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Health, Nutrition, and Population (HNP) Discussion Paper
MALNUTRITION IN YOUNG CHILDREN AND THEIR MOTHERS IN TIMOR-LESTE

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ABSTRACT

According to the Timor-Leste Demographic and Health Survey, in 2016 about 46 percent of all children less than five years old are stunted, 24 percent are wasted, and 40 percent are anemic. These are high percentages by international comparisons. The short height of women, an average of 151.6 centimeters (cm), may explain why about a half of all stunted children are born stunted, while most of the other half become stunted between 6 and 24 months of age. If 20 percent of mothers give birth as adolescents, this could also contribute to the small size of babies at birth (17 percent ≤ 2.5 kilograms (kg) and help explain why 26 percent of children aged less than three months are wasted.

Rural children are more at risk of being malnourished than urban children; boys are at greater risk than girls of being malnourished in their first two years of life; and thin mothers are at risk of having wasted or thin children. Only children of mothers in the richest wealth group and with the highest level of education are at lower risk of being stunted, but the differences are not large. Breastfeeding practices are better in poor and less well-educated women than among the wealthiest and best-educated women. The diversity of the complementary diet of children was generally poor. The coverage of vaccinations in Timor-Leste is generally low. The majority of households drink safe water, but children in poor households that use unprotected water sources are at greater risk of being stunted.

The short stature of mothers may take a generation or more to eliminate. Delaying marriage and pregnancy until the age of 20 years, as recommended by the World Health Organization (WHO), could be an important intervention. Interventions during pregnancy for thin, small women may help prevent low-birthweight babies and malnutrition early in childhood.

Keywords: Timor-Leste, stunted, wasted, thin, stature

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ACKNOWLEDGMENTS

PREFACE

This report reviews and summarizes the most recent information on the nutrition of children and their mothers in Timor-Leste. The report examines differences in percentages of children who are stunted, wasted, underweight, or anemic by their location, age, and sex, and examines characteristics of the mother and features of the household that are associated with differences in these anthropometric indicators to try to understand risks and potential causes within the limitations of cross-sectional data. Women in Timor-Leste are among the smallest in the world by international comparisons, a result of many generations of malnutrition, so their children are generally small too. There is potential to prevent children from being born small by delaying pregnancy and providing antenatal nutrition interventions, while stunting can be prevented during the first two years of life by programs for young children and their families. But it will likely take several generations, as it has done in other countries, for the prevalence of stunted children to be reduced substantially.

1 INTRODUCTION

According to UNICEF's report on *the State of the World's Children* (2017), Timor-Leste has the joint second-highest percentage of stunted children less than five years old in 144 countries in the world (50 percent), fewer than in Burundi (56 percent) and equal to Eritrea and Papua New Guinea.[1] This proportion may have decreased to 46 percent in the most recent Demographic and Health Survey (DHS) in Timor-Leste in 2016, but the percentage of wasted children reported in the DHS has risen to 24 percent, which is the highest in the world in comparison with the data presented by UNICEF. UNICEF data cite only three countries where more than 20 percent of children wasted—South Sudan (23 percent), Djibouti (22 percent), and India (21 percent). The UNICEF report, however, states that only 11 percent of children in Timor-Leste are wasted—probably based on the national Food and Nutrition Survey (FNS) in 2013[2]—so the data are not consistent.

1.1   INDEXES AND INDICATORS OF MALNUTRITION

Most surveys calculate three main indexes of the anthropometric status of children less than five years old: height-for-age, weight-for-age, and weight-for-height. These indexes are calculated from measurements of the child's body weight, length or height, and age in months. Errors in making or recording any of these measurements can affect these indexes, so the quality of data is important. The indexes are then classified into indicators as follows:

- Stunted, if a child's height-for-age is < -2 standard deviation (SD) below the reference median. Being stunted is usually taken to be an outcome of chronic malnutrition that has slowed or even stopped linear growth. The growth of the fetus can be impaired during pregnancy because the mother is small or malnourished or, typically, linear growth faltering occurs during the first two years of life because of repeated infectious diseases and a poor diet. There may be some potential for catch-up growth, especially during adolescence.

- Wasted, if a child's weight-for-height is < -2 SD below the reference median. Being wasted is usually taken to be an outcome of acute malnutrition as a result of acute infectious diseases and a poor diet, which cause children to fail to gain weight or even to lose weight. Children can regain lost weight.

- Underweight, if a child's weight-for-age is < -2 SD below the reference median. Being underweight is a composite indicator due to being stunted or wasted, or both. Almost all the variance in the z-score of weight-for-age is explained by height-for-age and weight-for-age.

- Thin, if a child's body mass index-for-age is < -2 SD below the reference median, which is very similar to weight-for-height. It is not usually reported for children less than five years, but is used for children age 5 to 19 years. This indicator is examined in Appendix A1.

The percentage of underweight children was the main nutrition indicator of the Millennium Development Goals (MDGs). The percentages of children who are stunted or wasted are the nutrition indicators of the Sustainable Development Goals (SDGs).

Most surveys report the percentage of stunted, underweight, or wasted children separately. This does not capture the total percentage of children who have become malnourished: some children show two outcomes while a few show all three. The percentage of children who show any outcome of malnutrition is called the Composite Index of Anthropometric Failure (CIAF), and children can be classified separately by the combinations of the single indicators into six groups: stunted only; underweight only: wasted only: stunted and underweight: underweight and wasted: and stunted, underweight, and wasted. Children cannot be both stunted and wasted without being underweight. Children who are not yet stunted or not yet wasted can be underweight. The CIAF captures the total burden of malnutrition in children in a community.

If stunting is defined as the process of faltering linear growth due to chronic malnutrition by which children may become stunted, which is the outcome of that process, then children who are currently stunted may no longer be experiencing stunting; it may have happened several years previously during growth in the mother's womb, or during the first two years of life for a child aged three to five years. The simple binary classification of a child as stunted is in most instances historical, and does not necessarily indicate current malnutrition. The potential of any cross-sectional data to identify the determinants of malnutrition is therefore weak because causes are measured after the outcome has occurred, so are not related to each other in time for children who are classified as stunted or wasted, and the analysis excludes children who are currently experiencing malnutrition but are not yet classified as stunted or wasted. Most surveys can only identify persistent causes and risk factors for malnutrition at a point in time, and assess whether they are sufficiently common to be potential causes of the malnutrition observed. Having diarrhea in the last two weeks is an indicator of the risk of diarrheal disease for a child and the child's community, it is not in itself a cause of whether a child is classified as stunted or wasted, as these outcomes occurred before the current illness. The DHS and other surveys collect data on children and their mothers at a point in time or have a very short recall period, so they do not capture long-term influences on nutritional status or the precise factors that caused a child to become malnourished, which may have happened several years ago. This greatly limits the ability to assess the causes of malnutrition, so data are mostly descriptive or indicative. The analysis of data is an important means to identify gaps in services that could prevent malnutrition.

1.2   SOURCES OF DATA AND INFORMATION

There have been two national Living Standard Surveys (LSS) in Timor-Leste, in 2007 and in 2014;[3] two Demographic and Health Surveys (DHS), in 2009–10 and in 2016; and a national Food and Nutrition Survey (FNS) in 2013.[4, 2, 5] Data have been extracted from these reports, and some basic analysis of the two DHS data sets has been done, mostly to provide estimates with 95 percent confidence intervals (CIs). Some more detailed analysis of the 2016 data has been done to illustrate the most recent nutritional situation. Because the sample sizes stated in the published reports of the DHS are different from the sample sizes in the published data sets, estimates here are slightly different from those in the DHS reports.

Information was also extracted from two recent reviews of nutrition in Timor-Leste,[6, 7] which are based on many other documents not cited here.

2 DIFFERENCES BETWEEN SURVEYS IN INDICATORS OF MALNUTRITION

Figure 1 shows the percentage of children who were classified in the five surveys as stunted, underweight, or wasted, with 95 percent CI. The points cannot be joined to show trends as there are only two data points for each LSS and DHS and a single FNS, and the surveys used different sampling methods. The period between each pair of surveys is about seven years. The differences can be summarized as follows:

- - 3.4 percent stunted, -15.3 percent underweight, and -11.6 percent wasted between the LSS in 2007 and in 2014

- -11.1 percent stunted, -3.8 percent underweight, and +5.7 percent wasted between the DHS in 2010 and in 2016

If the five surveys (including the FNS in 2013) are taken collectively, there are slight downward trends in the percentage of stunted children by 0.9 percent a year, and 1.3 percent of underweight children a year. However, as there are only five data points, these trends are not statistically significant. The percentage of wasted children shows a significant U-shaped distribution, so there is no difference between the percentage of wasted children in the first LSS in 2007 (24.3 percent) and the second DHS in 2016 (24.2 percent). A prevalence of wasted children of ≥15 percent is classified as critical during an emergency according to the World Health Organization (WHO),8 but the high prevalence in Timor-Leste seems to be persistent rather than a sudden occurrence. Seasonal declines of an average of -0.3 z-scores of weight-for-height have been recorded in children in Timor-Leste.[9] If this decline is applied to the national data from the 2016 DHS, assuming a reasonable standard deviation (SD), it is equivalent to a 7 percent increase in the prevalence of wasted children, from 24 to 31 percent.

Figure 2 shows separately the percentages of stunted, underweight, or wasted children in municipalities in the Demographic and Health Surveys in 2009–10 and in 2016. Although in the 2016 DHS, 46.5 percent of children were stunted, 40.4 percent were underweight, and 24.2 percent were wasted, none of these percentages records the total percentage of malnourished children. This is captured by the CIAF, which reveals that 65.1 percent of children in Timor-Leste in 2016 were either stunted, underweight, or wasted. More data on the separate components of this index are described in Appendix 1.

Figure 2 shows that nearly 50 percent of children in Aileu were recorded as wasted in 2010, which is a prevalence associated with famine, whereas in five contiguous municipalities it was between one-fifth and two-fifths of this proportion: Liquiçá (10 percent), Manutoto (15 percent), Ainaro (18 percent), Manufahi (19 percent), and Ermera (21 percent). In contrast, the percentage of stunted children in Aileu (30 percent) was half the proportion of stunted children in Ainaro (69 percent), Ermera (68 percent), and Manatuto (66 percent).

