

DECREASING OF NEONATAL MORTALITY AT UNIVERSITY GYNECOLOGY AND OBSTETRICS CLINIC IN SKOPJE- OUR MATERIAL

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Abstract

Introduction: Neonatal mortality (NNM) is a mortality in newborns in the first 28 days after birth, or of newborns born after 22 weeks of gestation and with a birth weight greater than 500 g, per thousand live births. For many years, N. Macedonia and the University Gynecology and Obstetrics Clinic in Skopje (UGOC- Skopje), were between leaders in NNM in Europe. From 2018, the NNM in Macedonia and on UGOC- Skopje has started to decrease.

Aim of the study: The aim of the paper is to present and compare the NNM figures in the Neonatal Intensive Care Unit (NICU) at UGOC- Skopje, in two different periods - the period when the NNM at the clinic was high from 2011-2017 and during 9 months study which was made in 2019-2020 on the same clinic, when the NNM rate began to fall significantly on the clinic and in the country.

Material and methods: Several previously conducted retrospective studies on NNM at UGOC- Skopje and one prospective study that lasted 9 months from May 2019 to the end of January 2020 were used to obtain and compare the results for NNM rate at the Clinic in this paper.

Results: In 9 month, study in 2019-2020, the NNM at the Clinic and in the country, began to record a significant decline. There is a significant decrease in NNM in the group of very premature newborns, born from 28-32 weeks of gestation compared to previous years 2011-2017. NNM rate has significantly decreased and in the group of newborns born with very low birth weight (from 1000-1499 g) and low birth weight (1500-2499 g) compared to previous years.

Conclusion: The UGOC- Skopje and N. Macedonia have made progress in the last 5 years in reducing the NNM, which was one of the highest in Europe. This was helped by improved vital statistics, the use of the latest protocols for reducing NNM, and improved technical conditions at NICU.

Key words: Gestational weeks- G.W., Low birth weight- LBW, Neonatal mortality- NNM, Neonatal Intensive Care Unit- NICU, North Macedonia- N. Macedonia, University Gynecology and Obstetrics Clinic Skopje- UGOC- Skopje.

Introduction

Neonatal mortality (NNM) is a mortality of live births, in the neonatal period in the first 28 days after birth, or of newborns born after 22 weeks of gestation and with a birth weight greater than 500 g, per thousand live births [1-2].

Neonatal mortality is divided into early neonatal mortality, which covers the period of the first 7 days after birth (168 hours), regardless of gestational age, and late neonatal mortality, which covers the mortality of live newborns from 8-28 days after birth [3]. Mortality after 28 days after birth is included in the so-called postnatal or infant mortality [4].

Early neonatal mortality is higher, and therefore survival of the newborn in the first 7 days after birth is very important [3]. Survival in the first 24 hours after birth is especially important [5].

Almost 66% of neonatal deaths occur in the first seven days after birth, from which more than half die in the first 24 hours [6].

Early neonatal mortality is most often the result of the prematurity and immaturity of the newborn or of factors such as morbidity and comorbidities of the pregnant woman, fetal suffering during childbirth, the speed and way of delivery, and the efficiency of perinatal and neonatal services. Late neonatal mortality,

from 8-28 days after birth, is mortality that occurs most often as a result of complications that occur after the initial care and treatment of newborns in the neonatal intensive care unit. It is always lower than the early neonatal mortality [7].

The neonatal period is the period with the highest risk for survival in human life and mortality is highest during this period of life, in the first 28 days after birth [1-3]. Over 130 million babies are born worldwide each year [8], and 4.4 million died within the first 4 weeks of life, or 37 neonatal deaths per 1000 live births in 1990 [9].

That number is declining, and in 2022, 2.3 million newborns died in the first 28 days after birth, or 17 deaths per 1,000 newborns. NNM in 2022 accounted for 47% of the total mortality of children under 5 years of age, worldwide.

