

# Impact of Perinatal Health Care Organization on Mortality of Low Birth Weight Infants in the Federation of Bosnia and Herzegovina

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**Aim.** Goal of the study was to assess the frequency of birth and mortality of low birth weight infants based on the level of neonatal institution where they were born and/or treated according to gestational age, in the Federation of Bosnia and Herzegovina.

**Methods.** Through the prospective study over one-year period from 01.01. to 31.12.2009, the infants were analysed (stillborn and liveborn) of both genders, gestational age 24-42 weeks and birth weight below 2500 grams.

**Results.** During the assessment period, 22897 infants were born, 669 with low birth weight, so that the incidence was 2.9 %. Gender breakdown is proportional. Most of the infants were born in two largest Cantons, Sarajevo and Tuzla. In the first level neonatal institutions 29 infants were born, 286 in the neonatal institutions of the second level, and 354 low birth weight infants were born in the neonatal institutions of third level. There is statistically significant discrepancy in frequency of low birth weight infants' births between neonatal institutions of first and second level ( $\chi^2=272.1$ ;  $P<0.0001$ ), as well as second and third level ( $\chi^2=13.4$ ;  $P<0.0002$ ). Of 29 low birth weight infants born in neonatal institutions of first level, 26 were referred to other institutions, while 3 died in the institution where they were born. Neonatal institution of second level kept 127 infants at treatment, 53 of whom died. There was no statistically significant discrepancy in mortality of low birth weight infants between the institutions of first and second level ( $\chi^2=0.71$ ;  $P=0.398$ ), with relative risk [RR=0.507 (95% CI 0.148- 1.738)]. In third level neonatal institutions, 513 infants were treated and 461 survived, while 52 died. Statistically significant discrepancy was found in the mortality rate of low birth weight infants between the institutions of second and third level ( $\chi^2=71.8$ ;  $P<0.0001$ ), with high relative risk [RR=6.349 (95% CI 4.030-10.003)].

**Conclusion.** Survival of low birth weight infants born in the maternity hospitals with neonatal institutions of third level is statistically higher than the survival rate of infants born in the maternity hospital with neonatal institutions of first and second level.

**Keywords.** perinatal regionalization, low birth weight infants, incidence, early neonatal mortality rate, survival rate

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## Competing interests

The authors declare no competing interests.

