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Risk Factors for Early Neonatal Mortality in Morocco

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The aim of the analyze the risk factors for the main causes of early neonatal mortality in Morocco. At the national level, Intrauterine hypoxia, prematurity, perinatal infection and neonatal jaundice account for 90% of neonatal deaths in Morocco. Intrauterine hypoxia, prematurity, perinatal infection and neonatal jaundice account for 90% of neonatal deaths in Morocco. Factors associated with intrauterine hypoxia include: maternal anemia (OR :1.8 CI to 95% :1.5,3.2), placental infarction (OR :1.2 CI to 95%:1.1,2.2), parental smoking (OR :3.9 CI to95% :3.2,6.9), intrauterine growth retardation (OR :5. 6 CI to 95% :5.1,7.3) and gestational diabetes (OR :4.9, CI to95% :5.01,7.5), with regard to neonatal jaundice, the risk factors gravitate around hyperbilirubinemia (OR :1.6 CI to95% :1.2,2.5), premature birth less than 37weeks (OR :4. 6 CI to95% :3.4,7.1), congenital hemolytic anemia (OR :3.2 CI to 95% :3.1,4.2), and blood group incompatibility (OR :2.4 CI to 95% :2.2,3.9). For risk factors of perinatal infection, the study highlighted the association with maternal age less than 25years (OR :3. 5 CI to 95% :2.7,4.3), bacterial vaginosis (OR :4.2 CI to 95% :3.9,7.5), Placenta Preavia (OR :7.2 CI to 95% :5.3,8.5), and prenatal consultation frequency less than two visits (OR :6.4 CI to 95% :5.2,6.9. With regard to risk factors for neonatal infection, Escherichia coli, isolated by Cyto-Bacteriological examination, was the cause of 973 (31.9%) neonatal infections. The study highlighted several factors: premature rupture of membranes beyond 12 hours, (OR:5. 4 CI to 95%:4.2,6.3), gestational age less than 37 weeks of amenorrhea (OR:4.6 CI to 95%:3.4,7.1), on the other hand, cesarean section was a protective factor against perinatal infection (OR:0.3 CI to 95%:0.1,0.4). Screen and treat maternal anemia; educate on smoking cessation; manage gestational diabetes; monitor fetal growth. Identify and manage hyperbilirubinemia; care for premature infants; screen for hemolytic anemia; test blood group compatibility. Promote maternal health; screen for bacterial vaginosis; manage placenta previa; increase prenatal consultations. Manage membrane rupture; care for premature infants; use cesarean sections when needed; ensure neonatal hygiene.

Keywords: Early neonatal infection; Intrauterine hypoxia; Neonatal jaundice; Perinatal infection; Prematurity.

Indicators of neonatal mortality due to events occurring from birth to 28 days testify that, in certain respects, newborn survival is more determined by maternal factors, genetics, other environmental factors inherent in lifestyles and the family's socio-economic status. Knowing that

indicators of preventable newborn deaths record the fragility of the performance of health system services in reducing unavoidable neonatal deaths.[1] According to the United Nations Children's Fund, newborns who die in the neonatal period present with conditions and diseases associated with the absence of quality care at birth or the absence of care provided by qualified personnel immediately after birth and in the first days of life.[2] Premature births, complications during childbirth due to birth asphyxia or lack of breathing, and infections are the cause of most neonatal deaths.[3] According to the world Bank, Morocco ranks 15th in terms of mortality rate per thousand live births,[4] and the performance of hospital neonatal services largely determines the survival time of newborns. One study identified factors linked to facility management, as well as difficult working conditions marked by a low ratio of sick staff to newborn admissions, and high mortality among newborns under 7 days of age, as in most studies in our environment, the lack of mastery of emergency obstetric and neonatal care and neonatal resuscitation, as well as the delay in referring newborns referred from other health structures, present a significantly higher mortality rate, which can be explained by the delay in the decision to refer newborns to appropriate structures for their care, as well as the availability of means of transport that are not suitable for ensuring adequate and immediate care as soon as the newborn is referred to an appropriate neonatology unit .[5] By its nature, neonatal infection is considered to be alterations of the organism mainly due to group B streptococcus and Escherichia-coli, generally contracted during or after birth.[6] In Morocco, ore particularly infections bacterial neonatal infections which constitute a public health problem, since their incidence varies from 0.5 to 1% of births in industrial countries but remains higher (3 to 5%) in developing countries. In Morocco, neonatal infection is the cause of more than 16% of perinatal mortality.[7] The evaluation of the performance of management of neonatal infections involves the choice of criteria to demonstrate this, then of indicators allowing these criteria to be measured. In this regard, the world health organization has established standards to measure the performance of the hospital service in terms of average length of stay (ALS), average occupancy rate (AOR), rotation interval (RT) in order to evaluate the effectiveness, efficiency and quality of care for each hospital service.[8] These measures are linked by a functional relationship between them and are used to identify or evaluate the efficiency of a hospital such as the average occupancy rate and the average length of stay, on the one hand and the average length of stay and rotation interval (RT) of the other. However, separately, they provide only an incomplete partial picture of hospital effectiveness and efficiency.[9] The aim of the study was to identify the risk factors for neonatal morbidity associated with the four main causes of mortality in Morocco.

