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Overview

# Why do mothers die in Croatia?

**DRAGICA KOPIĆ**[1]
**NENAD KARANOVIĆ**[1]
**NEVEN ELEZOVIĆ**[1]
**DAMIR ROJE**[2]

[1]Department Of Anaesthesiology and Intensive Care
University Hospital Split, Croatia

[2]Department of Gynecology and Women Health
University Hospital Split, Croatia

**Correspondence:**
Dragica Kopić
Department Of Anaesthesiology and Intensive Care
University Hospital Split, Croatia
E-mail: dragica.kopic@st.t-com.hr

**Abbreviations:**
MMR – maternal mortality ratio
CS – Caeserean section
FFP – Fresh frozen plasma

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## INTRODUCTION

Maternal death is the death of a woman during pregnancy, labour, and delivery or within 42 days of termination of pregnancy. The cause could be related to, or aggravated by the pregnancy or its management, but not from accidental or incidental causes.

In the past maternal mortality was expressed as percentage or per mil. Now in the use is maternal mortality ratio (MMR), an international definition, which denotes the number of indirect and direct deaths per 100.000 live births.

There are two groups of maternal deaths, the first one »pregnancy related« and second one »pregnancy non related« deaths.

Pregnancy related (direct deaths) are deaths resulting from obstetric complications of the pregnant state, from interventions, omissions, incorrect treatment or from a chain of events.

Pregnancy non related deaths (indirect deaths) include deaths resulting from previous existing diseases, or diseases that developed during pregnancy not due to direct obstetric causes, but aggravated by the physiologic effects of pregnancy.

The tendency exists to include in maternal mortality late deaths occurring between 42 days and 1 year after abortion, miscarriage or delivery caused by direct or indirect maternal causes.

Coincidental deaths are category of maternal deaths from unrelated causes occurring in pregnancy or the puerperium.

At the end of nineteenth century maternal mortality rate in the countries of North Europe was 5–30‰ *(1)*. In the first decades of twentieth century *(2)* (Table 1) the rates of maternal mortality were still high and had been from 5‰ to 10. 0‰.

For 1927–1929 maternal mortality cited by Peller for Italy was 2.75‰, France 2.97‰, Spain 3.99‰, Belgium 5.47‰ and for England and Walles 5.86‰ *(2)*.

Respectable fall in maternal mortality in Europe and USA began after 1970. In 1970 maternal mortality in USA was 21.5/100.000, in 1975 it was 12.8 and permanently below 10.0/100.000 after 1980.

In developing countries rate of MMR is still high (Table 2), approximately it is 440/100.000. MMR for Africa is 830/100.000, for Asia 330/100.000. Global MMR is estimated to 400/ 100.000. The mortality caused by complications of pregnancy, delivery and during puerperal period in the entire world is approximately 500.000, but in developed countries is only 6.000, and the rest is for non developed countries.

**TABLE 1**

Maternal mortality in West and Central European countries in the 20-th century[1,2,3,4]

| Decade | <1900 | 1900–1920 | 1921–1930 | 1931–1940 | 1951–1960 | 1961–1970 | 1971–1980 | 1981–1990 | 1990–2000 |
|---|---|---|---|---|---|---|---|---|---|
| Mortality in ‰ | 5–30 | 5–10 | ≅3.5 | 3.1–3.8 | 0.43–1.89 | ≅0.28 | 0.11–0.33 | 0.046–0.155 | 0.016–0.13 |
| Mortality per 100.000 | 500–3000 | 500–1000 | ≅350 | 310–380 | 43–189 | ≅28 | 11.4–32.8 | 4.6–15.5 | 1.6–13.0 |

**TABLE 2**

Maternal mortality estimated by WHO/UN regions: 2000[3]

| Region | Maternal mortality ratio (maternal deaths per 100.000 live births) | Numbers of maternal deaths | Lifetime risk of maternal death |
|---|---|---|---|
| World total | 400 | 529,000 | |
| Developed regions* | 20 | 2,500 | 2,800 |
| Europe | 24 | 1,700 | 2,400 |
| Developing regions | 440 | 527,000 | 61 |
| Africa | 830 | 251,000 | 20 |
| Northern Africa | 130 | 4,600 | 210 |
| Sub-Saharan Africa | 920 | 247,000 | 16 |
| Asia | 330 | 253,000 | 94 |
| Eastern Asia | 55 | 11,000 | 840 |
| South Central Asia | 520 | 207,000 | 46 |
| South Eastern Asia | 210 | 25,000 | 140 |
| Western Asia | 190 | 9,800 | 120 |
| Latin America & the Caribbean | 190 | 22,000 | 160 |
| Oceania | 240 | 530 | 83 |

