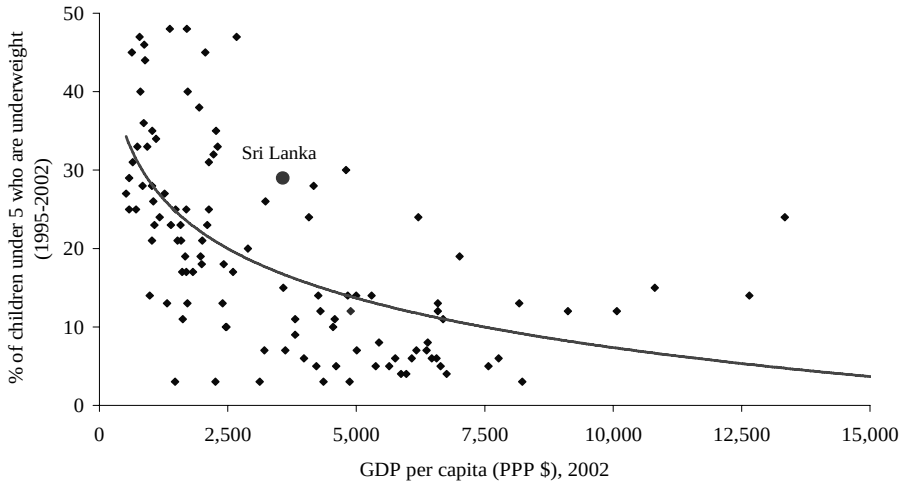
3. CHILD MALNUTRITION

Introduction

3.1 Reducing child malnutrition is a key millennium development goal, as child malnutrition produces a wide and diverse range of adverse economic and social consequences. Malnutrition substantially raises the risk of infant and child deaths, and increases vulnerability to a variety of diseases in later life. In addition, malnutrition impairs cognitive ability and decreases school performance, and lowers labor productivity and lifetime earnings. Combating child malnutrition is of central importance to the future economic and social welfare of countries.

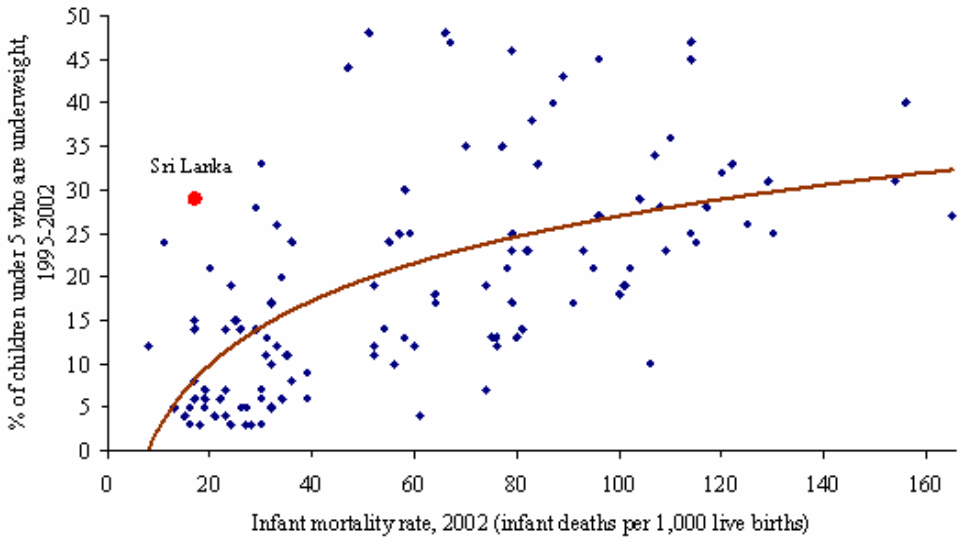
Figure 3.1: Relationship between Child Underweight Rates (1995-2002) and GDP per capita (2002) across a Cross-Section of Low- and Medium-Human Development Countries



3.2 Child malnutrition in Sri Lanka is very high. Nearly one in three children aged 3-59 months is underweight, and more than one in ten children in this age group suffers chronic or acute malnutrition. An international comparison of child malnutrition rates relative to per capita national income, based on a cross-section of 113 low- and medium-human development countries (data on which are obtained from the UNDP *Human Development Report 2002*), shows that Sri Lanka has a significantly higher child underweight rate than would be expected on the basis of its per capita GDP (Figure 3.1). This is in sharp contrast to Sri Lanka's celebrated performance on other human development outcomes such as primary education enrollment, adult literacy, infant mortality and life expectancy, where the country performs well above the levels that would normally be expected at its level of per capita income. Indeed, Figure 3.2 indicates that Sri Lanka has a child underweight rate that may be three times as high as what would be expected of a country with Sri Lanka's level of infant mortality. There is thus a big disconnect between Sri Lanka's performance on child health and its performance on child malnutrition. This incongruency is difficult to understand as most factors that bring about low rates of infant and child mortality (e.g., delivery and

utilization of high-quality health services, high female literacy, good hygiene and health practices, etc.) typically also result in lower rates of child malnutrition.

