

**PATTERN OF NEONATAL MORTALITY IN A TERTIARY HEALTH FACILITY IN
UMUAHIA, SOUTH EAST, NIGERIA**

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ABSTRACT (ARIAL, BOLD, 11 FONT, LEFT ALIGNED, CAPS)

Neonatal mortality rates are highest in Sub-Saharan Africa, with Nigeria inclusive. And so the aim of the current study was to audit the pattern of neonatal deaths.

Study Design: A cross sectional retrospective descriptive study was undertaken.

Place and Duration of Study: The study was carried out at the Newborn Special Care Unit (NBSCU) of Federal Medical Centre (FMC), Umuahia with a review of the admissions and mortality register between 2000 and 2010.

Methods:

A review of the admissions and mortality register of the NBSCU between 2000 and 2010 was undertaken. Total admission over the period was 2,756 comprising 1541 (55.9%) males and 1215 (44.1%) females. Total deaths was 440, comprising 235 (53.4%) males and 205 (46.6%) females.

Data extracted from the register included socio-demographic variables, birth weight, diagnosis/cause of death, duration of hospitalization, place of delivery (inborn/out-born), source of referral.

Results:

An overall case fatality rate of 16.0% per 100 live births was reported in the current study with mean age at death being 4.7+ 6.0 days (0.01- 28 days).

Majority of the cases were out-born, 263 (56.8%) compared to in-born, 177 (40.2%). Forty two percent (185 cases) of the deaths occurred within 24 hours of hospitalization while 25.9% (114 cases) passed on after 72 hours of admission.

The leading probable direct causes of neonatal deaths were birth asphyxia (141), premature delivery (133), neonatal sepsis (58), severe neonatal Jaundice (41), and

neonatal tetanus (14).

Most deaths (42.0%) occurred in the first 24 hours irrespective of the cause of death.

Conclusion:

High rate of neonatal mortality, most of which are largely preventable as observed in the index study still abound in our locale.

High cost effective maternal and newborn interventions could be applied even at community levels where most of the deliveries occur to save lives of the newborns.

Neonate; Mortality Rate; Pattern.

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1. INTRODUCTION (ARIAL, BOLD, 11 FONT, LEFT ALIGNED, CAPS)

Neonatal mortality is increasingly important because the proportion of under - five deaths that occur during the neonatal period is increasing as under five mortality declines.¹

Every minute seven newborn babies die worldwide (415 newborn babies every hour).²

Nearly 4.7 million mothers, newborns and children die each year in Sub-Saharan Africa;¹ 1,208,000 babies die before they reach one month of age.³ The vast majority of neonatal deaths occur in South Asia and Sub-Saharan Africa.^{4,5} Half of the 3.3million neonatal deaths in year 2009 were in five countries: India, Nigeria, Pakistan, China and Democratic Republic of Congo.

45 And neonatal mortality constitutes 40% of under- 5mortality and approximately 57
46 percent of infant mortality.⁴The neonatal mortality rate in Nigeria is 40 per 1000 live
47 births. This is largely higher than the 33 per 1000 live births overall in Africa.⁶
48 Various rates have been reported by different researchers in Nigeria ranging from
49 19.4 percentage ⁷ to 37.6 percentage ⁸ among hospitalized newborns and in a rural
50 community respectively.

51 The fourth goal millennium development goal (MDG 4) aims to reduce mortality rate
52 in children under the age of 5years (U5MR) by two thirds between 1990 and 2015.
53 Infants less than 1 month old account for about 40% of deaths of children under the
54 age of 5years globally.⁹ Achieving MDG4 will therefore need to include reducing
55 deaths during the neonatal period.¹⁰

56 With less than 2 years left to achieve the United Nations Millennium Development
57 Goals (MDGs) for maternal and child health, most African countries are currently
58 unlikely to meet their MDG targets.

59 The three main causes accounting for 88% of newborn deaths in the region include:
60 Infections (including sepsis/pneumonia, tetanus and diarrhoea); intra-partum related
61 conditions (birth asphyxia); and preterm births. ⁴ Up to 90% of newborns who die
62 are low birth weights (less than 2500grams) including preterm babies who have the
63 greatest risk of deaths.

