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**HOW HIGH IS INFANT MORTALITY IN
CENTRAL AND EASTERN EUROPE
AND THE CIS?**

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Abstract

This paper examines the measurement of infant mortality in the countries of Central and Eastern Europe and the Commonwealth of Independent States. There are worrying indications that official infant mortality counts, based on administrative data, may understate the true gravity of the problem in 15 countries in the region, including 11 out of 12 CIS countries, and four countries in South Eastern Europe. In the case of eight CIS countries in the Caucasus and Central Asia plus Romania, the evidence is strongest, not least because surveys that allow independent estimation of infant mortality have been carried out there. In the case of the remaining six countries, the evidence is more circumstantial, and based on inconsistencies within the official data themselves, combined with information on how live births are defined. However, the paper also finds that surveys are rather blunt instruments, and that the confidence intervals that surround estimates from these surveys are often large. Further work needs to be done, not only to improve the collection of official statistics on births and infant deaths in many countries across the region, but also to improve the effectiveness of surveys as a measurement tool.

Introduction

As the communist period recedes further in time, it is now clear that many of the 27 post-communist countries of Central and Eastern Europe and the Commonwealth of Independent States face continued challenges to improve the well-being of their citizens. Yet even as national incomes have fallen and poverty has increased, official data in nearly every CEE/CIS country suggest that infant mortality rates decreased through the 1990s, in many cases to within shouting distance of rates in Western Europe. Georgia, for example, posted an official infant mortality rate of 12 deaths per 1,000 live births in 2001, similar to that in Latvia, and only 5 deaths per 1,000 more than in Portugal. Is this credible?

For many countries, the short answer is 'no'. This paper identifies 15 countries – 11 out of 12 CIS countries, plus 4 countries in South Eastern Europe – where official infant mortality rates appear to understate the true picture. In some of these countries (including Georgia), survey data suggest that real rates may be more than twice the official figure. This is a worrying finding. The infant mortality rate is a key indicator of progress towards Millennium Development Goals.¹ Therefore, its accurate measurement is important. Moreover, evidence that official data understate the true picture must be taken as a sign that this international development target is in danger of not being reached.

¹ There are eight major Millennium Development Goals, the fourth one of which is to reduce under five mortality by two thirds between 1990 and 2015. In general, four in five deaths of children aged under 5 are in fact infant deaths.

Interrogation of official data in CEE/CIS countries is not new. The research in this paper builds on quite a large body of literature on infant mortality statistics in the Soviet Union, starting with Davis and Feshback (1980), running through to Anderson and Silver (1986), Velkoff and Miller (1995), Kingkade and Sawyer (2001) and UNICEF (2003). This existing literature lacks two elements: first, it does not present a clear picture of underestimation of infant mortality across the entire CEE/CIS region in the post-communist era, or a clear examination of the reasons that might lie behind it. Second, a rigorous analysis of the reliability of the major source of alternative estimates of infant mortality in the region – household surveys where women are asked about their reproductive histories – is also missing. It is in these two areas that this paper makes a contribution.

Why do official data understate the true picture in 15 countries? In most of these countries, the way a live birth is currently defined may reduce the infant mortality count. Mis-reporting, for example the reclassification of infant deaths as stillbirths, also appears to have increased over the 1990s. In some countries, deaths of older infants may be recorded as deaths of children aged over one year. And it is clear that in a few countries, the registration of births and infant deaths is less than complete: unregistered births and deaths are not included in official statistics. It must be added that most of this hard evidence pertains to CIS countries. Similar investigations have generally not been carried out in the countries of South Eastern Europe.

Can surveys be used to provide reliable alternative estimates of infant mortality in the CEE/CIS region? The answer is complex. For the most part, they appear accurate enough to support the contention that official data greatly understate the true infant mortality rate.

But some factors that are perhaps specific to CEE/CIS countries may increase uncertainty. With some estimates of infant mortality from survey data, the degree of uncertainty is particularly wide.

The paper is organized as follows. Section 1 discusses how infant mortality is typically measured, and presents estimates from different sources for countries in the region. Section 2 looks at the definition of ‘live birth’, which is particularly important in the CEE/CIS context. Section 3 examines misreporting of infant deaths, and Section 4 considers the problem of non-registration of births and infant deaths. In Section 5, attention is focused on uncertainty associated with survey based estimates. Section 6 concludes.

1. MEASURING INFANT MORTALITY

The infant mortality rate represents the probability that a child will die before reaching age of 1 year in a specific period of time (usually a year) and in a specific geographical area (usually a country). There are number of ways of calculating infant mortality rates. For example, the method used by the

Russian statistical office, Goskomstat (and generally recognised as acceptable), is:

$$m = \left[\frac{M}{N} + \frac{M^{-1}}{N^{-1}} \right] \bullet 1000$$

where N and M are, respectively, the number of live births in the year for which the rate is computed and the number of infant deaths that follow these births in the same year; N^{-1} is the number of live births in the previous year, and M^{-1} is the number of deaths of infants in the current year, who were born in the previous year (Goskomstat, 2002).²

Table 1 shows recent infant mortality rates for all 27 countries in the CEE/CIS region. The official rates for 2001, provided by national statistical offices and available for all countries except Tajikistan, are calculated from civil registration data on births and deaths. The rates range from 4 per 1,000 live births in Czech Republic and Slovenia, to 44 per 1,000 live births in Kyrgyzstan. Survey estimates, calculated from household surveys where women of childbearing age are asked about their reproductive histories, are available for 11 countries in the region. These surveys, Demographic Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS) Reproductive Health Surveys (RHS) and Living Standards Measurement Surveys (LSMS), have been carried out since the 1970s in many developing countries where there are usually few official data available for monitoring well-being and for planning public services such as health care. Most of the surveys used in this analysis were carried out in the late 1990s, and estimates of infant mortality refer to a particular point in time or to a 5 year period prior to the survey year. For four countries (Azerbaijan, Kazakhstan, Tajikistan and Uzbekistan) there are two independent survey estimates. In the case of two surveys, however (MICS 2000 for Albania and Uzbekistan), no period or point estimate is reported, diminishing somewhat the value of estimates from these surveys.

Table 1 indicates that in nine out of the ten countries with a period-specific survey estimate, infant mortality rates from the survey data are considerably higher than the official rates for the corresponding years. This is also true where two surveys have been carried out in one country. For Romania, the survey estimate is a third greater. In Azerbaijan, the two survey based estimates of 79 and 74 infant deaths per 1,000 live births are over four times as big as the corresponding official rates. Ukraine is the only country where the difference between the official rate and the survey estimate is small. Yet in this case, the survey estimate is likely to greatly understate the true picture, for reasons discussed at different points throughout this paper.³

² Rates calculated using formulas such as these are simplified, and do not, for example, take account of migration. However, the impact of such factors is generally believed to be small. For a more detailed discussion of the calculation of infant mortality rates, see Shyrock *et al* (1976).

³ It is worth noting that surveys carried out in some countries in the region around the late 1990s, including Bosnia-Herzegovina (MICS 2000), Moldova (RHS 1997), Russia (RHS 1996), and

Table 1: *Official infant mortality rates and survey based estimates (deaths per 1,000 live births)*

	Official rate (2001)	Survey estimate	Survey name and year	Years of survey estimate	Average official rate for corresponding years	Absolute difference (survey estimate less official rate)
Tajikistan		89	MICS 2000	(1993)	47	42
	-		LSMS			
Tajikistan		79	2000	(1996-2000)	-	
Kyrgyzstan	44	61	DHS 1997	(1993-1997)	29	32
Turkmenistan	20	74	DHS 2000	(1995-2000)	33	41
Kazakhstan		40	DHS 1995	(1991-1995)	27	13
Kazakhstan	19	62	DHS 1999	(1994-1999)	24	38
Azerbaijan		79	MICS 2000	(1996)	20	59
Azerbaijan	18	74	RHS 2001	(1996-2000)	17	57
Romania	18	32	RHS 1999	(1995-1999)	21	11
Uzbekistan		49	DHS 1996	(1992-1996)	30	19
Uzbekistan	18	52	MICS 2000	Not reported		
Moldova	16					
Armenia	15	36	DHS 2000	(1995-2000)	15	21
Russia	15					
Bulgaria	14					
FR Yugoslavia	13					
Albania	12	28	MICS 2000	Not reported		
Georgia	12	43	RHS 1999	(1995-1999)	16	27
FYR Macedonia	12					
Ukraine	11	16	RHS 1999	(1995-1999)	14	2
Latvia	11					
Belarus	9					
Estonia	9					
Hungary	8					
Lithuania	8					
Poland	8					
Croatia	8					
Bosnia- Herzegovina	8					
Slovakia	6					
Slovenia	4					
Czech Republic	4					

Source: Official rates - UNICEF (2003), Statistical Annex Table 3.1; survey data - see Appendix I.

Serbia and Montenegro (MICS 2000), did not collect information on child and infant mortality, suggesting perhaps that official data were seen as adequate in these countries.

There are several exogenous reasons why we should be wary of official infant mortality rates in many countries in the region (see UNICEF, 2003). In this paper, we set aside these exogenous factors, and concentrate on the differences between official and survey data, and inconsistencies in the official data themselves. The method is as follows:

1. In nine countries, independent surveys suggest that official infant mortality rates may understate the true situation.
2. Evidence within the official data, for example unexpected patterns, may support our claim that official rates in these nine countries appear low.
3. If we find similar evidence in official infant mortality data for other countries in the CEE/CIS region for which we do not have survey data, then we may be able to suggest that the level of infant mortality in these countries is higher than the official data suggest.

