INFANT AND CHILD MORTALITY 9

Jeremiah M. Sullivan, Auken Mashkeev, and Adyl Katarbayev

9.1 Background and Assessment of Data Quality

This chapter presents information on mortality among children under five years of age. The rates shown provide information on mortality levels, time trends, and differentials between population subgroups. Mortality differentials are useful to agencies providing health services because they identify population subgroups in which the risk of dying in early childhood is high.

The mortality rates presented in this chapter are expressed as deaths per 1,000 live births, except in the case of child mortality rates, which are expressed as deaths per 1,000 children surviving to age one. Rates are presented for the following age intervals:

- Neonatal mortality (NN): the probability of dying within the first month of life.
- Postneonatal mortality (PNN): the difference between infant and neonatal mortality.
- Infant mortality ($_1q_0$): the probability of dying between birth and the first birthday.
- Child mortality ($_4q_1$): the probability of dying between exact ages one and five.
- Under-five mortality ($_5q_0$): the probability of dying between birth and the fifth birthday.

The 1999 KDHS questionnaire included a reproductive history in which questions were asked about each of a woman's pregnancies. Respondents were asked to report their pregnancy outcomes in terms of standard international definitions (WHO, 1993). *Live birth* was defined as any birth, irrespective of the duration of pregnancy, that, after separation of the infant from the mother, showed any signs of life such as breathing, beating of the heart, or movement of voluntary muscles. *Infant death* was defined as the death of a live-born child under one year of age.

For each live birth reported in the pregnancy history, questions were asked about the date of birth (month and year), sex, survivorship status, and current age (for surviving children) or age at death (for deceased children). Mortality estimates for specific periods preceding the survey were calculated from this information.

The accuracy of mortality estimates from the 1999 KDHS depends on the sampling variability of the estimates and on non-sampling error (i.e., the completeness and accuracy with which births and deaths are reported and recorded). Sampling variability is discussed in the next section of this chapter. Typically, the most serious source of non-sampling error in a retrospective survey is underreporting of both the birth and the death of children who do not survive (United Nations, 1982). Such underreporting results in underestimated mortality rates.

Underreporting of deceased children is usually most severe for deaths that occur in early infancy (i.e., in the neonatal period). Underreporting of neonatal deaths results in an abnormally low ratio of neonatal mortality to infant mortality. In retrospective surveys, underreporting of early infant deaths is usually more common for births occurring long before the survey than for births occurring close to the survey date. Hence, it is useful to examine the ratios of neonatal to infant mortality for different retrospective periods.

Neonatal and infant mortality rates from the 1999 KDHS are shown in Table 9.1. The value of the ratio of neonatal mortality to infant mortality for the periods 1984-89, 1989-94, and 1994-99 are 0.53, 0.50, and 0.54, respectively. In countries known for having complete and accurate mortality data at a level of infant mortality between 50 and 60 per 1000 (a range which includes the infant mortality rates estimated by the 1999 KDHS), the value of this ratio is typically between 0.50 and 0.60.[1] The ratios for Kazakhstan are in this range. Accordingly, this inspection of the data does not suggest substantial underreporting of neonatal deaths.[2]

9.2 Levels and Trends in Early Childhood Mortality

Table 9.1 shows infant and child mortality estimates from the 1999 KDHS. For the five years immediately preceding the survey (1994-99), the infant mortality estimate was 62 per 1,000 births. The estimates of neonatal and postneonatal mortality were 34 and 28 per 1,000 births, respectively. The estimate of child mortality (exact age 1 to exact age 5) was much lower: 10 per 1,000. The overall under-five mortality rate for the period was 71 per 1,000.

Table 9.1 Infant and child mortality

Infant and child mortality rates by five-year periods preceding the survey, Kazakhstan 1999

Years preceding survey	Calendar period[a]	Neonatal mortality (NN)	Postneonatal mortality (PNN)	**Infant mortality ($_1q_0$)**	Child mortality ($_4q_1$)	**Under-five mortality ($_5q_0$)**
0-4	1994-99	33.6	28.3	61.9	10.1	71.4
5-9	1989-94	24.6	25.1	49.7	7.3	56.7
10-14	1984-89	29.3	25.7	54.9	11.8	66.1

[a] Periods are from midyear to midyear: 1994-99 is mid-1994 to mid-1999.