Figure 3.2: Relationship between Percent of Children under 5 who were Underweight in 1995-2002 and the Infant Mortality Rate in 2002 across a Cross-Section of Low- and Medium-Human Development Countries of Low- and Medium-Human Development Countries



3.3 One possible explanation for the paradox is that infant mortality is largely a function of the utilization of preventive and curative health services, including immunization and maternal and child health services, while child nutrition depends additionally on food and dietary intake during infancy and early childhood. While Sri Lanka enjoys good medical infrastructure, feeding practices, especially for infants and young children, may be less than ideal. There is already some evidence (reviewed below) that a large proportion of newborns are not provided colostrum (the milk produced by the mother's breasts in the first 2-3 days after childbirth), which contains important antibodies and provides the child's first form of immunization. In addition, the duration of exclusive breast-feeding is also relatively short. These behavioral practices (established perhaps by cultural norms) could easily result in a situation where children are moderately under-nourished, yet healthy enough to survive into adulthood because of the availability of other complementary inputs to their health (e.g., good hygiene and access to immunization and prompt curative care).

3.4 However, data from the 1993 and 2000 rounds of the Demographic and Health Survey indicate that infant feeding practices are changing rapidly. Over this period, there was a sharp increase in the percentage of children exclusively breast-fed in their first three months of life, and a very significant increase in the mean duration of exclusive breast-feeding (see Section 3.6 below). In addition, a much larger proportion of children under 5 received colostrum in 2000 as compared to 1993. These data suggest that the incongruence between infant mortality and child malnutrition rates is likely to narrow over time as feeding practices and nutrition knowledge of mothers improve.

Child Malnutrition Patterns and Trends

3.5 **Levels**. The DHS data indicate that about 29% of children 3-59 months are moderately or severely underweight (Table 3.1).[1,2,3] A smaller, but still unacceptably high proportion (14%) of children in this age group suffer from stunting and wasting. These findings imply that children suffer from short-term acute food deficits, reflected in low weight for age, as well as longer-term chronic under-nutrition, manifested in high rates of stunting and wasting.

Table 3.1: Malnutrition Rates (%) of Children Aged 3-59 months, 2000

Indicator	Underweight (weight for age)	Stunting (height for age)	Wasting (weight for height)
Moderate or severe	29	14	14
Severe	5	3	1

Note: The malnutrition rates reported in Table 3.1 cover seven of the eight provinces, excluding the conflict affected North-Eastern Province, where the Demographic and Health Survey could not be conducted in 2000.
Sources: Department of Census and Statistics, Demographic and Health Survey, 2000 and Gunewardena, 2003.

3.6 **Trends**. The level of child malnutrition has been declining over time. The prevalence of underweight children fell from 38% in 1993 to 29% in 2000. The proportion of stunted children declined even more – from 25% to 14%.[4] Thus, the underweight and stunting rates have declined at annual rates of 1.3 and 1.6 percentage points, respectively, over the period 1993-2000 – impressive rates of decline.

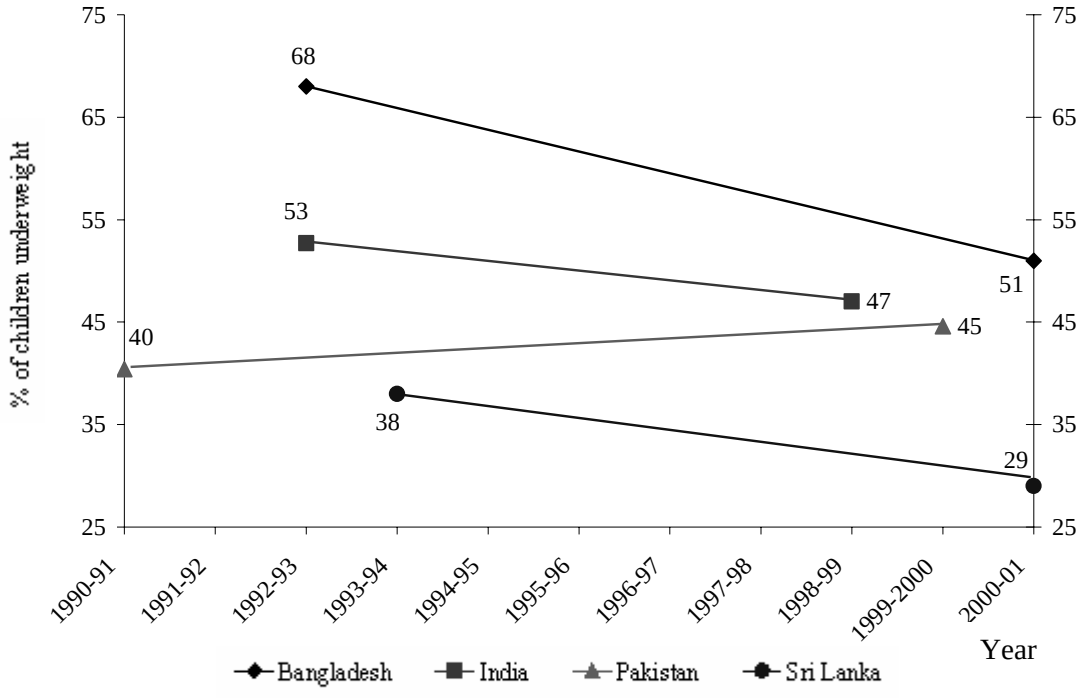
International Comparisons

3.7 How does Sri Lanka's performance on reduction of child malnutrition compare to that of its neighbors in South Asia? Figure 3.3 shows child underweight rates during the 1990s in four countries of the region. The only country that performed better than Sri Lanka in terms of reduction in child malnutrition was Bangladesh, where the underweight rate fell by an average of 2.1 percentage points annually. In India, the decline was more modest – 1 percentage point each year – while Pakistan actually saw its child underweight rate increase by 0.6 percentage points annually during the 1990s. However, it should be observed that the decreases in Bangladesh occurred from a much higher underweight rate (68% versus 38% in

