

Underestimation of Infant Mortality Rates in One Republic of the Former Soviet Union

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ABSTRACT. *Objectives.* Kazakhstan's live-birth definition—that dates from the former Soviet Union (FSU) era—differs from that used by the World Health Organization (WHO). We studied the impacts of both live-birth definitions on the computations of the infant mortality rate (IMR) and maternal and child health (MCH) planning in Zhambyl Oblast, Kazakhstan.

Methods. We interviewed caregivers and abstracted medical records to obtain birth weight and age-at-death information on infant deaths in Zhambyl Oblast from November 1, 1996, through October 31, 1997. Using the 2 indicators of birth weight and age at death, we created a matrix delineating the respective contribution to infant death (maternal health, newborn care, or infant care) for the cells. We then calculated the IMR, birth weight-specific IMR (BWS-IMR), and birth weight-proportionate IMR (BWP-IMR) for each cell.

Results. The observed IMR in Zhambyl Oblast, in 1996—using the definition of a live birth from the FSU—was 32 per 1000 live births. The recalculated IMR—using the WHO definition—was 58.7 per 1000 live births. Computed estimates of the contribution to infant death, by the categories of maternal health, newborn care, and infant care, were 10%, 23%, and 67%, respectively, when using the live-birth definition from the Soviet era. These estimates shifted to 24%, 41%, and 35%, respectively, when using the WHO definition, yet only 8% of the Zhambyl Oblast MCH budget was earmarked to maternal health and newborn care, which we estimated accounted for 65% of infant deaths.

Conclusions. The live-birth definition commonly used in the FSU underestimated the IMR and undervalued the contributions to infant death by both maternal health and newborn care. We recommend that all republics of the FSU adopt the WHO live-birth definition so that the IMR can serve as a better indicator for MCH planning. *Pediatrics* 2003;111:e596–e600. URL: <http://www.pediatrics.org/cgi/content/full/111/5/e596>; *infant mortality, former Soviet Union, perinatal, neonatal, maternal and child health.*

ABBREVIATIONS. IMR, infant mortality rate; WHO, World Health Organization; FSU, former Soviet Union; VLBW, very low birth weight; IBW, intermediate birth weight; NBW, normal birth weight; BWS, birth weight-specific; BWP, birth weight-proportionate.

Each year, >4 million infants (children younger than 1 year) in the world die before they reach the age of 1 month.¹ Preventing infant death is a high priority among international health agencies. For the past century, the infant mortality rate (IMR) has been used for intercountry comparisons that reflect health, economic, nutrition, and social status.² The IMR is published by the World Health Organization (WHO) to monitor progress toward achieving the specific goals in the Health-for-All by the Year 2010 global strategy. External donors also use the IMR to direct financial and technical assistance.

Kazakhstan is the largest land-locked country in the world with the second largest area in the Newly Independent States of the former Soviet Union (FSU), behind the Russian Federation. Kazakhstan's population of 14.8 million is divided into 14 administrative regions (Oblasts), each functioning with some autonomy. The United States Agency for International Development/Global Bureau funded a project in 1996 aimed at reducing childhood mortality as a result of acute respiratory infections and diarrheal diseases. As part of that project, we conducted a study designed to address these goals in Zhambyl (Djambyl/Dzhambul) Oblast. This Oblast has a population of approximately 1 000 000, 17 000 of whom are infants; it has 10 districts (*Raions*), 4 cities, 15 hospitals, 333 health units, 250 pediatricians, and 1200 feldshers (physician assistants).

In 1995, 142 000 deaths were reported among infants in all of the FSU.³ In that year, Kazakhstan reported >13 000 infant deaths, with an IMR of 40 deaths per 1000 live births. However, the reported IMRs from the FSU tend to be based on a definition

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of a live birth used in the Soviet era that differs from the definition now recommended by the WHO.³⁻⁵ IMRs provided to the United Nations Statistical Division by the Russian Federation and the Republics of Ukraine, Armenia, Georgia, Azerbaijan, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, Uzbekistan, Belarus, and Moldova excluded infants who were born alive and were <28 weeks' gestation, of weight <1000 g, or of length <35 cm and died within 7 days of birth.

