Perinatal and Maternal Outcomes in Tuzla Canton during 1992-1995 War in Bosnia and Herzegovina

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Aim To compare perinatal and maternal outcomes in Tuzla Canton during the 1992-1995 war in Bosnia and Herzegovina with those before (1988-1991) and after (2000-2003) the war.

Methods We retrospectively collected data on a total of 59 707 liveborn infants and their mothers from the databases of Tuzla University Department for Gynecology and Obstetrics and Tuzla Institute for Public Health. Data on the number of live births, stillbirths, early neonatal deaths, causes of death, gestational age, and birth weights were collected. We also collected data on the number of medically unattended deliveries, examinations during pregnancy, preterm deliveries, and causes of maternal deaths. Perinatal and maternal outcomes were determined for each study period.

Results There were 23 194 live births in the prewar, 18 302 in the war, and 18 211 in the postwar period. Prewar perinatal mortality of 23.3 per 1000 live births increased to 25.8 per 1000 live births during the war ($P<0.001$), due to a significant increase in early neonatal mortality (10.3‰ before vs 15.1‰ after the war, $P<0.001$). After the war, both perinatal mortality (14.4‰) and early neonatal mortality (6.6‰) decreased ($P<0.001$ for both). The most frequent cause of early neonatal death during the war was prematurity (55.7%), with newborns most often dying within the first 24 hours after birth. During the war, there were more newborns with low birth weight (<2500 g), while term newborns had lower average body weight. Women underwent 2.4 examinations during pregnancy (5.4 before and 6.3 after the war, $P<0.001$ for both) and 75.9% had delivery attended by a health care professional (99.1% before and 99.8% after the war; $P<0.001$ for both). Maternal mortality rate of 65 per 100 000 deliveries during the war was significantly higher than that before (39 per 100 000 deliveries) and after (12 per 100 000 deliveries) the war ($P<0.001$ for both).

Conclusion Perinatal and maternal mortality in Tuzla Canton were significantly higher during the war, mainly due to lower adequacy and accessibility of perinatal and maternal health care.

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Perinatal outcome is the measure of the quality of perinatal care given to the mother and child before, during, and after delivery. Although perinatal care amounts to only 0.5% of the total health care an average person receives in a lifetime, this type of care is crucial for general health later in life and a is good indicator of the health of the pediatric population (1-3). More deaths occur in the perinatal period than in the first 30 years of life, and this death rate depends on the organization, availability, quality, and level of the development of perinatal care (4). According to the World Health Organization (5), there are about 7 million perinatal deaths in the world per year, with perinatal death rates ranging from 4-7 per 1000 live births in developed countries, 39 per 1000 in South America, 53 per 1000 in Asia, to 75 per 1000 in Africa. Every year, approximately 600 000 women die of pregnancy-related causes (6).

Before the 1992-1995 war in Bosnia and Herzegovina, primary health care was provided in health centers and their outpatient facilities, secondary health care in general and regional hospitals and only partially in health care centers (specialized counseling), and tertiary health services were provided in medical centers, which were also university teaching hospitals (7). Perinatal care in Bosnia and Herzegovina had not been provided at the primary health care level, mostly due to insufficient perinatal knowledge and clinical skills of primary care physicians and other staff, and a lack of adequate equipment and space. Thus, in addition to tertiary health care, secondary health care, which was easily accessible, provided most of health care services to pregnant women, women giving birth, and newborns (7).

All deficiencies of the health care system organization in Bosnia and Herzegovina became obvious during the war period. Regular examinations during pregnancy could not be performed at any level of health care, health care at birth was inadequate, and neonatal health care was almost non-existent. Many hospital systems and the existing equipment were damaged or destroyed in war (8), shortage of medicines was evident, and a large proportion of health care staff either left the country or was needed on the battlefield. The existing hospital facilities were overcrowded with the wounded and patients with chronic diseases. The whole health care system was adapted to war circumstances. Perinatal care in Bosnia and Herzegovina rapidly deteriorated. Furthermore, there was massive migration of the population due to the war and some parts of the country, such as Tuzla Canton, were overburdened with a large number of refugees and displaced persons (8).

The aim of this study was to determine how increased inaccessibility of perinatal and maternal health care during the war reflected on perinatal and maternal outcomes in Tuzla Canton, Bosnia and Herzegovina.

