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Original Research Article

Factors Contributing to Birth Asphyxia in Neonates at Naivasha Sub-County Hospital

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Abstract: ***Introduction:*** The World Health Organization (2023) has identified neonatal asphyxia as being the third leading cause of early newborn deaths globally, accounting for approximately 24% of neonatal mortality (Workineh *et al*., 2020) found out that 24% of African births are affected by asphyxia. In Kenya, birth asphyxia accounts for 29% of deaths of neonates, and Nakuru County has a perinatal death rate (15/1000 live births) that surpasses WHO recommendations ((Ngare *et al*., 2020). The WHO recommends a maximum of 12 fatalities per 1000 live births and suggests interventions such as drying, stimulating, and warming newborns with birth asphyxia (Moshiro *et al*., 2019) ***Objective****:* To identify primary factors contributing to neonatal birth asphyxia at Naivasha Sub-County Hospital. ***Methods****:* A retrospective cross-sectional study design, using secondary data collected from the hospital's Newborn Unit records was used with the target population of asphyxiated neonates with APGAR scoring < 7 within the first minute of extra uterine life. ***Results:*** The highest incidence was observed in those aged 13-25 years (38%), married (65%), with secondary education (60%), and who attended their first ANC visit (56%). Employment status also played a role, with unemployed mothers contributing to 37% of cases. Foetal factors, such as low birth weight (55.83%), premature gestation (57.5%), vertex presentation (63.33%), and male sex (60.42%), significantly increased the risk. Maternal-obstetric factors, including PROM (42%), meconium-stained liquor (53%), infections (33%), pre-eclampsia (44%), and prolonged labour (28%), were prevalent, though not significantly different in their impact. Statistical analysis revealed significant differences among socio-demographic and foetal factors, while maternal-obstetric factors showed no significant variation in their contribution to birth asphyxia. ***Conclusion:*** Birth asphyxia remains a significant concern, with key contributors identified as socio-demographic factors (maternal age 13-25 years, marital status, low antenatal clinic attendance, and unemployment), maternal obstetric factors (premature rupture of membranes, meconium-stained amniotic fluid, vaginal delivery, and pre-eclampsia), and foetal factors (low birth weight, prematurity, and male gender).

Keywords: Birth asphyxia, Apgar score, neonatal mortality, maternal and foetal factors.

INTRODUCTION

Birth asphyxia remains a significant public health concern, mostly owing to its consequential effects. Therefore, to successfully address this issue, it is essential to determine its root cause. Birth hypoxia accounts for 900,000 deaths annually and is among the leading etiologies of early newborn deaths worldwide, ranking third behind preterm delivery and neonatal sepsis, which accounts for more than 24% of neonatal deaths (Moshiro *et al*., 2019). The WHO (2023) recommends a fatality rate not exceeding 12 mortalities per 1000 live births.

Birth asphyxia is accountable for 24.0% of all cases in Africa, with East and Central Africa accounting for two-thirds (15.9%) (Workineh *et al*., 2020. Despite showing significant decrease by the sub-Saharan Africa (SSA), the worldwide mortality rate among newborns has shown a consistent decrease over the last twenty years. However, this fall has been seen to be gradual in

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SSA region contributing to 38% of the total neonatal deaths globally (Usman *et al*., 2019).Within this geographic area, a significant proportion of fatalities mostly arise from preventable factors, notably perinatal asphyxia.

