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A COMPARATIVE ANALYSIS OF FIRST DAY NEONATAL MORTALITY BETWEEN ADOLESCENTS AND ADULT FEMALES GIVING BIRTH AT LIGULA HOSPITAL IN MTWARA, SOUTH EASTERN TANZANIA 2008 – 2009

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ABSTRACT

Objective: **Compare first day neonatal mortality between adolescents and adults delivering at the main referral hospital in Mtwara, Tanzania**
Design: **Cross-sectional chart review**
Setting: **The study was conducted at the main referral hospital in Mtwara, Tanzania. Rates of adolescent pregnancy at the hospital were 15.5% in 2009 and 14.3% in 2010**
Subjects: **A total of 450 adolescent and adult females delivering at Ligula Hospital between 2008 and 2009 were included in the study.**
Outcome measures: **First day neonatal mortality between adolescents and adults was the primary outcome. Secondary outcomes included neonatal birth weight, parity, gravidity, prematurity, HIV and neonates delivered.**
Results: **First day neonatal mortality was 5.56%. Birth weight was the only risk factor significantly associated with neonatal mortality**
Conclusion: **Younger women have predisposal to neonatal mortality due to underlying causal mechanisms. In order to validate the results of this study, further research on risk and causes of first day neonatal mortality at facilities is warranted.**

INTRODUCTION

Worldwide, neonatal mortality (death of infant during the first 28 days of life) accounts for 37% of under five deaths (2). The millennium development goal (MDG) 4, aims to decrease worldwide under five mortality by two thirds by 2015. The highest risk of neonatal mortality is on the first day of life (4).

Sub-Saharan Africa (SSA) has one of the highest risk of neonatal mortality (4). Tanzania, has had a decreasing neonatal mortality rate within the last decade and is currently 28.3deaths/1,000 live births (5). However, the MDG 4 target, has yet to be attained. According to a Ministry of Health and Social Welfare report, adolescents' (< 20 years) comprise of approximately 31% of the population (6), with a neonatal mortality of 41 deaths/ 1000 live births. This is 1.8, 1.41 and 1.08 times higher than 20–29 year, 30–39 year and 40–41 year age group respectively (7).The south east region of Tanzania has a neonatal mortality higher than the national average due to limited access to obstetric and neonatal care (8).

Although literature suggests neonatal mortality is associated with young maternal age, it is unclear whether it is due to a causal association or other mediated risk factors (9–18). For example, adolescents have an increased biological risk of clinical complications during pregnancy, requiring the need to attend antenatal care (ANC) during pregnancy. However, there have been differing results around the region in regards to ANC utilisation within this age group; ANC utilisation influences use of skilled personnel, detection of complications and increased vigilance to obtain vaccinations to decrease neonatal mortality (19–21).Further prospective research needs to be conducted in order to understand the true association between maternal age and neonatal mortality in rural areas where neonatal mortality and adolescent pregnancy rates are higher.

Explanatory factors which increase neonatal mortality in both sub-Saharan Africa and Tanzania are nulliparity (12,22); prematurity/earlier gestational age (gest) (17,23); low birth weight (LBW) (24); human immunodeficiency virus (HIV) (25); higher gravidity (grav) (22); lower education (14); multiple deliveries (26); maternal age of less than 16 years and more than 40 years (13,15–17); lower socio-economic status (27); smoking status of mother (28); history of previous still

births or miscarriages (13,14); maternal malaria (29); maternal tetanus vaccination status (4); provision of prophylactic anti- malarial or vitamins (30); presence of anemia (31); number of Ante-natal Care (ANC) visits during pregnancy (21); low pre-pregnancy weight (4,32) and obstetric factors such as breech, obstructed labour, prolonged second stage, maternal fever (>38°C) during labour, rupture of membrane more than 24 hours, meconium staining of liquor (4).

Literature has shown both supporting and intermediate evidence on the effect of maternal age on neonatal mortality. Our hypothesis was younger mothers have worse neonatal clinical outcomes in comparison to adult mothers. Since there have been limited studies directly comparing younger mothers to older mothers especially in rural settings, the aim of this study was to determine the difference in neonatal mortality between adolescent and adult women who delivered at a referral hospital in Mtwara, Tanzania (rural area) from 2008–2009, and to estimate the effect of maternal age on first day neonatal mortality at Ligula Hospital.

MATERIALS AND METHODS

Setting: In Mtwara, 58.6% of women delivered in health facilities (7). Ligula Hospital is the main referral hospital in the region. Rates of adolescent pregnancy at the hospital were 15.5% in 2009 and 14.3% in 2010 (33). As part of the routine recording and monitoring process at the hospital, the following variables are collected for every delivering mother: name, serial number, age, residence, mode of delivery (vaginal, cesarean, breech), Apgar score, birth weight (BW) of the neonate, neonatal outcome , episiotomy, tear, repair, estimated blood loss, HIV, parity, gravidity, gestational age at delivery and number of neonates delivered.

