prevalence of 6.1% of malnutrition at the baseline survey. Of this target group (229 children) 25 or 10.9% died which accounts for 26% of the total mortality. Therefore, concentrating on about 6% of the child population we would have the possibility of decreasing child mortality by more than 1/4.

Considering stunting and taking -3 SD H/A as the cut-off (below which mortality starts rising) we have a prevalence of severe stunting of 13.3% at the baseline survey. Of this target group (502 children) 23 died (4.5%) which is nearly 1/4 of the total mortality. Therefore, as in the case of MUAC, using this low cut-off we will identify 1/4 of the deaths but at the expense of a low specifity. So, in order to predict the same number of deaths, with MUAC we will concentrate the attention on 6.1% of the child population while with low H/A we will have to follow 13.3% of the population. Therefore, shortness or stunting, even of a severe degree, is much less linked to mortality than MUAC, although it is still related to a higher risk. The fact that only 4.5% of those below -3 SD H/A died vs 10.9% of those below 12.5 cm of MUAC could be due to the fact that the acute reduction in muscle mass could be related to recent events which directly threaten survival. Instead, linear growth could have been affected by past events acting more slowly and persistently which are more subtle in their mechanisms and therefore, their consequences would be less dramatic. It seems that, although less striking than thinness, shortness reduces survival at least when it is below -3 SD H/A. It would be sensible therefore to consider as really stunted those below -3 SD H/A in this community of Mbarara.

Some could argue that at such a low cut-off point for H/A there is also a high chance that the child will be also low for W/H and therefore the effect on mortality should probably be accounted for by the association of severe stunting with wasting. If the Waterlow classification is taken into account it is found that of those below -3 SD H/A, 2.9% were at the same time below -2 SD W/H. The percentage mortality which was 2% among the better nourished (>-3 SD H/A and -2 SD W/H) rose to 4.3% when shortness without thinness was present and to 7.8% when shortness was absent and thinness was present and to 13.3% when children were both below -3 SD H/A and below -2 SD W/H.

These different mortality rates which were all significantly higher than in the better nourished children suggest that shortness *per se* in the absence of wasting doubles the risk of mortality. It seems, therefore, that stunting has a deleterious effect on survival. This higher risk of mortality is true for severe stunting (<-3 SD H/A) while no higher risk was found between <-2 SD (the cut off point when stunting begins) and >-2 SD H/A.

4.4.8 Conclusions

It can be concluded that sensitivity was highest for MUAC followed by W/A, H/A and W/H. The addition of age into the logistic model improved the model for all the parameters except for MUAC indicating its age independent characteristic in predicting mortality.

We did not find an improvement in the predictive power of MUAC by adding other parameters, but, adding MUAC to the other parameters increased the goodness of the model. Therefore, MUAC can be usefully utilized to identify children at higher risk of death. The other advantages of MUAC, besides the high level of sensitivity, is that it is age independent, easy to use and does not require complicated equipment. Another characteristic of MUAC is its threshold effect when mortality suddenly increases below 10.5 cm, however caution is in order because of the small sample size below 10.5 cm.

The use of MUAC for targeting purposes might improve the effectiveness of interventions enabling the identification of children at higher risk of death and focusing intervention inputs on those families which need priority. MUAC is an inexpensive, simple and sensitive indicator for the purpose of targeting children at higher risk of death.

Stunting in Mbarara should only be considered below -3 SD H/A because there is no higher risk of death if we take -2 SD as cut off point. Therefore measurements of height or length would appear to have limited predictive value within the framework of routine MCH clinics.

CHAPTER V

DETERMINANTS OF CHILD MORTALITY

5.1 INTRODUCTION

5.1.1 Historical background

In developing countries, 15-20% of children die before reaching their fifth birthday compared to 1-2% in developed countries.[60] Child mortality is of great interest to parents, policy makers, health professionals and scientists, because despite the high level of imported medical technologies, it remains high in developing countries. Charlton and Rainon[61] analysing the trends of mortality due to specific diseases in six developed countries (France, Italy, Sweden, the UK, the USA and Japan) between 1950 and 1980, suggested that mortality from causes amenable to medical intervention declined faster than mortality due to causes not amenable to medical intervention and suggested that it was probably related to an expansion of medical services. This decline could have been caused by the expansion of health care facilities, but it could also have been due to socioeconomic development which was not analysed by the authors. During the period 1950-80 there was a large decline from all amenable causes in all the six countries, while other causes showed only a small decline. Whether or not this decline was due to the better availability of health services is a difficult question. Some authors[62,63] affirm that the decline in mortality during the last three centuries in developed countries was due to major socioeconomic changes which brought improvements in nutrition and hygiene and made available fertility control, while medical technology has made a much smaller contribution to the reduction of mortality. They affirm that the determinants of health are largely outside the medical care system and they say that mortality from most commom infectious diseases, such as tuberculosis, pneumonia and measles declined well before immunization and chemotherapy became available.

From national health records from France, Sweden, England and Wales it may be noted that mortality declined steadily from the beginning of the 19th Century, which is before the introduction of modern medical technology. According to McKeown,[62] in England and Wales 86% of the total reduction in the death rate from the beginning of the 18th century to the present day was attributable to the decline of infections. Of the total fall of mortality since the mid 19th Century, 40% was from airborne infections, 21% from water-food borne infections, 13% from other infections and 26% from non infective diseases.

It has to be noted that more than half of the decline of mortality from tuberculosis was before the end of the 19th century when chemotherapy was not available and measles mortality fell rapidly around the time of the First World War when immunization was not available. It seems, therefore, that the decline in mortality in developed countries was due to socioeconomic improvements, with better education, fertility control, better housing, the extension of hygienic measures and sanitation and improvement of nutrition through higher food consumption due to better food availability and affordability.

However, since World War II there has been an unprecedented decline in mortality in developing countries attributable to modern medical technology rather than to socioeconomic changes.[64-65] Preston[66] affirms that socioeconomic changes and medical technology contributed 50% each to the decline in mortality in developing countries after World War II, and he affirms that it is the economic capability of the individual family that is important to child survival. However, Gwatkin[67] suggested that the mortality decline has slowed down through the mid-1970s prompting a more critical consideration of the role of medical technology in reducing mortality.

5.1.2 Role of medical technology in the reduction of mortality

The dramatic fall in infant and child mortality in developed countries occurring in the 19th and 20th Centuries, due mainly to a reduction of deaths from infectious diseases, has nothing to do with medical technology according to McKeown[62] because it took place before chemotherapy and widespread immunization. The fall in child mortality seems mainly to have been due to better nutrition, hygiene, sanitation and birth spacing. However, this is not to say that socioeconomic development of developing countries will automatically decrease child mortality if wealth is not spread to the poorest sections of the community and, in any case, it will be a very slow process. Thus, specific action is needed to reduce child mortality because the major causes of death derive from a relatively small number of diseases such as diarrhoea and measles, deaths which could be prevented by Oral Rehydration Therapy (ORT) and immunization.

While measles is a relatively mild disease in developed countries it causes a high death toll directly and indirectly through pneumonia, diarrhoea and malnutrition in developing countries. Nutritional status, as was shown in Chapter IV, is important for child survival. Different studies[50,51] showed how well-nourished children in developing countries have mortality rates which are not very different from those of developed countries.

The difficulty of medical technologies to lower unacceptable levels of child mortality has led to more research into the determinants of child mortality in order to identify them for policy decisions.

5.1.3 Determinants of mortality

5.1.3.1 Introduction

A determinant of mortality is defined as a variable which would alter a population's mortality level if its own value were altered. The identification of important determinants of child mortality would make it possible to know which could be manipulated by policy decisions in order to reduce the level of mortality. An example would be the implementation of family planning programmes if short birth spacing was found to influence child mortality.

Biological factors (e.g. birth defects) play a significant role in perinatal mortality while environmental factors such as education, income, health service availability, water supply and sanitation are more important in infant and child mortality [68].

5.1.3.2 Birth order, birth spacing and maternal age influencing mortality.

Yerushalmy[69] observed a higher neonatal death rate in New York State for first births, for young ages of the mother, with a decline until the age of 28 followed by an increase among infants born to middle aged women. He concluded that young age of the mother and first parity had an independent relationship with high neonatal mortality. Heady[70,71] showed an increased neonatal death rate with increasing parity. Postneonatal mortality rates increased with birth order and young age of the mother, reflecting the negative effects of short birth intervals. The relationship between infant mortality, birth order and maternal age were constant in each social class. Osborne[72] found that birth spacing played a significant role in child survival even after controlling for age, parity of the mother and social class. High parity could affect child survival, not only because of short birth spacing but also because a large number of children carries a higher risk for spreading infections and many children compete for mother's time, care and family resources. Papavangelou[73] found that a birth order higher than six was strongly correlated with mortality from diarrhoeal diseases and acute respiratory infections but not from accidents, suggesting a higher opportunity of catching infections in large families. Taucher[74] found in Chile that the effect of maternal age is higher in the neonatal period and the effect of parity is stronger in the postnatal period. Centrelle and Leridon[75] found in Senegal that stopping breastfeeding at an early stage of pregnancy could explain why short birth spacing is linked to child mortality. This finding was also confirmed by Swmer in India[76] and by Cleland and Sathar[77] in Pakistan. Wolfers and Scrimshaw[78] confirmed a correlation between postneonatal mortality and birth interval in Ecuador. Thapa and Retheford[79] found in Nepal that mortality rates increased with birth order and short birth interval even when mother's age was controlled for, while mortality decreased with maternal age. Other studies[80] confirmed higher mortality when mother's age was below 20 or above 35 in a U-shape curve. Puffer and Serrano[81] analysing data from 35,095 deaths recorded in research conducted in 15 countries in the American continent found that mortality was higher when maternal age was below 20 or over 35 and it also increased with birth order.

Horwitz[82], used data from 8 American countries and found 4 socioeconomic indicators related to high mortality: low availability of animal proteins, low provision of safe water supply, low per capita income and low literacy rate.

Puffer and Serrano found that where young child mortality is high, infectious diseases account for 2/3 of the total mortality while in areas where child mortality is low, mortality from infectious diseases is also low. The most common infectious diseases causing mortality were diarrhoea and measles. Of the 35,095 deaths in the Serrano study, 10,052 were due to diarrhoea and 2,108 (6%) to measles. Protein Energy Malnutrition (PEM) was found in 59.3% of all deaths from measles.

5.1.3.3 Malnutrition and mortality

In Puffer and Serrano's study[81], infectious diseases were the most important direct cause of death. However, if we consider the indirect or associated cause of death, it appears that malnutrition was the most important, accounting for 35% of the total deaths below 5 years. In areas with high death rates, the proportion of mortality whose underlying or associated cause was malnutrition was also high; in contrast, where mortality rates were low, the proportion of mortality where malnutrition was an underlying cause, was also low. The synergism between infections and malnutrition is indicated by the fact that malnutrition was an associated cause in 60.9% of deaths from infectious diseases and only in 32.7% of deaths from other causes. All this suggests that malnutrition is probably the most important cause of excessive mortality in developing countries. Puffer and Serrano suggest the existence of a vicious cycle where mothers affected since childhood by malnutrition give birth to low weight infants, many of whom will die from infectious diseases, and those who survive will give birth to more low birth weight babies.

5.1.3.4 Socioeconomic influences on child mortality

5.1.3.4.1 Importance of father's education in child mortality

Kitagawa and Hauser[83] found education to be a direct measure of socioeconomic status. Hobcraft,[68] analysing data from the World Fertility Survey (WFS) found a correlation between parents' education, father's occupation, place of residence and child mortality. Caldwell[84] found in Nigeria that mother's education remained associated with child survival even after controlling for socioeconomic indicators, suggesting for the first time its direct relationship to child health, and not functioning as mere proxy for socioeconomic status. Mother's education was suggested to act through a lowering of fatalistic attitude, and belief to have the power to change the situation concerning child health, acceptance of new ideas, a higher confidence in dealing with health professionals, more direct responsibility in child rearing practices and more health knowledge. Kune[89] found that children of mothers with the highest education had a lower risk of death compared to their peers with mothers who had no education.

In one study carried out in Ghana[85], a significant relationship was found between place of residence, education and occupation of parents. It was estimated that children born to mothers resident in rural areas had a higher mortality compared to children living in urban areas. Children born to parents with 11 to 22 years of education had lower mortality than their counterparts born to parents with no education, and the same trend was recorded in urban and rural areas. Children with parents working in the public or private sectors had the lowest mortality. Generally, education has been regarded as a proxy of socioeconomic status and its influence on child survival was frequently given a simple economic interpretation. However, from the studies reviewed it appears that there are clear benefits on child mortality from education per se which are independent of socioeconomic conditions. In studies analysing data from 33 countries[86-87] there were consistent results about the positive influence of education on child mortality with an average decline in mortality ratio of 9% with each one-year increment in education. This influence of education on survival was found to be more prominent in Latin America than in Africa and with a stronger effect on child mortality than on infant mortality. There are few comparative inter-continental studies and the contrasting effects of education on mortality have largely been ignored. It would be interesting to know whether the harsh climate of Africa, with the very high carriage rate of parasitic diseases, might account for the somewhat blunted beneficial effects of education. In Latin America, Puffer and Serrano[81] found a tendency for children who died in the neonatal period to have more educated mothers than their peers who died between 1-4 years of age, indicating that among the better-educated mothers, the percentage of deaths under 5 years occurring in the neonatal period were much higher than deaths occurring afterwards. Puffer and Serrano[81] conclude "These significant differences in distribution of deaths by mother's education indicate that the factors responsible for mortality in these age periods must also differ". It can be suggested that education is less influential in avoiding neonatal deaths while the reverse is true for young child deaths which can be reduced through hygiene, sanitation, nutrition and preventive and curative medicine.

The influence of education was also reflected by the cause of death where "the percentage due to perinatal causes decreased from a high figure for mothers with better education to a much lower percentage for mothers with no education",[81] while for infectious diseases and malnutrition the reverse was true. Therefore, among children of mothers with post-primary education, a high proportion of deaths occurred in the neonatal period when deaths are less preventable due mainly to malformations and other perinatal factors. This was also true for areas of low infant mortality. In contrast, among mothers with no education, the proportion of deaths was high after the neonatal period when prevention, hygiene and nutrition are influential in avoiding mortality. The effect of better education could be mediated by longer birth intervals and reproduction in a less risky age group (20-35 years), better nutrition and health status of the mother, less heavy manual work with subsequently more time available for child rearing.

A precise answer to the question of how far the strong relationship between education and mortality reflects better socioeconomic conditions, as opposed to the other variables outlined in the above paragraph, is not easy. In the studies[88-95] which analysed the relationship between education and mortality after controlling for economic factors, the effect of education remained significant.

5.1.3.4.2 Importance of other socioeconomic factors in child mortality

Sex of the child was found to be important in Asian societies,[96] females having a higher risk of death compared to males, probably due to the fact that in some communities, males are considered of more value than females.

In Sierra Leone,[97] child mortality was positively correlated with maternal age, number of live births the woman had had, and low income of the household. Child survival was found to increase with women's age[98] except when the age was greater than 35.[99] Nutritional status may be considered as an intermediate variable through which socioeconomic factors operate to influence mortality. The other way through which socioeconomic factors influence mortality is through increased risk of morbidity, decreased availability of health services, poor sanitation, inadequate water supply and health knowledge. A study from Indonesia[100] found that the chance of dying for children who were first born, born shortly after a previous child, whose previous sibling had died, with young parents and with parents with little or no education was greater than for children without those characteristics. Palloni[101] found in Latin America, a high correlation between child survival and literacy level. Availability of safe water is also an important determinant of mortality. Puffer and Serrano[81] showed that families without access to safe water supply had a higher mortality compared with families who had piped water. For areas where piped water was available to 80% of the houses, the postnatal death rate varied from 4.8 to 29 per thousand, while in areas where there was less access to piped water, the death rate was between 42.9 and 83.9 per thousand. However, these differences could be due to better socioeconomic conditions in areas with high access to piped water supply. They could even be due to better nutritional status among those with better water supplies. It can be concluded that our understanding of the mechanism of influence of education on mortality remains limited and we still cannot discern the direct influence of education separated from economic status. Mosley and Chen[102] suggest that economic wealth improves child survival through prevention and cure of diseases, child spacing, hygienic practices, access to safe water supply and sanitation and more availability of food, all of which will contribute to survival through less infection and better nutrition.