More than 90% of neonatal deaths occur in developing countries, particularly in sub-Saharan Africa and Southeast Asia [10]. The lowest neonatal mortality rates in the world are in Japan, Iceland, Singapore, Finland, and Slovenia, with 1 neonatal death per 1,000 live births [11].

Quality collection and registration of data on every birth and newborn, on causes of death and all vital statistics, are important in obtaining information for reducing NNM globally [12].

All causes and diseases of the mother and the newborn should be noted in vital statistics in correlation with the International Classification of Diseases (ICD-10) and should be used [13].

For many years, N. Macedonia and UGOC- Skopje had a very high neonatal mortality rate, among the highest in Europe. In 1982, the neonatal mortality rate in N. Macedonia was over 20‰. Since independence in 1990, the neonatal mortality rate in N. Macedonia has ranged from 18.8‰ in 1990 to 7‰ in 2009-2012. From 2012-2017, the NNM rate increased and ranged within 7-9.5‰ per year (Picture 1). N. Macedonia was a European country with a high NNM rate, among the highest in Europe, and in 2017, with 7.4 neonatal deaths per 1000 live births, it was the second country with the highest NNM in Europe, right behind Moldova [14].

The countries surrounding N. Macedonia in that period had lower rates of neonatal deaths: Turkey-6.5; Albania-6.2; Bosnia and Herzegovina-4.7; Bulgaria-4; Serbia-3; Montenegro-2; Croatia-2 neonatal deaths per 1000 live births [15].

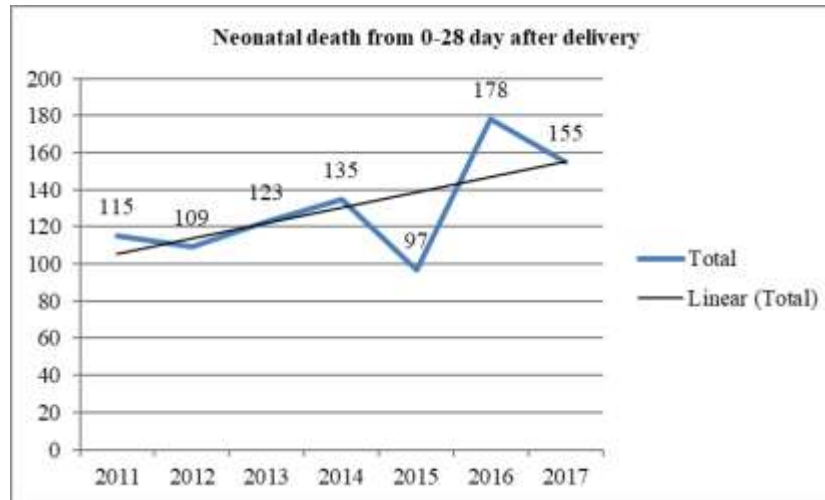


Picture 1. Neonatal mortality in Macedonia over the years.

Since 2018, the NNM in N. Macedonia has started to decrease and approach the European average, and N. Macedonia ended 2022 with a NNM rate of 2‰ (25).

The largest perinatal and neonatal center in the country is the University Clinic of Gynecology and Obstetrics-Skopje (UGOC-Skopje), with the largest Neonatal Intensive Care Unit (NICU) in the country. This clinic treats about 70% of premature newborns with complications from the entire country and accounts for almost 70% of neonatal deaths in the country.

From 2011-2017, the trend of NNM increased again at the Clinic, as well as throughout the country, compared to the previous few years (Graficon 1). The trend of NNM at the clinic began to grow during this period.



Graficon 1. Trend of NNM at UGOC- Skopje 0- 28 days after delivery, 2011-2017.

The aim of the paper is to present and compare the NNM figures in the Neonatal Intensive Care Unit of the clinic in two different periods - the period when the NNM at the clinic increased from 2011-2017 and in a smaller period of 9 months from May 2019 to the end of January 2020 during one study, when there was a significant decline in NNM and the structure of deceased neonates at the NICU [16].

