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Original Research Article

Prevalence and neonatal outcomes of preterm born at Garissa county referral hospital, Kenya

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ABSTRACT

Background: Despite the significance of late preterm and early term neonates in neonatal health, comprehensive data on their prevalence, morbidity, mortality, and associated maternal sociodemographic and economic characteristics is grossly lacking in Garissa County, Kenya. This study aimed to determine the prevalence, morbidity, and mortality of late preterm (LPN) and early term neonates (ETN) born at Garissa County Referral Hospital (GCRH), relative to full-term neonates (FTN).

Methods: Singleton live neonates in the three groups were enrolled. Prevalence was computed as percentages of births in each category relative to total singleton live births during the study period. Ordinal logistic regression analysis was used to assess morbidity patterns, with statistical significance set at $p<0.05$. Mortality rates were presented as total deaths per 1,000 live births within the first 28 days.

Results: The LPN, ETN, and FTN had a prevalence of 8.47%, 11.86%, and 9.2%, respectively. Maternal age was significantly associated with gestational age ($p=0.014$; $\Phi c=0.263$), while other sociodemographic and economic characteristics were comparable across groups ($p>0.05$). LPNs had lower odds of respiratory distress diagnosis on day 1 compared to ETNs (OR=-1.68896; 95% CI: -3.012335 to -0.365593; $p=0.012$). Mortality rates were comparable among gestational age categories ($p=0.649$).

Conclusions: Overall, the study shows that LPN and ETN are considerably prevalent in Garissa County and that, only maternal age impacts on gestational age. Targeted interventions, particularly for younger mothers, should be implemented to mitigate associated risks and improve neonatal outcomes.

Keywords: Early term neonates, Full term neonates, Late preterm neonates, Morbidity pattern, Mortality, Prevalence

INTRODUCTION

The rising incidence of preterm birth is a global health concern, notwithstanding the disproportionate impact on low- and middle-income countries (LMIC) compared to developed countries.[1,2] Sub-Saharan Africa and Asia bear the brunt, accounting for over 80% of the global preterm birth burden.[2]

Within the categories of preterm births, late preterm neonates (LPNs)-defined as those born between 34-36 weeks of gestation-represent a significant proportion, constituting approximately 75% to 85% of all preterm births and 9.1% of all births globally.[2-4] These late preterm and early term (37-38 weeks of gestation) births present distinct challenges, including heightened risks for neonatal morbidity and mortality as well as neurocognitive complications.[5]

Although a considerable global attention has been given to LPNs, there is paucity of data on this group from developing countries.[2,4-6] This is, at least in part, due to inaccuracies in gestational age assessment, poor data collection, and under-reporting.[4] Moreover, most existing studies have been retrospective in nature, and have largely focused on comparisons with term neonates, often overlooking early term neonates (ETNs) as a separate category for analysis.

Both LPN and ETN have the potential to contribute to substantial deaths that occur during the neonatal period. However, currently there is general lack of information on their prevalence, morbidity pattern and mortality in Kenya, particularly Garissa County. Given the limited data, the goal of this study was to address this gap-in-knowledge. The study aims were to (i) determine the prevalence of late preterm and early term births relative to their full-term counterparts and their associated maternal sociodemographic and economic factors and, (ii) to assess the neonatal outcomes of late preterm and early term births at Garissa County Referral Hospital.

METHODS

Study design and setting

We adopted a longitudinal study design, whereby neonates were enrolled at birth and thereafter followed-up during the neonatal period (28 days). The study was conducted at GCRH, situated in Garissa Town, approximately 366 km from Nairobi, the capital city of Kenya. GCRH is the largest government-owned referral hospital in Northeastern Kenya, with specialized departments including obstetrics and gynecology. In addition to specialized care, it provides primary health care. It has a 224-bed capacity and serves as a referral facility for complex cases from lower-level health facilities in Garissa County as well as neighboring counties. Further, the hospital conducts over 30 percent of total deliveries that occur in Garissa County and has the largest newborn unit with a 33-bed capacity.