Figure 1.   Percent Stunted, Underweight or Wasted Children, with 95% CI, in Five Surveys

Stunted

Underweight
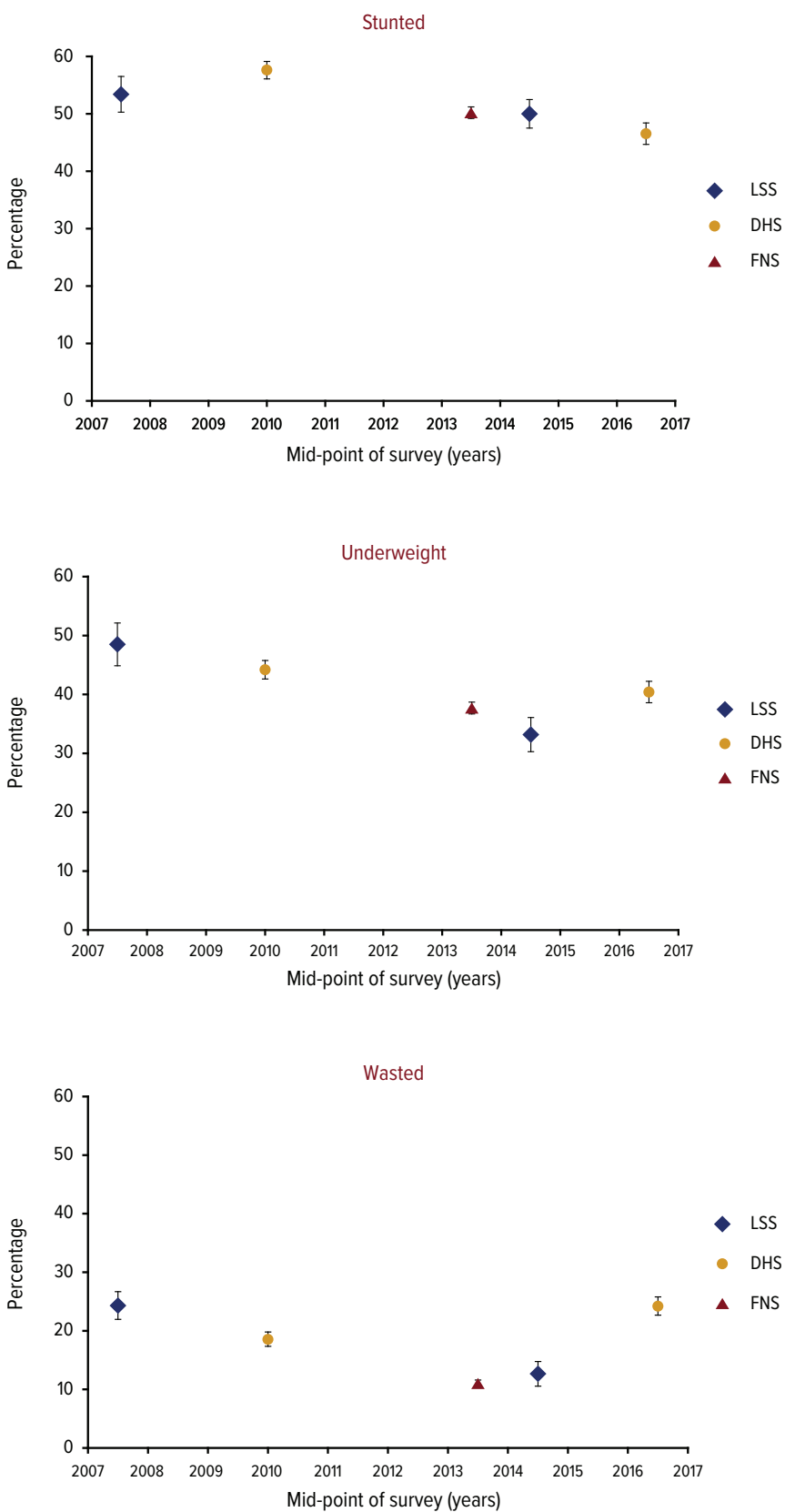
Wasted

Source: Refs 2, 3, 4, 5

Figure 2. **Percent Children Classified as Stunted, Underweight or Wasted in Demographic Health Surveys in 2009–10 and 2016, by Municipality**
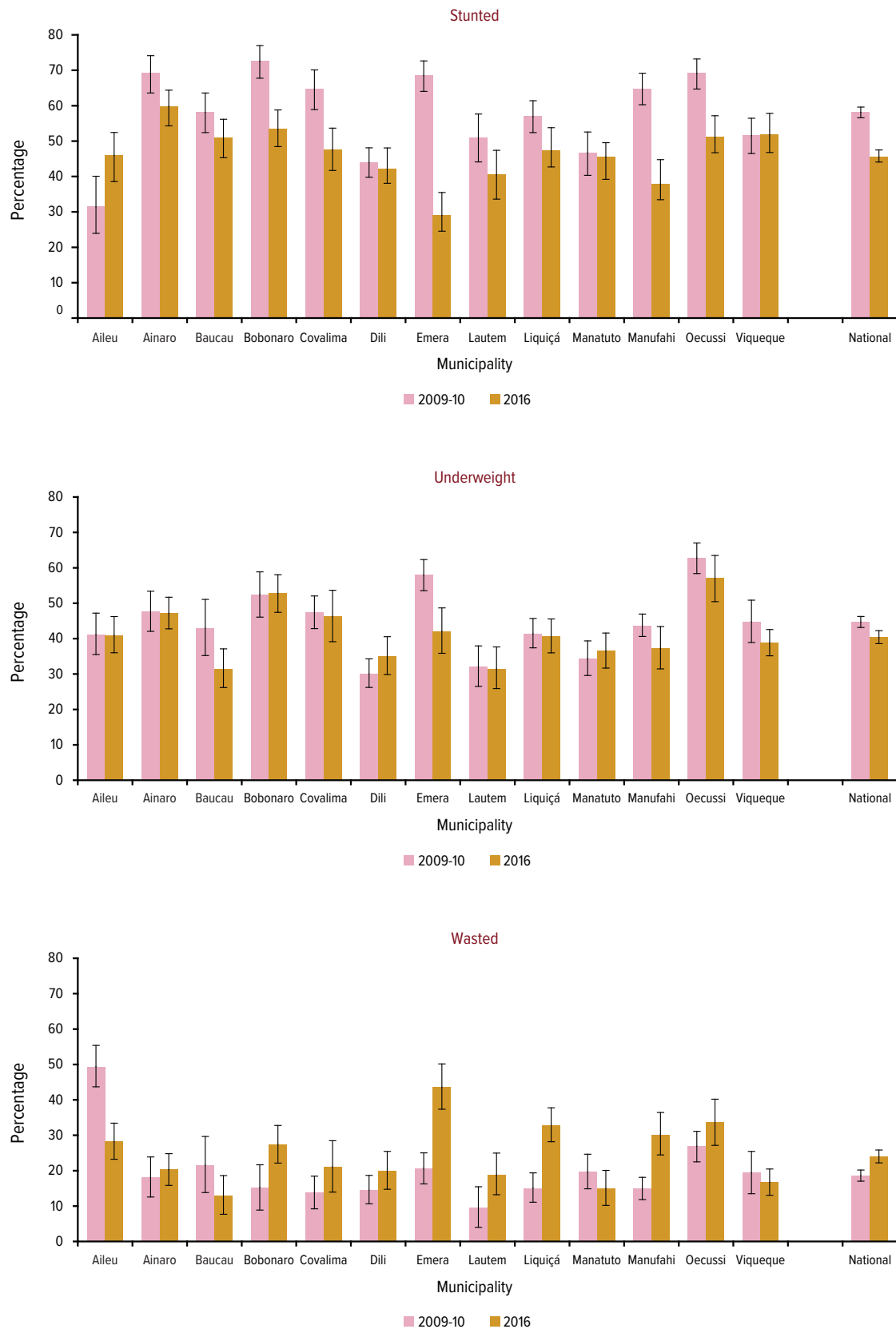
Source: Calculated from published data from the DHS (2009-10) and DHS (2016)

Figure 3 shows that the differences between the DHS in 2010 and 2016 in some municipalities are large, inconsistent both within and between municipalities, and hard to explain. The percentage of stunted children in Ermera was nearly 40 percentage points lower in 2016 than in 2010 (68.5 to 29.0 percent) and 36 percentage points lower than in the 2013 FNS.[2] However, the prevalence in Aileu, an adjacent municipality, was 10 percentage points higher (31.4 to 41.6 percent). The percentage of wasted children in Ermera was nearly 23 percentage points higher in 2016 than in 2010 (20.7 to 43.6 percent) and was 35 points higher than in the 2013 FNS (8.6 vs 43.6 percent); while the prevalence in Aileu was 21 percentage points lower (49.4 to 28.2 percent). These large differences in opposite directions may have canceled each other out to some degree when the national average is calculated, but four other municipalities showed a 25 percent or greater relative difference in the prevalence of stunted children between the two surveys over the same period, while the prevalence of wasted children doubled in two municipalities from 15 percent to over 30 percent. The prevalence of wasted children increased in 9 of 13 municipalities, while the prevalence of stunted children decreased in 11 municipalities. Wasting and stunting are not separate conditions, they have common causes: disease and poor diet.

There was no correlation between the percentages of children who were stunted or wasted in each municipality in the DHSs in 2010 and 2016, which should have been the case if the data in each municipality were consistent in trend.

In contrast, the data on the percentage of underweight children showed smaller differences, probably because any increase in the percentage of wasted children was offset by a decrease in the percentage of stunted children. The average difference was -4.3 percentage points and ranged from -16 to +5 percent, which is a narrower range (21 percent) than for the prevalence of stunted (54 percent) or wasted (44 percent) children. There was also a significant correlation between the percentage of underweight children in each municipality in surveys in 2010 and 2016 (r = 0.8, P = 0.001), indicating that the estimates of underweight were more consistent with each other. However this may just be an artefact of the opposite differences in the percentage of stunted or wasted children rather than reflecting a consistent trend.

The indicators of the quality of data in both DHS are poor. The data on z-scores from municipalities in each survey show high standard deviations, all beyond the acceptable range proposed by the WHO,10 except in Dili, as well as high intracluster correlation coefficients (ICC), indicating clustering. The overall ICC for the z-score of height-for-age in the 2016 DHS of 0.144 is equivalent to a design effect of 2.6 (455 clusters, N = 5,777), while the ICC in Aileu was 0.185 (32 clusters, N = 407), which is equivalent to a design effect of 3.2. The usual design effect applied to nutrition surveys, such as SMART surveys, is 1.5 to 2.0. The ICC in Dili was 0.043 (46 clusters, N = 634), which is equivalent to a design effect of 1.5. The number of clusters in Dili municipality was 40 percent larger than in other municipalities, and the standard deviations of mean z-scores of children were also within acceptable ranges. Dili also showed the smallest change in the prevalence of stunted children (-0.4 percent), but an increase of 5.0 percent in wasted children, which also explains the 4.0 percent increase in underweight children. If malnourished children are clustered, a relatively small sample size of clusters, 33 per municipality, may lead to oversampling malnourished children and biased estimates.