The WHO-recommended live-birth exclusion criteria for international comparisons differ from those used in Zhambyl Oblast (Fig 1). The WHO defines a live birth as "the complete expulsion or extraction from its mother of an infant, irrespective of the duration of the pregnancy, which after such separation shows any other evidence of life such as breathing, beating of the heart, pulsation of the umbilical cord or definite movement of the voluntary muscles." For international comparisons, infants who die after birth but who are <22 weeks' gestational age or weigh <500 g are considered stillbirths rather than perinatal deaths and are excluded from being considered a live birth.

In comparison, in Zhambyl Oblast, a birth that occurs without a sign of breathing, regardless of the presence of other signs of life, was considered to be a stillbirth.⁶ In addition, any infant who was born at <28 weeks' gestational age or weighed <1000 g, regardless of the presence of any sign of life, was considered an abortus unless the infant survived to 7 days of age.³ Use of these exclusion criteria is widespread throughout the FSU.^{3,6,7}

Maternal health (including health contributors of access to care⁸; family planning, anemia, nutrition, smoking, alcohol use, and human immunodeficiency virus/acquired immune deficiency syndrome⁹; common sexually transmitted diseases¹⁰; bacterial vaginosis¹¹; and substance abuse during pregnancy¹²) is the most important factor contributing to deaths among very low birth weight (VLBW) infants who die at any age (Fig 2).¹³⁻¹⁶ Newborn care (including clean delivery, thermal control, and high-risk infant follow-up) is the most important factor for intermediate birth weight (IBW) infants dying in the early or late neonatal periods and for normal birth weight (NBW) infants dying in the early neonatal period.^{13,14,17} Infant care (including immunization, breastfeeding, case management of acute respiratory infections and diarrhea, and injury control) is the major contributor to deaths of IBW infants who die

in the postneonatal period and to NBW infants who die in the late neonatal or postneonatal period.¹⁸ This study aimed to 1) calculate the IMR in Zhambyl Oblast using both the FSU and WHO live-birth definitions and 2) determine the impacts of these definitional differences on maternal and child health planning.

METHODS

We obtained representative birth weight distributions by a review of medical records from 600 consecutive live births that occurred from November 1, 1996, through October 31, 1997, using the WHO definition of a live birth, from the delivery hospitals in 2 districts of Zhambyl Oblast (96% of the reported births in the Oblast occur in hospitals). Given our knowledge of birth weight-specific (BWS)-IMR in settings in which neonatal intensive care units are lacking,¹⁹ we predicted the BWS-IMR for the VLBW and IBW infants to be approximately 800 and 400, respectively.

We determined the IMR by dividing the number of infant deaths by the total number of live births and multiplying by 1000. Infants were categorized on the basis of birth weight: VLBW, ≤1500 g; IBW, 1500-2499 g; and NBW, ≥2500 g. The BWS-IMR describes the IMR for a given birth weight category; for each birth weight category, we then calculated BWS-IMR by dividing total number of deaths in that specific birth weight category by the number of births in the same category and multiplying by 1000.

To recalculate the IMR by the working definition of a live birth as used in Zhambyl Oblast for November 1, 1996, to October 31, 1997, we used Zhambyl Oblast registries for births and deaths. The birth weight and age at death of all case-deaths were systematically obtained from medical records and, when not available in medical records, from caregiver interviews.

A total of 710 children younger than 5 years died in Zhambyl Oblast during the study period. Among those, 553 (78%) deaths occurred in those who were younger than 1 year. A total of 110 deaths were excluded: 77 who had congenital malformation noted as a cause of death on the medical record and for whom accurate birth weights were not obtained and 33 who died in orphanages and for whom accurate birth weight data were not available. This left 443 case-deaths eligible for enrollment. Of these, 34 had parents or caregivers who had moved and 13 had caregivers who refused participation and for whom birth weight data were not available, leaving 396 (72%) of 553 enrolled in the final data set.

Therefore, we gathered BWS data on a total of 396 (72%) of 553 case-deaths. The birth weight-proportionate (BWP)-IMR describes the contribution of a given birth weight category to total IMR. Computation of the BWP-IMR was performed to estimate the relative contribution that interventions in different birth-related periods (prenatal, neonatal, and postneonatal) could hope to achieve in alleviating the total infant mortality burden.

