Determinants of stillbirths in Katsina, Nigeria: a hospital-based study

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Abstract

Every year, about 3 million stillbirths occur globally, almost a third occurring during the intra-partum period. Almost all stillbirths (98%) occur in low and middle income countries, with Nigeria having the third largest burden. The aim of this study was to determine the stillbirth rate and its determinants in the Federal Medical Centre Katsina, located in north western Nigeria. This study was a retrospective review of all deliveries conducted between 1st March 2010 and 31st December 2012 in Federal Medical Centre Katsina. Data were extracted from labor room and theatre records, and patient folders. Cases were matched with controls by booking status. The privacy and confidentiality of information retrieved from cases and controls was also ensured by anonymizing the data retrieved. No conflict of interest was identified. The data was analyzed with SPSS 20. During the period under review, there were 6628 deliveries, out of which 331 of the products were stillborn. The stillbirth rate was 46.9±3.6 per 1000 deliveries. Determinants of stillbirths were antepartum hemorrhage, hypertensive disorders of pregnancy, uterine rupture, low birth weight and congenital fetal malformations. The study highlighted the poor perinatal health in the study population.

Introduction

Every year, about 3 million stillbirths occur globally, almost a third occurring during the intra-partum period.[1] The number of babies that are stillborn approximates the number of babies that die during the first seven days of life (the early neonatal period), and is eight times the number of mothers that die during pregnancy, childbirth and within the first 42 days of termination of the pregnancy (maternal deaths).[2]

Almost all stillbirths (98%) occur in low and middle income countries.[1-4] South Asia and Sub-Saharan Africa are the largest contributors with over a million and 943,000 stillbirths respectively in 2008.[4]

The WHO, in its neonatal and perinatal mortality estimates for 2004, had reported Nigeria's stillbirth rate as 43 per 1000 deliveries with 236,000 stillbirths that year.[5] As with all other human development indices, regional variations are known to occur.[6-12] The experience from the north western region may differ from that of other regions, as the region has the poorest health indices in the country.[13]

It has been suggested that in places with high stillbirth rates and poor health indices, strategies to reduce stillbirths should target the peri-partum period for maximal impact.[4] An understanding of the determinants of stillbirths in such places would enable the development of interventions that could potentially lead to the saving of lives. Given the poor indices in the North-west region of Nigeria compared to other regions in the country, especially the southern regions from where the bulk of all studies in Nigeria were conducted, new studies need to be conducted in this region to understand the burden and determinants of stillbirth in the region, and propose strategies to reduce it.

This study was therefore conducted, using secondary data, to measure the stillbirth rate in a federal tertiary hospital in Katsina, the capital of Katsina state in North western Nigeria. It also explored the immediate and remote determinants of these stillbirths.

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Materials and Methods

Secondary data (record of all deliveries from the labor room register) in the maternity unit of the Federal Medical Centre (FMC), Katsina collected over a two year eight months period (1st March 2010 to 31st December 2012) was utilized. The hospital provides antenatal, delivery and postnatal services, amongst others, attending to pregnant women that underwent antenatal care (booked) in the hospital, those booked in other hospitals and clinics, and those that did not have antenatal care during their pregnancy (unbooked cases). It is located in Katsina (population; 318,132), the capital city of Katsina State (population: 5,801,584).[14]

The case-control study design was used. Cases and control were matched by antenatal care attendance during pregnancy. Cases were stillbirths, defined as all babies delivered without evidence of life after 28 weeks gestation and with a weight of 1000 g or more. Cases were selected consecutively. The total number of deliveries that had resulted in babies whose gestational ages were greater than 28 weeks and whose weights were greater than or equal to 1000 g, spanning the two year eight months period being reviewed were used to calculate the stillbirth rate. This criterion was chosen as it corresponded with local conditions as recommended by the WHO.

Cases were sorted into macerated stillbirths and fresh stillbirths. Fresh stillbirths were further subdivided into those that died before the mother presented to the hospital and those that died while the mother was in the hospital and in labor. Those fetuses that died while the mother was in the hospital were used to determine the proportion of stillbirths that occurred while in the hospital. The records of selected cases were extracted onto a data extraction form. Cases whose records could not be traced were treated as missing values and were excluded from the analysis for determinants of stillbirths. Incomplete records were also treated as missing values. The data extraction form used for data extraction was designed before the commencement of data extraction.