In undertaking this analysis, it is worth defining explicitly what we wish to capture. The true infant mortality rate m can be conceptualised as follows:

$$m = \left[\frac{M_r + M_u}{N_r + N_u} \right] \cdot 1000$$

where N_r and N_u are registered and unregistered births, respectively, and M_r and M_u are registered and unregistered deaths. Therefore, the official infant mortality rate is calculated from M_r and N_r . The underlying assumption with official administrative data is that N_r and M_r represent 100 per cent of all births and deaths, respectively. If M_r and N_r do not capture all births and deaths, then the extent to which the official infant mortality rate is a good proxy for m can be called into question. It is a question which underlies the discussion in Sections 2, 3 and 4 below. The degree to which m can be captured from survey data is analogous. If N_r and M_r are defined as births and deaths recorded in the surveys, then survey based estimates of infant mortality will be representative of m only to the extent that sampling and non-sampling error allow. These issues are discussed in Section 5.

2. LIVE BIRTHS, STILLBIRTHS AND MISCARRIAGES

The first reason why estimates of infant mortality from official sources, and those calculated from surveys, may differ is related to definitions. If an infant is not considered to be born alive, then he or she cannot be considered to have died. Thus, the definition of ‘live birth’ is one crucial determinant of the infant mortality rate. The World Health Organization developed the following definition of a ‘live birth’ in 1950:

“The complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life, such as beating of heart, pulsation of the umbilical cord, or definite movement of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached.” (WHO, 1992, definition 3.1)

In other words, any birth with any signs of life, however insignificant, and which is then followed by death, however quickly, should be defined as a live birth and infant death. This definition is officially recognised in most countries, both developing and developed.

Partly, perhaps, as a result of Cold War differences, the Soviet Union maintained an alternative and less rigorous definition of live birth. This was also adopted in some communist countries of Central and Eastern Europe. The differences between the WHO and Soviet definitions are highlighted on Table 2. The Soviet definition only counts breathing as a sign of life, and presumes infants who are born before the end of 28 weeks of gestation, or who weigh less than 1,000 grams at birth (there is considerable overlap between these two groups) to be non-viable – they are not counted as live births until they have survived a full seven days (or 168 hours). If they survive for less than this time, they are considered as miscarriages, and not counted at all.

Table 2: *Soviet and WHO definitions of live birth*

	Infant born after the end of the 28 th week of pregnancy			
	No signs of life	No breath but other signs of life	Died during the first 7 days	Survived the first 7 days
USSR	Stillbirth		Live birth	
WHO	Stillbirth	Live birth		
	Infant born before the end of the 28 th week of pregnancy, or with weight under 1,000 gr. or length under 35 cm			
	No sign of life	No breath but other signs of life	Died during the first 7 days	Survived the first 7 days
USSR	Miscarriage			Live birth
WHO	Stillbirth	Live birth		

Source: Anderson and Silver (1986).

In some Central and East European countries, the WHO definition was introduced long before the lifting of the 'Iron Curtain', and after 1994, when Poland adopted the WHO definition, Bulgaria was the only European country outside of the CIS where the Soviet definition persisted.⁴ Table 3 shows, however, that in several CIS countries, the Soviet definition was still recently in use. Indeed, in those CIS countries where the definition of live birth was changed during the 1990s to move towards the WHO definition, it was done in a rather limited way. In Russia for example, a decree titled "On shifting to WHO definition of live birth and foetal death" (see Appendix II) was issued in 1992 by the Ministry of Health and Goskomstat. This defines as live birth a birth that shows any sign of life at any gestational age. However, the same document states that registration with the Civil Acts Register (ZAGS – Zapis ob Actah Grazhdanskogo Sostoyania), used in the calculation of official infant mortality statistics, shall be done only for the following:

- live births and stillbirths with birthweights of 1000 grams or more (or, if birthweight is unknown, length of 35 cm or more and period of gestation of 28 weeks and more)
- all infants with birthweight between 500 and 999 grams who survive 168 hours (7 days).

Thus, infants weighing less than 1000 grams who die within seven days, even though they are considered live born, are supposed to be registered only in medical documentation of the health facility where birth and subsequent death have taken place, but not in the civil register. Therefore they are not counted in official statistics.⁵

⁴ In Bulgaria, a variation of the Soviet definition applies: infants who weigh less than 1,000 grams are counted as miscarriages if they survive less than seven days; length and gestational age are not taken into account. In addition, all life signs, rather than just breathing, are seen as valid signs of life.

⁵ Indeed it has been suggested that little may be done to keep infants with a birthweight of under 1,000g alive. A recent item in a Moscow newspaper reads: 'Aleksandr Baranov, director of the Russian Academy of Medical Sciences Center for Children's Health, said that the low quality of health care in Russia has caused the infant mortality rate to grow "continuously." Further, he said the Duma must pass the draft law "On the Security of the Health of Children in the Russian Federation" to protect premature babies. In Russia, children born weighing less than one kilogram are not registered in the Civil Registrar's Office unless they live more than 7 full days. Until a child in that weight category is seven days old, he or she is not eligible to receive expensive intensive care treatment.' ("Doctor Lobbies for Lower Infant Mortality Rate" *Vechernyaya Moskva* 17 October 2003).

Table 3: *Definitions of live birth in CIS countries (Autumn 2003)*

	Legal instrument	Registration in medical documents	Civil Acts registration
Belarus	Decree of Ministry of Health and State Statistical Committee (1993)	Live birth: birth of product of conception, with birth weight greater than 500 grams (or length of 25 cm or more or born after 22 or more weeks of gestation) that breathes or shows any other evidence of life.	
Georgia	Decree of Ministry of Labour, Health and Social Affairs, Ministry of Justice and Committee of Social Economic Information (1993)		
Armenia	Decree Ministry of Health (1994)	Live birth: birth of product of conception, with birth weight greater than 500 grams that breathes or shows any other evidence of life.	All live and still births with birth weight greater than 1000 grams (or with length of 35 cm or more, or born after 28 weeks of gestation)
Kyrgyzstan	Instruction of Ministry of Health (2002)		
Moldova	Decree of Ministry of Health and State Department on Statistics (1995)		
Russia*	Decree of Ministry of Health and Goskomstat, (1992)		
Ukraine	Decree of Ministry of Health (1996)		
Azerbaijan	Soviet definition still in use for both medical and civil acts registration. Decrees soon to be issued for the adoption of WHO definition of live birth		
Kazakhstan	Soviet definition still in use for both medical and civil acts registration. WHO definition of live birth definition is used in two pilot regions (Almatinskaya oblast and Almaty city)		
Tajikistan	Soviet definition still in use for both medical and civil acts registration. Transition to WHO definition of live birth being discussed.		
Uzbekistan	Soviet definition still in use for both medical and civil acts registration. WHO definition of live birth is being used in one pilot oblast		
Turkmenistan	Soviet definition still in use for both medical and civil acts registration. Date for transition to WHO definition of live birth has not been set		

* According to Information Note of MOH of Russia (2002) “On statistical counting of infant born before 28 weeks of gestation and with birth weight of 1000 gram and more surviving perinatal period (168 hours)”, any termination of pregnancy before 28 weeks of gestation are completed is classified as an abortion regardless of outcome. Thus, if child is born before 28 weeks of gestation are completed, even though he or she will be registered with Civil Acts Registration Bodies, in medical documentation this will be registered as an abortion. It is not clear whether similar rules apply in other countries.

Note: Laws and decrees governing live birth and stillbirth definition and registration are referenced in more detail in Appendix II.

Another document, issued by Russian Ministry of Health in 2002 to further explain “Statistical counting of children born alive before 28 weeks of gestation are completed and weighing less than 1000 grams who survive perinatal period (168 hours)” (see Appendix II) states that any pregnancy which ends before 28 weeks of gestation are completed is classified as a *miscarriage* (abortion). If the infant survives seven days, a medical certificate of birth is issued and the infant is registered with the Civil Acts Registry as liveborn. However, such a pregnancy will still be classified in the documentation of the health facility as a miscarriage (abortion) and not a delivery, and will be recorded as a “termination of pregnancy (before 28 weeks)”, or as a case of “medical assistance to pregnant women”. It will not be included in the number of “Total deliveries” recorded by the health facility.⁶

The WHO definition of live birth was “adopted” in similar fashion in Armenia, Moldova, Ukraine and Kyrgyzstan. Thus, in these countries, in practice the shift from the Soviet to the WHO definition of live birth was partial in the case of both medical and civil registration statistics.⁷

What difference does the Soviet definition make to infant mortality statistics? Anderson and Silver (1986) have produced perhaps the most widely cited account of the possible impact on the official infant mortality rate if countries using the Soviet definition switched to the WHO definition. According to their estimates (based on data on infant survival for the US in 1960), the infant mortality rate would jump by between 22 and 25 per cent if the birth weight and gestation criteria in the Soviet definition were made consistent with WHO criteria. Table 4 shows that in the case of four countries where the change in definition was made in the early 1990s, and where infant mortality rates were recalculated, this estimate may still have some validity, but variation between countries and over years is considerable. In Poland, the infant mortality rate increased consistently by a fifth. In Moldova, the annual increase ranged from 5 to 17 per cent (however, as Table 3 notes, the new definition in Moldova retained several elements of the Soviet definition). In Latvia (where data, however, are presented for only one year) the infant mortality rate jumped by 40 per cent. Where other post-communist countries would fit within this range of increases is difficult to say, but the impact of the Soviet definition on infant mortality rates clearly remains important.