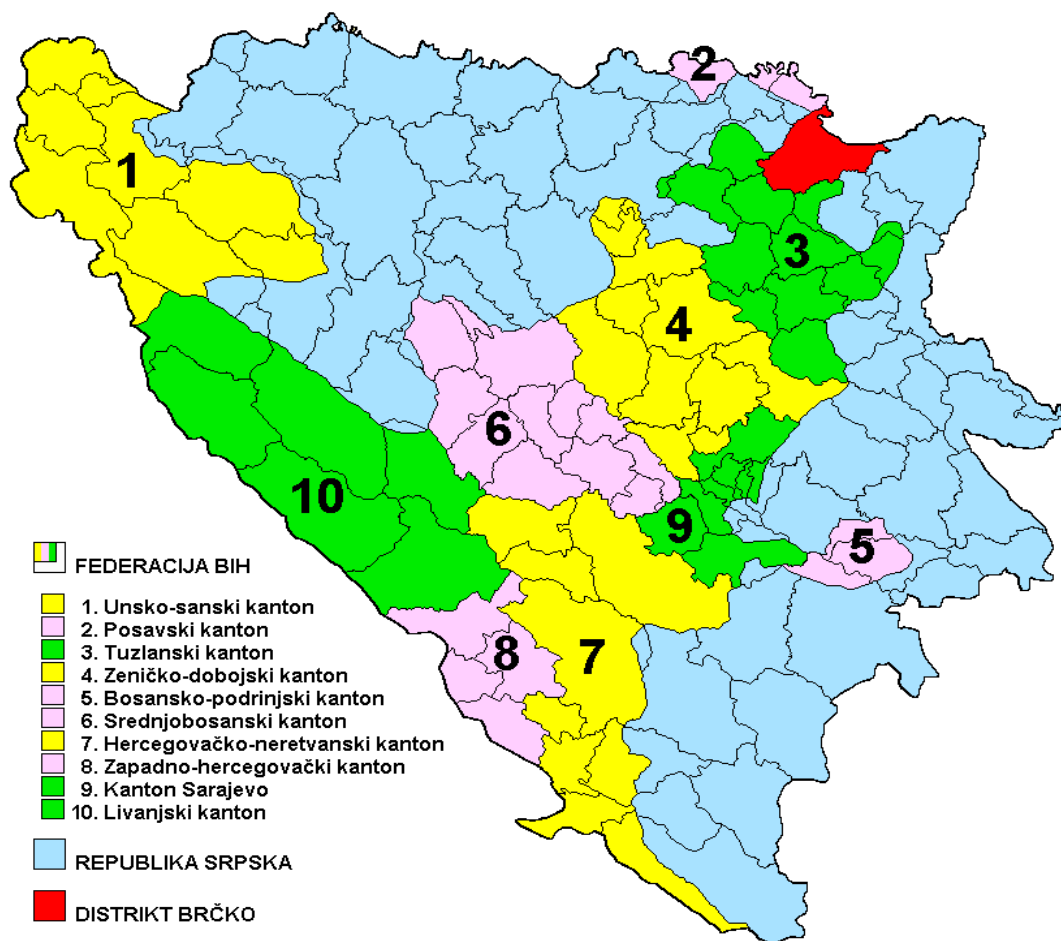
## INTRODUCTION

All infants with the birth weight below 2500 g are considered as Low birth weight (LBW), which is considered as an important predictor of mortality and morbidity in the neonatal period,[1,2] early postnatal growth, and growth during childhood.[3-5] It also affects adversely cognitive and behavioural development in the first years of life, health during childhood, and adulthood.[6] Infants who are born LBW are divided into two categories: those who were born too early and/or too small. Two categories of LBW preterm delivery (PTD) and intrauterine growth retardation (IUGR) have different causes and health outcomes[7]. Causes and risk factors for LBW, attributable to both PTD and IUGR, have been studied extensively, although earlier papers primarily grouped PTD and IUGR into the same larger LBW category. In de-

veloping countries, most cases of LBW are attributed to IUGR rather than PTD.

There are 9 to 19 per cent of high risk infants born annually of whom 80 per cent are LBW which means that over 20 million of the LBW infants are born annually all over the world, despite of increasing progress in perinatal medicine and better perinatal care. Prevalence rate of LBW deliveries is influenced by geographical and social factors. LBW infant rate in developed countries is 7 per cent.[8]

During the past thirty years, it has been recommended that LBW infants should be referred to the institutions with neonatal intensive care units.[9] Continuous improvement of perinatal health care in the second half of the 20th century resulted in better survival of newborns and their mothers. Although expensive, medical technology became available and well utilized in



**Figure 1.** Administrative organization of the Federation of Bosnia and Herzegovina (FB&H)

many huge hospitals. Due to the complexity of medical procedures, expensive medical equipment should be available in all maternity hospitals in order to improve overall neonatal health care. This was the reason why in the 1960s, many high risk infants had been referred to specialized better equipped and organized institutions.[10] At the beginning of the 1970s the model of regional organisation of perinatal care has been implemented in the United States of America[11], which has also been accepted by Canada,[12] Sweden,[13] The Netherlands,[14] Japan,[15] Greece,[16] some regions of Italy and urban areas of China.[17] Regionalization of perinatal care was not accepted by France,[18] United Kingdom,[19] some regions of Italy,[20] and Germany [21] but they developed well organized system of neonatal transportation.