We calculated the BWP-IMR by dividing the number of deaths in a given weight group by the number of total births in all weight groups. We then divided infancy into 3 age periods: early neonatal, from birth to age 7 days; late neonatal, from 7 to 28 days; and postneonatal, from 28 days to 1 year of age. We constructed a matrix demonstrating the principal contributors to deaths in each of these 3 age periods, by birth weight category. Economic data regarding budget allocations were obtained from the financial offices of the Kazakhstan Ministry of Health.

RESULTS

The birth weight distributions of the 600 consecutive live births using the WHO definition revealed that 1.8% were classified as VLBW, 4.2% as IBW, and 94% as NBW (Table 1). When infants who did not fit the FSU definition of a live birth (ie, those with a body weight <1000 g or <28 weeks' gestation) were excluded from this group, 0.7% was classified as VLBW; 4.1% were IBW, and 95.2% were NBW.

Using the FSU definition of a live birth, BWS-IMR based on the 600 consecutive live births was 443, 191, and 22 for VLBW, IBW, and NBW infants, respectively, with an overall IMR of 32 deaths per 1000 live

	WHO	Zhambyl Oblast
Stillbirth	No signs of life	No respirations
Abortus	< 500g or < 22 weeks	< 1000g or < 28 weeks*
		(*except surviving 7 days)

Fig 1. Comparison of live-birth exclusion criteria.

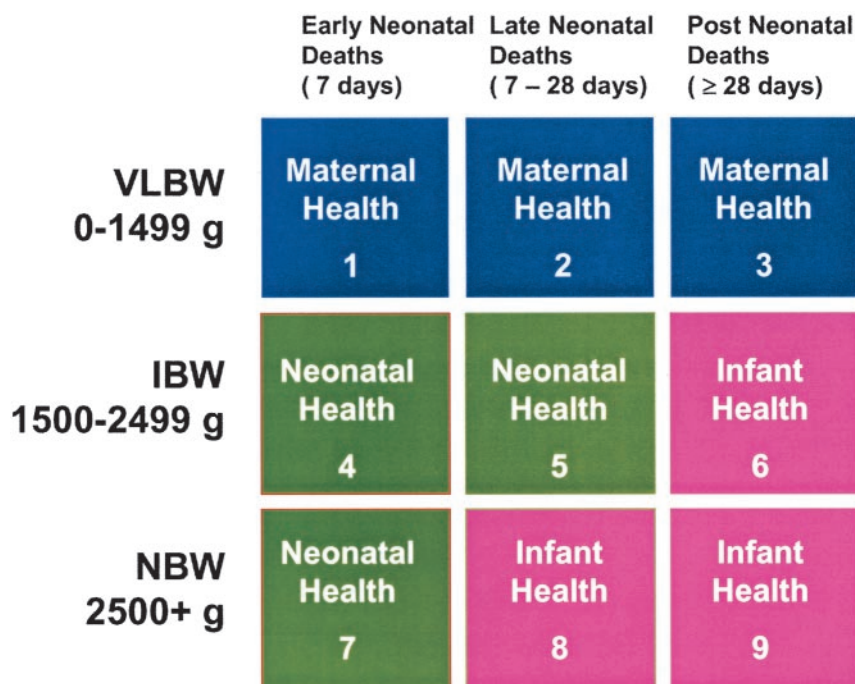


Fig 2. The relationship between birth weight and age-at-death to public health intervention.

TABLE 1. Comparison of the Distributions of Reported Birth Weights in Zhambyl Oblast, Kazakhstan, and Atlanta, Georgia

Location	VLBW (%)	IBW (%)	NBW (%)
Zhambyl Oblast (1996)-using FSU definition*	4 (0.7)	25 (4.1)	571 (95.2)
Zhambyl Oblast (1996)-expected values using WHO definition†	11 (1.8)	25 (4.2)	564 (94)
Atlanta, Georgia (1996)-among white women‡	231 (1.1)	964 (4.6)	19 725 (94.3)

* Calculated by measurement of 600 consecutive live births.

† Including Cobb, DeKalb, Fulton, and Gwinnett counties.

