AFRICA NUTRITION

Nutrition and Health Status Of Young Children in Mali

Findings from the 1987 Mali Demographic and Health Survey

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Food Security and Nutrition Monitoring Project

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SUMMARY

The nationally representative 1987 Mali Demographic and Health Survey (MDHS) provides information on the nutritional status of Malian children between the ages of 3 and 36 months at the national and urban/rural level. Overall, 24 percent of children are stunted (chronically undernourished), 11 percent are wasted (or acutely undernourished) and 31 percent are underweight. Undernutrition is significantly higher in Mopti/Gao/Tombouctou than in Kayes/Koulikoro or Sikasso/Segou. It is also higher in rural area than in urban areas.

Infant and child feeding practices are far from optimal in Mali, resulting in high levels of undernutrition by the age of 3 months. The prevalence of stunting increases steadily up to 21 months of age, peaking at about 35 percent, and remains at this high level through to the age of 3 years. Wasting also rises quickly in infancy and remains at over 10 percent among infants and children age 6 to 21 months before declining to around 7 percent. Thus, growth in both height and weight is noticeably retarded up to the age of 21 months, although further deterioration in nutritional status does not occur after this age. In fact, there is some improvement in the acute, but not chronic, nutritional status among older children.

A high proportion of infants are fed complementary liquids within the first two months of life. Exclusive breastfeeding for the first 4 months of life-- the optimal infant feeding practice recommended by the World Health Organization-- is practiced by the mothers of only 10 percent of infants.

While nearly all infants receive water and other liquids too early, a sizeable proportion of infants are also given complementary solid foods too late. WHO recommends that breastfed infants begin receiving complementary foods between 4 and 6 months of age. In Mali, however, 55 percent of infants age 6 to 9 months are not receiving complementary solid foods. Furthermore, studies suggest that the energy and nutrient content of commonly used complementary foods in Mali are not sufficient to meet the nutritional needs of the rapidly growing infant.

More than one in three children under five years of age has a recent history of diarrhea, one in three a recent history of fever, and one in 15 a recent history of cough. Morbidity patterns closely follow those for undernutrition. The prevalence of diarrhea and fever increases with age but the prevalence of cough remains stable for all ages. The prevalence of diarrhea is high through age 9 to 36 months while fever is high among children age 9 to 21 months. There are no urban/rural differences in the age-specific prevalence of diarrhea or fever.

Multivariate analysis shows that undernutrition is largely determined by a child's age, morbidity, and factors generally associated with poverty.

Efforts to improve nutrition in Mali need to focus on the first two years of life when undernutrition has its greatest effect on the infants and children. In particular, public health efforts need to work towards:

- increasing the duration of exclusive breastfeeding through the age of 4 to 6 months;
- increasing the number of infants receiving complementary solid foods at the appropriate age;
- improving the nutritional quality of traditional complementary solid foods;
- advising mothers to ensure that sick children are given food; and
- improving personal hygiene and environmental sanitation to help reduce the high levels of diarrhea.

MALI


ALGERIA
TIMBUKTU
GAO
MAURITANIA
KOULIKORO
SENEGAL
KAYES
MOPTI
NIGER
SEGOU
BAMAKO
BURKINA FASO
SIKASSO
GUINEA
COTE
D'IVOIRE

Chapter 1

INTRODUCTION

1.1 BACKGROUND

Mali is a land-locked Francophone West-African country covering 1.24 million square kilometers. It has a population of 9.2 million people, growing at a rate of 2.9 percent per year (OAU/UNICEF, 1992). Almost all of Mali's people live in the southern half of the country, where the country's two rivers, the Niger and the Senegal, flow. Mali is among the world's poorest countries. The World Bank estimate for GNP per capita in 1990 was only $270 (OAU/UNICEF, 1992).

The country is climatically divided into four zones: the desert, where rainfall is less than 20 mm per year; the Sahelian zone, where rainfall is between 250 and 600 mm a year; the Sudanian zone, which has between 600 and 1000 mm of rain a year; and in the far southwest the Guinean zone, which receives between 1000 and 1750 mm rain a year.

Historically, the north is a food deficit area and people are traditionally dependent upon livestock to provide both food and cash. Because of low and erratic rainfall, the area north of the fourteenth parallel, but below the desert, is a high-risk agricultural zone. The area lying to the south of the fourteenth parallel is regarded as the food surplus zone (Staatz et al., 1990).

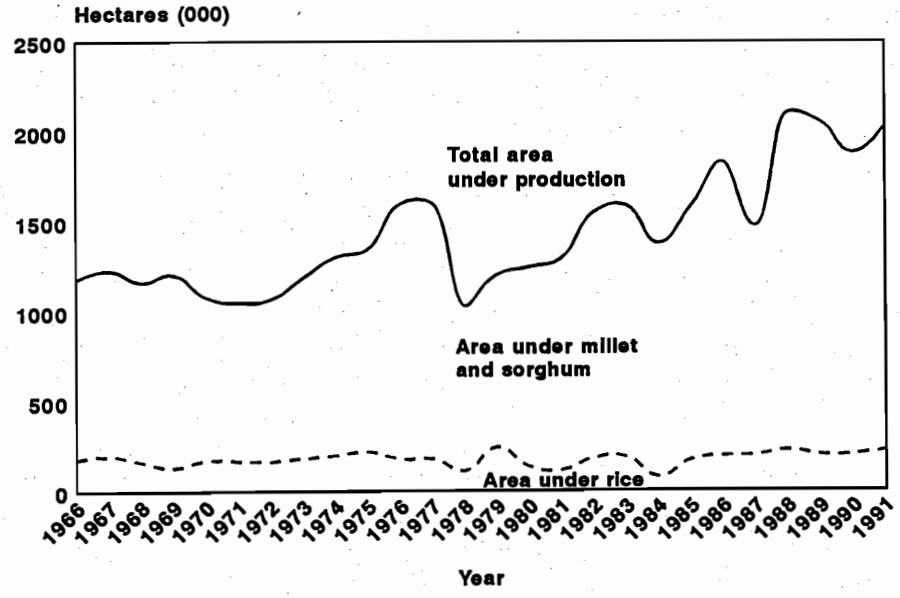
1.2 FOOD PRODUCTION

The Malian economy is based on subsistence agriculture. More than 85 percent of the population is employed in agriculture and livestock activities and many are small farmers (Dommen, 1985). About 40 percent of the land is desert and unsuitable for agriculture; 35 percent is in the Sahelian zone and suitable only for livestock; and 25 percent of the land is in the Sudanian and Guinean zone and suitable for agriculture. The Niger River is important for fishing and irrigation.

Most of Mali's crop production is dependent on a short rainy season. Variations in rainfall result in large annual fluctuations in both cereal production and pasture for grazing. More than one-half of the food crops grown in Mali are for subsistence; the surplus is sold to meet cash needs for other items, thus there are large fluctuations in the quantities of grain sold in the market. Furthermore, the concentration of cereal production into a few months of the year (May through September) induces significant seasonal fluctuations in both farm gate and consumer prices. Due to the lack of infrastructural facilities, marketing networks are poor and transport costs and marketing margins are high (Dommen, 1985; Republique du Mali, 1992). This further restricts access to cereals and other foods, particularly in the north. However, even in the food surplus areas, many people do not have the means to buy food commercially (UNICEF, 1989; Staatz et al., 1990). Crop losses are high. Indeed, it has been estimated that between 20 and 25 percent of the harvest may be lost due to poor handling, preservation, storage and processing (Dommen, 1985). These losses have important implications for the availability of food at the household level.

Currently some 32 million hectares of land are used for agriculture, of which 2 million hectares are under arable and permanent crops, and the remainder are permanent pasture (USDA/ERS, 1992). Food crops occupy over 80 percent of the arable area. Two-thirds of these crops consist of millet, sorghum and maize. Due to its drought tolerance, millet is the most important food crop and the preferred staple (USDA/ERS, 1992). Paddy rice is an important crop in the Niger River delta, where around 200,000 hectares is under rice.

Figure 1.1
Area under sorghum/millet and rice cultivation, Mali 1966-1991



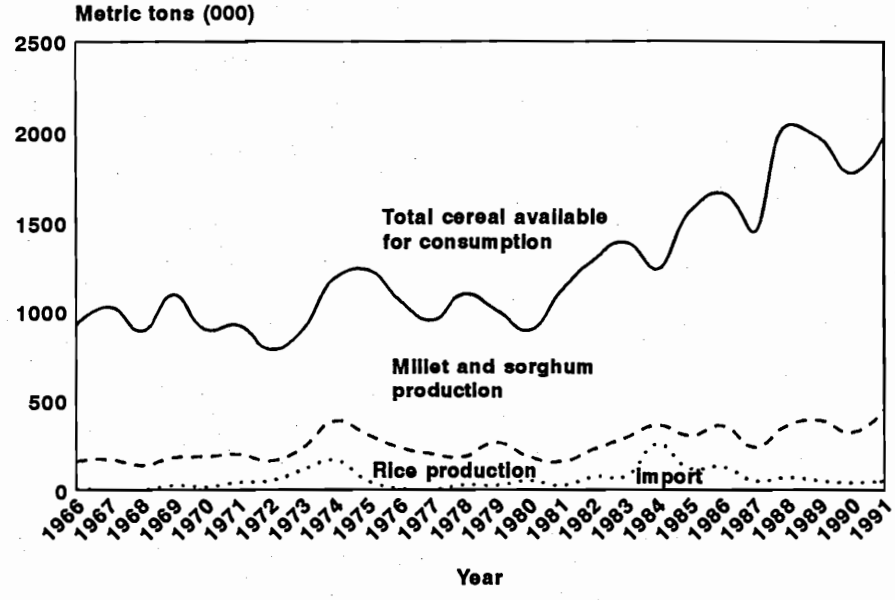
USDA/ERS, 1992

The area under millet and sorghum has steadily increased during the past decade, from around 1 million hectares, between 1966 and 1980, to 1.8 million in 1991 (Figure 1.1), largely because of the increased demand created by the rapidly expanding population. It is this extension of the area under millet and sorghum, rather than any increase in yield, which remains at less than 0.9 tons per hectare, that has contributed to the dramatic increase in cereal production since 1980 (Figure 1.2). Rice yields, however, have risen from around 1 ton per hectare in the early 1970s to 1.8 tons per hectare in 1991, accounting for the modest increases in rice production shown in Figure 1.2.

Imports of sorghum, millet and rice are negligible and currently contribute about 2 percent to the cereals available for consumption. Imports have been significant only during drought years, for example 1974 and 1984 (Figure 1.2).

Fresh vegetables, grown in the cool season, are more plentiful at the beginning of the year but their consumption varies across the regions (Dommen, 1985). The "hungry season" extends from April to September, coinciding with peak agricultural labor requirements (UNICEF, 1989). Table 1.1 illustrates some of the agricultural labor requirements in the Upper Niger River Valley (Opération Haute Vallée).

Figure 1.2
Sorghum/millet and rice production and imports, Mali 1966-1991



USDA/ERS, 1992

Table 1.1 Agricultural calendar

Agricultural activities in the Upper Niger River Valley, Mali (1988-1989)

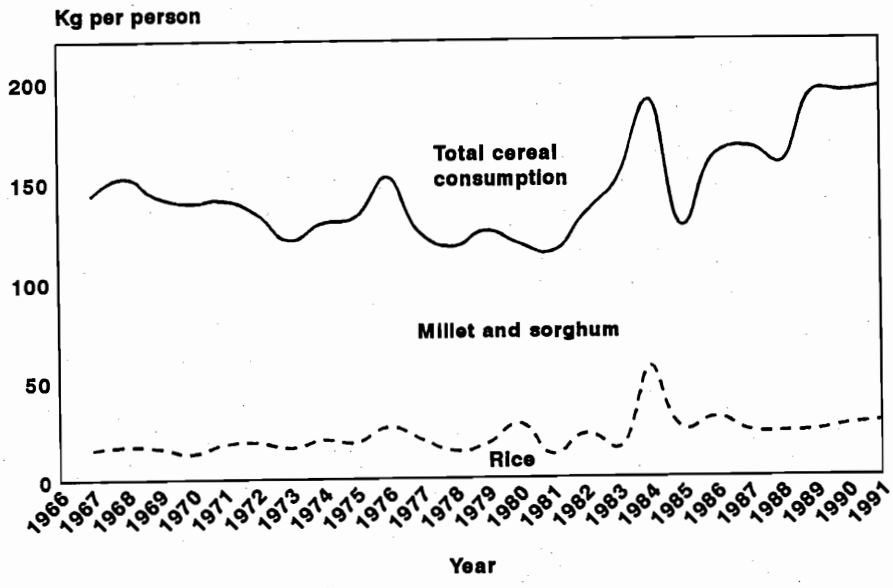
Month	Agricultural activities
March - April	Shelling nere & peanuts Spinning cotton
May	Clearing stalks from fields Burning fields Shelling peanuts
June	Plowing Planting millet, sorghum and peanuts
July	Plowing Planting First weeding of millet and sorghum
August	Second weeding of millet and sorghum Plowing Vegetable harvest begins
September	Final weeding of millet and sorghum Corn harvest begins Cow pea (niebe) harvest Vegetable harvest ends Yam and cassava harvest
October	Corn harvest ends Cowpea harvest Sunna harvest Petite millet harvest Peanut harvest Rice harvest Pimento harvest Tomato and onion planting Petite millet battage Sorghum harvest begins
November	Millet and sorghum harvest Peanut harvest Bush fires

Source: Sundberg, 1989a

1.3 FOOD CONSUMPTION

The staple diet in Mali comprises millet, sorghum and, to a lesser extent, rice and maize. Indeed, millet, sorghum, and maize account for over 80 percent of cereals consumed, while rice accounts for about 15 percent, and wheat less than 2 percent. Consumption of cereals has risen substantially since 1985 (Figure 1.3), mainly due to increased millet and sorghum intake, which is now around 168 kg per person per year (USDA/ERS, 1992). Rice consumption is currently about 27 kg per person (USDA/ERS, 1992), while that for wheat is less than 4 kg per person per year (Republique du Mali, 1992). Tuberous crops such as cassava and sweet potatoes are grown and eaten in the southern areas (Dommen, 1985). In spite of the importance of the livestock sector, particularly in the north, meat is not often eaten. Meat consumption is higher in urban than rural areas (Republique du Mali, 1992). Dried or smoked fish from the Niger River are marketed throughout the country.