A lower gestational age at delivery and a low birth weight (LBW) are two of the most important factors that increased the transfer of newborns at OINT and for elevated NNM [5].

Material and methods

This study compares the clinic's NNM in two different periods, a period when the clinic's NNM was quite high from 2011-2017 and a period when it began to decline significantly in 2019-2020. Several previously conducted retrospective studies on NNM at UGOC in Skopje and one prospective study that lasted 9 months from May 2019 to the end of January 2020 were used to obtain and compare the results for NNM at the Clinic, conducted by the same researchers. All results were taken and processed from the database of the NICU of the UGOC- Skopje, both for the retrospective and prospective analyses used in this paper. The results for the number of neonates transferred to the NICU and the numbers of NNM in the two processed periods were compared, by gestational age and by birth weight of the newborns, divided into several groups.

Results

The total number of live births at UGOC- Skopje, in the period from 2011-2017 was 36,733 live newborns. Of these, 4810 newborns were transferred to the NICU after delivery for further treatment, of which a total of 912 newborns died in the neonatal period of 28 days after delivery or 19% from all newborns transferred at NICU (Graficon 1) (Table 1).

According to gestational age at the time of delivery, newborns are divided into several groups: born at 22-27 weeks of pregnancy - extremely premature, the highest risk group; born at 28-32 weeks of pregnancy - very premature, a very risk group of premature babies; born at 33-36 weeks of pregnancy - moderately to late premature, a less risk group of premature babies; born over 37 weeks of pregnancy - term newborns in which group there were several transferred at NICU and the neonatal mortality rate was lowest.

Neonatal mortality in the group of extremely premature newborns from 22-27 weeks of gestation is very high and amounts to 91%, or it contributes 45% to the total mortality of all newborns in the NICU (Table 1) (Fig.1).

Table1. NNM at NICU and UGOC- Skopje by gestational age, 2011-2017.

Gestational week	22-27 g.w.	28-32 g.w.	33-36 g.w.	>37 g.w.	Total
Transferred at NICU by g.w. 2011-2017	452 9,4%	1664 34,6%	2357 49%	337 7%	4810 100%
NNM by g.w. 2011- 2017	411 45%	333 36,51%	123 13,49%	45 4,93%	912 100%
NNM % in the group B/A	411/452 91%	333/1664 20%	123/2357 5,22%	45/337 13,6%	912

Then mortality decreases in the following groups of very premature 28-32 weeks of gestation to 20% and in moderately to late premature 33-36 weeks of gestation to 5.22%. In term newborns transferred at NICU, mortality shows 13.6%, but it only contributes 4.93% to the total mortality in newborns and is the result mainly of severe congenital anomalies or acute obstetric conditions (Fig 1).