In Liberia[103], child mortality was found to be higher in households using unprotected water supplies (river or stream). Maternal illiteracy and birth intervals less than 2 years were significant predictors of high rates of childhood mortality. In Mali,[104] it was found that children who breastfed longer than 18 months had a higher mortality than those who stopped breastfeeding between 12 and 18 months. In Morocco,[105] infant mortality was found to be higher in rural areas compared with urban areas, probably because in urban areas there were higher socioeconomic standards, better education and a better availability of health services. Education of the parents and father's occupation were good predictors of child mortality. However, none of these studies included any assessment of the impact of malnutrition on mortality.

5.2 METHODOLOGY

Logistic regression was used to assess coefficients and Odds Ratios associated with different independent variables. First, a univariate analysis was carried out to select those variables which were significantly associated with mortality. A variable was considered significantly associated with mortality when its p value was below 0.10. This relatively high significant level was chosen instead of the usual 0.05 in order not to miss any possible variable associated with mortality and because of the notorious difficulty in finding significant associations between variables and mortality. These variables were then analysed in a multivariate logistic model. Finally, MUAC as the most sensitive nutrition indicator was added to the model in order to see how much nutrition influences other socioeconomic variables in relation to child mortality.

5.3 RESULTS

5.3.1 Introduction

As noted in Chapter III, the highest child mortality was in the 7th socioeconomic class (see Table 3.8). The most common causes of death are shown in Table 5.1

Table 5.1 Causes of death in percentage terms for a total number of 104 cases

CAUSE	%
Diarrhoea	23
ARI	20
Measles	14
Fever/malaria	13
Malnutrition	8
Tetanus	4
Others	18

5.3.2 Univariate logistic regression

The variables collected in the baseline, which were thought to be possibly related to mortality, were analysed one by one using logistic regression. The results (Table 5.2) show that if fluids were usually withdrawn during episodes of diarrhoea (according to what was declared by the mother in the baseline survey), the child had an Odds Ratio (OR) of dying of 3.3. If the family did not own a cow the OR was 3.2. The occupation of the father was not associated with mortality. If the family had recently arrived in the village (less than 3 years) there was a significant increased OR for child mortality of 1.8 compared with those families who were resident for more than 10 years. Although education of the mother below secondary school was associated with an OR of 3.8, the p value of the coefficient was not significant. The birth order most favourable to survival was 3-5, the least favourable was above 5 (OR 1.7).

Education of the father below 8 years of schooling was associated with an OR of 3.3. If the family used candles for lighting rather than kerosine lamps or other more precious forms of lighting, there was an OR of 1.8. Other variables which could have influenced mortality such as presence of a latrine, breastfeeding, distance from the nearest health unit, being weighed in the previous 3 months, acreage cultivated, hiring labour, maternal marital status presence of a growth chart, type of water supply used, crowding, sex, radio ownership, ethnicity, religion and withdrawing food during diarrhoea were not significantly associated with mortality.

Table 5.2 Univariate logistic regression for mortality (one single variable at a time is considered)

VARIABLE	COEFFICIENT	STD ERROR	P.VALUES	ODDS RATIO
Fluids withdrawn during diarrhoea	1.206	0.478	0.012	3.3
The household does not own a cow	1.168	0.321	0.001	3.2
Resident for 4-9 years	0.297	0.300	0.321	1.3
Resident for <4 years	0.576	0.240	0.017	1.7
Birth order 1 or 2	0.412	0.258	0.110	1.5
Birth order >5	0.579	0.267	0.030	1.7
Father's education ≤ P7	1.216	0.513	0.018	3.3
Candles are used for lighting	0.636	0.204	0.002	1.8
Father's Occupation:				
Government worker	-0.317	0.583	0.586	0.7
Dependent worker	0.522	0.657	0.426	1.6
Cattle keeper	-0.261	0.404	0.518	0.7
Subsistence farmer with small animals	0.503	0.344	0.144	1.6
Export crop farmer	0.649	0.374	0.083	1.9
Subsistence with no small animals	0.124	0.377	0.742	1.1
No latrine	-0.211	0.270	0.434	0.8
Age plus	-0.041	0.010	<0.001	0.9
no breastfeeding	0.205	0.308	0.505	1.2
Mother's education ≤ P7	1.354	1.010	0.179	3.8
Health Unit > 4 miles away	0.210	0.201	0.295	1.2
Child was not weighed	-0.434	0.325	0.182	0.6
Less than 2 acres	0.204	0.201	0.308	1.2
Mother divorced	0.514	0.469	0.273	1.6
No growth chart	0.113	0.214	0.597	1.1
Unprotected water used	0.152	0.324	0.637	1.1
Not hiring labour	0.517	0.371	0.163	1.6

continued overleaf

≥ 3 people per room	0.118	0.206	0.566	1.1
Working on other people's land	-0.029	0.152	0.847	0.9
Age	-0.034	0.006	<0.001	0.9
Female Child	-0.032	0.199	0.872	0.9
Radio not owned	0.103	0.245	0.672	1.1
Ethnicity:				
Baganda	-0.050	0.467	0.914	0.9
Rwandese	0.824	0.528	0.118	2.2
Bakiga	-0.182	0.355	0.608	0.8
Others	-0.441	1.02	0.664	0.6
Religion:				
Catholic	0.044	0.216	0.835	1.0
Muslim	-0.114	0.406	0.778	0.8
Others	-1.043	0.724	0.149	0.3
Foods withdrawn during diarrhoea	-0.249	0.426	0.559	0.7

5.3.3 Multivariate logistic regression

The variables which significantly influenced child survival, namely possession of a cow, length of stay in the village, birth order, father's education, withdrawing fluids during diarrhoea and candle used for lighting, were put together in a logistic model (Table 5.3). All of them remained significantly associated with child mortality, with the exception of withdrawing fluids during diarrhoea, which became statistically not significant and could, therefore, be considered confounded by other variables.

Table 5.3 Logistic model of variables which were found to significantly predict mortality in the univariate analysis of table 5.2

VARIABLE	COEFFICIENT	STD ERROR	P-VALUE	ODDS RATIO
Age	-0.028	-0.007	<0.001	0.9
The household does not own a cow	0.927	0.326	0.004	2.5
Resident in the village				
for 4-9 years	0.201	0.325	0.536	1.2
< 4 years	0.525	0.271	0.052	1.6
Birth order 1 or 2	0.155	0.278	0.577	1.2
birth order > 5	0.598	0.275	0.029	1.8
Father's education $\leq$ P7	1.012	0.517	0.051	2.7
Fluids withdrawn during diarrhoea	0.870	0.545	0.110	2.4
Candles are used for lighting	0.656	0.219	0.003	1.9

All these variables are related to poor socioeconomic conditions which lead to low purchasing power, poor sanitation, low availability of health services, malnutrition and infection, with the final outcome of child mortality (see Flowchart 5.1).

5.3.4 Addition of MUAC into the logistic model

When MUAC, as the most sensitive indicator for nutrition, was added into the model, the coefficient of the above mentioned variables remained significant although anthropometry had the strongest effect (Table 5.4). With the addition of MUAC, there was a strong, significant change in the deviance (likelihood statistic ratio of 31 with 1 DF) significantly improving the model.

Table 5.4 Addition of MUAC into the model of Table 5.3

VARIABLE	COEFFICIENT	STD ERROR	P-VALUES	ODDS RATIO
Age	-0.074	-0.076	0.332	0.9
The household does not own a cow	0.788	0.329	0.016	2.2
Residence in the village				
for 4-9 years	0.246	0.329	0.454	1.3
< 4 years	0.539	0.273	0.048	1.7
Birth order 1 or 2	0.154	0.280	0.581	1.2
Birth order > 5	0.605	0.278	0.030	1.8
Father's education ≤ P7	0.920	0.525	0.080	2.5
Fluids were withdrawn during diarrhoea	0.505	0.571	0.376	1.6
Candle are used for lighting	0.655	0.223	0.003	1.9
MUAC	-0.381	0.065	<0.001	0.6

Likelihood ratio statistic on 1 DF = 31.085 p<0.001

These findings confirm that nutritional status and socioeconomic factors are both important predictors of child mortality.

5.4 DISCUSSION

5.4.1 Introduction

The most important causes of death were, in order of frequency, diarrhoea, ARI, measles and malaria. Chen[106] found in Bangladesh that one third of deaths of children under 5 were due to tetanus, pertussis, measles and ARI. Handajani[107] found the same results in Java. The majority of these causes of death could be preventable through immunization, oral rehydration and simple drug therapy.

5.4.2 Neonatal tetanus and mortality

Tetanus usually occurs during the first or second week of life and is fatal in the majority of cases. Among the risk factors for neonatal tetanus are: environmental exposure, sex, place of delivery and lack of immunization of the mother. Suleiman[108] reported a higher incidence of tetanus in cattle and horse raising areas where contamination is very high. In Malaysia, Chen[109] reported the highest prevalence of tetanus among children delivered by untrained TBAs followed by trained TBAs and midwives. Immunization of the mother is 100% effective in preventing neonatal tetanus, thus training of TBAs and immunization are the priorities in tetanus prevention.

5.4.3 Whooping cough and mortality

Whooping cough as a cause of death is high in some countries and low in others[110] Voorhoeve[111] found in Kenya that case fatality rate for pertussis is 3 times higher under 1 year of age when compared to case fatalities above 1 year.

5.4.4 Measles and mortality

It is estimated that globally 1.5 million children die every year of measles, mainly through its complications such as pneumonia, diarrhoea and malnutrition.[112] Morley[113] noted in Nigeria that the measles case fatality rate was 25%. Measles was the main cause of child mortality in Africa in the 1960's.[114] Aaby[58] has suggested that children who died of measles had similar nutritional status to those who survived indicating that malnutrition may not be the cause of the high fatality rate in measles. However, Chen[50] recorded significantly higher measles mortality in underweight children in Bangladesh. As mentioned in Chapter IV, children with low anthropometric values run a significantly higher risk of dying from measles. Therefore, it seems very likely that malnutrition is one of the main contributors to the high fatality rate from measles, probably through a weakened immune response.[115,116]

5.4.5 Acute respiratory infections and mortality

Acute lower respiratory tract infections such as pneumonia and bronchiolitis are the main types of ARI responsible for mortality.[117] The underlying causes for the high case fatality rate of ARI appears to be young age and malnutrition. The case fatality rate for infants is higher than for young children. Because ARI can be effectively treated, availability of health services is another risk factor for mortality from ARI. As has been demonstrated by McCord and Kielman,[118] therapy with procain penicillin can reduce mortality at village level.

5.4.6 Diarrhoea and mortality

As can be seen from Table 5.1, diarrhoea remains the top killer. WHO estimated that diarrhoea causes 5 million deaths among children under 5 every year.[119] Low income, housing conditions, parental education, pollution of weaning foods, use of unprotected water and personal hygiene are all important variables influencing mortality from diarrhoea.

5.4.7 Influence of father's education on child mortality

Father's education was important, but mother's education did not have any significant effect. This is somewhat different from what has been found in other studies where mother's education was associated with lower mortality.[120] Martin et al[121] reported that father's education was more important than mother's education in reducing child mortality.

In this study, the effect of education is relevant at levels beyond primary school but no difference was found in child survival between no education and education between Primary 1 (P1) and Primary 7 (P7). This could be due to the fact that primary education is extremely basic in this District. The finding that the effect of education is pronounced beyond 7 years of schooling is confirmed by other studies.[97,122] This could explain why mother's education was not significant in influencing child survival, because only 4% of the women had secondary education, too small of a proportion to produce significant results. It should also be noted that other studies did not find any effect of mother's education on mortality.[85,123] In Nigeria,[123] mother's education was significantly associated with child survival in the bivariate analysis, but this relationship disappeared in the multivariate analysis when adjustment was made for the other variables. In the present study, mother's education was negatively correlated with child mortality, but this association was not statistically significant. Probably, the correlation between education of the mother and child mortality operated through its association with other socioeconomic variables. On the other hand, father's education had an important influence on child survival after adjustment was made for other variables. It is possible that fathers with a high level of education had greater purchasing power and were thus able to provide their families with better living conditions. They might have been better able to decide on what priority actions needed to be taken in child matters and influenced mothers decisions on preventive medicine such as immunization. They could have had a less fatalistic approach to diseases, been better informed as to how to use health facilities and could have shared family resources more equally, especially in favour of the children. A more educated father could have recognized the severity of diarrhoea and taken proper action before dehydration occured. Education of the father could have had an influence by encouraging and facilitating the mother to attend antenatal care and deliver in a health unit.

In many developing countries, women restrict their diet in order to have small babies who are easier to deliver, but may be at higher risk of death due to low birth weight. Antenatal care could influence the woman's diet during pregnancy besides taking proper action in case of any complication.

Educated husbands could encourage and facilitate their wives to undergo tetanus immunization which could prevent many infant deaths. An educated father could also positively influence weaning practices, thus limiting the prevalence of diarrhoea. He is more likely to take proper action in case of child illness. Father's education could also influence sanitation, health care practices, availability of health services, food consumption and reallocation of family expenditure from the older to the younger members of the family. In fact, even if a protected spring or a borehole is not very far from the house, if education is low, the family will still use the unprotected nearby pond. Using clean vessels to collect the water, cleaning hands and utensils before preparing foods, boiling drinking water and storing it separately from water used for other purposes and other healthy behaviours are almost impossible without a higher level of education or intensive health promotion.

Another effect of education could be through changing beliefs and health care related practices. It is expected that due to his dominance in family decision making, father's education could be even more important than mother's education and one would expect the children of an educated father and educated mother to experience a lower mortality than children with an uneducated father and an educated mother. Even if contraceptive supplies were available, an uneducated husband might remained unconvinced, especially in a male dominated society. High fertility rates are associated with high infant and child mortality, and they affect nutritional status of mother and child. But acceptance of family planning requires a radical change in behaviour of an educated husband because it is usually he who decides about the size of the family. The most obvious consequence of father's education is more knowledge of curable and preventable diseases and of nutritional requirements of infants and children. Education may inculcate a greater sense of personal responsibility for the welfare of children, replacing the more fatalistic approach of the uneducated father.

Father's education could influence mother's choices and increase her skill in health care practices related to contraception, nutrition, hygiene, preventive care and disease treatment.