Study population

The study population comprised of all live born singleton late preterm (34-36 weeks), early term (37-38 weeks) and full-term (39-41 weeks) neonates delivered at the hospital during the study period.

Sample size

Sample size was computed based on the aim of comparing risk factors, neonatal outcomes (mortality and morbidity patterns) as well as identification of predictors of survival among LPNs, ETNs and Full Term Neonates (FTNs) using G* Power® (Faul et al), F-test ANOVA: Fixed effect, omnibus, one way: using prioiri analysis. Using the statistical power of 80% and 5% level of significance, and assuming 20% attrition, we arrived at an adjusted sample size of 64 neonates per group, yielding a total sample size of 192. Figure 1 show flow chart for recruitment and follow-up of study participants.

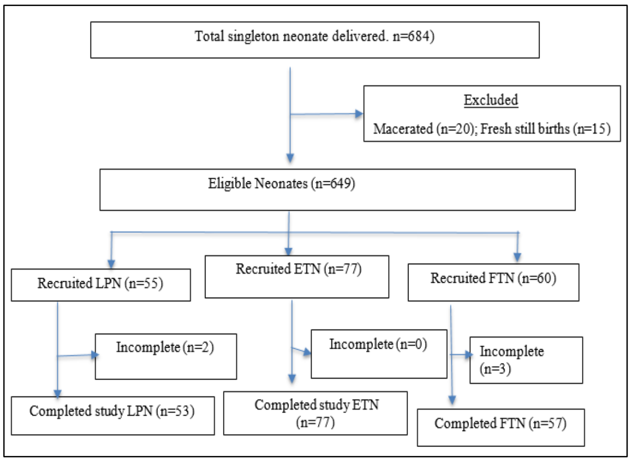

Figure 1: Flowchart for recruitment of study participants into different groups.

Recruitment study of subjects

Upon mothers/caregivers giving consent, the mother-neonate pair were consecutively enrolled into the study until the required sample size was achieved using convenience sampling method.

Inclusion criteria

The study included singleton live LPNs, ETNs, and FTNs born at Garissa County Referral Hospital during the study period, upon obtaining written informed consent from the mother or caregiver.

Exclusion criteria

Neonates were excluded if they exhibited major congenital anomalies or clinically identified chromosomal syndromes, if they were not born at the facility, or if they were part of twin or multiple pregnancies. Additionally, neonates were excluded if they died before the gestational age was assessed or if their mother or caregiver declined to give informed consent for participation. The rationale for excluding neonates from twin or multiple pregnancies and those with lethal congenital anomalies was based on existing literature indicating they have different morbidity and mortality risks.[7]

Data collection procedure

Two nurses M1 and N1 working at GCRH Maternity and Newborn Unit, respectively were recruited as research assistants, trained on research ethics, data collection protocols, and used to collect data from mothers/caregivers and hospital files of neonates who met the inclusion criteria. Mother-neonate pairs were identified at the maternity, postnatal and newborn unit within 24 hours post-delivery. Research assistants explained the purpose, objectives, benefits, and risk of the study to the mothers/caregivers of all neonates prior to enrollment into the study and sought their informed consent. Upon obtaining the consent, research assistants administered a pretested and validated structured questionnaire comprising of sociodemographic and economic characteristics, maternal and neonatal factors, including feeding, treatment and care practices, morbidity, and mortality. The research principal investigator (PI) supervised data collection. Data was collected between November 2022 and March 2023.

