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Original Article

Factors Associated with Neonatal Mortality in the Neonatology Department of the Regional Hospital Center, AGADIR, MOROCCO

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ABSTRACT

Background: Neonatal mortality is a major public health problem and concern worldwide. Despite significant improvement, the neonatal mortality rate is still high. The present study aimed to determine the factors associated with neonatal mortality in the Neonatology Department of the regional hospital center, Agadir, Morocco.

Methods: This is a retrospective case-control study in which the records of newborns admitted during 2019 (from January 1 to December 31), in the neonatal department of the regional hospital of AGADIR were studied. Neonatal and maternal characteristics were collected from the medical record using a pre-established exploitation form. A total of 760 mother-infant pairs were selected. The association between death and study variables was evaluated using the bivariate analysis conducted by the Chi-square test. Subsequently, multivariate analysis was performed using binary logistic regression to assess the effect of each factor.

Results: Significant associations were found between the onset of neonatal death and several factors such as distance traveled to the hospital facility (AOR = 3.588, 95% CI:1.952-6.594); multiparity (AOR = 3.301,95% CI: 1.919-5.680); the number of prenatal visits (AOR = 3.608,95% CI: 2.293-5.678); low birth weight (AOR = 0.314, 95% CI: 0.184-0.535); referral act (AOR = 0.368, 95%CI: 0.208-0.652); 5-min Apgar Score (AOR = 0.104, 95%CI: 0.42-0.257) and gestational age (AOR = 1.788, 95%CI: 0.608- 5.257).

Conclusion: Neonatal mortality is associated with several preventable factors. Further preventive measures for these risk factors are required, especially in terms of pregnancy monitoring, delivery conditions, and infant management at birth.

Keywords: Associated factors, Case-control study, Neonatal mortality, Neonatology

Introduction

Neonatal mortality is a reliable indicator of a country's level of social and economic development. Hence, it allows for evaluating the health status of a population and assessing the quality of the care provided. In addition, the identification of the underlying causes and the analysis of risk factors of neonatal deaths is essential for the development of a strategy to prevent neonatal mortality(1). To this end, mortality reduction can only be achieved by more knowledge of the risk factors that compromise the vital prognosis of the fetus or the newborn(2).

In 2015, The United Nations adopted the Sustainable Development Goals (SDGs), which aim to ensure a healthy life and promote the well-being of all children. Target 3.2 in SDG 3 involves ending preventable deaths of newborns and children under the age of 5 by 2030. For a child, the morbidity risk is highest during the neonatal period, i.e., during the first 28 days of life. Almost 4 million children die before they reach 28 days of the age of whom 2 million parish in the first week of life (3,4).

This implies that in countries with a high percentage of neonatal deaths, efforts to achieve the global development goal MDG4 must

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concentrate on preventing neonatal mortality, particularly by improving delivery conditions and neonatal care(2). By 2030, Morocco is committed to achieving the Sustainable Development Goals and the World Health Organization's Global Strategy on Women's, Children's and Youth Health 2016-2030, the first two targets of which are offending preventable maternal and newborn deaths (5,6).

In Morocco, according to the latest results of the national population and family health survey conducted by the Ministry of Health in 2018, the neonatal mortality rate is about 13.56 deaths per 1000 live births including 4 infant deaths and 3 neonatal deaths. Despite the significant progress in terms of reducing maternal and neonatal mortality between 1990 and 2015, the rate of in-hospital neonatal mortality is still fairly high despite investments made (7). The goal of the present study is to determine the factors associated with neonatal mortality in the neonatology department of the regional hospital center, AGADIR, MOROCCO.

Methods

We conducted a case-control study by examining the records of newborns hospitalized from January 1 to December 31, 2019, in the neonatal department of the regional hospital of Agadir. The cases and controls in our study were determined based on the data available in the hospital's service information system, particularly the admission register (N=760). Cases included newborns aged 0 to 28 days who died after admission to the department (n=380). Controls were random neonates admitted just after the cases in the same year and recovered at the end of their hospitalization (n=380 live neonates). The study was approved by the ethics committee of the Faculty of Medicine and Pharmacy in Rabat.

Using a pre-established exploitation form, we collected the socio-demographic and obstetrical information of the mothers, in particular maternal age, place of residence, parity, pregnancy follow-up (number of prenatal consultations, test results), and delivery data, as well as the infant information (gestational age, sex, birth weight, Apgar score at birth, and notion of resuscitation), their referral code, cause of hospitalization, clinical, paraclinical, therapeutic and evolutionary data, and finally the cause and death of death.

Statistical analysis

The data collected from the operating sheet was coded, and analyzed using IBM SPSS (V22) software. The association between death and variables was measured by bivariate analysis using the Chi-square test. The odds ratio with a 95% CI was calculated to estimate the risk of death. A p-value ≤ 0.05 was considered significant. Subsequently, multivariate analysis was conducted using binary logistic regression to evaluate the effect of each factor.