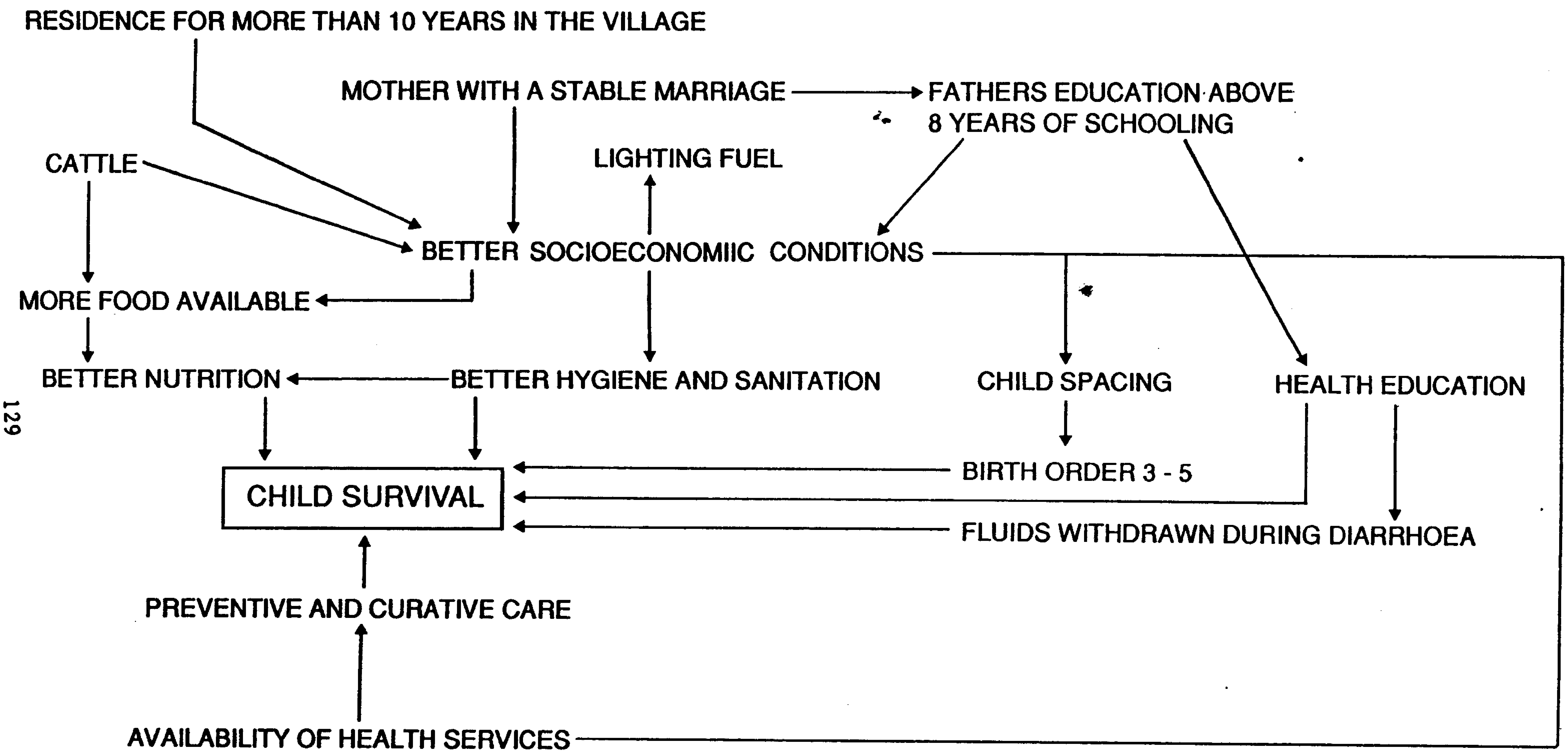
5.4.8 Socioeconomic factors influencing mortality

Living in households with candles for lighting, where the family did not own a cow or who were resident in the village for less than 3 years, were significantly associated with child mortality. Being of birth order higher than 5 or having a divorced mother also contributed significantly to child mortality. Being resident for only a short time had a negative influence on child survival in comparison with those families who had been resident for a long time. This could be due to the fact that families suffered economically from civil war strife which affected the area 2 years prior to the survey, while families who were resident for more than 10 years could have been of wealthier economic conditions. The most favourable birth order for child survival was between 3 and 5. This might be dependent on the age of the mother (child survival is best if mothers are aged 20 to 35 years),[99] but it could also be related to the total number of children a woman bears in a lifetime, and to child spacing.[124] The study did not include the age of the mother among its data and so was unable to control for this variable.

In conclusion, the results demonstrated the relative importance of some key variables as determinants of child mortality in Mbarara. The extent to which these variables are significant, independent predictors of child mortality, was assessed through logistic regression.

FLOWCHART 5.1

FLOWCHART OF CHILD SURVIVAL IN MBARARA



CHAPTER VI

DETERMINANTS OF NUTRITIONAL STATUS

6.1 INTRODUCTION

6.1.1 Background

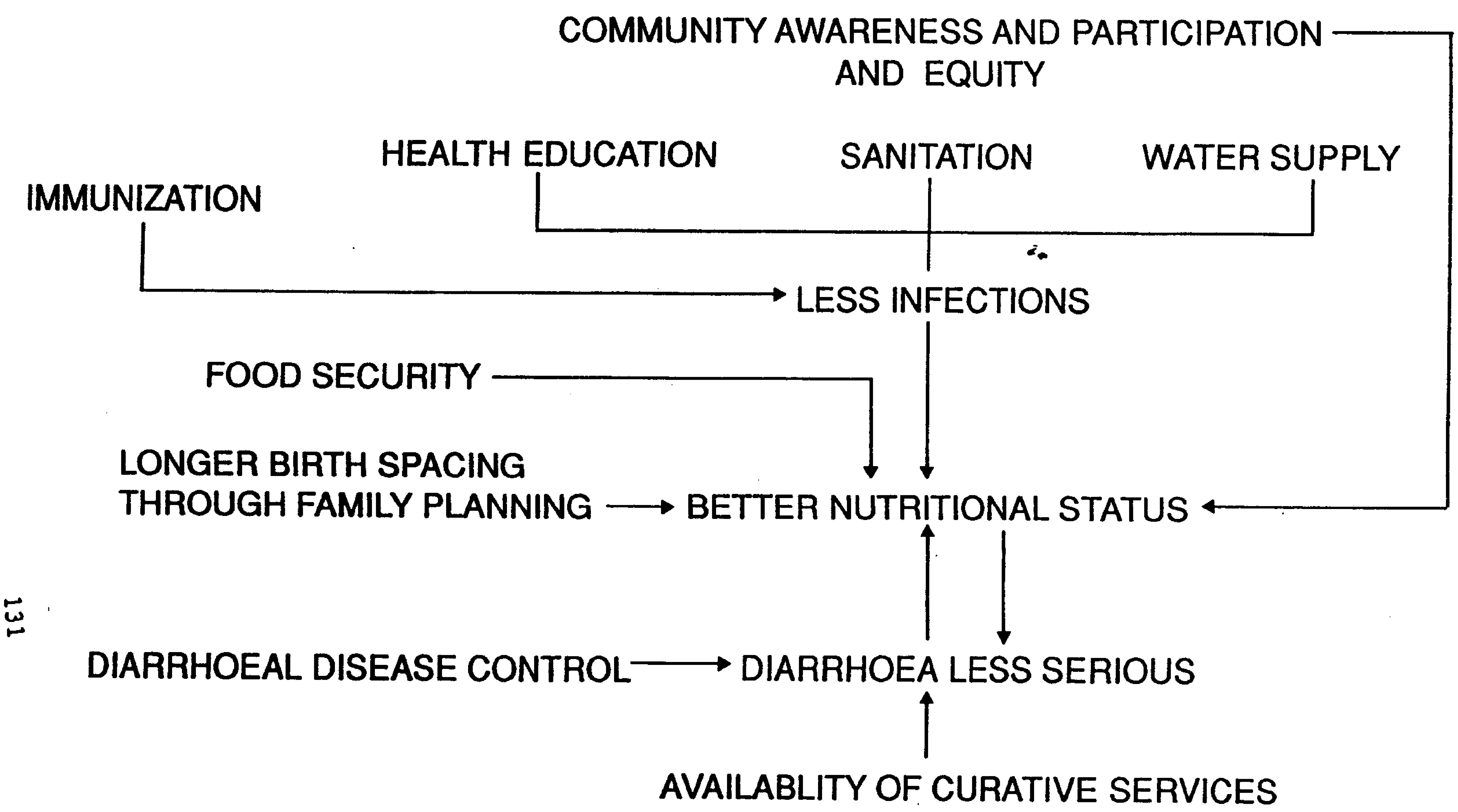
Nutritional status is the endpoint of an ecosystem which can be described in a nutrient flow model beginning with food production, food imports and exports, transportation, distribution, storage, processing, post-harvest losses and inter-family distribution (a function of income and food marketing). Once a given quantity of food is available to a family, the food consumed by the individual will depend on the intra-family distribution (a function of culture). Finally, infections (e.g diarrhoea) causing loss of appetite and malabsorption, and feeding practices determined by the level of education will determine how much of the food consumed by the individual will be assimilated and biologically utilized to maintain nutritional status. When the consumption and assimilation of nutrients is inadequate in quantity and quality to cover the individual energy and micronutrient requirements, there will be an impairment of health and physiological functions. For purposes of the present discussion, the term "malnutrition", in a very general way, will be used to describe these disorders of physiological functions.

6.1.2 Epidemiology of malnutrition

It is not possible to describe the epidemiology of malnutrition with a unidirectional model of causation because its ecology is formed by a complex system in which every variable is affected by a multitude of other variables, giving rise to simultaneous interacting causal models. Poverty, political upheaval, ignorance, taboos and feeding practices, economic and agricultural policies, type of production, processing and storage of food, sanitation, water supply, family size, mother's time for child rearing, natural and man

FLOWCHART 6.1

PHC APPROACH



made calamities, low wages, unemployement, epidemics and many other factors interact in a multidirectional way, forming a web of causation whose final outcome is malnutrition.

Thus, only if integrated interventions in the context of Primary Health Care (PHC) are developed can we have some chance of producing an impact on nutritional status (Flowchart 6.1). The chances of success are likely to be limited if single elements of PHC are excluded, or if the various components do not interact between each other. Health and nutrition are affected more by the socioeconomic situation than by health services _per se_ and, without a change in the socioeconomic structure, the inequality of resource distribution will persist with the perpetuation of poverty, which is at the base of the nutritional problem. Because of the difficulty of tackling poverty directly, interventions try to act on the other elements of the web of causation such as infections, whose negative interaction with nutritional status has been confirmed by many studies.[125-129] Infectious diseases, especially diarrhoea, affect nutritional status through malabsorption and lower food consumption,[130] but the relationship is bidirectional because malnutrition facilitates and worsens the common infectious diseases of childhood.[131] Despite the complex nature of the basis for malnutrition in a community, it is possible to examine specific risk factors which are characteristic of a particular community. This analysis forms the basis of the next sections.

6.2 METHODOLOGY

The anthropometric standard utilized in this study is the NCHS standard[26]; the different classifications used to define malnutrition are based on various cut-off points. Two main methods are used, referring to percentage of the median standard or to difference measured in standard deviation (SD) units from the median standard. The first method consists of calculating the percentage of the median standard represented by a certain W/A, H/A or W/H, and of choosing the point under which malnutrition may be regarded as occurring. The problem with the percentage of the median method is that the cut-off points chosen to define malnutrition differ for W/A, H/A and W/H.

The other method is to choose as cut-off point 2 standard deviation units below the median of the reference population. Only 2.5% of the total reference population should fall below -2 SD from the median, thus beyond this point the indicators W/A, H/A and W/H are considered to be low, and whoever is below this cut-off point has a high chance of being malnourished (that is with some degree of functional abnormality).

The advantage of the SD measure is that it is based on a statistical principle and it is the same for all anthropometric parameters. For this reason SD measures are used in this analysis.

The analysis of the determinants of malnutrition was carried out utilising multiple regression, the variables were considered influencing anthropometric parameters if their coefficient reached a significant level of $p<0.05$.

6.3 RESULTS

6.3.1 Introduction

Anthropometric indicators are often used to assess nutritional status. The most important are weight, height and mid upper arm circumference (MUAC). Weight for age (W/A) is a comparison between the weight found in a child of a given age with a standard weight for that age. It is an indicator of the total body mass, but it does not distinguish between actual and past malnutrition. Children who have suffered from malnutrition in the past can be small for their age, have lower body mass and weigh less than normal children at the same age, even if they are not malnourished at present. On the other hand, children who are tall for their age but actually malnourished could have normal weight for their age.

Height for age (H/A) compares the height of a child of a given age with a standard height for the same age; it is used as an indicator of stunting or shortness.

Weight for Height (W/H) compares the weight of a child of a given height with a standard weight for the same height, and it is an indicator of wasting or thinness.

MUAC is used to assess muscle wasting which is characteristic of thinness.

6.3.2 Prevalence of malnutrition

Looking at the distribution of the different parameters by age groups (Tables 6.1-6.4) it can be noted that low W/A was uncommon below 6 months (4% below -2 SD), reaching relatively stable levels around 20% in the other age groups.

H/A below -2 SD was 10% below 6 months, 24% between 6 and 11 months, and reached its peak in the second year, declining very slightly in the following years.

Low W/H was infrequent below 6 months (2.4%) reaching its peak between 6 and 11 months (6.5%) and declining afterwards to around 2% in the fourth and fifth year. Similar trends were obtained using the percentage of the median. However, the prevalences were different. In fact, a total prevalence of low W/A of 18.5% was obtained using the -2 SD; and 21.8% using below 80% of the median. The prevalence for stunting was 32.5% using below -2 SD; and 21.3% using below 90% of the median.

The total prevalence of wasting was 3.8% using below -2 SD W/H; and 2.7% using below 80% from the median. 26.6% of children in the second year were below 13.5 cm of MUAC, which is often considered the cut off point for moderate and severe muscle wasting. The situation improved in the following years to arrive at 2.6% in the fifth year. The overall prevalence of children above 1 year below 13.5 cm of MUAC was 12.5%.

According to Waterlow, a more complete classification of malnutrition can be obtained looking at W/H and H/A together in a 4 by 4 grid (Table 6.5). In this classification there are 4 groups, the first one being normal (above -2 SD H/A and W/H) and requiring no action. The second group is stunted but not wasted (below -2 SD H/A and above -2 SD W/H). The third group is wasted but not stunted (above -2 SD H/A and below -2 SD W/H). The fourth group is wasted and stunted (below -2 SD H/A and W/H).

Therefore, the Waterlow classification magnifies what was demonstrated by the other tables where each indicator was used by itself. We can conclude that the nutrition situation is satisfactory below 6 months, deteriorates in the second half of the first year, and later on, during the weaning period when all the problems connected with diarrhoea and insufficient nutrient intake slows down growth. The situation improves in the fourth and fifth years, but never reaches the level of the first 5 months. The inadequacy of "catch up" of the growth lost in the weaning period results in a high prevalence of stunting in older children.

The mean SD W/A H/A and W/H was similar to the NCHS standard in the first 3 months, declining steadily afterwards and thereafter remaining around -0.5 SD for W/H, -1 SD for W/A and -1.5 SD for H/A. The mean MUAC was always above 13.5 cm after the first year.

Table 6.1 Percent below -2 SD and 80% of the median W/A by age groups

	Age in Months 0-5 (380)	6-11 (460)	12-23 (904)	24-35 (865)	36-47 (800)	>47 (731)	TOTAL (4,140)
<-2 SD	3.9%	18.9%	22.1%	20.3%	18.3%	19.2%	18.5%
<80%	10.5%	24.3%	25%	21.3%	21.8%	22.7%	21.8%

Table 6.2 Percent below -2 SD and 90% of the median H/A by age groups

	0-5 (380)	Age in Months 6-11 (460)	12-23 (904)	24-35 (865)	35-47 (800)	>47 (731)	TOTAL (4,140)
<-2 SD	10%	23.9%	38.1%	32.6%	38%	36.8%	32.5%
<90%	7.1%	11.5%	22.1%	21.5%	27.9%	26.3%	21.3%

Table 6.3 Percent below -2 SD and 80% of the median W/H by age groups

	0-5 (380)	Age in Months 6-11 (460)	12-23 (904)	24-35 (865)	36-47 (800)	>47 (731)	TOTAL (4,140)
<-2 SD	2.4%	6.5%	6.2%	3.9%	1.9%	2.1%	3.8%
<80%	3.4%	4.3%	3.7%	2.8%	1.1%	1.6%	2.7%

Table 6.4 Percent below 13.5 cm of MUAC by age groups

	Age in Months 12-23	24-35	36-47	above 47	TOTAL
	(897)	(863)	(795)	(728)	(3,283)
	26.6%	11.0%	7.3%	2.6%	12.5%

Table 6.5 Waterlow classification
Numbers in brackets and cell percentages

		H/A SD <-2	>-2
W/H SD	<-2	(43) 1%	(116) 2.8%
	>-2	(1304) 31.5%	(2,677) 64.7%

The values for nutritional status for the entire age group were worst in SEG III compared to the other groups, while no difference was found for W/H among SEGs. MUAC was worse in SEG 3 and it nearly reached the significant level of 0.05.