Data management and statistical analyses

Data was entered, cleaned, and analyzed using Statistical Package for Social Scientist (SPSS) version 27. Descriptive statistics, including means and standard deviations, were calculated for continuous variables, while frequencies and percentages were computed for categorical variables. The Chi-square test was used to assess the associations between categorical variables such as maternal age, marital status maternal age, marital status, type of marriage, living with spouse, religious affiliation, ethnicity, place of residence, educational level and employment status with gestational age. Statistical significance was determined at an alpha level of α=0.05 and P<0.05 was considered statistically significant. Cramér's Phi statistics were computed to quantify the strength of associations among the categorical variables maternal age and gestational age, which showed significant association at Chi-square. The criteria for strength of association were defined as follows: $\Phi \leq 0.2$ indicated a weak association, >0.2 $\Phi \leq 0.6$ indicated a moderate association, and Φ>0.6 indicated a strong association. The Shapiro-Wilk test was used to ascertain the normality of continuous variables. It revealed that maternal age across the three gestational age categories was not normally distributed. Accordingly, the non-parametric Kruskal-Wallis H test was utilized to test for significant differences in maternal age across these categories, with all assumptions for the test being satisfied. Post-hoc analysis was done using the Mann-Whitney U test to identify specific groups with significant differences. Prevalence was computed by dividing the total number of singleton live births in each gestational age category by the aggregate number of all singleton live births at the facility during the study period, multiplied by 100%. Ordinal logistic regression analysis was performed to assess morbidity pattern at five distinct time points during the neonatal period (Day 1, 3, 7, 14 and 28). The P-value was generated at α=0.05 and P<0.05 was considered statistically significant. Neonatal mortality rate for LPN, ETN and FTN are presented separately as total number of deaths in each group during the first 28 days of life, expressed per 1,000 live births.

RESULTS

Sociodemographic and economic characteristics of the study participants

Table 1 shows the association between maternal sociodemographic and economic characteristics and neonatal outcomes in Garissa Hospital. The parameters that were assessed included maternal age, marital status, type of marriage, living with spouse, religious affiliation, ethnicity, place of residence, educational level, and employment status. The study revealed that the proportion of mothers with LPNs, ETNs and FTNs differed across maternal age categories (P=0.044), however, the association was weak as depicted by Cramér's Phi (Φc =0.263). All other variables namely marital status, marriage type, living with spouse, maternal religion ethnicity, county of residence, maternal education, and occupation were comparable across the groups (P>0.05), suggesting that the study population was largely homogeneous across the gestational age groups.

Table 1: Association between maternal socio-demographic and economic characteristics and neonatal outcomes in Garissa hospital.

Characteristics	Study group			P value	Cramér's Phi; Φ_c
	LPN (n=53)	**ETN (n=77)**	**FTN (n=57)**		
Mean maternal age[a]	24.83 (6.107)	25.74 (6.086)	24.65 (4.522)		
Maternal age (years)					
15-19; N (%)	12 (22.6)	10 (12.9)	4 (7.0)	0.044[b]	0.263*
20-29; N (%)	27 (50.9)	44 (57.1)	45 (78.9)		
30-39; N (%)	13 (24.5)	22 (28.6)	8 (14.0)		
>40; N (%)	1 (1.9)	1 (1.3)	0 (0)		
Marital status					
Single; N (%)	7 (13.2)	7 (9.1)	4 (7.0)	0.613[b]	
Married; N (%)	46 (86.8)	69 (89.6)	53 (93.0)		
Divorced; N (%)	0 (0)	1 (1.3)	0 (0)		
Marriage type					
Monogamous; N (%)	39 (73.6)	63 (81.8)	50 (87.7)	0.428[b]	
Polygamous; N (%)	7 (13.2)	6 (7.8)	3 (5.3)		

Continued.