Figure 3. **Absolute Differences between the Percent Stunted, Underweight, or Wasted Children in each Municipality and Nationally in the DHS in 2009-10 and the DHS in 2016**
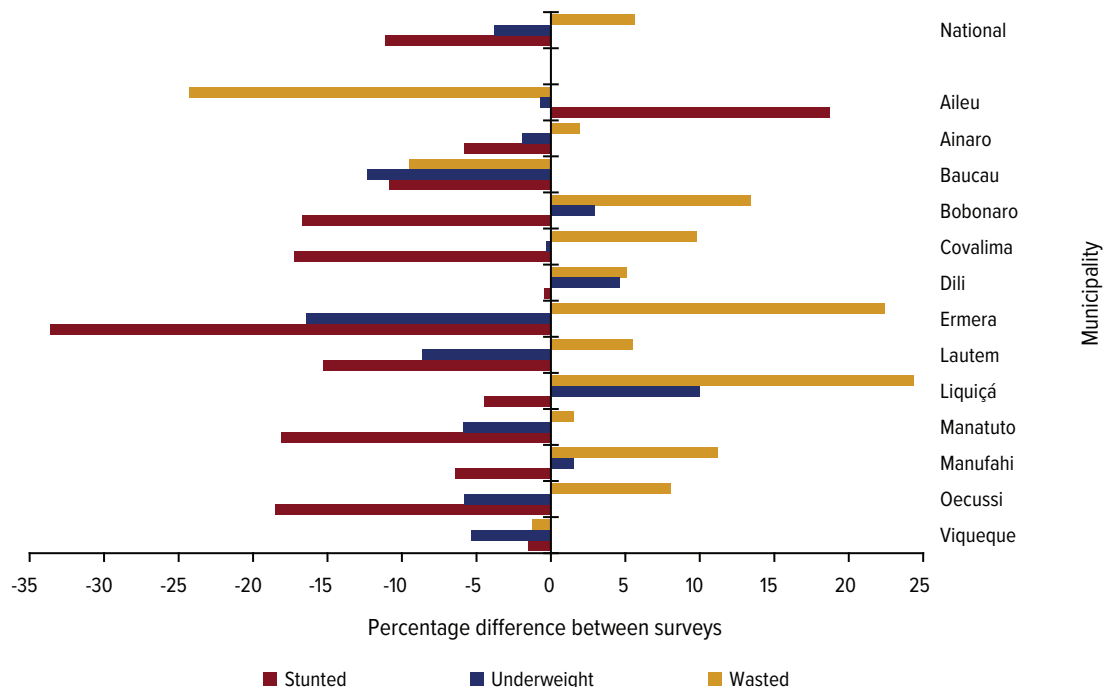
Source: Calculated from published data from the DHS (2009-10) and the DHS (2016)

In most anthropometry surveys, there are more moderately malnourished children than severely malnourished for any indicator, if the z-score is less than -2.3, when the proportions become equal. In both DHS surveys there is a greater proportion of severely stunted children than moderately stunted children. For example, in Manufahi in 2016, just under 27 percent of children were severely stunted, but only 11 percent were moderately stunted, an excess of 20 percent severely stunted children compared with an expected value estimated from the mean and standard deviation of the z-score. Four other municipalities had an excess of 10 percent or more severely stunted children, and the average was 9 percent. This indicates that severely stunted children have been oversampled in the survey.

Conclusion. The large differences between estimates of stunted or wasted children in successive DHS surveys, the lack of consistent differences in municipalities in these important indicators of malnutrition, the very high standard deviations of z-scores indicating wide distributions of values, the large intracluster correlations, and the excess of severely malnourished children all suggest that the differences in estimates between surveys and between municipalities may be due to sampling errors. The next DHS should apply a large design effect and collect data from more clusters per municipality. If wasting is seasonal, then interventions during those seasons are needed to reduce the risk of children becoming wasted. More data on the seasonality of malnutrition are needed.

3 DATA FROM THE DHS IN 2016

The data from the DHS in 2016 were examined in more detail to look at the most recent differences in indicators of malnutrition between Timor-Leste's municipalities and to examine anthropometric indicators by children's age, by indicators of mother's anthropometric status, between wealth groups, and by other factors known to be associated with children's nutritional status.

3.1   MALNUTRITION AND URBAN OR RURAL RESIDENCE

The 5,557 children in the 2016 DHS lived in 3,736 households, 70 percent of which were rural and 30 percent urban. Most of the poorest (97.5 percent) or poor (93.9 percent) households were rural, while 79.0 percent of the richest wealth group and 78.0 percent of the most educated mothers were urban. There were 6.4 percent more stunted children in rural households than in urban households (48.4 vs 42.0 percent, odds ratio [OR] = 1.29, P = 0.013); 8.8 percent more underweight children (42.9 vs 34.1 percent, OR = 1.45, P < 0.001); and 6.3 percent more wasted children (26.0 vs 19.7 percent, OR = 1.43, P < 0.001). When expressed as a percentage of the higher rural prevalence, the differences are 13, 20, and 24 percent, respectively.

Conclusion. Rural children are more at risk of being malnourished than urban children, but the difference may be largely a function of the wealth of the households and the education of mothers. Urban children are also stunted and wasted.

3.2   MALNUTRITION AND MUNICIPALITY

Table 1 shows the percentage of children in each municipality who were classified as stunted, underweight, and wasted, or showed any form of malnutrition (CIAF) in the 2016 DHS. The lowest prevalence of stunted children was recorded in Ermera at 34 percent, which was about half the prevalence in Ainaro (63 percent), but Ermera also had the highest prevalence of wasted children at 43 percent, a percentage that is nearly three times the prevalence described by the WHO as "critical."[8] These two districts adjoin each other, so the discrepancies are hard to understand.

Conclusion. The data from municipalities are inconsistent between surveys, probably due to sampling bias. Nevertheless, the overall prevalence of stunted and wasted children is high throughout all municipalities in Timor-Leste.

Table 1. **Percent Children Less than Five Years, Stunted, Underweight, or Wasted, and Showing Any Form of Malnutrition, by Municipality and Nationally, DHS 2016**

| Municipality	N	Stunted	95% CI	Underweight	95% CI	Wasted	95% CI	CIAF %	95% CI
Aileu	407	49.0	(42.6,55.4)	38.7	(33.7,43.9)	26.3	(21.1,32.4)	71.6	(65.7,76.9)
Ainaro	380	63.1	(58.2,67.6)	46.2	(41.7,50.7)	19.9	(16.7,23.7)	73.6	(68.8,77.9)
Baucau	398	47.2	(42.1,52.3)	32.1	(26.8,37.8)	13.1	(9.5,17.9)	58.9	(53.9,63.8)
Bobonaro	468	55.2	(49.5,60.6)	54.8	(49.4,60.1)	28.6	(23.5,34.2)	72.7	(67.8,77.1)
Covalima	374	47.8	(41.7,53.9)	45.5	(38.3,52.9)	22.2	(16.9,28.5)	65.2	(60.2,70.0)
Dili	634	43.1	(37.4,48.9)	35.1	(29.9,40.7)	19.4	(16.2,23.1)	60.3	(55.0,65.3)
Ermera	380	34.2	(28.2,40.6)	40.8	(34.5,47.3)	43.4	(35.8,51.4)	72.9	(68.5,76.9)
Lautem	444	41.8	(35.1,48.6)	32.2	(26.5,38.3)	20.0	(16.1,24.4)	56.6	(49.6,63.3)
Liquiçá	384	45.9	(39.4,52.4)	42.0	(37.3,46.9)	34.2	(28.5,40.4)	70.4	(65.6,74.9)
Manatuto	430	47.6	(43.6,51.4)	37.5	(32.6,42.5)	16.1	(13.0,19.9)	58.3	(54.1,62.5)
Manufahi	455	40.7	(34.2,47.5)	35.2	(29.4,41.4)	30.5	(26.2,35.2)	64.9	(59.8,69.6)
Oecussi	365	50.4	(44.3,56.4)	57.1	(50.4,63.5)	34.6	(29.1,40.4)	70.8	(64.4,76.4)
Viqueque	438	51.4	(45.3,57.4)	39.4	(35.7,43.2)	17.8	(13.8,22.8)	63.7	(59.3,67.8)
National	5,557	46.5	(44.6,48.4)	40.4	(38.5,42.2)	24.2	(22.7,25.8)	65.1	(63.4,66.7)

Source: Calculated from published data from the DHS (2016)

3.3 MALNUTRITION BY AGE

Figure 4 shows the percentage of children less than five years old who were classified as stunted, underweight, or wasted by three-month age groups. It shows that 23 percent of children in the two youngest age groups were stunted, and that the prevalence rises until about two years of age, when it flattens out. This indicates that about half of all stunted children are born stunted. As it is unlikely that interventions during early childhood can reduce that proportion substantially, stunting needs to be prevented before children are born. This also suggests that while it may be possible to prevent some children from becoming stunted between the ages of 6 and 24 months, this can only reduce the overall prevalence by about 20 percent, which is about the same as the percentage of children who seem to be born stunted. Any analysis of factors that are associated with being stunted during the first two years of life cannot exclude the half of all stunted children who are stunted at birth. The prenatal influences on linear growth may be different from postnatal influences and require more understanding.

Figure 4 also shows that the percentage of children who are wasted very early in life (26 percent, age 0 to 2 months) is close to the overall percentage in the whole age group (24 percent, 0 to 59 months), so the prevalence shows little difference with age. The percentage of children age 0 to 2 months who are wasted only is 23.5 percent (see Appendix 1), a percentage that drops rapidly until at 9 months of age it levels out at about 4.0 to 5.0 percent. Over the same period, the percentage of children who are underweight and wasted, or are stunted, underweight, and wasted rises, suggesting that children who are born wasted become stunted over time, probably as a result of chronic malnutrition.