Patients and methods

According to the 1991 census, Bosnia and Herzegovina had a population of 4.39 million, 2.78 million of which lived on the territory of the present Federation of Bosnia and Herzegovina, one of the two political entities in the Republic of Bosnia and Herzegovina. Today, approximately 2.54 million people live in the Federation. Tuzla Canton (2909 km^2) has 13 municipalities and 510 353 inhabitants.

Data collection

We retrospectively collected the data on a total of 59 707 liveborn infants and their mothers in Tuzla Canton, Bosnia and Herzegovina, from the databases of the Tuzla University Department for Gynecology and Obstetrics and Tuzla Institute for Public Health for three time periods: before (1988-1991), during (1992-1995), and after the war (2000-2003). Data on the number of live births, stillbirths, early neonatal deaths, causes of death, gestational age, birth weights, and body

length were collected. We also determined the number of examinations received during pregnancy, deliveries unattended by health care providers, maternal deaths, and causes of death. Perinatal and maternal outcomes were determined for each study period.

Perinatal criteria

Stillbirth rate was defined as the number of stillbirths after 24 weeks of gestation per 1000 total births in the same time period. Antepartum stillbirths were those that occurred before the onset of labor, whereas intrapartum stillbirths were those that occurred during labor. The fetus was assumed to be alive at the start of labor unless there was evidence for otherwise.

Early neonatal mortality was defined as the number of liveborn babies who died within the first 168 hours (7 days) after birth per 1000 live births.

Perinatal mortality was defined as the number of deaths of newborns born after ≥24 weeks of gestation or with body weight of ≥500 g per 1000 live births. Since autopsies were not performed, the causes of death were based on clinical diagnoses and categorized according to Wigglesworth's classification (9).

Intrauterine growth was estimated on the basis of birth weight and gestational age. Body weight, body length, and head circumference of newborns were measured in the first hour after birth. Body weight of infants without diapers and with the umbilical cord shorter than 10 cm was measured using spring scales to the nearest 100 g. Low birth weight was defined as the body weight of <2500 g at birth, irrespective of gestational age. High birth weight, above the 10th percentile of the birth weight distribution in our sample, was defined as body weight of >3500 g at birth. Body length (cm) was measured from crown to heal in a newborn with completely extended legs and feet at the angle of 90°. Head circumference (cm) was measured by a non-stretchable measuring tape placed around the head over a maximum occipital prominence and frontal bone above the eyebrows.

Gestational age in weeks was estimated from the number of days between the first day of the last menstrual period and date of birth and from ultrasound examination if performed. If these data were not available, gestational age was assessed on the basis of external physical characteristics of the newborn (10). Preterm birth was defined as a birth before completed 37 weeks of gestation. A post-term birth was defined as birth after completed 42 weeks of gestation.

Statistical analysis

Differences in categorical data between the study periods were assessed by the χ^2 test. For 2 by 2 tables, rate ratios with 95% confidence intervals (CI) were calculated. Linear trend was calculated for 500-g birth weight subgroup rates per 100 liveborn infants with extended Mantel-Haenszel χ^2 test for trends. STATISTICA 6.0 (StatSoft Inc., Tulsa, OK, USA) was used for all statistical analyses. $P<0.05$ was considered statistically significant.

Results

The number of live births during the war was by 20% lower than their number before the war, but not very different from the number after the war (Table 1). The prematurity rate of 12.5%

Table 1. Number of liveborn infants according to gestational age, stillbirths, early neonatal mortality, and total perinatal mortality at Tuzla University Department for Gynecology and Obstetrics in the prewar (1988-1991), war (1992-1995), and postwar (2000-2003) period

	No. of newborns				
Group of newborns	prewar (n = 23 194)	*P**	war (n = 18 302)	*P**	postwar (n = 18 211)
Gestational age (weeks):					
<37	2578	<0.001	2272	<0.001	1735
37-42	20 082	0.007	15 635	<0.001	16 257
>42	534	0.324	395	<0.001	219
Stillborns†	242 (10.3)	0.826	195 (10.5)	0.039	141 (7.6)
Early neonatal deaths†	250 (10.7)	<0.001	278 (15.1)	<0.001	122 (6.6)
Perinatal death†	492 (21.2)	0.002	473 (25.8)	<0.001	263 (14.4)

*χ^2_1 test.
†The number in the parentheses is the number of stillborns per 1000 total births.

was significantly higher during the war than before and after the war (11.1% and 9.5%, respectively; $P<0.001$ for both). Perinatal mortality rate of 25.8 per 1000 liveborn infants was significantly higher during the war, as well as early neonatal mortality rate (Table 1). However, the rate of stillborns was not significantly different before and during the war, but it significantly decreased after the war ($P=0.003$). Causes of early neonatal death were the same in all three study periods, but they differed in frequency, with prematurity being the most prevalent cause of early neonatal death during the war (Table 2).

