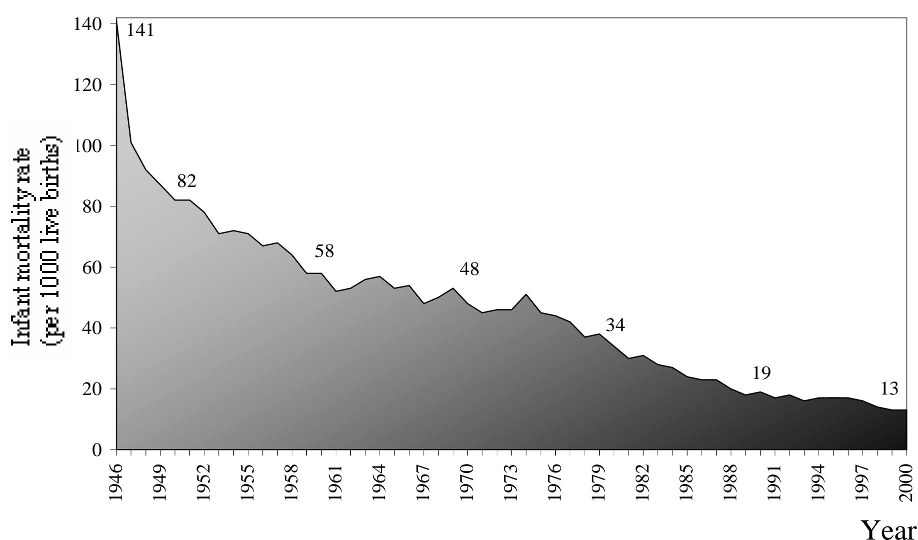
4. INFANT AND UNDER-FIVE MORTALITY

Introduction

4.1 Achieving low rates of infant and under-five mortality is of central importance for social well-being and human development. Sri Lanka has been extraordinarily successful in reducing its infant and child mortality rates over the last half-century. Indeed, over the period 1946-2000, Sri Lanka has been one of the most successful developing countries in the world in terms of infant and child mortality reduction. The infant mortality rate fell from 141 infant deaths per 1,000 live births in 1946 to a mere 13 deaths per 1,000 live births by 2000 (Figure 4.1).

Figure 4.1: Infant Mortality Rate (per 1,000 live births), 1946-2000



International Comparisons

4.2 At its current level of 13 infant deaths per 1,000 live births, Sri Lanka's infant mortality rate is unusually low by the standards of most developing countries and even by the standards of countries such as Russia, Ukraine and Argentina that are considerably wealthier than Sri Lanka. An international comparison of infant mortality rates relative to per capita national income, based on a cross-section of 120 low- and medium-human development countries (data on which are obtained from the UNDP *Human Development Report 2004*), shows that Sri Lanka has a significantly lower infant mortality rate than would be expected on the basis of its per capita GDP (Figure 4.2). Indeed, the figure suggests that Sri Lanka has an infant mortality rate that may be a fourth of what would typically be expected of a country at Sri Lanka's level of per capita GDP.

Figure 4.2: Relationship between the Infant Mortality Rate and GDP per capita across a Cross-Section of Low- and Medium-Human Development Countries, 2002