MATERIAL AND METHOD

Study design and setting

A cross-sectional observational study was conducted on 360 newborns born at the twelve regional pediatric centers of Morocco, admitted to the neonatology unit at the regional pediatric services of Morocco, from May 1 to July 31, 2023.

Study population

The sample selected for this study was designed to reflect as closely as possible the heterogeneity represented in the target population. Cluster-type probability sampling seemed to be the most appropriate for this study. This type of sampling allows researchers to divide the population into internal heterogeneous and external homogeneous sub-populations. The sample size depended on the representativeness of newborns less than 29 days from birth, the desired degree of precision, and the 95% confidence level, i.e. an á risk of 5%. The formula for determining the sample size (n) depends on: á= risk set at 5%, so Zá=1.96, i= precision level of 5%. The expected proportion is unknown, due to the absence of similar studies has been set at 50%.

Data collection

The study included newborns admitted to the neonatal unit of twelve neonatal units of regional pediatric services in Morocco. Participants were monitored for up to 28 days to assess their survival rates. The study followed Neonatal Unit Management Criteria (DMS, TOM, IROT), including birth weight, gestational age, antibiotics, phototherapy, CPR, vasoactive drugs, anticonvulsants, surfactants, blood products, and steroids.[10] Data were extracted using a pre-tested structured questionnaire. Variables likely to

assess the performance of the 12 neonatal units in maintaining newborn survival, ,premature infants at service level, included maternal age, socio-economic status, level of education, occupation, social security coverage, place of residence, references, marital status, parity, antenatal care visits (ANC), history of abortion, stillbirth, premature rupture of membrane (PROM), gestational age (GA), mode of delivery presentation, birth weight, APGAR scores, use of antibiotics, nasal positive airway pressure, intubation, phototherapy, CPR, vasoactive drugs, anticonvulsants, surfactants, blood products, steroids for hypoglycemia, and surgical interventions.

Statistical analysis

Prior to analysis, data entry was double-checked to ensure validity and accuracy. The data were then entered into EpiData and subsequently exported to the Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM Corp., Armonk, NY). and descriptive and analytical procedures were implemented, followed by descriptive statistics such as frequencies and cross-tabulations. Data analysis was performed using the chi-square test and Fisher's exact test where appropriate, with a significance level of 5%. Results were presented in text and table format.

Ethical considerations

The study protocol was approved by the Ethics Committee at Med University Morocco. Data collectors were trained, a pre-test conducted, and 20 participants provided informed consent. Confidentiality and supervision ensured reliability.

RESULTS

Sociodemographic characteristics of the study population

Among the 3048 mothers of newborns admitted to the twelve neonatal intensive care units, 1982(66%) were under 25 years of age, 1372(45%) of the newborns of mothers with low socio-economic status, of whom 1371.6 (45%) lived in rural areas. With regard to the educational level of mothers of newborns1372(45%) have a primary level in 884(29%) cases. As for the social status of mothers, 1371(45%) are single. In terms of social security coverage, 58% of the study population belonged to the lowest social class in Morocco (Table 1).