In the war period, the proportion of newborns who died within the first 24 hours of life was significantly higher than before or after the war ($P<0.001$ for both; Table 3). However, the number of newborns who died after the first 24 hours of life was significantly higher before the war than during or after the war (Table 3).

The distribution of newborn birth weights significantly differed before, during, and after the war (Table 4). Among the liveborn infants born during the war, 1373 (7.5%) had birth weight of <2500 g, which is significantly more in comparison with 851 (3.6%) liveborn infants in this birth weight group born before (rate ratio 2.110; 95% CI, 1.908-2.331) and 419 (2.3%) after the war (rate ratio, 3.931; 95% CI, 3.427-4.509). The proportion of liveborn infants with birth weight of 3000-3499 g was the highest during the war (46.5%); on the other hand, the proportion of liveborn infants with birth weight of >4000 g was the lowest (Table 4).

The average birth weight of term newborns during the war was 200 g and 300 g lower than the average birth weight of term newborns before and after the war, respectively. The body length of term newborns during the war was also slightly lower than before or after the war (Table 5).

Table 2. Causes of early neonatal mortality at the Tuzla University Department for Gynecology and Obstetrics in the prewar (1988-1991), war (1992-1995), and postwar (2000-2003) period

	No. (%) of newborns				
Causes of death	prewar (n = 250)	*P**	war (n = 278)	*P**	postwar (n = 122)
Congenital anomalies	34 (13.6)	0.262	29 (9.7)	0.001	31 (25.4)
Hypoxia and trauma	59 (23.6)	0.002	37 (13.3)	0.043	26 (21.3)
Prematurity	63 (25.2)	<0.001	155 (55.7)	<0.001	37 (30.3)
Infection	52 (20.8)	0.171	45 (16.1)	0.943	12 (9.8)
Miscellaneous	32 (12.8)	<0.001	8 (2.8)	0.079	11 (9.0)
Other	10 (4.0)	0.119	4 (1.4)	0.198†	5 (4.0)

*χ^2_1 test.
†Yates-corrected χ^2.

Table 3. Timing of neonatal death at the Tuzla University Department for Gynecology and Obstetrics in the prewar (1988–1991), war (1992-1995), and postwar (2000-2003) period

	No. (%) of newborn deaths				
Time of death (hours of life)	prewar (n = 250)	*P**	war (n = 278)	*P**	postwar (n = 122)
<24	26 (10.4)	<0.001	155 (55.7)	0.001	27 (22.1)
24-72	147 (58.8)	<0.001	69 (24.8)	0.900	31 (25.4)
>72	77 (30.8)	0.002	54 (19.4)	<0.001	64 (52.4)

*χ^2_1 test.

Table 5. Average birth weight, body length, and ponderal index of term newborns at the Tuzla University Department for Gynecology and Obstetrics in the prewar (1988-1991), war (1992-1995), and postwar (2000-2003) period

	Finding (mean±SD)				
Parameter	prewar (n = 22 343)	*P**	war (n = 16 929)	*P**	postwar (n = 17 792)
Birth weight (g)	3400 ± 189	<0.001	3200 ± 127	<0.001	3500 ± 202
Birth length (cm)	52.6 ± 0.6	<0.001	52.3 ± 1.2	<0.001	53.1 ± 1.5

*Independent samples *t* test.

Table 4. Proportion of 500-g birth-weight groups in the prewar (1988-1991), war (1992-1995), and postwar (2000-2003) periods at the Tuzla University Department for Gynecology and Obstetrics and rate ratios between war period and prewar and postwar periods