For the 15-year period preceding the survey, infant mortality declined 1984-89 (55 per 1,000) and 1989-94 (50 per 1,000) and then increased 1994-99 (62 per 1,000). The same pattern is evident in the estimates of child mortality: declines from 12 per 1,000 (1984-89) to 7 per 1,000 (1989-94) and then increases to 10 per 1,000 (1994-99). While these statistics evidence improving mortality conditions from the late 1980s to the early 1990s and deteriorating conditions from the early 1990s to the late 1990s, the true extent of mortality change may differ from the estimated rates because of sampling variability.[3]

[1] For example, see the neonatal and infant mortality rates for Hungary (1955), Italy (1955), and Puerto Rico (1957) in the *U.N. Demographic Yearbook, 1961* and for Portugal (1968) in the *U.N. Demographic Yearbook, 1974*.

[2] An examination of the ratio of the neonatal to the infant mortality rate can detect gross underreporting of events, but this indicator is not sufficiently sensitive to detect underreporting that is not severe. Thus, while capable of detecting severe event underreporting, this approach cannot confirm that events are completely and accurately reported.

[3] The mortality rates for the 1999 KDHS are based on data provided by a sample of 4,800 women age 15 to 49 and are subject to sampling variability. Of interest here is the 95-percent confidence interval for the estimated rates. For example, the estimated infant mortality rate for 1994-99 (62 per 1,000 live births) has a broad 95-percent confidence interval (47 to 76 per 1,000) (see Appendix B). Thus, the point estimate of 62 per 1,000 cannot be considered exact, and the true rate could be higher or lower.

Additional evidence that mortality levels have increased recently is provided by comparison with mortality estimates from the 1995 KDHS. The 1995 survey estimated an infant mortality rate of 40 per 1,000 for 1990-95. The 1999 survey estimate of 62 per 1,000 (1994-99) represents an increase of 55 percent. The sampling error associated with each of these estimates is substantial and precludes the absolute conclusion that mortality risks have increased. Nevertheless, the magnitude of the difference between the estimates strongly suggests some increase in mortality risks in the past five years.[4]

9.3 Infant Mortality Rates from the Agency on Health

Kazakhstan has a long history of demographic and health data collection. For births and infant deaths, the Agency on Health (AOH) collects data through a system in which reports from local health officials, which primarily document events occurring in health facilities, are forwarded up the reporting hierarchy to the *oblast* level and to the AOH. Official government statistics on infant mortality are published in annual statistical reports.

The protocols used by health officials for collecting information on births and infant deaths are those established during the time of the former Soviet Union. The definitions of events in those protocols differ from the definitions that are recommended by the World Health Organization. For classifying events as live births and infant deaths, the most important definitional difference is for pregnancies terminating at a gestation age of less than 28 weeks. The Soviet protocols classify such pregnancies as miscarriages (even if signs of life are present at the time of delivery) unless the child survives for seven days.[5] Alternatively, WHO defines a birth showing any sign of life (i.e., breathing, beating of the heart, or movement of voluntary muscles) as a live birth, irrespective of the gestation age at pregnancy termination (WHO, 1993). A less important difference in definition occurs for pregnancies terminating at 28 or more weeks of gestation. The Soviet system classifies such events as live births if breathing is present at delivery and otherwise as still births. WHO defines these events as live births if any sign of life is present at delivery and otherwise as stillbirths.

The definitional differences mean that some events classified as live births and infant deaths in the 1999 KDHS would be classified as miscarriages and stillbirths according to AOH protocols. As a result, infant mortality rates, and particularly neonatal mortality rates, reported by the 1999 KDHS can be expected to be greater than the estimates reported by AOH.

Table 9.2 shows infant mortality rates based on the AOH data for single calendar years from 1983 to 1997. Also shown are the average rates for the periods 1984-88, 1989-93, and 1994-97. Overall, the AOH rates show a modest decline between 1984-88 (30 per 1,000) and 1989-93 (27 per 1,000) and essentially no change between 1989-93 and 1994-97 (26 per 1,000).