Results

The two tables below summarize the information of mothers, pregnancy follow-up, details of delivery as well as the data on newborns included in the study. We recorded 380 deaths distributed as follows: 140 cases out of 6980 inborn newborns delivered at the maternity hospital of the Agadir Regional Hospital and 240 cases out of 684 outborn newborns transferred from peripheral maternity. The overall neonatal mortality rate at the maternity hospital of CHR AGADIR is 20.05 deaths per 1000 live births and this figure is 15.04 per 1000 live births for early neonatal mortality. The main causes of death are prematurity (49% of cases), perinatal asphyxia (13.6%), and respiratory distress (10.7%).

In the univariate analysis, multiparity was significantly associated with neonatal death. Indeed, 63.4% of mothers in the case group were multiparous as opposed to 40.8% in the control group (p <0.001) (Table 1). A significant association was also found with inadequate pregnancy follow-up so that only 2.6% of mothers of the deceased newborns had two prenatal consultations as opposed to 30.3% of mothers in the control group (p <0.001) and 2.6% of the women in the case group had two ultrasounds as opposed to 28.4% in the control group (p <0.001) (Table 1).

In contrast, no significant difference was observed in maternal age, marital status, and urban or rural origin (Table 1). On the other hand, a referral from another facility (p<0.001) and distance traveled (>50 km) (p <0.001) proved to be significant risk factors for neonatal death. (Table 2).

Similarly, low birth weight and prematurity were significantly associated with neonatal death, so there were 71.6% of neonates with birth weight <2500g in the neonatal death group as opposed to 38.1% in the control group (p < 0.001) (Table 2). Also, 52.4% of neonatal deaths were attributed to extreme premature versus 11.1% in the control group (p < 0.001).

A significant difference was also observed in the status of hospitalized neonates according to

the 5 min Apgar score (≤7 vs>7) (p < 0.001) observed (Table 2).

In contrast, we found no significant difference between hospitalized neonates in terms of mode of delivery (vaginal or cesarean section) (p=0.101) or the child sex (p=0.660) (Table 2).

Table1. Maternal sociodemographic characteristics and obstetric history

Variable	Cases		Controls		p- value
	(n)	%	(n)	%	
Age (years)					
<20ans	22	5,8	20	5,3	0,828
[20,30[	244	64,2	238	62,6	
[30,40[	98	25,8	101	26,6	
[40,50[	16	4,2	21	5,5	
Marital status					
Married	372	97,9	375	98,7	0,401
Single	8	2,1	5	1,3	
Place of origin					
Urban	245	64,5	223	58,7	0,101
Rural	135	35,5	157	41,3	
Parity					
Primiparous women	67	17,6	84	22,1	<0.001
Second parous women	72	18,9	141	37,1	
Multiparous women	241	63,4	155	40,8	
Number of prenatal visits					
0	30	7,9	20	5,3	<0.001
≤4	350	92,1	343	90,3	
>4	0	0	17	4,4	
Number of the ultrasound exam					
0	40	10,5	14	3,7	<0.001
1	329	86,6	255	67,1	
≥2	11	2,9	111	29,2	

Table 2. Delivery-related characteristics of women and newborns included in the study

Variable	Cases		Controls		p-value
	(n)	%	(n)	%	
Gestational age					
<28	199	52,4	42	11,1	<0.001
[28,32]	50	13,2	114	30,0	
[33,36]	119	31,3	183	48,2	
≥37	12	3,2	41	10,8	
Mode of birth					
Vaginal delivery	313	82,3	295	77,6	0.101
Cesarean delivery	67	17,6	85	22,4	
5-min Apgar					
≥7	262	68,9	370	97,3	<0.001
≤7	118	31,05	10	2,6	
Sex					
Female	159	41,8	165	43,4	0.660
Male	221	58,2	215	56,6	
Birth weight					
<2500	272	71.6	145	38.1	<0.001
≥2500	108	28.4	235	61.8	
Referral					
OUI	240	63,2	87	22,9	<0.001
NON	140	36,8	293	77,1	
Distance traveled to the hospital					
<5Km	66	17,4	257	67,6	<0.001
[5Km,50Km]	94	24,7	21	5,5	
>50Km	220	58,1	102	26,8	

The multivariate logistic regression analysis was conducted for all significant risk factors in the

univariate analysis. In this logistic regression model analysis, the above risk factors for neonatal death were found to be statistically significant (Table 3).