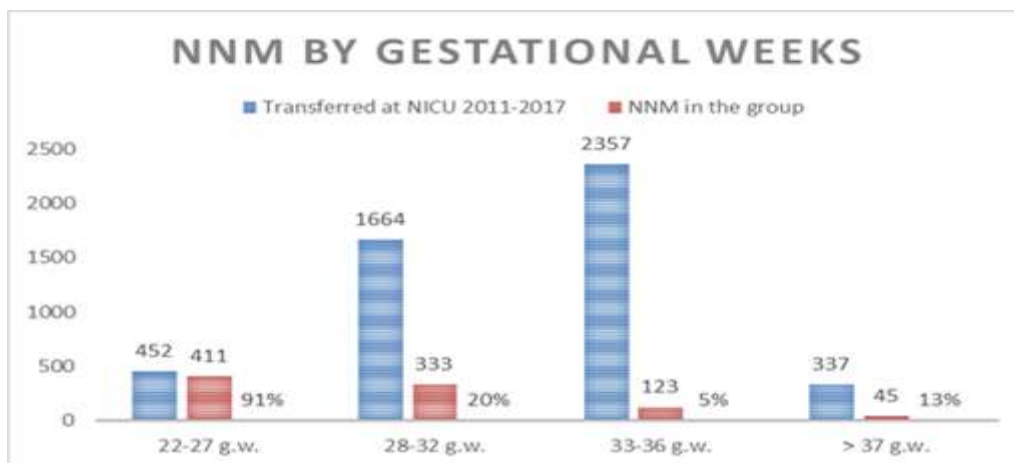


Figure 1. NNM at NICU and UGOC- Skopje by gestational age, 2011-2017

In the analyzed period of 9 months at the UGOC in Skopje, there were a total of 3453 live births. 445 (12.9%) of these newborns were transferred and treated at NICU. Of all newborns treated at NICU, 368 (82.7%) of newborns remained alive and 77 (17.3%) were neonatally deceased newborns in the first 28 days after birth (Table 2) (Fig.2).

Table 2. NNM at UGOC- Skopje by gestational age in a period of 9 months, 2019-2020.

Gestational week	22- 27	28-32	33-36	➤ 37	Total
Transferred an NICU newborns	42 9,43%	154 34,6%	218 50%	31 6,8%	445 100%
NNM by gestational week	37 48%	18 23,37%	15 19,5%	7 9%	77 100%
NNM % in the group	37/42 88%	18/154 11,7%	15/218 6,9%	7/31 22,6%	77 100%

There is a significant decrease in NNM in the group of very premature newborns from 28-32 weeks of gestation in this 9 months period to 12%, compared to previous years of greater NNM at NICU from 2011-2017 when the NNM in this group was 20%. NNM has also decreased slightly in the group of extremely premature newborns from 91% to 88%, during the study in this 9 months period.

The remaining two groups with bigger gestational age, have a very small number of newborn deaths during this study in the neonatal period and we don't discuss it (Fig.2).

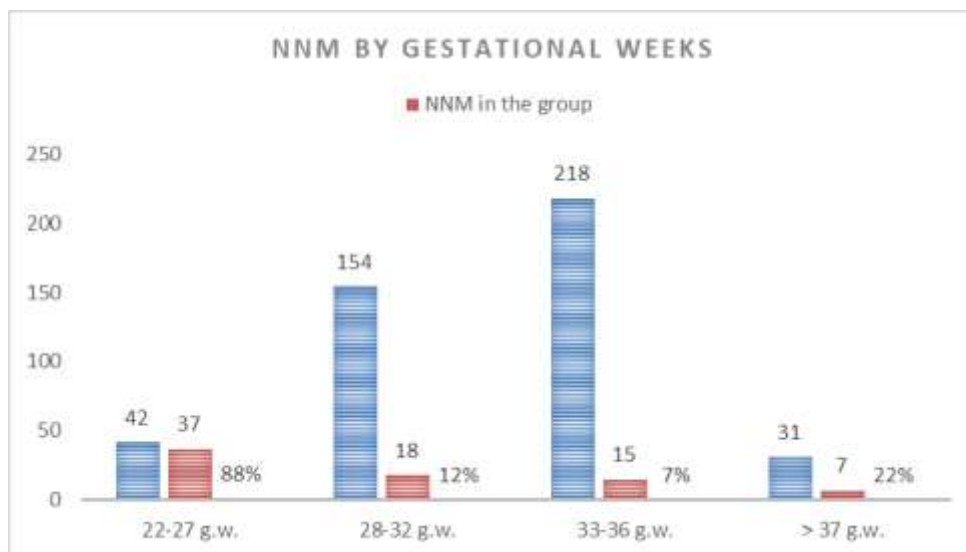


Fig. 2. NNM at NICU and UGOC- Skopje by gestational age, during 9 months study 2019/20.