⁶ If the premature infant is stillborn or survives less than 7 days, the mother is only entitled to sick leave “under general conditions”. She is entitled to maternity leave if the infant survives 7 days or more.

⁷ It is worth noting that while most advanced industrialized countries progressively adopted the WHO definition of live birth from the 1960s onwards, in these countries too, adoption of the WHO definition has often been slow and partial. During the early 1990s, some Central European countries surpassed several Western countries in terms of conforming to the WHO definition. See Gourbin and Masuy–Stroobant (1995).

Table 4: *Estimated increase in infant mortality rate caused by switch from Soviet to WHO definitions (per cent increase)*

	Estonia	Latvia	Moldova	Poland
1989			13	20
1990			14	21
1991		40	5	21
1992	17		16	21
1993	13		17	21
1994	11			
1995	22			
1996	11			

Source: Data supplied to MONEE Project by National Statistical Offices.

3. MIS-REPORTING OF INFANT BIRTHS AND DEATHS

As noted in the previous section, under the Soviet definition, a birth must fulfil several criteria in order to be counted as a ‘live birth’. Velkoff and Miller argue that if an infant in the Soviet Union died and there was doubt regarding any of the criteria, “it would have been to the benefit of the hospital or the clinic to err on the side of stating that the infant was extremely premature, or intentionally to mis-report the birth as a stillbirth, because infant mortality rates were one criterion used to evaluate hospitals and clinics.” (1995, p.243).

Many experts agree that mis-reporting of infant deaths was widespread in the Soviet Union, and that it has continued in many of its successor states (for example, see Buckley, 1998; Yeganyan *et al.*, 2001; Centers for Disease Control and Prevention and ORC Macro, 2003). Suspicions have also been raised in relation to some countries in South Eastern Europe, but little hard evidence has been presented (Serbanescu, Morris and Marin, 2001; Rechel and McKee, 2003). The literature notes two types of mis-reporting that reduce the infant death count:

1. The classification of live births (even according to the Soviet definition) as stillbirths or miscarriages – referred to in the citation above of Velkoff and Miller.
2. The recording of deaths of infants aged under one year as occurring when the infant was aged over one year.⁸

⁸ A third type of mis-reporting sometimes mentioned is the classification of deaths with ‘sensitive’ causes, for example intestinal infections, as being caused by other less sensitive factors, for example respiratory illness. This does not affect the infant mortality count, and is not considered here.

The reader should note the difference between mis-reporting, which is a conscious act or an unintended error by medical staff, and non-registration, which is an act of omission, often by parents, but which can also reduce the infant mortality count. Issues surrounding registration are discussed in Section 4.

Classification of infant deaths as stillbirths and miscarriages

Because in all countries, a high proportion of infant deaths occurs within a short period after birth (that is, in the first weeks, and even days and hours), the infant mortality rate is often decomposed into early-neonatal mortality (infant dies within 6 days of birth), neonatal mortality (infant dies within 27 days after birth) and postneonatal mortality (28 to 364 days). In general, one might expect the relationship between neonatal and post-neonatal mortality rates across countries to be reasonably stable. That is, countries with similar levels of neonatal mortality should also have similar levels of post-neonatal mortality. Velkoff and Miller (1995) find that for years up to 1990, in several republics of the Soviet Union, the ratio of official post-neonatal mortality rates to neonatal mortality rates was high when compared with Western countries. Is this still the case in CIS countries? Is it the case in other countries of Central and Eastern Europe?

Table 5 shows ratios of post-neonatal to neo-natal mortality rates for 15 western European countries, and 19 countries in the CEE/CIS region. These are average ratios for available years between 1970 and 2000 when the infant mortality rate was between 10 and 20 per 1,000 live births. Countries are grouped by geographical region. Data for Western European countries set a benchmark: the sorts of expected ratios where infant mortality is accurately captured by official statistics: these range from 0.24 in Sweden (denoting 24 post neonatal deaths for every 100 neonatal deaths) to 0.64 in the UK, with an average ratio of 0.43. Average ratios in seven Central European and Baltic countries are only slightly higher, at 0.50. In the other three sub-regions on Table 5, ratios for most countries are considerably higher. Exceptions are Bosnia-Herzegovina, Croatia, FYR Macedonia and Georgia, where ratios are similar to those in Western Europe. In the other countries (Albania, Romania, Moldova, Russia, Ukraine, Armenia and Azerbaijan), given the official count of post neonatal deaths, the number of neonatal deaths appears to be understated.⁹

⁹ The alternative interpretation, that the number of post-neonatal deaths is overstated, seems unlikely.

Table 5: Average Ratios of Post neonatal to neonatal mortality rates in official statistics, European and Central Asian countries, 1970-2000

Western Europe		Central Europe and Baltic states		South Eastern Europe		Western CIS		Caucasus and Central Asia	
<i>Average</i>	0.43	<i>Average</i>	0.50	<i>Average</i>	0.84	<i>Average</i>	0.83	<i>Average</i>	1.76
Austria (10)	0.56	Czech Republic (5)	0.45	Albania (4)	1.80	Moldova (6)	0.96	Armenia (10)	0.85
Belgium (12)	0.51	Estonia (4)	0.57	Bosnia-Herzegovina (4)	0.45	Russia (8)	0.69	Georgia (7)	0.51
Denmark (7)	0.31	Hungary (12)	0.39	Bulgaria (21)	0.85	Ukraine (7)	0.85	Azerbaijan (2)	3.93
Finland (5)	0.26	Latvia (13)	0.69	Croatia (10)	0.39				
France (11)	0.60	Lithuania (7)	0.56	FYR Macedonia (4)	0.45				
Greece (11)	0.34	Poland (15)	0.40	Romania (2)	1.10				
Ireland (8)	0.57	Slovenia (3)	0.48						
Italy (11)	0.29								
Netherlands (6)	0.37								
Norway (7)	0.41								
Portugal (10)	0.49								
Spain (9)	0.45								
Sweden (3)	0.24								
Switzerland (7)	0.45								
United Kingdom (5)	0.64								

Source: WHO Health for All Database

Notes: Average ratios (PNNMR/NNMR) are calculated for each country for years between 1970 and 2000 when official infant mortality rates were between 10 and 20 per 1,000 live births. Number of years from which averages are calculated are in parentheses.

The evidence presented on Table 5 is generally supported by a recent analysis by Kingkade and Sawyer (2001), where information on the monthly probabilities of dying at less than four months (that is, in the first month, second month, etc.), and between four and ten months, are used to estimate the 'true' infant mortality rate. Their method assumes that official rates for deaths that occur up to the fourth month in CEE/CIS countries may understate the true situation, while official rates for deaths between four and ten months in infancy are generally correct. The method also assumes that the pattern of deaths up to the fourth month can be estimated using historical US and German data from points in time when their infant mortality levels (between months 4 and 10) were similar to those in the different CEE/CIS countries (see also Kingkade and Arriaga, 1997). Table 6 presents their underestimation factors, which range from close to zero per cent in most central European countries, to 25 per cent and more in most countries of South Eastern Europe and the CIS. Belarus is a notable exception, with an adjustment factor of only

13 per cent, similar to that of Latvia. It is worth noting also that Kingkade and Sawyer's analysis does suggest, in contrast to the evidence on Table 5, a degree of underestimation in official rates in both FYR Macedonia and Georgia. However, it is worth noting that underestimation factors for Azerbaijan, Georgia, Tajikistan and Turkmenistan are calculated from only one observation per country.

Table 6: Estimates of adjustment factors for infant mortality rates in CEE/CIS countries, 1987-2000

	Average official infant mortality rate 1987-2000	Adjustment factor (per cent)	Adjusted infant mortality rate 1987-2000
Albania (4)	28.4	+110.9	59.83
Bulgaria (5)	15.1	+56.6	23.64
Croatia (6)	9.8	+0.8	9.90
FYR Macedonia (8)	27.9	+32.9	37.05
Romania (9)	23.5	+81.2	42.57
Czech Republic (6)	8.2	+0.6	8.21
Estonia (10)	12.9	+9.7	14.18
Hungary (12)	12.9	+0.5	12.94
Latvia (6)	14.7	+13.6	16.70
Lithuania (7)	11.7	+6.2	12.46
Slovakia (4)	11.6	+0.3	11.61
Slovenia (10)	7.4	+7.3	7.99
Armenia (6)	16.7	+78.9	29.90
Azerbaijan (1)	22.6	+167.3	60.51
Georgia (1)	15.5	+27.0	19.70
Kazakhstan (5)	25.6	+84.0	47.09
Kyrgyzstan (7)	61.9	+100.3	62.09
Tajikistan (1)	38.7	+102.6	78.37
Turkmenistan (1)	43.2	+69.5	73.19
Uzbekistan (2)	29.3	+98.4	58.18
Belarus (6)	12.2	+13.0	13.75
Moldova (4)	20.0	+65.0	33.07
Russia (10)	17.9	+26.5	22.61
Ukraine (7)	13.9	+54.5	21.52
Average		+46.6	

Source: Kingkade and Sawyer (2001), Table 2.