There are two important differences between the infant mortality rates of the AOH and the 1999 survey (Figure 9.1). First, the AOH's rates are approximately 50 percent lower than the survey estimates. As suggested above, this discrepancy arises to some extent from definitional differences. Second, the trends of the two sets of estimates differ; the AOH's rates show no change between the

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[4] It should also be noted that there is a significant difference between the 1995 KDHS infant mortality estimate for 1990-95 (40 per 1,000) and the 1999 KDHS estimate for 1989-94 (50 per 1,000). An explanation for this difference is not known at this time. However, it is more likely that the 10-point difference is due to sampling error than is the 22-point difference between the 1990-95 estimate from the 1995 survey (40 per 1,000) and the 1994-99 estimate from the 1999 survey (62 per 1,000).

[5] In cases where the gestation age is unknown, fetuses that weigh less than 1,000 grams or measure less than 35 centimeters in length are considered immature and are classified as miscarriages.

Table 9.2 AOH infant mortality rates

Infant mortality rates reported by the Agency on Health (AOH), Kazakhstan 1983-97

Year	Infant mortality rate (per 1,000)
1997	24.9
1996	25.4
1995	27.0
1994	27.1
1993	28.0
1992	26.2
1991	27.4
1990	26.4
1989	25.9
1988	29.2
1987	29.4
1986	29.0
1985	30.1
1984	30.2
1983	31.2
Mean 1994-97	26.1
Mean 1989-93	26.8
Mean 1984-88	29.6

Sources: 1983-93, Church and Koutanev, 1995; 1994-97, UNDP, 1998

recent periods (i.e., 27 per 1,000 for 1989-93 and 26 per 1,000 for 1994-97), while the 1999 KDHS estimates show mortality increases between those periods (i.e., 50 per 1,000 for 1989-94 and 62 per 1,000 for 1994-99).

A thorough investigation of the difference between the two sets of estimates is beyond the scope of this report. However, such an investigation would need to consider definitional differences between the AOH and the 1999 KDHS and the degree to which specific subintervals of infancy contribute to the overall difference in infant mortality estimates. Rates from both the AOH and the survey can be calculated for the early neonatal period (0-6 days), the late neonatal period (7-28 days), and the postneonatal period (29-365 days). Reviewing these rates is important because only differences contributed by the early neonatal period can be ascribed to definitional differences between systems. The sampling variability of the survey's estimates would also need to be considered.

9.4 Socioeconomic Differentials in Childhood Mortality

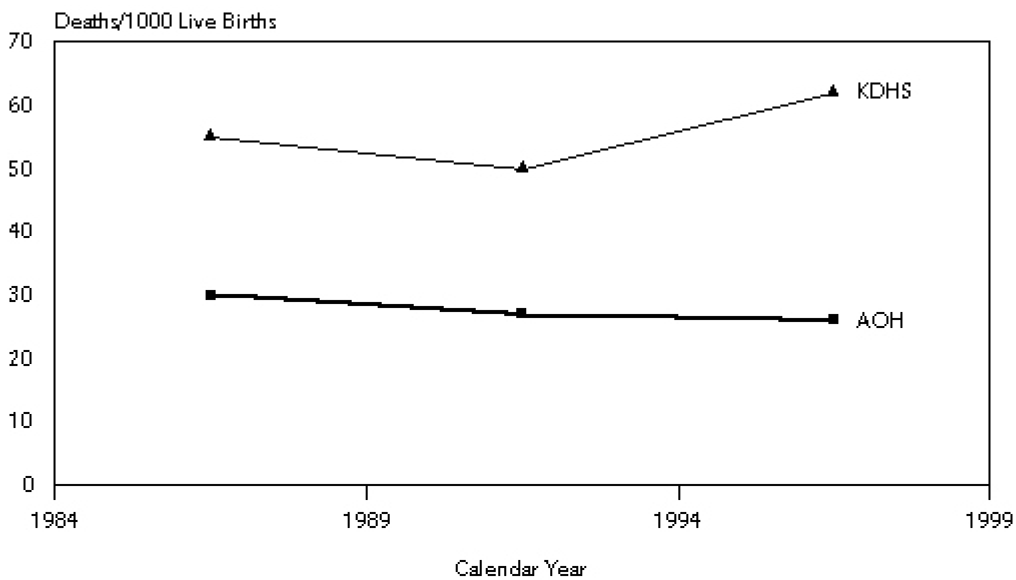
Table 9.3 shows infant and child mortality by selected socioeconomic variables (residence, mother's education, and mother's ethnicity). The mortality rates are presented for the 10-year period preceding the survey. A 10-year period is used to calculate the rates for population subgroups to reduce the sampling variability of the estimates.