Figure 1.3
Sorghum/millet and rice consumption, Mali 1966-1991



USDA/ERS, 1992

The 1987-89 per capita daily energy supply for Mali was estimated to be 2236 kcal, which is 95 percent of the minimum requirements (World Food Council, 1992). In rural areas millet, sorghum, and maize provide between 70 and 80 percent of energy intake, but there are seasonal and regional variations in the contribution of different cereals to total energy intake. Maize is more important in the diet in Tombouctou and Gao than in the other regions. Livestock products are important sources of energy and protein in Mopti, Gao and Tombouctou, where nomads make up a large proportion of the population. Fish is eaten in areas along the Niger River. In general, the diet of rural people is sufficient in energy and protein but lacks some vitamins and minerals, namely vitamins A and C, iron and calcium (Republique du Mali, AED).

Cereals account for between 61 and 84 percent of energy intake in the urban diet, which is similar to that of rural people, except that rice predominates as the staple. Rogers and Lowdermilk (1988) suggest that urban dwellers prefer rice over coarse grains because it requires less labor, time, and fuel to prepare. They also estimate that as much as one-half of the urban population is at risk of inadequate food intake.

Malians typically eat three times a day. The early morning meal consists of porridge or gruel (see Table 1.2). The mid-day and evening meals consist of rice or millet served with a sauce, often made from okra, peanut butter, tomatoes, and onions, or fermented locust bean. Meat and fish, if consumed, are pounded and added to the sauce. Meals are communal; a large bowl of food is set on the floor and people, or groups of people, eat using their right hands (Dettwyler, 1987).

Table 1.2 Malian meals

Malian meal times and foods eaten

Meal time	Food eaten (season)	Description of food
Early morning "Daraka"	Seri or bouillie (all year)	A thin porridge of boiled millet flour and water, with milk and sugar added, if available.
	Moni (Jun-Oct)	A lumpy gruel with lemon or tamarind added, if available.
	Dege (Jun-Oct)	A liquid gruel with hot peppers added.
	Kini (Nov-May)	(a) A more solid, pasty preparation for which the millet is ground rather than pounded, usually eaten with a peanut-based sauce. (b) Cooked rice.
Mid-morning "Tilelafana"	Toh (all year)	Millet flour cooked to the density of bread dough, served with a sauce containing a combination of any of the following: baobab or moringa leaves, gumbo, tomatoes, onions, hot peppers, spices, fish, or meat.
	Basi (Nov-May)	Millet couscous, prepared by steaming millet flour until it reaches a fluffy consistency, with a sauce of beans, cassava, tomatoes, onions, and/or peanuts. May also be eaten dry, with water or milk and sugar. (Considered food for special occasions or for travelers.)
	Seri (Nov-May) Rice (all year)	
Mid-afternoon (optional) "Wulalafana"	Dege (all year)	
Evening "Surafana"	Seri (Jun-Oct) Harvested pulses (Jun-Oct) Toh (Nov-May) Rice (Nov-May)	

Source: Holley et al., 1990

Milk, the staple food for nomads, is complemented by cereals, meat, sugar, and dates. Milk accounts for about 70 percent of energy intake for the Tuaregs, while cereals contribute about 25 percent and meat less than 10 percent. The contribution of cereals to the total energy intake increases during the dry season when milk production diminishes. People claim to reserve milk for women and children during the dry season (Republique du Mali in AED, nd).

1.4 FOOD EXPENDITURES

Malians spend one-half of their household incomes on food, except in Mopti, Gao, and Tombouctou, where absolute food expenditures are lower than in the other regions but account for 60 to 70 percent of total expenditures (Table 1.3) (Republique du Mali, 1992). The proportion of household expenditure spent on food is perhaps not as high as expected reflecting Mali's high dependency on subsistence food.

Table 1.3 Household expenditure

Mean annual household expenditure and percent spent on food by region, Mali

Region	Mean annual household expenditure		Percent spent on food
	CFA	US$	
Kayes	892,213	2,974	47
Koulikoro	804,387	2,681	48
Sikasso	955,673	3,185	48
Segou	981,181	3,270	51
Mopti	577,957	1,926	71
Tombouctou	680,287	2,268	58
Gao	663,012	2,210	60
All Mali	883,649	2,945	51

Source: Republique du Mali, 1992

Little is known about the association between patterns of household food expenditure and actual food intake in Mali. The evidence to date suggests there is little variation in both the quality of the diet and energy intake among different income groups. Mondot-Bernard (1980) and Dettwyler (1992) report that rising income is not correlated with an increase in quality or quantity of the diet, and there is little correlation between household indicators of economic well-being or wealth and child nutrition (Staatz et al., 1990; Holley et al., 1990). There is, evidence, however, of heterogeneity in nutritional status between villages (Holley et al., 1990). Rogers and Lowdermilk (1988), in contrast, found that while the mix of foods in the urban diet did not differ by income level, the amount consumed and the total energy intake increased sharply with income. They also found that the proportion of rice and coarse grains consumed in the diet did not vary by income level indicating that coarse grains are not substituted with rice, or vice-versa, as income rises. The authors conclude that food consumption levels in Mali are so low that even when expenditure levels are relatively high, households increase the quantity of staple food they normally consume rather than diversify their diet.

1.5 MICRONUTRIENT DEFICIENCIES

It is estimated that between one-half and two-thirds of Malian women and 40 percent of children have iron-deficiency anaemia (UNICEF, 1989; Republique du Mali, 1992). Parasitic infections, including malaria, contribute to the high level of anaemia. Iodine deficiency disorders affect 30 percent of the population, except in Tombouctou and Gao, which benefit from naturally iodized salt beds (Republique du Mali, 1992).

Nightblindess, a sign of vitamin A deficiency, has long been identified in the local languages of the different ethnic groups. Vitamin A deficiency is a public health problem[1] in Mali, despite the year-round availability of foods rich in vitamin A (Table 1.4). Rosen et al. (1991) report that during 1986, the prevalence of nightblindness was 6.0 percent, corneal ulceration 0.8 percent, and corneal scars 0.4 percent among

[1] Defined as prevalence levels for nightblindness over 1 percent, Bitot's spots over 0.2 percent, corneal xerosis or ulceration or keratomalacia over 0.01 percent, and corneal scars over 0.05 percent (FAO/WHO, 1992).

children under the age of 5 years in Segou and Tombouctou. These levels of nightblindness and corneal ulceration far exceed the limits set by WHO/FAO. Nightblindness (9 percent) and corneal scars (1.3 percent) were also a significant health problem among children age 6 to 10 years. About 5 percent of rural children and 1 percent of urban children under the age of five years in Sikasso were nightblind during 1988 (Rosen et al., 1991). More recently, the Ministry of Health found that 3 percent of children under the age of 6 years in Segou were nightblind and 2 percent had Bitot's spots (Republique du Mali, 1992; FAO, 1992).

Table 1.4 Vitamin A foods

Calendar for foods containing vitamin A in Mali

Food	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Courgette									x	x	x	x
Liver	x	x	x	x	x	x	x	x	x	x	x	x
Dairy products							x	x	x			
Baobab leaves							x	x	x			
Carrots	x	x	x									
Mango	x	x		x	x	x	x					
Papaya	x											x
Cassava leaves	x									x	x	x
Cow pea leaves							x	x	x			
Smoked fish	x	x	x	x	x	x	x	x	x	x	x	x
Fried fish	x	x	x	x	x	x	x	x	x	x	x	x
Sweet potato	x	x	x									x
Oseille leaves							x	x	x			
Onion leaves	x	x	x							x	x	x
Locust bean powder	x	x	x	x								
Chicken egg	x	x	x	x	x	x	x	x	x	x	x	x
Guinea fowl eggs			x	x	x	x	x	x				
Palm oil	x	x	x	x	x	x	x	x	x	x	x	x
Palm nuts	x	x										x
Amaranth	x	x	x	x	x	x	x	x	x	x	x	x
Aubergine leaves							x	x	x			
Potato leaves								x	x			

Source: VITAP/SCF in Roseen et al., 1991.

1.6 DATA SOURCE AND TYPE OF INFORMATION COLLECTED

The data for this report are drawn from the Mali Demographic and Health Survey (MDHS) conducted by the Centre d'Etudes et de Recherches sur la Population pour le Dévelopment Institut du Sahel (CERPOD) between March and August, 1987[2] (Baba et al., 1989). The MDHS was a national sample survey designed to provide information on fertility and family planning among women of childbearing age, as well as on the health of their children age one month to 59 months and the nutritional status of their children age 3 to 36 months. A total of 8,258 women between the ages of 15 and 49 years were interviewed. The MDHS sampling frame is described in Appendix A.

Full sampling details and data collection procedures are given in Baba et al., (1989). Briefly, the MDHS collected information on household characteristics such as type of housing, water supply, type of

[2] Unless otherwise noted, all data presented in this report are from the sample of all living children under five years of age drawn from the 1987 Mali Demographic and Health Survey.

toilet facilities, availability of electricity, and ownership of a transportation vehicle and household amenities such as a radio or television. Information was also collected on the composition of the household, including the age, sex and educational level of all household members. Appendix B describes the characteristics of the households participating in the MDHS.

For individual women, detailed information was collected on reproductive behavior and intentions; knowledge and use of contraceptives; employment; marital status; husband's education and occupation; maternal health; and treatment for sick children. In addition, for children born in the previous five years, information was collected on breastfeeding and infant feeding practices, child health, and vaccination status. The heights and weights of children age 3 to 36 months were measured using standard anthropometric techniques (UN Department of Technical Co-operation for Development and Statistical Office, 1986).

The survey was funded by the Malian government and the US Agency for International Development with technical support from the Institute for Resource Development (IRD)/MACRO International Inc., located in Columbia, Maryland, USA.

Chapter 2

BASIC INDICATORS OF NUTRITIONAL STATUS

Three indicators using measures of weight and height in combination with age are commonly used to determine nutritional status: stunting, wasting, and underweight. Stunting,[1] the failure to grow adequately in height in relation to age, reflects past or chronic undernutrition. It results from an inadequate intake of food over a lengthy period of time and is also affected by chronic illness. Wasting,[2] the failure to gain weight in relation to height, reflects recent or acute undernutrition. Wasting results from a recent shortage of adequate nutrition and is affected by acute illness, in particular diarrhea. Underweight,[3] or low weight in relation to age, can be due to either chronic or acute undernutrition. Some aspects of the quality of MDHS nutrition data are discussed in Appendix C.

In this chapter, the association between the nutritional status of infants and children age 3 to 36 months and a number of nonbiological (geographic, demographic, social, and economic) and biological (health and age-related) factors are examined.

2.1 LEVELS OF UNDERNUTRITION

The Mali Demographic and Health Survey data show that 24 percent of Malian children age 3 to 36 months are stunted, 31 percent are underweight and 11 percent are wasted (Figure 2.1). In other words, nearly one in four children is too short, one in three too light and one in ten too thin. These are 10, 15 and 5 times, respectively, the levels expected in a healthy well-nourished population.

It is difficult to compare MDHS findings with other surveys because the latter used different research methods and tended to be site specific rather than regionally representative. In the fifty-four surveys identified by Sundberg (in Parlato and Fishman, 1988; Sundberg, 1989b) that have been carried out to assess acute undernutrition in Mali (mainly as a consequence of the 1983-1985 drought) and the seven to determine chronic undernutrition in urban and rural areas between 1978 and 1989, levels of wasting ranged from 5 to 43 percent and stunting varied from 13 to 37 percent (Appendix D).

2.2 NON-BIOLOGICAL FACTORS

Geographic Characteristics

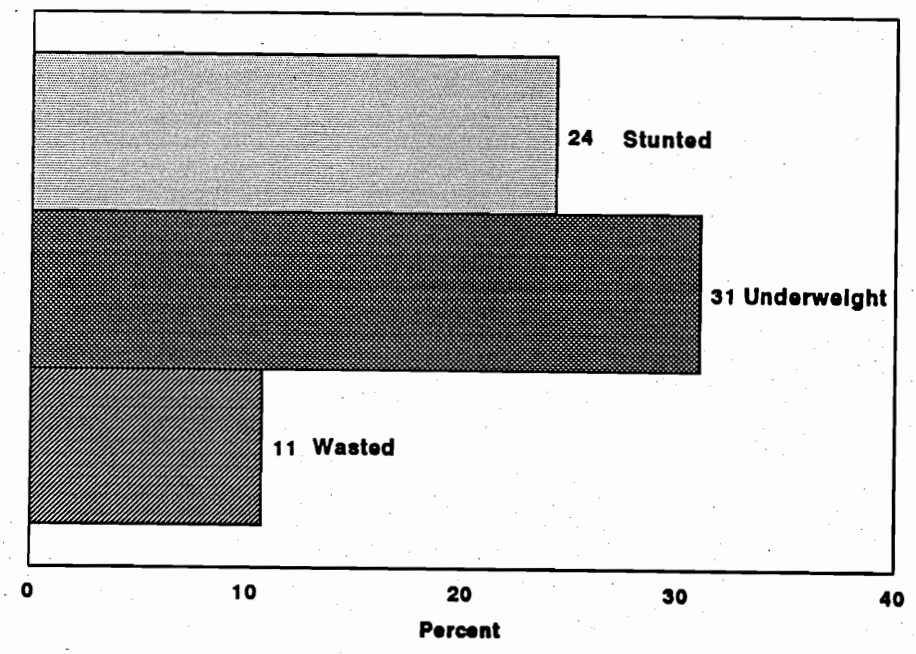
The MDHS found noticeable regional differences in nutritional status (Figure 2.2). Undernutrition is highest in Mopti, Gao and Tombouctou. In these arid, agriculturally poor areas, where households have access to few resources, around 30 percent of the children are stunted, 40 percent are underweight, and 10

[1] Stunted children are those whose height-for-age Z score is less than -2 standard deviations of the mean based on the NCHS/CDC/WHO reference population.

[2] Wasted children are those whose weight-for-height Z score is less than -2 standard deviations of the mean based on the NCHS/CDC/WHO reference population.

[3] Underweight children are those whose weight-for-age Z score is less than -2 standard deviations of the mean based on the NCHS/CDC/WHO reference population.