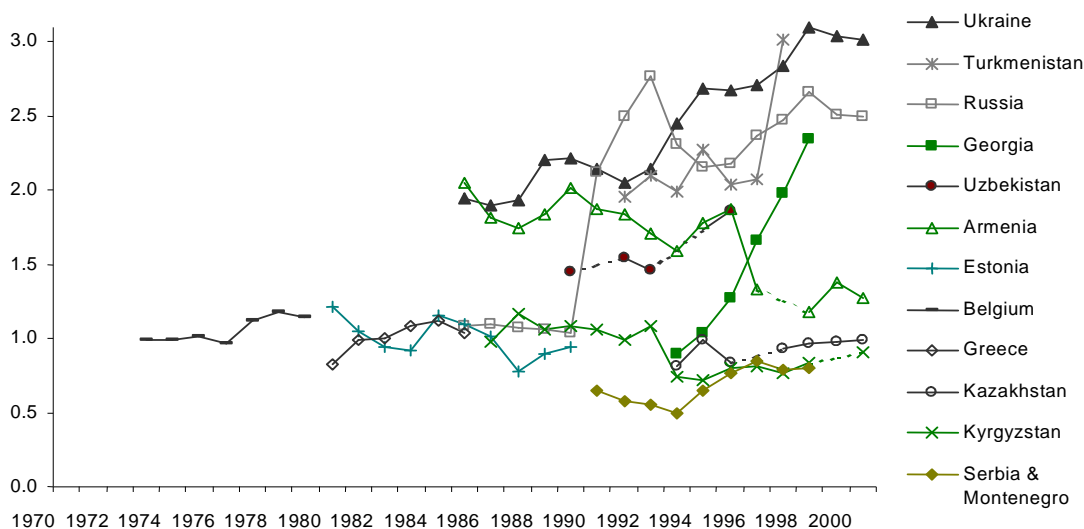
Note: The adjustment factors represent average adjustment for years between 1987 and 2000 to make the pattern of infant death before the fourth month, and at the fourth and tenth months, consistent with historical patterns observed in US and German life tables. The number of years' data from which the adjustment factors are calculated are in parentheses.

The mismatches outlined on Tables 5 and 6 for several countries in South Eastern Europe and the CIS do not constitute *proof* that infant deaths are being hidden or recorded as stillbirths or miscarriages. However, they do show that the pattern of infant death does not conform to expected patterns in many countries. Moreover, they suggest that the problem of undercounting of infant mortality may not just be confined to countries of the Caucasus and Central Asia, where surveys confirm this to be the case, but also to other countries in the CIS and South Eastern Europe, where survey data are not available.

Mis-reporting early neonatal deaths as stillbirths

It is also possible, using official statistics, to address the more specific issue of whether early neonatal deaths are being mis-reported as stillbirths. This is done by examining the relationship between stillbirths and early neonatal deaths in the official data. Given the mortality rate that prevailed (according to official counts) in several transition countries during the 1990s, one might expect to find a ratio of about one stillbirth for every early neonatal death. A 'stillbirths ratio' far in excess of 1:1 suggests that some early neonatal deaths were being misreported as stillbirths (Velkoff and Miller, 1995).

Figure 1 shows stillbirths ratios for some countries and years where the official neonatal mortality rate ranged from 6.5 to 11 per 1,000 live births. Data are available for most CIS countries, but not for any countries in South Eastern Europe except Serbia and Montenegro. The expected 1:1 stillbirths ratio prevailed in Belgium and Greece in the 1970s, Estonia in the 1980s, and in Serbia and Montenegro in the 1990s. The 1:1 stillbirths ratio was also evident in Russia in the late 1980s, but it began to rise steeply from 1990. In Georgia, the ratio increased from 1992 onwards. In Turkmenistan, Ukraine and Uzbekistan, the stillbirths ratio climbed during the 1990s to about 2:1 or even 3:1.

Figure 1: *Ratio of stillbirths to early neonatal deaths, 1970-2000*

Source: WHO Health for All database.

Note: Only those countries and years are selected for which the early neonatal mortality rate was between 6.5 and 11 per 1,000 live births. Depending on the country and the year, the definition of live birth may vary.

The case of Georgia is interesting because this country officially adopted the WHO definition of live birth in 1994 (see Table 3), and because a study of birth outcomes in the year 2000 in hospitals in Tbilisi provides at least a partial independent check on what the expected stillbirths ratio should be. Asatiani (2001) examined medical records (primary medical history journals rather than medical death certificates) for 15,000 births at obstetrics clinics in Tbilisi, Georgia, in 2000 – a third of all births in Georgia in that year. In this sample, there were 22.3 stillbirths per 1,000 births, and 15.6 early neonatal deaths per 1,000 live births, giving a stillbirths ratio 1.43:1 – a far lower ratio than what the official data show, suggesting perhaps a degree of massaging of official infant death figures.

Trends in the stillbirths ratio for Armenia, Kazakhstan and Kyrgyzstan, on the other hand, are difficult to explain. In these countries, the ratio remained at about 1:1 or declined towards this level during the 1990s. At face value, this would imply accurate counting of early neonatal deaths. Given the gap between survey based estimates and official data, and the evidence of underestimation of neonatal deaths in Table 5, this idea is difficult to sustain. Moreover, small scale analyses of hospitals in Armenia and Kazakhstan tend to confirm the practice of misreporting (Ministry of Health of and UNICEF Armenia, 2002; Wuhib, 1998; Ministry of Health and ZAO, 2002). Another possibility is that in these countries, a significant number of infant deaths are simply not reported at all, for example, because they follow home births.

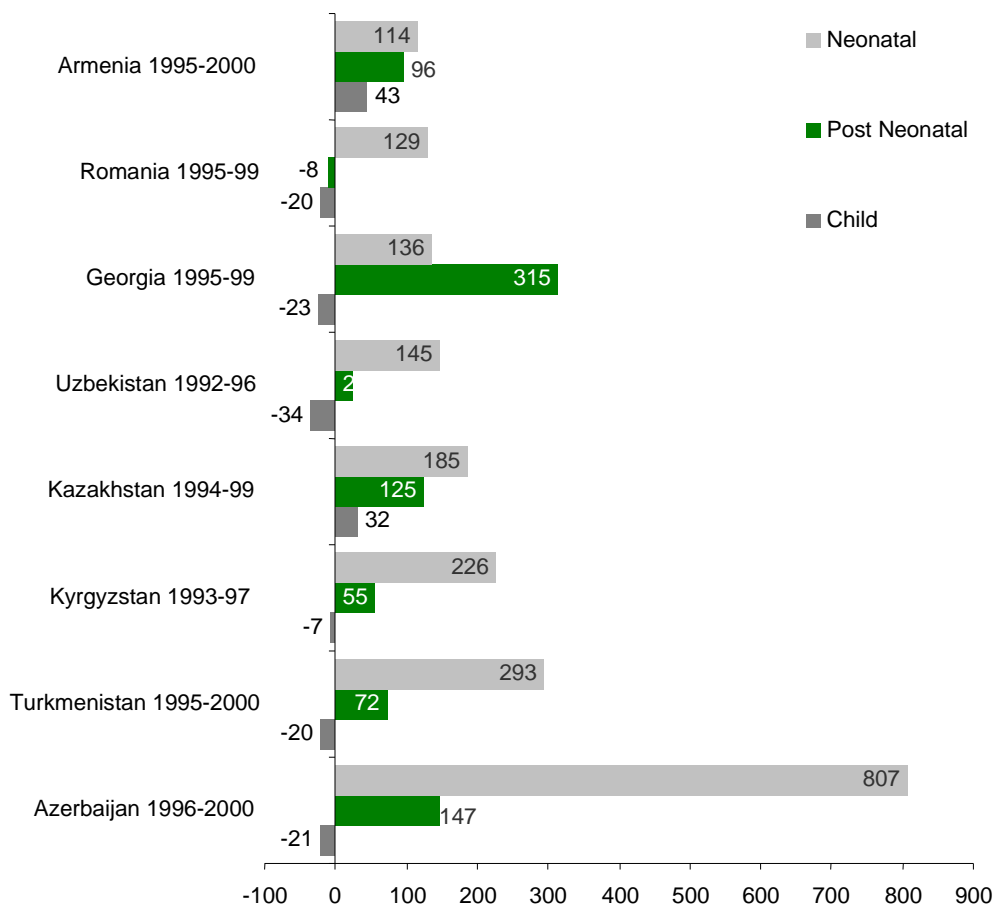
Mis-reporting post neonatal deaths as child deaths

Another specific type of misreporting that can be investigated with an ‘internal consistency’ check is the possibility that deaths of older infants are recorded as occurring after their first birthday, and are thus not included in the infant mortality count. Velkoff and Miller (1995) cite a study by Ksefontenova (1990) which suggests that in the Muslim republics in particular, misreporting of the infant’s age was used to reduce the infant mortality count.

We do not have official data for infant deaths by age in months, or by age in single years past their first birthday. However, it is possible to compare official and survey data on neonatal, post neonatal and child mortality rates, the latter being for deaths occurring after the child’s first birthday, but before their fifth. Figure 2 shows the differences between survey based estimates and official data for eight countries. In all countries except Georgia, the difference between survey estimates and official data is greatest for neonatal deaths. This is not surprising, given the discussion above on misreporting infant deaths as stillbirths or miscarriages. What is more surprising is the finding that in six of the eight countries, the surveys appear to *underestimate* child deaths in comparison with official data. This finding is not easy to rationalize, except perhaps with reference to the misreporting of infant deaths as child deaths in the official data, thus boosting the child death count. One alternative explanation – that child deaths are misreported as infant deaths in the surveys – seems unlikely, for reasons discussed in Section 5.

To summarise: there is little hard evidence on misreporting of infant deaths, but available data do suggest problems in all the countries of Caucasus and Central Asia, and also in Moldova, Russia and Ukraine (evidence relating to Belarus is scarce). Problems may also exist in some South East European countries, although evidence for these countries is mixed. Misreporting does not seem to be a problem in the EU accession countries of Central Europe and the Baltic states.