In terms of gestational weight, a difference in NNM by groups, among newborns was also observed during the period of 9 months study in 2019-2020, compared to previous years from 2011-2017, when the NNM was higher at UGOC- Skopje. According to birth weight, newborns are divided into: Newborns with extremely low birth weight- less than 1000 g. (from 500 to 999 g.); newborns with very low birth weight- less than 1500 g. (from 1000-1499 g.); newborns with low birth weight- less than 2500 g. (from 1500-2499 g.) and newborns with a weight greater than 2500 g.

In the analysis of the NNM at the Clinic in the period from 2011-2017, NNM in newborns weighing under 1000 grams are the highest and account for 47.26% of all neonatal deaths (Table 3).

Table.3. NNM at NICU and UGOC- Skopje by gestational weight, 2011-2017.

Year Birth weight	2011	2012	2013	2014	2015	2016	2017	Total NNM B.W.
<1000 gr.	52 45.22%	39 35.77%	66 53.66%	68 50.37%	47 48.5%	75 42.13%	84 54.19%	431 47.26%
1000-1499 gr.	30 26.0%	35 32.11%	29 23.58%	29 21.48%	23 23.7%	55 30.9%	32 20.64%	233 25.55%
1500-2499 gr.	26 22.6%	28 25.7%	22 17.85%	34 25.2%	20 20.62%	38 21.34%	31 20%	199 21.82%
>2500 gr.	7 6%	7 6.42%	6 4.9%	4 3%	7 7.22%	10 5.61%	8 5.16%	49 5.37%
Total NNM in 7 years	115 100%	109 100%	123 100%	135 100%	97 100%	178 100%	155 100%	912 100%

As the birth weight of newborns increases, the mortality of newborns decreases, and decreases especially in newborns with a birth weight over 2500 grams. (Table 3) (Figure 3).

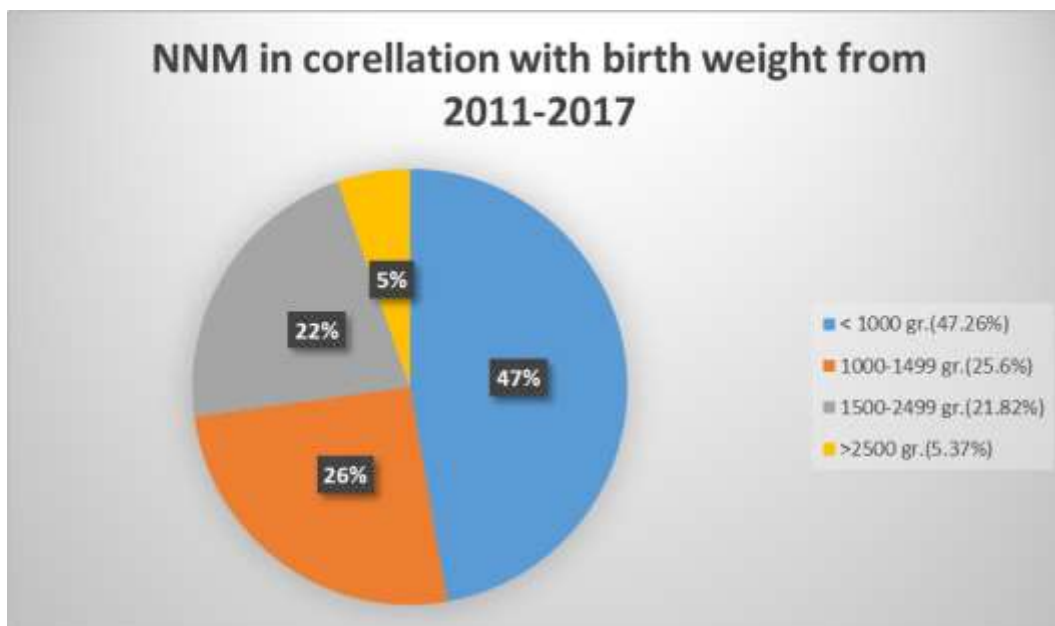


Figure 3. Percent of NNM in correlation with the birth weight at NICU and UGOC- Skopje/ 2011-2017.