64 It is unfortunate that most of these deaths are preventable with such simple
65 actions/care like warmth, feeding, hygiene and early treatment of infections.¹¹
66 Worldwide, birth asphyxia, birth trauma, infections, prematurity, and malformations,
67 are the major causes of early neonatal deaths while sepsis, pneumonia, meningitis,
68 diarrhoeal disease and tetanus account for most of the mortality during the rest of
69 the neonatal period.⁵

70 High neonatal mortality rate remains a problem in developing countries including
71 Nigeria where the economic situation and poor planning of health services have led
72 to little appreciable advancement in neonatal care.¹² Neonatal mortality is therefore
73 a reflection of the effectiveness of obstetric and neonatal services in any particular
74 community.¹³

75 Adequate training and retraining of personnel involved in deliveries with provisions
76 of equipment required for neonatal resuscitation of newborns with intra-partum

77 asphyxia has shown a significant decrease in deaths attributable to birth
78 asphyxia.^{10,14,15}

79 Evidence from several observational studies shows that facility – based basic
80 neonatal resuscitation may avert 30% of intrapartum- related neonatal deaths.¹⁶

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82 However, other interventions to reduce neonatal deaths should include
83 improvements in obstetric care and immediate care of the newborn afterbirth. It has
84 been reported that basic emergency obstetric care (providing antibiotics, oxytocics,
85 anticonvulsants, removal of placenta and retained products, assisted vaginal
86 delivery and newborn care in healthcare centres) and comprehensive emergency
87 obstetric care (blood transfusion caesarean sections, care to sick and low birth
88 weight newborns in district hospitals) and skilled birth care can reduce intra-partum
89 deaths by 25 – 85%.¹⁸

90 It is pertinent therefore that periodic audit of neonatal admissions and deaths be
91 carried out to determine the impact of current preventive measures and newer
92 challenges to neonatal survival, so that effective preventive measures could be
93 applied. The aim of the current study was to audit the neonatal deaths at the
94 newborn special care unit, of Federal Medical Centre, Umuahia over a ten year
95 period, so that priority areas requiring improved planning of neonatal services could
96 be identified.

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100 **2. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY** 101 **(ARIAL, BOLD, 11 FONT, LEFT ALIGNED, CAPS)**

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103 This study was undertaken in the newborn special care unit (NBSCU) of Federal
104 Medical Centre, Umuahia, Abia State, South East, Nigeria.

105 The Centre serves as a major referral centre for patients from within Abia State and
106 also some surrounding states of Imo and Rivers. The newborn babies basically are
107 referred in house from the Department of Obstetrics and Gynecology and out-born
108 (those babies born before arrival to the hospital). The NBSCU has three sections:
109 for inborn (delivered in FMC, Umuahia), out-born (referrals) and an isolation section

110 for very ill-newborns all geared towards reduction of cross infection within the
111 nursery. About 1500 deliveries are recorded annually in the Centre.
112 It is a tertiary hospital base audit analyses of neonatal admissions outcome.
113 Data on newborns that died during the period under review (from 1st January, 2001
114 to 31st December, 2010) were extracted from the admissions/mortality register.
115 Data extracted from the case record files included: age on admission (in hours),
116 gender, place of delivery (inborn/out-born), diagnosis(es) at presentation, cause of
117 death, duration of hospitalization and age at death.
118 Babies born before 37 completed weeks of gestation are generally regarded as
119 preterm delivery while birth asphyxia is defined as history of failure or delayed onset
120 of spontaneous respiration after birth or 5 minutes APGAR score < 7, or history of
121 delayed cry or need for resuscitation for > 10 minutes in full term babies.^{18,19}
122 Usually the registrar on duty admits and first assesses the presenting newborn and
123 is subsequently reviewed by a senior registrar and the supervising consultant.
124 Socioeconomic classification of the study population was not ascertained as most of
125 the case record files did not capture information on parental educational
126 backgrounds and occupation/employment status.
127 Ethical clearance for the study was sought from Research and Ethics Committee of
128 Federal Medical Centre, Umuahia.
129 The data retrieved were collected with the aid of a structured study proforma and
130 entered into a personal computer and analyzed with SPSS Version 18. The level of
131 significance was set at 5%.