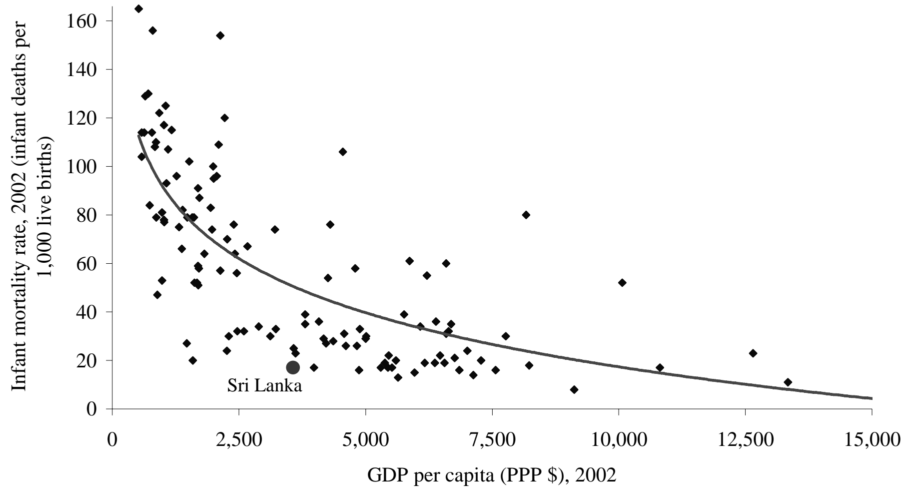
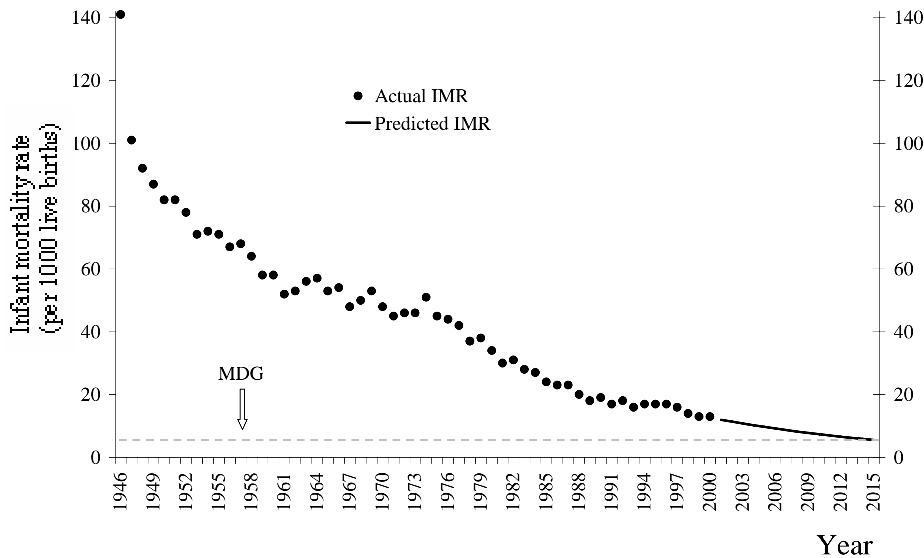


Figure 4.3: Projection of Infant Mortality Rate (per 1,000 live births) to 2015 (based on observed time trends from 1946 to 2000)



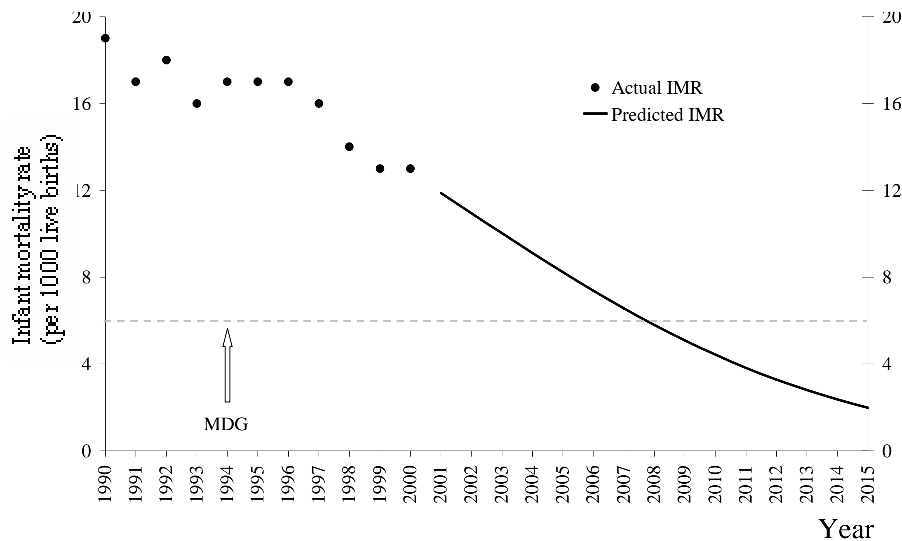
Trends and Projections to 2015

4.3 The infant mortality rate in 1990 in Sri Lanka was 19 deaths per 1,000 live births. Thus the MD goal of reducing infant mortality by two-thirds between 1990 and 2015 would translate to an infant mortality rate of about 6 deaths per 1,000 live births. How likely is Sri Lanka to attain this level of infant mortality rate given its past mortality reduction efforts? If

we extrapolate the country's experience between 1946 and 2000 forward to 2015,[1] the infant mortality rate could be expected to continue to decline to a level of just about 6 deaths per 1,000 live births by 2015 (Figure 4.3). This would mean that Sri Lanka would just manage to meet its MD goal by 2015.