In the 9-month period examined from may to the end of January in 2019-2020 at the NICU and UGOC- Skopje, 77 newborns died out of a total of 445 newborns transferred and treated at NICU. The mortality of newborns with lower birth weight was higher. (Table 4).

Table 4. NNM at NICU by gestational weight in 9 months period, 2019/20

Neonatal deaths	500-999 gr.	100-1499 gr.	1500-2499 gr.	>2500 gr..	Total newborn
1- 7 day NNM	30	12	8	6	56
8-28 day NNM	12	3	3	3	21
NNM by groups	42 (54,5%)	15 (19,4%)	11 (14,3%)	9 (11,6%)	77 (100%)
Total NNM in the group	42 (77,8%)	15 (18%)	11 (4,3%)	9 (17,65%)	77 (17,3%)
Survived newborns	12 (22,2%)	68 (82%)	246 (96%)	42 (82,35%)	368 (82,7%)

Mortality is again highest in the group of newborns with extremely low birth weight- 54,5% , like in the previous period from 2011-2017, which is expected, but it has significantly decreased during 9 months study, in the group of newborns with very low birth weight (from 1000-1499 g) to 19,4% and in the group of low birth weight (1500-2499 g) to 14,3% compared to previous years when it was 26% and 22% in the same groups.

This means that survival in these two groups of very low and low birth weight newborns during the 9-month study has significantly improved, compared to the previous period from 2011-2017. (Fig.4).

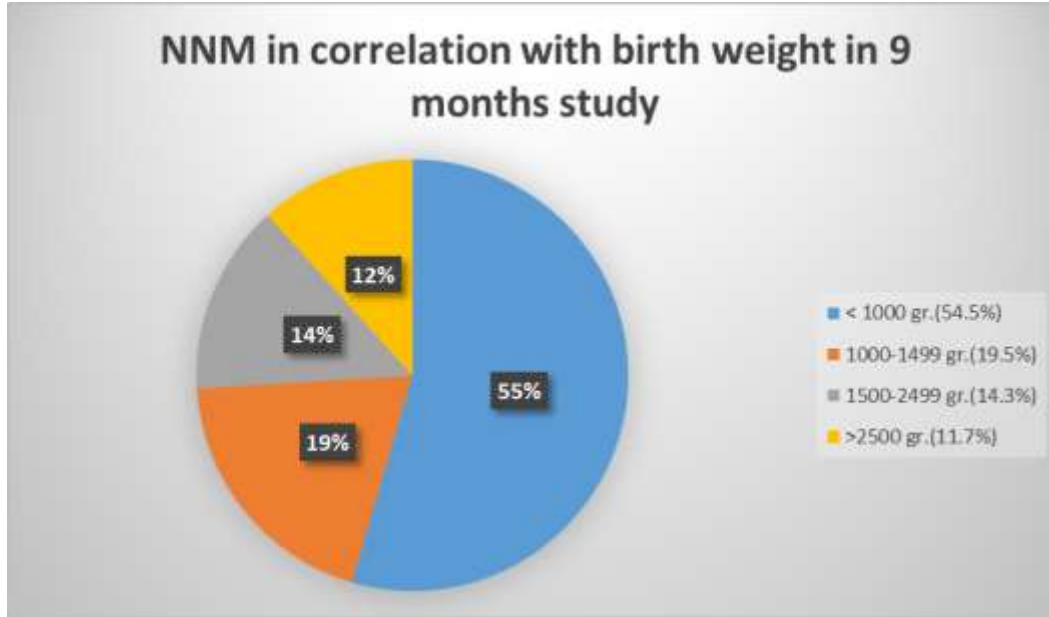


Figure 4. Percent of NNM in correlation with the birth weight at NICU and UGOC- Skopje, in 9 months study 2019/20

Discussion

If we look at the results for the NNM at the Clinic from the two periods processed, a difference in the NNM in different groups, based on the gestational age and gestational weight of newborns is noted, in the period when it was highest at the Clinic from 2011-2017 and in the monitoring period during the 9 months study which held on the Clinic in 2019-2020. During this period of 9 months study at UGOC-Skopje, the NNM at the Clinic and in the country began to record a significant decline [16].

