AFRICA NUTRITION CHARTBOOKS

NUTRITION OF INFANTS AND YOUNG CHILDREN IN MALI

Findings from the 1995-96 Mali DHS Survey

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Introduction

Malnutrition is one of the most important health and welfare problems among infants and young children in Mali. It is a result of both inadequate food intake and disease. Inadequate food intake is a consequence of insufficient food available at the household level and improper feeding practices. Infectious diseases, particularly diarrhea, acute respiratory illness, malaria and measles, result from inadequate health care, poor environmental sanitation and insufficient water supplies. Both inadequate food intake and disease reflect underlying social and economic conditions.

Among the significant health and economic consequences of malnutrition, the most serious is an increased risk of death. Other adverse consequences include an increased risk of illness, lower cognitive development and poor pregnancy outcomes.

The Mali data analyzed here are from the 1995-96 Mali Demographic and Health Survey (MDHS-II), a nationally representative survey of 8,716 households conducted by the Cellule de Planification et de Statistique, Ministère de la Santé, de la Solidarité et des Personnes Âgées, and the Direction Nationale de la Statistique et de l'Informatique, Bamako. Technical assistance was provided by Macro International Inc. and funding was provided by the U.S. Agency for International Development. Fieldwork was conducted between November 1995 and April 1996. Of the 5,237 living children age 0-35 months that were included in the MDHS-II, 4,678 with complete date of birth and anthropometric data are included in these analyses. Nutrition-related information collected on these children include height, weight, age, breastfeeding history, and feeding patterns. Information was also collected on diarrhea, fever and cough in the two weeks prior to the survey and on relevant sociodemographic characteristics. For comparison purposes, data are presented from Demographic and Health Surveys conducted in other sub-Saharan countries.

An earlier nutrition chartbook was published in 1993 based on data from the 1987 Mali Demographic and Health Survey (MDHS-I). Where applicable, findings from the MDHS-II have been compared with those from the MDHS-I. A minor difference between the first and second chartbooks is that the second chartbook presents anthropometric data for children 0 to 35 months, whereas the first presented anthropometric data for children 3 to 36 months. Comparisons in the text between 1987 and 1995-96 thus apply to the overlapping 3 to 35 month age-range. Other slight differences in presentation between the two chartbooks result from modifications in the MDHS survey design between 1987 and 1995-96.
Figure 1: Malnutrition among Children under 3 Years, Mali

In Mali:

- **Thirty percent of children aged 0 to 35 months are chronically malnourished.** In other words, they are too short for their age or *stunted.*¹ The proportion of children who are stunted is 15 times the level expected in a healthy, well-nourished population.²

- **Acute malnutrition,** manifested by *wasting,*³ results in a child being too thin for his or her height. Wasting affects 23 percent of children, which is eleven times the level expected in a healthy, well-nourished population.

- **Forty percent of children are underweight**⁴ for their age. This is 20 times the level expected in a healthy, well-nourished population.

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¹ A *stunted* child has a height-for-age Z-score that is below -2 standard deviations (SD) based on the NCHS/CDC/WHO reference population. Chronic malnutrition is the result of an inadequate intake of food over a long period of time and may be exacerbated by chronic illness.

² The distribution of children’s mean height and weight for a given age from the International Reference Population as defined by the National Center for Health Statistics (NCHS), the Centers for Disease Control (CDC), and the World Health Organization (WHO) is shown in Appendix 2.

³ A *wasted* child has a weight-for-height Z-score that is below -2 SD based on the NCHS/CDC/WHO reference population. Acute malnutrition is the result of a recent failure to receive adequate nutrition and may be affected by acute illness, especially diarrhea.

⁴ An *underweight* child has a weight-for-age Z-score that is below -2 SD based on the NCHS/CDC/WHO reference population. This condition can result from either chronic or acute malnutrition, or a combination of both.
Figure 1
Malnutrition among Children under 3 Years, Mali

Note: Stunted reflects chronic malnutrition; wasted reflects acute malnutrition; underweight reflects chronic or acute malnutrition, or a combination of both.