4.4 However, if we only consider Sri Lanka's recent experience in mortality reduction (during the 1990s) in projecting future trends in the infant mortality rate, the scenario looks even brighter. Sri Lanka is expected to reach an infant mortality rate of a mere 2 deaths per 1,000 live births under this scenario (Figure 4.4). Thus, no matter which way one looks at it, the prospects of Sri Lanka attaining the infant mortality MDG are bright.

Figure 4.4: Projection of Infant Mortality Rate (per 1,000 live births) to 2015 (based on observed time trends from 1990 to 2000)



4.5 Of course, these projections have to be tempered by the fact that the decline in infant mortality experienced by Sri Lanka during the past 50 years is unprecedented. Declines from high initial levels of infant mortality are driven mainly by reductions in the number of post-neonatal deaths (i.e., deaths occurring between the age of one month and twelve months). These deaths are more easily averted by the typical (and relatively inexpensive) child survival interventions, such as child immunizations and oral rehydration therapy. However, as the overall level of infant mortality comes down, further reductions in overall infant mortality can only be obtained via reductions in neonatal mortality. Averting neonatal deaths typically requires more expensive interventions, such as professionally-attended deliveries, prompt treatment of neonatal infections (such as pneumonia), and availability of emergency obstetric care at lower levels of health-care facilities. Thus, sustained infant mortality reduction becomes increasingly more difficult and expensive. In Sri Lanka, more than three-quarters of infant deaths now occur in the first month of life, so future reductions in infant

[1] This projection considers the fact that the rate of reduction in infant mortality has slowed down in Sri Lanka over time, as it has in most countries.

mortality will have to be driven largely by reductions in neonatal mortality, which are considerably more difficult and expensive to attain.

Regional Variations

4.6 Sri Lanka's performance at overall infant mortality reduction should also be tempered by the fact that there exist large regional disparities in infant mortality in the country. In 1996, the infant mortality rate in the province with the highest infant mortality (North-Central) was nearly four times as large as that in the province with the lowest infant mortality (Eastern) (Table 4.1). Four provinces (North-Central, Central, Sabaragamuwa, and Southern) had mortality rates of about 20 or more deaths per 1,000 live births. Likewise, there were large provincial variations in the rate of infant mortality reduction between 1991 and 1996. In the North-Western province, infant mortality rates fell by an average of 7.6% annually, while infant mortality rates in the North-Central province actually increased by 8.5% annually. Five provinces (Southern, Northern, North -Central, Uva and Sabaragamuwa) saw an increase in infant mortality during 1991-96.

Table 4.1: Infant Mortality Rate by Province of Registration (per 1,000 live births), 1991-96

Province	1991	1993	1996
Western	20.7	19.5	17.2
Central	24.9	23.0	23.2
Southern	15.1	15.2	19.7
Northern	8.5	12.3	11.7
Eastern	9.3	7.3	6.9
North-Western	19.2	14.3	12.9
North-Central	16.6	15.4	25.0
Uva	11.9	12.6	15.0
Sabaragamuwa	19.8	15.8	20.7

Source: Registrar General's Dept.

4.7 District-level variations in infant mortality are even larger than provincial variations (Table 4.2). In 1996, infant mortality in the district with the highest infant mortality rate in Sri Lanka (Anuradhapura) was almost 20 times as high as infant mortality in the district with the lowest infant mortality rate (Trincomalee). Seven districts – Colombo, Kandy, Nuwara Eliya, Galle, Matara, Anuradhapura, and Ratnapura – had infant mortality rates that were greater than 20 deaths per 1,000 live births. The district-level data also show very wide variations in the rate of infant mortality reduction between 1991 and 1996, with 13 districts (out of a total of 25) showing an increase in infant mortality.