The aim of regionalized perinatal health care was to improve health of pregnant women and infants, with as low as possible costs, and to centralize the staff and equipment in order to cover health care needs of high risk mothers and neonates. It has been currently proven that regionalization of perinatal health care reduces neonatal mortality and improves their neurodevelopmental outcome.[22]

According to the level of risk, mothers and newborns are distributed in the regionalized perinatal healthcare system. The 1st level institutions are responsible for low risk pregnancies (about 80 per cent of all pregnan-

cies). Medium risk pregnancies (about 16 per cent of all pregnancies) are identified in the regionalized health care system and referred to the 2nd level institutions. Pregnant women with the highest possible risk (about 4 per cent of all pregnancies) and complex health problems are referred to the maternity hospitals of the 3rd level. The institutions of the 2nd level are equipped with the neonatal special care units (NSCU), while in the 3rd level institutions there are neonatal intensive care units (NICU).[23] It is well known that outcome of LBW infants is dependent on the level of care where they are born. In order to follow the outcome of LBW infants it is mandatory to organize the surveillance of the mortality and morbidity of the LBW infants at different levels of care.[24 ]

The hypothesis was that the survival of LBW infants is affected by the place of birth and the level of perinatal care.

The objective of this study was to assess the LBW rate in the FB&H depending on the gestational age and the level of institution where they were born.

## METHODS

All LBW infants of gestational age from 22 to 42 weeks of gestation, either live-born or stillborn in the period from January, 1st to December, 31st, 2009 in the FB&H were included to the study. Questionnaire with the

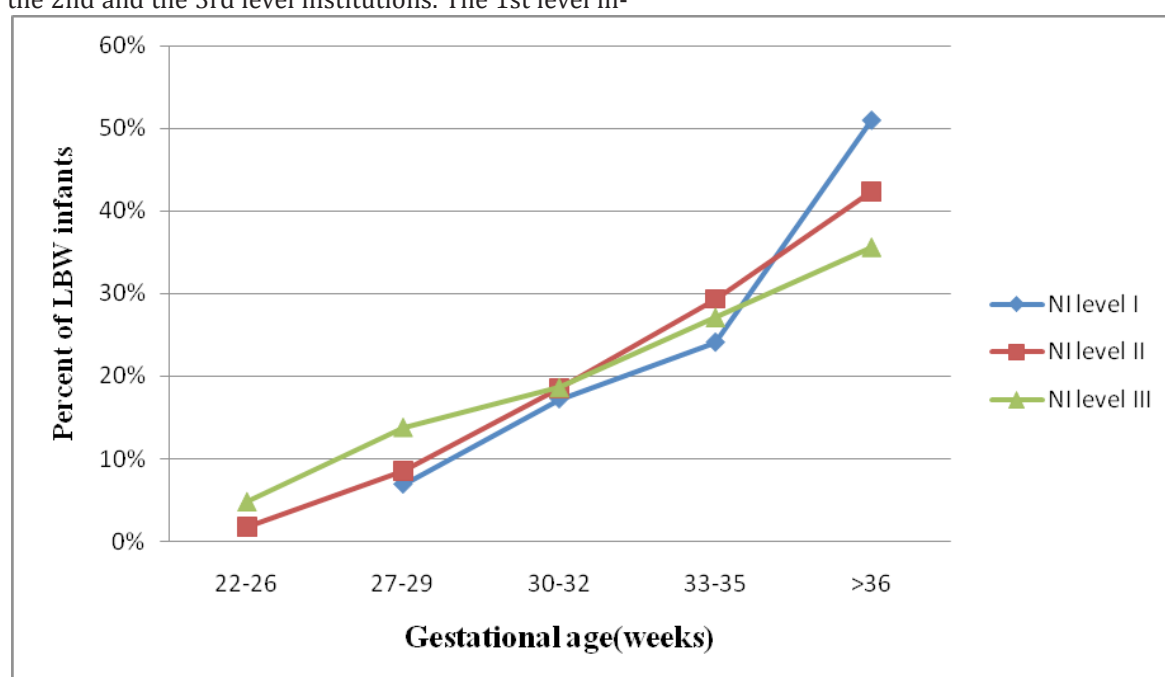
**Table 1.** Distribution of Stillborn and live-born rate of LBW infants in the cantons and the Federation of Bosnia and Herzegovina in the year 2009