Table 3. Factors of neonatal mortality: multivariate logistic regression analysis

Variable	OR bruts	IC à 95%	p-value	AOR	ICà95%	p-value
Multiparity	3,045	2,149-4,314	<0,001	3.301	1,919-5,680	<0,001
Number of prenatal visits	6,280	4,349-9,069	<0,001	3.608	2,293-5,678	<0,001
Ultrasound exam	6,040	3,966-9,200	<0,001	2,692	1,485-4,880	0,001
Referral	5,754	4,189-7,903	<0.001	0,368	0,208-0,652	0,001
Mode of birth						
Low birth weight	4,082	3,011-5,533	<0.001	0,314	0,184-0,535	<0,001
5 min Apgar Score(≤7)	0,060	0,031-0,117	<0.001	0,104	0,042-0,257	<0,001
Distance traveled to the hospital			<0,001			<0,001
<5Km						
[5Km,50Km]	8.399	5.870-12.016		3.588	1.952-6.594	
>50Km	0.482	0.284-0.817		0.295	0.138-0.633	
Gestational age			<0,001			<0,001
<28						
[28,32]	0.62	0.030-0.127		0.240	0.082-0.705	
[33,36]	0.662	0.323-1,377		1.788	0.608-5.257	
≥37	0.450	0.227-0.891		0.663	0.249-1.762	

Discussion

Multiple causes and risk factors associated with neonatal mortality have been identified in the medical literature. The frequency of these factors varies from one country to another and from one region to another influenced by several socio-demographic and health determinants.

More profound knowledge of these risk factors for neonatal mortality allows more efficient planning for prevention strategies and their adaptation to the realities of each context.

In our study, we analyzed the risk factors for neonatal deaths at the neonatology department of a regional hospital and identified factors associated with neonatal mortality. We believe these factors should be taken into account in the development of regional strategies to combat neonatal mortality.

Among these factors, maternal parity was significantly associated with neonatal death so death risk was three times higher in multiparous women as opposed to primiparous ones (AOR=3.301, 95% CI: 1.919-5.680). The same association has also been reported in other studies, particularly that of Baidaa A et al. (8) The maternal exhaustion syndrome has been proposed by some authors as a mechanism that could explain this neonatal mortality through the adverse outcomes of pregnancies in women with short inter-genital intervals and high parity(9).

Inadequate pregnancy follow-up was also a significant risk factor for neonatal death in our study. Indeed, limited prenatal visits were significantly associated with neonatal mortality (AOR=3.608, 95%CI: 2.293-5.678; p-value<0.001). Our findings are comparable to that of Batista CB who found that lack of prenatal care increased the risk of neonatal death by 2.8 times (10). On the other hand, several studies have reported that prenatal consultation with good pregnancy follow-up decreased the risk of neonatal mortality (11-14). The protective effect of antenatal care is assumed to be linked to its quality and education of pregnant women, especially prevention, early detection, and management of pregnancy conditions such as nutritional deficiencies, infections, and premature delivery, which mitigate adverse pregnancy outcomes and the risk of perinatal and neonatal mortality (15).

Similarly, a significant association was found between inadequate ultrasound monitoring of pregnancy and neonatal death (AOR=2.692, 95%IC: 1.485-4.880; p-value=0.001). Ultrasound follow-up is part of recommendations outlined in good professional practice, according to which three screening ultrasounds are normal for pregnancy(16). Even in low-resource countries, at least one routine prenatal ultrasound between 11 and 14 weeks of amenorrhea is recommended because it helps determine the gestational age, discover early congenital anomalies and multiple pregnancies, monitor fetal well-being, and detect clinical complications such as preeclampsia and placental insufficiency resulting inappropriate management(17).

Our results also indicated a statistically

significant difference in the evolution of newborns admitted to the neonatology department according to the place of reference. Accordingly, neonatal deaths recorded in the group of newborns transferred from the maternity hospitals of the Sub-MASSA region (outborn) were higher than those born at the maternity hospital of the CHR Agadir (inborn), (AOR = 0.368, 95%CI: 0.208-0.652; p-value <0. 001). Thus, our results are consistent with those reported by other authors (18, 19). Indeed, a recent study by Wan-Hsuan Chen found a significantly higher neonatal mortality rate among outborn infants as opposed to inborn ones (2.05 ± 0.79 vs. 0.39±0.07, p-value = 0.002) (20).

Similarly, a longer distance traveled to reach the hospital was associated with a higher risk of neonatal death with a 3-fold increase in risk for newborns whose referral center was more than 5 km (between 5 and 50 km) from the neonatology department (AOR=3.588, 95%CI: 1.952-6.594; p-value<0.001). Referral to a specialized neo-natology service is often correlated with the detection of a serious anomaly that can jeopardize the life of the newborn. Moreover, delayed transfer and transfer conditions can worsen the condition of the newborn and increase the risk of mortality. Indeed, several studies have shown that distance from health facilities is a risk factor for neonatal death. Therefore, it is essential to ensure access to quality care, whether geographically, financially or socio-psychologically (21-23).