Table 6.6 Prevalence of malnutrition among SEGs (Socioeconomic Groups)

	SEG I (1,295)	SEG II (1,715)	SEG III (656)	TOTAL (3,666)	Significance
<-2 SD W/A	15.1%	20%	22.3%	18.7%	<0.001
<-2 SD H/A	26.2%	35.1%	39.2%	32.7%	<0.001
<-2 SD W/H	4.2%	3.5%	4.1%	3.9%	0.538 NS
<13.5 cm MUAC (above 1 year)	(1,023) 11.4%	(1,373) 13.3%	(507) 15.6%	(2,903) 13%	<0.07 NS

6.3.3 <u>Determinants of malnutrition (see Tables 6.6-6.9)</u>

6.3.3.1 <u>Variables correlated with W/A</u>

Among the variables negatively correlated with W/A were: mother having withdrawn fluids during the last episode of diarrhoea, having suffered from measles in the previous 3 months, diarrhoea in the previous 2 weeks, living in a family not able to hire labour, having a divorced or pregnant mother, not having a latrine in the household, living with more than 3 people per room, living more than 4 miles from a health unit, having a father working as a subsistence farmer and with an education below 8 years of schooling, being first or second born and living in a family with less than 2 acres of land. Living in a family which did not own cattle, and was Catholic were other variables negatively associated with W/A. Among the variables positively influencing the coefficient W/A were being of the Bakiga tribal group, and not being breastfed.

6.3.3.2 Variables influencing H/A

Among the variables negatively influencing the coefficient H/A were diarrhoea or eye infections in the previous 2 weeks, not having a latrine, living in a household which did not hire labour and where somebody in the family worked on other people's land, having a father with less than 8 years of education, living in a crowded household which did not own a cow and having a pregnant mother. Not being breastfed, having a family whose religion was Muslim positively influenced the coefficient of H/A.

6.3.3.3 Variables influencing the coefficient of W/H

The following variables negatively influenced the coefficient of W/H: living in a household where candles were used for lighting. Having suffered from diarrhoea in the previous 2 weeks or measles in the previous 6 months, having a divorced mother, living more than 4 miles from a health unit, being Catholic or Muslim. On the other hand, being Bakiga positively influenced the coefficient of W/H.

6.3.3.4 Variables influencing MUAC

The following variables negatively influenced the coefficient of MUAC: having withdrawn fluids during the last episode of diarrhoea, living in a household with more than 3 people per room, which did not own a radio, did not hire labour, was living more than 4 miles from a health unit, cultivated less than

2 acres of land and used candles for lighting. If the child was not weighed in the previous 3 months and suffered from diarrhoea or worm infestation in the previous 2 weeks, there was a negative coefficient for MUAC.

Belonging to the Rwandese or Bakiga tribal group, having a father working as a professional or export crop farmer and not being breastfed were associated with a positive coefficient for MUAC.

6.3.3.5 Variables associated with more than one parameter

Diarrhoea was negatively associated with all the anthropometric parameters. The variables negatively associated with at least 3 anthropometric parameters were age, distance from a health unit more than 4 miles, living in a household not hiring labour, being Catholic, having a father with education below 8 years of schooling and living in a crowded household.

The variables which were negatively associated with at least 2 parameters were: living in a household with no latrine, cultivating less than 2 acres of land, not owning a cow, having a mother who withdraws fluids during diarrhoea and having a pregnant mother.

The variables with a negative correlation with only one parameter were: being first or second born, having a father working as a subsistence farmer, living in a family whose members worked on other people's land in the previous 6 months, not having been weighed in the previous 3 months and having suffered from worm infestation or eye infections in the previous 2 weeks. The variables which had a positive influence on the anthropometric parameters were: belonging to a Bakiga or Rwandese family and, having a father working as a professional or export crop farmer. Being Muslim was positively associated with H/A and negatively with W/H.

A finding which seems contradictory, but which was found by other researchers[132,133,148] is the fact that not breastfeeding was associated with a better nutritional status. This is due to the fact that prolonged breastfeeding (after 12 months) negatively affects nutritional status as shown in graph 6.1-6.4. If the relationship between breastfeeding and nutritional status is analysed, controlling for socioeconomic groups (SEGs), it can be noticed (graph 6.5-6.8) that breastfeeding after 12 months is associated with a lower nutritional status in all SEGs.

TABLE 6.7 Relationship between W/A and socioeconomic, cultural and environmental variables in multiple regression

Variable	Coefficient	S.E	Significance
Using protected water supply	0.022	0.063	0.728
Family worked on other people's land	-0.006	0.008	0.443
The child was not weighed	-0.063	0.080	0.431
Residence in the village:			
4-9 years	0.069	0.066	0.300
< 4 years	0.011	0.066	0.861
Age	-0.013	0.001	<0.001
Morbidity:			
Fever/malaria	-0.145	0.082	0.078
Respiratory Infections	-0.075	0.059	0.207
Diarrhoea	-0.445	0.077	<0.001
Worms	-0.217	0.160	0.175
Eye infections	-0.401	0.231	0.083
Measles in the past 3 months	-0.297	0.149	0.046
Others	0.082	0.099	0.404
The household does not own a cow	-0.146	0.071	0.039
The household does not have a latrine	-0.158	0.054	0.003
The child is not breastfed	0.219	0.069	0.001
Maternal education <8 years	-0.072	0.118	0.543
Paternal education <8 years	-0.207	0.074	0.005
The household does not have a radio	-0.091	0.054	0.093
Health Unit > 4 miles away	-0.103	0.044	0.019

continued overleaf

Birth order:			
1 or 2	-0.126	0.051	0.013
above 5	0.013	0.054	0.808
Tribal group:			
Baganda	-0.034	0.111	0.755
Rwandese	0.197	0.160	0.217
Bakiga	0.155	0.069	0.025
Others	0.011	0.181	0.951
Father Occupation:			
Goverment worker	-0.098	0.102	0.337
Professional	0.286	0.154	0.064
Cattle keeper	0.109	0.085	0.196
Subsistence with small animals	-0.108	0.076	0.155
Export crop farmer	-0.097	0.085	0.253
Subsistence without animals	-0.171	0.077	0.027
Religion:			
Catholic	-0.093	0.046	0.045
Muslim	-0.014	0.096	0.879
Others	-0.183	0.236	0.436
The mother is pregnant	-0.132	0.060	0.029
Fluids were withdrawn during diarrhoea	-0.331	0.168	0.049
Less than 2 acres of land	-0.127	0.045	0.004
The household did not hire labour	-0.149	0.071	0.035
Candles are used for lighting	-0.085	0.049	0.085
The mother is divorced	-0.395	0.137	0.004
Food was withdrawn during diarrhoea	-0.001	0.080	0.989
More than 3 people per room	-0.125	0.044	0.005

R^2 0.08 Significant F <0.001

Table 6.8 Relationships between H/A and socioeconomic, cultural and environmental variables in multiple regression

VARIABLE	COEFFICIENT	S.E.	SIGNIFICANCE
Use of protected water supply	-0.129	0.084	0.124
Family worked on other land	-0.027	0.011	0.019
The child was not weighed	-0.035	0.107	0.741
Residence in the village:			
4 to 9 years	0.158	0.088	0.073
< 4 years	0.005	0.088	0.946
Age	-0.019	0.002	<0.001
Morbidity previous 2 weeks:			
Fever/malaria	-0.175	0.109	0.109
Respiratory Infections	-0.030	0.079	0.697
Diarrhoea	-0.491	0.102	<0.001
Worms	-0.134	0.213	0.529
Eye infections	-0.699	0.307	0.023
Measles in the past 3 months	-0.021	0.198	0.914
Others	0.064	0.131	0.622
The household does not have a cow	-0.298	0.094	0.001
The household does not have a latrine	-0.163	0.071	0.023
The child is not breastfed	0.346	0.091	<0.001
Maternal education <8 years	0.091	0.157	0.560
Paternal education <8 years	-0.219	0.099	0.027
The household does not own a radio	-0.103	0.072	0.152
Health unit >4 miles away	-0.014	0.058	0.804
Birth order:			
1 or 2	-0.083	0.068	0.221
>5	0.116	0.072	0.108
Tribal group:			
Baganda	-0.102	0.148	0.489
Rwandese	0.333	0.212	0.117
Bakiga	-0.080	0.092	0.383
Others	0.225	0.241	0.351

continued overleaf

Occupation of the father:			
Government worker	-0.032	0.136	0.814
Professional	0.289	0.205	0.159
Cattle keeper	0.095	0.113	0.397
Subsistence with small animals	-0.082	0.101	0.420
Export crop farmer	-0.043	0.113	0.703
Subsistence without animals	-0.167	0.103	0.104
Religion:			
Catholic	-0.003	0.061	0.951
Muslim	0.348	0.128	0.006
Others	0.090	0.313	0.773
The mother is pregnant	-0.231	0.080	0.004
Child was not weighed	-0.035	0.107	0.741
Fluids were withdrawn during diarrhoea	-0.168	0.224	0.453
Less than 2 acres of land	-0.116	0.059	0.051
The household did not hired labour	-0.194	0.094	0.040
Candles are used for lighting	0.012	0.065	0.852
The mother is divorced	-0.324	0.183	0.076
Food was withdrawn during diarrhoea	-0.037	0.107	0.727
More than 3 people per room	-0.122	0.059	0.039

R^2 0.07 Significant F <0.001

Table 6.9 Relationship between W/H and socioeconomic, cultural and enviromental variables in multiple regression

VARIABLE	COEFFICIENT	S.E	SIGNIFICANCE
Use of protected water supply	0.112	0.059	0.057
Family worked on other people's land	0.011	0.008	0.163
The child was not weighed	-0.087	0.075	0.243
Residence in the village:			
4-9 year	-0.013	0.062	0.822
< 4 years	0.013	0.062	0.832
Age	-0.003	0.001	0.046
Morbidity previous 2 weeks:			
Fever/malaria	-0.051	0.077	0.507
Respiratory Infections	-0.077	0.055	0.166
Diarrhoea	-0.226	0.072	0.001
Worms	-0.217	0.149	0.147
Eye infections	-0.017	0.216	0.933
Measles previous 3 months	-0.414	0.139	0.002
Others	0.071	0.092	0.438
The household does not own a cow	0.026	0.066	0.687
The household does not have a latrine	-0.070	0.050	0.164
The child is not breastfed	-0.036	0.064	0.568
Maternal education <8 years	-0.190	0.110	0.085
Paternal education <8 years	-0.129	0.069	0.063
The household does not own a radio	-0.032	0.050	0.521
Health unit >4 miles away	-0.134	0.413	0.001
Birth order:			
1 or 2	-0.084	0.047	0.077
>5	-0.057	0.050	0.259
Tribal group:			
Baganda	0.034	0.103	0.737
Rwandese	0.026	0.149	0.859
Bakiga	0.254	0.065	<0.001
Others	-0.135	0.169	0.424

continued overleaf

Paternal Occupation:			
Government worker	-0.124	0.096	0.194
Professional	0.138	0.144	0.337
Cattle keeper	0.066	0.079	0.401
Subsistence with small animals	-0.054	0.071	0.446
Export crop farmer	-0.074	0.079	0.348
Subsistence without animals	-0.053	0.072	0.458
Religion:			
Catholic	-0.108	0.043	0.012
Muslim	-0.287	0.089	0.001
Others	-0.262	0.220	0.234
The mother is pregnant	-0.013	0.056	0.815
Fluids were withdrawn during diarrhoea	-0.248	0.157	0.115
Less than 2 acres of land	-0.081	0.042	0.051
The household did not hire labour	-0.027	0.066	0.684
Candles are used for lighting	-0.104	0.046	0.024
The mother is divorced	-0.282	0.128	0.028
Food was withdrawn during diarrhoea	0.007	0.075	0.925
More than 3 people per room	-0.069	0.041	0.098

R^2 0.04 Significant F <0.001

Table 6.10 Relationships between MUAC and socioeconomic,cultural and environmental variables in multiple regression

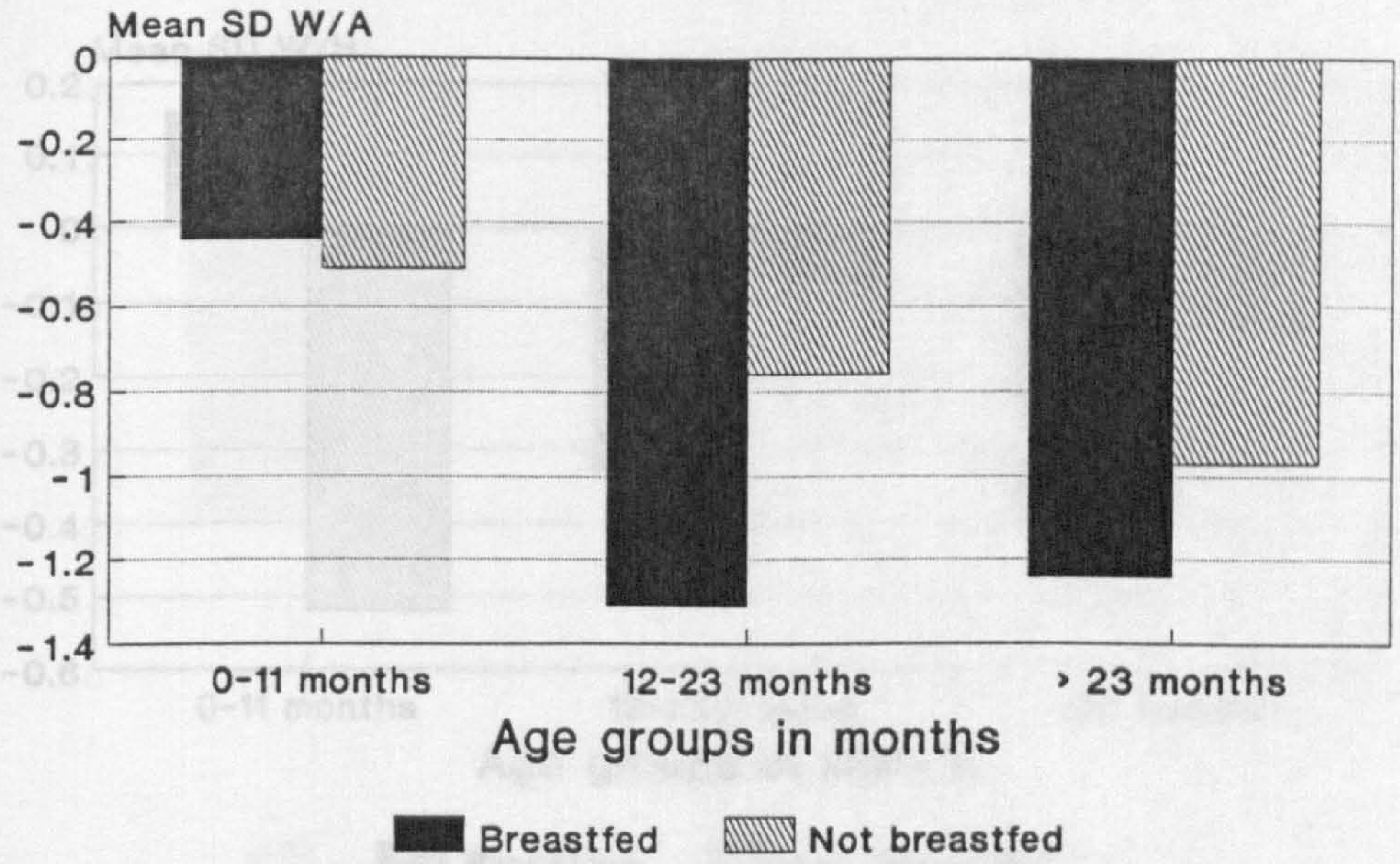
VARIABLE	COEFFICIENT	S.E.	SIGNIFICANCE
Use of protected water supply	-0.026	0.065	0.687
Family worked on other people's land	-0.001	0.008	0.950
The child was not weighed	-0.255	0.083	0.002
Residence in the village:			
4-9 years	-0.029	0.068	0.672
<4 years	-0.087	0.068	0.199
Age	0.036	0.001	<0.001
Morbidity previous 2 weeks:			
Fever/malaria	0.021	0.085	0.803
Respiratory Infections	0.013	0.061	0.828
Diarrhoea	-0.186	0.079	0.019
Worms	-0.323	0.165	0.050
Eye infections	-0.078	0.241	0.745
Measles previous 3 months	-0.151	0.153	0.324
Others	0.208	0.101	0.040
The household does not own a cow	-0.096	0.073	0.189
The household does not have a latrine	0.001	0.055	0.990
The child is not breastfed	0.367	0.071	<0.001
Maternal education <8 years	0.054	0.122	0.653
Paternal education <8 years	-0.238	0.077	0.002
The household does not own a radio	-0.203	0.055	<0.001
Health Unit >4 miles away	-0.166	0.045	<0.001
Birth order:			
1 or 2	-0.064	0.052	0.222
> 5	-0.065	0.056	0.240
Tribal group:			
Baganda	-0.043	0.114	0.705
Rwandese	0.383	0.163	0.019
Bakiga	0.273	0.071	<0.001
Others	-0.094	0.187	0.614