Figure 4. **Percent Stunted, Underweight, or Wasted Children with 95 percent CI, in Three-Month Age Groups, 2016 Demographic and Health Survey**
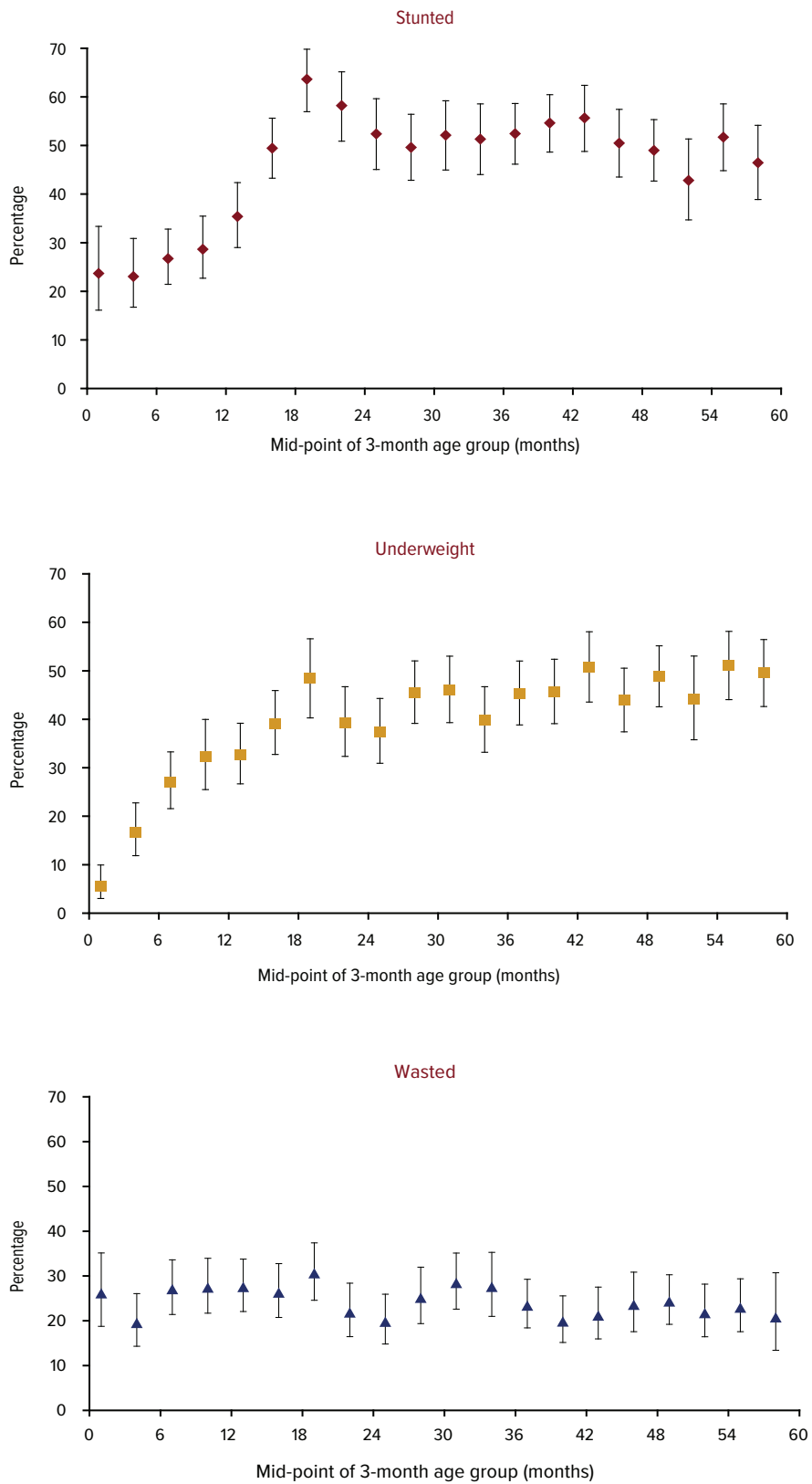
Source: Calculated from published data from the DHS (2016)

Data from the 2016 DHS on the reported birthweight of 3,144 children showed that 9.3 percent weighed less than 2.5 kilograms (kg) at birth and another 8.1 percent weighed exactly 2.5 kg, for a total of 17.4 percent of children who were born small. Children of poor rural families may be born at home without being weighed, so the data may be biased and the percentage, an underestimate.

These data suggest that 20 to 25 percent of all children are born small or wasted, again showing the need for antenatal nutrition services. Although some children recover, others become wasted, underweight, and stunted, perhaps because of slow linear growth, so that the prevalence of wasted children barely differs over the whole age range between birth and five years.

The percentage of children who are underweight by age group is highly correlated with the percentage who are stunted, which explains about two-thirds of the variance in underweight. The percentage of children who are underweight by age group is not correlated with the percentage who are wasted.

3.4 MALNUTRITION BY SEX OF CHILD

Figure 5 shows that in 2016 a significantly greater percentage of boys than girls were

- Stunted: 49.8 vs 43.2 percent (OR = 1.30, P < 0.001)
- Underweight: 42.6 vs 38.2 percent (OR = 1.20, P = 0.004)
- Wasted: 25.8 vs 22.6 percent (OR = 1.19, P = 0.014).

Nearly 70 percent of boys showed one of the three main outcomes of malnutrition, captured in the CIAF, compared with 62 percent of girls (68.6 vs 61.5 percent, OR = 1.37, P < 0.001).

The difference between the sexes occurred in children less than 24 months old. When compared with older children, boys < 2 years old were more likely than girls to be stunted (OR = 1.65, P < 0.001); underweight (OR = 1.52, P < 0.001); wasted (OR = 1.32, P = 0.014); and have a higher CIAF (OR = 1.84, P < 0.001). After 24 months of age there were no significant differences between the sexes. This probably cannot be explained by a larger number of deaths of severely malnourished boys: mothers reported that 396 sons had died, compared with 259 girls, a difference of 137 children in the DHS sample (27/1,000), but probably not sufficient to influence the prevalence by a large degree. A difference in mortality of >50/1,000 is needed to achieve survivor bias.[11]

Figure 5.

Percent Stunted, Underweight, or Wasted Boys and Girls and Those Showing Any Form of Malnutrition, CAIF, DHS 2016
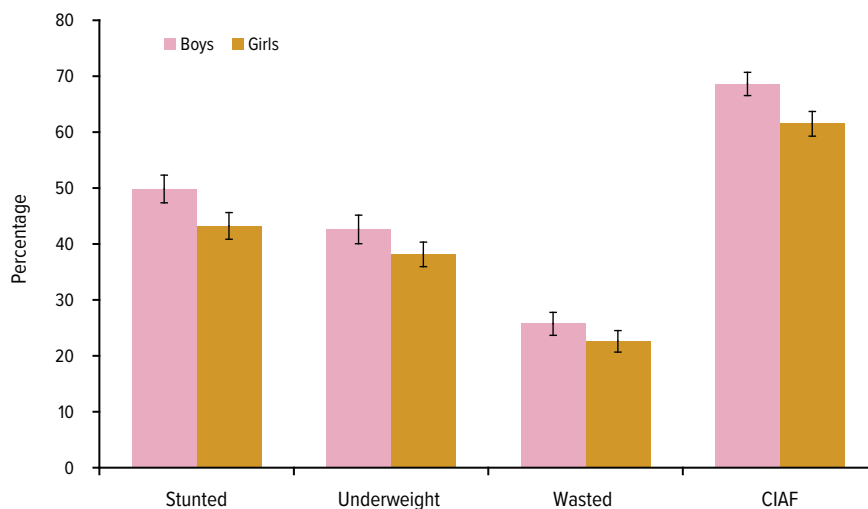
Source: Calculated from published data from the DHS (2016)

Other studies in Timor-Leste confirm that more boys than girls are stunted and have poorer growth, but there is evidence that they may continue to grow into adulthood and may catch up to a small degree, albeit slowly.[9, 12, 13]

Conclusion. Boys are at greater risk than girls of being malnourished in their first two years of life; thus, they also probably have a greater risk of dying.

3.5 MOTHERS' STATURE

Women of shorter stature have a greater risk for complications during child birth due to their smaller pelvis, and are at risk of delivering a baby with low birth weight. Stunted mothers also tend to be poor and, as a consequence, are often less well educated than mothers with taller stature. These interrelated factors could all affect children's growth in the first years of their lives as well as in the womb. It is not possible to separate these influences on a child's growth using cross-sectional data.

Mothers in Timor-Leste are generally very short. The average height of women in the 2016 DHS is 151.6 centimeters (cm), and the range is narrow: 50 percent of all mothers are within ± 3.5 cm of the mean, and 90 percent are within ± 6.6 cm of the mean, thus, in a range of 13.2 cm. About 10 percent of women are 145 cm or shorter. Women in Timor-Leste are on average about 16 cm shorter than average women in the Netherlands.[14]

The difference in average height of mothers between the poorest and richest wealth groups is only 1.8 cm. Only the difference in average height between the two wealthiest groups is statistically significant, indicating that only women in the richest wealth quintile are taller than the rest, but that difference is very small. When most people are short, this may be seen as normal.

The height of mothers is associated with the z-score of the height-for-age of their children, an observation noted in another study in Timor-Leste.[13] For each additional centimeter in mother's height, children studied in the DHS are less stunted by 0.049 z-scores; thus, 10 cm in height is equivalent to about 0.5 SD, which is substantial. This is equivalent to a 13 percent lower percentage of stunted children in the 2016 DHS (assuming a mean z-score of -1.5 and an SD of 1.3). If the analysis is restricted to children who are age 12 months or less, this difference per centimeter is slightly greater, at 0.056 z-scores, perhaps reflecting the effect of a mother's stature on the growth of the baby in the womb.

Figure 6 shows the percentage of stunted children in two age groups, 0 to 24 months and 24 and 59 months, by quintiles of their mothers' height. It shows that short mothers have a greater proportion of stunted children than tall mothers, but that the difference is greater for children age 24 months or older (27.8 percent difference between Q1 and Q5) compared with children less than 24 months old (13.6 percent difference between Q1 and Q5). The average difference between the percentages of stunted children in each quintile in Figure 6 is 14.4 percent (range 11.4 to 18.7), excluding the highest quintile of height, in which there is no difference in the percentage of stunted children among the tallest mothers. This may reflect the long-term effects of mothers' short stature on their children's growth as well as on disease and a poor diet.

Figure 6.   **Percent Stunted Children (95% CI) against the Mean Height of Mothers in Quintiles of Height**
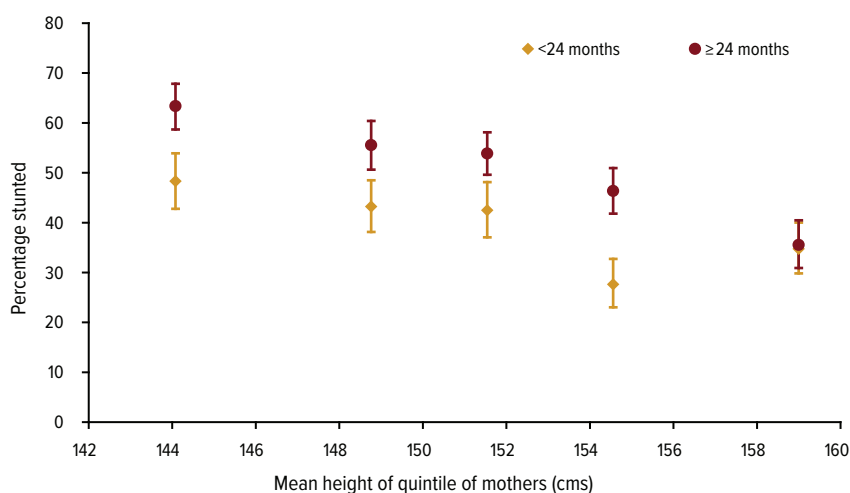
Source: Calculated from published data from the DHS (2016)

Conclusion. The shorter height of adult women is a result of the combined effects of their mothers' stature and of malnutrition during childhood. As a woman's stature has a significant influence on the length of her child at birth, it will take more than one generation of greater adult height to reduce the effect of women's small stature on their children's height and, thus on the prevalence of stunted children in Timor-Leste. Preventing female children from becoming stunted during their first two years of life will have an impact on their female children, the next generation of mothers.