Table 4.2: Infant Mortality Rate by District of Registration (per 1,000 live births), 1991-96

District	1991	1993	1996
Colombo	27.0	24.7	21.6
Gampaha	9.9	10.9	11.2
Kalutara	16.6	14.8	10.6
Kandy	26.8	25.9	26.7
Matale	11.5	8.3	10.6
Nuwara Eliya	28.9	27.5	23.9
Galle	13.0	17.7	21.8
Matara	23.2	17.8	24.9
Hambantota	6.5	5.0	3.3
Jaffna	10.2	15.3	17.5
Kilinochchi	3.9	8.6	10.8
Mannar	41.7	11	7.2
Vavuniya	4.5	9.7	8.4
Mullaitivu	4.3	5.7	7.8
Batticaloa	12.4	10.2	12.6
Amparai	8.0	5.1	5.4
Trincomalee	5.6	6.6	1.4
Kurunegala	19.2	15.7	14.1
Puttalam	19.4	11.6	10.9
Anuradhapura	21.0	14.3	27.5
Polonnaruwa	6.7	17.7	18.2
Badulla	14.6	15.6	19.2
Moneragala	5.3	5.8	4.8
Ratnapura	22.6	18.6	22.7
Kegalle	14.3	10.8	17.1

Source: Registrar General's Department.

Correlates of District Variations in Infant Mortality

4.8 An interesting question is what explains the large inter-district variations in infant mortality observed in Table 4.2. To some extent, the differences could be explained by variations in living standards across districts. Ratnapura, Nuwara Eliya and Matara are relatively poor districts and have high infant mortality rates. On the other hand, Gampaha and Kalutara are relatively prosperous districts having low infant mortality rates. However, living standards alone cannot explain the entire variation in infant mortality. For instance, Monerangala has one of the lowest infant mortality rates in the country despite being the poorest district, while Colombo has a relatively high infant mortality rate given its affluence.

4.9 Figure 4.5 plots the infant mortality rate in 1996 against the mean monthly consumption expenditure per capita in 1995-96 across districts for which both data series are available. In fact, a counter-intuitive weakly positive association is observed between infant mortality and district living standards, largely because of the higher-than-expected infant

mortality rate in the Colombo district. However, not much can be made of this association, since it does not control for any other factors that may also influence infant mortality.

Figure 4.5: Infant Mortality Rate (1996) and Mean Monthly Consumption Expenditure per capita (1995-96) across Districts

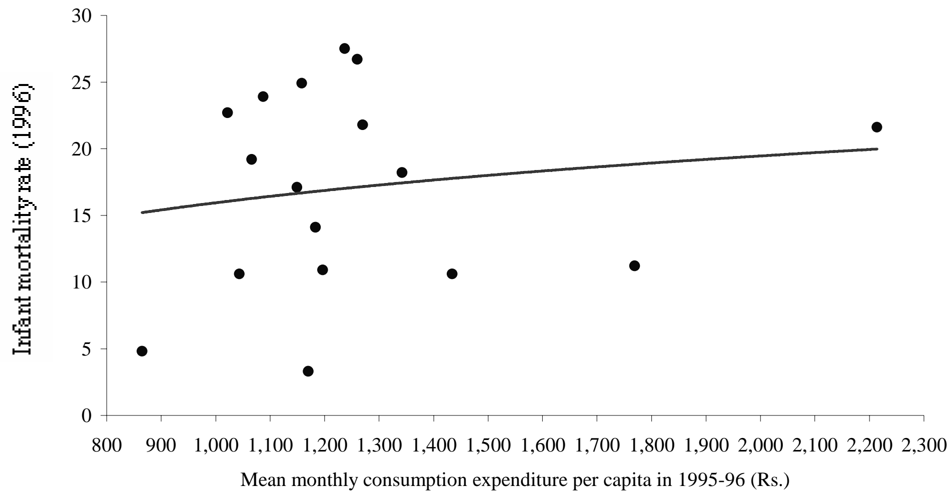
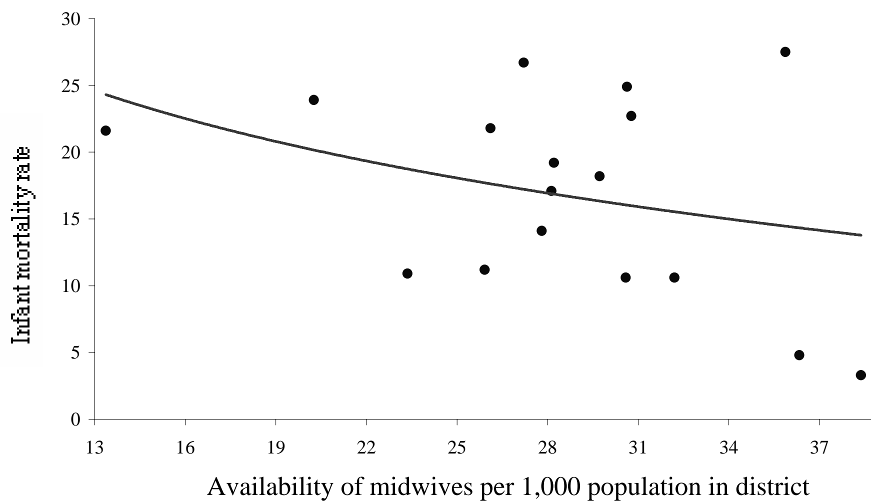