*Includes UK, Canada, USA, Japan, Australia and New Zeland which are excluded from the regional totals

Maternal mortality in Croatia is similar to mortality of some surrounding Mid-European countries. Decreased maternal mortality is caused by better prenatal care, delivering in hospitals, development of transfusiology, introduction of antibiotic therapy and modern anaesthesiology. But it must be emphasized that the hospital deliveries had the highest influence on decrease of MMR in Croatia. In 1954 hospital deliveries were estimated to 32.8%, and MMR 168/100.000. In 1961 the number of delivery in hospitals rose to 59.6% resulting in three times less maternal deaths, and was 51/100.000. Introduction of regional anaesthesia techniques in obstetric practise as well as development of anaesthesia had high impact on decrease of MMR. In the United States anaesthesia is sixth leading cause of maternal death after haemorrhage, embolism, pregnancy-induced hypotension complications, infection and cardiomiopathy *(4)*.

## The causes of maternal deaths

The most frequent causes of direct maternal deaths are: haemorrhage, eclampsia-preeclampsia, infection and thromboembolism. Indirect causes of maternal deat-

**TABLE 3**

The causes of maternal deaths (in %).

| Country | Number of deaths | Haemorrhage | Embolia pulmonum et amnialis | Eclampsia et preeclampsia | Infections | Other direct causes | Indirect causes |
|---|---|---|---|---|---|---|---|
| World-WHO[6] | 585.000 | 24,8 | – | 12,8 | 14,9 | – | 19,8 |
| USA 1987–90[3] | 1.453 | 28,7 | 19,7 | 17,6 | 13,1 | 12,7 | 8,1 |
| UK 1994–96[7] | 237 | 4,2 | 20,7 | 8,4 | 5,9 | 15,7 | 45,1 |
| Japan 1991–92[8] | 219 | 39,2 | 11,0 | 7,8 | 2,3 | 18,7 | 9,6 |
| Croatia 1991–2000[9] | 46 | 26,0 | 23,9 | 15,2 | 15,2 | 6,6 | 11,8 |

hs, such as cardomiopathy and diabetes are more frequent. The hamorrhage is leading cause of maternal deaths (Table 3) for world globaly, but in the developed countries as UK it is embolism.

## Maternal death due to Caesarean deliveries

MMR during caesarean deliveries is far more higher than during vaginal delivery. At the end 19th century during caesarean deliveries the mortality rate was 75%, while at the beginning of 20th was 7%. At the Department of Gynecology and Obstetrics in Zagreb Hospital in period 1931–1945 MMR during caesarean deliveries was 2.35%, *(9, 10)*. The main causes of maternal mortality during caesarean deliveries have been haemorrhage, eclampsia--preeclampsia and thromboembolism.

Analysing anaesthesia deaths during 1979–90 period, the maternal mortality rate showed a similar decline to those in Great Britain. Declining was from 4.3/1,000.000 live births in years 1979–81 to 1.7/1,000.000 in years 1988–90 representing 3.3% of all maternal deaths during surveillance period. The calculated risk ratio between general and regional anaesthesia was 2.3:1 in the period of 1979–81 vs. 16.7:1 in the period of 1987–90 *(11)*. In the majority of these deaths occurring during caesarean delivery 49% were caused by airway difficulties. General anaesthesia was administered to 67 of the 129 patients who died, and causes were aspiration (33%), induction/in-

**TABLE 4**

The number of maternities, caesarean sectiones and deaths caused by anesthesia in UK during three survillance periods (13).

| Trienium | Maternities (n) | Caeserean section (CS) | | Direct deaths due to anaesthesia | Direct deaths due to anaesthesia for CS | Rate of Direct deaths due to anaesthesia per 100,000 CS* |
|---|---|---|---|---|---|---|
| | | (n) | (%) | | | |
| 1964–66 | 2,600,000 | 88,000 | 3.4 | 50 | 32 | 36 |
| 1982–84 | 1,884,000 | 190,000 | 10.1 | 19 | 11 | 6 |
| 2000–02** | 1,997,000 | 425,000 | 21.0 | 7 | 4 | 1 |

*England and Wales 1964–84, United Kingdom 1982–84 and 2000–02
**CS data for the UK (2000–02) are grossed from Hospital Episode Statistics for England

**TABLE 5**

Maternal mortality during pregnancy, vaginal delivery, and caesarean deliveries in Croatia in the period 1994–2009.