Approximately 1468(58%) of the mothers participating in the study were multiparous, 900 (70.5%) had antenatal consultations, of which more than three thirds (1859, 78.5%) had incomplete

Table 1. Sociodemographic characteristics among Mothers population

Age of mother in years	Effectif and percentage (%)
<25	1982(66)
>25	1066(34)
Residence	
Urban	1676.4(55)
Rural	1371.6(45)
Socioeconomic status	
Low	1372(45)
Medium	1066(35)
Higher	609(20)
Educational level	
University	183(6)
Secondary	610(20)
Primary	1372(45)
Illiterate	884(29)
Marital status	
Married	1677(55)
Single	1371(45)
Medical coverage	
No	701(23)
Medical assistance regime	1066(35)
National fund of social Welfare	457(15)
Organizations	
National social security Fund	640(21)
Private insurance	182(6)

Table 2. Obstetric characteristics of mothers

Parity	
Primiparous	1280,16(42)
Multiparous	1767.84(58)
Antenatal care follow-up	
d"2	2148(70.5)
e"2	900(29.5)
During of labour	
d"12 hr	345(16.2)
e"12 hr	2704(83,8)
Mode of delivery	
Vaginal deliveries	2286(75)
Cesarean section	762(25)
Appearance of amniotic fluid	
Clear	1972(64.7)
Meconium	1075(35.3)

antenatal consultations 2148(70.5%) (<4). Some 2704(83.8) experienced a duration of labor during delivery that exceeded 12h.With regard to mode of delivery, 2286(75%) gave birth vaginally, however, 762(25%) were cesareanized. Mothers had pathologies during pregnancy: hypertension (25%), diabetes (34%), complications leading to caesarean delivery (25.4%) and PROM (18.5%).

Gyneco-obstetric characteristics of mothers

Performance results of twelve neonatal units in Morocco

The main causes of neonatal mortality in Morocco are prematurity in 28% of cases, followed by intra- uterine hypoxia in 24.2% of cases, perinatal infection in 8.5% of cases, and neonatal jaundice in 1.1% of cases. The neonatology service at the 12 regional units in Morocco have seen the average occupancy rate rise steadily, with estimates from the Ministry of Health noting that 6034763 newborns were hospitalized at the twelve Moroccan regional neonatal units. However, the average occupancy rate stagnated from 2014 until 2019, which but from 2019, the rate fell until 2021, that said, the effectiveness of the neonatal care service notes questionable effectiveness (Table 2,& Figure 1).

Performance results for twelve neonatal units based on average occupancy rate and length of stay

The graph above shows a stable average length of stay from 2015 to 2019, followed by an increase from 2019 to 2020. However, the rotation interval experienced a regression from 2015 to

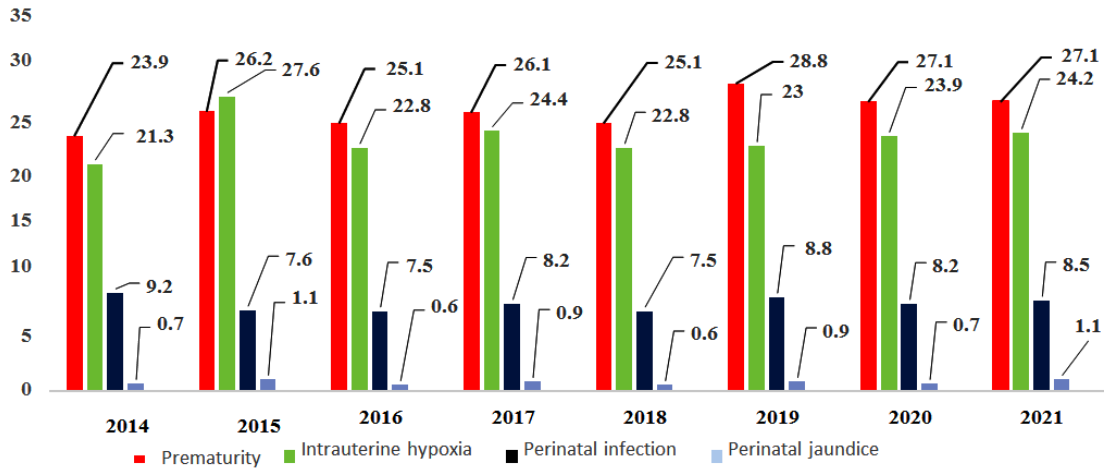
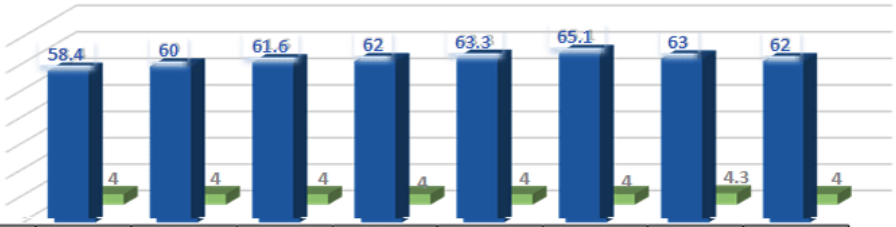