Figure 4.6: Infant Mortality Rate and Availability of Midwives per 1,000 Population across Districts



4.10 Variations in health infrastructure across districts likely explain some of the inter-district variations in infant mortality that cannot be explained by living standard variations. The experience of other countries, as well as of Sri Lanka itself (see Pathmanathan *et al.* 2003), has demonstrated the importance of having well-trained health professionals, birth attendants and midwives at the local level for safe deliveries and neonatal health. For the most part, it is these health professionals that are responsible for the implementation of the

government's vertical health program at the local levels. These professionals are also the first points of contact with the health system for the vast majority of people living in the rural areas.

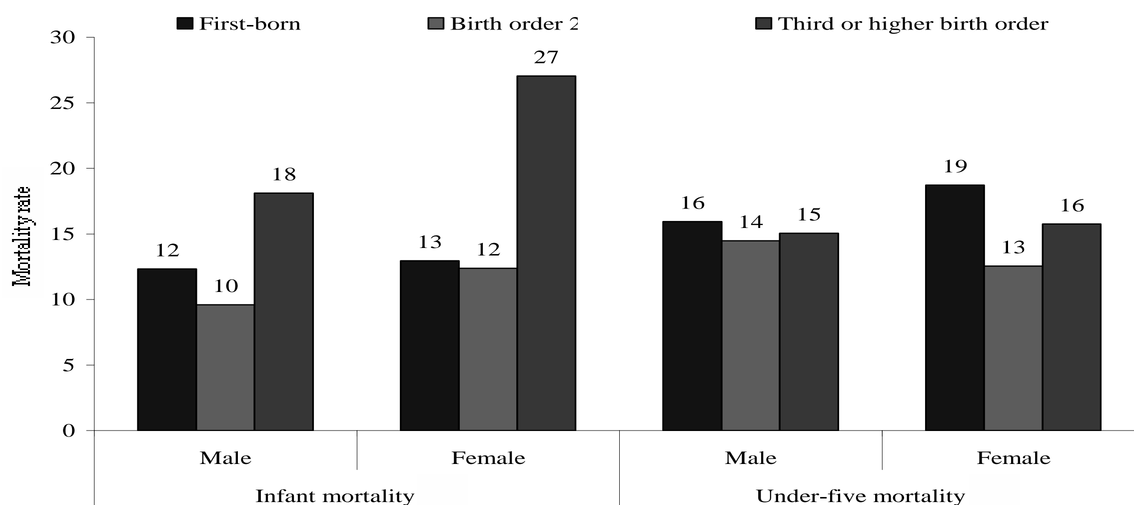
4.11 Figure 4.6, which plots the district infant mortality rate with the number of midwives per 1,000 population in each district shows a strong inverse association between the two variables. The data seem to indicate that a one-percent increase in the number of midwives per 1,000 population in a district is associated with a one-percent decrease in infant mortality in that district.