Currently, asphyxia is accountable for more than one-third of regional neonatal fatalities and is linked to substantial long-term impairments in those who survive making a disproportionate contribution to the worldwide mortality burden caused by asphyxia, accounting for 46% of these fatalities (Ariff *et al*., 2024).Nigeria with a population estimate of 200,964 and Ethiopia with a population estimate of 1,120,790 are the primary contributors to the regional burden of asphyxia (A. Usman *et al*., 2019)

While a total of 2.6 million perinatal deaths were recorded throughout the world in 2016, the rate in Kenya was 22.6 deaths for every 1000 live births. In Kenya, there were a total of 52,574 cases of birth asphyxia (Arunda *et al*., 2021)

According to studies in Nakuru county from 2014 to 2017, births amounting to 59,152 were recorded at 9 various healthcare settings. Of these births, 929 were later identified as perinatal fatalities. Birth Asphyxia at delivery was reported as a contributing factor in 275 (29.6%) of perinatal deaths. The neonatal mortality rate in Nakuru County was much higher than the guideline made by the WHO, which is less than 12 mortalities per 1000 live births. Instead, there were 15 fatalities per 1000 live births (Ngare *et al*., 2020)

METHODS

The study site was Naivasha Sub-County Hospital located in Nakuru town constituency, Naivasha Sub-County, Nakuru County, Kenya. study population: The study population in this case was asphyxiated neonates born at Naivasha Sub-County Hospital from January 1st to December 31st, 2022, acquired from Hospital records. The target population in this case was asphyxiated neonates with APGAR scoring < 7 within the first minute of life.

The sampling design in this case was the systematic sampling procedure which is a method of probability sampling where the researchers select population members at set intervals. In this case, the sampling frame was the hospital's Newborn Unit records from January to December 2022. This retrospective research design with secondary data collection implemented a systematic sampling by randomly picking a subset of records from the hospital's Newborn Unit records.

This was accomplished by producing a random list of records or by picking records at regular intervals from the data collection. The k^{th} number was calculated by taking the population and dividing by the sample size. If the population is N and the sample size is n which in this case is 240, then the k^{th} number was N/240 where k=3.

In this study, we made use of a researcher administered questionnaire by using a checklist. A checklist was employed to assess maternal and foetal factors that led to an asphyxiated neonates with APGAR scoring < 7 within the first minute of life

RESULTS

Sample characteristics

The study population consisted of a target population of asphyxiated neonates with APGAR scoring < 7 within the first minute of extra-uterine life.

Table 1: Demographic characteristics

Characteristics	Frequency Of Birth Asphyxia	Percentage of Birth Asphyxia
Socio-demographic characteristics		
Age		
13-25	91	37.92%
26-35	63	26.25%
36-50	86	35.83%
Marital Status		
Married	157	65.42%
Single	83	34.58%
Level of Education		
Primary	55	22.92%
Secondary	143	59.58%
Tertiary	42	17.5%
ANC Attendance (Visits)		
1st	134	55.83%
2nd	36	15.0%
3rd	35	14.58%
4th	35	14.58%

Occupation		
Employed	83	34.58%
Self-employed	69	28.75%
Unemployed	88	36.67%

Age

While there doesn't appear to be a huge difference in birth asphyxia across age groups, it's worth noting that almost 38% of the 13-25 age group experienced birth asphyxia closely followed by the 36-50 age group with almost 36% and lastly the 26-35 age group with a percentage of about 26%.

Marital Status

The percentage of married individuals experiencing birth asphyxia stands at 65.42%, while single individuals had almost half the percentage with 34.58% indicating a potentially higher risk among the married population.

Level of Education

Even though there wasn't a clear pattern, the percentage of birth asphyxia among those with tertiary education was slightly lower at 17.5% compared to other educational levels.

ANC Attendance

The percentage of birth asphyxia decreases with subsequent ANC attendances, with the lowest percentage (14.58%) observed for the 4th ANC attendance and the highest being those with only one clinic attendance (55.83%).