Fig. 1. Trends in neonatal deaths in Morroco by cause, 2014-2021



	2014	2015	2016	2017	2018	2019	2020	2021
Average occupany rate	58.4	60	61.6	62	63.3	65.1	63	62
Mean length of stay	4	4	4	4	4	4	4.3	4

Fig. 2. Efficiency-based assessment of service performance based on Average occupany rate and Mean length of stay

2019, followed by an ascent in MDS from 2019 to 2021.the period from 2020 to 2021, which demonstrates a better degree of quality of care, this while efficiency remains questionable at the level of Morocco's twelve regional neonatal units 24h/24h medicalized, it ends at 16h (Figure 2).

Risk factors

Intrauterine hypoxia

About half (45%) of newborns from 3048 births had intrauterine hypoxia; born between 37- and 38-weeks amenorrhea, first risk factor [Odds ratio: 2.1, 95% confidence interval (CI): 1.07,2.1]. In bivariate analysis, the factors associated with intrauterine hypoxia included the rate of hemoglobin<12g/dl, [OR:1.8; CI to 95%:1.5,3.2]; Placental infarction [OR:1.2, CI to 95%:1.1,2.2], Umbilical cord occlusion [OR:2.2; CI to 95%:1.01,2.3], Epidural analgesia [OR:1.9, CI to 95%: 1.52,7.4], Apgar score at 5 minutes <7[OR:1.7: CI to 95%: 1.1:2.5],Apgar score at 10 minutes <5 [OR:3.2,CI to 95%:3.1,4.2],Smoking[OR: 3.9,95% CI: 3.2,6.9],Depression[OR: 2.5,CI to 95%: 2.3, 4.6], Intrauterine growth retardation [OR: 5.6,CI to 95%:5.1,7.3],and Gestational Diabetes [OR:4.9,CI to 95%:4.01,7.5],Hypoxia, was confirmed by culture(Table 3). It is important to note that intrauterine hypoxia is intricately connected to various maternal, placental, and fetal conditions, manifesting in different forms such as preplacental hypoxia and uteroplacental hypoxia, where maternal oxygenation remains normal. One of the primary complications of chronic hypoxia is the fetus's inability to achieve its genetic growth potential.[10] Therefore, it is important to note that

Table 3. Logistic regressionanalysis of the association between intrauterine hypoxia and n risk factor from 2017 to 2021

	Cases No. %	Controls No.%	OR	95% CI	Adjusted OR[a]	95% CI *P*
Gestational age (37–38)	1395(45%)	1653(54%)	2.3	[1.1,2.5]	2.1	[1.07,2.5] < 0.001
Hb<12g/dl	856(28%)	2192(72%)	2.7	[2.7,3.4]	1.8	[1.5,3.2] < 0.005
Placental infarction	319(10.46%)	2729(89.54)	1.9	[1.4,2.5]	1.2	[1.1,2.2] < 0.001
Umbilical cord occlusion	793(26.01%)	2255(73.99)	2.3	[2.1,3.8]	2.2	[1.01,2.3] < 0.001
Epidural analgesia	219(7.18%)	2829(92,82)	2.1	[1.9,8.5]	1.9	[1.52,7.4] < 0.001
Antecedent of Apgar score at 5 minutes <7	956(31.3%)	2092(68,7)	2.12	[2.1,6.5]	1.7	[1.1,2.5] < 0.003
Antecedent of Apgar score at 10 minutes < 5	729(23.91%)	2319(76.09)	3.4	[2.2.4,9]	3.2	[3.1,4.2] <0.005
Smoking	682(22.37%)	2366(77,63)	4.5	[4.3,7.5]	3.9	[3.2,6.9] < 0.005
Depression	1563(51.2%)	1485(48,8)	3.4	[3.1,5.8]	2.5	[2.3,4.6] < 0.001
Intrauterine growth retardation	765(25%)	2283(75)	6,5	[6.4,9.7]	5.6	[5.1,7.3] < 0.001
Gestational Diabetes	974(31.9%)	2074(68,1)	5.2	[5.1,9.5]	4.9	[4.01,7.5] < 0.001

Abbreviations and acronyms CI, confidence interval; OR, odds ratio; Hb Hemoglobin, a : Adjusted for intrauterine hypoxia: gestational age, Hemoglobin, placental infarction, Umbilical cord occlusion, Epidural analgesia, Apgar score at 5 minutes <7, Apgar score at 10 minutes <5, Smoking, Depression, Intrauterine growth retardation and gestational diabetes, Values may not sum to totals because of missing data.