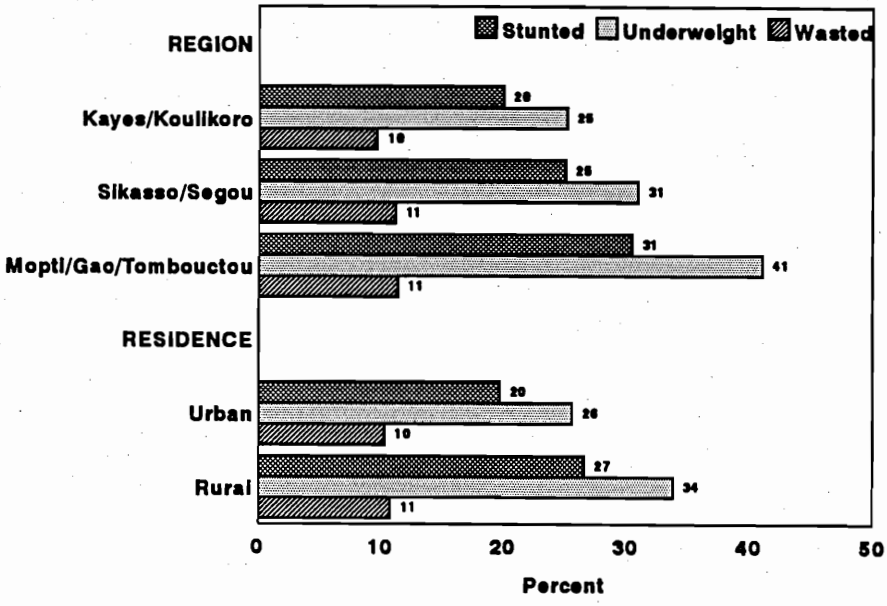
Figure 2.1
Undernutrition among children age 3 to 36 months, Mali



percent are wasted. Carnell and Guyon's (1990) data for Tombouctou during 1985 showed 28 percent of children under 5 years of age were wasted. This problem was particularly acute among children from nomadic households, of whom 43 were wasted compared with 20 percent of children from sedentary agricultural households. In Gao, 19 percent of children were wasted but the children from sedentary agricultural households fared worse than nomadic children (30 versus 18 percent). The lower levels of wasting indicated by the MDHS data, compared with those of Carnell and Guyon, are probably explained by the timing of the Demographic and Health Survey, which was conducted after the 1983-85 drought.

Chronic undernutrition is more prevalent among rural children than among urban children. The MDHS data show that the prevalence of stunting and underweight children in rural areas is al least 30 percent higher than in urban areas (Figure 2.2).

Figure 2.2
Undernutrition among children age 3 to 36 months by region and residence, Mali



Social and Economic Characteristics

The social and economic data collected in the MDHS that are associated with undernutrition are presented in Table 2.1. Children whose fathers have attended secondary or higher schools have lower levels of chronic undernutrition than children whose fathers have less education. Maternal education, however, is not associated with better nutrition, most likely because so few mothers have been to school. Children whose mothers work outside the home for an income are better nourished than those whose mothers do not.

Other indicators reflecting higher social and economic status, such as a better type of floor in the home, roof material, source of drinking water, availability of toilet facilities, type of transportation owned, and ownership of electrical items, are also positively associated with better nutrition. Many of these social and economic factors, however, not only interact with each other, but also with region and residence and are discussed further in Chapter 5.

2.3 BIOLOGICAL FACTORS

Birth Weight

Officially, the Ministry of Health states that 10 percent of newborn babies have low birth weight (below 2.5 kilograms) (Republique du Mali, 1992), while WHO (1980) and UNICEF (1989) both give

estimates of 13 percent. The prevalence of low birth weight varies by region.[4] In Bamako district, it is reported to be 7.7 percent, in Kayes 6.0 percent, in Koulikoro 13.3 percent, in Sikasso 8.3 percent, in Segou 13.5 percent, in Mopti 6.5 percent, in Gao 6.0 percent, and in Tombouctou 10.0 percent (Republique du Mali, 1992). The mean birth weight of children born in Bamako, where it is estimated that 85 percent are delivered in clinics or hospitals, is 3.01 kilograms (WHO, 1980).

Pregnant women often restrict their food intake in order to have smaller babies and thus an easier delivery (Dettwyler, personal communication). Poor maternal health and nutritional status, reflected in the high prevalence of anaemia, also contribute to low birth weights. In addition, Mali has a high rate of twin births, which can result in smaller babies. Dettwyler, using local maternity clinic records, estimated twinning at 17.8 per thousand births, a rate comparable to that previously estimated (17.9 per thousand) for the Bambara and Mandika ethnic groups by Imperato (Dettwyler, 1992).

Health Characteristics

The occurrence of diarrhea in the preceding two weeks, or fever or cough in the preceding four weeks, increases the likelihood of a child being undernourished (Table 2.2). Birth interval also has a significant impact on nutritional status. Children whose preceding birth interval is less than two years are more likely to be chronically undernourished than those whose mothers spaced births farther apart.

Table 2.1 Stunting, underweight and wasting by nonbiological factors

Percentage of children age 3 to 36 months who are stunted, underweight and wasted by non biological factors, Mali 1987

Nonbiological factors	Stunted	Underweight	Wasted
Husband's education			
None	25.3	32.6	11.4
Primary	29.5	34.8	7.7
Secondary+	7.2	14.3	9.3
	p<0.01	p<0.05	ns
Mother working			
No	26.7	33.1	11.8
Yes	16.3	24.1	7.3
	p<0.005	p<0.02	p<0.02
Type of floor			
Cement/tiles	19.5	26.4	10.0
Earth/sand	26.2	32.8	10.9
	p<0.05	ns	ns
Type of roof			
Corrugated iron	16.9	25.0	11.0
Earth	25.4	32.3	10.4
Straw/other	29.3	34.1	11.1
	p<0.01	ns	ns
Source of drinking water			
Private supply	24.0	30.5	8.8
Community supply	23.4	29.6	9.9
Open-air	34.3	47.6	22.6
	ns	p<0.02	p<0.001
Toilet facilities			
No	28.1	37.7	10.0
Yes	23.1	28.9	10.0
	ns	p<0.02	ns
Type of transport			
None	26.3	35.3	12.3
Bicycle	28.2	33.2	9.4
Mo-ped	19.3	24.6	10.1
Car	14.1	17.0	6.0
	p<0.05	p<0.01	ns
Possession score			
0	29.8	36.9	11.3
1	20.3	27.2	10.2
2+	17.0	20.6	9.7
	p<0.002	p<0.002	ns
Overall	24.3	31.0	10.7
Number	925	925	1530

Note: Level of significance determined using Chi-Square test.
ns = not significant

Age-Specific Patterns of Undernutrition

The MDHS data show a clear age-specific pattern in the prevalence of undernutrition. Among infants age 3 to 5 months, the prevalence of stunting and underweight are already at 7 percent, while wasting is 3 percent (Figure 2.3 and Appendix Tables E.1 and E.2). After 5 months of age, these prevalences increase dramatically up to the age of 12 to 14 months. Thereafter, the prevalence of underweight children levels out and wasting declines,

[4] These data are from hospitals or health centers and are unlikely to reflect birth weights of rural infants.

but stunting continues to rise until 18 to 21 months of age. Between 18 and 21 months, nearly four in ten children are stunted, four in ten are underweight, and 14 percent are wasted (Appendix Table E.1).

Because deficits in height are not readily made up, the prevalence of stunting remains over 30 percent among older children. However, a reduction in the prevalence of wasting does occur. Similar findings, indicating that children between the ages of 12 and 23 months are the most vulnerable to undernutrition, have been reported by Monod-Bernard et al. (1980), Licross (1979), Sundberg (1989b), and Dettwyler (1991).

Although chronic undernutrition is a greater nutritional problem in Mali than acute undernutrition, the prevalence of acute undernutrition exceeds 10 percent among infants older than 6 months but less than 21 months of age. Inappropriate infant and child feeding practices, which are discussed in Chapter 3, are strongly associated with the high levels of undernutrition seen in young children.

Table 2.2 Stunting, underweight and wasting by biological factors

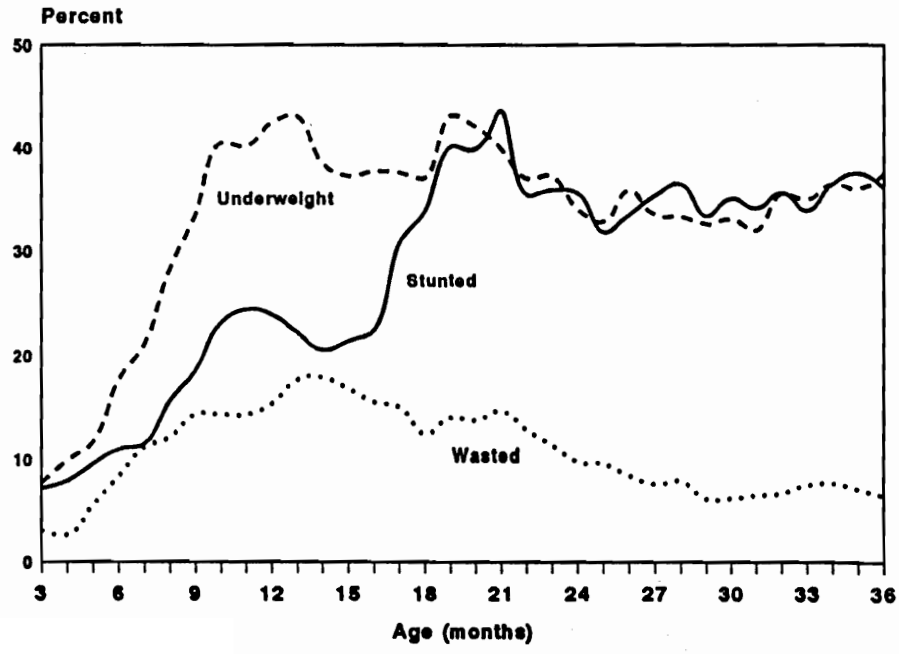
Percentage of children age 3 to 36 months who are stunted, underweight and wasted by biological factors, Mali 1987

Biological factor	Stunted	Underweight	Wasted
Diarrhea (2 weeks)			
No	23.2	27.7	9.4
Yes	25.7	35.5	12.4
	ns	p<0.02	ns
Fever (4 weeks)			
No	25.2	30.1	8.9
Yes	22.8	32.5	13.6
	ns	ns	p<0.005
Cough (4 weeks)			
No	24.5	30.4	9.5
Yes	24.4	40.5	24.9
	ns	ns	p<0.001
Preceding birth interval			
<24 months	33.7	34.3	10.0
24+ months	21.3	30.8	10.8
	p<0.002	ns	ns
Number	925	925	1530

Note: Level of significance determined using Chi-Square test.
ns = not significant

Despite significant differences in the prevalence of undernutrition between the regions and urban/rural areas (Appendix Tables E.1 and E.2), the age-specific pattern of undernutrition remains similar throughout Mali. These data indicate that the most critical period of nutritional vulnerability for Malian children is during the first 18 to 21 months of life.

Figure 2.3
Undernutrition among children age 3 to 36 months by age, Mali



Chapter 3

INFANT AND CHILD FEEDING PRACTICES

3.1 INITIATION OF BREASTFEEDING

Although the MDHS did not collect data on the initiation of breastfeeding, research available suggests varying use of colostrum. UNICEF (1989) reports that, in general, colostrum is believed to be harmful. Abel (1981) notes that rural mothers believe colostrum to be harmful so they discard it and feed their infants lukewarm water containing sugar during the first few days of life. Holley et al. (1990) report that one-third of infants receive breast milk as their first food and 95 percent are given water within their first 5 months.

A study of ethnically diverse mothers in a peri-urban community near Bamako, the majority of whom had their babies at a maternity clinic, found that infants were put to the breast immediately after birth. Thus they received the full benefits of colostrum and breastfeeding was on demand. Maternity nurses, however, advised mothers to give newborns sugar water if they cry frequently. Mothers also believe that giving babies warm water during the first days of life will "open the baby's stomach" (Dettwyler, 1986; 1987).

3.2 EXCLUSIVE BREASTFEEDING

The MDHS found that, while breastfeeding is nearly universal, breastfeeding practices are far from optimal. The World Health Organization recommends that infants be exclusively breastfed for the first 4 to 6 months of life. Exclusive breastfeeding, however, is not often practiced in Mali. About two-thirds of last-born infants were given plain water in addition to breast milk within the first 2 months of life (Figure 3.1 and Appendix F).

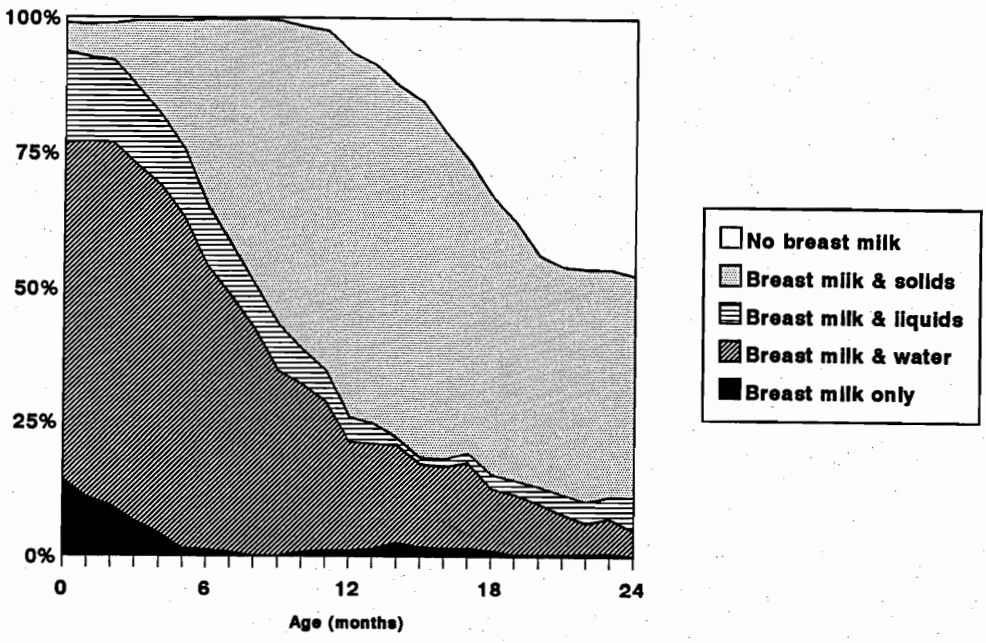
While giving plain water in tropical climates has long been recognized not only as a cultural pattern, but also as accepted medical practice, recent research has conclusively established that healthy infants who are exclusively breastfed do not need additional water (Sachdev et al., 1991). However, the prevalence of exclusive breastfeeding among infants less than 4 months of age in Mali is only between 5 and 15 percent, with slight variations within this range depending on whether the family's residence is urban or rural and in what region they live. Full breastfeeding is practiced by 60 to 70 percent of mothers in all regions, 65 percent of mothers in rural areas, and 72 percent in urban areas (Figure 3.2).