TABLE 2. BWS-IMRs in Zhambyl Oblast, Kazakhstan, and Atlanta, Georgia, 1996–1997

	BWS-IMR*			IMR*
	VLBW	IBW	NBW	
Zhambyl Oblast-observed	443	191	22	32
Zhambyl Oblast-using WHO definition†	800	400	30	58.7
Atlanta, Georgia USA (1996)‡	272	12	2	5.4

* Per 1000 live births.

† Estimated distributions using expected BWS-IMRs.

‡ Including Cobb, DeKalb, Fulton, and Gwinnett counties.

births (Table 2). Using the WHO definition and expected BWS-IMR in a developing country,²⁰ the recalculated overall IMR was 58.7 deaths per 1000 live births. Of the 600 consecutive births used to estimate birth weight distribution, 100% of the infants who were born weighing <1500 g died before discharge from the delivery hospital, and the mean number of days of stay in the delivery hospital was 6 days.

The BWP-IMRs stratified by 3 intervention categories of maternal health, newborn care, and infant care revealed that by using the FSU definition of a live birth, the attributable contribution, by intervention category, to infant mortality was 10% from maternal health, 23% from newborn care, and 67% from infant care (Table 3). Using the recalculated IMR based on the WHO definition and expected BWS-IMR, the estimate of the attributable contribution, by interven-

tion category, was 24% for maternal health, 41% for newborn care, and 35% for infant care. On the basis of the data provided by the Kazakhstan Ministry of Health, \$5.5 million was budgeted for maternal and child health activities in Zhambyl Oblast in 1997, yet only 8% was earmarked for maternal health and newborn care.

DISCUSSION

This study demonstrated that the definitional criteria for a live birth and fetal death used widely in the FSU masked opportunities for intervention to reduce the true burden of infant death. Using the reported numbers from a representative oblast in Kazakhstan (Zhambyl) based on the commonly used definition of a live birth from the FSU and used widely throughout the region, we estimated an IMR

TABLE 3. Proportion of the Contribution to Infant Mortality, by Intervention Category, Zhambyl Oblast, Kazakhstan, 1996–1997

Intervention Category	% Zhambyl Oblast-Observed	% Zhambyl Oblast-Using WHO Definition	% Zhambyl Oblast-Budgeted
Maternal health	10	24	4
Newborn care	23	41	4
Infant care	67	35	92

of 32, compared with an IMR of 58.7 when using the definition recommended by WHO. This puts into perspective the lack of understanding that Western demographers have had in conceptualizing the low and moderate IMRs (15–29.9 per 1000 live births) historically reported from the FSU^{3,6,7} and underscores the importance of ascertaining case definitions when making international comparisons of mortality data.

This study had several limitations. Birth weight information was not available for 157 (28%) of the 553 case-deaths. The possibility exists that exclusion of these uncaptured deaths would result in a selection bias, although no systematic differences could be anticipated that would lead us to expect that nonparticipants would differ in weight from participants. However, it should be noted that we only abstracted birth weight information from hospital deliveries. Although 96% of births occurred in the hospital, it is possible that the 4% home births could have influenced the estimate, especially if home births had a greater proportion of low birth weight infants. Unfortunately, information on the birth weight of home deliveries was not available, but it is reasonable to hypothesize that home births might indeed skew the birth weight distribution in favor of a greater underestimation of the contribution of the lower birth weight groups. In evaluating potential difficulties that could result from missing data, no systematic biases were identifiable referent to the 157 case-deaths for which birth weight information was not available.

The live-birth exclusion criteria used in Zhambyl Oblast are those that were used during the FSU and are still widely used. In comparison to WHO exclusion criteria, the use of the FSU-era criteria selectively removes LBW infants from the numerator, and, consequently, the lower BWS-IMRs are systematically underestimated. The reasons that the FSU-era definition of a live birth evolved as it did are multifactorial; certainly the Central Statistical Administration of the Soviet state did not want data to reflect poorly on the quality of social, economic, and environmental conditions for which the centrally planned economy had assumed direct responsibility.³ In approaching this evaluation, we realized that it would be of value to describe the true frequency and distribution of stillbirths and congenital malformations that occur in this environment. However, in this Oblast, these data were not gathered in a systematic manner that would allow for generalizable conclusions.