	Proportion (%)			Rate ratio (95% confidence interval)*			
Birth weight groups (g)	prewar (n = 23 194)	war (n = 18 302)	postwar (n = 18 211)	war/prewar	*P*	war/postwar	*P*
500-999	0.068	0.114	0.065	1.663 (0.867-3.188)	0.166	1.741 (0.856-3.540)	0.168
1000-1499	0.357	0.535	0.104	2.166 (1.745-2.690)	<0.001	1.768 (1.420-2.205)	<0.001
1500-1999	0.564	1.223	0.691	1.007 (0.961-1.056)	0.765	1.109 (1.056-1.164)	<0.001
2000-2499	2.677	5.627	1.438	2.110 (1.908-2.331)	<0.001	3.931 (3.427-4.509)	<0.001
2500-2999	3.660	16.189	5.842	2.101 (1.899-2.326)	<0.001	3.911 (3.410-4.486)	<0.001
3000-3499	33.081	46.486	32.139	4.422 (4.088-4.785)	<0.001	2.770 (2.575-2.980)	<0.001
3500-3999	39.238	18.921	32.546	0.482 (0.461-0.503)	<0.001	0.581 (0.554-0.609)	<0.001
4000-4499	9.916	6.212	16.533	0.626 (0.582-0.674)	<0.001	0.375 (0.349-0.403)	<0.001
≥4500	10.433	4.688	10.636	0.449 (0.414-0.486)	<0.001	0.440 (0.405-0.504)	<0.001

*Linear trend was calculated for 500 g birth weight subgroup rates per 100 liveborn infants with extended Mantel-Haenszel χ^2 test for trends.

The proportion of deliveries attended by health care providers was 75.9% during the war, which was significantly lower than before (99.1%) or after (99.8%) the war ($P<0.001$). The number of examinations during pregnancy was 2.4 per pregnant woman in the war period, which was low in comparison with the number of examinations before (5.4 per pregnant woman) and after (6.3 per pregnant woman) the war ($P<0.001$ for both). Maternal mortality rate was 65 per 100 000 deliveries during the war, ie, higher than before (39 per 100 000 deliveries) and after (12 per 100 000 deliveries) the war ($P<0.001$ for both). The causes of maternal death were similar in all three study periods, but they differed in frequency. Of 9 women who died from delivery-related causes before the war, 4 died from eclampsia, 2 from embolism, 1 from atony,1 from aortal aneurism, and o1 from ablation. Delivery-related causes of death in 12 women during the war were eclampsia in 4, embolism, atony, ablation, and ruptured uterus in 1 woman each, previous condition and war wounds in 2, and sepsis in 2. After the war, only 1 woman died from eclampsia and 1 from Marfan syndrome.

Discussion

We found that perinatal and maternal mortality in Tuzla Canton significantly increased during the 1992-1995 war in Bosnia and Herzegovina. The main factor accounting for the increase in perinatal mortality was increased early neonatal mortality, primarily due to prematurity. There were also significantly more newborns with small birth weight, fewer examinations of women during pregnancy, more unattended deliveries, and more maternity deaths. It seems that insufficient health care for pregnant women and newborns in Bosnia and Herzegovina in war circumstances, combined with poor socio-economic conditions, constant fear, stress, and destruction of homes and families, was the main factor accounting for the increase in perinatal and maternal morbidity and mortality during that period.

Perinatal mortality has declined over time world wide, but the rate of decline in many industrialized countries has slowed down (11-15). Although stillbirth ratio is an important indicator of the quality of antenatal and obstetric care (16,17), early neonatal mortality reflects low quality or lack of care provided immediately before, during, and after delivery. This was confirmed by our findings. The early neonatal mortality at Tuzla University Department for Gynecology and Obstetrics significantly increased during the war. One of the important reasons for this increase was the fact that there were only two incubators, one respirator, and one neonatologist at the Department. The causes of early neonatal mortality did not differ from those before or after the war, but their distribution did, with prematurity being the main cause of death. After the war, early neonatal mortality at our Department still decreased, but it has not approached that in Slovenia (2,4), the Czech Republic (1,4), Austria (2,4) or Sweden (1,9), where it has reached the biological minimum (5). The increase in early neonatal mortality was the main cause of the increase in perinatal mortality in Tuzla Canton during the war, which almost returned to the level perinatal mortality in the developed countries in the 1950s. However, after the war, it decreased again. In comparison with Finland, European country with one of the lowest perinatal mortality rates (6.3 per 1000), Tuzla Canton had more than twice as high perinatal mortality after the war and rated somewhere between Greece (12.8 per 1000) and Portugal (15.5 per 1000) (17).

We found that birth rate during the war in the Federation decreased by approximately 50%, compared with the prewar rate of 14.9 live newborns per 1000 population. The data for 1995 (after the war) showed that the rate increased again to 11.4 per 1000, with a still increasing trend (18). According to the Tuzla Institute of

Public Health data, crude birth rate in Tuzla Canton during the war was 9.8 per 1000 population (in Tuzla Canton, there were 21% fewer newborns during the war than before the war), ie, evidently lower than the rate before (12.6 per 1000 population) and after the war (10.5 per 1000 population).