132 **Acknowledgements**

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138 **Authors' contribution:** All authors contribute equally to this work

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3. RESULTS AND DISCUSSION

Total number of neonatal admissions over the period was 2,756 comprising 1541 (55.9%) males and 1215 (44.1%) females.

Total deaths was 440, comprising 235 (53.4%) males and 205 (46.6%) females. The neonatal mortality rate during the period of review was 159 per 1,000 live births.

Mean age at death was 4.7 ± 6.0 days (0.01-28 days). One hundred and eighty five (42.0%) of the deaths occurred within the first 24 hours, 141 (32.1%) died after 24 hours, but within 72 hours while 144 (25.9%) died after 72 hours, but within 28 days.

One hundred and seventy (40.2%) were out-born indicating that place of confinement of the mothers had a significant effect on outcome of delivery ($\chi^2 = 55.33, p < 0.01$).

One hundred and fifty one (57.4%) of the out born patients who died were delivered in secondary health facilities including private hospitals, 74 (28.1%) were born in primary health centres and maternity homes, 36 (13.7%) were delivered at home while 2 (0.8%) were delivered in prayer houses. More than half of the babies (294) who died were delivered through spontaneous vertex delivery, 97 by emergency caesarean section, while 26 had no record of method of delivery.

Out of the 440 neonates that died, 400 had their birth weight recorded of which 52.8% (211) were low birth weight.

Table I shows the demographic characteristics of neonates during the period of review.

The leading probable direct causes of neonatal deaths were complication of birth asphyxia (141), preterm delivery (133), neonatal sepsis (58), severe neonatal jaundice (41, and neonatal tetanus (14).

Table II shows the probable direct causes of neonatal deaths at the medical centre over the period, 2000-2010. Most deaths (42.0%) occurred in the first 24 hours of life irrespective of the cause of death. Sixty five (46.1%) of the 141 deaths due to complication of birth asphyxia occurred within the first 24 hours of life so also 51 (38.3%) of the 133 deaths due to preterm delivery.

Table III depicts the duration of hospitalization (age at death) of the neonates who died and their probable cause of death. There was no significant difference in the age at death with respect to the probable cause of death ($\chi^2 = 32.76, p = 0.06$).

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Table 1. Demographic characteristics of neonates (mortalities)

LIVE BIRTHS	SURVIVED	DIED	
2,756	2316	440	
BIRTH WEIGHT			
	LOW (2<2.5KG)	NORMAL (2.5KG)	TOTAL
SURVIVED	683 (30.8%)	1532 (69.2%)	2215
DIED	211 (52.8%)	189 (47.2%)	400
SEX			
	MALE	FEMALE	
SURVIVED	1306 (56.4%)	1010 (43.6%)	
DIED	235 (53.4%)	205 (46.6)	
PLACE OF BIRTH			
	INBORN	OUT-BORN	
SURVIVED	1379 (59.5%)	937 (40.5%)	
DIED	177(40.2%)	263 (59.8%)	

+METHOD OF DELIVERY	OF	SPONTANEOUS	C/S (ELECTIVE)	C/S (EMERGENCY)	INSTRUMENTS	BREECH EXTRACTION	OTHERS
		294	15	97	5	3	26
+FACILITY OF DELIVERY	OF	HOME	*PHC	*SHC	*THC	PRAYER HOUSE	OTHERS
		31	69	141	174	2	23
+DURATION OF HOSPITALIZATION	OF		≤24 HOURS		>24, HOURS	≤72 DAYS	>72HOURS, ≤28
			185		141	144	

204PHC- primary health care, SHC = secondary health care, THC=tertiary health care

205 + refers to patients who died

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232TTable II: Probable direct causes of neonatal deaths