[1] As in the literature, a child is considered underweight when his or her weight-for-age is more than two standard deviations below the NCHS/WHO reference weight. A child is stunted when his or her height-for-age is more than two standard deviations below the NCHS/WHO reference. Severe underweight and stunting occur when the relevant nutrition indicator is more than three standard deviations below the NCHS/WHO reference.
[2] Another important form of malnutrition that is not pursued in this report is inadequate consumption of micronutrients, such as Vitamin A, iron and iodine.
[3] Throughout this report, data on child malnutrition rates are reported only for children aged 3 months or older. As seen below in Table 3.3, child malnutrition in Sri Lanka, as in most other countries, only sets in after the age of 6 months, when children are weaned from exclusive breast-feeding.
[4] The prevalence of wasting, however, declined only marginally over the same time period, from 16 percent in 1993 to 14 percent in 2000.

Sri Lanka). As the underweight rate declines, it is progressively more difficult to achieve further reductions in child malnutrition.

Figure 3.3: Child Underweight Rates (%) during the 1990s, South Asia



3.8 It is worth noting that even though moderate child malnutrition is pervasive in Sri Lanka, the rates of severe malnutrition are very low. For instance, Table 3.1 indicates that severe underweight and stunting rates are only in the range of 3-5% – approximately a fifth of the corresponding moderate rates. In contrast, the rate of severe stunting in India is as high as one-half of the moderate stunting rate, and the severe underweight rate is about 40% of the moderate underweight rate. In Bangladesh as well, the severe stunting rate is approximately 40% of the moderate stunting rate and the severe underweight rate is about 30% of the moderate underweight rate. This implies that the weight and height gains required to lift the vast majority of underweight and stunted Sri Lankans out of under-nutrition are comparatively smaller, which should make the task of eradicating child malnutrition relatively less difficult.

Regional Disparities

3.9 Child malnutrition is highest in the estate sector with over 43% of children underweight, followed by the rural sector, where about 27% of children are underweight, and the urban sector, where around 20% of children are underweight. A similar pattern can be observed for stunting, with considerably higher rates in estate areas, followed by the rural and urban sectors. While the incidence of underweight and stunting has declined

substantially over time in all areas, the decrease has been greatest in the urban sector, followed by the rural and estate sectors.

3.10 The highest child malnutrition rates are in the Uva and Central provinces (Table 3.2). The next highest malnutrition rates are in the North-Western, North-Central and Sabaragamuwa Provinces. In terms of economic zones, these high malnutrition provinces consist of estate areas, rainfed dry zone and irrigated dry zone areas, and the coastal lowlands. They tend to be the poorer districts, with fewer economic opportunities. The Western province, with its more advanced economy based on industries and services, exhibits the lowest level of child malnutrition. It should be noted, however, that, during the period 1993-2000, child malnutrition declined in all the provinces, with the sharpest declines in the North-Central, Sabaragamuwa and Southern Provinces. The North-Western Province, in contrast, recorded only a slight decrease.

Table 3.2: Province Level Variations in Child Malnutrition (% of children 3-59 months who are moderately or severely underweight), 1993-2000

Province	1993			2000		
	All children	Boys	Girls	All children	Boys	Girls
Western	28	24	32	21	19	23
Central	42	40	45	37	37	38
Southern	39	37	42	28	24	33
North-Eastern	na	na	na	na	na	na
North-Western	35	33	38	32	31	33
North-Central	48	44	53	31	28	33
Uva	47	47	48	39	40	38
Sabaragamuwa	42	44	40	31	39	22
Sri Lanka	38	35	40	29	29	30

Source: World Bank estimates based on the Department of Census and Statistics, Demographic and Health Surveys, 1993 and 2000.

Demographic Patterns

3.11 **Age Patterns**. Malnutrition for a large proportion (about a fifth) of children begins after the sixth month of life (Table 3.3). Reasons for this may be low-birth weights, sustained and nurtured by inadequate breast-feeding and complementary feeding practices. But the risk of malnutrition increases sharply in the second year of life (beginning at age 12 months), when most children stop breast-feeding and begin relying almost exclusively on solid foods. The insufficiency and inadequacy of weaning diets in Sri Lanka increases the risk of malnutrition among infants.