The rates for residence display an expected pattern that agrees with the pattern found in most countries. The mortality estimates for rural areas are greater than the estimates for urban areas at all ages. The rural estimate of infant mortality (64 per 1,000) exceeds the urban estimate (44 per 1,000) by 46 percent. The rural estimate of under-five mortality (73 per 1,000) also exceeds the urban estimate (50 per 1,000) by 46 percent.

Mortality estimates by mother's education also display the expected differentials. The rates of infant mortality, for children of women with a primary or secondary education (57 per 1,000) or secondary-special education (56 per 1,000) exceed the rate for children of women with a higher education (47 per 1,000).

Pronounced mortality differentials exist by mother's ethnicity. The infant mortality rate for children of Kazakh ethnicity (58 per 1,000) exceeds the rate for children of Russian ethnicity (40 per 1,000) by 46 percent. The estimate of under-five mortality for children of Kazakh ethnicity (68 per 1,000) is greater than the estimate for children of Russian ethnicity (44 per 1,000) by 56 percent.

Figure 9.1 Trends in Infant Mortality Agency on Health and KDHS



KDHS 1999

Table 9.3 Infant and child mortality by background characteristics

Infant and child mortality rates for the 10-year period preceding the survey, by selected socioeconomic characteristics, Kazakhstan 1999

Background characteristic	Neonatal mortality (NN)	Postneonatal mortality (PNN)	**Infant mortality ($_1q_0$)**	Child mortality ($_4q_1$)	**Under-five mortality ($_5q_0$)**
Residence					
Urban	25.5	18.2	43.7	6.7	50.1
Rural	30.7	33.0	63.8	10.1	73.2
Education					
Primary/secondary	28.0	29.0	57.0	11.0	67.4
Secondary-special	30.2	26.0	56.2	6.6	62.5
Higher	24.8	22.3	47.1	8.2	55.0
Ethnicity					
Kazakh	26.5	31.7	58.2	10.4	68.0
Russian	33.5	6.4	39.8	3.8	43.5
Other	30.4	28.7	59.0	6.6	65.2
Total	28.4	26.5	54.9	8.5	63.0

9.5 Demographic Differentials in Childhood Mortality

The relationship between early childhood mortality and selected demographic variables is shown in Table 9.4. As was the case with the socioeconomic differentials, the rates are shown for the 10-year period preceding the survey.

In Kazakhstan, as in almost all populations, the infant mortality rate for male children (62 per 1,000) exceeds the rate for female children (47 per 1,000). The child mortality rate (ages one to five) for males (11 per 1,000) also exceeds the rate for females (6 per 1,000).

The relationship between mortality and birth order indicates that births of order four or higher are at greater risk of dying than births of lower orders.

A clear association is indicated between mortality risk and the length of the preceding birth interval. The risk of dying in the first year for births occurring less than two years after a previous birth (83 per 1,000) is substantially greater than for births occurring after an interval of 2-3 years (46 per 1,000) or an interval of four or more years (40 per 1,000). This relationship suggests that some reduction in mortality would result if the proportion of births occurring after a short birth interval.