Participants: A total of 450 records of women who were admitted to deliver in the study hospital between September 1st 2008 and August 31 2009 were reviewed. Data were collected for 225 adolescent and 225 adult women.

Procedures: A total of 450 women were selected from labour ward records. The women were selected by stratified random sampling with every 10th adolescent and 10th adult selected based on the inclusion criteria (maternal age, neonatal outcome and five out of the six confounding variable values present). Women were stratified by age groups and risk factors. If no outcome events were recorded amongst the stratified group and sample size was too small, groups were combined to avoid Type I error. Additionally, groups were combined if the 95% CI of ORs of cases overlapped between the stratified groups when observing the association between maternal age and neonatal mortality.

Data was double entered using the software EpiData by the principal investigator. A second individual verified every 20th record in the database to the original health records.

Variables within the records being analysed were maternal age, neonatal outcome, gestational age, parity, HIV, birth weight, gravidity and number of neonates delivered. The data were analysed using software Stata 10.0.

Analysis: Initially an association between age and neonatal mortality was conducted using Odds. Mothers were stratified by age groups based on risk factors reported within literature (age group of ≤ 15 years and ≥35 years). If no outcome events were recorded amongst the stratified group and sample size was too small, groups were combined to avoid Type I error. Additionally, groups were combined if the 95% CI of ORs overlapped. The age groups were selected to, at minimum, differentiate between females under the age of 20 and females 20 years and older.

The confounding variables (BW, parity, grav, gest, HIV, neonates delivered) were analysed through a bivariate analysis using Odds Ratio and Likelihood Ratio Test (LRT) to find an association with neonatal mortality. BW, parity, grav were analysed linearly; whereas gest, HIV and neonates delivered were analyzed categorically. If an association was found (95% CI ≠1 or p≤0.2), the crude difference between groups and it's associated p-value was calculated. The logistic regression was used to control for confounding variable simultaneously and to identify most parsimonious model describing the factors associated with neonatal mortality in our sample. In order to consider a factor significant the logistic regression had to show a p≤0.05.

Ethics: Ethical approval was obtained from Ifakara Health Institute, National Institute of Medical Research, London School of Hygiene and Tropical Medicine and Ligula Hospital. Since data were collected from health records, no identifying information about participants was collected posing no risk to study participants.

RESULTS

Table 1
Descriptive analysis of study subjects

Variable (n)	
Maternal Age (450)	
10 – 15	2%
16–19	48%
20-29	34%
30-34	8%
≥35	8%
Median	19.5 years
Neonatal outcome (450)	
Alive on day one	94.44%
Dead	5.56%
Birth Weight (447)	
Normal (≥ 2500 grams)	85.91%
Low (< 2500 grams)	14.09%
Median	3000g
Parity (450)	
Primiparous	252 (56)
Multiparous	198 (44)
Median	0
Gravidity (449)	
1	245 (54.44)
≥2	204 (45.33)
Median	1
Prematurity (Gestational age at birth) (438)	
≤ 37 weeks	98.63%
≥38 weeks	1.37%
Median	36
HIV (445)	
Negative	93.03%
Positive	6.97%
Neonates delivered (450)	
Singleton	98.44%
Twins	1.56%

Table 1 shows that, ages 16-29 comprised of 82% of the women delivering at the labour ward in 2008–2009. Of the 450 women giving birth, the mean average of first day neonatal mortality was 5.56% (56 deaths/1,000 live births). Fourteen percent of the neonates had low birth weight; 56% were primiparous; 54.44% of the women pregnant for the first time (primigravidae); 98.63% delivered prematurely (≤ 37 weeks), 6.97% were HIV positive and 98.44% delivered one neonate.

Table 2

Univariate analysis between dependent variables and neonatal mortality

Dependent Variable	Stratification (n)	% of neonatal mortality	Odds of neonatal mortality…/ χ2
Maternal age	Adolescent (225)	4.44%	1.0
	Adult (225)	6.67%	1.54 (0.67 – 3.50, p = 0.31)
Birth Weight	Low (63)	17.46%	For a 100 gram increase in birth weight: 0.89 (0.85 – 0.94, p ≤0.01)*
	Normal (384)	3.65 %	
Parity	Primiparous (252)	5.95%	For 1 neonate increase: 0.99 (0.73 – 1.34, p = 0.93)
	Multiparous (198)	5.05%	
Gravidity	1 (245)	5.31%	For 1 conception increase: 1.14 (0.94 – 1.39, p = 0.18)*
	≥2 (204)	5.88%	
Gestational age at birth	Premature (≤37 weeks) (432)	5.56%	For 1 week increase in gestational age: 0.69 (0.56 – 0.84, p≤0.01)*
	Term (≥38 weeks) (6)	16.67%	
Maternal Human Immunodeficiency Virus	Positive (31)	3.23%	1.0
	Negative (414)	5.80%	1.85 (0.24 – 14.1, p = 0.55)
Neonates delivered	Singleton	5.64%	χ2 = 0.42 (p = 0.52)+
	Twins	0%	

*If p≤0.2, a univariate analysis was done with it's relationship to maternal age
+Since there were no cases of neonatal mortality in the twins group, OR could not be calculated.