Source: MDHS 1995/96
Among the sub-Saharan countries surveyed:

- The percentage of children age 3 to 35 months who are stunted ranges from 23 to 48 percent. **At 33 percent, the proportion of stunted children in Mali is in the middle range of the sub-Saharan countries surveyed.** Stunting is a good long-term indicator of the nutritional status of a population because it is not markedly affected by short-term factors such as season of data collection, epidemic illnesses, acute food shortages, recent shifts in social or economic policies.

- The percentage of children age 3 to 35 months who are underweight ranges from 14 to 44 percent. **At 44 percent, the proportion of underweight children in Mali is the highest among the sub-Saharan African countries surveyed.** Because underweight represents either children who suffer from chronic or acute malnutrition, or both, underweight is influenced by both short- and long-term determinants of malnutrition. Underweight is often used as a general indicator of a population's health status.

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1 Comparisons of countries based on stunting and underweight levels are useful in depicting the general nutrition situation in sub-Saharan Africa. Caution should be exercised in interpreting the rankings of countries based on nutrition indicators in isolation from other data. For policy and programmatic decisionmaking purposes, data on nutrition indicators should be interpreted together with other relevant social, economic, demographic and health data.
Figure 2

Malnutrition among Children Age 3 to 35 Months in Mali Compared with Other Sub-Saharan Countries

Note: Stunted reflects chronic malnutrition; underweight reflects chronic or acute malnutrition, or a combination of both.

Source: DHS Surveys 1986-1995
In Mali, between 1987 and 1995-96:

- The proportion of children age 3 to 35 months who are stunted has increased by 38 percent.
- The proportion of children age 3 to 35 months who are wasted has more than doubled.
- The proportion of children age 3 to 35 months who are underweight has increased by 42 percent.

The nutrition situation in Mali has declined markedly since the 1987 MDHS. This decline is at first surprising, in light of the fact that infant and child mortality levels have declined. Moreover, the 1995-96 survey was conducted during months usually considered more food secure (November through April) compared with the 1987 survey (conducted March through August), indicating that season of data collection cannot explain the increase in malnutrition. Little change in the methodology of anthropometric data collection between the two surveys occurred, however even if slight improvements in measurement accuracy in 1995-96 occurred, this would result in differences in both positive and negative directions.

The similar levels of wasting seen across socioeconomic groups (Figures 10-13), as well as the high levels of maternal malnutrition (Figures 18-20), suggest that insufficient food intake may be an important causative factor in the rise of malnutrition in Mali. Additional long-term factors may be contributing to the troubling rise in stunting. Relevant agricultural, economic, and health service utilization data are available and should be studied in order to better understand the current nutrition situation in Mali and to identify appropriate interventions which may be warranted.
Figure 3
Changes in Malnutrition Rates among Children 3 Months to 3 Years of Age, Mali 1987 to 1995

Note: Stunted reflects chronic malnutrition; wasted reflects acute malnutrition; underweight reflects chronic or acute malnutrition, or a combination of both.

Source: MDHS 1987 and 1995/96
In Mali, the time between 3 months and 14 months of age is a vulnerable period:

- **The proportion of children stunted increases gradually from 0 to 21 months of age, at which time it peaks at about 55 percent.** The proportion of children stunted drops somewhat between 22 and 27 (probably due to an artifact inherent in the reference standard), then rises again to over 50 percent through the remainder of the third year. This pattern highlights the first two years of life as the most nutritionally vulnerable for children in Mali.

- **The proportion of children wasted rises rapidly from 3 to 12 months of age, at which time it peaks at about 40 percent of children.** During the second year, the proportion of children wasted declines slightly, to about a third of children, and in the third year wasting continues to decline to about 20 percent of children. **In the first month of life, already 15 percent of newborn infants are wasted,** suggesting that the rate of low birth weight is very high, and that mothers are not in an optimal state of health during pregnancy.