continued overleaf

Paternal occupation:			
Government worker	-0.103	0.106	0.328
Professional	0.337	0.158	0.033
Cattle keeper	0.099	0.087	0.257
Subsistence with small animals	-0.003	0.079	0.961
Export crop farmer	0.201	0.087	0.021
Subsistence without animals	0.124	0.079	0.118
Religion:			
Catholic	-0.139	0.047	0.003
Muslim	-0.075	0.098	0.446
Others	0.149	0.241	0.535
Mother pregnant	-0.016	0.062	0.793
Fluids were withdrawn during diarrhoea	-0.467	0.174	0.007
Less than 2 acres of land	-0.091	0.046	0.049
The household did not hire labour	-0.152	0.073	0.037
Candles are used for lighting	-0.156	0.051	0.002
The mother is divorced	-0.048	0.140	0.732
Food was withdrawn during diarrhoea	-0.063	0.083	0.444
More than 3 people per room	-0.103	0.046	0.024

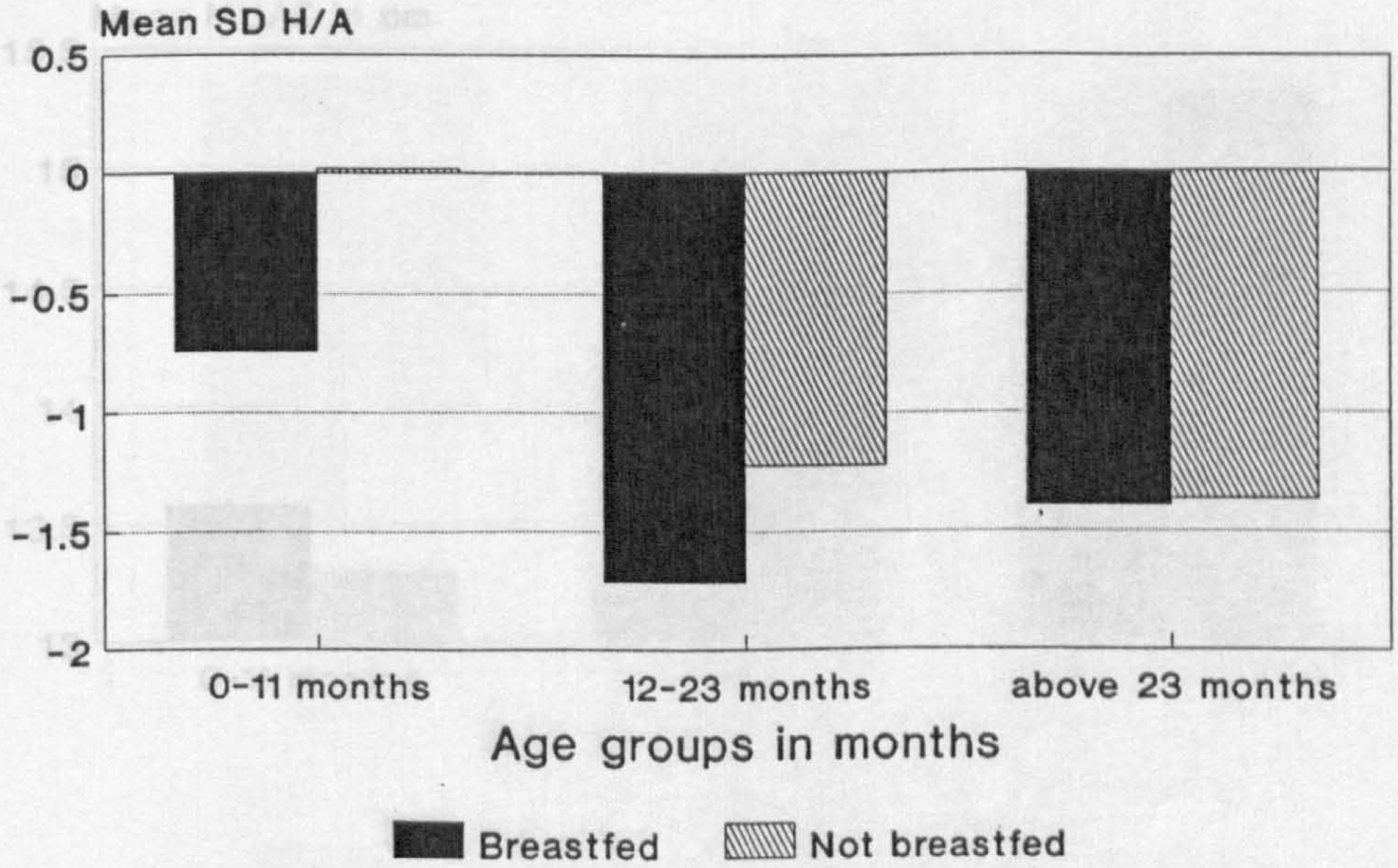
R^2 0.29 Significant F <0.001

Graph 6.1 Mean SD W/A between breastfed and not breastfed by age groups



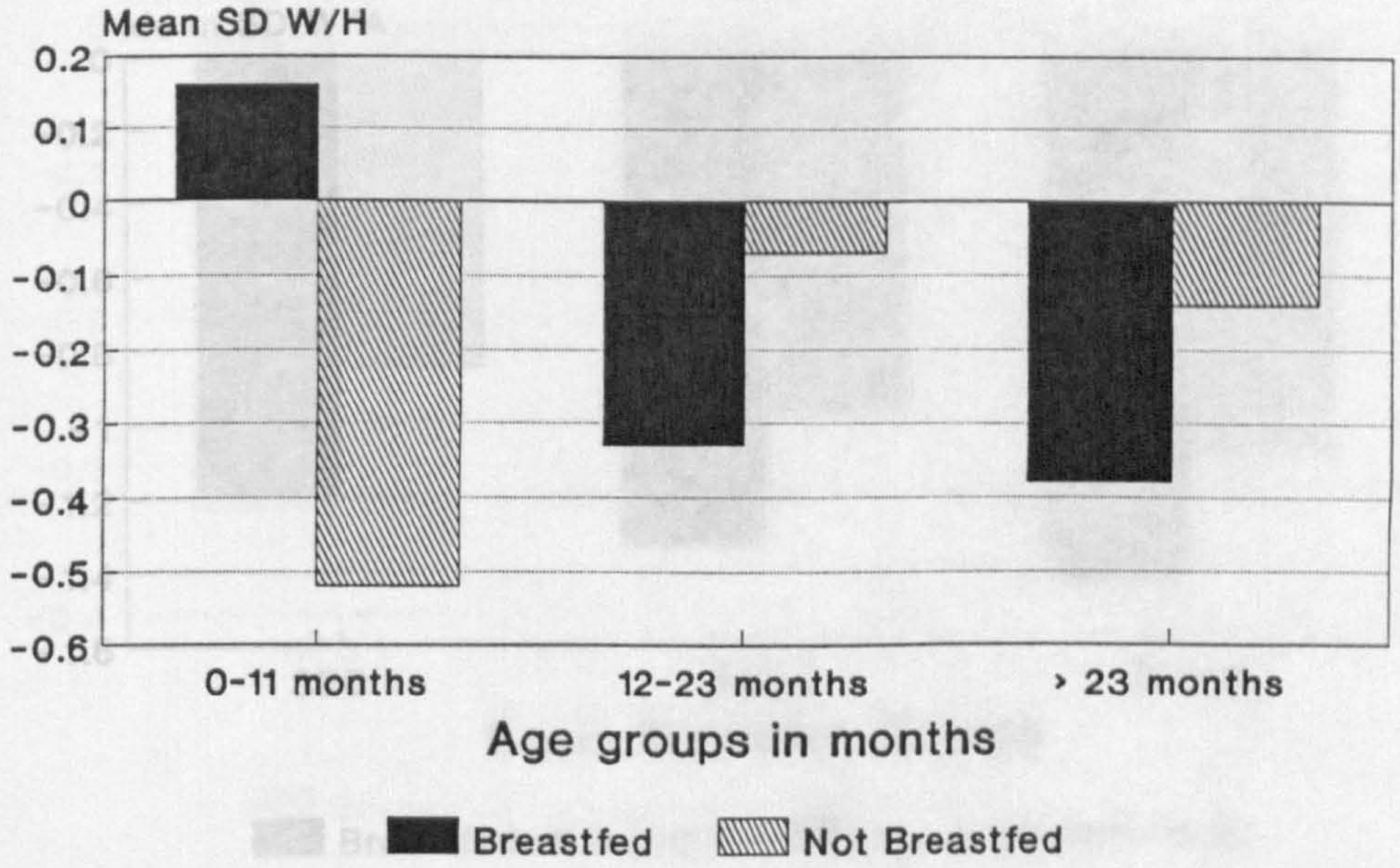
ANOVA Significance of F ‹0.001

Graph 6.2 Mean SD H/A between breastfed and not breastfed by age groups



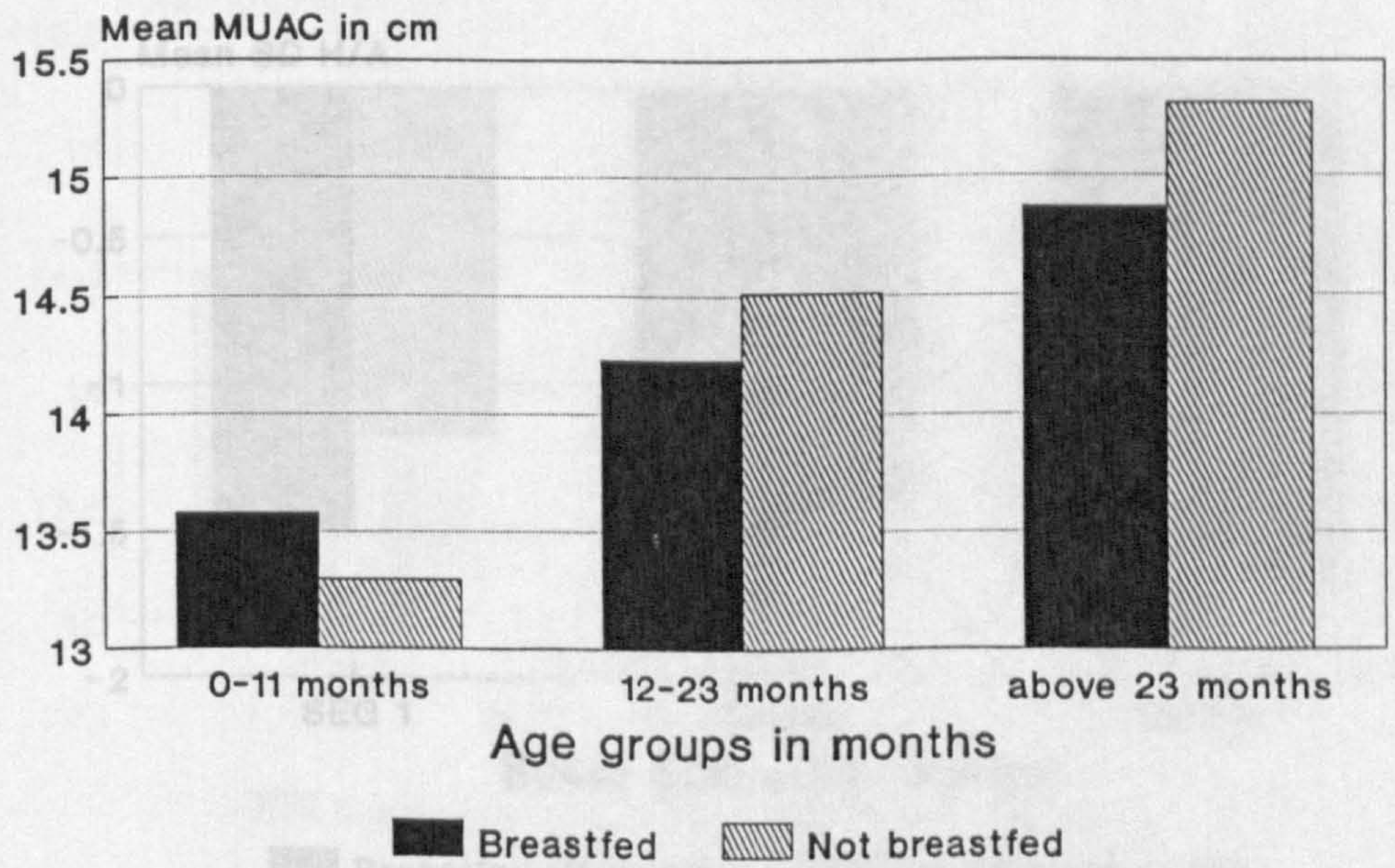
ANOVA Significance of F ‹0.001

Graph 6.3 Mean SD W/H between breastfed and not breastfed by age groups



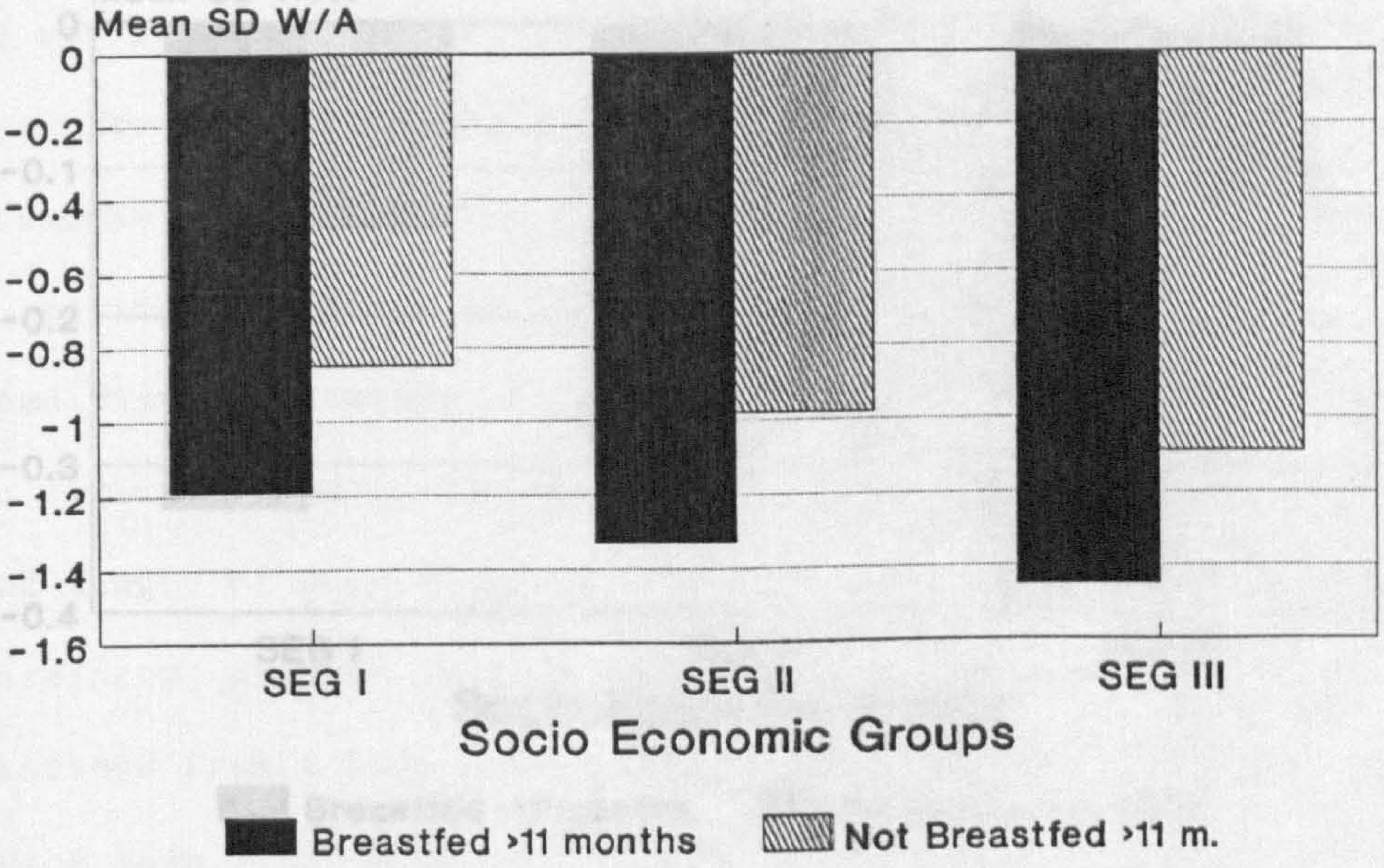
ANOVA significance of F 0.028

Graph 6.4 Mean MUAC between breastfed and not breastfed by age groups



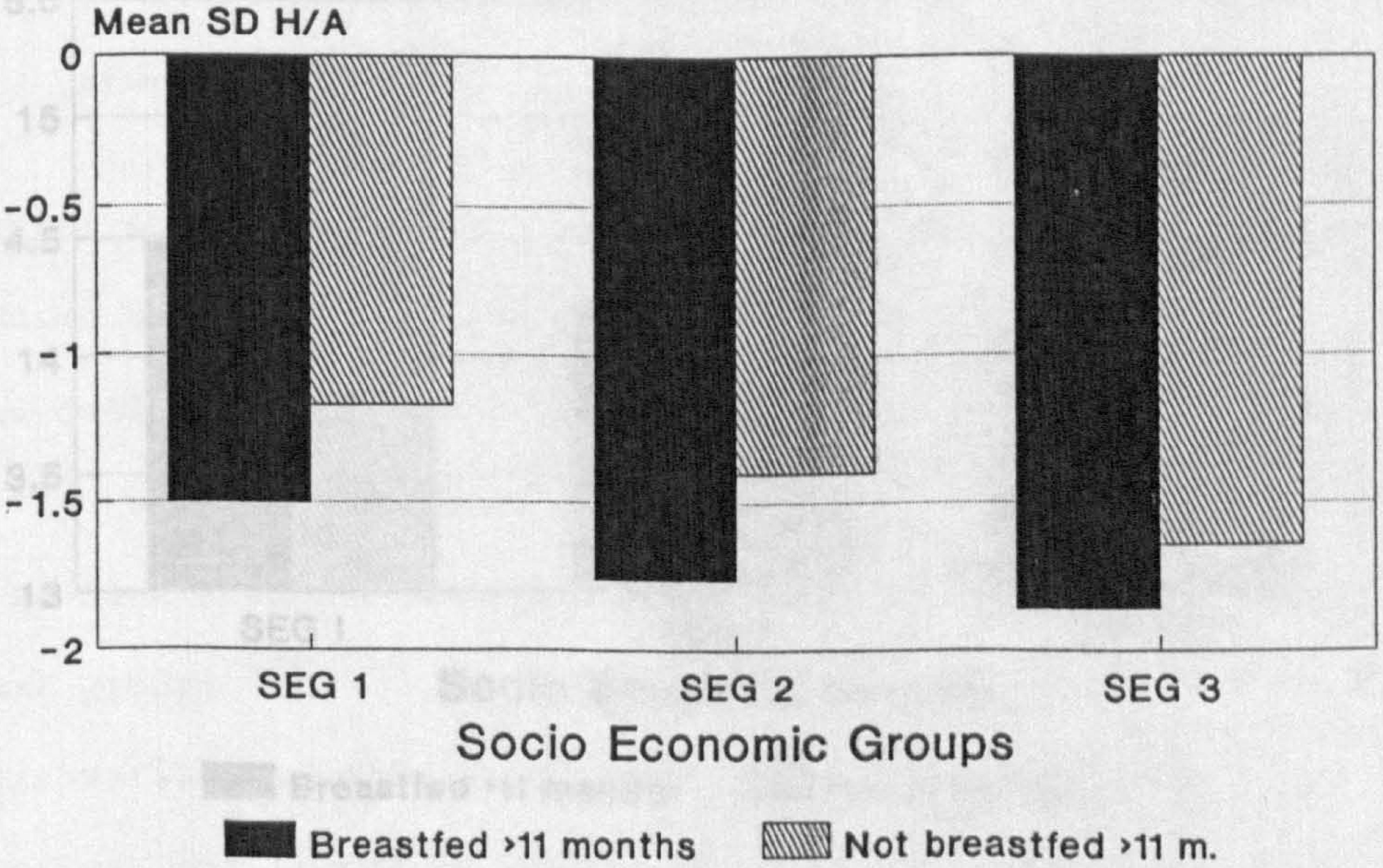
ANOVA Significance of F <0.028

Graph 6.5 Mean SD W/A by SEGs
by breastfeeding above 1 year



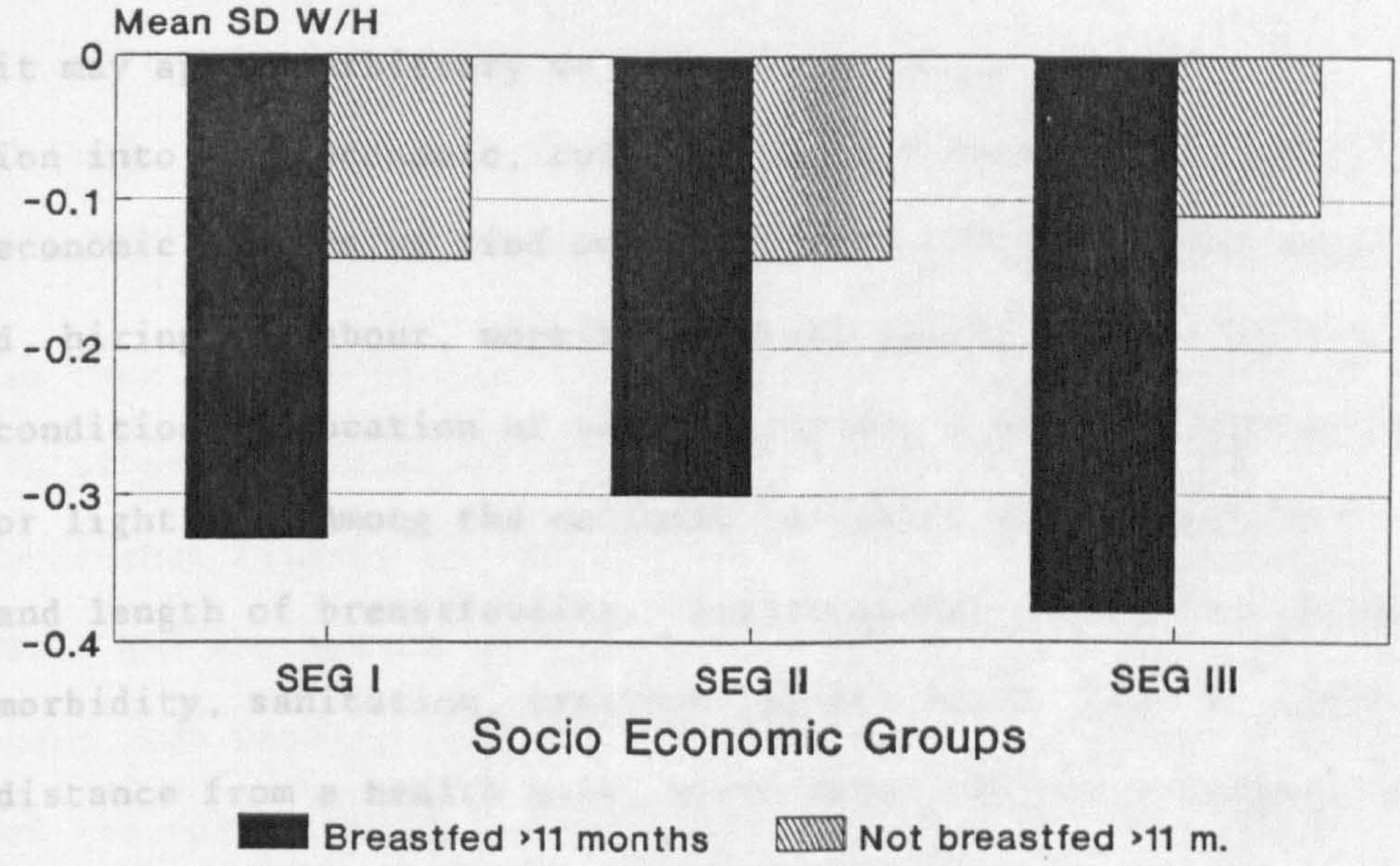
ANOVA Significance of F <0.001

Graph 6.6 Mean SD H/A by SEGs
by breastfeeding above 1 year



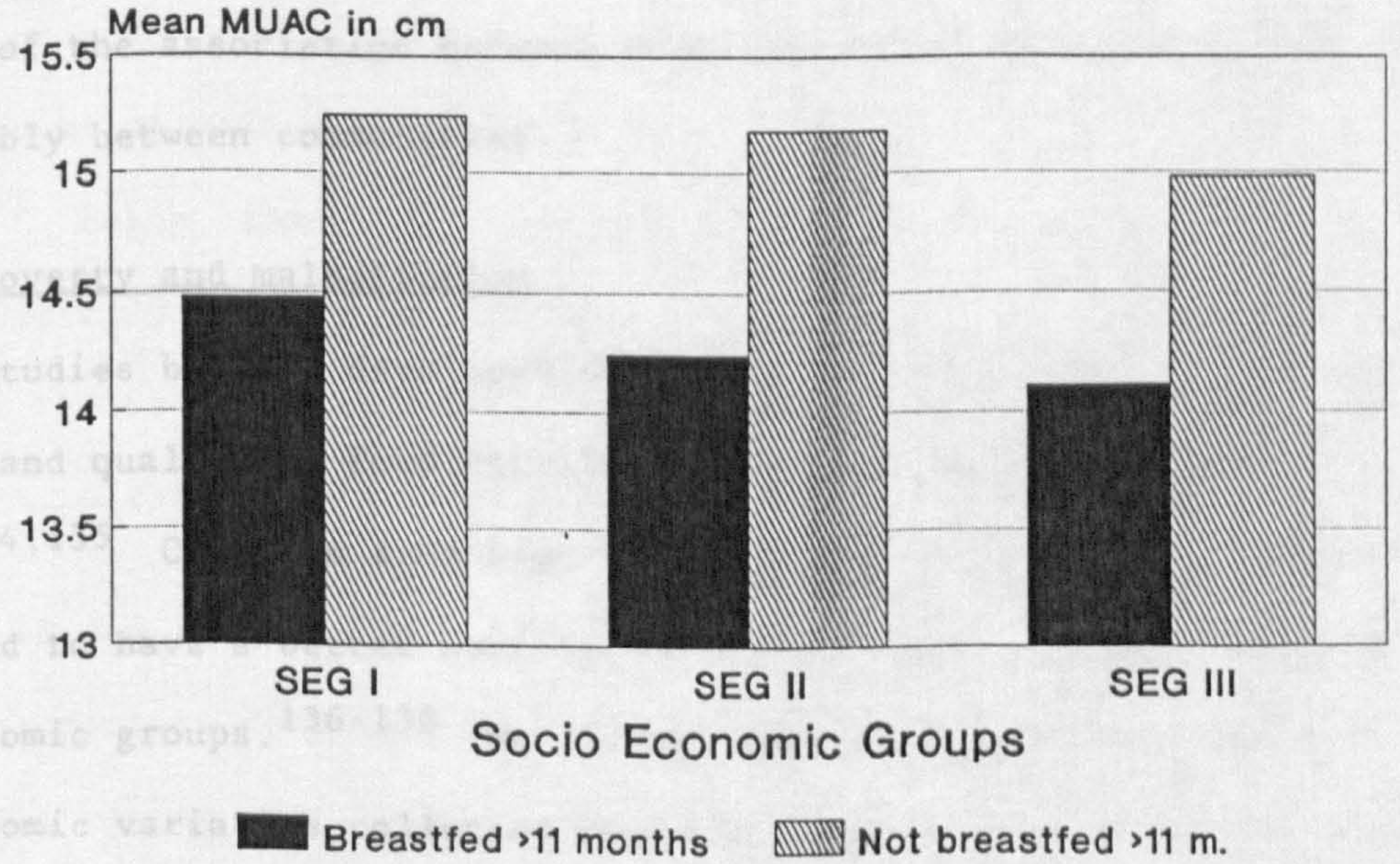
ANOVA Significance of F <0.001

Graph 6.7 Mean SD W/H by SEGs by breastfeeding above 1 year



ANOVA Significance of F 0.002

Graph 6.8 Mean MUAC in cm by SEGs by breastfeeding above 1 year



ANOVA significance of F ‹0.001

6.4 DISCUSSION

6.4.1 Introduction