In Table 2 we conduct a univariate analysis between neonatal mortality and it's dependent covariates. The odds or neonatal mortality are 54% higher in the adult group in comparison to the adolescent group (95% CI: 0.67 – 3.50). Birthweight, gravidity and gestational age at birth were associated with neonatal mortality. A 100g increase in birthweight showed an 11% decrease in odds of neonatal mortality (p ≤0.01); a 1 conception increase increased odds of neonatal mortality by 14% (p=0.18) and a 1 week increase in gestation age decreased odds of neonatal mortality by 31% (p ≤0.01). Parity, maternal HIV positive status, number of neonates delivered that day did not show any association with day one mortality and hence were not included in the logistic regression model.

Table 3

Relationship between variables associated with neonatal mortality and maternal age

Dependent Variable	Adolescent (Mean)	Adult (Mean)	Difference in means (95% CI, p-value)
Birth Weight	2855.27	2987.82	-132.55 (-240.85 to -24.25, p=0.02)*
Gravidity	1.10	3.00	-1.91 (-2.15 to -1.66, p≤0.01)*
Gestational age at birth	35.89	35.84	0.06 (-0.14 to 0.26, p=0.58)

* If p≤0.2, the variable was included in the multivariable logistic regression

In order to consider a covariate a confounder, an association had to be established for maternal age. Covariates, which had a p ≤0.2, were tested through a t-test to determine relationship with maternal age. The unpaired t-test showed that on average, neonates born to adolescent mothers were 132.55 grams lighter (95% CI : 24. 25 – 240.85 g) than adult mothers. Adolescent mothers were likely to have two fewer children in comparison to their adult counterparts and gestational age at birth was similar for both groups (p = 0.58).

Table 4
Multivariable logistic regression on predictors of neonatal mortality and maternal age[5]

Number of observations: 446
$R2 = 0.10$

Exposure variables	Crude OR	Adjusted OR (95% CI, p-value)
Adolescent (10–19 years)	1.00	
Adult (20 – 45 years)	1.54	1.34 (0.49 – 3.72, p=0.57)
BW (odds/ 100 gram increase)	0.89	0.89 (0.85 – 0.94, p≤0.01)
Gravidity (odds/1 conception increase)	1.14	1.12 (0.87 – 1.45, p=0.57)

A multivariable logistic regression analysis is demonstrated in Table 4. The crude OR of neonatal mortality changed in the adult group after controlling for birthweight and gravidity (1.54 to 1.34). Both BW and gravidity played a negative confounding effect on first day neonatal mortality. BW showed an 11% decrease in the odds of neonatal mortality with a 100 g increase in BW (95% CI: 0.86 - 0.97). The effect of gravidity was nullified after adjusting for birthweight p=0.57) The R^2 shows that maternal age, BW and gravidity can explain 10% of the variation.

DISCUSSION

Previous studies of the association between neonatal mortality and maternal age in SSA have focused on tertiary care hospitals where there is a high risk of complicated cases and hence neonatal mortality (34). Most rural hospitals are less accessible, have fewer skilled personnel and have lower vaccination rates which decrease generalisability between urban and rural health facilities (18). A stratified sample of mothers delivering at Ligula Hospital in Mtwara demonstrated a neonatal mortality rate higher than the national average. Maternal age was not associated with neonatal mortality. However, adolescents had increased odds of delivering lighter neonates, and BW was the only factor showing an association with first day neonatal mortality. Since this data was obtained from health records at a hospital, some important confounders contributing to neonatal death were not routinely recorded. These confounders include: education (14); socio-economic status (27); smoking status (28) ; history of previous still births or miscarriages (13,14); malaria status (29); tetanus vaccination status (4); provision of prophylactic anti-malarial or other routine drugs like Vitamin A or multivitamins (30); presence of anemia (31); number of Ante-natal Care (ANC) visits during pregnancy (21); expecting mothers' weight (32) and obstetric factors (4).

Tanzania aims to reduce under five child mortality from 32 deaths to 29 deaths per 1000 live births by 2015. Although the target has been met nationally, Mtwara has a rate of 31 deaths per 1000 live births (7). The prevalence of neonatal mortality within our sample was double in rate in comparison to the Tanzania Demographic Health Survey (TDHS) (7). This difference in neonatal mortality could be attributed to the fact that the TDHS is a household survey, which includes the community, hence healthier individuals. Furthermore, since Ligula Hospital is the main referral hospital, there is an increased chance of experiencing complicated cases which in turn increasing risk of neonatal mortality.