3.6 MOTHERS' AGE

Adolescent girls are at risk of giving birth to small babies. Only 2.6 percent of all mothers in the 2016 DHS were age 19 years or less—assuming that their age is recorded accurately—so are classified as children. There were no differences between adult women and mothers' aged less than 19 years in the proportions with stunted, underweight, or wasted children or in the CIAF, but the sample size of young mothers was small (n = 106).

However, the survey sample may underestimate the number of mothers who are adolescent because 772 women in the survey reported that they had given birth when they were age 18 years or less, which is 20.3 percent of all mothers in the 2016 DHS. This proportion was significantly larger among women in their 20s than among women in their 40s (23.2 vs 11.3 percent, P < 0.001), which suggests that the proportion of adolescent mothers has increased over time. This analysis is not consistent with the actual number of adolescent mothers studied in the DHS, which suggests that either the sample is biased and adolescent mothers are underrepresented, or that adolescent mothers are not reporting their correct age. Analysis published by the United Nations Population Fund (UNFPA) found that 19 percent of girls in Timor-Leste were married before they were 19, and 24 percent had a baby before they were 20 years old.[15] The death rate among adolescent mothers during childbirth in Timor-Leste is twice the rate for older women.[16]

The age of adult mothers (defined as ≥ 20 years) was not associated with whether a child was stunted or not, but mothers aged 40 to 49 were more likely to have an underweight child than mothers aged 20 to 29 (41.2 vs 34.3 percent, P = 0.017).

Conclusion. The proportion of adolescent mothers in the 2016 DHS is too small compared with historical data reported by mothers on the age at which they had their first child, and compared with published reports. If 20 percent of mothers give birth when they are still adolescent, this could explain a substantial proportion of the 24 percent of children age less than 3 months who are stunted and the 26 percent who are wasted, because they were small babies, for whatever reason. Delaying marriage and pregnancy until the age of 20, as recommended by the WHO,17 could be an important intervention to prevent adolescent girls giving birth to small babies.

3.7 MOTHERS' BODY MASS INDEX

The median Body Mass Index (BMI) in Timor-Leste of women, defined as 19 years or older, is 20.9 kilograms/square meter (kg/m^2): 20.0 percent are classified as thin, 65.6 percent have a BMI in the normal range, 12.5 percent are classified as overweight and 1.8 percent as obese. The small number of girls aged 19 years or less in 2016 (N = 106) have a lower BMI than all other women (19.4 kg/m^2), but adult cutoffs are not applied to this age group, they have their own.

If there is an average gain in body weight over time among women without an increase in height, the percentage of women who are overweight and obese will increase, as will the risk of noncommunicable diseases (NCDs), such as type 2 diabetes and hypertension.

Mothers' BMI is not associated with their children's height-for-age but is significantly associated with children's weight-for-height and BMI-for-age. This is illustrated in Figure 7, a plot of the mean BMI of mothers in groups against the percentage of wasted children. The relationship is equivalent to about 0.055 z-scores of weight-for-height for every one unit of BMI, but Figure 7 indicates that the relationship flattens out, so most of the relationshp occurs in women with a BMI of 23 or less. Even 20 percent of the best nourished mothers have wasted children.

Mothers in the poorest wealth group had a mean BMI that was 2.2 kg/m^2 lower than mothers in the richest wealth group (20.2 vs 22.4 percent, P < 0.001), while mothers with no education had a BMI that was 0.7 kg/m^2 lower than women with primary education (20.6 vs 21.3 percent, P < 0.001).

Figure 7.   **Relationship between Mother's BMI (Calculated in Groups) and Wasting in Children (Percent)**

$$y = 0.0613x^2 - 3.8607x + 79.136$$
$$R^2 = 0.6531$$
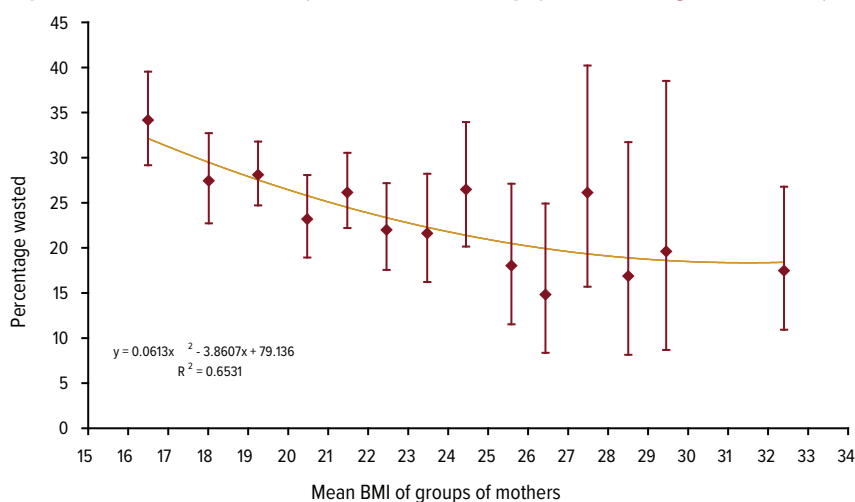
Source: Calculated from published data from the DHS (2016)

Conclusion. Thin mothers are at risk of having wasted or thin children, but thin mothers are also poor and poorly educated. The future risk of increasing women's body weight is overweight and obesity, which should be considered proactively, as simply shifting the distribution of BMI will lead to more obesity.

3.8   MALNUTRITION AND HOUSEHOLD WEALTH

Figure 8 shows the percentage of children in households in each of five quintiles of wealth in 2016 who were classified as stunted, underweight, or wasted, and the percentage who show any of these three forms of malnutrition, the CIAF. There were no differences in the prevalence of stunted children between the first four wealth groups (46 to 50 percent), and even in the highest wealth group, in which it was significantly lower, 37 percent of children were stunted. There was no significant difference in the percentage of wasted children in the middle to highest wealth group (19 to 23 percent), but it is higher in the two poorest groups (28 percent). Over a half of all children in the highest wealth group show at least one form of malnutrition (55 percent), but this was significantly lower than in the other four groups (64 to 70 percent).

A regression analysis of the relationship between wealth groups and the z-score of height-for-age showed that wealth overall was associated with a z-score 0.08 SD higher, but this was mainly due to the effect of the richest quintile, which was 0.39 SD higher, rather than being a general trend. The difference in the percentage of stunted children between the poorest and richest quintiles was 13 percent; the difference in the percentage wasted was 9 percent; and for underweight, it was 17 percent—as this is a combination of both stunted and wasted. The same differences between the fourth-highest and highest wealth quintile were 9 percent, 3 percent, and 11 percent for stunted, wasted, and underweight, respectively.

Figure 8.   **Children Showing Any Form of Malnutrition in Five Equal-sized Wealth Groups (Percent)**
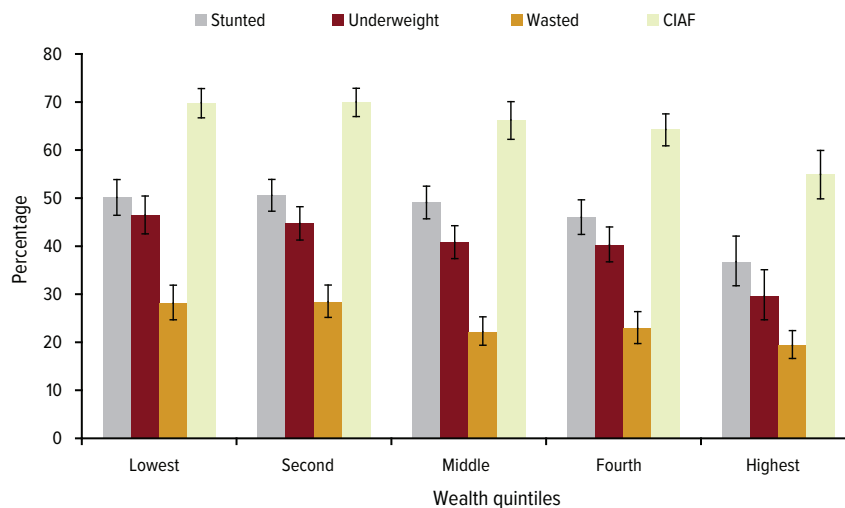
Source: Calculated from published data from the DHS (2016)

Conclusion. Only children in the highest wealth group are less stunted than the other 80 percent of children in Timor-Leste, but not by a large degree. Malnutrition affects the children of all wealth groups, but a smaller percentage of children in the wealthiest 20 percent of households are malnourished. This does not mean that household wealth is not an important factor in preventing malnutrition in childhood, but rather that most households need to be better off and better nourished.

3.9 MALNUTRITION AND MOTHERS' EDUCATION

Although there are differences in the percentage of malnourished children between wealth groups, this may not be due to affluence alone, it could also be due to the fact that mothers in the highest wealth group tend to have more education than poor mothers. Almost a half of all mothers in the poorest wealth group had received no education (47.5 percent) compared with only 4.0 percent in the highest wealth group. The median number of years of education of the poorest mothers was 2 years; the median in the richest group was 12 years. Education may provide knowledge about children's health and nutrition or it may be an indicator of empowerment—women's control over household resources to be able to look after their children.

Figure 9 shows the percentage of children classified as stunted, underweight, or wasted, and the percentage who show any of these three forms of malnutrition, the CIAF, by mother's level of education (with their median years of education). There was no difference between the children of mothers who had no education or only primary education, and little or no difference between children of mothers who had received primary education or secondary education. Only children of mothers who had higher than secondary education—so had received a median of 16 years education—were better nourished, and even then, 36 percent were stunted, 16 percent were wasted, and 51 percent had at least one indicator of malnutrition.

Each year of education a mother had received was associated with a higher z-score of height-for-age in children of 0.019 SD, which is a modest difference. When education was classified into four groups (none, primary, secondary, and higher), children's height-for-age was 0.10 SD higher, but that was mainly due to the impact of the group of women who had received higher education, which was 0.43 SD higher.