| Year | Delivery number (N) | | | Maternal mortality | |
|---|---|---|---|---|---|
| | Total | Vaginal | Caesarean deliveries | N | MMR/ 100.000 |
| 1994 | 46.087 | 42.091 | 3.996 (8,7)* | 3 | 6,5 |
| 1995 | 45.913 | 41.793 | 4.120 (9) | 5 | 10,9 |
| 1996 | 48.774 | 44199 | 4.575 (9,4) | 4 | 8,2 |
| 1997 | 49399 | 44504 | 4.895 (9,9) | 5 | 10,2 |
| 1998 | 47427 | 42303 | 5.124 (10,8) | 3 | 6,3 |
| 1999 | 45347 | 40114 | 5.233 (11,5) | 5 | 11 |
| 2000 | 43927 | 38477 | 5.4508 (12,4) | 3 | 6,8 |
| 2001 | 40980 | 35308 | 5.672 (13,84) | 1 | 2,4 |
| 2002 | 40898 | 34963 | 5.935 (14,84) | 7 | 17 |
| 2003 | 39521 | 33544 | 5.977 (15,2) | 5 | 12,7 |
| 2004 | 40744 | 34514 | 6.230 (15,48) | 3 | 7,5 |
| 2005 | 43024 | 36088 | 6.936 (16,39 | 3 | 7,07 |
| 2006 | 41957 | 35064 | 6.893 (16,63) | 4 | 9,65 |
| 2007 | 42450 | 35430 | 7.020 (16,79) | 6 | 14,2 |
| l2008 | 44033 | 36289 | 7.744 (17,75) | 3 | 6,9 |
| 2009 | 45056 | 36972 | 8.084 (18,2) | 7 | 6,9 |
| Total | 705.537 | 611.653 | 93.884 | 67 | |

*(percentage of CS)

**TABLE 6**

Maternal deaths and pregnancy termination mode.

| | Maternal deaths | |
|---|---|---|
| | (N) | (%) |
| Vaginal birth | 41 | 61.2 |
| Caesarean delivery | 22 | 22 |
| Pregnancy | 4 | 4 |
| Total | 67 | 100 |

tubation problems (22%), inadequate ventilation (15%), respiratory failure (3%), cardiac arrest during anaesthesia (22%), and unknown (5%) *(11)*.

The rate of caesarean deliveries in Croatia, as in the entire world, is constantly increasing *(12)*. In UK in period 1964–1968 the rate of caesarean deliveries (Table 4) was 3.4%, while in period 2000–2002 has risen to 21.0%. In the same period, the number of direct maternal deaths due to anaesthesia progressively decreased and was 4 (1/100.000).

Elimination of anaesthetic-related maternal mortality requires the careful administration of the appropriate anaesthetics by well trained specialists.

## Maternal mortality in Croatia in 1994–2009

Maternal mortality data in Croatia is continuously reported at Perinatal mortality symposiums since 1991, and are available within statistical reports of the Croatian national institute of public health. Table 5 presents maternal deaths in period 1994–2009. During this period, the overall number of deliveries was 705.537, while 611.653 were vaginal ones, and 93.884 caesarean deliveries. Continuous increase of operative deliveries is evident, with maximal rate of 18.2% in 2009. In three years 2002, 2003 and 2007 maternal mortality rate is above 11/100.000 (17, 12 and 14.2/100.000, respectively). The lowest MMR 2.4/100.000 (1 maternal death) was reported in 2001.

Since 2008, MMR is in decreasing trend and is similar to neighbouring mid European countries.

Sixty seven women have died during pregnancy, delivery and puerperal period. During early pregnancy 4 women have died, 41 during vaginal delivery and 22 following or due to complication of caesarean deliveries (Table 6).

Out of the total of 611.653 vaginal deliveries, 45 women have died (Table 7), and out of 93.884 caesarean de-

**TABLE 7**

Maternal mortality during vaginal birth and caesarean section in Croatia 1994–2009.

| | Deliveries (N) | Maternal deaths (N) |
|---|---|---|
| Vaginal delivery | 611.653 | 45 |
| Caesarean section | 93.884 | 22 |
| Total | 705.537 | 67 |

*$\chi^2$=22.15; p<0.001

**TABLE 8**

Clinical diagnosis of maternal deaths in Croatia in period 1994–2009.