Figure 2: Survey estimates of neonatal, post neonatal and child mortality rates (per cent difference from official rates)



Source: Official data: WHO *Health for All* Database, Survey data: Uzbekistan DHS 1996, Kyrgyzstan DHS 1997, Kazakhstan DHS 1999, Georgia and Romania RHS 1999, Armenia and Turkmenistan DHS 2000, and Azerbaijan RHS 2001. See Appendix I.

It is important that the reader is not given the impression of systematic misreporting in these countries as a result of directives from ministries and high ranking bureaucrats. Certainly, incentive systems, coupled with the looser Soviet definition of live birth that gives room for some interpretation, may encourage a degree of misreporting. Equally, however, the trauma felt by medical staff who often have to care for dying infants with inadequate training and equipment, and who may feel powerless to save them, should not, perhaps, be underestimated.¹⁰

¹⁰ The authors are grateful to Iryna Mogilevkyna for this insight.

4. RELIABILITY OF REGISTRATION

The definition of a live birth, and its interpretation by medical staff, are not the only factors that can affect the official infant mortality count. As is noted in Section 2, only births and deaths that are registered are included in official statistics. In the Soviet Union and many other communist countries, parents were expected to register the births of children, except in the case of stillbirths and deaths that took place before the mother left the hospital, when it was the job of the hospital administration to make the declaration. In many countries, similar procedures exist today. To a large extent, therefore, the completeness of the registry will depend on parental willingness to register the birth and death of a child.

Problems with the registration of births and deaths in CEE/CIS countries are under-researched, and hard evidence exists only for a small number of countries. Table 7 shows 2000 survey evidence of proportions of children at 0-5 months, 6-11 months and 48-59 months who were unregistered at time of interview in seven countries in the region. In Tajikistan non-registration is particularly acute: the births of four in ten children aged between 6 months and one year, and more than one in ten children aged between four and five years (48-59 months) were not registered in 2000. The situation in Georgia is also severe, with the births of 5 per cent of children aged 48-59 months not registered. The reason for high levels of non-registration in Tajikistan and in Georgia is simple – registration at the time of the survey was costly.¹¹ In Albania, Bosnia-Herzegovina, Moldova and Uzbekistan, on the other hand, where registration was formally free, the picture looks more benign.

Table 7: *Births not registered 2000, by age of child (per cent)*

	under 6 months	6-11 months	48-59 months
Tajikistan	55.1	39.4	12.4
Georgia	12.0	5.3	4.8
Moldova	11.5	2.0	1.6
Azerbaijan	13.6	6.0	1.2
Bosnia-Herzegovina	7.4	0.9	0.9
Albania	7.9	3.0	0.5
Uzbekistan	2.5	0.3	0.0

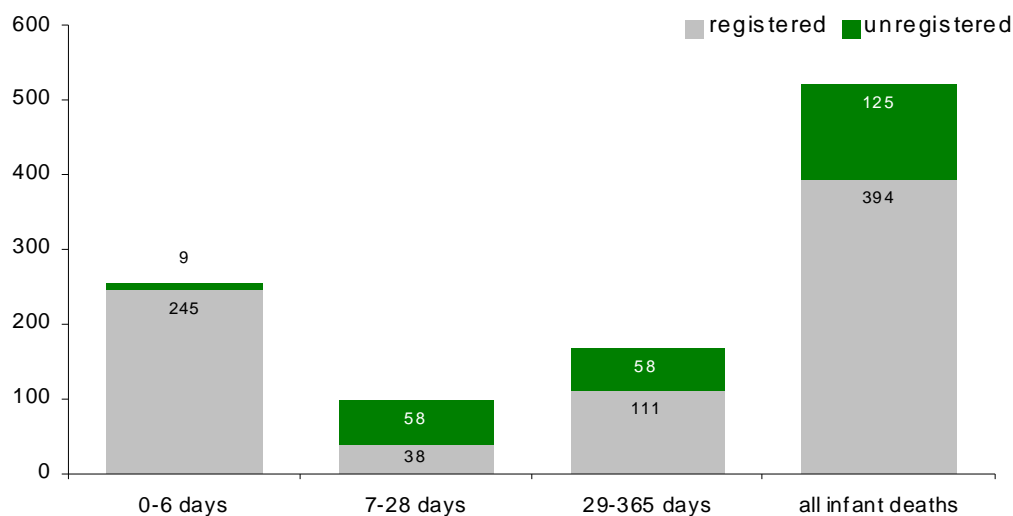
Source: MICS 2000 data. See Appendix I.

Note: Information on birth registration in the MICS refers to proportions of children aged under 5 years whose birth has not been registered. Includes some cases where parents are unsure whether their children's births are registered.

¹¹ Formal birth registration fees have recently been abolished in Tajikistan, but persist in Georgia. In Georgia, moreover, birth registration fees for infants born to mothers who are not in a registered marriage are double the fees for infants born to married mothers (personal communication, UNICEF Georgia).

However, the data in Table 7 refer only to living children. The proportion of children who have died whose births (and deaths) are not registered may be higher still. Evidence from a trace of over 500 medical death certificates issued by hospitals and other health facilities for Armenian infants in 2000 shows that a quarter of deaths remained unregistered. Figure 3 shows that among infants who medical staff recorded as live-born and who died at 0-6 days, registration was reasonably effective because it was the hospital's responsibility. But among older infants, where parents were responsible for registration at civil offices, compliance was poor. It is not clear from this exercise how many of these infants' births were also unregistered. Nonetheless, if non-registration of infant deaths occurs in some other countries in the region on a similar scale as in Armenia, then this clearly constitutes one important source of undercounting in official infant mortality rates.

Figure 3: *Infant deaths in Armenia registered at medical facilities but unregistered at Civil Acts Registration Bureau, 2000 (absolute number from survey of 519 deaths)*



Source: Ministry of Health and UNICEF (2002) *Infant mortality in Armenia: A review of procedures and registration, classification and related medical services*, Ministry of Health Armenia and Republic of Armenia: Yerevan, Table 15.

Note: Medical facilities issue medical death certificates in cases where they are involved in treatment of the infant. If the infant is less than a week old, medical facilities are responsible for registering deaths with the Civil Acts Registration Bureau (CARB), which compiles official vital statistics for the National Statistical Service. If the infant is more than 6 days old at time of death, parents are responsible for registering the death directly with the CARB, without which the infant's death will be excluded from the official count. The total number of infant deaths reported by the National Statistical Service in 2000 was 540 (Source: MONEE Project Database).

5. ESTIMATING INFANT MORTALITY FROM SURVEY DATA

While the preceding three sections outline issues that strongly point to undercounting of official infant mortality rates in several countries, alternative estimates, derived from survey data, cannot simply be assumed to be ‘correct’. This section seeks to add to existing literature on the survey based estimation of infant mortality in two important ways: first, to point to some specific problems in the estimation of infant mortality from survey data in former communist countries during the transition; and second (and more generally), to question some assumptions made about the indirect estimation of infant mortality from limited maternity histories.

Calculating infant mortality from survey data

As Table 1 shows, survey based estimates of infant mortality are based on three main survey types – the DHS, the RHS and the MICS. In addition, one LSMS conducted in Tajikistan in 1999 included a module that allows the calculation of infant mortality rates. All surveys were based on random stratified samples, and all aimed to be representative of either national populations, or of women of reproductive age (15-44 or 15-49).¹²

The way infant mortality rates are computed depends on what type of information is collected in a survey. The DHS, RHS and the Tajikistan LSMS ask respondents to report all their pregnancy outcomes in some detail. For all live births, date of birth, survival status and (for not surviving children) age at death were obtained. The mortality rates calculated from these surveys are based on the deaths of children over a specific time period, usually five years preceding the survey.¹³

In MICS, on the other hand, women are asked to report the total number of births they have had in their life and total number of children who were born alive but later died. Because no information is collected regarding dates of birth (except for the very first birth) or age at death, mortality rates can be estimated only indirectly, using a method developed by Brass (1964). This method (discussed in more detail below) produces estimates of mortality for several reference years, which are usually averaged into a final estimate, represented by a mid-point year.

Non-sampling and sampling error

Asking women about their children who have died is a difficult matter, not least because the death of children is invariably painful for a mother to talk about. There is a danger that some mothers may withhold some details, or

¹² For information sources on the surveys, see Appendix I.

¹³ Data for the most recent period will include some children who have not been exposed to the risk of dying for a full year. To compensate for this, a method of synthetic cohort probabilities is used to compute probability of death for this group. A description of this procedure can be found in Sullivan *et al* (1994).

'overlook' some deaths, or even terminate the interview. Responses such as these will affect the quality of the survey.

Even where mothers answer all questions, they may interpret them in different ways. While respondents to all surveys are asked to report pregnancy outcomes according to the WHO definition of live birth, it is not always clear how respondents themselves interpret both questions and events. In the case of a death that occurred shortly after birth and where medical staff assisted at the birth (as is the case with most births in CEE/CIS countries), there are three possible ways how the mother might report this event to the interviewer:

- * she will report what she recalls herself
- * she will repeat what she has been told by medical personnel
- * she will report what has been written in the death certificate

In the first case the accuracy of report will depend on how clear her memory of event is (this is an issue in any retrospective survey). The second and third cases are of particular importance in the context of CEE/CIS countries where medical staff sometimes misreport pregnancy outcomes. If respondents were influenced by what they were told by medical staff, then the survey results will also be influenced by mis-reporting in the health system (Wuhib, 1998).