- **The proportion of children underweight increases rapidly from 3 to 14 months of age, at which time it peaks at about 55 percent.** The proportion of children underweight essentially remains at this high level through the second and third years of life. While the overall age pattern is similar to that observed in 1987, the proportion of children underweight has increased dramatically.
Figure 4
Stunting, Underweight and Wasting by Age, Mali

Note: Stunted reflects chronic malnutrition; wasted reflects acute malnutrition; underweight reflects chronic or acute malnutrition, or a combination of both.

Source: MDHS 1995/96
Improper feeding practices, in addition to infectious diseases, are important determinants of malnutrition. The World Health Organization (WHO) recommends that \textit{all infants be exclusively breastfed from birth until about 6 months of age}.\footnote{World Health Organization, Forty-seventh World Health Assembly (WHA 47.5), May 9, 1994.} In other words, infants should be fed only breast milk during the first months of their lives.

In Mali, the introduction of liquids, such as water, sugar water, juice, tea, powdered or fresh milk, formula, and solid foods, takes place far earlier than the recommended age of about 6 months. This practice has a deleterious effect on nutritional status for a number of reasons. First, the liquids and solid foods offered are nutritionally inferior to breast milk. Second, the consumption of liquids and solid foods decreases the infant's intake of breast milk which, in turn, reduces the mother's supply of milk. (Breast milk production is determined, in part, by the frequency and intensity of suckling.) Third, feeding young infants liquids and solid foods increases their exposure to pathogens and thus puts them at greater risk of diarrheal disease.

- \textbf{In Mali, 12 percent of children under the age of 4 months are exclusively breastfed,} as is recommended by WHO. This represents a small increase in exclusive breastfeeding since the 1987 MDHS, when only 10 percent of mothers followed the WHO recommendation.

- \textbf{Nearly 22 percent of infants under 4 months old are given some form of supplements other than water, which is not recommended.} The majority of these infants receive liquids other than breast milk and or water.
Figure 5
Feeding Practices for Infants under 4 Months, Mali

Breast milk only (recommended) 12%
Breast milk and other liquids 20%
Breast milk and solid foods <2%
Breast milk and water 67%

Note: WHO recommends that all infants be breastfed exclusively until they are about 6 months old.

Source: MDHS 1995/96
The failure to exclusively breastfeed young infants, the introduction of liquids and solid foods at too early an age, and the use of bottles, increase the risks of diarrhea and mortality in Africa.

- **In most of the sub-Saharan countries surveyed, relatively few mothers of infants under 4 months follow the recommended practice of breastfeeding exclusively.** Less than one-eighth of mothers in Mali breastfeed their young infants exclusively. This places them in the lower/middle range of sub-Saharan countries. Exclusive breastfeeding has increased slightly since the 1987 MDHS, when 10 percent of children were exclusively breastfed.

- **Bottle feeding, which is not recommended by WHO, is used by only 3 percent of mothers of infants under 4 months in Mali.** The proportion of mothers who bottle feed their children in Mali has not changed since the 1987 MDHS.
Figure 6
Infants under 4 Months Who Are Exclusively Breastfed and Those Who Receive a Supplemental Bottle in Mali Compared with Other Sub-Saharan Countries

Note: Information on feeding practices is based on the 24 hours preceding the survey. WHO recommends that all infants should receive nothing but breast milk until about 6 months of age.

Source: DHS Surveys 1986-1996
The WHO recommends that solid foods be introduced to infants around the age of 6 months because breast milk alone is no longer sufficient to maintain a child's optimal growth. Thus, *all infants over 6 months of age should be receiving solid foods* along with breast milk.

- **In Mali, 31 percent of infants age 6 to 9 months are fed solid foods in addition to breast milk.** *The proportion of mothers who feed their infants solid foods in addition to breast milk has decreased by 33 percent since the 1987 MDHS.*

- **Over two-thirds of infants age 6 to 9 months are not fed solid foods in addition to breast milk;** less than 1 percent are fully weaned from the breast.
Figure 7
Feeding Practices for Infants Age 6 to 9 Months, Mali

Note: WHO recommends that by the age of 6 months all infants should receive solid foods in addition to breast milk.