Table 4. Logistic regression analysis of the association between puerinatal jaundice and neonatal Risk factors in Morocco from 2017 to 2021

	Cases No. %	Controls No. %	OR	95% CI	Adjusted ORa	95%CI p
Spontaneous vaginal delivery	973(31.9)	2075(68)	4.3	[3.1,6.5]	3.7	[2.6,4.9] <0.001
Hyperbilirubinemia	356(11.6)	2692(88)	2.7	[1.9,3.2]	1.6	[1.2,2.5] <0.003
Premature birth<37WG	723(24)	2325(76)	5.9	[3.9,7.1]	4.6	[3.4,7.1] <0.001
Umbilical cord occlusion	345(11.3)	2703(73)	6.1	[5.1,9.4]	5.4	[4.2,6.3] <0.001
Breech foetal presentation	495(16.24)	2553(83)	7.3	[4.7,8.3]	6.2	[6.1,8.4] <0.003
Sibling history	537(17.6)	2511(82)	2.2	[2.1,3.5]	1.4	[1.3,1.9] <0.005
Congenital hemolytic anemia	914,4(30)	2319(70)	3.4	[2.2.4,9]	3.2	[3.1,4.2] <0.001
Intrauterine growth retardation	691(22.37)	2357(77)	5.3	[4.3,7.5]	4.9	[4.3,7.9] <0.001
Poor sucking or feeding	867(28.4)	2172(71)	7.9	[6.3,8.5]	6.3	[5.2,7.1] <0.005

Table 5. Logistic regression analysis of the association between premature and neonatal Period risk factors in Morocco from 2017 to 2021

	Cases No. %	Controls No. %	OR	95% CI	Adjusted ORa	95%CI p
Smoking	1979(64.9)	1069(35.7)	6.7	[5.9,8.2]	5.3	[4.5,6.7] <0.000
Female sex of newborn	2134(70)	2692(30)	5.9	[4.8,6.1]	4.6	[4.3,7.3] <0.001
Drug use	223 (7.3)	2825(76)	2.4	[2.1,3.2]	1.6	[1.4,2.5] <0.001
Lower socioeconomic	2189(71)	859(29)	9.6	[7.4,9.8]	6.2	[5.3,9.9] <0.005
Illiterate	879(28.8)	2151(71,2)	7.3	[4.7,8.3]	6.9	[6.1,8.4] <0.003
Age of Mother ≤5	1997(65.5)	1051(34.5)	4.3	[4.2,5.6]	3.5	[2.7,4.3] <0.001
Gestational diabetes	914,4(34.5)	2134(70)	3.2	[2.8,4,1]	2.4	[2.3,4.2] <0.005
Bacterial vaginosis	689(22.6)	2359(77,4)	6.2	[5.3,7.9]	4.2	[3.9,7.5] <0.001
Placenta Preavia	987(67.6%)	2061(91.3)	8,2	[7.3,9.4]	7.2	[5.3,8.5] <0.005
ANC<2	2150(70.5)	890(29.5)	7.1	[6.7,8.3]	6.4	[5.2,6.9] <0.001

Table 6. Logistic regression analysis of the association between perinatal infection and neonatal Period risk factors in Morocco from 2017 to 2021