The controls were live-births that took place in the same hospital during the period cases were selected. For each selected case, two controls matched by antenatal care attendance were selected; one immediately preceding the case in the register and the other after the case. Controls whose records could not be traced were treated as missing values and were excluded from the analysis for determinants of stillbirths.

Sample size determination

The minimum sample size for the study was determined using GPower 3.1.7 application written by Franz Faul, Universitat Kiel, Germany (Copyright 1992-2013). A minimum sample size of 88 stillbirths and 88 controls was calculated for a medium effect size of 0.3, a P-value of 0.05, a power of 80%, and 1 degree of freedom.

Ethical concerns

Informed consent was obtained from the institution's ethical review board before the research was commenced. The privacy of cases and controls selected and confidentiality of information retrieved from their case notes was also ensured by anonymizing the data retrieved. No conflict of interest was identified.

Data analysis

Data retrieved from the records were entered into data analysis software (SPSS version 20.0). The study population was described using summary and dispersion measures. Normally distributed continuous variables were described with means and standard deviations. Continuous variables that were skewed were described with medians and inter-quartile ranges. Proportions and percentages were used to describe categorical variables. Graphical and tabular displays were used where appropriate. Associations between the determinants of stillbirth and stillbirths were tested with chi-square and fisher's exact tests for categorical determinants, differences between means (paired samples) for normally distributed continuous determinants, and the Mann-Whitney U tests for non-parametric continuous determinants. The relative contributions of determinants of stillbirths were tested with logistic regression. Levels of significance were set at 0.05. Bonferroni corrections were applied for all logistic regressions.

Results

Stillbirth rate

There were 6628 deliveries during the period under review; 331 of the products of these deliveries were stillborn. The mean stillbirth rate over the 32 months was 46.9±3.6 stillbirths per 1000 deliveries. When compared with the WHO estimate for Nigeria in 2009, the difference was not statistically significant (mean difference: 5.2 stillbirths per 1000 deliveries; 95%CI: –2.16, 12.57).

Figure 1 depicts the trend of monthly stillbirth rate over the study period compared to total monthly births. As the total delivery increases, the stillbirth rate also increases and vice versa. There were no records for January and February in 2010 and 2011.

Cases and controls

Of the 331 cases identified, only 157 (47.4%) case files could be retrieved for data extraction. Six hundred and sixty two controls were selected for use as comparators to the 331 cases. Of these, 298 (45%) case files could be retrieved for data extraction. These percentages were comparable between the two groups. Data were thus extracted for 455 deliveries; 157 cases and 298 controls giving a ratio of 1.9 controls to each case. Of the 157 stillbirths used as cases, there were 52 macerated stillbirths (33%) and 105 fresh stillbirths (67%) giving a ratio of 2 fresh stillbirths to each macerated stillbirth. About a quarter (23.8%) of the fresh stillbirths occurred while the parturient was in labor at the Federal Medical Centre, Katsina. Of these 455 deliveries for which data were extracted, nine were twin deliveries. There were no higher order deliveries during the period under review. Five of the women that had twin deliveries delivered the first of the set of twin at home before presenting to the hospital. The remaining four women delivered the twins in the hospital. There were thus 459 babies produced from the 455 deliveries.

Determinants of stillbirths

Data were extracted on many risk factors known to be associated with stillbirths. The various risk factors were categorized into socio-demographic, pre-natal, intra-partum and fetal factors.

Socio-demographic determinants of stillbirths

Five socio-demographic factors were reviewed as determinants of stillbirths. Table 1 summarizes the odds and 95% confidence interval associated with them as risk factors for stillbirths. Mothers who delivered stillborn babies had significantly increased odds of being 35 years or older, grand multiparous (have 5 or more previous delivery), and not having undergone any form of antenatal care anywhere during the pregnancy.

Pre-natal determinants of stillbirths

Table 2 summarizes all the pre-natal risk factors evaluated with their odd ratios and 95% confidence intervals. Anemia, whether mild, moderate or severe, abruptio placentae (premature separation of the placenta) and placentae praevia (abnormally located placenta), premature rupture of fetal membranes before the onset of labor, chorioamnionitis and hypertensive disorders of pregnancy were all significantly associated with stillbirths.

Intra-partum determinants of stillbirths

Mothers with stillborn babies had significantly increased odds of having prolonged rupture of fetal membranes, being delivered by caesarean section and rupturing the uterus during labor as summarized in Table 3.