Although it may appear arbitrary we can divide the determinants of malnutrition into socioeconomic, cultural and environmental factors. Among the socioeconomic factors we find ownership of a cow and radio, area of land cultivated, hiring of labour, working on other people's land, occupation, crowding conditions, education of parents, having a divorced mother and, using candles for lighting. Among the cultural variables we find ethnicity, religion and length of breastfeeding. Environmental and health variables include: morbidity, sanitation, treatment of diarrhoea (such as withdrawal of fluids), distance from a health unit, birth order, having a pregnant mother and not having been weighed in the previous 3 months.

6.4.2 Socioeconomic variables

6.4.2.1 Introduction

Malnutrition is a valuable indicator of deprivation, reflecting economic factors affecting food availability in the household. The major causes of malnutrition are often of a social economic and political nature, but the strength of the association between deprivation and malnutrition varies considerably between communities.

6.4.2.2 Poverty and malnutrition

Various studies both in developed and in developing countries have shown that quantity and quality of food obtained by the household vary with income.[134,135] Children from high socioeconomic groups in developed countries were found to have a better nutritional status than children from low socioeconomic groups.[136-138] We did not have data on income but the socioeconomic variables collected could be considered a proxy for income and purchasing power, and it can be seen that those families with the worst socioeconomic conditions had children with lower nutritional status. More purchasing power leads to the purchase of food in times of crisis, of seeds, fertilizers, insecticides, farming tools and more land, which will increase food production; and these better-off farmers will probably have more access to roads and markets where they can sell their produce.