Table 3.3: Child Malnutrition Rates by Age and Sex, 2000

Age in Months	Moderate or severe malnutrition				Severe malnutrition			
	Weight for age		Height for age		Weight for age		Height for age	
	Males	Females	Males	Females	Males	Females	Males	Females
3-5	0.90	0.00	6.12	1.83	0.90	0.00	3.23	1.83
6-11	23.50	14.54	6.17	5.02	1.71	4.30	1.64	1.76
12-23	30.57	26.87	11.74	21.53	5.04	4.27	2.89	3.76
24-35	31.95	36.26	10.54	14.47	4.5	7.09	1.74	4.41
36-47	26.69	35.23	12.02	14.76	1.72	7.59	1.03	2.84
48-59	38.20	37.47	18.95	19.28	3.99	6.93	4.43	3.49
All	29.04	29.81	11.90	15.34	3.37	5.80	2.41	3.35

Source: World Bank Estimates from the Demographic and Health Survey 2000

3.12 **Gender Disparities**. Child underweight rates are fairly similar across boys and girls (Table 3.3). However, this was not the case in 1993, when the underweight rate among girls was greater than that among boys. Between 1993 and 2000, there was a steep fall in underweight rates among both boys and girls, with the sharper decline occurring among girls, especially in the North-Central, Sabaragwamua, Southern, Western and Uva provinces. As a consequence, gender parity in underweight rates was established by 2000 in the country as a whole, although girls continue to face higher underweight rates than boys in the Western, Southern and North-Central provinces. Sabaraguamuwa is an unusual province in that the incidence of malnutrition is significantly greater among boys than among girls (39% versus 22%).

3.13 However, severe malnutrition shows significant gender differences, with girls having a 40% and 70% greater likelihood of being severely stunted and underweight, respectively, than boys (Table 3.3). Of course, rates of severe malnutrition are significantly lower than that of moderate malnutrition among both boys and girls.

3.14 **Birth Order and Gender Disparities**. There is a very clear pattern of child malnutrition rates increasing with the birth order of children (Table 3.4). For sixth- and higher-order children, the risk of malnutrition is nearly two times as large as that for first-born children. In the case of stunting, gender appears to interact with birth order, such that higher order girls have a significantly greater likelihood of being stunted than higher order boys.

Table 3.4: Child Malnutrition Rates by Birth Order and Sex, 2000

Child's birth order	Moderate or severe malnutrition				Severe malnutrition			
	Weight for age		Height for age		Weight for age		Height for age	
	Males	Females	Males	Females	Males	Females	Males	Females
Firstborn	23.50	25.46	8.55	10.42	3.27	4.96	1.32	2.25
Second	31.97	30.87	11.41	16.03	2.14	5.30	2.10	3.56
3-5	35.21	36.28	18.85	23.53	4.37	8.02	4.12	4.81
6^{th} and above	48.16	47.79	25.07	33.88	15.88	10.00	15.88	11.77
All	29.04	29.81	11.90	15.34	3.37	5.80	2.41	3.35

Source: Calculations from DHS 2000 data

Proximate Causes and Correlates of Child Malnutrition

3.15 **Mother's Age at Birth**. The literature on child malnutrition identifies the age of a mother as a significant risk factor in her children's nutritional status. Delivery complications resulting in low birth weight are more likely among babies born to women in their teens or their late 30s and 40s. The evidence for Sri Lanka shows a clear U-shaped association between maternal age and child malnutrition (Table 3.5). Malnutrition is lowest among children born to mothers in their mid-late twenties. Mothers in their teens and their 30s, especially the late 30s, are significantly more likely to have children suffering from malnutrition.

Table 3.5: Rates of Child Malnutrition among Children Aged 0-59 months, by Mother's Age and Education, 2000

Maternal characteristics		Moderate or severe malnutrition		Severe malnutrition	
		Underweight	Stunting	Underweight	Stunting
Age of mother at child's birth	14-18 years	35.56	9.96	3.82	1.40
	19-23 years	31.38	12.96	5.03	2.02
	24-29 years	23.26	10.95	3.75	2.32
	30-34 years	29.96	14.98	4.39	3.58
	35-50 years	32.72	13.55	4.84	2.82
Mother's years of schooling	None	48.37	39.90	15.32	15.71
	1-5 years	41.07	22.99	5.98	3.79
	6-10 years	32.49	14.23	4.73	2.72
	O/Level	25.04	10.65	3.75	1.99
	A/Level	10.17	6.68	1.34	2.21
	Degree and above	17.26	0.30	3.39	0.0

Source: Calculations from DHS 2000 data

3.16 **Maternal schooling**. Table 3.5 also shows a strong association between mother's schooling and child underweight rates. The underweight rate among children whose mothers have no formal schooling is as high as 48%, while the corresponding rate among children whose mothers have completed their A-levels is merely 10%. The differences in severe malnutrition rates are even more striking, with unschooled mothers facing severe underweight rates among their children that are more than 10 times as large as those observed among children whose mothers have completed A-levels. The favorable association between maternal schooling and child malnutrition can be attributed to such factors as superior knowledge and practices concerning childcare, feeding practices, environmental health, and household hygiene. Mother's schooling can also proxy for higher socio-economic well-being of households over and above the effect of per capita consumption expenditure. Overall, the findings confirm results documented in the development literature across a large number of countries that investment in female education is one of the best long-term, inter-generational interventions to combat child malnutrition.