The omission by respondents of dead children from the birth history can also bias results. One indicator of omission may be the ratio of male to female infant mortality. The expected ratio of male to female deaths is between 1.16 and 1.32 (Curtis 1995). A higher ratio might indicate under-reporting of female deaths. Table 8 shows that both Georgia and Kazakhstan (1995) have a ratio of 1.8 for neonatal mortality, while Georgia, Turkmenistan and Uzbekistan have high ratios for total infant mortality. This may mean that female infant deaths are under-reported in these surveys, and that survey based estimates of infant mortality rates in these countries that understate the true total.¹⁴

The very low estimate of infant mortality from the Ukraine RHS underlines the difficulty in collecting information of this kind in surveys, and the large impact that non-reporting error can have on results. As noted in Table 1, the Ukraine RHS produces an infant mortality estimate that is very similar to the official rate. Yet the problems with the Ukraine official data discussed in Sections 2 and 3 of this paper clearly imply that the real infant mortality rate should be higher than the official rate. There seems little doubt

¹⁴ There are several other types of non-sampling error (not necessarily specific to CEE/CIS countries) that can affect infant mortality estimates. These are discussed in greater detail in Sullivan, *et al.*, (1994).

therefore, that the Ukraine RHS underestimates the true level of infant mortality in that country.¹⁵

Table 8: *Sex differentials in infant mortality*

	<i>Infant mortality rate</i>		<i>Neonatal mortality rate</i>		<i>Post-neonatal mortality rate</i>		<i>Mortality ratio Male/Female</i>		
	Male	Female	Male	Female	Male	Female	Infant	Neo-natal	Post neo-natal
Romania 1999	32.1	26.3	21.0	16.0	11.1	10.3	1.2	1.3	1.1
Armenia 2000	46.1	41.9	29.4	22.7	16.7	19.3	1.1	1.3	0.9
Azerbaijan 2001	83.6	77.8	45.7	29.9	38.0	47.9	1.1	1.5	0.8
Georgia 1999	48.3	31.5	31.5	17.1	16.8	14.5	1.5	1.8	1.2
Kazakhstan 1995	46.7	34.6	24.5	13.3	22.2	21.3	1.3	1.8	1.0
Kazakhstan 1999	62.0	47.3	32.6	24.0	29.5	23.3	1.3	1.4	1.3
Kyrgyzstan 1997	71.9	60.2	36.6	29.6	35.4	30.6	1.2	1.2	1.2
Turkmenistan 2000	83.0	59.7	36.6	29.0	46.4	30.7	1.4	1.3	1.5
Uzbekistan 1996	50.2	36.7	24.1	19.3	26.1	17.4	1.4	1.2	1.5

Source: Kazakhstan DHS 1995 and 1999, Uzbekistan DHS 1996, Kyrgyzstan DHS 1997, Georgia and Romania RHS 1999, Armenia and Turkmenistan DHS 2000, and Azerbaijan RHS 2001. See Appendix I.

Account also needs to be taken of sampling error. As infant death is typically a rare event, sampling error for survey based mortality estimates can be substantial, implying great deal of uncertainty regarding the true population rate. Some uncertainty in estimates, exemplified by the width of the confidence intervals, might be caused by small sample sizes. Table 9 presents standard errors and sample sizes for countries in the region and for some developing countries outside the region with similar levels of infant mortality. Because fertility levels in the countries of the Caucasus and Central Asia are generally lower than those in many other developing countries, the number of births from which infant mortality rates are estimated also tends to be lower. The infant mortality rate estimated from the 1989 Kenya Demographic and Health Survey, for example, is 61 per 1,000 live births, similar to that in Kazakhstan. However, the sample of infants from which the Kenya infant mortality rate is calculated is 7,319, compared with 1,501 in the case of Kazakhstan. The 95 per cent confidence interval surrounding the Kenyan estimate is narrower, ranging from 52.2 to 69.3 per 1,000 live births, compared with a range of 45.3 to 78.6 for Kazakhstan.¹⁶ Nonetheless in the case of Kazakhstan and most other countries in the region, the lower bound of

¹⁵ These worries are echoed by the US Centres for Disease Control, which sponsored the survey. The Child Mortality module on the Ukraine 1999 RHS produced results that were inconsistent with expectations, for example a very low stillbirths rate and an extremely high ratio of post-neonatal deaths. While overall, the survey was judged to be satisfactory, these problems may have been the result of inadequate training of survey interviewers for the reproductive history module (personal communication, Howard Goldberg, CDC).

¹⁶ Sample size is not the only factor in determining confidence intervals. Re-weighting of the sample may also increase sampling variability. All DHSs and RHSs require re-weighting.

the confidence interval is still notably above the official infant mortality rate for the time period corresponding to the survey (Table 1 shows the official rates). Exceptions are Ukraine (for reasons discussed above) and Romania, where the official rate (21 deaths per 1,000 live births) falls just within the lower bound of the 95 per cent confidence interval for the survey estimate (20 per 1,000 live births).¹⁷

Table 9: *Survey sizes and sample errors*

	Infant mortality rate	Standard error	95 per cent confidence interval upper bound	95 per cent confidence interval lower bound	Number of women interviewed	Total fertility rate ^a	Number of births ^b
Turkmenistan, 1996-2000	73.9	5.4	84.7	63.1	7919	2.9	3696
Tajikistan, 1996-2000	78.8	6.7	92.2	65.4	2133	3.8 ^c	2530
Azerbaijan 1996-2000	74.4	6.4	87.2	61.6	7668	2.1	3153
Kyrgyzstan, 1993-1997	61.3	7.2	75.6	47.0	3848	3.4	2026
Kazakhstan, 1994-99	61.9	8.3	78.5	45.3	4800	2	1501
Uzbekistan, 1992-1996	49.1	6.6	62.3	35.9	4415	3.3	2455
Georgia, 1994-1999	41.6	5.7	53.0	30.2	7798	1.7	3049
Kazakhstan 1991-1995	39.7	5.6	50.9	28.5	3771	2.5	1597
Armenia, 1996-2000	36.1	5.4	46.9	25.3	6430	1.7	1657
Romania 1995-1999	31.5	6.0	43.5	19.5	6888	1.3	1792
Ukraine 1995-1999	15.2	3.0	21.1	9.3	7128	1.4	1269
Egypt 1988-1992	61.5	3.2	67.9	55.1	9864	3.9	8915
Egypt 1984-1988	73.2	4.1	81.3	65.1	8911	4.5	8898
Kenya 1985-1989	60.7	4.3	69.3	52.1	7150	6.7	7319
Burundi 1983-1987	73.7	5.3	84.3	63.1	3970	6.9	3963
Brazil 1982-1986	73.2	5.7	84.6	61.8	5892	3.4	3595

^a Total fertility rate 15-49 for the three years preceding survey, expressed per woman (Ukraine - 2 years preceding survey)

^b Number of births in last five years preceding survey. In most survey reports, only the weighted number of births is reported. However, this is usually close to the unweighted total.

^c Tajikistan: fertility rate is average of official rates for 1998-2000

Sources: Authors' calculations; Macro International (1995), pages 14-15; see also Appendix 1.

¹⁷ For discussion of the estimation of change in infant mortality over time see UNICEF (2003), pages 49-51.

Model error (the Brass method)

Uncertainty due to sampling and non-sampling error is an inherent component of all survey based estimates. However, in the case of the indirect estimation of mortality, using techniques such as the Brass method, new sources of error are introduced, mainly as a result of some modelling assumptions that need to be made. The limited range of questions asked of MICS respondents does reduce the chances of non-response or inaccurate response discussed above. But it does also mean that this indirect estimation technique must be used to estimate infant mortality with these data. Table 1 shows that in the CEE/CIS region, MICS data have been used for this purpose in the case of Albania, Azerbaijan, Tajikistan and Uzbekistan.

The Brass method allows mortality rates to be estimated from aggregate information on the number of children born to women in 5-year age groups (15-19, 20-24 etc), and the proportion of children in each group who die. What the Brass method does is convert the *observed proportion* of children dead among those born to women in a certain age group into an estimate of *probability of dying* by some exact age, using a set of multipliers which depend on this summary information from the surveys, and data derived from model life tables. There are several versions of the Brass method. The Trussel version (1975), discussed here, is based on model life tables (developed by Coale and Demeny, 1983) which are aggregated into four groups, North, South, West and East, each describing mortality patterns in different regions of Europe and some other countries in 19th and 20th centuries. Thus the Trussel version produces four different sets of mortality estimates for each set of birth and mortality data.

Table 10 demonstrates an application of the Trussel version of the Brass method to Azerbaijan MICS data. Number of children born, average number of children per woman in each age cohort, and proportion who have died are calculated from the survey data. Multipliers derived from model life tables are then used to convert proportions of children dead into the probability of dying by the exact age of 1, 2, 3, 5, 10, 15 and 20. At the last step, model life tables are again applied to convert the probabilities of dying by ages 2 and over to a common index: the probability of dying by age 1.