	Cases No. %	Controls No. %	OR	95% CI	Adjusted OR[a]	95%CI *P*
Escherichiacoli	973(31.9)	2075(68)	4.3	[3.1,6.5]	3.7	[2.6,4.9] <0.001
Female sex of newborn	356(11.6)	2692(88)	2.7	[1.9,3.2]	1.6	[1.2,2.5] <0.001
Gestational age < 37WG	723(24)	2325(76)	5.9	[3.9,7.1]	4.6	[3.4,7.1] <0.001
PROM >12H	345(11.3)	2703(73.99)	6.1	[5.1,9.4]	5.4	[4.2,6.3] <0.001
Oligohydramnios	495(16.24)	2553(83,7)	7.3	[4.7,8.3]	6.2	[6.1,8.4] <0.001
Sibling history	537(17.6)	2511(82,4)	2.2	[2.1,3.5]	1.4	[1.3,1.9] <0.001
Congenital hemolytic anemia	914,4(30)	2319(70)	3.4	[2.2.4,9]	3.2	[3.1,4.2] <0.003
Intrauterine growth retardation	691(22.37)	2357(77,63)	5.3	[4.3,7.5]	4.9	[4.3,7.9] <0.005
Poor sucking or feeding	867(28.4)	2172(71,6)	7.9	[6.3,8.5]	6.3	[5.2,7.1] <0.001
Blood type incompatibility	323(10.5)	2725(89.5)	3.1	[2.7,4.5]	2.4	[2.2,3.9] <0.001
Vaginal deliveries	1914(62.8)	1134(37.2)	5.4	[4.9,6.3]	4.7	[3.7,5.2] <0.001
Caesarean delivery	685(22.5)	2363(77.5)	0.5	[0.3,0.7]	0.3	[0.1,0.4] <0.005
Use of forceps/Vacuum	448(14.7)	2600(85.3)	0.6	[0.3,0.7]	0.2	[0.1,0.5] <0.001
Appearance of amniotic fluid Clear	369(12.1)	2679(87.9)	0.6	[0.5,0.7]	0.2	[0.3,0.4] <0.005
Appearance of amniotic fluid Meconial	2546(83.3)	502(16.46)	5.9	[4.2.6,9]	4.2	[3.2.6,9] <0.001

intrauterine hypoxia is intricately connected to various maternal, placental, and fetal conditions, manifesting in different forms such as preplacental hypoxia and uteroplacental hypoxia, where maternal oxygenation remains normal. One of the primary complications of chronic hypoxia is the fetus's inability to achieve its genetic growth potential.[11]

Perinatal jaundice

Almost a third (31.9%) of the 3048 newborns with jaundice resulted from spontaneous vaginal delivery [OR:3.7; 95% CI:2.6,4.9]. In bivariate analysis, factors associated with neonatal jaundice included hyperbilirubinemia [OR:1.6.; 95% CI :1.2,2.5]; history of umbilical cord occlusion [OR:5.4; 95% CI:4.2,6. 3], breech fetal presentation[OR:6.2; 95% CI:6.1,8.4]; sibling history of neonatal jaundice[OR:1.4; 95% CI:1.3,1.9], congenital hemolytic anemia[OR:3. 2; 95% CI:3.1,4.2],intrauterine growth retardation[OR:4.9, 95% CI:4.3,7.9],Poor sucking [OR:6.3; 95% CI:5.2,7.1] and blood group incompatibility[OR:2.4; 95% CI:2.2,3.9](Table 4).

Premature

Regarding premature births, more than half of births (64.9%) were exposed in utero to passive smoking, either from the mother or the father. In bivariate analysis, factors associated with premature birth included, drug use[OR:1.6; 95% CI:1.4,2.5], Lower socioeconomic [OR:6.2; 95%

CI:5.3,9.9],illiteracy[OR:6.9; 95% CI: 6.1,8.4], mother's age less than 25 years [OR: 3.5; 95% CI:2.7,4.3], [OR:1.6; 95% CI:2.3,5.1],bacterial vaginosis[OR:4.2; 95% CI:3.9,7.5],placenta previa[OR:7.2; 95% CI:5.3.4,8.5], Gestational diabetes [OR:2.4;CI:2.3,4.2],Antenatal care follow-up<2 [OR:6.4; 95% CI:5.2,6.9](Table 5).

Perinatal infection

Regarding births with perinatal infection, Escherichia coli was isolated by Cyto-Bacteriological examination of urine, analyzing the mother's urine, as a routine examination upon admission to the maternity ward. More than a third of newborns contracted Escherichia coli [OR:3.7; 95% CI:2.6,4.9].In bivariate analysis, factors associated with premature birth included, female sex of the newborn [OR:1.6; 95% CI: 1.2, 2.5], the gestational age of the mother less than 37 weeks of amenorrhea [OR: 4.6; 95% CI: 3.4, 7.1], premature rupture of membranes beyond 12 hours, [OR: 5.4; 95% CI:4.2,6.3],Oligohydramnios[OR:6.2; 95% CI: 6.1.8.4], Sibling history [OR: 1.4; 95% CI: 1.3, 1.9], Congenital hemolytic anemia [OR: 3.2; 95% CI:3.1,4.2], Intrauterine growth restriction [OR:4.9 95% CI:4.3,7.9],Poor feeding suction [OR:6.3 95% CI:4.3,7.9], Group incompatibility blood [OR:2.4 95% CI:2.2,3.9], Vaginal births [OR:4.7 95% CI:3.7,5.2], Caesarean section[OR:0.3 95% CI: 0.1,0.4], Use of forceps/aspirator [OR:0.2 95% CI:0.1,0.5], Amniotic fluid appearance Clear[OR:0.2 95% CI:0.3,0.4], Amniotic fluid appearance Meconium [OR:4.2 95% CI:3.2,6.9] (Table 6).