Maternal Factors

Table 2: Maternal Factors

Maternal Factors		
Membrane Status	(n)	%
Spontaneously ruptured	70	29.17%
Intact	48	20%
Artificially ruptured	21	8.75%
PROM	101	42.08%
Liquor Status		
Clear	93	38.7%
Meconium stained	126	52.5%
Blood stained	15	6.25%
Missing	6	2.5%
Mode of Delivery		
Vaginal delivery	140	58.33%
Caesarean section	74	30.83%
Assisted delivery	26	10.83%
Medical Conditions		
Hypertension	12	14.63%
Infection	27	32.93%
DM	15	18.29%
Malaria	2	2.44%
TB	1	1.22%
HIV	7	8.54%
Cardiac disease	1	1.22%
Anaemia	17	20.73%
Obstetric Factors		
Hyperemesis gravidarum	4	10.26%
Polyhydramnios	6	15.38%
Oligohydramnios	3	7.69%
Preeclampsia	17	43.59%
Eclampsia	6	15.38%
APH	3	7.69%
Duration of Labour		
Prolonged > 12 hours	66	27.8%
Normal < 12 hours	174	72.5%
Progress of Labour		
Obstructed	46	19.12%
Precipitate	6	1.25%
Normal	191	79.58%

Foetal factors

Table 3: Foetal Factors contributing to birth asphyxia

Fetal Factors		
Birth Weight	**n**	**%**
Normal	81	33.75%
Low	134	55.83%
Macrosomia	25	10.47%
Maturity		
Term	88	36.67%
Premature	138	57.5%
Post term	14	5.83%
Fetal Presentation		
Breech	48	20%
Others	40	16.67%
Vertex	152	63.33%
Sex		
Male	145	60.42%
Female	95	39.58%

Birth Weight: Low birth weight babies have a notably higher percentage (55.83%) of birth asphyxia compared to normal birth weight babies (33.75%). Maturity: Premature babies had a higher percentage (57.5%) of birth asphyxia compared to term babies (36.67%) with post-term babies having the lowest percentage at 5.83%. foetal Presentation: Breech presentation had a lower percentage (20%) of birth asphyxia compared to vertex presentation (63.33%). Foetal sex: Males, 60.42%, were more prevalent to birth asphyxia compared to females, 39.58%.

The distribution of birth weight among infants is crucial in understanding their susceptibility to birth asphyxia. Normal birth weight infants, while representing a significant portion, are outnumbered by low-birth-weight infants, indicating a higher risk of birth asphyxia among infants with lower birth weights. Macrosomia, though less common, also presents its own set of challenges during childbirth.

Maturity, defined by the gestational age at birth, plays a vital role in the likelihood of birth asphyxia. Term infants, born at the expected gestational age, experience birth asphyxia less frequently compared to premature infants, who are born before reaching full term. Post-term infants, born after the expected due date, also face risks associated with prolonged gestation.

The fetal presentation refers to the position of the fetus in the birth canal during delivery. Infants in the vertex presentation, with their head down and facing the birth canal, are more commonly observed and generally have a smoother delivery process. However, breech presentation, where the baby's buttocks or feet are positioned to emerge first, presents challenges and may increase the risk of birth asphyxia.

The distribution of birth asphyxia cases based on sex highlights potential gender-related differences in susceptibility or outcomes. Male infants appear to be more commonly affected by birth asphyxia compared to females. Understanding these differences can aid in developing targeted interventions or treatment strategies.

DISCUSSION

Maternal factors

Our findings align and contrast with prior studies in meaningful ways, offering a nuanced understanding of birthasphyxia and its associated factors. Our research underscores key contributing factors to birthasphyxia, such as the vulnerability of teenage mothers due to limited prenatal care, the role of educational attainment in maternal outcomes, and the significance of antenatal care (ANC) visits.

Interestingly, we observed a distinct pattern concerning maternal education, with a notable percentage of cases involving mothers who had completed secondary school (60%), and a distribution across primary (23%) and tertiary (18%) levels. Furthermore, marital status emerged as a significant factor, with 65% of cases linked to married mothers, and a relatively smaller proportion among single mothers (35%). Young mothers, particularly those aged 15-19, were at an increased risk of birth asphyxia-a conclusion strongly supporting our findings on teenage vulnerability to adverse outcomes (Ayazbekov *et al*., 2020).