Table 10: *Application of Trussel version of the Brass Method to the data from Azerbaijan MICS 2000.*

	Age group	Number of children ever born	Average number of children ever born per woman	Parity ratios	Proportions dead	Multipliers	Age	Probability of dying by exact age x	Common index: probability of dying by age 1	Reference dates
i	(1)	(2)	$P(i)$	$P(i)/P(i+1)$	$D(i)$	k	x	$q(x)=k(i)xD(i)$	$q(1)$	$t(i)$
1	15-19	59	0.044	0.069	0.068	1.253	1	0.085	0.085	2000.0
2	20-24	647	0.649	0.417	0.085	1.100	2	0.094	0.082	1998.8
3	25-29	1358	1.556	0.707	0.096	1.010	3	0.097	0.081	1996.8
4	30-34	2217	2.202	0.813	0.096	1.009	5	0.096	0.077	1994.3
5	35-39	3203	2.708	0.865	0.111	1.025	10	0.113	0.084	1991.5
6	40-44	2990	3.131	0.836	0.126	1.008	15	0.127	0.089	1988.4
7	45-49	2310	3.744		0.129	1.000	20	0.129	0.085	1985.0

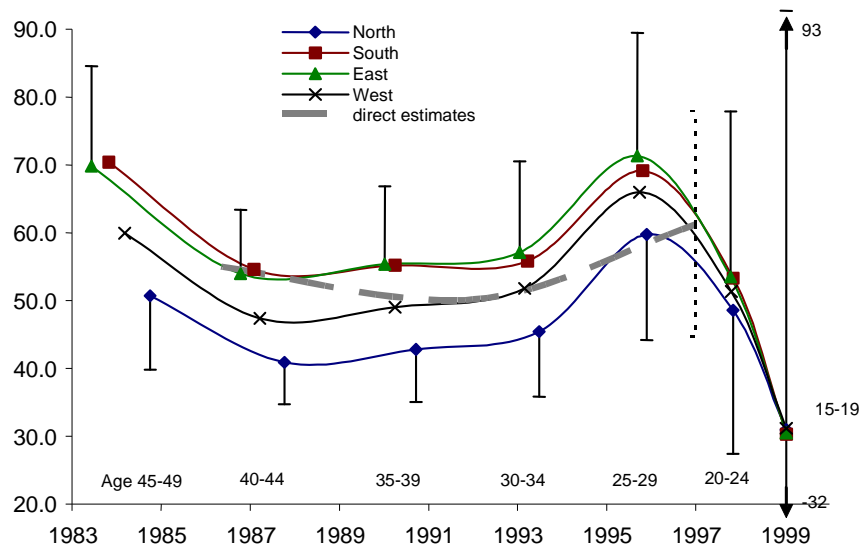
Source: authors' calculations on Azerbaijan MICS 2000 data.

Three important assumptions underly the Brass method, deviation from which may result in distorted estimates of mortality. *First*, the method assumes that mortality is steady or has been changing steadily over time. If there were any sharp fluctuations in mortality during the period analysed, the Brass method would fail to reflect them. *Second*, mortality risk is assumed to be homogenous for each age group of mother. This assumption is generally incorrect, because risk is higher with first births, which are generally to younger women. The *third assumption* relates to fertility: the Brass method assumes that fertility has been constant during 30-35 years preceding the survey. If fertility has been declining, the model will not be able to capture this, meaning shorter than the actual exposure to the probability of dying, and therefore multipliers ($k(i)$ in Table 10) that are too high, leading to overestimated mortality rates. The first and third assumptions are particularly important in the CEE/CIS context, where trends in both infant mortality and fertility may have accelerated since the 1980s. For example, in all countries in the region, fertility has declined, often steeply, since the end of communism (UNICEF, 2001).

The impact of another source of variation in the Trussell version of the Brass Method, the choice of model (North, South, East or West), is also worth considering. There are no strict rules regarding which model is more appropriate for a given population. Figures 4, 5 and 6 show estimates of infant mortality for all four models as applied to the Kazakhstan DHS, the Azerbaijan MICS and the Tajikistan LSMS data. In the case of Kazakhstan and Tajikistan they also show infant mortality estimates computed directly from the same data, while for Azerbaijan, direct estimates are derived from RHS data. These direct estimates give some idea of the error that may be introduced by the simplifying assumptions of the Brass method. The North model produces the lowest estimates of IMR, and the East model gives the highest rates. Solid vertical bars on the graphs represent lower and upper

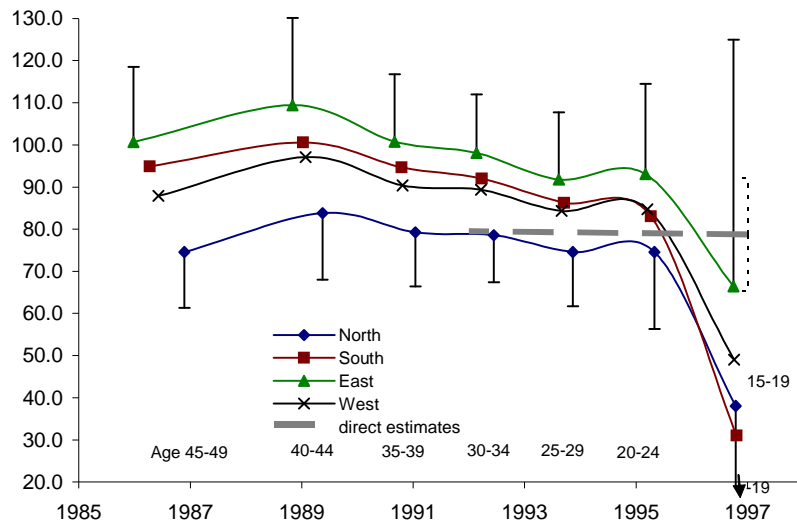
boundaries of 95 per cent confidence intervals for the North and East sets of estimates. The range that they show combines two components of uncertainty associated with Brass estimates: the uncertainty due to the choice of model life table and uncertainty due to sampling variability. The figures clearly show that mortality rates based on samples of young women (that is, the estimates for the most recent years prior to survey) are generally unreliable, with higher standard errors than those for older women. The most reliable estimates (with confidence intervals closest to those computed for direct estimates of infant mortality) appear to be those in the middle period, referring approximately to years 1991-1994. Even here, however, the range is wide, for example between about 70 and 110 deaths per 1,000 live births in the case of Tajikistan.

Figure 4: *Kazakhstan DHS 1999, Brass estimates of infant mortality rates (jackknife standard errors)*



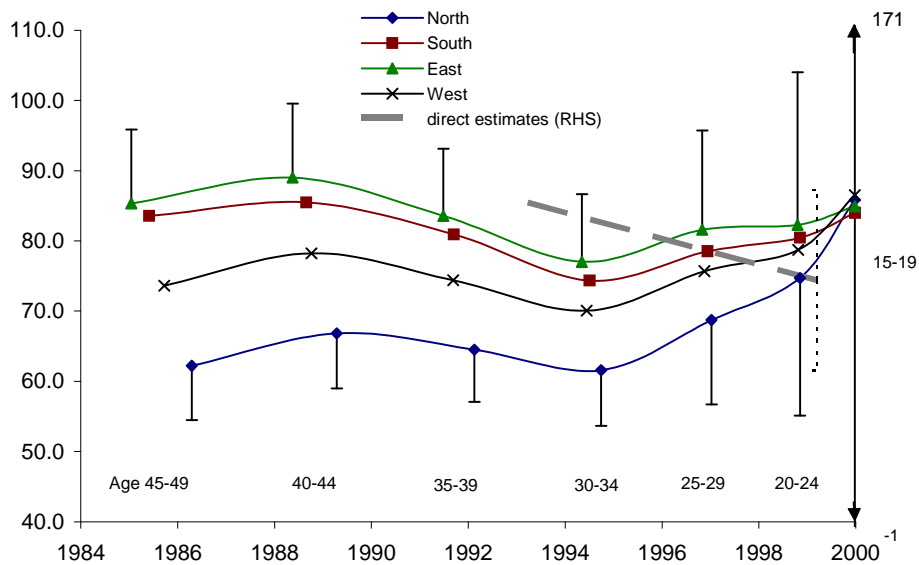
Source: Authors' calculations from Kazakhstan DHS 1999 data.

Figure 5: Tajikistan LSMS 1999, Brass estimates of infant mortality rates (jackknife standard errors)



Source: Authors' calculations from Tajikistan LSMS 1999 data.

Figure 6: Azerbaijan MICS 2000, Brass estimates of infant mortality rates (jackknife standard errors)



Source: Azerbaijan RHS 2001 (see Appendix I) and authors' calculations from Azerbaijan MICS 2000 data.

Discussion

While there is widespread agreement that official infant mortality rates in several CEE/CIS countries understate the true picture, there is less agreement on which countries (particularly outside of the eight countries of Caucasus and Central Asia) the problem extends to. There is also some uncertainty as to what the real level of infant mortality is in these countries. This analysis has attempted to add fresh elements to the debate on these issues.

Where do official infant mortality rates understate the true picture? Figure 7 summarises the evidence presented in this paper. Cell colour indicates for each country in the region the strength of evidence regarding the accuracy of official measures of infant mortality. The dark grey cells indicate evidence suggesting underestimation. The light grey cells denote an absence of any evidence at all, while the white cells indicate evidence supporting the official data. From this information, it seems likely to us that real infant mortality rates are poorly reflected in official counts in all countries of the CIS - except perhaps Belarus, where evidence is quite scarce. In South Eastern Europe, too, the accumulated evidence points to underestimation in official data in Albania, Bulgaria, Romania and perhaps also in FYR Macedonia. In Croatia and the Central European and Baltic countries, on the other hand, there is nothing to suggest that the official data understate the true picture.