Table 9.4 Infant and child mortality by demographic characteristics

Infant and child mortality rates for the 10-year period preceding the survey, by selected demographic characteristics, Kazakhstan 1999

Demographic characteristic	Neonatal mortality (NN)	Postneonatal mortality (PNN)	**Infant mortality ($_1q_0$)**	Child mortality ($_4q_1$)	**Under-five mortality ($_5q_0$)**
Sex of child					
Male	32.6	29.5	62.0	10.6	72.0
Female	24.0	23.3	47.3	6.4	53.4
Age of mother at birth					
<20	(52.2)	(27.3)	(79.5)	(4.8)	(83.9)
20-29	24.4	26.5	50.9	10.3	60.7
30-39	25.7	24.6	50.3	5.4	55.5
Birth order					
1	29.7	21.4	51.0	11.2	61.6
2-3	26.2	25.6	51.7	5.2	56.7
4+	30.6	32.2	62.8	15.5	77.3
Previous birth interval					
<2 yrs	42.3	40.3	82.6	5.8	87.9
2-3 yrs	14.8	30.9	45.8	9.0	54.3
4+ yrs	23.5	16.6	40.1	6.5	46.3
Total	28.4	26.5	54.9	8.5	63.0

( ) Rate based on 200-499 births

9.6 High-Risk Fertility Behavior

Previous research has shown a strong relationship between the fertility patterns of women and the mortality risks of their children (Sullivan et al., 1994). Typically, mortality risks are greater for children who are born to mothers who are too young or too old, who are born after a short birth interval, or who have a high birth order. In this analysis, a mother is classified as *too young* if she is less than 18 years of age, and *too old* if she is older than 34 years of age. A *short birth interval* is defined as a birth occurring within 24 months of the previous birth, and a child is of *high birth order* if the mother had already given birth to three or more children.

Table 9.5 shows the distribution of children born in the five years before the survey by risk category. While first births to women age 18 to 34 are considered an unavoidable risk, they are included in the analysis and are shown as a separate risk category.

Table 9.5 High-risk fertility behavior

Percent distribution of children born in the five years preceding the survey by category of elevated risk of dying, and the percent distribution of currently married women at risk of conceiving a child with an elevated risk of dying, by category of increased risk, Kazakhstan 1999

Risk category	Births in 5 years preceding the survey: Percentage of births	Births in 5 years preceding the survey: Risk ratio	Percentage of currently married women[a]
Not in any high-risk category	28.1	1.0	32.3[b]
Unavoidable risk category			
First birth between ages 18 and 34	33.2	1.3	5.3
Single high-risk category			
Mother's age <18	2.2	1.2	0.2
Mother's age >34	3.8	0.2	35.9
Birth interval <24 months	15.8	1.5	7.3
Birth order >3	8.2	1.1	2.5
Subtotal	30.1	1.2	45.9
Multiple high-risk category			
Age >34 & birth interval <24 mo.	0.4	7.9	0.3
Age >34 & birth order >3	4.0	0.8	14.2
Age >34 & birth interval <24 & birth order >3	0.4	4.8	0.7
Birth interval <24 & birth order >3	3.9	2.4	1.3
Subtotal	8.6	2.0	16.5
In any avoidable high-risk category	38.7	1.4	62.4
Total	100.0	-	100.0
Number of births	1,449	-	3,018

Note: Risk ratio is the ratio of the proportion dead of births in a specific high-risk category to the proportion dead of births not in any high-risk category.
[a] Women were assigned to risk categories according to the status they would have at the birth of a child, if the child were conceived at the time of the survey: age less than 17 years and 3 months, age older than 34 years and 2 months, latest birth less than 15 months ago, and latest birth of order 3 or higher.
[b] Includes sterilized women

Column 1 of Table 9.5 shows that in the five-year period before the survey, 30 percent of births were in a single high-risk category and 9 percent were in a multiple high-risk category.

Column 2 of the table shows risk ratios for avoidable high-risk births relative to births not having any high-risk characteristics. Overall, the risk ratio for births in a single high-risk category is 1.2 (20 percent higher than births in the no high-risk category). For births with multiple high-risk characteristics, the risk ratio is 2.0 (elevated by 100 percent).

Column 3 of Table 9.5 looks to the future and addresses the question, How many currently married women have the potential for having a high-risk birth? The results were obtained by simulating the risk category into which a birth to a currently married woman would fall if she were to become pregnant at the time of the survey. For example, a woman who was 37 years old at the time of the survey and had three previous births, the last of which occurred three years earlier, would be classified in the multiple high-risk category for being too old (35 or older) and at risk of having a high order birth (greater than 3).

Overall, 62 percent of currently married women have the potential to give birth to a child with an elevated risk of dying. Seventeen percent of women have the potential to give birth to a child with multiple high-risk factors.