3.17 **Infant Feeding Practices**. Infant feeding practices are an important determinant of child nutrition. The health and nutrition benefits to the child of exclusive breast-feeding

during the first four months of a child's life and continued breast-feeding thereafter are well-known. In addition, it is important that the child receives *colostrum* (the milk provided by the mother's breasts in the first 2-3 days) which contains important antibodies and provides the child's first form of immunization. This information is communicated to mothers in Sri Lanka verbally by public health workers (midwives) as well as in the literature distributed to mothers through the public health system.

3.18 Data from the Demographic and Health Surveys of 1993 and 2000 indicate a sharp increase in the percentage of children exclusively breast-fed in their first three months of life, and an increase in the mean duration of exclusive breast-feeding from 1.2 months to almost 4 months (Table 3.6). Over three-quarters of all children under 5 received *colostrum* in 2000, compared with only 55 percent in 1993.

Table 3.6: Patterns of Breast-feeding, 1993 and 2000

Indicator		1993	2000
Percent of children ever breast-fed*		98.0	98.0
Percent of children received colostrum*		54.9	76.8
Percent of children exclusively breast-fed**	0-1 months	34.5	83.9
	2-3 months	17.4	65.0
	0-4 months		57.6
Mean duration of exclusive breast-feeding***		1.2	3.7

Notes: *All children below 5 years of age. ** Youngest living child below 3 yrs of age.
*** Children below 3 yrs of age
Source: DCS (2002)

3.19 Table 3.7 indicates a higher incidence of malnutrition among children who did not receive *colostrum* than among those who did. Children who were exclusively breast-fed for four months or more also had a lower incidence of malnutrition than those to whom supplementary feeding was introduced before the completion of four months.

Table 3.7: Rates of Child Malnutrition (%) among Children Aged 0-59 months by Infant Feeding Practices, 2000

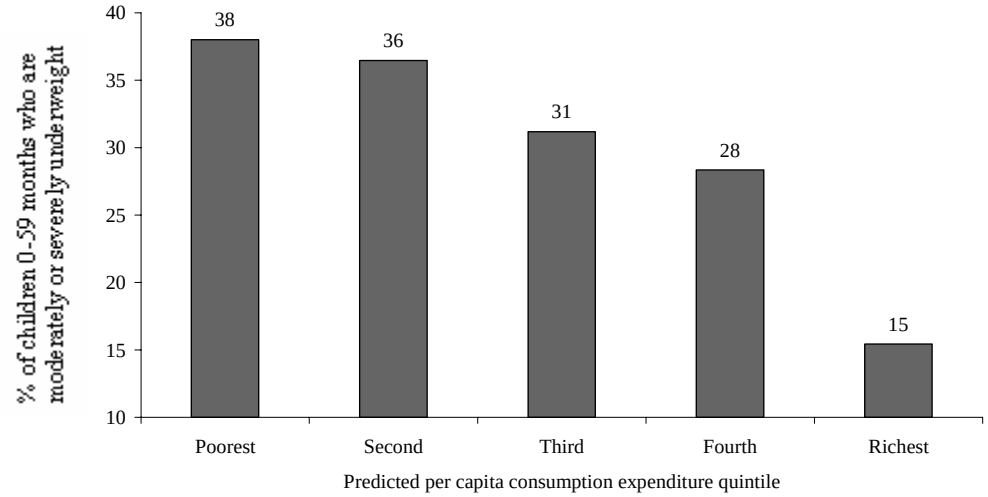
		Moderate or severe malnutrition		Severe malnutrition	
Breast-feeding practice		Underweight	Stunting	Underweight	Stunting
Colostrum was:	given to the baby	27.94	12.58	3.95	2.52
	discarded	34.49	16.60	6.46	3.70
Breast-feeding was exclusively practiced:	4 months or more	28.40	12.33	3.52	2.32
	< 4 months	32.37	15.42	6.30	3.34

Source: Calculations from DHS 2000 data

3.20 **Living Standards**. Recent studies of child malnutrition in developing countries have awarded importance to the analysis of the relationship between malnutrition and income growth (Haddad et. al., 2003) and interventions (Stifel and Alderman 2003). Data from the DHS 2000 show an association between rates of child malnutrition and household living standards, when predicted household consumption expenditure per capita is used as a proxy

for household living standards (Figure 3.4).[5] While the data show an inverse association between underweight rates and consumption quintiles, the gradient in the relationship is not steep until one gets to the richest quintile of children aged 0-59 months. Between the fourth and fifth quintiles, the underweight rate falls from 28% to 15%. There are two important things to note from these results. First, child malnutrition is pervasive in Sri Lanka, with a third of children in the bottom four quintiles being underweight. At the same time, the fact that as many as 15% of children in the top quintile – a group that is likely to have very good economic access to food – are malnourished suggests that cultural and social factors have an important role to play in determining child malnutrition in Sri Lanka.