Figure 7: Summary of evidence on estimation of official infant mortality rates

	Evidence from large scale surveys (Table 1)	Definition of live birth (Table 3)	Ratio of post-neonatal to neonatal mortality (Table 5)	Kingkade and Sawyer's adjustment factors (Table 6)	Ratio of stillbirths to early neonatal deaths (Figure 1)	Under-estimation of child deaths in surveys (Figure 2)	Non-registration of births and deaths (Table 7)	Evidence from small scale studies*
<i>CIS</i>								
Armenia	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Azerbaijan	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Belarus	Light Grey	White	Light Grey	Light Grey	Light Grey	Light Grey	Light Grey	Light Grey
Georgia	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Kazakhstan	Dark Grey	Dark Grey	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Kyrgyzstan	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Moldova	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Russia	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Tajikistan	Dark Grey	Dark Grey	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Turkmenistan	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Ukraine	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Uzbekistan	Dark Grey	Dark Grey	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
<i>South Eastern Europe</i>								
Albania	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Bosnia-Herzegovina	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Bulgaria	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Croatia	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
FR	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Yugoslavia	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
FYR	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Macedonia	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Romania	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
<i>Central Europe</i>								
Czech Republic	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Estonia	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Hungary	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Latvia	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Lithuania	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Poland	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Slovakia	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
Slovenia	Light Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey
<i>Key</i>								
Evidence of underestimation in official data				Dark Grey				
No evidence either way				Light Grey				
Evidence of accuracy in official data				White				

* Small scale studies include the following: Armenia - Ministry of Health and UNICEF Armenia (2002); Georgia - Asatiani (2001); Kazakhstan - Wuhib (1998), and Ministry of Health and ZAO Kazakhstan (2002); Tajikistan – Guerra *et al* (2003).

Note: this table summarises the evidence presented in this paper regarding the underestimation of infant mortality rates in official data. A white cell indicates that evidence does not point to underestimation of official data in terms of the indicator concerned. A light grey cell indicates that there is no evidence either way from the relevant indicator about the accuracy of official data. A dark grey cell indicates that evidence for the relevant indicator suggests underestimation of official infant mortality rates.

How high is infant mortality? In the 11 CIS countries and four South East European countries where there is some evidence of official undercounting of infant mortality, the question remains: what is the real level? Here, this analysis can offer few definitive answers. In those countries where the Soviet definition of infant mortality has been largely maintained, the real infant mortality rate is likely to be at least a fifth higher than the official rate. Where misreporting and non-registration of births are deaths are problems, the real rate will be higher still, although difficult to quantify. Where surveys have been carried out, these should give us some clue as to the real infant mortality rate. But as this analysis shows, they are rather blunt instruments. Because fertility in CEE/CIS countries is low in comparison with that in many developing countries, the number of babies born to respondent women, from whom the infant mortality rate is estimated, is also low. Thus sampling variability and confidence intervals are wide. Moreover, there are several sources of non-sampling error. One of these, the interpretation of survey questions in CEE/CIS countries where medical staff attend most births, and where they also sometimes misreport pregnancy outcomes, has not been adequately studied. If some survey respondents report pregnancy outcomes in accordance with what they have been told by doctors, then the surveys too may underestimate the true level of infant mortality. The case of the Ukraine 1999 RHS discussed in this paper serves as a warning that infant mortality is difficult to measure, and that non-sampling error can seriously bias results.

Where indirect methods (for example, the Brass method) are used to estimate levels of infant mortality from survey data, the analysis shows that the potential for error is compounded by both sampling variability and model choice, implying a low level of certainty as to where the true population value lies. On the other hand, the analysis also shows that in Azerbaijan and Tajikistan, where two independent surveys have been carried out, one that allows direct estimation, and one that only allows indirect estimation, results are compatible, suggesting perhaps a robustness in the estimates in spite of wide confidence intervals.

Some useful policy and methodological conclusions come out of this analysis. First, as has been argued in a recent UNICEF analysis, progressive adoption of the WHO definition of live birth, and steps to reduce misreporting of infant deaths and to improve civil registration need to be taken across the CIS and South Eastern Europe (UNICEF, 2003). Second, surveys that can capture infant mortality need to be carried out in all those countries where the official rate is in doubt. Third, the surveys themselves need to be improved, in two ways in particular. More research needs to be carried out on how questions in these surveys are interpreted by respondents, and sample sizes need to be increased, so that the number of births from which infant mortality is estimated is sufficiently large, and sampling variability is reduced. This analysis shows that as things currently stand, there is little accurate

information on progress towards the key development goal of reducing child and infant mortality in many countries in the region. Better data are needed to fill this gap.

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Appendix I: Survey data sources used in this article

In some cases where the authors had access to the original microdata, results used in this analysis were calculated by the authors themselves. In most cases, however, survey results used in this article are taken from publications describing the surveys conducted in the region. Surveys and the publications associated with them are listed below. Full references are in the bibliography:

Armenia DHS 2000	NSS, MH and ORC Macro (2001)
Azerbaijan MICS 2000	SSCA and UNICEF (2000)
Azerbaijan RHS 2001	Serbanescu, F, L Morris, S Rahimova and L Flowers (2002)
Albania MICS 2000	UNICEF (2000a)
Bosnia and Herzegovina MICS 2000	UNICEF (2002)
Georgia RHS 2000	Serbanescu, F, L Morris, Nk Nutsbidze, P Imnadze and M Shaknazarova (2001)
Georgia MICS 2000	State Department of Statistics, National Center for Disease Control and UNICEF, Georgia (2000)
Kazakhstan DHS 1995	National Institute of Nutrition, Academy of Preventive Medicine of Kazakhstan and Macro International (1996)
Kazakhstan DHS 1999	APM and ORC Macro (2000)
Kyrgyzstan DHS 1997	RIOP and ORC Macro (1998)
Moldova RHS 1997	Serbanescu, F, Leo Morris, Mihai Stratila and Octavien Bivol (1998)
Romania RHS 1999	Serbanescu, F, L Morris and M Marin (eds) (2001)
Russia RHS 1996	VCIOM and CDC (1998)
Tajikistan LSMS 1999	State Statistical Agency and Center for Strategic Studies, UNDP and World Bank (2000)
Tajikistan MICS 2000	UNICEF (2000b)
Turkmenistan DHS 2000	GECRCMCH and ORC Macro (2001)
Ukraine RHS 1999	Kiev International Institute of Sociology, CDC and USAID (2001)
Ukraine MICS 2000	State Statistics Committee of Ukraine (undated)
Uzbekistan DHS 1996	Institute of Obstetrics and Gynecology and Macro International (1997)
Uzbekistan MICS 2000	State Department of Statistics and UNICEF (2000)

Further information on the surveys can also be found in the following websites:

DHS – www.measuredhs.com

RHS – www.cdc.gov/nccdphp/drh

MICS – www.childinfo.org

LSMS – www.worldbank.org/lms

Appendix II: Legal sources for definition of live birth and stillbirths

Armenia

Decree No.776/84 of 16.08.1994: Instruction On Defining the Standards for Live Births, Still Births and the Perinatal Period

Belarus

Ministry of Health and State Committee for Statistics and Analysis, Belarus (09.11.93), Decree N0 254/75 “*On shifting to WHO Standards for Live Births and Still birth*”, [Министерство здравоохранения Республики Беларусь и Государственный комитет по статистике и анализу Республики Беларусь № 254/75 от 9 ноября 1993 г, “Инструкция об определении критериев живорождения, мертворождения и перинатального периода”, приказ-постановление.“О переходе на рекомендованные Всемирной организацией здравоохранения критерии живорождения и мертворождения”]

Georgia

Joint decree (N 334/o, N134, N95/s) of Ministry of Labour, Health and Social Affairs, Ministry of Justice and Committee of Social Economic Information, 9 November 1993, on "Registration of birth, stillbirth and child mortality".

Kyrgyzstan

Ministry of Health , Kyrgyzstan (11.12.2002), Instruction No 551 on introduction of international live birth definition.

Moldova

Ministry of Health (03.03.95) and the Department of Statistics and Sociology (28.02.95), Moldova , Joint Decree No 103/No 3 “*On shifting to WHO Standards for Live Births and Still birth*” .

Russia

Ministry of Health, Russia (01.07.2002), Letter No 2510/6513-02-32, “On statistical counting of children born alive before 28 weeks of gestation are completed and weighting less than 1000 grams that survive perinatal period (168 hours)”, Moscow [Письмо Минздрава РФ от 01.07.2002 г. N 2510/6513-02-32 "О статистическом учете случаев рождения живыми детей (плодов) в сроке до 28 недель гестации и массой тела до 1000 г, переживших перинатальный период (168 часов)". <http://www.apteki.nnov.ru/docs/357/5-6-1.html>]

Ministry of Health and Goskomstat, Russia (04.12.92), Decree No 380/190 “*On shifting to WHO Standards for Live Births and Still birth*”, Moscow

[Министерство здравоохранения и медицинской промышленности Российской Федерации и Госкомстата Российской Федерации, приказ-постановление 4.12.92 № 380/190 «О переходе на рекомендованные Всемирной организацией здравоохранения критерии живорождения и мертворождения»,

http://www.med-pravo.ru/PRICMZ/PricMZ1992/Pric318_190-92.htm]

Ukraine

Ministry of Health, Ukraine (19.02.96), Decree No 31 “*On introduction of definitions of life birth, stillbirth and perinatal period*”, Kiev [Міністерство охорони здоров'я України, Н а к а з, Зареєстровано в Міністерстві юстиції України (крім пунктів 1.2 та 1.3) 5 квітня 1996 р. за N 160/1185, “Про затвердження Інструкції про визначення критеріїв живонародженості, мертвонародженості та перинатального періоду”, http://rada.gov.ua/laws/pravo/new/termin/t_15.html]

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