Having less than 2 acres of land negatively influenced W/A and MUAC. This variable is directly related to the quantity of food production. These were mainly subsistence farmers who did not have enough land to mantain adequate food supplies and who had to work on other people's land in order to survive. These farmers were usually found with hardly anything left in the granaries at the time of the survey which was conducted in the pre-harvest season.

Crowding was negatively associated with all anthropometric parameters except W/H; it is probably one of the most sensitive indicators of socioeconomic deprivation.

Having a divorced mother negatively affected nutritional status and this could be due to the economic and psychological insecurity created by the divorce. Family disruption due to parental separation and divorce were found to be one of the causes of malnutrition in Nigeria,[139] Zaire,[140] Tanzania[141,142] and Uganda.[143] Using candles for lighting was negatively associated with W/H and MUAC, reflecting the low purchasing power of the family. Therefore, poverty is one of the major causes of malnutrition, probably acting through low food intake and infections.

However, if low food intake is one of the causes of malnutrition why is it that supplementary feeding programmes have resulted in only a minor improvement of the situation? Beaton and Gassemi[144] reviewing the literature on feeding programmes, suggest that they did not improve dietary intake substantially due to the leakage of food to non-target subjects. However, not all supplementary feeding programmes are ineffective. In an intervention conducted in 4 villages in Guatemala in which two villages received a protein caloric supplement while the other 2 received a low-caloric drink, there was a height and weight improvement in the villages receiving the caloric protein supplement, while no improvement was evident in the 2 villages reveiving a low-caloric drink.[145] The implication is that if food is made available to poor families in sufficient quantity, they might experience an improvement in nutrition. On the other hand, they may not, because poor environment and frequent diseases decrease the impact of the supplementation. Indeed, the poorer the family the least likely it is that food supplementation on its own will improve nutrition.

6.4.3 <u>Parental education and malnutrition</u>

Education of the father below 8 years of schooling was negatively associated with H/A and MUAC. Education of the mother below 8 years of schooling was not significantly associated with low W/H, but it nearly reached the significant level of 0.05 (p 0.08).

Fonaroff[146] found a significant correlation between maternal education and malnutrition in Jamaica. Coulter,[147] comparing malnourished with well nourished children, found that the mothers of the former were more frequently pregnant and had poorer housing conditions, sanitation and water supply and less education than the mothers of normal children.

The relationships between parental education and nutritional status could be related to more health knowledge, but it could also be due to better socio-economic conditions of the higher educated. However, because education remained significantly associated with nutrition after allowing for other socioeconomic variables, it is probable that this association is due to better knowledge of child rearing practices.

6.4.4 Cultural variables

Being Bakiga was positively associated with W/A, W/H and MUAC, and being Rwandese was positively associated with MUAC. Being Catholic was negatively associated with W/H and MUAC, while being Muslim positively influenced H/A and negatively influenced W/H. Belonging to a religion or a tribal group could be associated with socioeconomic conditions so that Bakiga and Rwandese could be better off and Catholic worse off. However, another reason for the association between nutrition and cultural variables may be the influence on living conditions, food taboos and behavioural practices which might affect or improve nutritional status. Food taboos could lead to deprivation of important foodstuffs.

Another variable which could be related to the cultural background is prolonged breastfeeding which negatively affected the coefficients of W/A, H/A and MUAC. In other words, those children who continued breastfeeding after 12 months had significantly lower anthropometric parameters in comparison with their peers who stopped breastfeeding before 12 months of age. These data confirm findings in Ghana by Brakohiapa et al[148] where breastfeeding beyond 12 months was found to be associated with malnutrition. Brakohiapa found that before cessation of breastfeeding protein and energy intake were about half those of normal controls and when the malnourished children were weaned, their nutrient intake rose until it reached that of the normal controls, while those who continued breastfeeding maintained their low nutrient intake. It is suggested that prolonged breastfeeding can be associated with less food intake also due to mother's perception of child food needs and thus causing malnutrition. These finding have been confirmed by other researchers.[132,133]

It is possible that breastmilk production after 12 months is quite diminished and therefore the suckling child receives less total energy protein intake compared to those children who stop breastfeeding earlier. It is also possible that the child who is on the breast is reluctant to accept other foods in sufficient quantity, as demonstrated by the findings in Ghana where children increased their food intake significantly after stopping breastfeeding. This association between prolonged breastfeeding and poor nutritional status being due to socioeconomic factors can be excluded because it did not disappear in the multiple regression where many socioeconomic variables were controlled for and furthermore, was present in all three SEGs.

In the light of the finding that prolonged breastfeeding is related to malnutrition it would be advisable to pay particular attention to those families in which breastfeeding is prolonged. Although there was not enough data available it seems likely that the intake of solid foods was not satisfactory in those children who were breastfed for longer than 12 months. The data does not suggest stopping breastfeeding after 12 months. On the contrary it is essential during time of illnesses to continue breastfeeding during the second year of life. There is a need for further research to know why children who are breastfed after the 12th month appear to be malnourished in comparison to those children who stopped breastfeeding before 12 months.

6.4.5 <u>Environmental variables</u>

Lack of a latrine was negatively related to W/A and H/A. Withdrawing fluids during diarrhoea negatively affected MUAC, probably due to an association with other behavioural practices such as giving less foods during diarrhoea or the convalescent period, retarding the catch-up in growth. Having a pregnant mother was negatively associated with W/A and H/A, reflecting less capacity by the mother to care adequately for the child. All the environmental variables influence diarrhoea and other infections through hygiene and sanitation.

6.4.6 Diarrhoea and malnutrition

Diarrhoea in the previous 2 weeks negatively influenced all anthropometric parameters, and this association was highly statistically significant. Scrimshaw et al[149] suggested that the relationship is bidirectional where diarrhoea has a negative influence on nutrition and malnutrition predisposes to diarrhoea. The association between diarrhoea and poor nutritional status was confirmed in many studies.[128,150] Rowland et al[129] estimated that if diarrhoea was eliminated in the Gambia, children would achieve a weight gain of 200-400 grams per month, similar to children living in developed countries. Cole and Parkin[151] found in Uganda that diarrhoea was significantly related to weight loss. Various researchers found that diarrhoea was significantly associated with linear growth[152] and weight faltering.[153,155] However, Guzman et al[154] found in Guatemala no association between growth and frequency of illness.

6.4.6.1 Mechanisms through which diarrhoea causes malnutrition

During typhoid, caloric expenditure may increase up to 50% and there may be an average protein loss of 500-800 grams.[156] Severe persistent diarrhoea could cause a loss of 2.5 Kg in a 1 year old child, equivalent to 11 days loss of proteins and 20 days loss of calories.[157] Considering that there may be defects in absorption in the convalescent period, it is obvious why it takes several weeks to catch up the lost growth. It is estimated that to catch up growth during several weeks after infections there is an increase in requirement of 30% in calories and 100% in proteins.[158] Thus, after diarrhoea is finished, to recover the weight lost, proteins and calories should be provided in excess until the deficit is recovered. Diarrhoea influences nutritional status through a lower food intake due to anorexia or withdrawal of food by the mother,[159-161] and by malabsorption.[162,163] The mechanism for malabsorption could be pancreatic disfunction, bacterial fermentation of sugars and bile disfuction,[164,165] reduction of disaccaridase enzymes,[166,167] reduction of the absorption surface of the gut due to structural damage, faster transit time of the ingested food and direct loss of protein due to structural damages of the intestinal surface.[168]

Rotavirus, which is probably the most frequent cause of weaning diarrhoea, causes mucosal damages in the gut through exudation.[169] It is estimated that diarrhoea leads to 25% loss of ingested proteins as compared to the normal 8%.[170] Fat losses are normally between 3-7% of fat ingested,[171] while they are 28% during diarrhoea.[172] Children in developing countries experience a higher number of attacks of diarrhoea than children from developed countries and the severity of each attack is greater in developing countries than in developed ones. Another difference between developed and developing countries is that in the former, children catch up growth quickly while in the latter, children's catch-up growth is slower due to recurrent infections and poor convalescent food intake. Mata[131] thinks that diarrhoeal diseases are more important than lack of food as a cause of malnutrition. However, it is more reasonable to believe that both infections and lack of foods are at the basis of malnutrition.

6.4.6.2 Malnutrition and susceptibility to infections

If infections, and particularly diarrhoea cause malnutrition, there is evidence that the relationship is bidirectional with malnutrition producing a state of susceptibility to infections. Malnutrition weakens immunological defenses[173-175] with cell immunity most affected. In malnutrition it has been found that there is atrophy of the thymus gland and thymic dependent areas of lymphonodes with subsequent reduction of T lymphocytes. Phagocytosis and antibody production are less affected.

Reddy et al[176] found that the phagocytic activity of leucocytes was diminished in malnourished children compared to normal controls; also, lymphocyte numbers were found to be less in malnourished children while the antibody response was normal. McMurray et al[177] found delayed hypersensitivity reactions to BCG vaccination, reduced lymphocyte transformation and smaller lymphoid glands in malnourished children compared to normal children. McMurray also found that the cell mediated immunological responses are restored to normal within 4-6 weeks of nutritional therapy. This impaired immune response should put the malnourished child at a higher risk of infections compared to normal children. Delgado et al[178] found that children with low W/A and W/H were at higher risk for developing diarrhoea especially during the rainy season. James[179] found that the attack rate for diarrhoea among children 36-60 months under 75% W/A was twice that of controls whose W/A was above 75%. When compared to normal children, diarrhoea was significantly longer in duration in underweight children who were also more frequently hospitalized. These differences were not due to socioeconomic conditions, which were equal between underweight and normal children.

Tomkins[180] found a higher incidence of diarrhoea associated with low W/H. The duration of diarrhoea was greater in children with low W/A, H/A and W/H. Trowbridge et al[181] found that the percentage of time during which diarrhoea was reported was significantly associated with W/H, H/A and MUAC, but they concluded that this association could be due more to socioeconomic factors than to nutritional status per se. In all these studies, wasting was a better predictor of risk of infection than stunting.

Another infectious disease besides diarrhoea which was related to poor nutritional status was measles, which is frequently accompanied by chronic diarrhoea.

6.4.7 <u>Conclusions</u>

In conclusion, nutrition would probably improve if diarrhoea and other infections could be prevented through an improvement of educational level and poverty conditions; however, these changes require time. In the short term, changes in environmental sanitation, hygiene, water supply, and in behaviour through health education could considerably reduce the faecal oral transmission of pathogens causing diarrhoea. Major enteropathogens like Escherichia coli are found in contaminated weaning foods introduced by contaminated water, utensils, unhygienic food handling and by storage of cooked foods for many hours. In order to allow for the hygienic disposal of human wastes, which should reduce transmission of pathogens, sanitation is a priority. Unfortunately, many sanitation programmes fail due to the difficulty in changing deep-rooted behaviours, failure to assess disease perception, wrong sanitary technology which does not adapt to community feasibility, lack of education and lack of use of the latrine by the children, particularly when they suffer from diarrhoea, with the resulting major contamination of the environment.

Water supply is often contaminated with enteropathogens, but even when it is pure at the source, it easily becomes contaminated in the household. Personal hygiene, child rearing and feeding practices are another route of transmission of diarrhoeal diseases. Usually, weaning foods take a long time to be prepared, so they are prepared in large quantities to avoid waste of time and the leftovers are used after many hours of their preparation, with subsequent proliferation of bacteria in the food. Often, weaning foods, besides being contaminated, are bulky and of low caloric density, failing to supplement adequately the breastmilk component of the diet.

Improvement of water supply and environmental sanitation will be worthless if people do not change behavioural practices which pollute the water inside the household, if they do not wash their hands before preparing and eating food, do not protect foods from contamination, do not use the latrine and do not improve household sanitation through hygiene practices. Such achievements are theoretically possible with intensive health education and could result in lower incidence of diarrhoea and other infections with subsequent better child growth. This is particularly true in those populations with marginal nutritional status not due to low nutrient intake, as is the case in Mbarara where food supply does not seem to be a problem. Indeed, it will be interesting to observe the changes as a result of the PHC programme in this district.

Previous studies[182,183] show that improvement of water supply and sanitation does not automatically lead to a decrease in diarrhoea morbidity without behavioral changes. These behavioural changes should include the use of a protected water supply for drinking purposes, even if it is far away, storing drinking water in separate clean containers, boiling drinking water before using it, washing hands with soap before preparing and eating foods and after using the latrine, keeping latrines clean, properly washing and storing cooking utensils, protecting cooked food and avoiding a lot of leftovers to be eaten many hours after preparation, avoiding having domestic animals into the house, disposing of garbage properly, sweeping the household compound and washing clothes.

People need to be made aware of the problems connected with poor hygiene and sanitation and think about their solutions, taking into account practical constraints. To all this it must be added that rehydration with oral rehydration therapy and continuation of feeding during diarrhoea are crucial in order to avoid death and malnutrition. Finally, the child must be fed extra calorically-dense food during convalescence from diarrhoea in order to catch up growth. It seems likely that the causes of infections and malnutrition are strongly related to poverty and environmental conditions and the severity and length of the infections are related to nutritional status. Improving nutritional status can result in a better immune defence against infections and is likely to result in lower mortality.

FLOWCHART 6.2

EPIDEMOLOGY OF MALNUTRITION IN MBARARA

CONCLUSIONS

Parent's education and father's occupation were individually the most distintictive variables responsible for the grades of socioeconomic classification developed by the Multiple Correspondence Analysis. The top socioeconomic group (SEG I) was better off in terms of socioeconomic conditions, availability of services, nutritional status and mortality rates, while the worst group (SEG III) had generally lower standards.

Previous studies found a strong relationship between anthropometry and mortality which increased as anthropometric parameters fell. The most sensitive indicators in terms of predicting mortality were, in descending order, MUAC, W/A, H/A and W/H. Alam[57] followed 2,449 children aged 12 to 59 months for 6 months and found a mortality rate among stunted children (<85% H/A) of 15.4%, compared to 3.6% above 89% H/A. Chen[50] followed 2,019 children aged 12 to 23 months for 24 months and found a mortality rate of 11.3% below 85% H/A compared to 3.3% above 94% H/A. Mortality for wasted children (<80% W/H) was 15% vs 5.4% above 89% W/H in the Alam's study, while in the Chen's study mortality was 14.6% among *those below 70% W/H*, vs 5.2% among those above 89% W/H. Also in this study mortality increased as anthropometric cut offs decreased. Sensitivity at same levels of specificity was higher for MUAC, decreasing for W/A, H/A and W/H. A particular finding in the present study was the steep increase in mortality below 10.6 cm of MUAC, where nearly 1/3 of the children died. Therefore, this cut-off should be regarded very seriously with immediate referral of such children to a health unit. However, only a small proportion of children were in this severe category and it may be that there was obvious illness in these children and they would have been referred to clinics anyway. A particularly interesting characteristic of MUAC is that its predictive value for mortality using a given cut-off is the same at every age, whereas the other anthropometric parameters were more age-dependent. The predictive power of MUAC was not increased by the addition of other anthropometric parameters, conversely the addition of MUAC to the other parameters significantly increased their predictive power for mortality. There was a higher risk of death for specific illnesses such as fever, diarrhoea, acute respiratory infection and measles, but the strength of association between anthropometry and individual infections varied considerably. Malnutrition weakens immunological defences, possibly through decreased body stores of proteins and micronutrients such as zinc, vitamin A and iron. In malnutrition it has been found that there is atrophy of the lymphoid tissues with reduction of T lymphocytes and leucocytes (see chapter VI). This reduced immune response puts children at higher risk for infections and death.