Source: MDHS 1995/96
In Mali:

- **Sixty-eight percent of infants age 6 to 9 months do not receive solid food in addition to breast milk.** This is the highest among all the countries surveyed, indicating a very low degree of compliance with WHO recommendations.
Figure 8

Infants Age 6 to 9 Months Not Receiving Food in Addition to Breast Milk in Mali Compared with Other Sub-Saharan Countries

Note: WHO recommends that by the age of 6 months all infants should receive solid foods and liquids in addition to breast milk.

Source: DHS Surveys 1986-1996
Figure 9: Stunting and Wasting among Children under 3 Years by Region, Mali

In Mali:

- Stunting occurs in approximately one-third of children in all regions except Bamako, where 17 percent of children are stunted, and Mopti, where 28 percent of children are stunted.

- Wasting occurs in approximately one-fourth of children in all regions except Kayes, where wasting affects 17 percent of children.
Figure 9
Stunting and Wasting among Children under 3 Years by Region, Mali

Note: Stunting reflects chronic malnutrition.
Wasting reflects acute malnutrition.
Source: MDHS 1995/96
In Mali:

- **In rural areas**, where over two-thirds of the population lives, **33 percent of children under 3 years are stunted, and 23 percent are wasted.**

- Urban children are less likely than their rural counterparts to be stunted, but not less likely to be wasted: **22 percent of urban children under 3 years are stunted, and 24 percent are wasted.**

- Similar levels of wasting in urban and rural areas suggest that **food shortages may be affecting all segments of the population.**
Figure 10
Stunting and Wasting among Children under 3 Years
by Residence, Mali

Note: Stunting reflects chronic malnutrition.
Wasting reflects acute malnutrition.

Source: MDHS 1995/96
Maternal education, which is related to household wealth, is a determinant of good child-care knowledge and practices. In Mali, 84 percent of mothers with children under 3 years of age have never attended school. Twelve percent of mothers have attended primary school and only 5 percent have a secondary school, or higher, education. Maternal education varies across regions and urban and rural residence. With the exception of Bamako, over 75 percent of mothers have no education, between 6 and 17 percent have a primary education, and 1 to 8 percent have a secondary or higher education. However, in Bamako, the rates of education are higher: 56 percent of mothers have no education; 22 percent have a primary education and 22 percent have a secondary or higher education. In urban areas, almost 70 percent of mothers have never been to school and 13 percent have been to secondary school or higher. In rural areas, 90 percent of mothers have not been to school, while only 1 percent have been to secondary school.

- **Stunting is twice as high among children of mothers with no education compared with children of mothers with secondary or higher education, and a third higher compared with children of mothers with only primary school education.**

- **There is no difference in the level of wasting between children of mothers with secondary or higher education and children of mothers with primary school education, and very little difference in wasting between these children and those whose mothers have no education.** The fact that wasting affects children of all socioeconomic levels, as represented by mother's education, suggests that insufficient food intake may be a problem affecting all classes of children.
Figure 11

Stunting and Wasting among Children under 3 Years by Mother’s Education, Mali

Source: MDHS 1995/96

Note: Stunting reflects chronic malnutrition. Wasting reflects acute malnutrition.
A household's source of drinking water is associated with child nutritional status directly, through its impact on hygiene and the risk of diarrheal disease, and indirectly, as a measure of wealth and availability of water. Without an adequate supply of good quality water, a household's personal, domestic and food hygiene are compromised and the risk of contamination (and thus diarrheal diseases) increases. Poor households are likely to have an insufficient supply of water and to obtain drinking water from contaminated sources, such as surface water.

Nearly half (45 percent) of the households in Mali obtain drinking water from a public well. Of the remainder, 21 percent have a well in their residence, 15 percent use a borehole, 4 percent use open water sources (spring, river, pond or lake), 10 percent use a public tap, and 5 percent have piped water in their home.

- **Among households with piped water, 18 percent of children are stunted; among other households the percentage of children stunted is over 26 percent.**

- **The level of wasting is similar across all households, irrespective of the source of drinking water.** This suggests that socioeconomic differences, represented by source of water, cannot fully explain the level of wasting in Mali. The fact that wasting affects even households with piped water suggests that insufficient food intake may be affecting children of all socioeconomic levels.
Figure 12

Stunting and Wasting among Children under 3 Years by Source of Drinking Water, Mali

Note: Stunting reflects chronic malnutrition.
Wasting reflects acute malnutrition.