DISEASE	(N)	%
ASPHYXIA	141	32.0
PRETERM	133	30.2
NEONATAL SEPSIS	58	13.2
SEVERE NEONATAL JAUNDICE	41	9.3
NEONATAL TETANUS	14	3.2
NEONATAL MENINGITIS	12	2.7
MECONIUM ASPIRATION SYNDROME	8	1.8
SURGICAL CONDITIONS	8	1.8
MULTIPLE CONGENITAL ANOMALIES	7	1.6
PNEUMONIA	5	1.1
SEVERE ANAEMIA	3	0.7
*MISCELLANEOUS	10	2.3
TOTAL	440	100.0

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235• Haemorrhagic disease of newborn, cyanotic congenital heart disease, HIV related, Birth trauma

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238TTable III: Time of death from probable direct causes of death

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240CCause of death

Time of death

	WITHIN 24 HRS	>24 HRS, ≤ 72HRS	>72 HRS, ≤ 28DAYS	TOTAL
BIRTH ASPHYXIA	65	58	18	141
PRETERM	51	40	42	133
SEPSIS	23	16	19	58
SEVERE JAUNDICE	20	10	11	41
TETANUS	5	2	7	14
MENINGITIS	5	2	5	12
MECONIUM ASPIRATION SYNDROME	6	2	0	8
SURGICAL CONDITIONS	4	1	1	6
MULTIPLE CONGENITAL ANOMALIES	2	3	2	7
PNEUMONIA	1	2	2	5
SEVERE ANEMIA	1	2	0	3
MISCELLANEOUS	5	4	7	16
TOTAL	184	142	114	440

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242 $\chi^2 = 32.76, p = 0.06$

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DISCUSSION

The overall neonatal case fatality rate of 16.0% observed in the current study is quite high. It is however, higher than the, 13.0%²⁰ reported in Ilesha, South-West Nigeria and lower than 19.4%⁷ in a similar study in Nnewi, South-East Nigeria. All three studies are hospital based and do not represent the actual magnitude of the problem in the general population. However, the emphasis of the current study is to highlight the pattern of neonatal mortality in our locale from a tertiary hospital point of view and sensitize the authority to review the existing facilities and programmes linked with newborn services for optional service to save newborn lives.

Majority of the cases occurred among the males, in conformity to other similar reports.^{7, 21, 22, 23.}

It is likely that the higher risk of mortality in male neonates may be due to large proportions of neonatal deaths occurring in the first week of life, which is the time when gender differences in neonatal mortality are more pronounced.²⁴ The biological factors that have been implicated with this increased risk of neonatal deaths in male infants include immunodeficiency,²³ increasing the risks of infectious diseases in males, late maturity²¹ resulting in a high prevalence of respiratory diseases in males, and congenital malformations of the urogenital system.²⁵

Case fatality rate was lower among babies delivered in the hospital (inborn) compared to the out-born (born before arrivals, or referred babies) confirming previous reports by other workers.^{7,26.}

Some of the babies could have been transported from rural areas with challenges of hypothermia and contamination before getting to the Facility and hence increasing mortality in them.

In the current study it was observed that some of the mothers had the deliveries of their babies conducted either at homes or prayer houses by traditional birth attendants and in some cases by auxiliary nurses/midwives. This practice has been associated with increased morbidity and mortality in the newborns.²⁷ The practice could either be due to poverty or failure of the health system. Birth weight has been shown to be a strong predictor of newborn survival/outcome. In the current study low birth weight was associated with higher mortality as in other similar studies.^{7, 8, 26.}

The leading probable direct causes of neonatal deaths in our series included birth asphyxia, preterm delivery, sepsis, jaundice and tetanus and mirror other reported pattern of neonatal mortality elsewhere in Nigeria.^{7, 20, 27, 28} and indeed Sub-Saharan Africa.²⁹

Most of these causes are largely preventable with simple actions/care. It was observed that most of the mortality occurred within 24hours of hospitalization, majority of which were due

to perinatal asphyxia. It has been shown that basic training on newborn resuscitation skills and proper newborn resuscitation immediately after birth has proved to reduce mortality among babies born with asphyxia by up to 40%.^{14, 15, 16, 30}

However, there was no significant statistical difference in the age at death with respect to the probable cause of death ($\chi^2 = 32.76, p = 0.06$).