DISCUSSION

Many maternal-fetal and hospital management factors can influence the perinatal health of newborns. This study explored various fetal and maternal factors, including those related to newborn sex, mode of delivery, gestational age at birth less than 37 weeks' amenorrhoea, low haemoglobin, adverse pregnancy history, amniotic fluid status, umbilical cord occlusion, placental health and Apgar scores. In this prospective case-control study, the results indicate that birth weight, amniotic fluid contamination and Apgar scores at 5 and 10 minutes may have an impact on intrauterine hypoxia (HI). Specifically, gestational diabetes, smoking, as well as epidural analgesia, placental infarction, depression, a low 5-minute Apgar score (d"7) and a low 10-minute Apgar score (d"5) may increase the risk in infants: 'gestational age less than 37 weeks. The study highlighted the association between intrauterine hypoxia and intrauterine growth retardation (OR: 4.9 95% CI: 5.1,7.3), which is in full agreement with the results of a systematic review that highlighted abnormal placental implantation in complicated IUGR pregnancies, caused by gestational, hypertension which increases the risk for the mother and fetus of developing cardiovascular disease later in life.[12,13] Common complications related to hypoxia include meconium aspiration, cerebral palsy, and cognitive dysfunction.[14] Acute and chronic hypoxia are also associated with a variety of fetal and functional cardiac changes aimed at compensating for reduced oxygenation to vital organs.[15] Smoking and primiparity expose more people to intrauterine hypoxia (OR: 3.9, 95% CI, 3.2, 6.9), this is perfectly consistent with the results of a study which demonstrated that maternal tobacco consumption doubles the risk of intrauterine fetal death in 10% of late intrauterine fetal deaths have been attributed to tobacco,[16] as well as to malformations linked to the development of the neural tube.[17] The study results confirmed that gestational diabetes is the primary risk factor for exposure to intrauterine hypoxia (OR: 6.9, 95% CI 5.01, 7.5), but they corroborate the results of a study carried out in Romania which highlighted.[18] Gestational diabetes was diagnosed in 974 (31.9%), as well as depression in 1,563 (51.2%) women and placental infarction 319 (10.46%). Was significantly associated with intrauterine hypoxia, respectively (OR : 6.9, 95% CI 5.01, 7.5), (OR : 2.5, 95% CI 2.3, 4.6) and (OR : 1.2, 95% CI 1.1, 2.2). These results corroborate a study carried out on intra-partial cardiotocographic patterns linked to hypoxia (OR 1.94, 95% CI 1.64–2.34) as well as the results of Apgar scores (< 5 and 7 min) (OR 6.64, 95% CI 1.84-12.03) were observed in women with gestational diabetes compared to those who did not have it, remember that the Apgar score is used as an indicator to judge the degree of neonatal asphyxia.[19]

Regarding the factors relating to neonatal jaundice, this study highlighted a number of associated factors, including gestational age less than 37 weeks (OR:4.6, 95% CI 3.4,7.1)