The use of breast milk substitutes (powdered whole milk, fresh milk and/or formula) is prevalent in Mali. During the first 2 months of life, more than one in five infants is given breast milk substitutes (Figure 3.1 and Appendix F). The introduction of plain water, other liquids, or complementary solid foods to breast-fed infants under the age of 4 months spurs three major nutritional concerns. First, the liquids and solid foods offered are nutritionally inferior to breast milk. Second, the introduction of other liquids and solid foods causes the infant to lower its intake of breast milk, in turn reducing the mother's milk supply, since breast milk production is partially determined by both the frequency and intensity of suckling. Third, feeding young infants other liquids and solid foods increases their exposure to pathogens and consequently puts them at higher risk of diarrheal disease.

3.3 BOTTLE USE

The MDHS found that only 3 percent of infants under 6 months of age are fed using a bottle. Because so few infants use a bottle, this practice shows little regional or rural/urban variation. Dettwyler (1988) observed that mothers who give their babies breast milk substitutes often use empty tin cans rather than bot-

Figure 3.1
Feeding patterns by age, Mali



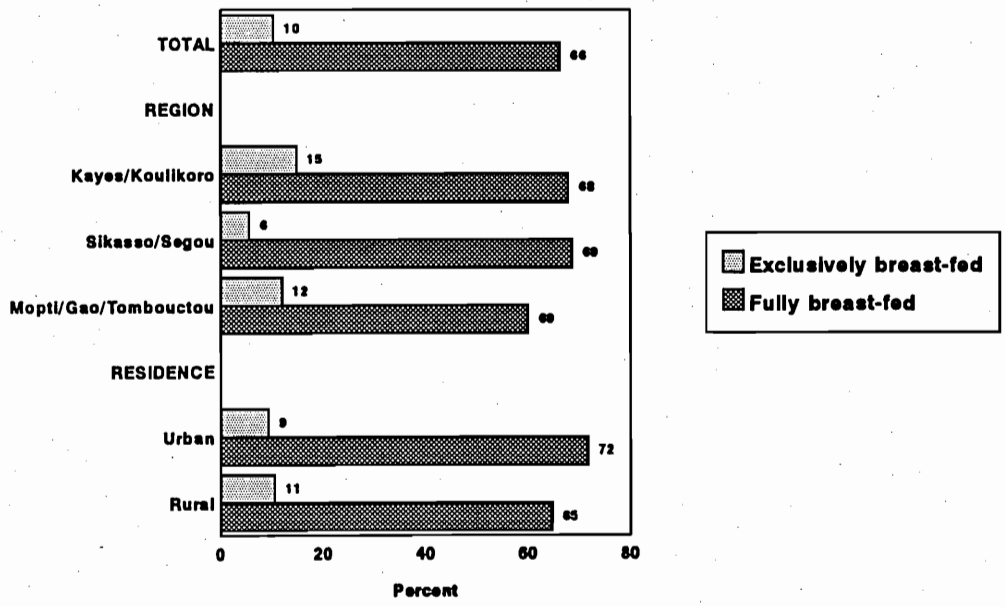
tles. The Malian government actively discourages the use of infant formula and bottles, which can be purchased only at pharmacies. Not only are restrictions imposed on advertising baby formula in the printed media and on promoting it in maternity clinics, but traditional breastfeeding practices are actively encouraged both through clinic personnel and radio programs (Dettwyler, 1986; 1988).

3.4 INTRODUCTION OF COMPLEMENTARY FOODS

The MDHS data show that by 6 months of age, nearly all infants are still being breastfed in Mali (Appendix F), a finding similar to the figure cited by OAU/UNICEF (1992). Nevertheless, a delay in introducing complementary solid foods to older breastfed infants is as serious a concern as the inappropriate feeding of infants under 4 months of age. The World Health Organization recommends that complementary foods be introduced to infants between the age of 4 and 6 months. In Mali, however, over one-half of the infants between the ages of 6 and 9 months are still not receiving complementary solid foods (Figure 3.3 and Appendix F).

The delayed introduction of complementary solid foods has also been noted by Mondot-Bernard and Labonne (1982), Sundberg (1988c), and Holley et al. (1990), who report that the average age for the first introduction of solid foods is 10 to 11 months, 6 to 14 months, and 8 to 12 months, respectively. Holley et al. (1990) observed that 30 percent of children do not receive complementary foods until after the age of 8 months. Dettwyler (1986; 1987; 1989a&b; 1991) found that over three-quarters of children in a peri-urban

Figure 3.2
Exclusive and full breastfeeding among infants under 4 months by region and residence, Mali

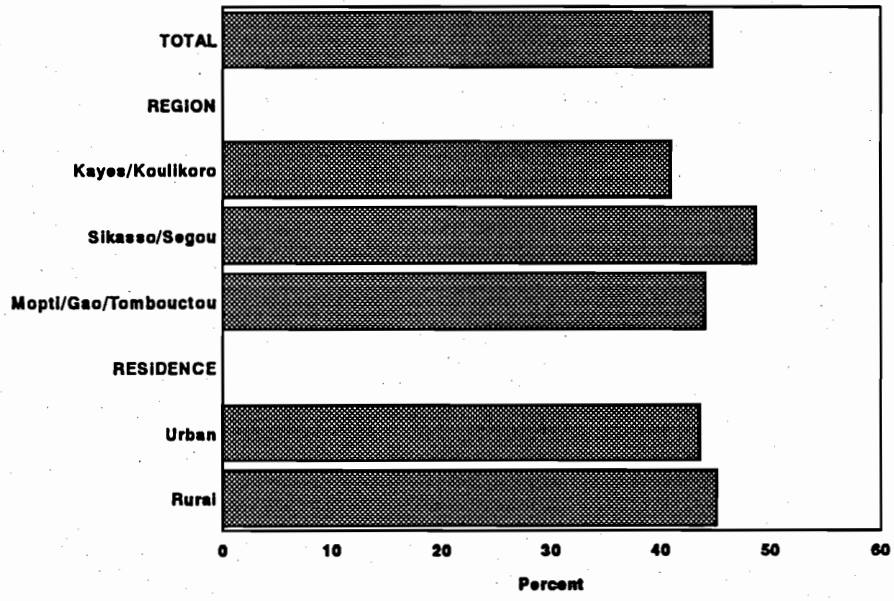


community were introduced to complementary solid foods between the ages of 4 months and 9 months, with a range from 3 to 24+ months.

Porridges, made from millet or rice, are the first complementary foods offered to infants. Eggs, meat and fish are not often offered to children in rural areas and, even when they are, the quantities are small (UNICEF, 1989). Millet and rice prepared in the style eaten by adults are considered inappropriate for infants under 12 months of age because they are thought to cause an enlarged stomach, choking, digestive problems, delayed growth, delayed crawling and walking, and general ill health (Dettwyler, 1986).

While no data are available on the energy density of foods offered to children, both porridges and adult foods in Mali are bulky. Dettwyler (1986) and UNICEF (1989) suggest that the low energy and protein densities of foods given to children, coupled with the monotony of the Malian diet, contribute to high levels of undernutrition. Silva-Barbeau (1991), however, cites data from the Food Technology Laboratory in Mali showing millet "bouillie," to contain 10 percent protein, 3 percent fat and 7 percent moisture. Assuming the remaining 79 percent consists of carbohydrate/ash, the bouillie provides about 275 kilocalories per 100 grams. The Ministry of Health is working on developing a millet/cow pea bouillie, which would not only provide more energy, but also a more balanced diet, particularly in terms of the amino acid composition. Experimental trials on the impact of the improved bouillie on children's growth, however, have been inconclusive.

Figure 3.3
Breastfeeding with complementary foods among infants age 6 to 9 months, by region and residence, Mali



The peri-urban mothers studied by Dettwyler changed neither the frequency nor duration of breastfeeding once complementary foods are introduced to their infants. However, these mothers believe infants do not need complementary foods before 8 months, the age at which children join the family's communal meal and are able to eat out of the bowl without assistance. For Malians, the purpose of eating is to satisfy hunger rather than for nutrition or good health. Mothers strongly believe a child will eat if hungry and only the child can tell when hunger is felt. Therefore, self-feeding is the rule and children are not forced to eat against their will. This belief also applies to sick children, who may go for several days drinking only breast milk and/or water (Dettwyler, 1986; 1987; 1989a; 1989b).

The MDHS data show the adverse effect on nutrition status of delaying the introduction of complementary solid foods to infants. Infants age 7 to 12 months denied complementary solid foods are more likely ($p<0.02$) to be underweight (45.7 percent), compared with those who do receive them (31.2 percent). In the 12 to 24 month age range, the disparity becomes more striking-- 44.0 percent of breastfed infants not yet given solid foods are likely to be underweight, compared with 22.5 percent of those who are both breastfed and receiving complementary foods ($p<0.001$).

3.5 FULL WEANING

The MDHS data show that the duration of breastfeeding is lengthy in Mali. Over 95 percent of all infants are breastfed throughout their first year of life and over half are breastfed well into their second year

(Figure 3.1 and Appendix F). Maternity clinics advise mothers to introduce complementary solid foods at 6 months of age. They suggest weaning girls at 18 months of age and boys at 24 months, because of the belief that boys are inherently weaker than girls (Dettwyler, 1987).

The median duration of breastfeeding is 22 months (Table 3.1). Mothers in Bamako tend to breastfeed for a slightly shorter period, and, among the Peul, the duration of breastfeeding is shorter still, 18 months, while members of the Dogon ethnic group breastfeed for 27 months. Neither the mother's age nor educational level are associated with a shorter duration of breastfeeding.

Table 3.1 Median duration of breastfeeding

Median duration of breastfeeding among children under 3 years by nonbiological factors, Mali 1987

Nonbiological factors	Median duration of breastfeeding (months)	Number
Age of mother		
Below 30 years	21.6	1257
30 years and above	21.5	884
Residence		
Urban	20.2	512
Rural	22.0	1630
Region		
Kayes/Koulikoro	21.9	652
Sikasso/Segou	21.7	884
Mopti/Gao/Tombouctou	21.7	444
Bamako	19.3	161
Mother's education		
None	21.7	1843
Primary+	21.5	279
Ethnic group		
Bambara	22.1	727
Peul	17.9	277
Malinke	21.7	241
Sarakole	19.5	235
Senoufo-Minianka	21.5	205
Dogon	27.2	212
Other	21.3	244
All children	21.6	2141

Source: Baba et al., 1989

The MDHS data are similar to those of Sundberg (1988b), who found that full weaning in rural areas takes place at 23 to 24 months of age and Holley et al. (1990), who cite 18 to 24 months. Abel (1981) indicates that 24 to 30 months is the norm. The cessation of breastfeeding is abrupt. Dettwyler (1986; 1987), UNICEF (1989), and Holley et al. (1990) state that the most common reason for full weaning is a belief that the child is "old enough" to stop breastfeeding and the next most common reason is a new pregnancy. Abel (1981) cites a new pregnancy as the primary reason why rural women cease breastfeeding a child.

Young children are given food four times a day: at dawn, mid-day, late afternoon, and after sunset. Younger children, however, are often asleep at the time of the evening meal. Holley et al. (1990) report that 30 percent of infants under 12 months of age eat fewer than three meals a day. Mothers do not always supervise a child's meals and are thus often unaware of the quantity of food a child may have eaten. Holley et al. (1990) note that only about 20 percent of children eat two or more meals with their mothers. The same study found that fully weaned children are expected to eat adult foods and are thought to have no special dietary needs, while Dettwyler (1987) reports that the majority of peri-urban Bamako children are given extra food once they are fully weaned and that mothers notice their children's appetite tends to improve. This increase in food intake after weaning has a small but positive impact on growth.

The delayed introduction of solid foods is an important factor associated with the poor nutritional status of infants and young children in Mali and partially explains why undernutrition is manifested so early in childhood. Efforts to improve the nutritional status of infants and children need to focus on extending the duration of exclusive breastfeeding, advising on the appropriate time to introduce complementary foods, improving the nutrient content of foods offered to infants and young children, and making parents aware of the consequences of inequitable food distribution within the household.

Chapter 4

MORTALITY AND HEALTH

4.1 INFANT AND UNDER-FIVE MORTALITY

Mali has among the highest infant and under-five mortality rates in the world. Thirteen out of 100 infants die before reaching their first birthdays, and 28 out of 100 children die before reaching age 5 (Table 4.1). Seventy percent of infant and child deaths are attributable to malaria, measles, tetanus, acute respiratory infections, diarrhea, and undernutrition (Republique du Mali, 1992).

Although the infant death rate has dropped by 36 percent and under-five mortality has fallen by 31 percent during the 10-year period between 1972-76 and 1982-86 (Baba et al., 1989), it is doubtful whether Mali will be able to achieve the under-five mortality target established by the 1990 World Summit for Children (below 70 per 1,000 live births by the year 2000). This would entail a 75 percent decline in Mali's under-five mortality rate between 1987 and the end of the century, equivalent to an annual reduction of 15 deaths per 1,000 births. (The World Food Council (1992) cites 14 deaths per 1,000.)

Infant and under-five mortality rates differ by region as well as by urban/rural residence. Both infant and under-five mortality rates in rural areas are about 50 percent higher than in urban areas, and those in Mopti, Gao and Tombouctou are over 55 percent higher than in Bamako. Infant, but not under-five, mortality is nearly 10 percent higher among boys than girls.

Both infant and under-five mortality rates vary according to the mother's age, mother's education, child's birth order, and preceding birth interval. Infants and children of younger mothers and mothers who have not attended school are at greater risk of dying, as are first-borns or those whose order of birth is seventh or higher, or those with a preceding birth interval of less than two years. The MDHS findings are consistent with other studies associating young maternal age, high parity, and birth intervals of less than 2 years with increased risk of infant and under-five mortality.

Table 4.1 Infant and under-five mortality rates

Infant and under-five mortality rates for the ten-year period preceding the survey, by selected background factors, Mali 1987

Background factor	Mortality rates (per 1000)	
	Infant	Under-five
Residence		
Urban	92	203
Rural	144	303
Region		
Kayes/Koulikoro	125	279
Sikasso/Segou	126	246
Mopti/Gao/Tombouctou	172	380
Bamako	73	165
Sex		
Males	138	281
Females	125	277
Mother's education		
None	139	290
Primary	74	200
Mother's age at birth		
Less than 20 years	177	337
20-29 years	116	263
30-34 years	114	258
34 years and older	142	(275)
Birth order		
1	168	295
2 to 3	117	271
4 to 6	114	268
7 or more	151	295
Previous birth interval		
Less than 2 years	202	393
2 to 3 years	81	216
4 or more years	45	129
Overall	131	279

Note: Rates based on fewer than 500 cases are in parenthesis
Source: Baba et al., 1989

4.2 MORBIDITY TRENDS AND USE OF HEALTH FACILITIES

As in many countries, the interaction between undernutrition and morbidity in Mali is compounded by seasonality. Malaria is hyperendemic in Mali (Licross, 1979), particularly during the rainy season (June to August). Mondot-Bernard et al. (1980) report malaria incidence to be over 90 percent in all regions for all age groups studied. In the rainy season other infectious diseases, most notably diarrhea and acute respiratory infections, predominate. Measles is more prevalent during the cooler winter months. Children are thus caught in a vicious cycle of ill-health and undernutrition. They enter the hot dry "hungry season," when levels of undernutrition are highest, weakened by illness suffered during the preceding cooler months (UNICEF 1989).