Figure 3.4: Percent of Children 0-59 months who are Moderately or Severely Underweight, by Predicted per capita Consumption Quintile, 2000



3.21 **Clean Drinking Water and Safe Sanitation**. Clean drinking water and safe sanitation reduce the risk of diarrheal diseases that diminish nutrient absorption and increase the risk of malnutrition among children. The information on Sri Lanka shows higher levels of malnutrition among children who live in homes with unsafe sanitation such as houses with no toilets or merely bucket latrines, or inferior sanitation facilities such as pit latrines (Table 3.8). Child malnutrition rates are noticeably lower in houses with access to safe forms of sanitation, such as flush or water seal toilets. Similarly, children from households that

[5] While the DHS 2000 data do not include information on household income or consumption expenditure, we have imputed monthly consumption expenditure per capita to sample DHS households. This has been done by making use of the availability of identical variables to those found in the DHS (household demographics, housing and assets, and location) as well as expenditure data in the Sri Lanka Integrated Survey (SLIS) 1999/2000. The latter data set was used to estimate a regression of log consumption expenditure per capita on location (rural/urban and district dummies), ownership of consumer durables (radio, TV, bicycle, refrigerator, motorcycle), type of materials used for the roof and wall of the household's dwelling, household size and demographic composition, and age, schooling, sex and marital status of the household head. The estimated regression coefficients were then used to make out-of-sample predictions of log consumption expenditure per capita for the DHS 2000 sample.

consume drinking water from unsafe sources, such as rivers, tanks, streams or unprotected wells, have higher malnutrition rates than children from households consuming drinking water from safe sources, such as main line taps, and protected wells and tube wells. Boiling water prior to consumption is also positively associated with lower levels of child malnutrition. Households that boil their drinking water experience sharply lower child malnutrition rates than households that consume drinking water that is not boiled.

Table 3.8: Rates of Child Malnutrition among Children Aged 0-59 months, by Drinking Water Source, Type of Toilet and Housing Conditions, 2000

Water, sanitation and housing indicator		Moderate or severe		Severe malnutrition	
		Underweight	Stunting	Underweight	Stunting
Drinking water source	Tap (main line)	19.06	9.38	2.67	1.86
	Protected well or tube well	29.96	12.56	5.28	3.20
	Bowser, unprotected well, river, tank or stream	38.96	23.41	5.23	4.06
Boiled water used for drinking water	For all family members	27.81	15.01	4.45	3.05
	For children under 5 years	25.66	10.74	4.00	2.99
	Not used at all	40.11	19.38	6.39	3.69
Type of toilet	Flush or water seal	25.95	12.34	3.79	2.54
	Pit latrine	42.19	18.03	7.02	2.10
	Bucket or none	44.86	27.79	9.21	9.33
Type of roof material	Tile, asbestos or tin	28.37	14.13	4.52	3.04
	Cadjan/palmyrah/straw, waste materials or other	45.48	20.45	7.80	3.84
Type of wall material	Brick/cement/stone/cabook	24.70	11.26	3.37	2.60
	Mud or wood	44.90	24.41	9.10	4.72
	Cadjan/palmyrah	51.59	18.76	7.48	3.32

Source: Calculations from DHS 2000 data

Major Polices and Programs to Decrease Child Malnutrition

3.22 The overarching policy framework of the Government of Sri Lanka to reduce child malnutrition contains four broad strategies.

3.23 **Direct food consumption based measures to ensure adequate nutrition intake among households and individuals**. The main intervention in this strategy has been the provision of food assistance to populations affected by the secessionist conflict in the North-Eastern Province, including displaced persons. The value of food assistance under this program ranges between Rs. 336 for families consisting of one individual to Rs. 1260 for families of five persons. This food assistance program is a hunger and malnutrition mitigation measure in the conflict-affected areas. A second major intervention is the *Thriposha* (triple nutrient) program. This is a pre-cooked cereal based food designed to supplement energy, protein and micronutrients among nutritionally vulnerable women and children. *Thriposha* is given to pregnant and lactating women during the first 6 months and infants between 6-11 months of age. In addition, it is given to children between 12-60 months who are at risk, as shown by growth faltering or other measures and as certified by the Medical Officer of Health. A third important intervention is a school-feeding program under which poor children are given a hot meal in school. The twin objectives of the school

meal are to attract poor children to attend school and to provide these children with adequate nutrition to stay in school and do well in school work.

3.24 **Poverty reduction programs**. The chief government poverty reduction initiative is the *Samurdhi* program. Under Samurdhi, the government provides an income supplement of between 500-1,000 rupees depending on family size and household poverty level, which can be used to purchase food items, such as grains, cereals and legumes. In addition, the *Samurdhi* program has officers trained in maternal and child nutrition and infant care who work with target groups such as pregnant women, lactating mothers and under-nourished children to help improve nutrition levels. In addition to the government *Samurdhi* program, there are numerous NGOs that engage in poverty reduction activities, including nutrition awareness programs. Donors such as UNICEF and WFP work through such NGOs.

3.25 **Measures to address specific nutrition problems**. The government has initiated a series of measures to combat specific nutrition problems. First, there are campaigns to promote breast-feeding of infants, including awareness creation of the nutritional benefits of breast-feeding, distribution of feeding bottles and teats to maternity hospitals and health care providers, and the provision of free and low cost supplies of infant formulae to hospitals and health-care facilities. Second, there is a salt iodization program to combat iodine deficiency disorders, including the prevalence of goiter and thyroid deficiencies. Third, there is a program to fortify wheat flour with iron to combat problems of iron deficiency anemia. A variant of this program is pilot testing the mixing of iron and vitamin supplements in wheat flour.