While our research aligns with the broader theme of education's impact, there is a slight discrepancy as most cases in Abubakari's study involved mothers who had completed secondary education, diverging from the emphasis on lower educational levels in prior studies (Abubakari *et al*., 2019).

Studies by highlight the importance of antenatal care in reducing birth asphyxia. Consistent with these findings, our research observed a higher prevalence of

birth asphyxia among mothers with inadequate ANC visits (56% had only one visit), underscoring the preventive role of regular prenatal care (Tibebu *et al*., 2023)

Ayebare *et al*. (2022) and Li *et al*. (2023) reported varying influences of sociodemographic factors such as maternal occupation and marital status. Ayebare *et al*. emphasized the role of subsistence farming and low education levels, findings that mirror our conclusions regarding occupation's impact (employment contributing to 35%, self-employment 29%, and non-working 37%). However, Li *et al*.'s study observed no significant difference in birth asphyxia rates based on marital status, contrasting with our findings where married mothers had a higher prevalence(Aslam *et al*., 2014).

Abdullahi Orey (2023) emphasized the challenges faced by teenage mothers, such as insufficient prenatal care and delayed recognition of pregnancy complications. These findings are consistent with our observations regarding the elevated risks associated with younger mothers and insufficient ANC attendance.

This comparative exploration highlights a common thread: the critical role of timely and adequate prenatal care in mitigating birth asphyxia. Furthermore, the interplay of sociodemographic factors like education, occupation, and marital status demonstrates regional and contextual variations that warrant tailored interventions.

Fetal Factors

In a study conducted by in Ethiopia, 12,249 live births were considered in nine separate studies. The combined total prevalence of perinatal asphyxia was 24.06%. Low birth weight was one of the contributing variables associated with birth asphyxia(Tibebu *et al*., 2023) . In the maternity ward of the Kakamega County Referral Hospital in Kenya, perinatal factors were associated with birth asphyxia among neonates. Neonates born with a birth weight of 1500 to 2500 g were three times more likely to develop birth asphyxia than those born with a birth weight of 2600 to >3500g (Groen-Blokhuis *et al*., 2011).

The neonate's gender was not a risk factor, nor was resuscitation. Asphyxia at birth did not significantly correlate with age at birth. A study by Meshesha *et al*., (2020) to identify determinants of perinatal asphyxia in referral hospitals in Ethiopia found associations between intrapartum and neonate-related variables to birth asphyxia (Meshesha *et al*., 2020). Prolonged labor, assisted delivery, place of delivery (at health centers), and low weight at birth were recognized as determinants of newborn perinatal asphyxia where neonates with birth weight (<2.5 kg) had increased chances of birth asphyxia compared to those with normal weight (≥2.5 kg) at birth. These findings are congruent with our research findings where normal birth weight infants, while representing a significant portion, were outnumbered by low-birth-weight infants, indicating a higher risk of birth asphyxia among infants with lower birth weights. Macrosomia, though less common, also presents its own set of challenges during childbirth.

August 2021, a study conducted on 144 live births found that 71.53% of birth mothers had one ANC visit, and over half of the neonates were male (62.50%). The percentage of neonates with asphyxia at birth was 11.11%. Male neonates were 5.02 times more prone than female newborns to have asphyxia. Mothers without at least one ANC visit were 3.72 times more predisposed to have a neonate with asphyxia than those who had at least one antenatal visit. Mothers with adverse pregnancy outcomes had a probability of 7.0 to have an asphyxiated neonate compared to mothers without such history. The sex of the neonate, antenatal visits, and poor outcomes of pregnancy were determined to be risk factors associated with birth asphyxia (Tibebu *et al*., 2023).These study findings are congruent with our research findings where the distribution of birth asphyxia cases based on sex highlights potential gender-related differences in susceptibility or outcomes. Male infants appear to be more commonly affected by birth asphyxia compared to females.