Figure 9. **Children Who Are Stunted, Underweight or Wasted, and Showing Any Form of Malnutrition (CIAF), by Mother's Level of Education (Percent)**
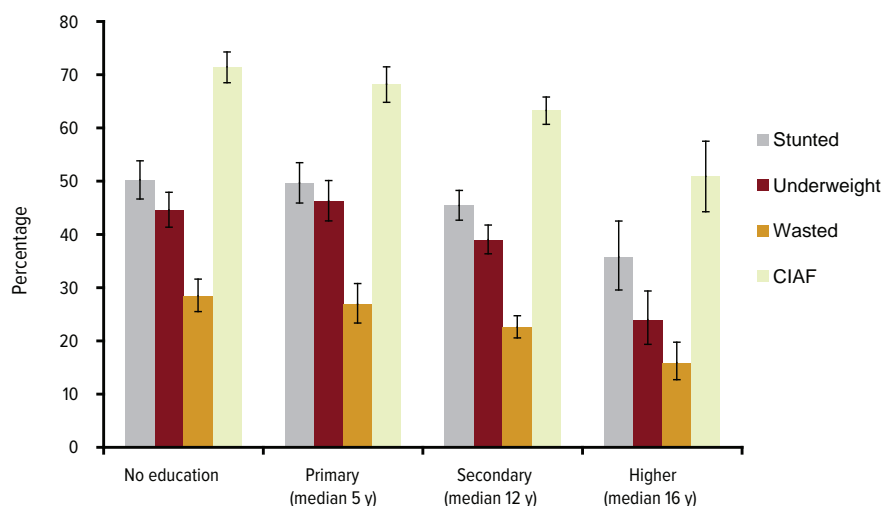
Source: Calculated from published data from the DHS (2016)

Conclusion. Only children of mothers with the highest level of education—a level that is hard to achieve—are at substantially lower risk of being malnourished. This analysis says nothing about the relevance or quality of any education that mothers have received that could influence their own or their child's nutrition. Poor, uneducated mothers can be taught about nutrition, but resources and the control to apply them, are essential.

3.10 MOTHERS' DIETARY RESTRICTION

Small women may restrict their food consumption during pregnancy in the hope of having a small child that will be delivered easily. This practice may not be good for the mother as the nutrient needs of the fetus may be preserved at the expense of her own nutrient reserves, rather than from her current diet.

Nearly 40 percent of 3,732 mothers responded that they ate less during their most recent pregnancy, so the indicator was applied to the data on the younger child if the mother had more than one child who was measured. The prevalence of stunted or wasted children was not different between mothers who said that they had eaten less during their pregnancy and the remainder who did not. Narrowing the analysis to children age less than 12 months (N = 925) or 6 months (N = 420) also did not reveal any differences.

Conclusion. Mothers who report that they ate less during pregnancy were at no greater risk of having a malnourished child than mothers who did not. This says nothing about the general quality or quantity of food consumed by women during pregnancy, which may generally be inadequate.

3.11 MALNUTRITION AND FEMALE-HEADED HOUSEHOLDS

About 10 percent of all households were headed by a woman (11.1 percent, 95% CI 9.9, 12.5). The children in those households were no different from children in male-headed households in their risk of being stunted, underweight, wasted, or anemic. This was different from the 2014 LSS, in which 12 percent fewer children were stunted.[7]

3.12 MALNUTRITION, BEING BREASTFED, AND DIETARY DIVERSITY

Breast milk is sterile and nutritious, while breastfeeding a child can also help avoid infectious diseases. After an infant reaches six months of age, breast milk may not provide sufficient energy or nutrients, and exclusively breastfed older children can become malnourished, so nutritious complementary food is required after this age. The DHS provides data on whether the child is currently breastfed or not and whether or not a child was given a food in each of 12 main food groups. The number of food groups consumed is an indicator of dietary diversity. However the current diet of a child reported in a survey does not necessarily reflect the diet of a child during the preceding months of life, so associations are often weak or cannot be detected.

Breastfeeding is common in Timor-Leste: 94.4 percent of children less than six months old are breastfed, and there is no significant difference between the percentage of stunted children under the age of six months who are breastfed or not (22.7 vs 23.3 percent, P = 0.960). Most of these children were probably born stunted. Older children continue to be breastfed: 85.7 percent of children age 6 to 11 months, 61.3 percent of children age 12 to 17 months, and 43.4 percent of children age 18 to 23 months are breastfed.

Between the ages of 6 and 23 months, the period when the prevalence of stunted children rises from about 23 to 58 percent (see Figure 4). The percentage of children who are stunted is 9 percent lower in children who are still breastfed than those who are not (40.1 vs 49.4 percent, P = 0.003). There is no difference in the mean age of mothers who do or do not breastfeed their child aged 6 to 23 months, but mothers who had the highest level of education were less likely to breastfeed their child of this age range than mothers with no education (45.5 vs 72.0 percent, P < 0.001). In addition, mothers in the richest wealth group were less likely to breastfeed their child aged 6 to 23 months than the poorest mothers (55.7 vs 73.9 percent, P < 0.001).

The percentage of children aged 6 to 23 months who were wasted was nearly 5 percent higher among children who were breastfed than were not breastfed, but the difference was not statistically significant (28.5 vs 23.9 percent, P = 0.079). This suggests that some children may not be receiving sufficient energy in their complementary diets.

Between the ages of 24 and 59 months, there was no difference in the percentage of stunted or wasted children who are still breastfed or not, so prolonged breastfeeding was not associated with malnutrition or better nutrition.

At six months of age, infants should be given nutritious and energy-dense food to complement breastmilk, so breastfeeding should be sustained. A dietary diversity score was created for a subsample of 37 percent of children for whom data were recorded in the 2016 DHS. The median number of 12 different food groups consumed was 3 (IQR 2–6) with a mean of 4.4, which is low. There was no association between the absolute diet diversity score and any indexes or indicators of malnutrition for 1,252 children aged 6 to 23 months, the age group that most require good complementary food. When scores were grouped into four or fewer or five or more food groups, there was also no difference between groups in the percentage of stunted, underweight, or wasted children.

The 2013 FNS found that only 13 percent of children were receiving an optimal complementary diet, which is based on a diverse diet and a minimum meal frequency.[2] While 79 percent of children were fed often enough, only 28 percent were given a sufficiently diverse diet.

Table 2 shows data recorded in the Food and Nutrition Survey in 2013 on the diversity of complementary foods given to children age 6 to 23 months and of the quality of the diet of the household. If children are mostly given rice alone as the main staple with a vegetable, the quality of the diet will be poor. Children need to be given rice and maize, rice and beans, or rice and nuts, so that the amino acids in each of those foods complement each other and their proteins are collectively more nutritious. Every meal should contain colored vegetables cooked with a small amount of oil to dissolve carotenes and provide extra energy; and at least one good source of protein should be given at one meal a day, such as an egg, meat, fish, or a dairy product. The dairy product will provide calcium, or small whole fish can be eaten. Complementary foods could also be fortified with a micronutrient powder.

If 72 percent of households in Oecussi municipality consume an acceptably diverse diet, there should be no reason why 87 percent of children in Oecussi (100 - 13 percent) are given an inadequately diverse diet (see Table 2).

Conclusion. Breastfeeding practices are better in poor and less well-educated women than among the wealthiest and best-educated women. There was no evidence that prolonged breastfeeding was associated with better or worse nutrition of their children. The diversity of the complementary diet of children age 6 to 23 months was generally poor, probably because children were not being given the same foods being consumed by adults, which can easily be modified in texture, easily fortified with oil and micronutrients, and given to young children.

Table 2. **Children in Timor-Leste Who Consumed Four of Seven Food Groups on the Previous Day and Households with an Acceptable Food Consumption Score, 20132 (Percent)**

Munici-pality	Grains, roots or tubers	Legumes, nuts	Dairy products	Animal foods	Eggs	Fruits & vegetables containing carotenes	Other fruit & vegetables	Child minimum dietary diversity	Household diet acceptable
Ainaro	99	22	23	27	42	82	46	42	66
Aileu	100	23	27	29	40	86	42	43	73
Baucau	99	8	14	21	21	67	25	21	36
Bobonaro	99	15	26	26	24	67	28	30	70
Covalima	99	7	30	21	18	68	23	21	58
Dili	99	19	47	39	28	70	35	42	77
Ermera	98	10	20	14	14	62	23	16	46
Liquiá	100	12	12	16	14	61	23	19	64
Lautem	100	9	14	18	17	46	16	13	65
Manufahi	100	10	17	18	15	62	19	17	40
Manatuto	100	11	28	25	27	69	33	30	63
Oecussi	100	5	16	15	8	60	22	13	72
Viqueque	100	14	14	20	29	73	33	23	55
National	99	13	23	27	41	82	46	28	61

Source: Ministry of Health, Timor Leste. 2013. Timor-Leste Food and Nutrition Survey 2013. Dili, Timor-Leste Ministry of Health.
Note: Consuming four of seven food groups is defined as child minimum dietary diversity.

3.13 HOUSEHOLD DIETARY INFORMATION FROM OTHER SOURCES

In 2014 the poorest households in the LSS, most of which are rural, spent an estimated 57 percent of their income on food, which is only 7 percent more than the richest households, most of which are urban.[7] For all groups this is a large proportion. Between 2007 and 2014, the estimated amount of energy consumed each day per person fell by 6 percent. Most people get about 60 percent of their energy from cereals, 12 percent from oils and fat, 6 percent from tubers, and 5 percent from sugar. The consumption of fruit, vegetables, and pulses was lower in 2014 than in 2007. The household dietary diversity score was about 8.5/12 in both 2007 and 2014, but this says nothing about how food groups are distributed between members of the household. It has been reported that women only eat meat or fish at festivals and ceremonies.[18]

It is not possible to judge the quality of the diet from the LSS data and assess the risk of deficiencies. Very little energy was derived in the diet from milk and its products, which is an important source of calcium for children's bone growth and development unless small whole fish are consumed.

Conclusion. Macro data on energy consumption and dietary diversity from surveys does not shed light on the adequacy of the diet of women and children in particular. More information is needed.

3.14 MALNUTRITION AND WATER SOURCES

Unclean drinking water can transmit infectious diseases, which contribute to malnutrition, most commonly through diarrheal diseases. Over 80 percent of households in the 2016 DHS had access to water either piped to their house (37.2 percent) or to a standpipe (23.7 percent), or households got their water from a protected well or borehole (15.9 percent) or from a tank or bottles (4.8 percent). Only 18.4 percent of households, two-thirds of which were in the two poorest wealth groups, obtained their drinking water from an unprotected source. Drinking unsafe water is associated with poverty, lack of education, and living in a rural area.