Also, prematurity was found to be the second most important cause of death in the current study. Management of premature babies requires highly specialized equipment, highly trained personnel and financial support.^{31,32} Despite the challenges of meeting these in our environment, some specific and simple measures have been identified which could be implemented to reduce deaths related to low birth weight and prematurity in low income countries.^{33,34,35} among others. These include prophylactic use of steroids during premature labour, antibiotics for premature rupture of membranes, early breastfeeding, treatment of infectious, Kangaroo mother care, prevention of hypothermia. All these if effectively implemented and sustained will help in reducing the neonatal mortality rate in our setting.

Globally, neonatal tetanus accounts for 7% of neonatal deaths but accounts for up to 20% in Nigeria, one of the 27 countries that account for 90% of the global burden of the disease.^{9,36,37} It is not surprising therefore that some babies in our series passed on as a result of neonatal tetanus.

Neonatal tetanus has been identified as a disease of poverty, the uneducated and adverse social and environmental circumstances.³⁸ All these variables for propagation of tetanus infection are in operation in our locale, and hence the need to highlight it and ensure that effective tetanus vaccination and early and appropriate prophylaxis of at risk neonates is the rule.

Neonatal deaths resulting mainly from preventable causes namely birth asphyxia, neonatal infectious including tetanus, prematurity/low birth weight among others are still the leading causes of neonatal mortality in our setting. Neonatal mortality rate is a critical index of under 5 mortality.⁴ And significant reduction in neonatal mortality will go a long way in ensuring that Nigeria meets the MDG 4 for child health. Knowledge of the existing pattern of neonatal mortality is key to determining which measures to be applied to reverse the unacceptable trend of newborn deaths in our setting.

4. CONCLUSION

High rate of neonatal mortality, most of which are largely preventable as observed in the index study still abound in our locale.

High cost effective maternal and newborn interventions could be applied even at community levels where most of the deliveries occur to save lives of the newborns.

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343 **COMPETING INTERESTS**

344

345 We declare no competing interest

346

347 **AUTHORS' CONTRIBUTIONS**

348

349 Authors may use the following wordings for this section: " 'Author A' designed the study,
350 performed the statistical analysis, wrote the protocol, and wrote the first draft of the
351 manuscript. 'Author B' and 'Author C' managed the analyses of the study. 'Author C'
352 managed the literature searches..... All authors read and approved the final manuscript."

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354 **CONSENT (WHERE EVER APPLICABLE)**

355

356 No manuscripts will be peer-reviewed if a statement of patient consent is not presented
357 during submission (wherever applicable).

358 This section is compulsory for medical journals. Other journals may require this section if
359 found suitable. It should provide a statement to confirm that the patient has given their
360 informed consent for the case report to be published. Journal editorial office may ask the
361 copies of the consent documentation at any time.

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363 Authors may use a form from their own institution or SDI Patient Consent Form 1.0. It is
364 preferable that authors should send this form along with the submission. But if already not
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368 If the person described in the case report has died, then consent for publication must be
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374 informed consent was obtained from the patient (or other approved parties) for publication of
375 this case report and accompanying images. A copy of the written consent is available for
376 review by the Editorial office/Chief Editor/Editorial Board members of this journal."

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384 provide a statement to confirm that the authors have obtained all necessary ethical approval
385 from suitable Institutional or State or National or International Committee. This confirms
386 either that this study is not against the public interest, or that the release of information is
387 allowed by legislation.