Correlates of Household Variations in Infant Mortality

4.12 Even though the overall level of infant and under-five mortality is low in Sri Lanka, it may be useful from a policy perspective to understand whether high levels of infant and under-five mortality are associated with specific household characteristics. Table 4.3 tabulates infant and under-five mortality by a variety of household characteristics, including maternal schooling, female headship, and access to infrastructure.

4.13 **Sex and Birth Order**. On average, infant mortality rates for females are about 20% higher than those for males, but under-five mortality rates are almost identical. Excess infant mortality among females is observed throughout South Asia, and reflects parental discrimination against their female children in the allocation of nutrition and medical care. The higher infant mortality for females than for males is surprising in Sri Lanka in view of the high levels of adult female literacy and extensive access to medical facilities and care through much of the country.

Figure 4.7: Infant and Under-Five Mortality Rates, by Birth Order and Sex, 2000



4.14 Another child-specific factor that increases the risk of infant death is birth order. Higher birth order children are much more likely to die prematurely than lower birth order children (Figure 4.7). What is interesting to note from the figure, however, is that birth order and sex interact with each other to produce the highest risk of premature death for higher-order girls. For instance, the infant mortality rate among girls of birth order 3 or higher is as high as 27 deaths per 1,000 live births, as compared to an infant mortality rate of only 13 deaths per 1,000 live births among first-born daughters. The comparable rates for boys are 18 and 12 deaths per 1,000 live births. Thus, while all higher-order children face a greater risk of premature death, the risk is particularly large for higher-order girls. Again, these patterns are widely observed in other parts of Asia (Pakistan, India and Bangladesh), but their presence in Sri Lanka is surprising in view of the high-levels of female literacy and good access to health facilities for much of the population.

4.15 **Mother's schooling**. There is a very large literature from around the world that demonstrates the significance of mother's schooling to low mortality outcomes among children. The pathways from mother's schooling to lower mortality rates include, but are not limited to, greater likelihood of obtaining pre- and ante-natal care, better nutrition during pregnancy (and hence lower likelihood of low child birthweight), seeking prompt medical care at the first sign of a child's illness, and more appropriate breast-feeding and nutritional supplementary practices. The DHS 2000 data from Sri Lanka do not suggest a monotonic association between mother's schooling and infant and under-five mortality rates (Table 4.3). Indeed, the main difference in mortality outcomes occurs among mothers with no or primary schooling and those with post-primary schooling. For instance, the latter have an infant mortality rate of 9 deaths per 1,000 live births while the former have an infant mortality rate which is nearly two and a half times higher (24 deaths per 1,000 live births).

4.16 **Mother's age at child's birth**. Another maternal variable that has a strong bearing on the survival prospects of a child is the mother's age at the time of the child's birth. As is well-established in the medical literature, the risk of complicated deliveries is high among very young and older mothers. The DHS data indicate that the risk of infant or child death among mothers who give birth past the age of 40 years is 3-4 times the risk among mothers who give birth between the ages of 21 and 40 years (Table 4.3). Likewise, infant and under-five mortality rates are nearly two times as high when the mother is 20 years old or younger than when she is 21-40 years of age.

4.17 **Mother's vaccination**. The DHS obtained data on whether mothers were vaccinated against rubella disease. Women of child-bearing age are usually immunized with this vaccine to prevent congenital rubella syndrome, which can cause fetal death or multiple birth defects that greatly increase the risk of death of an infant. Only about half of the mothers in Sri Lanka appear to be immunized against rubella. The data suggest large benefits – in terms of reduced mortality outcomes among children – when the mother has been immunized against rubella (Table 4.3). For instance, the children of mothers who were not immunized against rubella were nearly twice as likely to die as children born to mothers who had received the rubella vaccine.