The percentage of stunted children in the 18.4 percent of households drinking unsafe water was 7.7 percent higher than in households with a safe source of drinking water (52.8 vs 45.1 percent, OR = 1.36, P = 0.002) and 6.6 percent more were underweight (45.8 vs 39.2 percent, OR = 1.31, P = 0.007), but there was no difference in the percentage of wasted children (24.7 vs 24.1 percent, P = 0.74). This suggests that the effect is mediated through chronic malnutrition rather than acute malnutrition.

Conclusion. The majority of households drank safe water, but children in poor households that use unprotected water sources are at greater risk of being stunted and of being underweight.

3.15 MALNUTRITION AND SANITATION

The safe disposal of human feces is an important means of preventing the transmission of infectious diseases. About a quarter of all households (25.4 percent) reported that they had no toilet and defecated in the open, which included 67 percent of the poorest wealth group. The percentage of stunted children was 5 percent higher in households that did not use a toilet, compared with households that did (50.3 vs 45.3 percent, OR = 1.22, P = 0.019), and the percentage of underweight children was 7 percent higher (45.6 vs 38.6 percent, OR = 1.33, P = 0.001). There was no significant difference in the percentage of wasted children.

Conclusion. A lack of sanitation in poor households puts children at risk of malnutrition, probably caused by disease. The difference in having a latrine on the prevalence of stunted or underweight children is as big as the difference between households in the lowest quintile and the fourth quintile of wealth. All households should have access to a clean, sanitary latrine, and should use it.

3.16 MALNUTRITION AND TREATMENT FOR WORMS

There is little information on the prevalence of infections with intestinal worms in young children in Timor-Leste, though the prevalence may not be high. Data from a water and sanitation project in Manufahi found that 24 percent of subjects of all ages were infected with Ascaris and 61 percent with hookworms,19 which tend to be more common in adults than in young children. While treating children for intestinal worms is simple and effective, it does not necessarily lead to improved nutrition. The main effect of periodic treatment is to keep the number of worms small, which can help prevent malnutrition. Treatment alone does not improve children's nutritional status; that requires food.

The DHS records only whether a child has been treated for worms in the last six months, rather than how many treatments a child has received. About one-half of all children had been treated recently (47.9 percent). The percentage of untreated children who were wasted was significantly lower than among treated children (21.9 vs 26.2 percent, OR = 0.79, P = 0.004), but the percentage of stunted children was higher in treated compared with untreated children (49.7 vs 43.6 percent, OR = 1.28, P = 0.001). It is likely that being infected with worms is associated with poverty and a lack of a household latrine. Children in the richest households were more likely to have been treated for worms than children in the poorest households (50.8 percent vs 43.2 percent, OR = 1.35, P = 0.034). Children in households without a toilet were less likely to have been treated than children in households with a toilet (42.5 vs 48.8 percent, OR = 0.78, = 0.017).

Conclusion. If the prevalence of any species of intestinal worms is >50 percent, then treatment twice a year is warranted and will prevent moderate to heavy burdens of worms from being accumulated. Children in the poorest households without a toilet are least likely to be treated for worms but are most likely to need treatment.

3.17 MALNUTRITION AND VACCINATIONS RECEIVED

The DHS recorded whether children had received three vaccinations to protect them from diphtheria, pertussis and tetanus, three vaccinations against polio, and single vaccinations against tuberculosis and measles, making a total of eight vaccinations. Just over one-half of children had not received any vaccinations according to DHS data, and only about a third had received all eight vaccines. If the 655 children who were reported by mothers to have died were killed by a vaccine preventable disease and were malnourished, their data do not appear in the DHS data set, and the prevalence of malnutrition will be underestimated.

There was no significant difference in the percentage of wasted or underweight children between those who had received all eight vaccinations and those who had not received any vaccinations, but a larger percentage of fully vaccinated children were stunted compared with unvaccinated children (48.8 vs 43.6 percent, P = 0.029).

Conclusion. Vaccination is essential to protect children from dying due to infectious diseases, whether or not it protects children from malnutrition. The coverage of vaccinations in Timor-Leste is generally low. At least 95 percent of children need to be vaccinated against measles to prevent transmission.

3.18 MALNUTRITION AND BED NETS

Malaria is endemic in Timor-Leste, but there was a 97 percent reduction in incidence between 2006 and 2012, largely through use of rapid diagnosis test kits and insecticide-treated bed nets by pregnant women and children.[20] Sleeping under a bed net may also help to control dengue fever, which is also endemic, although this is transmitted by mosquitoes that feed at dusk.

Mothers reported that 55 percent of their children had slept under a bed net on the previous night. The percentage varied by region from 36.6 percent in Ainaro to 64.4 percent in Liquiçá, while in eight municipalities the percentage was over 60.0 percent. There was no difference between the wealthiest or poorest households, as in both categories 47.5 percent of children had slept under a bed net on the previous night, but the percentage in the middle and richer groups were both just above 60 percent. There was little or no difference between the children of uneducated or highly educated mothers (49.3 vs 52.3 percent), but the children of mothers with secondary education were more likely to have slept under a bed net (57.6 percent). There was no difference in the percentage of stunted, wasted, underweight, or anemic children who had slept under a bed net compared with children who had not.

Conclusion. Malaria may no longer be a major disease, but effective control measures need to be applied to sustain this progress, which means that all children should sleep under an impregnated bed net until the disease is eradicated from the whole island.

3.19 MALNUTRITION AND VITAMIN A

An oral dose of vitamin A given to children every six months can protect them from deficiency and from the severe consequences of infectious diseases, especially measles. This has been known since 1932.[21]

The 2013 national Food and Nutrition Survey reported that only about 8 percent of children had a low concentration of retinol, the most active form of vitamin A, in their blood.[2] There were no differences between children by age, sex, wealth, or residence, but the sample size was small.

The 2016 DHS found that nearly two-thirds of mothers reported that their child had been given a dose of vitamin A in the last six months (63.3 percent). About 14 percent more children in the richest quintile of wealth had been given vitamin A than in the poorest quintile (69.3 vs 55.4 percent, OR = 1.82, P < 0.001), and about 20 percent more children of the most educated mothers were treated than children of mothers with no education (72.4 vs 52.3 percent, OR = 2.39, P < 0.001). There were no differences in the percentage of children who were stunted, underweight, wasted, or anemic, whether or not they had received vitamin A.

Conclusion. The third of children who do not get vitamin A are likely to be from the poorest households with uneducated mothers. They need to be the targets of programs, to increase coverage, and protect them from the risk of dying due to measles, if only 50 percent are vaccinated.

3.20 ANEMIA, NATIONALLY AND BY MUNICIPALITY

The hemoglobin concentration, corrected for altitude, is used to calculate the percentage of children and mothers who are anemic, which is a good general indicator of micronutrient status because iron, folate, vitamin B12, vitamin A, and vitamin C are all required for its manufacture.

Table 3 shows the percentage of children less than five years old and their mothers, nationally and in each municipality, who were classified as anemic. The national percentage of 40.8 in children is just over the WHO threshold to classify it as a severe public health problem: anemia is a severe problem in nine municipalities, a moderate problem in three, and a mild problem in one. There is a threefold range in prevalence of anemic children from 18.4 percent in Manufahi to 60.0 percent in Liquiçá. The prevalence is about 22 percent lower than recorded in the national FNS 2013.[2]

The prevalence of anemia in nonpregnant mothers of 26 percent is classified as moderate: it is a severe problem in only one municipality (Oecussi), a moderate problem in seven municipalities, and a mild problem in five. The prevalence is about 13 percent lower than recorded in the national FNS 2013.[2]

Most mothers reported that they had been given or had bought iron supplements during their last pregnancy or taken iron (86.2 percent, 95% CI 84.4, 87.9), with a range from 67 percent in Manatuto to 94 percent in Aileu.

There was no correlation between the prevalence of anemia in mothers and in their children. Although 60 percent of children in Liquiçá were anemic, only 18 percent of mothers in the same municipality were anemic. Disease may play a role in anemia as much as diet.

Conclusion. The control of malaria and hookworm disease, and antenatal iron supplements may all have contributed to the relatively low prevalence of anemia in women, but it is still a public health problem in young children that must be treated, ideally by dietary means: adding a micronutrient powder to a child's meal is an easy way.

Table 3. **Children Less Than Five Years and Their Mothers Classified as Anemic, Corrected for Altitude, in Each Municipality and Nationally, Demographic and Health Survey 2016 (Percent)**

Municipality	Children			Mothers		
	n	Anemic	95% CI	n	Anemic	95% CI
Aileu	91	31.1	21.1, 43.2	117	20.1	12.4, 30.8
Ainaro	136	45.4	34.0, 57.3	147	25.0	19.2, 31.9
Baucau	128	38.5	27.5, 50.8	135	33.6	22.9, 46.3
Bobonaro	138	40.4	30.5, 51.2	154	14.6	8.3, 24.5
Covalima	111	48.3	35.9, 60.9	123	21.5	13.8, 31.8
Dili	159	41.1	33.0, 49.8	203	30.1	24.2, 36.8
Ermera	105	44.2	30.9, 58.5	122	18.0	10.8, 28.5
Lautem	133	41.2	32.2, 50.8	157	32.8	22.2, 45.6
Liquiçá	129	60.0	48.3, 70.7	151	17.9	11.8, 26.2
Manatuto	112	43.9	35.2, 53.0	130	18.2	10.5, 29.9
Manufahi	129	18.4	11.4, 28.1	157	17.5	10.7, 27.4
Oecussi	100	42.3	32.0, 53.3	121	44.1	34.6, 54.1
Viqueque	141	29.4	19.4, 41.9	158	29.2	19.8, 40.9
National	1,612	40.8	37.5, 44.1	1,875	26.1	23.5, 29.0

Source: Calculated from published data from the DHS (2016)

3.21 OTHER NUTRITIONAL FACTORS

o data were collected in the 2016 DHS on the presence of iodized salt in households. The 2013 Food and Nutrition Survey found that 54 percent of households consumed iodized salt and reported a median urinary iodine concentration in nonpregnant mothers of 170 µg/L, which is within the acceptable range.[2] Deficiencies of iodine could be localized, especially in mountainous areas where rainwater may leach iodine from the soil, so more information is needed.

bout a third of nonpregnant women (36 percent) in the 2013 FNS had a low blood ferritin concentration, corrected for inflammation, which indicated that the cause of the anemia in 57 percent of women was an iron deficiency.[2] This indicates that the cause of anemia in more than a third of all women (43 percent) is something other than an iron deficiency, and thus will not be treated by iron supplements. Supplements of other vitamins are probably required.