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389 All manuscripts which deal with animal subjects must be approved by an Institutional Review
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REFERENCES

1. UNICEF (2009) State of the World's children 2010. New York: UNICEF.
2. Stanton C, Lawn JE, Rahaman H, Hill K. Still birth rate: delivering estimates in 190 Countries. Lancet 2006; 377: 1487 – 14994
3. Bryce J, Requejo JH, editors. Tracking progress in maternal, newborn and child survival: The 2010 Report. New York: UNICEF.
4. Black RE, Cousen S, Johnson HL, Lawn JE, Rudon L, Bassani DG.... Mather C, Global, regional, and national causes of child mortality in 2008: A systematic analysis. Lancet 2010; 9730; 1969-1987.
5. WHO. (2011B). Indicator compendium.
<http://www.who.int/whosis/indicators/en>).
6. The state of the World's children. United Nations Children's Fund: neonatal mortality rate. Last updated in UN Data: 9 April, 2012.
7. Ezechukwu CC, Ugochukwu EF, Egbonu I, Chukwuka JO.
Risk factors for neonatal mortality in a regional tertiary hospital in Nigeria. Nigerian Journal of Clinical Practice 2004; 7 (2): 50 – 52.
8. Lawoyin TO. Risk factors for infant mortality in a rural community
in Nigeria. The Journal of the Royal Society for the provision of health 2001; 121:114 – 118.

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9. Lawn JE, Cousen S, Zubpanj. 4 Million neonatal deaths: when? where? why? Lancet 2005; 365: 891 – 900.
10. Velaphi S, Rhoda N. Reducing neonatal deaths in South Africa- are we there yet, and what can be done? SA Journal of Child Health 2012; 6 (3): 67 – 71.
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11. Lawn JE, Wilczynska – ketende K, Cousens SN. (2006) Estimating the causes of 4 million neonatal deaths in the year 2000. Int J Epidemiol 2006; 35: 706 – 718.
12. World Health Organization. Maternal and newborn health/safe motherhood estimates. Geneva: World Health Organization; 1997.
13. World Health Organization. Perinatal mortality; a listing of available information. Geneva: World Health Organization. 1996, FRH/MSM/96.7.
14. Carlo WA, McClure EM, Chomba E, Chakraborty H, Hartwell T, Harris H, Lincetto O, Wright LL. Newborn care training for midwives and neonatal and perinatal mortality rate in a developing country. Pediatrics 2010; 126(5): e1064-e1071.
15. Perlman JM, Wyllie J, Kattwinkel J, Atkins DL, Chameldes L, Hazinski MF, Morley C, Richmond S, Simon WM, Singhal N, Szyld E, Tamura M, Velaphi S. Neonatal resuscitation: 2010 International Consensus on cardiopulmonary Resuscitation and emergency cardiovascular Care Science with Treatment recommendation. 2013copyright, American Academy of Pediatrics
16. Wall SN, Lee ACC, [..], Lawn JE. Neonatal resuscitation in low- resource settings: what, who, and how to overcome challenges to scale up? Int J Gynaecol Obstet 2009; 107(suppl I):S47-S64.
- 478
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480
481
482
483
484
485
17. Lee AC, Cousen S, Darmstadt G, etal. Care during labour and birth for the prevention of intrapartum-related neonatal deaths: a systematic review and Delphic estimate of mortality effect. BMC Public Health 2011; 11 Suppl 3:S10.
18. Memon S, Shaikh S, bibi S. To compare the outcome (early) of neonates with birth asphyxia in relation to place of delivery and age at time of admission. Journal of Pakistan Medical Association
- 486
487
488
489
490
491
492
493
494
19. Shreen N, Nghar N, Mollah AH. Risk factors and short term outcome of birth asphyxiated babies in Dharka Medical College Hospital 2009; 33(3):83-89.
20. Owa JA, Osinaike AI. Neonatal morbidity and mortality in Nigeria. India J Pediatr 1998; 65 (3): 441 449.
21. Titaley CR, Disley MJ, Agho K, Roberts CL, Hall J. Determinants of Neonatal mortality in Indonesia. BMC Public Health 2008, 8: 232.