Canton	LBW		
	Stillborn ( %)	Live-born (%)	Total (%)
Una – Sana	17 (0.6%)	87 (3.1%)	104/2842 (3.6%)
Posavina	-	2 (0.8%)	2/255 (1.1%)
Tuzla	15 (0.3%)	131 (2.7%)	146/4898 (2.9%)
Zenica – Doboј	9 (0.2%)	126 (3.0%)	135/4186 (3.2%)
Bosnia – Podrinje	1 (0.4%)	4 (1.7%)	5/236 (2.1%)
Middle Bosnia	19 (0.8%)	73 (2.7%)	92/ 2462 (3.7%)
Herzegovina – Neretva	11 (0.6%)	55 (2.9%)	66/ 1870 (3.5%)
West Herzegovina	1 (0.1%)	18 (2.5%)	19/722 (2.6%)
Sarajevo	16 (0.3%)	168 (3.4%)	184/4898 (3.7%)
Livno	1 (0.2%)	5 (1.1%)	6/438 (1.7%)

data concerning the last menstrual period, expected day of birth, day of birth, place of birth, birth weight (in grams), gestational age (in completed gestational weeks), time of referral to another institution, and infant outcome was sent to all departments of neonatology in the FB&H. The response rate was 80 per cent. Paediatricians from all institutions participated in the data collection. According to the criteria of the Association of Neonatologists and Intensive Care Experts of the F B&H, the institutions were on the basis of the diagnostic and therapeutic possibilities assigned to the 1st, the 2nd and the 3rd level institutions. The 1st level in-

stitutions are responsible for the care of the healthy eutrophic term newborns and their healthy mothers, the 2nd level institutions have the possibility to treat term newborns with hyperbilirubinemia, hypoglycaemia and acidosis, and the 3rd level institutions are providing care for all high risk infants of all gestational ages and birth weights with the possibility of conventional mechanical ventilation, exchange transfusion and surgery except cardiosurgery.

It has been recommended that all high risk infants who were born in the institutions of the lower level should

**Figure 2.** Distribution of LBW infants in the Federation of Bosnia and Herzegovina according to the gestational age and the level of care

**Table 2.** Distribution of LBW infant rate at different levels of care in the Federation of Bosnia and Herzegovina in the year 2009

Level care	Number of all live-born infants	Number of LBW live-born (%)
The 1 <sup>st</sup>	1651	29 ( 1.76%)
The 2 <sup>nd</sup>	9490	286 ( 3.01%)
The 3 <sup>rd</sup>	11666	354 ( 3.03%)
<b>Total</b>	<b>22807</b>	<b>669 (2.9%)</b>

\*  $\chi^2=272.1$ ;  $P<0.0001$  the difference between the first and the second level of care

\*\*  $\chi^2=13.4$ ;  $P<0.0002$  the difference between the second and the third level of care

\*\*\*  $\chi^2=8.00$ ;  $P=0.004$  the difference between the first and the third level of care

be transported to the higher level within four hours of birth. The early neonatal mortality and stillbirth rate were followed. Early neonatal death is defined as the death of live-born infant of 22 to 42 weeks of gestation above 500g who died within 168 hours after birth, expressed as early neonatal death rate per 1000 live-born. Antepartum Stillbirths were considered antepartal if occurred before the onset of labour, while intrapartum stillbirths occurred during labour. The foetus was considered alive at the start of labour unless there was evidence for otherwise.

The FB&H consists of ten Cantons, which is shown in the Figure 1.