About a third (34 percent) of all children in the same survey were found to have a low concentration of zinc in their blood,[2] so the population is considered to be at risk of deficiency. Zinc is required as a cofactor by many enzymes throughout the body, and a deficiency is associated with stunted linear growth.[22] Zinc is used with oral rehydration solution to treat children with diarrhea.[23]

In the national FNS 2013, 83 percent of children had aflatoxin detected in their blood.[2] This toxin is produced by a fungus that grows on poorly stored grains; chronic exposure is associated with liver tumors. It is also postulated that aflatoxin may affect children's immune function and growth.[24]

Conclusions. Not all anemia is due to iron deficiency, so multiple micronutrient supplements should be considered instead of only iron and folate.

3.22 OTHER AGE GROUPS

Little is known about the nutritional status of other age groups in Timor-Leste. The growth of Timorese children throughout childhood to 19 years of age is close to the fifth percentile of the WHO reference values for both height and weight.[12] Timorese adolescent girls appear to reach maturity at the same age as well-nourished girls, but gain less height during the growth spurt, which contributes to their small stature as adults.[12] The growth spurt of males is later and smaller than in well-nourished populations.[12] A study in Kenya indicated that good nutrition during adolescence could contribute to catch-up growth in previously stunted children,[25] something that may be possible in Timor-Leste.

No information was found on the nutritional status of the elderly (age ≥ 65 years), who make up 3.6 percent of the total population, according to United Nations data. This group is relatively small, but will grow rapidly as the population ages and more survive.

Conclusion. The adolescent growth spurt of girls should be a target for nutritional interventions.

4 RECOMMENDATIONS

The long-term goal is to increase the stature of Timorese adults by improving their nutritional status and growth in the womb and throughout childhood. The objective is to reduce the percentage of stunted children less than five years old by 1.5 percent a year from 2016, so by 7.5 percent every five years to reach a target of 16 percent stunted by 2036.

The Government of Timor Leste has committed all sectors to prevent malnutrition. This requires the convergence of interventions in households with pregnant women and young children so that all ministries, not just the Ministry of Health, treat the prevention of stunting as a priority. The coordination of sectors to deliver their interventions to the same beneficiaries will be crucial to achieve better outcomes for the nutrition, growth and development of children.

The following table shows the recommended actions, the interventions and the institutions responsible to prevent low birth weight and childhood stunting.

Recommended Action	Interventions	Responsible Institutions				
		Ministry of Health	Ministry of Education, Youth and Sport	Ministry of Agriculture and Fisheries	Ministry of Public Works	Ministry of Social Solidarity
To reduce the proportion of children who are born with a Low Birth Weight	Delay pregnancy until the age of 20 years	X	X			
	Educate women about the need for good nutrition and rest during pregnancy; provide iron and folate supplements; provide treatment for worms after the first trimester; provide supplementary food to pregnant women who have a low BMI (< 18.5 kg/m^2) or are of short stature (< 145 cm); or enroll such women in social protection programs to receive a direct cash transfer through strengthening the Bolsa Da Mae program	X				X
	Provide health and nutrition education to empower and include adolescent girls and and women of reproductive age including social groups and social media	X	X			

Recommended Action	Interventions	Responsible Institutions				
		Ministry of Health	Ministry of Education, Youth and Sport	Ministry of Agriculture and Fisheries	Ministry of Public Works	Ministry of Social Solidarity
To reduce the proportion of children who become stunted during the first two years of life, interventions and services are needed to improve and sustain the nutritional status of children from birth	Support women to start breastfeeding their baby within an hour of birth and offer breastfeeding counseling. Give breastmilk exclusively for six months	X				
	Support parents to ensure that all infants who are not exclusively breastfed are given at least three complementary meals a day made from at least four of seven food groups, with nutritious snacks between those meals	X				
	Support parents to give their children the same food that they eat, mashed and fortified with oil and micronutrient powder	X				
	Increase the percentage of: children who sleep under an insecticide-treated bed net to > 90 percent; the percentage of children < 5 years who receive a dose of vitamin A every six months to > 90 percent; the percentage of children < 5 years who are treated for worms at least once a year to > 90 percent	X				
	Increase the coverage of all essential vaccinations to > 90 percent	X				
	Provide treatment for children with severe acute malnutrition, ideally with a locally made and culturally appropriate supplementary food	X				
	Ensure that all sick children have access to good quality preventative and curative health services, especially in remote rural areas	X				
	Ensure that all children drink clean, safe water and hygiene practices with the support of clean water facilities	X	X		X	
	Support agriculture by smallholders, particularly women and youths, to grow diverse and nutritious crops and increase productivity and yields, depending on the crop, and promote homestead gardening to provide green leafy vegetables throughout the year			X		

5

APPENDIX

Figure A.1 shows the percentage of children by three-month age groups in each of the six separate categories within the composite index of anthropometric failure:

- Stunted only
- Underweight only
- Wasted only
- Stunted and underweight
- Underweight and wasted
- Stunted, underweight, and wasted

Note that it is not possible to be stunted and wasted without also being underweight.

Figure A.1 shows that 23.6 percent of children age 0 to 2 months, the youngest age group, were wasted only, which is only 2.5 percent less than the percentage of any children who were wasted shown in Figure 4. These children were probably born with a low birthweight. The percentage of children who were wasted only was lower in older age groups, while the percentages who were wasted with other outcomes were higher in older age groups. This indicates that wasting leads to children also becoming underweight or underweight and stunted.

Table A1 shows the difference in percentages in each category of the CIAF between the poorest and richest quintiles of wealth. The percentage of children who are stunted only is little different between wealth groups, suggesting that it is inherent to the population, probably a consequence of intergenerational malnutrition that affects all households.

Table A.1. **Children in Each CIAF Category, the Difference and Statistical Significance of the Difference between Children in the Poorest and Richest Wealth Quintiles (Percent)**

Category of the CIAF	Poorest	Richest	Difference	P
Stunted only	16.6	17.3	0.7	0.717
Underweight only	1.3	4.0	2.7	0.014
Wasted only	6.8	8.0	1.2	0.377
Stunted and underweight	23.8	14.3	-9.5	<0.001
Underweight and wasted	11.6	6.1	-5.5	<0.001
Stunted, underweight & wasted	9.8	5.2	-4.6	0.001
Any index, CIAF	69.8	54.9	-14.9	<0.001

Source: Calculated from published data from the DHS (2016)

Figure A.1. Children with 95% Confidence Intervals in Each of the Six Categories of the Composite Index of Anthropometric Failure (Percent)
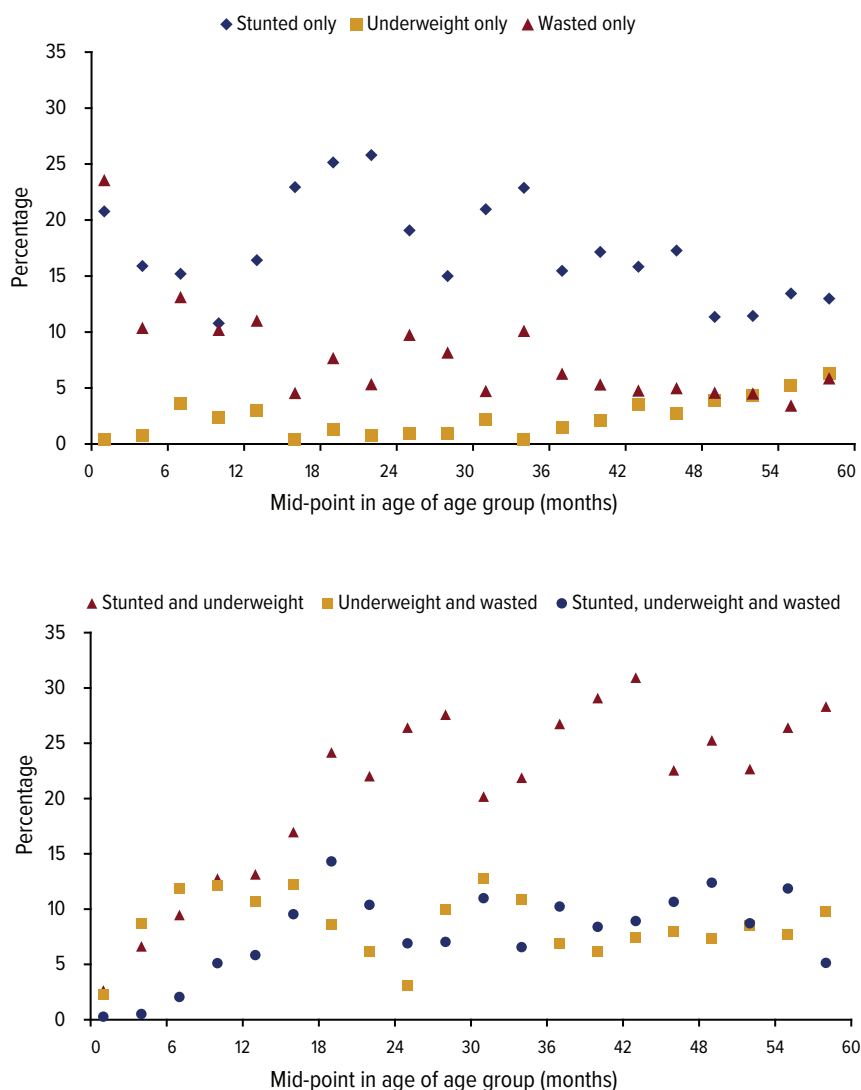
Source: Calculated from published data from the DHS (2016)

There is little difference in Table A.1 between wealth groups in the percentage of children who are wasted only, indicating that wealth is not protective against acute malnutrition. There are more wealthy children who are underweight only, but it is a small group (4 percent) as most underweight children are also stunted or wasted, or all three. In all the categories of two or more indicators of malnutrition, the richest households have a 40 to 50 percent smaller proportion of malnourished children, but 55 percent of all of the richest children have some form of malnutrition in comparison with international growth references.

BMI-for age of children

Height-for-age and BMI-for-age are the only two indexes that can be calculated for children from birth to 19 years of age, so they have value for tracking changes in the same index and derived indicators, stunted or thin, throughout childhood. BMI-for-age is highly correlated with weight-for-height, which explains 95 percent of the variance in the z-score. Just over 20 percent of all children in the 2016 DHS were classified as thin (20.5 percent); 17.2 percent of children less than 3 months were thin; and the prevalence was nearly 30 percent in children between 6 and 11 months, reflecting the risk of malnutrition during the start of complementary feeding, which may be both of poor quality and expose children to infectious diseases. After the age of 12 months, the prevalence of thin children remained stable at just under 20 percent.

A study of growth velocity in a cohort of Timorese children found two growth patterns using BMI-for-age: children who are born with an adequate BMI that declines with age, and children who are born with a low BMI and remain thin.[12] This latter group may characterize Timorese children: they are born small and stay small.

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