Thirty-six percent of the children in the MDHS were reported to have had diarrhea in the two weeks preceding the survey, while 35 percent had fever during the previous month and 7 percent had a cough (Table 4.2). The high prevalence of fever reported in the MDHS is supported by the findings of Mondot-Bernard et al. (1980). There are no regional differences in the prevalence of diarrhea or cough, but fever was reported more often in Kayes and Koulikoro than in other regions. Cough (but not diarrhea or fever) was more prevalent in rural than in urban areas.

The mothers of three-quarters of the children with a recent history of fever sought treatment for them, while treatment was sought for about two-thirds of children with diarrhea and with cough (Table 4.2). Mothers in different regions, but not urban/rural areas, vary in their search for advice on children's cough. In contrast, there are urban/rural as well as regional differences in seeking advice for diarrhea and fever. More children with diarrhea, fever or cough are taken for treatment in Sikasso and Segou than in other regions, while the least help is sought in Mopti, Gao, and Tombouctou. Children with diarrhea or fever in rural areas are less likely to be taken for treatment than those in urban areas.

Table 4.2 Prevalence of diarrhea, fever, and cough

Percentage of children under 5 years with diarrhea in the two weeks preceding the survey, fever in the four weeks preceding the survey, and cough in the four weeks preceding the survey by region and residence, Mali 1987

Region and residence	Percentage of children with:			Number	Percentage who sought treatment for:		
	Diarrhea	Fever	Cough		Diarrhea	Fever	Cough
Region							
Kayes/Koulikoro	36.8	40.0	6.5	1079	62.5	70.7	64.5
Sikasso/Segou	35.5	31.6	6.5	1154	78.9	87.2	72.5
Mopti/Gao/Tombouctou	34.7	29.5	8.7	515	57.5	61.5	45.7
	ns	p<0.001	ns		p<0.001	p<0.001	p<0.02
Residence							
Urban	36.0	31.4	3.3	690	73.6	86.0	57.8
Rural	35.8	35.5	8.1	2058	66.7	72.5	64.0
	ns	ns	p<.001		p<0.05	p<0.001	ns
Overall	35.9	34.5	6.9	2748	68.4	75.6	63.3

Note: Level of significance determined using Chi-square test.
ns = not significant

The variations in seeking medical assistance found throughout Mali probably reflect people's access to health facilities, the time available to get help for a sick child, and past experiences with taking children for treatment. They may also reflect the level of mothers' concern about the illness, as well as cultural factors that determine the norm regarding a child's health status.

Traditional herbalists are often sought to treat sick children. Evidence of the widespread use of traditional herbalists is reflected by the large percentage of mothers who seek their help, compared with those who go to medical facilities. About 50 percent of children with diarrhea, 30 percent with fever, and 35 percent with cough are taken to traditional herbalists. Government-run health facilities are free but the medicines prescribed are very expensive. Indeed, it is estimated that about 70 percent of Mali's population can neither afford nor obtain drugs (World Bank, 1990).

The World Bank (1990) also estimates that only 20 percent of Malians have access to medical facilities and these facilities are generally of a poor quality. Furthermore, Bamako, which contains less than 10 percent of the population, has 40 percent of the medics, para-medics, and sanitation workers. This absence of easy access to health facilities is partly reflected in the fact that fewer than a third of the children in the MDHS had a health card. While the proportion of children having a health card was as high as 68 percent in urban areas, only 17 percent of children in rural areas possessed a health card. By region, 41 percent of children had a health card in Kayes and Koulikoro, 25 percent had one in Mopti, Gao, and Tombouctou and 22 percent had one in Sikasso and Segou.

Only 3 percent of the MDHS mothers whose children had diarrhea in the preceding two weeks administered oral rehydration therapy (ORT) by giving them oral rehydration salts or recommended home-made fluids. There were no regional differences in the use of oral rehydration therapy, but urban children were more likely to be given ORT (9 percent) than rural children (1 percent).

The Ministry of Health initiated a program for the Control of Diarrheal Disease (CDD), after the MDHS, which has met with some success. One year after the program began, the Ministry of Health (1989) reported that one-third of diarrheic children had received oral rehydration salts. OAU/UNICEF (1992) reports 41 percent ORT use during the 1987-1989 period. In the Dettwyler (1992) study, however, while many mothers in the peri-urban community near Bamako had heard of oral rehydration salts, only about 10 percent administered them to diarrheic children.

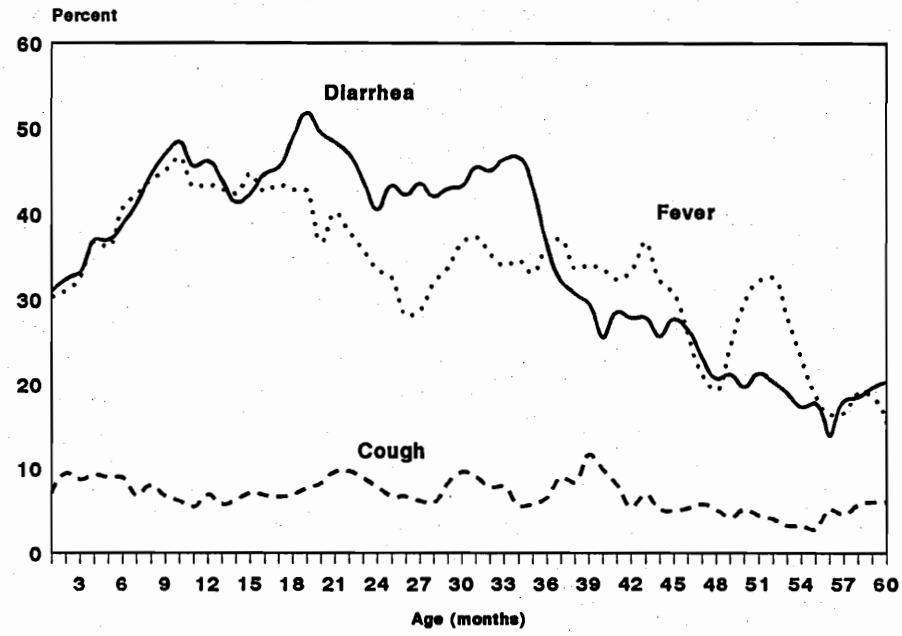
The problem of children not receiving treatment while they are sick is exacerbated by the opinion held by many mothers that diarrhea, vomiting and weight loss are transitory and part of the process of introducing complementary foods to infants and young children (UNICEF, 1989). Another exacerbating factor is that mothers do not consider it necessary to encourage sick children to eat (Dettwyler, 1986).

4.3 AGE-RELATED PATTERN OF DIARRHEA

It is well established that illness, especially diarrheal disease, has a negative influence on the nutritional status of children under age 5. In Mali, the age-specific prevalence of diarrhea (Figure 4.1) closely matches that for wasting (Figure 2.3). Among infants as young as one month, the prevalence of diarrhea is already 16 percent and it increases dramatically to nearly 40 percent by the age of 6 months. The prevalence of diarrhoea peaks between 9 and 36 months of age, after which it drops rapidly. Similar age-specific patterns for diarrhea are found in both urban and rural areas and in the different regions of Mali.

Overall, there is no sex-specific difference in the prevalence of diarrhea. However, in urban areas, significantly ($p<0.05$) more boys (39 percent) are reported to have had diarrhea than girls (32 percent). It is not clear whether this finding represents the fact that more male children do in fact have diarrhea or whether

Figure 4.1
Diarrhea, fever, and cough by age, Mali



urban mothers are more likely to report diarrhea for their male children. The MDHS data show that children under 24 months of age are the most vulnerable to diarrheal disease. Diarrhea is negatively and significantly related to underweight (but not wasting) among children under 24 months.

4.4 AGE-RELATED PATTERN OF FEVER

The prevalence of fever is extremely high among all age groups (Figure 4.1) and in all regions (Table 4.2), but particularly in Kayes and Koulikoro. This finding may reflect seasonal factors since the MDHS was partly conducted during the peak malaria season. Overall, there is no difference in the prevalence of fever by urban/rural residence. Fever is positively associated with a higher level of wasting, which indicates that the anorexia associated with illness has an adverse effect on acute nutritional status. However, fever is not associated with stunting or underweight.

4.5 AGE-RELATED PATTERN OF COUGH

The prevalence of a recent history of cough is similar for children of all ages under five (Figure 4.1). Although mothers of children living in rural areas are more likely to report cough in their child than mothers of urban children, the prevalence of cough does vary by region. As in the case of fever, cough is positively associated with a higher level of wasting, further illustrating the adverse impact of anorexia on acute nutritional status, but it is not associated with either stunting or underweight.

Chapter 5

NUTRITION AND CARING CAPACITY OF THE FAMILY

The social, economic, health, and child-related variables identified as important in the bivariate analyses in Chapter 2 have been used to build a logistic regression[1] model to explain (or predict) the stunting, wasting and underweight found among Malian children age 3 to 36 months. This model estimates the probability that the event of stunting, underweight or wasting will occur. Regression estimates of greater than 1 indicate that the risk of undernutrition is greater than for the reference category.

The following variables have been used to develop the best model to explain stunting, underweight and wasting among children age 3 to 36 months. Only those variables that are significant are discussed in the sections that follow.

Nonbiological variables:

1. Region (Kayes/Koulikoro, Sikasso/Segou, Mopti/Gao/Tombouctou)
2. Residence (urban, rural)
3. Father's education (primary+, none)
4. Mother's work outside the home (no, yes)
5. Transport (car/mo-ped, bicycle, none/animals)
6. Source of drinking water (piped to house, public, open-air)
7. Toilet facilities (yes, no)
8. Type of floor (tiles/cement, earth/sand)
9. Type of roof (corrugated iron, earth, straw/other)
10. Possession score (maximum score of 4 based on the availability of electricity and ownership of a TV, radio and refrigerator)

Biological variables:

1. Diarrhea (no, yes)
2. Fever (no, yes)
3. Cough (no, yes)
4. Number of dead children of mother (0, 1, 2, 3, 4+)
5. Preceding birth interval (24+ months, <24 months)
6. Diet
   (a) 3 months[2] (exclusive and fully breastfed, partially breastfed)
   (b) 4 to 6 months[3] (breastfed, fully weaned)

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[1] Logistic regression models are explained in Appendix G.

[2] The optimal practice has been taken to be exclusive and full breastfeeding. Full breastfeeding is included because so few infants are exclusively breastfed.

[3] The recommended practice is to introduce infants to solid foods between the ages of 4 and 6 months. Thus, all children in this age group should still be breastfed.

(c) 7 to 12 months[4] (breastfed with complementary foods, breastfed but no complementary foods)
(d) 13 to 24 months[5] (breastfed with complementary foods, fully weaned)
(e) 25 to 36 months[6] (fully weaned, breastfed with complementary foods)

Initially, separate analyses were conducted for individual age groups because appropriate feeding patterns depend on age. Risks of undernutrition were compared with the optimal feeding practice for each group: infants 3 months old, infants 4 to 6 months, infants 7 to 12 months, children 13 to 24 months, and children 24 to 36 months old. The age-specific logistic regression models for undernutrition, however, did not show diet to be an important predictor of stunting, underweight or wasting for any age group, except for children who were 13 to 24 months old. Among 13 to 24 month olds, children who were still being breastfed and receiving complementary solid foods were more likely to be underweight than fully weaned children, indicating insufficient food intake among these breastfed children. Because diet was not found to be an important predictor of nutritional status at different ages, the model presented here includes all children.

5.1 STUNTING

The important determinants of stunting among Malian children age 3 to 36 months are the child's age group and preceding birth interval (Table 5.1). The risk of stunting increases with age, because the pernicious effects of poor nutrition take time to manifest themselves in stunting. Children between 3 and 12 months of age fall into the lowest risk group, those 13 to 24 months old are at medium risk, and those 25 to 36 months old comprise the highest risk group.

Children born within 24 months of an older sibling are 13 percent more likely to be stunted than those born after that. Short birth intervals can result in low birth-weight babies who, unless they are well fed, will grow more slowly than children born with a normal weight. Short birth intervals also tend to place excessive demands on a mother's ability to provide optimal child care for closely spaced children, including adequate, appropriate feeding of a younger child.

Because they are associated with region and urban/rural residence, proxies for wealth, such as husband's education, mother's work outside the home, type of flooring, type of roof, source of drinking water, quality of toilet facilities, type of transport owned, and possessions, are not good predictors of stunting among young children in Mali. Once the effects of region on stunting residence are removed, the urban/rural residence and wealth-related factors are no longer significant. Morbidity variables are not good predictors of stunting because these data refer only to the previous two or four weeks and do not reflect a history of illness.

5.2 UNDERWEIGHT

Both nonbiological and biological factors are important determinants of underweight among 3 to 36 month old Malian children. Children in the second year of life are 25 percent more likely to be underweight than children age 3 to 12 months, and those in the third year of life are 16 percent more likely to be

[4] By the age of 6 months, all infants should be receiving complementary solids in addition to breast milk, so this is used as the reference category.

[5] It is recommended that children be breastfed beyond the age of 12 months even if they are receiving complementary foods.

[6] Beyond the age of two years, breast milk does not contribute significantly to the energy and nutrient requirements needed for growth. For this reason the reference category is fully weaned.

underweight. These patterns are probably the result of inap-propriate social and cultural feeding practices and greater exposure to pathogens among old-er children, which increase the risk of illness. Diarrhea, which has an immediate effect on energy balance, increases the risk of being underweight by over 15 percent. Diet is an important predictor of underweight only for the 13 to 24 month age group, in which breastfed children receive complementary solid foods of insufficient quality and quantity to meet their nutritional needs and are thus more than twice as likely to be underweight than fully weaned children.

Children in Sikasso and Segou are at 10 percent greater risk and those in Mopti, Gao, and Tombouctou at 25 percent greater risk of being underweight than children in Kayes and Koulikoro. While living in a particular region does not by itself cause undernutrition, region must be acting as a proxy for other factors associated with poor nutrition, such as access to food, feeding practices, and child care practices, that were not measured by the MDHS.

Underweight is also influenced by the type of transport owned, a proxy for economic well-being. Wealth determines, among other things, the environment in which a child lives and the availability of food at the household level. Children from households which do not own any means of transportation, or own only a bicycle, are at about one-fifth greater risk of being underweight than children from households owning a car or mo-ped. Other social and economic variables, also proxies for wealth, fell out of the logistic regression model because of their associations with region and type of transport owned.