Source: MDHS 1995/96
Figure 13: Stunting and Wasting among Children under 3 Years by Type of Toilet, Mali

The type of toilet used by a household is an indicator of household wealth and a determinant of environmental sanitation. Poor households are less likely to have sanitary toilet facilities. Poor sanitation results in increased risk of diarrheal disease, which contributes to malnutrition. In Mali, two-thirds of households use traditional pit latrines, less than 1 percent own or share a flush toilet, 8 percent use an improved pit latrine, and the remainder have no facility.

- **In** (the small proportion of) households where a flush toilet exits, stunting among children under 3 years is significantly lower (13 percent) than in all other households, where approximately one-third of children are stunted.

- **Wasting**, on the other hand, is similar across all households, irrespective of type of toilet facility. About one-fourth of children are wasted. As was noted with source of water (Figure 12), this suggests that socioeconomic differences, represented by type of toilet, cannot adequately explain the level of wasting in Mali. The fact that wasting affects even households with flush toilets suggests that insufficient food intake may be affecting children of all socioeconomic levels.
Figure 13
Stunting and Wasting among Children under 3 Years by Type of Toilet, Mali

Note: Stunting reflects chronic malnutrition. Wasting reflects acute malnutrition.
Source: MDHS 1995/96
In Mali:

- **Twenty-five percent of children under 3 years of age had diarrhea in the preceding two weeks.** The level of diarrhea has declined compared with 1987, when 42 percent of children under 3 years had diarrhea. The prevalence of diarrhea increases rapidly during infancy until it peaks at 13 months of age, when over 35 percent of children are reported to have had diarrhea. By 21 months of age, the prevalence of diarrhea declines to around 30 percent, and in the third year of life it declines to about 25 percent. The age pattern of diarrhea is similar to that observed in 1987, except that the overall level of diarrhea was higher in 1987.

  The rapid rise in the prevalence of diarrhea during infancy reflects the increased risk of pathogen contamination associated with the early introduction of water, other liquids, and solid foods. In addition, once infants begin to crawl and move around, they tend to put objects into their mouth, again increasing the risk of pathogen contamination.

- **About 15 percent of children under the age of 3 had cough with rapid breathing in the preceding two weeks.** This is about twice the level observed in 1987, when 7 percent of children had respiratory difficulty or rapid breathing. The prevalence of respiratory illness does not vary much by child age, but appears to be slightly higher during infancy than during the second and third years.
Figure 14
Age-Related Pattern of Diarrhea and Cough with Rapid Breathing, among Children under 3 Years, Mali

Source: MDHS 1995/96
High fertility rates, especially when accompanied by short intervals between births, are detrimental to children's nutritional status. In most countries in sub-Saharan Africa, families have scarce resources to provide adequate nutrition and health care for their children. As the number of children per woman increases, fewer household resources are available for each child. High fertility also has a negative impact on women's health, thus increasing the chances that a mother may deliver a low birth weight baby and/or not be able to breastfeed or care for her children adequately. Young children, who are more vulnerable to malnutrition and disease, are more likely to die.

- **At current fertility levels, each woman in Mali will have an average of 6.7 children by the end of her childbearing years** (this is the total fertility rate for women age 15 to 49 years). This rate is among the highest in the sub-Saharan countries surveyed and has declined only slightly since the 1987 MDHS.

- **Under-five mortality is very high in Mali compared with other sub-Saharan countries. At current mortality levels, almost one-quarter of children born will die before their fifth birthday.** Mali's under-five mortality rate of 238 deaths per 1,000 births is the second highest among all the sub-Saharan countries surveyed. The under-five mortality rate has declined by 5 percent from the rate for the period 1982-86.
Figure 15
Fertility and Child Mortality in Mali Compared with Other Sub-Saharan Countries

Source: DHS Surveys 1986-1996
Malnutrition and mortality both take a tremendous toll on young children. This figure illustrates the proportions of children who have died or are malnourished at each age, in 1987 and in 1995-96.