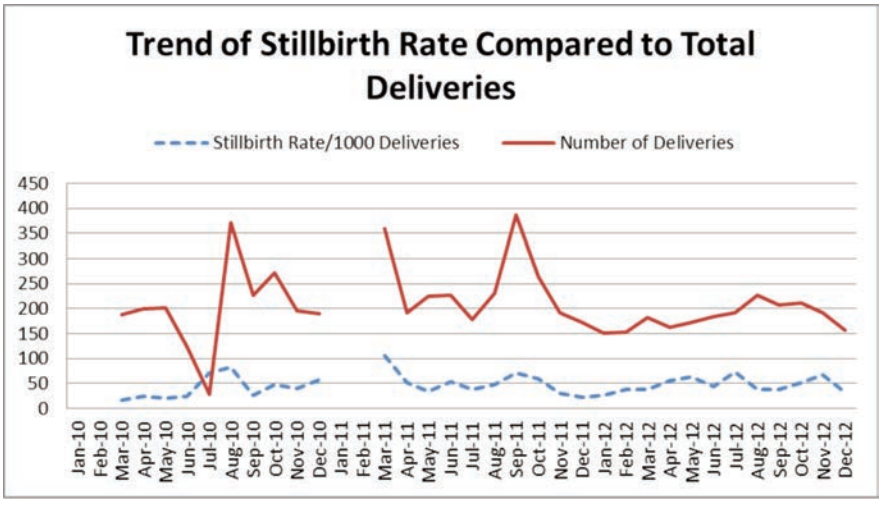

Figure 1. Trend of stillbirth rate compared to total deliveries.

Fetal determinants of stillbirths

Table 4 summarizes the fetal factors that were studied as determinants of stillbirths. Stillborn babies had significantly increased odds of being very low birth weight (1000 g to 1499 g) or low birth weight (1500 g to 2499 g) at delivery, and having congenital malformations.

Classification of stillbirths by clinical circumstances of death

The 157 cases of stillbirths that were retrieved were classified by clinical circumstances (cause of death) about the time of delivery as proposed by Baird *et al*.[15] (the Aberdeen classification). Table 5 summarizes the causes of death identified. About a third is unexplained. The commonest causes of death were antepartum hemorrhage, trauma and hypertensive disorders of pregnancy. In those with antepartum hemorrhage, more than four-fifths are due to premature abruption of the placenta.

Causes of delay in those that died intra-partum post admission

Of the 105 babies that were delivered fresh stillbirths, 25 (23.8%) died post admission in the labor room at the Federal Medical Centre, Katsina. Causes of delay could be discerned in 20 (80%). More than two-thirds (70%) died in the labor room without the fetus being identified as distressed. A fifth (20%) died before intervention because of delay in obtaining consent. One fetus each (5%) died because of delay in the operating theatre and the labor room.

Discussion

The hospital stillbirth rate calculated for all deliveries over the three year period (2010 to 2012) was 46.9±3.6 stillbirths per 1000 deliveries. The narrow confidence interval assures of the adequacy of the number of cases reviewed. The rate was not statistically different from the stillbirth rate estimated for Nigeria in 2009 by the WHO, in spite of the fact that in countries with low institutional delivery rate, hospital based stillbirth rates are estimated to be about 10% higher than population based studies.[2] The monthly stillbirth rates varied directly with total number of deliveries, possibly a consequence of a decreased ratio of skilled health care attendants to women in labor when monthly delivery rate increases.[4]

Comparison with other studies from Nigeria reveals no particular pattern with significant variation. This might be a consequence of the marked regional variation between the regions in healthcare indices, which is considerably poorer in the northern regions compared to the southern regions.[13] It might also be a consequence of the different study designs used by the different authors in the various studies.

Although only about half of the records of potential cases and controls could be retrieved for data extraction, the number was still almost twice the sample size needed to detect

Table 1. Socio-demographic determinants of stillbirths.