Table 4.3: Infant and Under-Five Mortality, by Various Characteristics, 2000

Variable	Value	Infant mortality	Under-five mortality
Mother's schooling	None	10.2	13.8
	1-5 years	27.7	26.4
	6-10 years	9.4	11.2
	GCE O/L or equivalent	9.0	15.6
	GCE A/L or equivalent	9.0	16.0
	College or university	n.a.	15.9
Mother's schooling	None or 1-5 years	23.8	23.7
	6 or more years	9.0	13.2
Mother's age at child's birth	< 21 years	20.7	26.5
	21 - 40 years	11.0	13.6
	> 40 years	39.6	30.8
Whether mother vaccinated against rubella during pregnancy?	No	15.8	20.8
	Yes	9.3	10.7
Sex of child	Female	13.9	15.7
	Male	11.6	15.2
Birth weight of child	<= 2,500 gms.	50.9	50.9
	> 2,500 gms.	7.8	21.3
Head of household is:	Female	15.3	20.6
	Male	12.1	14.3
Access to electricity in house?	Yes	7.0	11.6
	No	25.7	23.8
Access to piped drinking water (private or public tap)?	No	11.9	14.6
	Yes	14.9	17.9
Access to sealed or flush toilet?	Yes	7.3	11.4
	No	29.3	26.5

Source: Authors' calculations from DHS 2000 data.

4.18 **Birth weight**. Birth weight has been universally established to be a very important risk factor in neonatal deaths. Reasons for low birth weight include preterm births, multiple births (twins, triplets, etc.), and poor nutrition and medical problems of the mother. While advances in newborn medical care have greatly reduced the risk of infant deaths associated with low birth weight in developed countries, low birth weight continues to remain a very high risk factor for mortality in developing countries. The DHS data indicate that low-birth weight babies (i.e., babies born with a weight of 2,500 grams or less) are nearly seven times more likely to die during infancy than normal-weight babies (Table 4.3). Interestingly, the data also show that if low birth weight babies survive infancy, their risk of subsequent death (during ages 1-5 years) is no different than that of normal-weight babies.

4.19 **Household headship**. Surprisingly, the sex of a household head is associated with the risk of mortality for an infant or child. In households headed by males, infant and child mortality rates are 12.1 and 14.3 deaths per 1,000 live births, respectively, while the

comparable rates in female-headed households are 15.3 and 20.6 deaths per 1,000 live births, respectively (Table 4.3).

4.20 **Access to infrastructure**. Availability of electricity in a household is associated very strongly with infant and under-five mortality. In households having no access to electricity, infant mortality is more than three times as high (25.7 versus 7 deaths per 1,000 live births) and under-five mortality is more than two times as high (23.8 versus 11.6 deaths per 1,000 live births) as in households having access to electricity (Table 4.3). Likewise, access to a sealed or flush toilet is also associated strongly with infant and under-five mortality rates. However, access to piped water has a puzzling perverse (positive) association with infant and under-five mortality.

Role of Contextual and Policy Variables

4.21 The roles of social values and public action in bringing down infant and child mortality rates in Sri Lanka cannot be discounted. A pervasive influence on social development in Sri Lanka has been the traditional value system which gave priority to the health and schooling of both men and women. Traditionally, children were accorded a special place in society, and with Sri Lanka having reached the replacement level of fertility, the value that society places on children has further increased. The decision of the government, as early as 1945, to provide free schooling at all levels in an extensive network of highly-accessible schools has resulted in a society with high literacy rates among both men and women.

4.22 In turn, the high literacy rates have increased individual demand for health-care services. Data from various household surveys and the Consumer Finance survey of 1996 show that the vast majority – 88% – of individuals experiencing an illness obtained treatment from allopathic (Western) hospital outpatient facilities or private clinics. Such high rates of health utilization are uncommon in South Asia, where most illness episodes go untreated or are self-treated. The DHS 2000 reports that 72% of children who reported a diarrheal episode in the two weeks prior to the survey had been taken to a medical practitioner. All households reported that sick children were brought to a hospital within 2-3 days of the onset of an illness episode, unless they resided in very remote and uncleared areas of the North-Eastern Province, where night-time transport continues to be a problem. Thus, Sri Lanka is characterized by relatively high levels of health care utilization for a country at its income level (Hsiao 2000). Outpatient physician contacts are high for a developing country and inpatient utilization rates are among the highest in the world.