Table 5.1 Net relative risk of stunting, underweight, and wasting

Net relative risk of stunting, underweigt and wasting among children age 3 to 36 months by background factors, Mali 1987

Background factors	Stunted	Underweight	Wasted
Age group			
3 to 12 months	1.00[a]	1.00[a]	1.00[a]
13 to 24 months	1.13[b]	1.25[b]	1.06[b]
25 to 36 months	1.22[b]	1.16[b]	0.98
Preceding birth interval			
24+ months	1.00		
Less than 24 months	1.13[b]		
Diarrhea (2 weeks)			
No		1.00	
Yes		1.17[b]	
Fever (4 weeks)			
No			1.00
Yes			1.05[b]
Cough (4 weeks)			
No			1.00
Yes			1.18
Region			
Kayes/Koulikoro		1.00[a]	
Sikasso/Segou		1.10[b]	
Mopti/Gao/Tombouctou		1.25[b]	
Transport owned			
Car/mo-ped		1.00[a]	
Bicycle		1.23[b]	
None		1.19[b]	
Mother works			
No			1.00
Yes			0.94[b]
Number	810	959	1254

[a] Overall $p<0.05$
[b] $p<0.05$ compared with reference category

5.3 WASTING

Children between 13 and 24 months of age are at 6 percent greater risk of being wasted than either infants age 3 to 12 months or children age 25 to 36 months. This finding is probably due to poorer dietary practices and high morbidity among children who may be dependent on someone other than the mother to feed them complementary solid foods.

The presence of a fever or cough in the previous four weeks increases the risk of wasting, possibly because of the anorexia that often accompanies illness. The situation is made worse because mothers usually do not encourage their sick children to eat (Dettwyler, 1989).

Whether a mother works outside the home is an important predictor of wasting. However, it would appear that the income earned by the mother may be more important than any negative consequences that might arise from not being at home to look after the child herself. Children whose mothers work outside the home for wages are at 6 percent less risk of being wasted than those whose mothers do not work outside the home. Mother's income has both direct and indirect effects on nutrition, through increasing the ability to buy more food, buy better quality food and/or afford better child care.

In summary, stunting, underweight and wasting are largely determined by the child's age, morbidity, and factors generally associated with poverty. Because infants and young children are not being fed optimally, undernutrition manifests itself soon after birth. The situation is exacerbated by very high levels of diarrheal disease and fever at a very young age. The prevalence of undernutrition increases dramatically up to the age of 12 months. Between 13 and 24 months of age stunting continues to rise to over 40 percent. After 24 months of age, slight improvements are seen in measures of underweight and wasting, and morbidity levels fall, which indicates a decline in the nutritional risk for children once they enter the third year of life. This improvement is most likely due to the fact that children are better able to actively partake in the traditional family diet once they are older. These findings clearly indicate that efforts to improve child nutrition in Mali should focus on the first two years of life when inadequate dietary intake and morbidity have their greatest impact on undernutrition.

Chapter 6

RECOMMENDATIONS

6.1 RECOMMENDATIONS

The MDHS was the first attempt to provide nationally representative data on the nutritional status of Malian children age three years and younger. The associations between the age-specific risk for undernutrition and illness, coupled with infant feeding patterns, point to five major areas that need attention if child nutrition in Mali is to be improved.

1. Policy makers, administrators, professionals, and the public at large need to be made more aware of the nutritional problems in Mali.

2. Nutrition programs need to focus on the first two years of life because children under two are at most risk. Specifically, health professionals, paramedics and traditional birth attendants need to:

   (a) be made aware of the importance of advising mothers to feed colostrum to their newborn infants and to initiate breastfeeding immediately, while actively discouraging pre-lacteal feeding;

   (b) advise mothers to exclusively breastfeed their infants until they are 4 to 6 months old;

   (c) advise mothers that, by the age of 6 months, their infants must receive complementary solid foods made from locally available foods;

   (d) develop culturally acceptable and economical methods to improve the nutrient quality of traditional foods that can be used as complementary solid foods for young children;

   (e) advise mothers to continue breastfeeding and about the type of foods and number of meals to give a sick child;

   (f) advise mothers of the importance of encouraging sick children to eat, no matter how mild or insignificant they consider the illness. At the same time, mothers need to be taught about the degrees of diarrhea and fever, what action to take at home, and when to seek medical attention.

3. The rapid increase in the prevalence of diarrhea during the first three years of life suggests that pathogen contamination from food and/or serving utensils is common. Efforts to improve food hygiene (washing hands, cleaning serving utensils, etc.) will benefit children's nutritional status. However, increased mobility as infants get older will inevitably expose them to diarrhea-causing pathogens aside from those found in contaminated food.

4. Mothers need to be provided with information on the visual clues that accompany undernutrition at its early stages. Otherwise, they will continue to assume their children are growing normally when, in fact, they may be too short and/or too thin. At the same time, it is important to teach mothers that proper feeding practices will prevent poor growth and illness (Dettwyler, 1991) and that young children need individual attention at meal times rather than assuming they will get sufficient food from the "common" pot.

5. The high levels of chronic undernutrition among children in their third year suggest that there is either insufficient food or an unequal distribution of food within the household. Enabling households to reduce storage losses and preserve food through low-cost methods will help increase the amount of food available. This should include, for example, solar drying of fruits and vegetables during the season of surplus. Nutrition and health education messages must be addressed to fathers as well as mothers in order to bring about sufficient changes in food distribution within the household to benefit the family's children.

Clearly, better child feeding and child care alone are unlikely to solve Mali's nutrition problems. The complex issue of poverty is paramount and, aside from addressing this general problem, many specific areas continue to need direct attention, including environmental sanitation (such as access to both safe drinking water and toilets) and better maternal health and nutrition.

6.2 ADDITIONAL INFORMATION NEEDS

The Mali DHS data have identified several areas where further information would be useful.

1. Evaluation of current nutrition programs.

In view of the high rates of undernutrition and poor infant and child feeding practices, it is essential to review and evaluate current nutrition programs in Mali, in particular those incorporating nutrition education, in order to identify the bottlenecks to the dissemination of *appropriate* messages to both health care providers and families.

2. Information on maternal nutrition.

The MDHS did not set out to collect information on maternal nutrition. Nevertheless, maternal nutrition is important both in terms of the welfare of pregnant and lactating mothers and of unborn children. Of special concern are teenage girls who become pregnant before their own growth has ceased. Further work is needed on assessing the nutritional status of all mothers.

3. Information on micronutrient deficiencies.

Iron-deficiency anaemia, iodine deficiency and vitamin A deficiency are becoming increasingly important nutritional problems in Mali but there are currently no data on the extent or severity of these micronutrient deficiencies. Efforts to improve the quality of traditional complementary foods should also ensure that the micronutrient content of these foods meet infant and child requirements. It would also be prudent to identify foods which can be readily fortified with iodine, iron and vitamin A. The locally produced bouillon cube may be one example.

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Appendix A

SAMPLE DESIGN

The 1976 census was used as the basis of the sampling frame for the Mali Demographic and Health Survey.[1] The MDHS sample is representative at the national, urban and rural levels. Although the urban population is fully represented, the rural sample represents 90 to 95 percent of the rural population due to the exclusion of nomads and the rural population in Tombouctou and Gao.

The urban sample was selected using sixty census enumeration areas (*section d'énumération*), containing about 1,000 people each. Urban areas included *communes* (towns with a population of 5,000 or more inhabitants, based on the 1976 census) and towns which are the headquarters of each *cercle*, even if they contained fewer than 5,000 inhabitants. The sixty census enumeration areas were divided into segments of 500 inhabitants and stratified on two levels, towns and *communes*.

For towns, the subsequent sampling stage involved four steps: (a) seven towns were selected proportional to population size; (b) within each selected town, two census enumeration areas were selected, again proportional to population size; (c) within each of the fourteen selected enumeration areas, a segment comprising about 500 people was selected proportional to population size; (d) within each segment, households were systematically selected so that the sampling fraction was 1/340.

A three-stage sampling procedure was used for *communes:* (a) forty-six census enumeration areas were allocated to the *communes* proportional to the population size of the *commune;* in each *commune* the number of census enumeration areas were selected with equal probability; (b) within each selected census enumeration area, one segment was selected proportional to population size; (c) within each segment, households were systematically selected.

In the rural areas, a four-stage sampling procedure was followed: (a) thirty-four *arrondissements* were allocated to the regions proportional to the population in each region; within each region, the *arrondissements* were selected proportional to population size; (b) within each of the selected *arrondissements*, two villages (or groups of villages) were selected proportional to the number of segments in the village (or groups of villages) (a segment consisted of 500 inhabitants from one or more neighboring villages); (c) within each selected village (or groups of villages), one segment was selected proportional to population size; and (d) within each segment, households were systematically selected so that the sampling fraction was 1/490. In total, the rural sample consisted of ninety-one villages. Three villages, however, were not surveyed because two were inaccessible and, in another, no households were selected.

[1] This section is summarized from Baba et al., 1989.

Appendix B

HOUSEHOLD AND RESPONDENT BACKGROUND CHARACTERISTICS

CHARACTERISTICS OF THE HOUSEHOLD POPULATION

The MDHS collected information on all usual residents of each survey household and visitors who had slept the previous night in that household. A household was defined as a person or group of people living together and sharing a common pot of food. Average household size was 5.0 people. Households were larger in urban areas (5.4 people per household) than in rural areas (4.9 people per household) (Baba et al., 1989).

Overall, 10 percent of the households in the MDHS were headed by women, 90 percent by men (Ekouevi et al., 1991). Notable urban/rural diversity existed, however, with fifteen percent of urban households headed by women but only 8 percent in rural areas.

CHARACTERISTICS OF HOUSEHOLDS WITH CHILDREN UNDER AGE FIVE

Demographic Factors

A total of 1,979 mothers and 2,905 children under the age of five years are included in the analyses presented in this report. The distribution of children under five and their mothers by region (Kayes/Koulikoro, Sikasso/Segou and Mopti/Gao/Tombouctou) and residence (urban, rural) is shown in Table B.1. Three-quarters of the mothers and children surveyed are from rural areas. Officially, residents of rural areas comprise about 85 percent of Mali's population (UNICEF, 1989). More boys than girls were included in the sample of Kayes/Koulikoro than in the other two regions. There was no variation either within or between the regions in the mean age of children under five.

Table B.1 Nutrition sample from the Mali DHS

Percentage of mothers of children under 5 years in the Mali DHS nutrition sample, and among children the percentage that are male and the percentage that are female, by region and residence, Mali 1987

Region and residence	Mothers		Children		
	Percent	Number	Male	Female	Number
Region					
Kayes/Koulikoro	38.7	766	41.3	37.0	1145
Sikasso/Sego	41.5	822	40.9	42.4	1209
Mopti/Gao/Tombouctou	19.7	390	17.3	20.6	550
Level of significance			p<0.02		
Residence					
Urban	25.0	494	25.3	25.3	735
Rural	75.0	1485	74.7	74.7	2170
Level of significance			ns		
Overall	100.0	1979	50.6	49.4	2905

Note: Levels of signifance determined using Chi-square test.
ns = not significant

Overall, there were on average 7.2 people per household among households with children under the age of five years and there are regional differences (Table B.2). Households in Kayes/Koulikoro, which includes Bamako, tend to have an additional person per household compared with households in the other two regions. Urban households tend to be larger than rural households, in part because the urban population growth rate (4.8 percent) is more than twice the national average (2.1 percent) (Dommen, 1985). Rural-urban migration, especially to Bamako, is high. Findley et al. (1988) cite a study which estimated the migration rate for 1976-1987 to be 14.9/1000 people, indicating that one out of three new residents added to the population of Bamako was a migrant.

Table B.2 Mean and standard deviation for living and dead children

Mean and standard deviation for number of children living at home, total number of children per mother, and number of dead children per mother, among children under 5 years, by region and residence, Mali 1987

Region and residence	Number of children at home	Total number of children	Number of dead children	Number
	Mean (SD)	Mean (SD)	Mean (SD)	
Region				
Kayes/Koulikoro	7.96 (3.68)	3.52 (2.09)	1.19 (1.46)	766
Sikasso/Sego	6.85 (3.31)	3.34 (2.05)	1.07 (1.38)	822
Mopti/Gao/Tombouctou	6.57 (3.60)	3.10 (1.93)	1.53 (1.70)	390
Level of significance	p<0.001	p<0.005	p<0.001	
Residence				
Urban	7.74 (4.12)	3.51 (2.24)	0.90 (1.30)	494
Rural	7.06 (3.33)	3.31 (1.97)	1.31 (1.54)	1485
Level of significance	p<0.001	ns	p<0.001	
Overall	7.23 (3.56)	3.36 (2.04)	1.21 (1.48)	1979

Note: Levels of significance determined using ANOVA.
ns = Not significant.

There are regional, but not urban/rural, differences in the mean number of children living at home (Table B.2). Mothers in Kayes/Koulikoro have more children living at home than do mothers from both Sikasso/Segou and Mopti/Gao/Tombouctou. Mothers in Sikasso/Segou have, on average, 1.1 children who have died, which is less than the 1.2 for mothers in Kayes/Koulikoro and the 1.5 for those in Mopti/Gao/Tombouctou (Table B.2). Rural mothers are more likely to have had a greater number of children who have died than urban mothers. The number of children who have died in a family is known to be associated with increased risks to the nutritional status of surviving siblings.

Maternal, social, and economic factors

Table B.3 shows the mean age of mothers with children under five years of age by region and urban/rural residence. The mothers sampled in Mopti/Gao/Tombouctou tended to be older than those in Kayes/Koulikoro and Sikasso/Segou. There was no urban/rural difference in the mean age of mothers included in the survey.

Table B.3 Mother's age

Mean and standard deviation for age of mothers of children under 5 years, by region and residence, Mali 1987

Region and residence	Mother's age, in years	
	Mean (SD)	Number
Region		
Kayes/Koulikoro	29.1 (7.4)	766
Sikasso/Sego	28.4 (7.4)	822
Mopti/Gao/Tombouctou	29.8 (7.5)	390
Level of significance	p<0.02	
Residence		
Urban	28.7 (6.9)	494
Rural	29.0 (7.6)	1485
Level of significance	ns	
Overall	29.0 (7.4)	1979

Note: Levels of significance determined using ANOVA.
ns = not significant

Overall, 86 percent of mothers had never been to school (Table B.4). Mothers in Kayes/Koulikoro were more likely to have been to school than those in the other regions. Rural mothers were less likely to have attended school than their urban counterparts. Only 14 percent of Malian girls have access to schooling (AED, nd), thus the MDHS findings partly reflect the availability of schools.