Risk factor	Livebirths, n (%)	Stillbirths, n (%)	Odds ratio (95%
Maternal age			
Teenagers (≤9 yrs)	49 (16.4)	19 (12.1)	0.814 (0.456, 1.454)
20 to 34 yrs	212 (71.1)	101 (64.3)	Reference group
≥ 35 yrs	37 (12.4)	37 (23.6)	2.099 (1.256, 3.508)*
Maternal education[a]			
No formal education	21 (42)	22 (73.3)	2.095 (0.548, 8.009)
Primary education	9 (18)	0 (0)	0.099 (0.005, 2.130)
Secondary education	12 (24)	4 (13.3)	0.667 (0.128, 3.469)
Post-secondary education	8 (16)	4 (13.3)	Reference Group
Parity[b]			
Primiparous (0)	98 (33.2)	28 (17.8)	0.669 (0.392, 1.141)
Normal Parity (1 to 4)	117 (39.7)	50 (31.8)	Reference Group
Grandmultiparous (≥5)	80 (27.1)	79 (50.3)	2.311 (1.467, 3.639)*
Booking status[c]			
Not booked anywhere	36 (22.8)	111 (70.7)	8.178 (4.929, 13.57)*
Booked	122 (77.2)	46 (29.3)	Reference Group
Place of booking[d]			
Tertiary care center	41 (33.6)	19 (41.3)	Reference Group
Secondary care center	24 (19.7)	8 (17.4)	0.719 (0.273, 1.893)
Primary care center	38 (31.1)	16 (34.8)	0.909 (0.409, 2.018)
Private facility	19 (15.6)	3 (6.5)	0.341 (0.090, 1.293)

[a]Information on mother's education available for 80 mothers only; [b]Information on mother's parity missing for 3 controls; [c]Information on Booking Status unclear for 140 mothers; [d]Information on Place of Booking available only for Booked mothers; *Significantly increased odds of exposure following a stillbirth delivery.

Table 2. Pre-natal determinants of stillbirths.

Risk factor	Livebirths, n (%)	Stillbirths, n (%)	Odds ratio (95% CI)
Packed cell volumea			
Severe anemia (≤18)	3 (8.8)	13 (43.3)	58.5 (8.684, 394.1)*
Moderate anemia (19-24)	2 (5.9)	13 (43.3)	87.75 (11.09, 694.4)*
Mild anemia (25-29)	2 (5.9)	2 (6.7)	13.5 (1.189, 153.3)*
No anemia (≥30)	27 (79.4)	2 (6.7)	Reference Group
Syphilisb			
Yes	1 (2.9)	0 (0)	0.793 (0.030, 20.63)
No	34 (97.1)	14 (100)	Reference Group
Diabetes mellitus[c]			
Yes	1 (0.3)	0 (0)	0.691 (0.028, 17.07)
No	297 (99.7)	143 (100)	Reference Group
Sickle cell disease[d]			
Yes	0 (0)	1 (0.7)	6.284 (0.255, 155.2)
No	298 (100)	142 (99.3)	Reference Group
HIV infection[e]			
Yes	2 (0.8)	0 (0)	0.321 (0.015, 6.736)
No	238 (99.2)	148 (100)	Reference Group
Abruptio placentae	0 (0)	47 (29.9)	256.6 (15.69, 4198)*
Placentae praevia	4 (1.3)	11 (7.0)	5.538 (1.734, 17.69)*
Premature membrane rupture	4 (1.3)	9 (5.7)	4.47 (1.354, 14.75)*
Chorioamnionitis	0 (0.0)	5 (3.2)	21.53 (1.183, 391.9)*
Hypertensive disorders of pregnancy	27 (9.1)	30 (19.1)	2.371 (1.353, 4.155)*
Multiple gestation	4 (1.3)	5 (3.2)	2.418 (0.64, 9.134)

[a]Data on packed cell volume recorded for only 64 mothers; [b]Data on syphilis available for only 49 mothers; [c]Information on diabetes mellitus in pregnancy unclear for 14 mothers; [d]Data on sickle cell disease not available for 14 mothers; [e]Information on HIV Infection not recorded for 67 mothers. *Significantly increased odds of exposure following a stillbirth delivery.

a 30% increase in odds of stillbirth delivery. There was no difference in percentage of case notes retrieved for cases and controls. It had been anticipated that if there were missing case notes, it will be random leading to a random misclassification effect, which might lead to a reduction in the observed effect sizes.[16]

The high proportion of fresh stillbirths relative to macerated ones was also expected. Previous studies have shown that in countries with high stillbirth rates (greater than 25 stillbirths per 1000 deliveries), fresh stillbirths form a larger proportion of the stillbirths.[4] This usually reflects fetal death during labor, usually a consequence of poor intra-partum care. Many of the deliveries that ended with the birth of a stillbirth babies in the current study were not booked anywhere (70.7%), and might only have come to the hospital because of the complications experienced. The death of the fetus might therefore be a reflection of the poor intra-partum care and delayed presentation to the hospital.