- 495 22. D' Souza S, Chem LC. Sex differentials in mortality in rural Bangladesh. *Population*
496 *and Development Review* 1980, 6 (2) 257 – 270.
- 497
- 498 23. Green MS. The male predominance in the incidence of infectious diseases in
499 Children: a postulated explanation for disparities in the literature. *International*
500 *Journal of Epidemiology* 1997, 2, (2): 381 – 386.
- 501
- 502 24. Shakya K, McMurray C. Neonatal mortality and maternal health care in Nepal:
503 Searching for patterns of association. *Journal of Biosocial Science* 2001, 33 (1): 87
504 – 10J.
- 505
- 506 25. Alonso V, Fuster V, Luna F. Causes of neonatal mortality in Spain (1975 – 1998):
507 influence of sex, rural urban residence and age at death. *Journal of Biosocial*
508 *Science* 2006; 38: 537 – 551.
- 509
- 510 26. Onwuanaku CA, Okolo SN, Ige kO, Okpe SE, Toma BO. The effects of birth weight
511 and gender on neonatal mortality in North Central Nigeria. *BMC Research Notes*
512 2011; 4:562.
- 513
- 514
- 515 27. Lawoyin TO, Onadeko MO, Asekuu-Olarimoye EO. Neonatal mortality and perinatal
516 risk factors in rural South-Western Nigeria: a community based prospective study.
517 *West Africa J Med* 2010; 29: 19 – 23.
- 518
- 519 28. Oladokun RE, Orimadegun AE, Olowu JA. A ten –year review of neonatal deaths in
520 the special care baby unit at the University College Hospital, Ibadan. *Nigeria Journal*
521 *of Paediatrics* 2004; 31: 119 – 125.
- 522
- 523 29. Nmbaga BT, Lie RT, Olomi R, Mahande MJ, Kvale G, Dalt-viet AK. Cause-specific
524 neonatal mortality in a neonatal care unit in Northern Tanzania: a registry based
525 cohort study. *BMC Pediatrics* 2012, 12: 116.
- 526
- 527
- 528 30. Dawodu AH, Effiong CE. Neonatal mortality: effects of selective interventions.
529 *Pediatr* 1985; 75: 51 – 57.
- 530
- 531 31. Wall SN, Lee ACC, Carlo W, Goldenberg R, Niermeyer S, Darmstadt GL, Keenan
532 W, Bhutta ZA, Perlman J, Lawn JE. Reducing intra-partum related neonatal deaths
533 in low and middle income countries – what works? *Semin Perinat* 2010; 34: 395 –
534 407.
- 535
- 536
- 537 32. Carlo WA, Gnidar SS, Jehan I, Chomba E, Tshetu A, Garces A, Parida S, Althabe F,
538 Moclure EM, Derman RJ, Goldenberg RL, Bose C, Krebs NF, Panigrahi P, Buekens
539 P, Chakraborty H, Hartwell T, Wright LL. First breath study group: high mortality rate
540 for very low birth weight infants in developing countries despite training. *Pediatr*
541 2010; 126: e1072 – e1080.
- 542
- 543 33. Darmstadt GL, Bhutta ZA, Cousens S, Adam T, Walker N, de Bernis L. Evidence
544 based, cost effective interventions: how many newborn babies can we save? *Lancet*
545 2005; 365 (9463): 977 – 988.
- 546
- 547 34. Vinod PK. The current state of newborn health in low income countries and the way
forward. *Semin Fetal Neonatal Med* 11: 7 – 14.

- 548
549 35. Barros F, Bhutta Z, Batra M, Hansen T, Victoria C, Rubens C, Group IGR. Global
550 Report on preterm birth and still birth (3 of 7): evidence for effectiveness of
551 interventions. BMC pregnancy and childbirth 2012; 10 (Suppl 1): 53.
552
553
554 36. Federal Ministry of Health Situation Analysis. National Child Health Policy. Nigeria:
555 Federal Ministry of Health, 2005.
556
557 37. National Planning Commission, UNICEF. The Main causes of mortality and
558 morbidity among children and women. In: children's and women's rights in Nigeria; a
559 wake-up call: situation assessment and analysis. New York: UNICEF 2001; 40 – 54.
560
561
562 38. Oruamabo RS. Neonatal tetanus in Nigeria: does it still pose a major threat to
563 neonatal survival. Arch Dis Child 2007; 97: 9 – 10.
564
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583 **DEFINITIONS, ACRONYMS, ABBREVIATIONS**

584 Here is the Definitions section. This is an optional section.

585 **Term:** Definition for the term

586

587 **APPENDIX**