In Mali:

- Between 0 and 15 months of age, the percentage of children who are alive and well nourished drops rapidly. This pattern was similar in 1987 and 1995-96.

- In 1995-96, at 18 months of age, almost 16 percent of children have died, 56 percent are severely or moderately malnourished,\(^1\) and only 28 percent remain alive and well nourished. In 1987, at 18 months of age, 25 percent of children had died, 37 percent were malnourished, and 38 percent remained alive and well nourished.

- While the mortality rate has decreased since the 1987 MDHS, the proportion of children who are alive, but malnourished has increased, resulting in more children surviving, but in a worse nutritional condition.

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\(^1\) A child with a Z-score below -3 SD on the reference standard is considered severely malnourished while one with a Z-score between -3 and -2 SD is considered moderately malnourished.
Figure 16
Survival and Nutritional Status of Children
Mali 1987 and 1995/96

Note: Solid lines represent data from the 1987 MDHS

Source: MDHS 1987 and 1995/96
Malnutrition is an important factor in the death of many young children in Mali. Formulas developed by Pelletier et al.\textsuperscript{1} are used to quantify the contributions of severe and mild-to-moderate malnutrition to under-five mortality.

- More than half (57 percent) of all deaths that occur before the age of five are related to malnutrition. That is 136 deaths per 1,000 live births.

- Because of its extensive prevalence, \textbf{mild-to-moderate malnutrition contributes to more deaths (100 per 1,000) than does severe malnutrition (36 per 1,000)}. Thus, mild-to-moderate malnutrition is implicated in almost three-fourths of all under-five deaths associated with malnutrition. Severe malnutrition is implicated 15 percent of all under-five deaths.

- The \textbf{contribution of malnutrition to under-five deaths has risen since 1987}, when less than half (47 percent) of under-five deaths were associated with malnutrition. \textbf{The contribution of severe malnutrition to under-five deaths in 1995-96 is about twice as large as it was in 1987 (8 percent)}.

- Although small improvements in under-five mortality have been made in Mali since 1987, \textit{malnutrition has worsened, and this has probably prevented greater improvements in mortality from occurring}.

Figure 17
Contribution of Malnutrition to Under-five Mortality, Mali

Note: Calculation based on Pelletier et al., 1994.
Figure 18: Malnutrition among Mothers of Children under 3 Years by Region and Residence, Mali

A mother's nutritional status affects her ability to successfully carry, deliver, and care for her children and is of great concern in its own right. While there are no generally accepted cut-off points for indicators of malnutrition among adult women, ad hoc standards can be applied.

Women who are too short—largely due to stunting during childhood and adolescence—may have difficulty during childbirth because of the small size of their pelvis. Evidence also suggests there is an association between maternal height and low birth weight. Women less than 145 centimeters in height are considered too short.

Malnutrition in women, can be assessed using the Body Mass Index (BMI), which is defined as a woman's weight in kilograms divided by the square of her height in meters. Thus, BMI = kg/m². When the BMI of non-pregnant women falls below the suggested cut-off point of 18.5 kg/m², malnutrition is indicated.

- Sixteen percent of mothers of children under age 3 in Mali are malnourished, while less than 1 percent are too short.
- Malnutrition does not differ greatly between urban and rural areas, but rural mothers are 13 percent more likely to be malnourished than urban mothers.
- By region, the highest prevalence of maternal malnutrition occurs in Koulikoro, where 21 percent of mothers are malnourished.
Figure 18
Malnutrition among Mothers of Children Under 3 Years by Residence and Region, Mali

Note: Malnutrition levels are based on the percentages of mothers whose BMI is less than 18.5 kg/m². Source: MDHS 1995/96
In Mali:

- Mother's level of education affects whether or not a woman is likely to be malnourished. Compared with mothers who have no education, mothers with a primary education were 13 percent less likely to be malnourished, and mothers with a secondary or higher education were 38 percent less likely to be malnourished.
Figure 19
Malnutrition among Mothers of Children under 3 Years
by Education, Mali

Note: Malnutrition rate are based on the percentages of mothers whose BMI is less than 18.5 kg/m$^2$. Source: MDHS 1995/96
Malnutrition among mothers is likely to have a major impact on their ability to care for themselves and their born and unborn children.