The association between stillbirths and advanced maternal age (age greater than or equal to 35 years) and grand multi-parity (having five or more previous deliveries) is complementary. In the current review, more than 90% of mothers with advanced maternal age were also grand multiparous, and the average age of grand multiparous women was 32.7 years. Previous studies have documented these findings. It might be related to increased prevalence of obstetrics complications with grand multi-parity and advanced maternal age.[17,18] The prevalence of chronic medical conditions and congenital malformations in fetuses also increases with advanced maternal age.[17] The two occurring in the same pregnant subject may complement each other.

Anemia, whether mild, moderate or severe, increased the odds of delivering a still birth. The very large effect size and wide confidence interval was a reflection of the small sample of subjects that had this complication. A larger sample will be required to estimate the true effect size of this obstetric complication. Anemia might predispose to stillbirth through hypoxic insult on the unborn fetus.[19] On the other hand, the same pathology that predispose to anemia may also predispose to the death of the unborn fetus.[20] In the data set, 71% of those with anemia either had abruptio placentae or placentae praevia, both obstetrics complications with increased odds of occurrence with stillbirth deliveries.

Premature rupture of fetal membranes may predispose to fetal death either through infection or by precipitating preterm delivery. Both infection and preterm delivery have been proven by previous researchers as important mechanisms precipitating stillbirths.[19] None of the studies cited from Nigeria had identified this risk factor as a determinant of stillbirth. This is important as its management is shrouded with a lot of controversies.[21] The very wide confidence interval of the risk factor reflects inadequate number of cases and controls with respect to the complication in the data set. Review of more data will therefore be needed to determine its true effect size.

Hypertensive disorders of pregnancy have been identified by previous workers as an important determinant of stillbirth.[6-12,22] It might result in stillbirths by chronic fetal insufficiency with retarded fetal growth.[19]

All the women that were recorded as having had abruptio placenta had stillbirths. Abruptio placentae is graded according to the extent of placental separation from mild cases with marginal separation (usually less than 25%) to severe cases (greater than 50% to total separation). While the severe forms usually present with severe vaginal bleeding, milder forms may not manifest any form of external bleeding (concealed hemorrhage). All the cases in our data set had severe vaginal bleeding. Although previous studies have associated abruptio placentae especially severe forms, with stillbirths, the mortality figures reported from developed countries is several fold less

Table 3. Intra-partum determinants of stillbirths.

Risk factor	Livebirths, n (%)	Stillbirths, n (%)	Odds ratio (95% CI)
Prolonged rupture of membranes	3 (1.0)	16 (10.2)	11.16 (3.199, 38.92)*
Use of partograph[a,b]			
No	0 (0.0)	2 (1.6)	10.74 (0.510, 225.9)
Yes	196 (67.6)	91 (72.2)	Reference Group
Came in second stage	94 (32.4)	33 (26.2)	0.756 (0.474, 1.207)
Duration of labor[c]			
Prolonged	8 (4.1)	5 (5.3)	1.327 (0.422, 4.172)
Normal	189 (95.9)	89 (94.7)	Reference Group
Delivery by caesarean section	17 (5.7)	35 (22.3)	4.742 (2.558, 8.79)*
Uterine rupture	0 (0.0)	10 (6.4)	42.5 (2.474, 730.1)*

[a]Data on use of a partograph to monitor labor missing for 1 mother; [b]Data on use of a partograph to monitor labor not applicable for 38 mothers; [c]Information on duration of labor not available for 164 mothers; *Significantly increased odds of exposure following a stillbirth delivery.

Table 4. Fetal determinants of stillbirths.

Risk factor	Livebirths, n (%)	Stillbirths, n (%)	Odds ratio (95% CI)
Weight of the baby[a]			
Very low birth weight	5 (1.7)	18 (14.0)	14.85 (5.286, 41.72)*
Low birth weight	18 (6.1)	37 (28.7)	8.479 (4.496, 15.99)*
Normal birth weight	231 (78.0)	56 (43.4)	Reference Group
Macrosomia (>4000 g)	42 (14.2)	18 (14.0)	1.768 (0.947, 3.301)
Sex of the baby[b]			
Male	162 (54.2)	89 (61.4)	1.344 (0.897, 2.014)
Female	137 (45.8)	56 (38.6)	Reference Group
Congenital malformations[c]			
Yes	2 (0.7)	7 (4.5)	7.095 (1.456, 34.57)*
No	300 (99.3)	148 (95.5)	Reference Group
Baby's position if a set of twins[d]			
Second baby of a set of twin	5 (100.0)	4 (50.0)	0.090 (0.004, 2.178)
First baby of a set of twin	0 (0.0)	4 (50.0)	Reference Group

[a]Data on baby's weight missing for 34 babies; [b]Data on baby's sex missing for 15 babies; [c]Information on congenital malformations not available for 2 babies; [d]Data on Baby's position in multiple gestation only available for twin gestation; * Significantly increased odds of exposure if stillborn.