The following cantons and their capitals (in brackets) exist in the FB&H:

- Una – Sana Canton (Bihać)
- Posavina Canton (Orašje)
- Tuzla Canton (Tuzla)
- Zenica – Doboij Canton (Zenica)
- Bosnia – Podrinje Canton (Goražde)
- Middle Bosnian Canton (Travnik)
- Herzegovina – Neretva Canton (Mostar)
- West Herzegovina Canton (Siroki Brijeg)

- Sarajevo Canton (Sarajevo)

- Livno Canton (Livno)

## STATISTICAL ANALYSIS

The data were analyzed by the  $\chi^2$  test in the contingency 2 by 2 tables. The data were shown according to the level of perinatal care. The results of the logistic models were expressed as odds ratios (OR) with 95% confidence intervals (CI). Those infants who were born at the lower level of care were identified and their outcome was presented as number of transported infants with early neonatal mortality rate. Statistical analysis was performed with SAS software, version 9.1 (SAS Institute, Cary, NC).  $P<0.05$  was considered statistically significant.

## RESULTS

There were 22897 infants born in the FB&H in the period from 01.01.to 31.12.2009. of whom 669 (2.9%) were LBW, with the range of birth weight from 500g to 2499g. There were 345 male infants (51.6%) and 324 female LBW infants (48.4%) which was not statistically different ( $\chi^2=1.19$ ;  $P=0.27$ ). A relative risk of LBW for both genders was equal [OR = 1.133 (95% CI 0.914-

**Table 3.** Outcome of low birth weight infants dependent on the level of perinatal care in the Federation of Bosnia and Herzegovina in the year 2009

Level of care	Number of LBW infants (%)	Number of treated LBW infants (%)	Number of survived LBW infants (%)	Number of LBW infants who died (%)
The 1 <sup>st</sup>	29 (4.3%)	3 (0.5%)	0	3 / 3 (100%)*
The 2 <sup>nd</sup>	286 (42.8%)	153 (22.8%)	100/153 (65.4%)	53/153 (34.6%)**
The 3 <sup>rd</sup>	354 (52.9%)	513 (76.7%)	461/513 (89.9%)	52/513 (10.1%***)
<b>Total</b>	<b>669 (100%)</b>	<b>669 (100%)</b>	<b>561/669 (76.9%)</b>	<b>108/669 (16.1%)</b>

\*  $\chi^2=0.99$ ;  $P=0.083$  the difference between the first and the second level of care

\*\*  $\chi^2=51.45$ ;  $P<0.0001$  the difference between the second and the third level of care

\*\*\*  $\chi^2=16.73$ ;  $P<0.0001$  the difference between the first and the third level of care



1.404)].

Majority of LBW infants were born in Sarajevo, Middle Bosnia, Una – Sana and Herzegovina – Neretva Cantons. As it is shown in the Table 1, many LBW infants were born in the lower level institutions where they should not be born, because they needed neonatal intensive care which was not available.

Over 47% of LBW infants in the FB&H were born in the 1st and the 2nd level institutions, while 53% of them were born in the 3rd level institutions with NICUs.

Distribution of the LBW infants rate according to the level of care in relation to the total number of live-born infants is presented in the Table 2.

There were 29 out of 1651 of LBW infants born in the 1st level institutions, while 286 out of 9490 infants were born in the 2nd level institutions. LBW rate statistically significantly differed between the 1st and the 2nd level institutions ( $\chi^2=272.1$ ;  $P<0.0001$ ). In the 3rd level institutions there were 354 out of 11666 LBW infants, which was significantly different compared to the 2nd level institutions ( $\chi^2=13.4$ ;  $P<0.0002$ ).

Outcome of low birth weight infants dependent on the level of perinatal care in the Federation of Bosnia and Herzegovina in the year 2009 is presented in Table 3.