3.26 **Health interventions**. An integrated package of maternal and child health services to address child malnutrition and promote child growth has been designed by the government. The package commences at conception and proceeds through fetal life, infancy and childhood. The interventions include family planning to space and limit children, antenatal care to ensure fetal growth and well-being, breast feeding, promoting appropriate weaning, growth monitoring, immunization programs, prevention of infections such as water-borne diseases, worm infestation and respiratory illnesses, use of oral rehydration solutions for children suffering from diarrhea, feeding during infections and food supplementation.

3.27 These policies and programs to reduce child malnutrition are complemented by health and nutrition education. The Ministry of Health provides a range of health and nutrition education services. In terms of maternal education, activities exist to promote adequate food consumption and health care of pregnant and lactating mothers. Exclusive breast feeding is encouraged and growth monitoring promoted for the first 4-6 months. Nutrition education is carried out by health workers at the central, provincial and divisional levels. The school curriculum also contains material on nutrition, including hygienic food preparation, nutritious feeding habits, safe sanitary habits and consumption of clean drinking water. In addition, universities offer courses in nutrition at undergraduate and postgraduate degree levels.

3.28 Yet there is fragmentation of nutrition policies and programs across different sectors and ministries, without a leadership role played by any institution. This is preventing the government from developing a coherent approach to reducing child malnutrition.

3.29 In addition, few of these direct and indirect public nutritional interventions have been subjected to any rigorous evaluation. As such, little is known about their effectiveness and the extent to which they have contributed to a decline in child malnutrition.

Multivariate Analysis

3.30 To examine the likelihood of Sri Lanka attaining the child underweight MD goal, we have estimated a multivariate model of child underweight rates, using unit record data from the DHS 2000.[6] The multivariate model has the advantage of controlling for several variables that may be simultaneously associated with child malnutrition. The estimation results are reported in Annex Table 3, while only the broad findings of the empirical analysis are discussed here.

3.31 The multivariate model confirms many of the bivariate relationships discussed earlier. After controlling for other variables, the risk of child malnutrition increases with age, albeit at a diminishing rate. While girls have a significantly lower likelihood than boys of being underweight, the nutritional advantage of girls diminishes with age and is completely eliminated by age 21 months. The results suggest that beyond that age, girls have a higher likelihood of being underweight relative to boys. Finally, the results also confirm that, even after controlling for age, higher birth order children are significantly more likely to be underweight than lower birth order children.

3.32 Maternal schooling has an inverse association with underweight rates, but only for schooling levels beyond the O-level (typically grade 10). Children whose mothers have A-level (12 years) or more schooling are more than 50% less likely to be underweight than children whose mothers have less than 12 years of schooling. Surprisingly, however, such a relationship is not observed with respect to father's schooling. Any secondary schooling of the father is associated with lower levels of child malnutrition. These results are counter-intuitive, since, in much of the literature, it is maternal, not paternal, schooling that is observed to have the strongest associations with the risk of child malnutrition.

3.33 The log of predicted monthly consumption expenditure per capita (proxying for the household's living standard) also has a strong inverse association with the risk of a child being underweight, with a one percent increase in predicted consumption expenditure per capita being associated with a 0.16% decline in the risk of being underweight.

3.34 Infrastructure generally has predictable associations with child malnutrition. Children in households having a flush toilet and piped water are, on average, 24% and 31%, respectively, less likely to be underweight than children in households not having access to a flush toilet or piped water. Access to electricity has an even stronger association, with a one percent increase in electricity coverage in a province being associated with a 1.2% decline in child malnutrition.

[6] Since the dependent variable in the model is a dichotomous variable (i.e., whether or not a child is underweight), the model has been estimated by the maximum-likelihood probit method.

Simulations to 2015

3.35 Based on the multivariate probit model estimated above, we have undertaken simulations of the child underweight rate in Sri Lanka from 2001 to 2015 under certain assumptions. The nature and magnitude of the interventions are detailed in Table 3.9. As noted previously, the scope and magnitude of the assumed interventions are only meant to illustrate the likely reduction in child malnutrition under one possible scenario. It is obviously not possible to predict whether the assumed interventions will indeed take place, and, even if they do, whether they will proceed as the pace assumed in Table 3.9.