Table B.4 Mother's education

Percent distribution of mothers of children under 5 years by level of education, according to region and residence, Mali 1987

Region and residence	Educational level			
	None	Primary+	Total	Number
Region				
Kayes/Koulikoro	81.9	18.1	100.0	766
Sikasso/Sego	88.0	12.0	100.0	820
Mopti/Gao/Tombouctou	88.6	11.4	100.0	390
Level of significance	p<0.001			
Residence				
Urban	67.7	32.3	100.0	494
Rural	91.8	8.2	100.0	1485
Level of significance	p<0.001			
Overall	85.8	14.2	100.0	1976

Note: Levels of significance determined using Chi-square test.

One-quarter of Malian mothers were engaged in waged employment (Table B.5), many of these residing in the regions of Kayes/Koulikoro and Sikasso/Segou and in urban areas.

Table B.5 Mother's employment

Percent distribution of mothers of children under 5 years by whether the mother works outside the home, according to region and residence, Mali 1987

Region and residence	Mother works outside the home		Total	Number
	No	Yes		
Region				
Kayes/Koulikoro	71.3	28.7	100.0	766
Sikasso/Sego	73.3	26.7	100.0	820
Mopti/Gao/Tombouctou	90.6	9.4	100.0	390
Level of significance	p<0.001			
Residence				
Urban	68.1	31.9	100.0	494
Rural	78.5	21.5	100.0	1485
Level of significance	p<0.001			
Overall	75.9	24.1	100.0	1976

Note: Levels of significance determined using Chi-square test.

Ninety-eight percent of the mothers interviewed were currently married and, among these women, 90 percent of their husbands were living at home (Table B.6). Mothers in Mopti/Gao/Tombouctou were less likely to be married (particularly those in urban areas) than mothers in Kayes/Koulikoro or Sikasso/Segou. In Kayes/Koulikoro, a higher proportion of husbands were working and living elsewhere, compared with the other two regions. Overall, urban mothers were less likely to be married and, among currently married mothers, less likely to have their husbands living with them than rural mothers. Forty-four percent of the mothers surveyed were in a polygamous union, with the highest proportions found in Kayes/Koulikoro and rural areas (Table B.6).

Eighty-eight percent of the husbands had not had any formal education (Table B.7). This was the most evident in Sikasso/Segou and in rural areas, reflecting the availability, access to, and use of educational institutions. Seventy-one percent of the husbands were farmers (Table B.8), which reflects Mali's high dependency on subsistence farming (officially put at 90 percent). Relatively more men had professional/ managerial occupations in Kayes/Koulikoro, most of them in Bamako.

Table B.6 Mother's marital union and residence of husband

Percentage of mothers of children under 5 years who are currently married, percentage of married mothers whose husbands live at home, and percentage of mothers in a polygamous union, by region and residence, Mali 1987

Region and residence	Currently married	Number	Husband present	Polygamous union	Number
Region					
Kayes/Koulikoro	97.2	766	82.6	46.0	743
Sikasso/Sego	98.9	822	96.3	42.5	813
Mopti/Gao/Tombouctou	96.2	390	92.1	41.9	375
Level of significance	p<0.01		p<0.001	ns	
Residence					
Urban	96.3	494	85.4	19.4	474
Rural	98.2	1485	91.8	80.6	1457
Level of significance	p<0.02		p<0.001	p<0.001	
Overall	97.7	1978	90.2	43.7	1931

Note: Levels of significance determined using Chi-square test.
ns = not significant

Appendix B.7 Husband's education

Percent distribution of husbands of mothers of children under 5 years by husband's level of education, according to region and residence, Mali 1987

Region and residence	Husband's education				
	None	Primary	Secondary or higher	Total	Number
Region					
Kayes/Koulikoro	86.1	9.0	4.9	100.0	701
Sikasso/Sego	91.4	6.8	1.8	100.0	783
Mopti/Gao/Tombouctou	83.1	12.1	4.8	100.0	378
Level of significance	p<0.001				
Residence					
Urban	67.2	19.6	13.3	100.0	425
Rural	93.8	5.5	0.7	100.0	1437
Level of significance	p<0.001				
Overall	87.7	8.7	3.6	100.0	1862

Note: Levels of significance determined using Chi-square test.

Table B.8 Husband's occupation

Percent distribution of husbands of mothers of children under 5 years by husband's occupation, by region and residence, Mali 1987

Region and residence	Husband's occupation: Professional/ managment	Farming	Skilled/ unskilled	Total	Number
Region					
Kayes/Koulikoro	22.0	65.6	12.4	100.0	759
Sikasso/Sego	13.0	75.8	11.2	100.0	822
Mopti/Gao/Tombouctou	15.9	71.4	12.7	100.0	390
Level of significance	p<0.001				
Residence					
Urban	51.3	17.4	31.2	100.0	494
Rural	5.5	89.0	5.5	100.0	1477
Level of significance	p<0.001				
Overall	17.0	71.0	11.9	100.0	1971

Note: Levels of significance determined using Chi-square test.

Twenty-seven percent of mothers lived in houses where there were no toilet facilities (Table B.9). Toilets were more common in Kayes/Koulikoro, Sikasso/Segou and urban areas. Seventy-two percent of the mothers surveyed obtained drinking water from community sources, that is public taps and wells, particularly in rural areas (Table B.10). Thirty-five percent of rural residents and 55 percent of urban residents are estimated to have access to safe water (AED, nd). At the time of the survey, only sixteen percent of households had a bar of soap on the premises, irrespective of whether the household was in an urban or rural area. These data suggest the widespread absence of hygiene and sanitation facilities throughout the country.

Table B.9 Availability of toilet

Percent distribution of households with children under 5 years by availability of toilet facilities, according to region and residence, Mali 1987

Region and residence	Toilet facilities: No	Yes	Total	Number
Region				
Kayes/Koulikoro	15.9	84.1	100.0	765
Sikasso/Sego	27.0	73.0	100.0	819
Mopti/Gao/Tombouctou	48.7	51.3	100.0	390
Level of significance	p<0.001			
Residence				
Urban	3.5	96.5	100.0	493
Rural	34.8	65.2	100.0	1481
Level of significance	p<0.001			
Overall	27.0	73.0	100.0	1974

Note: Levels of significance determined using Chi-square test.

Table B.10 Source of drinking water

Percent distribution of households with children under 5 years by source of drinking water, according to region and residence, Mali 1992

Region and residence	Source of drinking water: Private supply	Community supply	Open-air	Total	Number
Region					
Kayes/Koulikoro	21.2	73.4	5.4	100.0	766
Sikasso/Sego	24.9	66.9	8.2	100.0	822
Mopti/Gao/Tombouctou	3.1	82.1	14.8	100.0	390
Level of significance	p<0.001				
Residence					
Urban	44.1	51.8	4.1	100.0	494
Rural	10.9	79.3	9.9	100.0	1485
Level of significance	p<0.001				
Overall	19.2	72.4	8.4	100.0	1979

Note: Levels of significance determined using Chi-square test.

Fifty-two percent of mothers surveyed lived in a household which owned a radio and forty-nine percent actually listened to the radio at least once a week. Radio ownership and use were more prevalent in Kayes/Koulikoro, Sikasso/Segou and in urban areas (Table B.11). Table B.12 shows that over three-quarters of the mothers surveyed lived in houses with an earth/sand floor, a material that was more common in rural than in urban areas. The majority of households also lived in houses with an earth roof, 25 percent had a straw/other roof and 19 percent a corrugated iron roof (Table B.13). Corrugated iron was more evident in Kayes/Koulikoro than in the other regions. Table B.14 shows that 44 percent of mothers came from households that did not own any means of transportation. Bicycles were the most common vehicles, especially in rural areas, but mo-peds were more common in urban areas.

Table B.11 Exposure to radio

Percentage of mothers of children under 5 years that own a radio and percentage of mothers who listen to the radio at least once a week, by region and residence, Mali 1987

Region and residence	Own radio	Listen to radio weekly	Number
Region			
Kayes/Koulikoro	62.0	66.0	758
Sikasso/Sego	53.7	42.0	818
Mopti/Gao/Tombouctou	30.1	28.6	386
Level of significance	p<0.001	p<0.001	
Residence			
Urban	77.7	79.6	492
Rural	43.8	38.3	1470
Level of significance	p<0.001	p<0.001	
Overall	52.3	48.6	1962

Note: Levels of significance determined using Chi-square test.

Table B.12 Floor material

Percent distribution of households with children under 5 years by type of floor material, according to region and residence, Mali 1987

Region and residence	Floor material: Earth/ sand	Cement/ tiles	Total	Number
Region				
Kayes/Koulikoro	26.4	73.6	100.0	766
Sikasso/Sego	18.1	81.9	100.0	822
Mopti/Gao/Tombouctou	19.0	81.0	100.0	390
Level of significance	p<0.001		p<0.001	
Residence				
Urban	71.6	28.4	100.0	494
Rural	4.8	95.2	100.0	1485
Level of significance	p<0.001		p<0.001	
Overall	21.5	78.5	100.0	1979

Note: Levels of significance determined using Chi-square test.

Table B.13 Roof material

Percent distribution of households with children under 5 years by type of roof material, according to region and residence, Mali 1987

Region and residence	Roof material: Corrugated iron	Earth	Straw/ other	Total	Number
Region					
Kayes/Koulikoro	29.7	41.0	29.3	100.0	766
Sikasso/Sego	17.2	71.0	11.8	100.0	822
Mopti/Gao/Tombouctou	0.1	55.0	44.9	100.0	390
Level of significance	p<0.001				
Residence					
Urban	61.7	30.7	7.6	100.0	494
Rural	4.3	64.7	30.9	100.0	1485
Level of significance	p<0.001				
Overall	18.7	56.2	25.1	100.0	1979

Note: Levels of significance determined using Chi-square test.

Table B.14 Transport owned

Percent distribution of household with children under 5 years by type of transport owned, according to region and residence, Mali 1987

Region and residence	Type of transport owned				Total	Number
	None	Bicycle	Mo-ped	Car		
Region						
Kayes/Koulikoro	45.6	27.7	22.4	4.4	100.0	765
Sikasso/Sego	32.9	39.5	25.9	1.8	100.0	822
Mopti/Gao/Tombouctou	66.9	14.1	16.2	2.8	100.0	388
Level of significance	p<0.001					
Residence						
Urban	41.9	9.5	36.7	11.9	100.0	494
Rural	45.3	36.7	17.9	0.0	100.0	1481
Level of significance	p<0.001					
Overall	44.5	29.9	22.6	3.0	100.0	1976

Note: Levels of significance determined using Chi-square test.

A possession score, based on the availability of electricity and the ownership of a radio, refrigerator and/or television set was devised as a proxy for wealth. Each asset's value was one. Table B.15 shows that an equal proportion of mothers lived in households with a score of zero or one. A majority in rural areas and in Mopti/Gao/Tombouctou had a score of zero. The fact that so few respondents belonged to households with a possession score greater than one suggests widespread poverty.

Table B.15 Possession score

Percent distribution of households with children under 5 years by possession score, according to region and residence, Mali 1987

Region and residence	Possession score			Total	Number
	0	1	2+		
Region					
Kayes/Koulikoro	36.7	53.9	9.4	100.0	766
Sikasso/Sego	46.2	49.0	4.8	100.0	822
Mopti/Gao/Tombouctou	70.0	27.1	2.9	100.0	390
Level of significance		p<0.001			
Residence					
Urban	21.5	53.9	24.6	100.0	494
Rural	55.7	44.1	0.1	100.0	1485
Level of significance		p<0.001			
Overall	47.2	46.6	6.2	100.0	1979

Note: Levels of significance determined using Chi-square test.
Possession score: Score 1 for availability of electricity and/or ownership of a radio, refrigerator, or television.

Antenatal Care

About 34 percent of mothers had consulted a trained medical practitioner for antenatal care during the pregnancy of their last-born child, 4 percent had made use of an untrained attendant and nearly two-thirds had obtained no antenatal care whatsoever (Table B.16). The absence of antenatal care is particularly common in rural areas and in the Mopti/Gao/Tombouctou region.

Table B.16 Antenatal care provider

Percent distribution of mothers of children under 5 years by type of antenatal care provider, according to region and residence, Mali 1987

Region and residence	Antenatal care provider				
	None	Trained	Untrained	Total	Number
Region					
Kayes/Koulikoro	57.0	42.0	0.9	100.0	1122
Sikasso/Sego	61.9	30.6	7.5	100.0	1189
Mopti/Gao/Tombouctou	76.5	22.8	0.7	100.0	543
Level of significance		$p<0.001$			
Residence					
Urban	25.7	73.1	1.1	100.0	725
Rural	75.3	20.2	4.5	100.0	2130
Level of significance		$p<0.001$			
Overall	62.7	33.6	3.6	100.0	2854

Note: Levels of significance determined using Chi-square test.

Appendix C

ANTHROPOMETRIC DATA VERIFICATION

Of the 1,692 children between the ages of 3 months and 36 months who took part in the survey, 92.1 percent were weighed and measured. The Z-scores for height-for-age and weight-for-age could not be calculated for 42 percent of the children because they had no identifiable date of birth.

Children for whom there were no anthropometric measurements tended to be over 18 months of age whose mothers had never been to school. These children tended to live in Mopti/Gao/Tombouctou region and in rural areas. All of these characteristics, however, tended to be interrelated.

There was some evidence of digit preference in the height and weight data (Table C.1). Digit preference was more prominent for height than weight. Height preferences favored terminal digits ending in 0 and, to a lesser extent, 5 and 2, while weight preferences tended to be for the digit on either side of 0 and 5. It is not possible to determine whether the tendency was to round upwards or to round downwards. These findings for digit preference should not affect the calculated prevalences of undernutrition. They will, however, reduce the probability of finding significant associations between undernutrition and explanatory variables.