Similarly, to improve neonatal prognosis and reduce neonatal mortality in our study, it is essential to emphasize the importance of in-utero transfer for high-risk fetal pregnancies and improve neonatal transfer conditions through conditioning, prevention, and treatment of deteriorated clinical and hemodynamic status of the newborn during transfer(24).

Low gestational age and low birth weight were risk factors significantly associated with neonatal death in our study (AOR= 1.788, 95% CI: 0.608-5.257; p-value<0.001) and (AOR= 0.314, 95%CI: 0.184-0.535; p-value<0.001), respectively. This is consistent with data obtained from several other studies that showed early neonatal mortality is related to gestational age and low birth weight (25-27). Indeed, prematurity and intrauterine growth retardation expose newborns to a host of complications and therefore contribute to high neonatal mortality(28). For this reason, it is essential to strengthen measures to prevent prematurity and intrauterine growth retardation in the national strategy to combat neonatal mortality.

Apgar scores below 7 at 5 min were significantly linked to neonatal death in our sample (AOR= 0.104, 95%CI: 0.42-0.257; p-value<0.001). This association has also been reported in several studies that found perinatal asphyxia is a major risk factor for neonatal death. The study by Fawole et al. in Nigeria found that neonates with an Apgar score of 6 or less than5 min were at risk of death in almost half of the cases (47.7%) compared to only 0.2% of neonates with an Apgar score of 7 and higher (29). Similarly, Moster et al. and RémiKaboré reported that the risk of neonatal death was higher in newborns with a low Apgar score (30,31).

Other factors did not have a significant impact on the risk of neonatal death, such as the mode of birth. Cesarean delivery was the mode of delivery in 17.6% of the deceased neonates as opposed to 22.4% of neonates in the controls and the difference was not significant in the univariate analysis. It contrasts with the results of other researchers such as M. Garba who reported that children born by Cesarean section had a lower risk of death than those born by natural route (p = 0.0000; OR = 0.17 with CI [0.11; 0.25](10). Vaginal delivery would be a risk factor for neonatal death due to certain complications such as dystocia and perinatal asphyxia. Paradoxically, other researchers, such as Takramah and Aheto, found that newborns delivered by Cesarean section have a significantly higher risk of death (32). This is mainly due to the indications of the Cesarean section and its delays rather than the procedure per se. Similarly, we did not find a significant association between the percentages of neonatal deaths and maternal age There are divergent findings on the impact of maternal age on the risk of neonatal death in the medical literature. While some researchers such as Ouahid et al. and Garba et al. did not find an association between the risk of neonatal death and maternal age (2,27) others reported a higher risk of neonatal death in newborns of mothers older than 35 years, attributing it to the elevated risk of chromosomal abnormalities, fetal growth retardation and preterm birth (33,34).

Our study did not find any association between the risk of neonatal death and marital status unlike the study of Thakur et al. and Izugbara who reported a higher risk of neonatal death in single mothers, which is probably due to the inherent difficulties of this condition such as stress, lack of social support and economic hardship (35,36) Likewise, we did not find a significant association between the mothers'

background and neonatal death, which is aligned with the study of Ouahid et al, whose results suggested that the background has no impact on neonatal death(2). While some authors have stated that the probability of neonatal death is higher in rural women than in urban women due to the difficulty of accessing quality care, especially in low-resource countries(37, 38), other researchers have reported contradictory results with the neonatal death rate being higher in urban women compared to those with a rural origin (39,40) Disparity in conditions and lifestyles of urban women such as working outside the home, stress, and pollution are put forward as hypotheses that may explain this outcome (36).

The male sex accounted for more than 58.2% of in-hospital neonatal deaths, but there was no statistically significant difference (p-value =0.860). It is in contrast with the results of other researchers who found that neonatal mortality is predominant in the male sex (23,27,41). The higher rate of morbidity and mortality in males has been attributed to later pulmonary and immunological maturation as well as more frequent congenital malformations of the urogenital system in males by some authors (42).

This study can help clinical and organizational management to prevent and reduce neonatal mortality. The multiple data sources, the rigor of data collection and analysis, and the completeness of the case population reinforce the validity of the results; however, given time constraints, the on-site research was limited to the neonatology department. We are aware that we have only explored part of this problem and further multicenter studies are warranted to shed further light on this problem.

Conclusion

Neonatal mortality remains a major problem today. It is associated with several risk factors including multiparity, insufficient prenatal consultations, distance traveled to the neonatal facility, Apgar score, gestational age, and low birth weight. Its underlying causes are prematurity and perinatal asphyxia. In light of our findings, the strategy to combat neonatal mortality in our region should focus chiefly on upgrading the quality of prenatal monitoring of pregnancies and obstetric and neonatal care, improving the conditions for the neonatal transfer, and finally preventing and addressing prematurity and low birth weight.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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