Table 3.9: Assumptions about Various Interventions to Reduce the Child Underweight Rate, 2000 to 2015

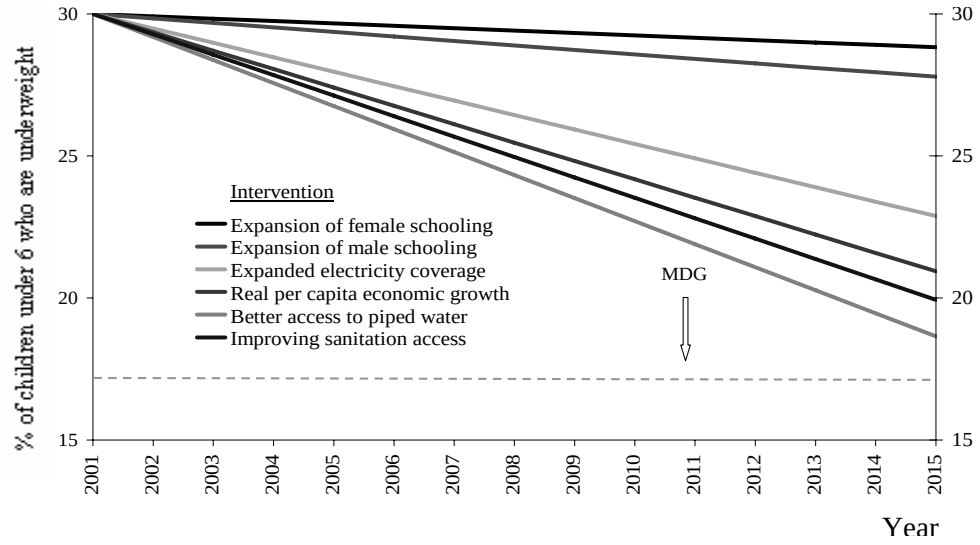
Intervention	Starting value in 2000	Assumed change per year	Ending value in 2015
% of adult females who have completed GCE A/L or equivalent	15.5	0.5	23.0
% of adult males who have completed GCE A/L or equivalent	13.3	0.5	20.8
Predicted monthly consumption expenditure per capita (Rs.)	3,150	3%	4,908
Flush toilet coverage (%)	80	1	95
Piped water access (%)	25	1	40
% of households with electricity connection in province	57	1	72

3.36 As in the previous chapter, we assume that monthly consumption expenditure per capita will grow annually at about 3% to 2015. In addition, we assume that the percent of adult males and females who have completed GCE A/L or equivalent schooling will increase by 0.5 percentage point annually, and that flush toilet, piped water and electricity access will increase by 1 percentage point annually to 2015. As noted earlier, none of these assumptions are sacrosanct; they are only meant to be illustrative. The projections could be undertaken for any combination of changes in the policy or environmental variables.

3.37 Figure 3.5 shows the projected path of the child underweight rate in Sri Lanka to 2015 with all of the six policy and environmental changes shown in Table 3.9 occurring. The largest decline in the child underweight rate (by 5 percentage points) is obtained from expanded electricity coverage. Economic growth resulting in an annual 3% increase in household consumption expenditure per capita is associated with another 2 percentage point reduction in child malnutrition. Each of the other four changes is associated with a percentage point decline. Together, the six interventions are associated with a reduction of about 11 percentage points in the child underweight rate, bringing the child underweight rate down from 30% to 19% – nearly 7 percentage points or 60% above the MDG level of no more than 12% of children being underweight). This suggests that attainment of the child nutrition MDG will be challenging in Sri Lanka, although it should be possible to bring child underweight rates down significantly with a package of interventions that includes economic

growth, expansion of male and female schooling, and improved infrastructure (viz., piped water, sanitation access, and electricity coverage).

Figure 3.5: Projected Percent of Children under 6 who are Underweight to 2015, under Different Intervention Scenarios (graph shows cumulative effect of each additional intervention)



Box III.1. Child malnutrition among children in the North-Eastern Province

Child malnutrition is considerably higher in the conflict affected North-Eastern Province (46 percent) than in the rest of the country (29 percent).* In this province, the prevalence of malnutrition is significantly greater among boys, 50 percent, than among girls, 42 percent. This gender differential is in sharp contrast to the malnutrition pattern in the rest of the country, where malnutrition rates are very similar for boys and girls. The age pattern of malnutrition shows that the proportion of children who are underweight reaches a peak in the age groups 12-35 months, and then tapers of slightly from 36-59 months. This age pattern is similar to the rest of the country. Urban-rural differences in malnutrition are small, varying by just one percentage point. This is different to the pattern in other parts of the country, where malnutrition rates are noticeably higher among rural children than urban children. Maternal education is strongly associated with lower levels of malnutrition. Among mothers with no education the prevalence of child malnutrition is 63 percent. As the education attainment of mothers rises, the prevalence of child malnutrition declines: 54 percent among primary educated mothers, 42 percent among secondary educated mothers, and 36 percent among tertiary educated mothers. This pattern is consistent with evidence from the rest of the country which also shows a favorable association between maternal education and child malnutrition.

At the district level, within the North-Eastern Province, Batticaloa, 53 percent, and Vavuniya, 51 percent, exhibit the worst levels of child malnutrition. These are followed by Trincomalee, 45 percent, Ampara, 44 percent and Jaffna, 43 percent. Mannar, with 38 percent child malnutrition, performs best among the North-Eastern districts.

Note: * The DHS 2000 conducted in the North-Eastern Province covered six districts, Ampara, Batticaloa, Jaffna, Mannar, Trincomalee and Vavuniya. The survey could not be conducted in two districts, Kilinochchi and Mullativu. Levels of malnutrition in these two districts are likely to be at least as high as in the rest of the North-Eastern Province.
Source: DHS 2000.