Table C.1 Digit preference in anthropometric data

Percentage of height, weight, and age data falling as specific integers, Mali 1987

Integers/ age	Height	Weight
0	16.6	9.1
1	7.8	12.8
2	11.4	9.4
3	8.6	7.4
4	9.1	11.5
5	13.1	10.3
6	8.3	11.2
7	6.3	7.9
8	9.0	9.2
9	9.5	11.3
Total	100.0	100.0

Appendix D

MALI NUTRITION SURVEYS

Appendix D.1 Weight for age data - 1978-1987, Mali

Prevalence of acute protein-energy malnutrition among children in Mali: A summary of existing studies

Arrondissement[1]	Study date	Sample size	Age in months[2]	Percentage less than 80% standard weight for height[3]		Surveyor
Region I						
1 Mioro (city)	Aug 1984?	1939	0 - 60	5.5	- -	SSP
2 Diema (city)	Aug 1984?	273	0 - 60	6.6	- -	SSP
Region II						
3 Dilly	Apr 1984	445	0 - 72	23.6	- -	MSF
4 Faiou	Apr 1984	287	0 - 72	16.0	- -	MSF
5 Guire	Apr 1984	295	0 - 72	14.9	- -	MSF
6 Mourdiah	Apr 1984	726	0 - 72	14.4	- -	MSF
7 Balle	Apr 1984	671	0 - 72	16.0	- -	MSF
8 Balle	Dec 1986	324	6 - 60	4.9	(0.0)	SAP
9 Balle	Jun 1987	450	6 - 60	14.2	- -	SAP
10 Balle	Aug 1987	450	6 - 60	10.7	(1.8)	SAP
Regions II & III						
11 Random villages	Jul-Aug 1978 Mar-Apr 1979	339	0 - 60	7.0	- -	ORAMA
Regions II,III & IV						
12 CMDT Nord }	Nov 1984-Feb 1985	3660	0 - 60	26.0	- -	EMMPN
13 CMDT}				20.0	- -	
Region V						
14 Douentza (cercle)	Mar-May 1984	1282	6 - 60	7.4	(0.0)	MSF
14 Douentze (city)	Mar-May 1984	338	6 - 60	6.6	(0.6)	MSF
16 Douentze Central	Sep 1986	200	6 - 60	8.0	(0.0)	SAP
17 Kandie	Sep 1986	200	6 - 60	7.5	(0.0)	SAP
18 N'Gouma	Sep 1986	200	6 - 60	14.5	(0.0)	SAP
19 N'Gouma	Mar 1987	450	6 - 60	7.3	(1.1)	SAP
20 Sah	Mar 1987	305	6 - 60	11.4	(2.7)	SAP
21 Miono Central	Apr 1987	305	6 - 60	11.1	(2.6)	SAP
Region VI						
22 Rharous (cercle)	Jun 1984	1368	0 - 60	19.5	(3.8)	MSF
23 Niafunke (cercle)	Jun 1984	1115	0 - 60	10.3	(1.2)	MSF
24 Dire (cercle)	Jun 1984	1163	0 - 60	25.7	(3.5)	MSF
25 Goundam (cercle)	Jun 1984	387	0 - 60	22.7	(2.0)	MSF
26 Timbuktu (cercle)	Jun 1984	718	0 - 60	15.9	(1.7)	MSF
27 Entire Region	May 1985	1800?	0 - 60	18.5	- -	MSF
28 Entire Region	Jul 1986	1836	6 - 72	6.1	(0.7)	MSF
29 Rharous (cercle)	Jul-Aug 1986	600	6 - 60	10.2	(0.8)	SAP
30 Rharous (cercle)	Feb 1987	450	6 - 60	7.1	(0.4)	SAP
31 Dire (cercle)	Feb 1987	1000	6 - 60?	8.6	(0.6)	UNICEF
32 N'Gorkow	Jul 1987	440	6 - 60	10.2	(3.2)	SAP
33 Timbuktu Commune	Sep 1987	858	6 - 72	8.9	(1.4)	MSF
Region VII						
34 Manaka (cercle)	Apr 1985	923	0 - 72	41.7	(9.7)	Red Cross
35 Entire Region (sedentary)	Oct 1985	920	0 - 72	23.0	(4.9)	Red Cross
36 Kidel (cercle) (nomadic)	Oct 1985	909	0 - 72	2.6	- -	Red Cross
37 Bourem (cercle)	Dec 1985	?	0 - 72?	26.5	- -	Red Cross
38 Almoustarat	Jul 1986	210	0 - 72	21.4	- -	SAP
39 Almoustarat	Jul 1986	200	0 - 72?	12.0	(4.0)	Red Cross
40 Bamoa	Jul 1986	?	6 - 60?	6.5	- -	UNICEF
41 Bouram Central	Jul 1986	210	0 - 72	16.7	- -	SAP
42 Tomera	Aug-Sep 1986	?	0 - 60?	23.6	- -	UNICEF
43 Almoustarat	Sep-Oct 1986	642	3 - 72	16.8	- -	UNICEF
44 Almoustarat	Oct 1986	198	6 - 60	43.0	(3.5)	SAP
45 Tessit	Oct 1986	193	6 - 60	1.5	(0.5)	SAP
46 Bouren Central	Oct-Nov 1986	?	6 - 60?	16.0	- -	UNICEF
47 Almoustarat	Nov 1986	825	3 - 72	9.8	- -	UNICEF
48 Ansongo (cercle)	Nov-Dec 1986	204	6 - 60	8.3	(0.5)	SAP
49 Bouram (cercle)	Nov-Dec 1986	298	6 - 60	13.7	(2.0)	SAP
50 Almoustarat	Mar 1987	600	6 - 72	3.5	(0.8)	UNICEF
51 Bamba	Mar 1987	574	6 - 72	9.8	(2.8)	UNICEF
52 Temera	Mar 1987	505	6 - 72	7.1	(1.0)	UNICEF
53 Bouram Central	Mar 1987	600	6 - 72	10.2	(1.5)	UNICEF
54 Temara	Dec 1987	412	6 - 60	8.2	(0.2)	SAP

[1] Arrondissement given unless "cercle" or another designation is specified.
[2] If the age of the child is unknown, surveyors generally measure children between approximately 65 and 115 or tall.
[3] Weight for height figures below 80% and above 70% of NCHS/WHO/CDC standards are considered to be an indicator of moderate acute malnutrition.Ratios below 70 of the standard indicate severe acute malnutrition.The first figure in the column gives the percentage of malnourished children, including those considered to be both moderately and severely malnourished. The second figure in the column gives the percentage of children below 70 percent of the standard, i.e., those considered severely malnourished. A dash indicates that the latter figure was not available.

Source: Sundberg in Parlato & Fishman, 1988.

Appendix D.2 Weight for age data - 1978-1987, Mali

Prevalence of chronic protein-energy malnutrition among children in Mali: A summary of existing studies

Arrondissement	Study date	Sample size	Age in months	Percentage less than 80% standard weight for height[1]	Surveyor
Region I Kita, Bafouitable, & Keniaba cercles	May 1981	10007	0 - 14	35.8	World Bank/ EMMPM
Region II Nonsombougou arrondissement	April 1984	539	0 - 5	13.0	UNDP
Region III Yanfolila cercle	March 1980	1443	0 - 14	16.7	EMMPM/ UNDP
Region II & III					
CMDT Nord }				15.6	
}	Nov 1984-Feb 1985	3660	0 - 5		EMMPM
CMDT Sud }				16.0	
Region V Koro (city)	December 1981	210	0 - 5	16.0	USAID
Bamako, Segou & eight villages in Regions I, III, V, VI & VII	July-Aug 1977 &	139	0 - 5	34.0	Mondot-
	Jan-Apr 1978	107	6 - 14	23.5	Berrard

[1]All studies except Mondot-Berrard use Harvard standards of height for age. Mordot-Berrard uses NCHS standards. Children whose height for age lies below 90 percent of the standard are said to be growth stunted, an indicator of chronic malnutrition.

Source: Sundberg in Parlato and Fishman, 1988.

Appendix E

REGIONAL, RESIDENTIAL, AND GENDER DIFFERENCES IN PREVALENCE OF UNDERNUTRITION, BY CHILD'S AGE

Appendix E.1 Undernutrition by region and age group

Percentage of children age 3-36 months who are undernourished by region and age group, Mali 1987

Age group (months)	Stunted	Underweight	Wasted
Mali	n=925	n=925	n=1530
3-5	6.9	7.2	3.4
6-8	11.5	21.9	11.1
9-11	22.8	39.1	13.0
12-14	25.8	44.4	17.2
15-17	25.6	38.2	16.7
18-21	38.3	38.2	13.9
21-23	31.5	34.9	8.2
24-26	31.9	29.2	6.6
27-29	34.4	36.4	6.9
30-32	36.0	35.7	7.9
33-35	43.0	37.8	5.4
Kayes/Koulikoro	n=382	n=382	n=582
3-5	7.9	7.9	2.3
6-8	14.1	11.1	6.5
9-11	23.9	29.6	12.0
12-14	18.2	36.9	20.9
15-17	14.7	36.6	26.4
18-21	29.1	36.0	8.9
21-23	23.7	18.7	1.8
24-26	26.5	29.2	8.4
27-29	28.9	30.4	3.1
30-32	26.8	30.5	10.5
33-35	25.6	25.6	11.8
Sikasso/Segou	n=319	n=319	n=678
3-5	6.7	9.4	5.3
6-8	5.8	27.7	13.0
9-11	20.3	42.2	10.1
12-14	30.0	41.8	14.4
15-17	40.0	36.5	11.0
18-21	49.8	40.8	17.8
21-23	31.0	28.2	14.4
24-26	51.4	33.3	7.2
27-29	12.7	37.3	7.3
30-32	32.3	20.1	6.4
33-35	58.4	58.4	4.7
Mopti/Gao/Tombouctou	n=225	n=225	n=270
3-5	4.8	0.0	0.0
6-8	15.0	32.4	16.4
9-11	24.2	50.3	22.3
12-14	27.5	60.5	18.8
15-17	36.4	43.2	4.4
18-21	37.5	38.3	14.1
21-23	39.9	57.5	7.4
24-26	25.5	25.5	0.0
27-29	51.4	41.3	13.3
30-32	65.1	72.0	7.1
33-35	52.2	38.9	0.0

Appendix E.2 Undernutrition by residence, gender and age group

Percentage of children age 3-36 months who are undernourished by residence and gender according to age group, Mali 1987

Age group (months)	Stunted	Underweight	Wasted
Urban	n=311	n=311	n=389
3-5	4.8	1.6	1.5
6-8	4.0	10.8	10.6
9-11	20.4	33.5	17.0
12-14	21.7	28.5	17.2
15-17	24.9	37.5	10.9
18-21	24.9	31.6	14.5
21-23	24.0	44.6	4.9
24-26	34.4	36.8	8.2
27-29	34.2	17.3	4.9
30-32	17.3	25.0	6.7
33-35	23.1	25.2	10.1
Rural	n=614	n=614	n=1141
3-5	7.6	9.1	3.8
6-8	15.2	27.4	11.2
9-11	23.7	41.3	11.8
12-14	27.5	51.0	17.3
15-17	25.8	38.5	18.4
18-21	47.1	42.3	13.6
21-23	28.8	26.3	9.6
24-26	29.4	20.8	5.8
27-29	46.6	50.0	7.5
30-32	45.3	43.1	8.4
33-35	50.0	42.7	4.1
Males	n=486	n=486	n=803
3-5	7.2	8.1	3.0
6-8	16.0	18.7	12.6
9-11	24.8	42.6	14.4
12-14	28.3	45.0	16.3
15-17	29.2	44.3	13.3
18-21	31.1	31.9	15.6
21-23	23.9	19.1	11.2
24-26	28.0	38.1	10.6
27-29	31.2	36.6	9.0
30-32	40.4	37.3	11.4
33-35	24.6	16.4	4.8
Females	n=439	n=439	n=728
3-5	6.5	6.1	3.8
6-8	7.0	25.3	9.5
9-11	19.9	34.2	11.2
12-14	22.7	43.5	18.3
15-17	22.4	32.9	19.6
18-21	45.3	44.3	11.7
21-23	36.0	44.4	5.9
24-26	35.2	21.6	2.7
27-29	39.8	35.9	4.6
30-32	30.5	33.6	3.7
33-35	75.6	75.6	6.4

Appendix F

FEEDING PRACTICES, BY CHILD'S AGE

Table F.1 Feeding practices by age

Percent distribution of children under 24 months by feeding practices, according to age group, Mali 1987

Age (months)	Breastfed and:								
	Nothing	Water	Other liquids	Milk	Solids	Milk and solids	Fully weaned	Total	Number
Age range									
0-1 months	13.7	64.1	10.8	5.1	4.9	0.0	1.4	100.0	119
2-3 months	7.6	68.0	5.5	9.9	6.8	1.4	1.0	100.0	146
4-5 months	3.1	64.6	6.5	5.6	16.6	3.0	0.6	100.0	137
6-7 months	0.0	50.6	4.2	8.5	28.3	8.4	0.0	100.0	139
8-9 months	0.0	39.5	0.9	4.7	38.6	15.8	0.5	100.0	125
10-11 months	0.0	24.0	0.8	7.3	48.4	18.5	1.0	100.0	111
12-13 months	3.0	23.0	0.0	3.7	45.2	19.9	5.1	100.0	127
14-15 months	1.0	18.1	0.0	0.0	43.5	21.5	15.9	100.0	88
16-17 months	2.1	13.1	1.4	1.5	43.0	18.9	20.1	100.0	79
18-19 months	0.0	14.8	0.7	1.7	29.0	17.5	36.2	100.0	82
20-21 months	0.9	6.3	0.6	1.2	32.6	11.9	46.5	100.0	97
22-23 months	0.0	4.8	4.0	2.0	27.9	11.2	50.1	100.0	82

Appendix G

LOGISTIC REGRESSION MODELS

Logistic regression analysis, as opposed to multiple regression analysis, is used when the dependent (or outcome) variable has only two values. In other words, an event can either occur or not occur. In this report, logistic regression models have been developed to explain (or predict) three outcomes, namely, stunting, underweight and wasting among Malian children. These models estimate the probability that an event occurs; in this case being stunted, underweight, or wasted.

In each model the value of one of the categories listed under the variable heading is a reference category against which all other values are compared. For each variable, the category in the bivariate analysis most positively associated with the "outcome variable" has generally been used as the reference category. By default, values for these reference categories are given a regression estimate of 1.00. Regression estimates greater than 1.00 indicate that the odds for the "outcome variable" for the category in question are greater than for the reference category. Conversely, regression estimates of less than 1.00 indicate that the odds for the "outcome variable" for the category in question are less than that for the reference category.

For example, in Table 5.1, the group 3 to 12 months of age is the reference category for the age variable and has a numerical value of 1.00. The net relative risk of being stunted for infants age 13 to 24 months is 1.13, i.e., 13 percent greater, which is significantly different to being stunted among infants 3 to 12 months of age. Similarly, children age 25 to 36 months are 22 percent more likely to be stunted than infants age 3 to 12 months; this difference is also statistically significant. The net relative risk of being wasted for infants age 13 to 24 months is 6 percent greater than among infants 3 to 12 months old, a difference which is also statistically significant. Children age 25 to 36 months, with a net relative risk value of 0.98, are 2 percent less likely to be wasted than infants age 3 to 12 months, but this difference is not statistically significant.