Out of 669 LBW infants 354 (52.8%) were born in the institutions of the 3rd level, while 159 (23.8%) were referred from the 1st and the 2nd level institutions. Only 31 (19.5%) out of 159 LBW infants referred from other institutions were transported to the higher level institutions within recommended 4 hours after birth.

In the 1st level institutions 29 LBW infants were born of whom 26 were referred to the higher level institutions, while 3 died in the institution of birth. In the 2nd level institutions 153 (22.8%) out of 286 of LBW infants were treated 53 (34.6%) of whom died. The rate of infants who died in neonatal institutions of the 1st level was 5.6 per 1000 live-born. In neonatal institutions of 3rd level 513 infants were treated and 461(89.9%) survived, while 52 (10.1%) died, which was 4.5 per 1000 live-born. The difference between the mortality rate of LBW infants between the institutions of 1st and 2nd level was not statistically significant ( $\chi^2=0.99$ ;  $P=0.083$ ).

Statistically significant difference of the mortality rate of LBW infants was found between the 1st and the 3rd level ( $\chi^2=16.73$ ;  $P<0.0001$ ), and between the 2nd and the 3rd level ( $\chi^2=51.45$ ;  $P<0.0001$ ) institutions.

## DISCUSSION

In 10 cantons of the FB&H in the period from 01.01. to 31.12.2009 22897 infants were born of whom 11 live-born infants had birth weight below 500 grams, which was the exclusion criterion. The total population of 22897 infants was left of whom 669 (2.9%) were LBW. LBW rate in the FB&H is relatively low in the comparison with other countries where it ranges from 3.3 to 38%. LBW rates are particularly high in Asia and sub-Saharan countries. In Burkina Faso, it is estimated that

19% of all live births in 1999–2005 were LBW. An estimated 20% of infants are born prematurely in Bangladesh, 30% of whom are LBW. Perinatal outcome is the indicator of the quality of perinatal care. LBW is a public health problem, and complicates around 17% of all births. It is among the major mortality risk factors in early infancy.[27]

Majority of LBW infants were born in Sarajevo, Middle Bosnia, Una – Sana, and Herzegovina – Neretva Cantons. In neonatal institutions of the 1st level, 29/1651 low birth weight infants were born, while in the neonatal institutions of the 2nd level 286/9490 infants were born. LBW infant rate between the institutions of the 1st and the 2nd level is significantly different between these institutions and the institutions of the 3rd level. At the beginning of the regionalization of perinatal care (1970-1985) in the USA, relatively small number of LBW infants was born in the 3rd level institutions. Comparing our results with currently available reports from the countries with existing regionalized perinatal care, the LBW infant rates in FB&H are low.[28]

Regionalization is a regulatory approach to rationalization of resource allocation, especially for highly specialized medical services or technologies. Proposals to encourage regionalization have waxed and waned in popularity over the years. A major argument in favour of regionalization is the possibility of achieving better patient outcomes. Experiences in regionalizing perinatal and neonatal care have resulted in improved outcomes for mothers and infants.[29]

Comparing our results with the results from the developed countries, it is evident that the survival rate of LBW infants is relatively low, and the mortality rate is higher than in Croatia,[30] and Finland.[31] Comparing the survival rate of the assessed population with the survival rate of the infants from other countries in the institutions of the same level of care, the differences are even higher.[32] The limitation of our study is that it was not taking into account the differences between the regionalized and non regionalized institutions which are treating sick newborns like paediatric trauma centres and neonatal intensive care units.

## CONCLUSION

It would be ideal that every high risk pregnant woman is transferred to the institution of appropriate organisational level before delivery. Unfortunately, it is not always possible to predict the delivery of high risk infants, which makes transport „in utero“ not always possible. In these circumstances post-natal transport of severely sick newborn is mandatory. The existing regionalization of perinatal care in the FB&H significantly affects the mortality of LBW infants. Survival rate of infants born in the institutions of the 3rd level was statistically much higher than the survival rate of infants who were born in the 1st and the 2nd level institutions.

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