Reports on the mortality rates for 1992-1995 war period indicate a rough mortality rate 3-5 times higher than in 1991 (18). There are no reliable data for the period after the war. In 1991, the newborn mortality rate was 14.5 per 1000 live births, but during the war time, in 1993, it increased to approximately 24.7 per 1000. The estimated newborn mortality rate for 1996 was 13.6 per 1000 live births (18).

The incidence of premature births in the world is stable, 5-6% annually. In Tuzla Canton during the war, prematurity rate was twice as high. From the public health standpoint, prematurity rate can be lowered by better medical supervision of women during pregnancy, which would allow timely management of adverse factors that lead to premature deliveries (19).

Good socioeconomic conditions are associated with proper diet and good medical care of pregnant women and thus are important for appropriate growth of the fetus. Birth weight figures are a useful parameter for assessing the effectiveness of prenatal medical care and indirect indicators of the share of the at-risk newborns in the newborn population. The average birth weight of newborns ranges between 2500 and 3999 g. Newborns with low birth weight of <2500 g are exposed to both higher neonatal and postnatal morbidity and mortality (20). In 1981-1983 and 1995-1997 periods, Canada's incidence of low-birth-weight newborns was 4.95% and 4.61%, respectively (21). In Sao Paolo, Brazil, the incidence of 8% was stable over 25-year period (22), whereas in the United States the percentage of low-birth-weight children increased from 6.7% in 1984 to 7.8% in 2002 (23). In Sweden, 3.1% of newborns had a birth weight of <2500 g (24). During the war, Bosnia and Herzegovina did not introduce any measures (eg, increase the level of health consciousness in collective centers and distribute larger quantities of humanitarian aid to pregnant women) to at least partly counteract unfavorable socio-economic situation. Stress, fear, exile, and inadequate antenatal surveillance on the length of gestation may have had a negative influence on newborn birth weight. However, as a previous study showed (25), improvements in the quality of care and access to health care cannot be expected during the war.

We also found a gradual increase in the number of newborns weighing >4000 g at birth over the three study periods, a finding similar to that of Bergmann et al (26). Increased maternal height probably accounts for the increase in infant birth weight more than any other improvement in the quality of the intrauterine life (27).

Many women die of pregnancy-related causes each year, with 98% of these deaths occurring in developing countries. Various factors are potentially responsible for adverse pregnancy and perinatal outcomes and they differ between developed and developing countries (28-30). Complications of pregnancy and childbirth are also the leading cause of death and disability among women of reproductive age in developing countries (31). In fact, maternal mortality itself contributes to underdevelopment, because of its severe impact on the lives of young children, the family, and society in general.

During the 1992-1995 war in Bosnia and Herzegovina, the whole social structure in the country was destroyed, many families were shattered, and the individual was often left without adequate family and social system support (32). High maternal mortality during the war was a combined result of different factors, from inadequate education, social, and economic status to limited access to basic health services, family planning services, and nutrition before, during, and after childbirth; lack of attendance at deliv-

ery by health professionals; and no access to good quality care in case of complications. For example, during the war approximately 25% of deliveries took place out of health care facilities, usually at home, with the help of traditional birth attendant, as opposed to <1% of out-of-hospital deliveries in the postwar period. As health care and life conditions started to improve after the war, the maternal mortality rate started to decrease. According to the data of the World Health Organization Regional Office for Europe from 2000, maternal mortality rate in Europe was 9.2 per 100 000 deliveries, in European Union it was only 5.6 per 100 000 deliveries, whereas in Central European and East European countries, it was 12.7 per 100 000 deliveries (5,33,34). The maternal mortality rate in Tuzla Canton today is comparable to that in Central and East European countries.

The limitations of our study were incomplete data on the gestational age, sex, parity, and pathological conditions of mothers and children during pregnancy, such as pathology associated with premature childbirths and intrauterine growth retardation with consequential low birth weight and hypertrophy of infants. We were also unable to examine risk factors such as chronic and comorbid conditions, congenital malformations, obstetric complications, and infections. However, the available data were complete and allowed reliable analyses.

In conclusion, we found that limited accessibility and quality of perinatal and maternal health care during the war in Bosnia and Herzegovina had detrimental effects on the health and survival of newborns and their mothers. Early neonatal mortality and maternal death can be decreased by timely and appropriate perinatal health care, regular health care during pregnancy, and skilled attendance at delivery.

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