| | 2009 | 2008 | 2007 | 2006 | 2005 | 2004 | 2003 | 2002 | 2001 | 2000 | 1999 | 1998 | 1997 | 1996 | 1995 | 1994 | Total* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Direct causes** | | | | | | | | | | | | | | | | | |
| Embolia pulmon. | 2 | 2 | | | | | | 2 | 1 | | 2 | 1 | 1 | 1 | 1 | | **13 (19,4)** |
| Embolia amnialis | 1 | | | | 1 | | 2 | | | | 1 | 1 | | | | | **6 (9,0)** |
| Sepsis | 1 | | 2 | 1 | 1 | 1 | | | | 2 | 1 | | | | 1 | 1 | **11 (16,4)** |
| Eclampsia-preeclampsia | 3 | | | 1 | | | 1 | 1 | | | | | 1 | 1 | 2 | | **10 (14,9)** |
| Haemorrh., DIC | | | 1 | 1 | | 1 | 1 | 2 | | 1 | 1 | 1 | 1 | 1 | 1 | | **12 (17,9)** |
| Mors e anaesthesia | | | | | | | | 2 | | | | | | 1 | | | **3 (4,5)** |
| **Subtotal** | **7** | **2** | **3** | **3** | **2** | **2** | **4** | **7** | **1** | **3** | **5** | **3** | **3** | **4** | **5** | **1** | **55 (82,1)** |
| **Indirect causes** | | | | | | | | | | | | | | | | | |
| Arestus cardiopul. | | 1 | | | | | | | | | | | | | | | **1 (1,5)** |
| Cardiomyopath. | | | 2 | | | | | | | | | | 2 | | | | **4 (6,0)** |
| Vitium cordis | | | | | 1 | | | | | | | | | | | 2 | **3 (4,5)** |
| Haemorrh. cerebri | | | 1 | | | | | | | | | | | | | | **1 (1,5)** |
| Other | | | | 1 | | 1 | 1 | | | | | | | | | | **3 (4,5)** |
| **Subtotal** | **0** | **1** | **3** | **1** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **2** | **0** | **0** | **2** | **12 (17,9)** |
| **Total** | **7** | **3** | **6** | **4** | **3** | **3** | **5** | **7** | **1** | **3** | **5** | **3** | **5** | **4** | **5** | **3** | **67 (100,0)** |

*(percentage)

liveries 22 have had fatal outcome. Significantly more women died from caesarean deliveries then from vaginal delivery ($\chi^2=22.15$; $p<0.001$).

The data in Table 8 represent maternal deaths in relation to clinical diagnoses. In the surveillanced period, the most frequent direct cause of maternal death were thromboembolic events (19.4%), followed by haemorrhage with slightly lower rate (17.9%). These results are different comparing with period from 1991 to 2003 *(12)*, when the haemorrhage was the leading cause of maternal deaths. Disseminated intravascular coagulation and haemorrhage were cause of 7 out of 12 deaths, while caesarean delivery was performed in 9 cases.

Anaesthesia has directly caused death in 3 cases. In one case malfunction of anaesthesia machine caused death, the aspiration was the death cause in second one, but the third case was caused by the drug intoxication. Cardiac diseases (cardiomyopathies and congenital cardiac diseases) were the most frequent indirect cause of maternal deaths.

## DISCUSSION

Data regarding maternal death causes are similar to those in developed countries. Higher frequency of deaths caused by thromboembolism could be related to increasing number of caesarean deliveries, which are accompanied with higher risk of thrombo-embolic events. Hence, at the Department of gynaecology and maternal diseases, University Hospital Split, a Protocol was adopted for prevention of thrombo-embolic events in operative deliveries. As prevention, low molecular heparin is used until the complete mobilisation of parturient, for at least 5 days period.

Haemorrhage is the second leading cause of maternal deaths. If more attention is paid to every parturient with high risk of haemorrhage, a part of these deaths could be avoided. High risk and bleeding parturient should be actively managed, with team work consisting of obstetrician, anaesthesiologist, haematologist, transfusiologist and biochemist. The most common misjudgement in amount of blood loss is in obstetrics. Each hospital should introduce protocol for the management of massive obstetric haemorrhage. It is quite common for the junior members of the obstetric team to underestimate the amount of blood loss, as the parturient does not show signs of significant blood loss until over 1200 mL has been lost. For a rapidly exsanguinating patient, a formula based transfusion protocol may be required, as waiting for the results of such testing is not practical *(14)*. As a guide, 2–4 units of FFP (Fresh frozen plasma) and one adult dose of platelets (4–6 units) should be given for every 10 red cell units transfused. FFP should be considered if the prothrombin time or activated partial thromboplastin time is greater than 1.5 times of normal. Thrombocytopaenia usually results from haemodilution but may occur due to increased consumption. Platelets are indicated if the platelet count is less than $50 \times 10^9$/L or if the count is less than $100 \times 10^9$/L in the presence of diffuse microvascular bleeding. In the presence of hypofibrinogenaemia (less than 1.0 g/L), cryoprecipitate may be indicated, but FFP should supply enough fibrinogen to correct most deficiencies but shuold be given in the dose greater than 15 mL/kg.

## CONCLUSION

Adequate routine prenatal care and intensified care of high risk obstetric patient, as well as performing deliveries in hospitals is essential for prevention of maternal death. Obstetric Emergencies are a shared responsibility of obstetric, anaesthetic, laboratory (blood bank) and »nursing« team. Team work is crucial for decreasing maternal deaths.

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