Table 5. Causes of death among all stillbirths (Aberdeen classification).

Clinical circumstance	Number (%)
Premature baby: cause unknown	14 (8.9)
Mature baby: cause unknown	22 (14.0)
Trauma	41 (26.1)
Hypertensive disorders of pregnancy	16 (10.2)
Antepartum hemorrhage	57 (36.3)
Abruptio placenta	47 (82.5)
Placenta praevia	10 (17.5)
Maternal disease	4 (2.5)
PreROM/severe oligohydramnios	1 (25.0)
SCA in pregnancy	1 (25.0)
Severe anaemia in pregnancy	2 (50.0)
Fetal deformity	3 (1.9)

PreROM, premature rupture of fetal membranes; SCA, sickle cell anemia.

than those reported from LMIC.[6,7,9-12,22,23] It may be that milder forms of abruptio placentae, where the babies survive, are not readily detected in LMIC, or because of late presentation to hospitals, the mild forms progress to severe forms before they are seen in health facilities.

Mothers with deliveries complicated by uterine rupture had a 42 fold increased odds of having a stillbirth. There were 10 deliveries complicated with uterine rupture in this review. All the products of these deliveries were stillborn. In previous studies by Okeudo *et al*.[12] and Ukaegbe and Nwogu-Ikojo,[8] uterine rupture was also identified as an important determinant of stillbirth. Once more, the gap in the quality of care rendered by health care facilities in developed countries compared to those in developing and under-developed countries is exemplified by neonatal outcome after uterine rupture. Both Miller and Leung *et al*.[24,25] were able to demonstrate that with prompt intervention, stillbirth is rare and neonatal outcome is very highly favorable after uterine rupture. The poor outcome experienced in developing countries may be a consequence of delayed presentation to the health facility by patients, failure to identify the condition and poor emergency preparedness and response. Credence to this is seen in our data set where almost a third (30.5%) of parturients in labor presented to the hospital in second stage. Stillborn babies, when compared to live born ones, have significantly greater odds of being low birth weight or very low birth weight at birth. The odds are greater the lower birth weight. This had been reported by previous studies.[10-12] Similarly, stillborn babies had greater odds of having congenital malformations compared to live born ones. This has also been previously reported by Okeudo *et al.*[12,22] and Olusanya and Solanke.[22] Many congenital malformations that predispose to stillbirths are incompatible with life.[26] The identification of congenital malformations in many LMIC, unfortunately, is limited by a lack of infrastructure and skills for perinatal autopsies. In a previous study, almost a third of causes of fetal deaths (29.9%) were changed following autopsy.[27] Identification of congenital malformations is particularly important because of the chances of recurrence.

Using the Aberdeen obstetrics classification by Baird *et al*.,[15] the most common causes of death identified in this review, in decending order of frequency, were antepartum haemorrhage (four-fifths of which were abruptio placentae), trauma (conditions associated with excessive mechanical stress of labour) and hypertensive disorders of pregnancy. A little less than a quarter were unexplained. Of those babies that were delivered fresh stillborn, almost a quarter died while the mothers were in the labour room: 70% of these foetuses were not identified as distressed, even though a partograph is supposedly being used. This might imply that the partograph is not being used properly. Another 20% died while waiting for consent for intervention to be carried out. This might have to do with the paternalistic nature of the northern part of Nigeria.[28] Decisions are usually taken by male members of the family.

Limitations

A major limitation of the study was the failure to conduct perinatal autopsies on the stillborn babies. Though the study was retrospective, autopsies were not performed because during that period, there was no hisptopathologist in the hospital. Studies conducted in facilities where perinatal autopsies are conducted may overcome this limitation.

Comparing the low facility delivery rate in the study state, the population's high fertility rate, and the sample size utilised, it may be difficult to generalise the findings of this study at a population level. This challenge could be resolved by conducting a population based survey of stillbirths.

Conclusions

The major causes of stillbirths in this study are preventable, if good quality antenatal care services and skilled attendance and appropriate care at delivery is made universally available and accessable.

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