The literature shows that the maternal age group of <20 and >40 years is a risk factor for neonatal mortality (7). The study sample when stratified by age groups showed a similar finding, with the ≥35 year age group having the highest neonatal mortality. However, the TDHS findings highlighted decreased neonatal mortality for the 20 – 29 year age group (7,14). A review paper and TDHS state that maternal age increases mortality of neonate at age 1 – 59 months (7,14). The distinction in results is explained by the lack of follow up data in this study and low facility delivery rate. It is therefore hard to generalise these findings to other studies and hence important to look at intermediate outcomes which could help in indicating neonatal mortality in the future.

Lower BW has consistently shown to be a predictor of neonatal mortality and an outcome of maternal age both within other settings and this study. A large study at Dar-es-Salaam's main referral hospital, Muhimbili showed that with a 100 gram increase in BW, decreased odds of neonatal mortality by 13% (13). These values are similar to our study and suggest that BW is an important determinant

for neonatal mortality especially first day mortality in Tanzania. The association of LBW with age was proven in a large Central Africa study, showing that adolescents had a higher odds of delivering LBW neonates in comparison to adults (21). However, factors such as race, nutrition, low pre-pregnancy weight, short maternal stature and malaria could influence BW (35).

The association between neonatal mortality and parity, grav, HIV and neonates delivered within the study period were not statistically significant. This could be because it was a different setting and because the outcome was measured too quickly decreasing the number of events recorded. In other settings where these variables were significant, neonatal mortality was measured at a later stage, hence showing significance.

In the sample, although the bivariate analysis of neonatal mortality was significantly lower for neonates born within the 31 – 36 gestational weeks in comparison to the 26 – 30 weeks in the crude analysis, the adjusted analysis suggests that women delivering between the 31 – 36 gestation week were more likely to have higher BW neonates, decreasing their chance of neonatal mortality. The association of BW and gest on neonatal mortality, has been demonstrated in a prospective cohort at a main referral hospital in Nairobi 36. In this study, the worst prognosis was amongst neonates who were < 1500 grams and < 32 weeks with 86.8% of the deaths occurring within the first week (36). A large retrospective cohort study in a referral hospital in Tanzania showed that odds of LBW doubled and were significantly associated with gestational age of < 37 weeks (37). The study results mirror that of other studies conducted in the subcontinent. A neonate born earlier has a higher tendency to be smaller (38). Being smaller is an indication of intra uterine growth restriction, a characteristic frequently observed in adolescents (15).

The study design and methodology has limitations, which could affect the findings and results. Since data collection was from labour ward health records, only existing set of variables that were pre collected during delivery could be used in the analysis. This limited the scope of the study, in that important confounders that contribute towards neonatal mortality could not be measured. Additionally, since neonatal mortality could only be captured within the first day instead of 30 days as per the definition (39) there was reduced comparability to other studies. Although, there were factors which could aid in predicting neonatal mortality according to existing literature, neonatal mortality after a month was not measured. Information bias could skew the results since inter rater reliability of nurses couldn't be deduced from routine existing data. This bias would deviate the results both ways in terms of the nurses' perception. Instrumental bias due to uncalibrated equipment would either over-estimate or under-estimate the findings reducing validity of the data.

Based on the results of this study, possible recommendations to hospital and health personnel in maternity wards in low-income settings could include:

1. Promotion of 4 ANC visits during the pregnancy through Community Health Workers to provide iron and folic acid pills to reduce anemia; Intermittent Preventive Treatment (IPT) for malaria; and physical measurements and information such as age, height, weight, hypertension and glucose.
2. Provision of nutrition counseling, if a woman is seen to be of a young age, with a low stature and low weight during the ANC visit.
3. Developing an adolescent safe space at the hospital to access and obtain contraceptives and other tests.
4. Identifying and targeting HIV positive women to access correct doses of treatment; counseling on nutrition to prevent mother to child transmission.
5. Provision of low cost special care units for LBW neonates to ensure adequate management and early intervention for possible complications to improve survival.
6. Access to corticosteroids for expecting mothers prior to delivery to increase newborn survival from lung prematurity.

Despite the limitations of a cross sectional study, the findings of this study may suggest underlying causal mechanisms associated with younger women in pregnancy. In order to validate the results of this study, further research on risk and causes of first day neonatal mortality at facilities is warranted. This would aide in understanding the high mortality rate and determining differences within the different levels of facilities. Furthermore, conducting this research would support the development of evidence-based interventions and guidelines focused to reduce maternal and neonatal morbidity and mortality at facilities.

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