4.23 Of course, the high rates of health service utilization would not have been possible had there not been an extensive network of health facilities throughout the country. Right from the early days of Independence, there was a concerted effort by the government to diffuse health services throughout the country. Already in 1975, Simeonov (1975) reported that a health care facility could be found no further than 0.8 miles from any home and a fee-exempt western type of health facility within 3 miles of any home. The access to health services has improved further over time. Within each district, health institutions are arranged in a hierarchical pattern, according to the level of sophistication of services offered, and all

hospitals have out-patient services. At present, medical officers are available at the lowest level of the hierarchy (rural hospitals) and services of specialist pediatricians are available at the level of base hospitals and above. The Lady Ridgeway Hospital for children, the apex institution for pediatric care, was built more than a century ago and continues to serve the children of the country. Thus, Sri Lanka has achieved relatively high levels of access to modern allopathic health facilities. In more recent year, midwives have been trained to recognize and manage dehydration, recognize acute respiratory problems, and assess the necessity of admitting a sick child to a hospital. In the rural areas, most communities have come to accept the Public Health Midwife as a health professional in her own right. Her advice is often sought by parents on child health problems and these skills are very useful in early referral of infants and children with respiratory illness and other health problems.

Multivariate Analysis

4.24 The problem with the correlates of infant and under-five mortality discussed above is that they do not control for the contemporaneous associations of mortality with other factors. To address this problem, we have estimated multivariate models of infant and under-five mortality using unit record data from the DHS 2000.[2] The estimation results are reported in Annex Table 4, while only the broad findings of the empirical analysis are discussed here.

4.25 After controlling for the other factors associated with infant and under-five mortality, twin births are observed to have a significantly higher (more than two times) risk of premature death than normal births. The results also demonstrate the higher risk of infant death for higher-order girls relative to lower-order boys and girls as well as to higher-order boys.

4.26 Access to piped water has a puzzling positive association with both infant and under-five mortality, although access to sealed toilets has the predicted negative association (although only for infant, not under-five, mortality). The age of the mother at the time of a child's birth has a strong, negative association with the risk of premature death for the child. In addition, the mother's immunization against rubella also has a significant inverse association with the risk of under-five (although not infant) mortality. Finally, community living standards, proxied by mean monthly consumption expenditure per capita in the district of residence, have a strong inverse association with both infant and under-five mortality. (It is likely that mean consumption per capita in a district proxies for a wide range of variables, including household affluence, improvements in community hygiene, and better physical and health infrastructure.) Indeed, the point estimates suggest that a one-percent increase in mean income (or, more appropriately, consumption) in a community is associated with more than two percent declines in both infant and under-five mortality.

Alternative Simulations to 2015

4.27 Based on the multivariate probit model estimated above, we have undertaken simulations of the infant and under-five mortality rate in Sri Lanka to 2015 under two

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[2] Since the dependent variables are dichotomous (viz., whether or not a child dies within 12 and 60 months of its birth), the models have been estimated by the maximum-likelihood probit method.

assumptions – (i) that sanitation access expands from 80% to 95% by 2015, and (ii) mean district monthly consumption expenditure per capita increases annually at the rate of 3% to 2015. These assumptions are merely illustrative, and meant to simulate the likely reduction in infant and under-five mortality under one possible scenario.

4.28 Figure 4.8 shows the projected trajectory of the infant mortality rate under this scenario. The infant mortality rate is observed to decline very modestly – by only one death per 1,000 live births – with expanded sanitation access. However, improvements in living standards are associated with very large declines in infant mortality. The infant mortality rate declines from a level of 13.9 per 1,000 live births to virtually zero by 2015. Since the MDG level is 6.33 deaths per 1,000 live births, the country is projected to attain the infant mortality MDG before 2009.

4.29 Thus, the simulation confirms the results of the simple trend analysis conducted earlier. The results thus suggest that it should be possible for Sri Lanka to attain the infant mortality-related MDG with strong economic growth and improved physical and health infrastructure.

Figure 4.8: Projected Infant Mortality Rate to 2015 (graph shows cumulative effect of each intervention)