Hyperbilirubinemia (OR:1.6 , 95% CI 1.2,2.5) premature birth (OR:4.6, 95% CI 3.4,7.1) umbilical cord occlusion (OR:5.4, 95% CI 4.2,6.3), congenital hemolytic anemia (OR:3.2, 95% CI 3.1,4.2) blood type incompability (OR:2.4, 95% CI2.2,3.9). In this regard, a study recommended that to reduce the risks associated with neonatal jaundice upon discharge from the hospital, carried out individualized monitoring for each infant and independently of gestational age at birth.[20] It is important to remember that neonatal hyperbilirubinemia is common in healthy newborns and usually resolves spontaneously. Excess unconjugated bilirubin in the plasma results from a temporary imbalance between bilirubin production mainly from the breakdown of red blood cells, which are more abundant and have a shorter lifespan in newborns than in adults.[21] Regarding factors associated with the risk of prematurity, statistical analysis showed significant associations with maternal age under 25 years, tobacco use, female sex of the newborn, low socioeconomic status, diabetes, bacterial vaginosis, placenta previa, and inadequate prenatal care.[22] Remember that premature births, intrapartum complications, discontinuity of care, infections, and congenital malformations are the cause of most neonatal deaths.[23] Maternal age has an influence on the occurrence of premature birth. Women (under 25 years old) presented an association with premature birth, which corroborates the existing literature.[24] A cohort study on the influence of maternal age on the risk of prematurity carried out showed that the risk of premature birth increased with maternal age, reaching a relative risk 7.5 times higher in women up to the age of 16.[25] In another study, even in places with lower income, women over 40 had 2.6 preterm births.[26] Gestational diabetes and placenta previa were linearly associated with increased exposure to premature births, in multivariate analysis the present study showed that gestational diabetes increases the risk of premature births by 24% (OR: 2.4 95% CI 2.3,5.1), this agrees with the results of a study carried out in Hubei, China (OR 2.5; 95% CI : 2.3, 2.9) .[27] The study also demonstrated that placenta previa exposes you to the risk of prematurity (OR: 7.2, 95% CI 5.3, 8.5), this is consistent with the results of a study on the risk factors for prematurity (OR 1.8; 95% CI). : 1.5, 2.2) .[28] Regarding the effect of prenatal monitoring on the birth of premature babies, the multivariate analysis shows that the risk of prematurity increases by six times (OR: 6.4; CI to 95% :5.2,6.9). The concordant results of a study carried out on a study on morbidity and mortality in Burkina Faso, which focused on the factors of death of prematurity, highlighted that the multivariate analysis that prematurity depends largely on rhythm of consultations prenatal (OR : 3.44; CI to 95% 1.26-9.35).[29] Regarding the risk factors for perinatal infection, among the 973 cases of perinatal infection, 31.9% of newborns contracted Escherchia coli infection from their mothers and developed septicemia. The age of onset was less than 12 hours, the cause of admission being premature rupture of the membranes. Eleven of the PROM cases of babies with sepsis (38%) were born 12 hours after premature rupture of membranes, compared to 62% of newborn cases in the control group ($P<0.005$). The results corroborate with the conclusions of a study entitled maternal and neonatal outecoma linked to delayed delivery following premature rupture of the membranes. The results demonstrate that the best neonatal and maternal outcomes are obtained if delivery takes place within 12 hours, and the worst if it takes place within 48 hours and/or even 72 hours.[30]

CONCLUSION

This study aimed to identify risk factors for early neonatal infection in Morocco. Results showed that that intrauterine hypoxia, prematurity, perinatal infection, and neonatal jaundice are responsible for 90% of neonatal deaths. Factors associated with intrauterine hypoxia include maternal anemia, placental infarction, parental smoking, intrauterine growth retardation, and gestational diabetes. For neonatal jaundice, risk factors include hyperbilirubinemia, prematurity, congenital hemolytic anemia, and blood group incompatibility. Perinatal infection is associated with maternal age under 25, bacterial vaginosis, placenta previa, and fewer than two prenatal visits. Escherichia coli was identified as the primary cause of neonatal infections, with risk factors including premature membrane rupture and gestational age under 37 weeks, while cesarean sections offered some protection. Strategies to mitigate these risks involve screening and treating maternal anemia, promoting smoking cessation, managing gestational

diabetes, monitoring fetal growth, identifying and managing hyperbilirubinemia, providing care for premature infants, screening for hemolytic anemia, ensuring blood group compatibility, promoting maternal health, screening for bacterial vaginosis, managing placenta previa, increasing prenatal consultations, managing membrane rupture, and ensuring neonatal hygiene.

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This research does not involve any clinical trials**.**

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Authors' Contribution

Fatima Aslaou,: Conceptualization, Methodology, Writing – Original Draft; Fatima Aslaou, Najat Ababsi, Halima Ibrahimi, Sima M. Boulebatt, My AbdellahNabaoui, Amina Essamett, Hefdhallah Al-Aizari:Data Collection, Analysis, Writing – Review & Editing; Fatima Aslaou, Hefdhallah Al-Aizari: Visualization.

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