- **About 16 percent of Malian mothers of children under 3 years of age are malnourished.** This is the second highest level of underweight recorded among the sub-Saharan countries surveyed.

- **Less than 1 percent of mothers of children under 3 years of age are short.** This is close to the lowest level found among the sub-Saharan countries surveyed.
Figure 20
Malnutrition among Mothers of Children under 3 Years in Mali Compared with Other Sub-Saharan Countries

Note: *Short* is the percentage of mothers under 1.45 m; *underweight* is the percentage of mothers whose BMI is less than 18.5 kg/m$^2$.

Source: DHS Surveys 1995-1996
Appendix 1
Stunting, Wasting and Underweight Rates by Background Characteristics
Mali 1995-96

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<td><strong>Child's Sex</strong></td>
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<td></td>
<td><strong>Location of Residence</strong></td>
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<td>Male</td>
<td>31.4</td>
<td>24.6</td>
<td>40.1</td>
<td>Rural</td>
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<td>23.4</td>
<td>43.2</td>
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<td>29.3</td>
<td>22.2</td>
<td>40.7</td>
<td>Urban</td>
<td>21.9</td>
<td>23.5</td>
<td>32.5</td>
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<td>NS</td>
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<tr>
<td><strong>Overall</strong></td>
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<td>23.4</td>
<td>40.4</td>
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Note: Level of significance is determined using the chi-square test.
NS = Not significant
### Appendix 1 (cont’d.)

**Stunting, Wasting and Underweight Rates by Background Characteristics**

**Mali 1995-96**

<table>
<thead>
<tr>
<th>Background Characteristic</th>
<th>Stunted</th>
<th>Wasted</th>
<th>Underweight</th>
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<tr>
<td><strong>Source of Drinking Water</strong></td>
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<tr>
<td>Piped into residence</td>
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<td>22.9</td>
<td>36.0</td>
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<tr>
<td>Well in residence</td>
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<td>39.0</td>
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<tr>
<td>Public well</td>
<td>31.6</td>
<td>23.6</td>
<td>43.0</td>
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<tr>
<td>Borehole</td>
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<td>22.7</td>
<td>40.9</td>
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<tr>
<td>Surface/other</td>
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<td><strong>Type of Toilet</strong></td>
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<td>Own/shared flush</td>
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<td>32.3</td>
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<tr>
<td><strong>Overall</strong></td>
<td>30.3</td>
<td>23.4</td>
<td>40.4</td>
</tr>
</tbody>
</table>

Note: Level of significance is determined using the chi-square test.
NS = Not significant
Appendix 2
WHO/CDC/NCHS International Reference Population

The assessment of nutritional status is based on the concept that in a well-nourished population the distributions of children's height and weight, at a given age, will approximate a normal distribution. This means that about 68 percent of children will have a weight within 1 standard deviation of the mean for children of that age or height, and a height within 1 standard deviation of the mean for children of that age. About 14 percent of children will be between 1 and 2 standard deviations above the mean; these children are considered relatively tall or overweight for their age, or relatively fat for their height. Another 14 percent will be between 1 and 2 standard deviations below the mean; these children are considered relatively short or underweight for their age, or relatively thin for their height. Of the remainder, 2 percent will be very tall or very overweight for their age, or very overweight for their height, that is, they are more than 2 standard deviations above the mean. Another 2 percent will fall more than 2 standard deviations below the mean and be considered malnourished. These children are very short (stunted) or very underweight for their age or very thin (wasted) for their height.

For comparative purposes nutritional status has been determined using the International Reference Population defined by the United States National Center for Health Statistics (NCHS standard) as recommended by the World Health Organization and the Centers for Disease Control.
WHO/CDC/NCHS Nutrition Reference Standard
Normal Distribution

Appendix 2

Malnourished (Underweight stunted or wasted)

Standard Deviations from Mean (Z-Score)