In terms of gestational age, there has been small progress in the survival of newborns in the group of extremely premature newborns from 24-27 weeks of gestation. Survival in this group is still low, around 12%, and survival of these infants is still lower, than that of the same infants in highly developed countries such as the USA or Japan [11].

During the follow-up of newborns at the OINT, during the processing of the study for 9 months period in 2019-2020, there was significant progress in survival, in the group of very premature newborns, born from 28-32 weeks of gestation, with a decrease from 20% to less than 12%, compared to the NNM from the previous processed years with the highest mortality at the clinic from 2011-2017 [16].

The survival of newborns now in the group of very premature babies, born from 28-32 weeks of gestation was 88% of newborns and in the group of moderately and late premature babies born from 33-36 g.w. survival is 93%.

Regarding the NNM by gestational weight in newborns, a significant difference in survival is also observed in certain groups during the 9 months study, compared to the previous period from 2011-2017, when the NNM was higher in some groups. Of the total number of newborns treated at the NICU, with extremely low birth weight < 1000 grams during the 9 months study, about 78% of the newborns died. Newborn survival increases exponentially, with increasing birth weight in newborns.

Mortality during the study was still high among newborns with extremely low birth weight from 500-999 grams, while in the group of newborns with very low birth weight from 1000-1499 grams we have a decrease in mortality from 26% to 19%. Also in the group of newborns with low birth weight from 1500-2499 grams, there is a decrease in NNM during this study among this newborns from 22% to 14% ,

compared to the previous period from 2011-2017. The survival of newborns in these two groups has increased significantly compared to past times [16].

This study showed that the consequences of prematurity and low birth weight are still the leading causes of neonatal mortality, which is consistent with many studies from less developed countries, as well as some studies in developed countries such as Canada, Portugal and South Africa [10-11].

The consequences of prematurity are more severe, with smaller gestational age of the newborn and in lower birth weight of the newborn at birth. As gestational age and birth weight of newborns increase, the chance of survival increases exponentially.

The higher survival of premature newborns at the clinic with smaller gestational age and lower birth weight, is likely a result of the use of newer protocols for their treatment, the greater use of corticosteroids for prenatal maturation in premature births, and the greater number of deliveries by cesarean section, when there is also less trauma during delivery of these newborns (Gabi). A larger number of incubators, respirators, and monitors were also purchased for the NICU, for better care, monitoring, and treatment of every newborn treated at NICU on UGOC- Skopje.

Prematurity and low birth weight, especially in extreme cases, continue to have higher mortality rates, so the fight to reduce extreme prematurity and extreme low birth weight in newborns remains the main method for reducing NNM. Therefore, mothers with high-risk pregnancies and risk of preterm birth should be identified and hospitalized in a tertiary care facility, and fetal maturation should be performed in cases with risk from premature birth on time. The termination of pregnancy and way of delivery should be chosen, either spontaneously or by cesarean section, in order to reduce the injuries of newborns and consequences of prematurity and low birth weight such as RDS, asphyxia, and infections and sepsis in newborns [17].

Conclusion

The UGOC- Skopje and N. Macedonia have made progress in the last 5 years in reducing the NNM, which was one of the highest in Europe, placing N. Macedonia today in the group of countries with the European average of NNM rate. This was helped by improved vital statistics, the use of the latest protocols for reducing NNM, and improved technical conditions and equipment for the treatment of newborns transferred and treated at the NICU on UGOC- Skopje.

Investing in education and new knowledge, improving technical equipment and applying the latest global protocols for the treatment of newborns, has also reduced the NNM at the Clinic and in the country.

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