Very few studies have examined the interaction of nutrition and socioeconomic status in relation to mortality. Although the levels of malnutrition and mortality were significantly higher for the worst off (SEG III), it could be argued that socioeconomic status could be the cause of the higher mortality, and malnutrition merely acted as a confounder. Both anthropometric parameters and SEGs were therefore entered into a logistic model, where the dependent was mortality. No interaction was found between the two. In other words, the malnourished had similar increased risks of death in every SEG, and it seems that malnutrition acts independently from socioeconomic class in producing a higher risk of death. At the same level of anthropometry, mortality is similar in various socioeconomic groups, indicating that children have a higher risk of death because they are malnourished and not because the malnourished children belong to the lowest socioeconomic group.

It is important to consider whether socioeconomic indicators or nutritional status can be used in the screening of 'at risk' children. The choice is not easy because both socioeconomic and nutritional factors act independently in increasing the risk of death. Therefore it seems logical to apply both indicators simultaneously to identify the maximum numbers of children at risk. The importance of socioeconomic status in predicting mortality is indicated by the significant relationship found between mortality and socioeconomic variables such as father's education, possession of cattle, type of lighting and crowding in the household. The advantage of socioeconomic indicators lies in the fact that they can be used once and for all to identify whole households at risk. The health worker could utilize the questionnaire developed through the Multiple Correspondence Analysis (see Chapter III) in order to identify households at risk. Although it was not part of the project to examine the feasibility of classifying households at risk, it appeared that health workers found it relatively easy to assess socioeconomic classification using a simple flow-chart. It may be of value to assess the use of such a socio-economic grading within the context of referrals and intervention activities of PHC.

The flowcharts (3.1-3.6) derived from the dynamic cluster method aim to identify what social class a family belongs to (given father's occupation and education, mother's education, ownership of radio, position of hiring labour or working on other's people land). These flowchart could be used by the health worker following the path of the lines in order to identify the families at risk (class 7).

The flowcharts on page 129,131,163 have only an illustrative purpose. There was no attempt in this study to assess the use of the flow chart during the routine work of the health worker. This could be evaluated in future research.

If anthropometry alone has to be chosen, MUAC could be used at a cut-off point equal or below 13.5, which coincides with the point where the risk of mortality starts to rise significantly.

Wasting (W/H below -2 SD) was 3.8%, undernutrition (W/A below -2 SD) was 18.5% and stunting (below -2 SD H/A) was 32.5%. The prevalence of wasting is relatively low and the prevalence of stunting is similar to other African communities.[184] As far as stunting is concerned, linear growth begins to falter from the fourth month onward. The average increment remains low till the end of the second year and afterwards it improves, but not enough to restore normal height, so that a deficit is established by the age of 5 years. Food intake and infections associated with low socioeconomic conditions seem to be responsible for linear growth faltering. The reason why the critical period for growth faltering is between 4 and 36 months is probably due to the weaning period when children are introduced to solid foods which are contaminated causing diarrhoea.

There could be several reasons why in this population stunting is relatively high and wasting is low.

Wasting represents a low weight in relation to height; it depends on low food intake and infections. Among children recovering from malnutrition, weight increases rapidly but linear growth only resumes when body weight has returned to normal.[185] Therefore the difference between stunting and wasting lies in the fact that the length velocity recovers slowly in comparison to weight velocity. Stunting, in comparison with the international standard is common in this population. There is still lack of agreement as to the causes of stunting among children in developing countries. However it is likely to represent a series of problems related to chronic dietary impairments especially of energy and protein but also of micronutrients, compounded by frequent infectious episodes. It is clear that stunting represents a chronic nutritional problem. Wasting, or thinness, may arise from two pathways. A child may be born with malnutrition and may continue to be thin for years. Another child might grow well and then loose weight to become thin as a result of severe infective illness or low nutrient intake. In this population the relatively high prevalence of stunting suggests long term nutritional stress. There were few wasted children suggesting that widespread severe food shortages were not a problem in this community.

It is argued that the difference in linear growth between countries depends on genetic differences, and therefore shortness in developing countries could be due to genetic reasons. In some populations, genetic factors could cause stunting when, compared to the international standard. However it is believed that stunting is the end result of chronic nutritional insufficiency and food infections.

That the economic status influences linear growth is confirmed by the fact that stunting was 20% in SEG I and nearly 40% in SEG III. Stunting has a multifactorial aetiology with clear association with poverty and poor living conditions, with no single factor being totally responsible. Thus we can presume that the improvement of stunting can only result if there is improvement of socioeconomic conditions or through PHC programmes which include water supply and sanitation, because there are no specific nutrition programmes able to reduce stunting. The present data show increased mortality from certain conditions in association with stunting, thus we can say that stunting is functionally important and is a sign of socioeconomic deprivation, requiring action to improve a range of conditions.

In this study, socioeconomic variables such as father's education, acreage, candles used for lighting and crowding conditions were the major determinants of nutritional status. Among non-socioeconomic variables, diarrhoea was the most negatively associated with nutritional status. Therefore, we can conclude that the poverty/infection cycle is the cause of malnutrition in the community of Mbarara. Breaking this cycle is not easy because it entails many socioeconomic and political changes, together with improved health services and environment through the PHC approach. Nevertheless, such an integrated approach has been achieved in other countries.

The major messages from this thesis are:

a) Low socioeconomic groups are at increased risk for mortality and malnutrition. The study has established a way of identifying them. Hopefully this would facilitate the appropriate targetting of the project activities to the most needy and to monitor that the most needy will participate to the project.

b) MUAC was the most sensitive anthropometric indicator at the same level of specificity in predicting mortality and should be considered the best indicator to be used in identifying children at higher risk of death.

c) Malnutrition is related to increased risk for specific causes of death especially diarrhoea, fever, A.R.I. and measles. Therefore improving nutritional status should help decrease the mortality from these specific diseases.

d) Prolonged breastfeeding is associated with worse nutrition. This does not appears to be due to socioeconomic differences between those who breastfed longer and those who did not. There are important cultural questions to answer before policies on prolonged breastfeeding could be formulated. It is important for example to investigate if those children who breastfeed longer receive less supplementary feeding.

e) Socioeconomic variables such as lack of ownership of cow, being resident in the village for less than 4 years, birth order above 5, father's education below secondary school and candles used for lighting were associated with child mortality. Thus socioeconomic deprivation leads to a higher risk of death.

f) Diarrhoea was the variable most strongly associated with malnutrition, therefore sanitation, health education, use of safe water supply, increasing food intake during the convalescence period should improve nutritional status through the decrease of diarrhoea prevalence.

There are some questions raised by this study which require further research:

a) The practicability of the questionnaire for identification of social class 7 should be investigated.

b) The impact on child mortality as a result of targeting programme's activities towards families in class 7 compared with targeting project activities towards children identified through MUAC could be compared. This could be done using the first method in a group of villages and the other method in another group of villages.

c) Because of the finding that prolonged breastfeeding after 12 months is associated with malnutrition future studies should assess whether prolonged breastfeeding is a marker of the amount of solids that a child get for whatever reason. Any such studies would need to have accurate information on intake of solids and breastmilk separately.

The data from this study has provided a strong baseline for future evaluations. It is hoped that the focused ways in which the nutrition/morbidity/mortality interaction have been analysed will facilitate the start of necessary changes for health improvement in this population.

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ANNEX

MBARARA BASE-LINE **QUESTIONNAIRE** **CODING**

Interviewer ....Date ....Parish .... Subparish .... Cell .... House Number.....

SECTION 1 **HOUSING**

1) Number of people living in the household ( )

2) Number of sleeping rooms ( )

3) Number of people per room (DO NOT FILL) ( )

4) Source of water used

Piped/tap	= 1
Borehole (handpump)	= 2
Protected spring (with pipe coming out)	= 3
Protected well	= 4
Dam	= 5
Surface water (swamp, river, lake, pond, etc)	= 6
Unprotected spring	= 7
Unprotected well	= 8
Rain water from roof	= 9
Other (specify)	= 10

5) Is there a latrine in the household ? (verify) Yes = 1 No = 2

6) Cooking fuel used

Wood	= 1
Charcoal	= 2
Kerosine	= 3
Gas/electricity	= 4
Other (specify)	= 5

7) Lighting fuel used

Candle	= 1
Kerosine lamp	= 2
Electricity	= 3
Other (specify)	= 4

8) Does the household own a working radio ? Yes = 1 No = 2

9) Does the household own a working bicycle ? Yes = 1 No = 2

10) Distance in miles from the nearest Health Unit ( )

CODING

Cell .... Household Number ....

1) Was the household visited by a trained health worker during the past 3 months ? Yes = 1 No = 2

SECTION 2 COMPLETE FOR ALL CHILDREN below 5 years LIVING IN THE HOUSE

1	2	3			4	5	6	7	8	CODING
Child number (*)	Full name of the child	Birth date			Age in months	Sex M=1 F=2	Birth order	Place of delivery/attendant Government Facility = 1 Private Clinic = 2 NGO Facility = 3 Tradition. Birth Attend. = 4 Relative/Friend = 5 Other (specify)......... = 6 Nobody = 7	Is child Breast-feeding Yes = 1 No = 2	
		D	M	Year						

(*) Select all the children below 5 year beginning from the younghest and give to each one a sequential number

FOR CHILDREN BELOW 5 YEARS

Child number	9 Duration of stay of the father in village (years)	10 Ethnic group of the father Banyank. = 1 Baganda = 2 Rwandese = 3 Bakiga = 4 Other = 5	11 Education Level of Father	12 Can the father read ? English =1 Vernacul=2 No =3 (A)	13 Occupation of the father (B)	14 Religion of the father	CODING

(A) Show English or Vernacular text

(B) Professional = 1 Government employee = 2 Higher Administrative = 3 Teacher = 4
Construction worker = 5 Trader/Shop keeper = 6 Artisan = 7 Butcher = 8 Police/Army = 9
Nomad/Pastoralist = 10 Hawker/Vendour = 11 Unskilled labourer = 12 Other (specify) ....= 10

FOR CHILDREN BELOW 5

Child number	15 Marital status of the mother Married = 1 Single = 2 Widowed = 3 Divorced = 4 Other = 5	16 Education level of the mother	17 Can the mother read ? English =1 Vernacular=2 No =3 (A)	18 Mother physical status Lactating = 1 Pregnant = 2 Non pregnant/ non lactating = 3	CODING

(A) Show English or Vernacular text

CODING

Cell .... Household Number ....

FOR CHILDREN BELOW 5 YEARS

Child Number	19 At what age did child stop breastfeeding (months)	20 Age of introduction of first solid foods besides breast milk	21 Does child have growth chart (GC) (verify) Yes = 1 No = 2	22 Does GC have marks inside it ? (verify) Yes = 1 No = 2	23 Does the mother know how to interpret the GC (*) Yes = 1 No = 2	24 Was child weighed in the past 3 months Yes = 1 No = 2

(*) Show the mother the Growth Chart you have with you

FOR CHILDREN BELOW 5 YEARS

CODING

Child number	25 Weight in Kg	26 Height in Cm	27 Mid Upper Arm circ Cm	28 Oedema present = 1 absent = 2	29 Vaccination Card Present = 1 Absent = 2 (*)	30 Vaccination status Full = 1 Partial = 2 None = 3

(*) Record vaccination status only in the presence of the vaccination card, if card is absent consider child not vaccinated ,whatever the opinion of the mother is. But check always the BCG scar.

CODING

	VACCINATION					
Child number	31 DPT 0,1,2,3	32 POLIO 0,1,2,3	33 MEASLES 0,1	34 BCG 0,1	35 BCG scar Yes=1 No=2	36 Mother TT 0,1,2

FOR CHILDREN BELOW 5 YEARS

CODING

Family Member Number	37 Foods eaten yesterday by the child	38 Number of meals eaten yesterday	39 Is the child stumbling frequently in the dark ? Yes = 1 No = 2

CODING

Subparish .... Household Number ....

SECTION 3

MORBIDITY IN THE FAMILY

1) Did anybody in the family suffer from any illness in the past 2 weeks ? If yes fill the table

1 Family member number (*) (*)	2 Age	3 Sex M = 1 F = 2	4 Illness in past 2 Weeks Fever = 1 Rash = 2 Short of breath with cough and fever = 3 Diarrhoea = 4 Other(specify) = 5	5 Duration in days	6 Treatment Tablets = 1 Injections= 2 Other (specify) = 3 Nothing = 4	7 Treatment from Gov. Facility =1 Priv.Clinic =2 NGO Facility =3 Trad. Healer =4 Relative/friend=5 Other(specify) =6 Nobody =7	CODING

8) Did anybody suffer from measles in the past 3 months ? Yes=1 no=2 (if yes include above)

(*) (*) For the family member number use the sequential number utilized in the section for children under 5, add other numbers for the other members of the family like father,mother, and children over 5 years of age.

CODING

Cell .... Household Number ....

SECTION 4 IN EACH HOUSEHOLD SELECT A MOTHER AT RANDOM AGED 15-50 YEARS

1) Age of the woman ( )

2) Last time your child suffered from diarrhoea did you
Continue breastfeeding = 1
Stop breastfeeding = 2
Not applicable = 3

3) Last time your child suffered from diarrhoea did you
Continue feeding = 1
Give less feeding = 2
Stop feeding = 3

4) Last time your child suffered from diarrhoea did you
Give more fluids = 1
Give fluids as usual = 2
Give less fluids = 3
Stop fluids = 4

5) Last time your child suffered from diarrhoea what treatment did you give him ?
Special prepared home solution (specify) .... = 1
Sugar Salt Solution = 2
ORS = 3
Tablets/Pills = 4
Injections = 5
Other (specify) .... = 6

6) Do you know how to prepare sugar salt solution
Yes = 1 No = 2

8 teaspoons of sugar
1 teaspoon of salt
2 tumpeco mug of boiled water

7) Have you ever seen a ORS packet (show packet)
Yes = 1 No = 2

8) Do you know how to use an ORS packet ?
Yes = 1 No = 2

Mix the packet in 2 tumpeco mugs of boiled water

9) Were you examined by a Trained health worker during your last pregnancy ? Yes = 1 No = 2
Yes = 1 No = 2

10) Do you know which diseases can be prevented by immunization ?
Yes fully = 1
Yes partially = 2
No = 3

Measles
TBC
Diphteria
Whooping cough
Tetanus
Polio

CODING

SECTION 5 QUESTIONS FOR THE HEAD OF THE HOUSEHOLD

1) Number of acres cultivated in the last 6 months ( )

2) Did you hire people to work your land during the last 6 months ?
Yes = 1 No = 2

3) Did anybody in the family work for money on other people's land during the past 6 months ?
Yes = 1 No = 2

4) Kind of crops cultivated..
....
....
....
....
....
....

5) Kind of livestock owned (e.g. cows,goats,chicken,pigs etc).................................
....
....

6) Kind of food purchased past 6 months ....
....

7) Kind of crops sold past 6 months..

SECTION 6 MORTALITY

Was there any death in the family in the past 12 months ? If yes fill the next table

DEATH AMONG FAMILY MEMBERS IN PAST 12 MONTHS

1 Sequential Number	2 Age in years	3 Sex M = 1 F = 2	4 According to the family what was the cause of death	5 Was diarrhoea present in the week preceeding death ? Yes = 1 No = 2

CODING

Cell .... Household Number ....

1) Number of children born in the past 12 months ( )

2) Number of children below 1 year ( )

SECTION 7 SELECT A MOTHER WITH A CHILD BETWEEN 12 - 24 MONTHS

1) Age of the child between 12 and 24 months ( )

2) Did you have a pregnancy before this child ? Yes = 1 No = 2 (If yes continue)

3) Did you have a live birth from that pregnancy ? Yes = 1 No = 2 (If yes continue)

4) Is that child still living ? Yes = 1 No = 2 (If yes continue)

5) How old is that child (in months) ? ( )