A study done to find the determinants and magnitude of newborn asphyxia among live neonates at public hospitals in northwest Ethiopia found the neonatal prevalence of asphyxia to be 27.1% (Admasu *et al*., 2022). Neonates born to mothers from rural areas, primiparous mothers, premature rupture of foetal membranes, and low weight at birth (< 2.5kg) were determined to be independent birth asphyxia predictors. The risk of birth asphyxia is greatly increased in pregnancies that are late-preterm or late-term, as well as in those with low birth weight (Rattanaprom *et al*., 2023). According to our research findings, premature babies had a higher percentage (57.5%) of birth asphyxia compared to term babies (36.67%) with post-term babies having the lowest percentage at 5.83%. while breech presentation had a lower percentage (20%) of birth asphyxia compared to vertex presentation (63.33%) probably attributed to the rare occurrence of breech deliveries.

CONCLUSION

Birth asphyxia remains a significant concern in the study setting, with various factors contributing to its prevalence. The study identified several sociodemographic factors, such as the age of the mother (13-25 years), marital status, low antenatal clinic attendance, and unemployment, as key contributors. Additionally, maternal obstetric factors, including premature rupture of membranes, meconium-stained amniotic fluid, vaginal delivery, and preeclampsia, were also associated with a higher risk of birth asphyxia. Among foetal factors, low birth weight (<2500g), prematurity, and male gender were found to be significant.

RECOMMENDATION

It is crucial to address these factors through targeted interventions to reduce the incidence of birth asphyxia. In terms of sociodemographic factors, it is essential to promote regular antenatal care attendance among all pregnant women, especially those in younger age groups, married women, and those who are unemployed. Regular antenatal visits provide an opportunity for early detection and management of potential complications, which is crucial in preventing birth asphyxia. Health education programs should be tailored to reach these vulnerable groups, emphasizing the importance of consistent prenatal care.

Addressing maternal obstetric factors requires a multi-faceted approach. Pregnant women should be educated on the risks associated with premature rupture of membranes (PROM) and encouraged to avoid activities that increase this risk, such as smoking and heavy lifting.

Additionally, close monitoring of labour, particularly in cases of meconium-stained amniotic fluid, is vital to prevent meconium aspiration and its complications. It is also important to ensure that women with preeclampsia receive appropriate medical management throughout their pregnancy, as this condition has been linked to an increased risk of birth asphyxia.

Regarding foetal factors, preventing preterm birth and managing low birth weight are critical. Pregnant women should be provided with education and support to adopt healthy lifestyle practices that reduce the risk of preterm birth, such as avoiding smoking and illicit drug use. Interventions should also focus on identifying and managing risk factors for preterm labour, such as cervical insufficiency or multiple gestations, to ensure better foetal outcomes.

Finally, community education and support are essential in creating awareness about the importance of prenatal care and healthy pregnancy practices. Outreach programs should be designed to educate pregnant women and their families about the contributing factors of birth asphyxia and the necessary steps to prevent it, ultimately leading to safer deliveries and improved maternal and neonatal health outcomes.

Declaration: The authors declare no conflict of interest.

Ethics approval and consent to participate

The study was approved by the Kabarak University Research and Ethics Committee (KUREC-050224) and was fully authorized by the National Commission for Science Technology and Innovation (NACOSTI- REF NO:474606, 802379, 835973, 250668). The county government of Nakuru permitted the study. All data were serialized to maintain confidentiality.

Consent for publication: Not applicable

Availability of data and materials

The authors confirm that the data supporting the findings of this study are available within the article [and/or] its supplementary materials.

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Author contribution

LW and TW conceptualized, acquired, and analyzed data for the study, interpreted the findings and wrote the first draft. DK, BM and SB contributed to the study design, interpreted the findings, and provided overall supervision to the project. All the authors critically reviewed, read, and approved the manuscript.

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