Unfortunately, reporting behaviors also continue

to reflect practices from the Soviet era in which there were disincentives to reporting infant deaths. In many regions of the FSU, it was common practice to investigate all infant deaths, and if a physician were found guilty of the infant's death, then he or she would be penalized. To avoid being investigated, physicians use the live-birth definition to their advantage and, given the choice, would classify as a stillbirth or abortus any infant who had been born alive but died shortly thereafter.³

If the study presented here were conducted in the early 1970s, then it would have obviated some consternation of demographers in understanding why IMR statistics increased in the FSU in the subsequent 2 decades.²¹ Speculation and discussion on this matter have revolved around issues of involvement of women in industry, disorganization of the family structure, high abortion rates, and financial constraints on the development of medical services.²¹ However, year-to-year comparisons in a setting in which there were disincentives for accurate reporting yielded data for which there was no clear meaning, and there was lack of understanding of the degree to which IMR estimates were truncated by use of the FSU live-birth definition.

In the past, several countries, including France and Spain, enumerated deaths within the first day of life separately from other infant deaths, but this practice was officially discontinued ~25 years ago.⁴ Even among countries that have adopted the WHO criteria of live birth and fetal death, subtle differences in the way that cases are classified as live birth or fetal death can still result in large differences in reported IMR.²² If comparability of data are useful for illuminating areas in which improvement in public health can be achieved, then there is something to be said for using as the definition of a live birth the definition adopted by the World Health Assembly.²³

With dissolution of the FSU, many of the republics have experienced economic deprivation resulting in reductions in health care spending; many health care facilities are in poor condition, and many lack electricity and running water. Given hospital conditions and absence of neonatal intensive care units, expected that BWS-IMRs used in this study are reasonable and might even be conservative. Of the 600 consecutive births used to estimate birth weight distribution, 100% of the infants who were born weighing <1500 g died before discharge from the delivery hospital.

If the observed BWS-IMRs for VLBW infants born in Zhambyl Oblast were accurate (443 deaths per 1000 live births), then they would be similar to those observed in Atlanta, Georgia (370 deaths per 1000 live births).²⁴ Given the economic disparities between these 2 settings, there is similarity in terms of survival of these 2 groups, raising the suspicion that some deaths are going unreported in the financially constrained environment of Zhambyl Oblast. Finland has one of the lowest rates of low birth weight in the world,²⁵ yet using Soviet-era exclusion criteria, the currently registered birth weight distribution for Zhambyl Oblast is similar to that of Finland.

CONCLUSIONS

The IMR in this Oblast is underreported. This is partially attributable to the differences between the Soviet-era and WHO definitions of live births and partially attributable to existing reporting disincentives for physicians. Consequently, these differences result in many early neonatal deaths being misclassified as stillbirths or abortions. Underreporting of early neonatal deaths severely underestimates the contribution made by both maternal health and newborn care to the overall IMR favoring overestimation of the contribution made by infant care to infant mortality.

One obstacle to improving perinatal health in developing countries is the erroneous belief that widespread use of high-technology neonatal intensive care would be required, necessitating massive investment in equipment, staff training, and support services.^{26,27} However, most infant deaths can be reduced through effective public health and clinical interventions,^{26,27} and many of the same interventions used to reduce early neonatal deaths also prevent maternal morbidity and mortality. Devising effective strategies to reduce infant deaths requires accurate measurement of the IMR, because the IMR can both provide insights into maternal, newborn, or infant care contributors to infant deaths and allow monitoring of infant mortality preventive strategies. However, differences in definition and registration practices among countries significantly curtail usefulness of the IMR as an indicator and a tool for maternal and child health planning.

The aims of this study were to examine the IMR when calculated by the Soviet-era method compared with the WHO method and to assess the impact of its calculation on maternal and child health in Zhambyl Oblast. We recommend that public health practitioners in the FSU collect information on all products of conception or at least use the WHO definition of a live birth and that the ministries of health in the FSU eliminate the punitive consequences for reporting accuracy and restructure public health practice to reflect the underestimated contribution made by both maternal health and newborn care. The implications for these findings command the urgent attention of health planners in the FSU if realistic assessments of infant mortality are to be made and if intervention programs are to be evaluated.

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