Characteristics	Study group			P value	Cramér's Phi; Φ_c
	LPN (n=53)	ETN (n=77)	FTN (n=57)		
Live with spouse					
Yes; N (%)	46 (86.8)	68 (88.3)	52 (91.2)		
No; N (%)	0 (0)	1 (1.3)	1 (1.8)	0.743[b]	
Not married; N (%)	7 (13.2)	8 (10.4)	4 (7.0)		
Maternal religion					
Muslim; N (%)	36 (67.9)	47 (61.0)	40 (70.2)		
Catholic; N (%)	4 (7.5)	3 (3.9)	1 (1.8)	0.416[b]	
Protestant; N (%)	13 (24.5)	27 (35.1)	16 (28.1)		
Ethnicity					
Kenyan Somali; N (%)	35 (66.0)	41 (53.2)	34 (59.6)		
Kamba; N (%)	9 (16.9)	21 (27.3)	12 (21.1)		
Kikuyu; N (%)	1 (1.9)	3 (3.9)	0 (0)		
Meru; N (%)	2 (3.8)	2 (2.6)	1 (1.8)	0.675[b]	
Luo; N (%)	1 (1.9)	1 (1.3)	3 (5.3)		
Malakote/Munyoyaya; N (%)	1 (1.9)	5 (6.5)	4 (7.0)		
Others; N (%)	4 (7.5)	4 (5.2)	3 (5.3)		
County of residence					
Garissa; N (%)	41 (77.4)	55 (71.4)	43 (75.4)	0.729[b]	
Other; N (%)	12 (22.6)	22 (28.6)	14 (24.6)		
Maternal education					
None; N (%)	26 (49.1)	34 (44.2)	23 (40.1)		
Lower primary; N (%)	1 (1.9)	2 (2.6)	1 (1.8)		
Upper primary; N (%)	9 (16.9)	27 (35.1)	14 (24.6)	0.406[b]	
Secondary; N (%)	14 (26.4)	11 (14.3)	15 (26.3)		
Post-secondary; N (%)	3 (5.7)	3 (3.9)	4 (7.0)		
Maternal occupation					
Domestic (unpaid); N (%)	47 (88.7)	65 (84.4)	47 (82.5)		
Permanent employment; N (%)	1 (1.9)	1 (1.3)	0 (0)		
Temporary employment; N (%)	1 (1.9)	3 (3.9)	2 (3.5)	0.769[b]	
Self-employment; N (%)	2 (3.8)	5 (6.5)	7 (12.3)		
Others; N (%)	2 (3.8)	3 (3.9)	1 (1.8)		

Data presented as n (%) or mean (std error of mean) as stated. [b]Statistical significance determined by Pearson Chi-Square tests *Cramér's Phi statistics (Φc) was used to determine strength of associations among categorical variable (maternal age) that showed significant associations at chi-square

Prevalence of late preterm, early term and full-term neonates

The prevalence rates are shown in Figure 2. The prevalence of live-birth singleton LPN was 8.47%, while that for ETN and FTN stood at 11.86% and 9.2%, respectively.

Morbidity pattern

Results of morbidity pattern are presented in Table 2. The study revealed that diagnosis of respiratory distress on day 1 was negatively associated with LPN (OR= -1.68896; 95% CI: -3.012335 to -0.365593; *P=0.012*). Intriguingly, LPNs had reduced odd of being diagnosed with respiratory distress on day 1 compared to ETN. However, for FTN, the association was not significant (OR = -0.32472; 95% CI: -1.844853 to 1.195406; p=0.675).

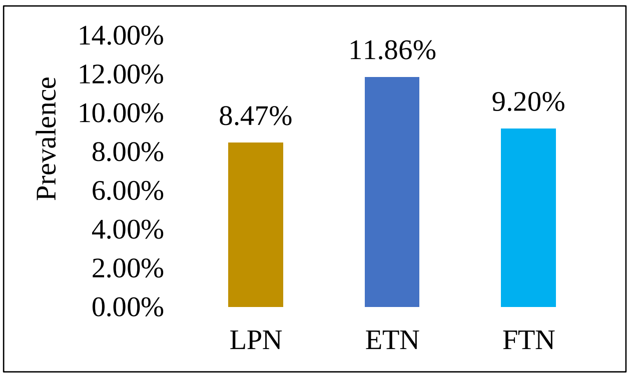

Figure 2: Prevalence rates for LPN, ETN and FTN born at Garissa County Referral Hospital.

Apart from respiratory distress on day 1, the odds of being diagnosed with other conditions were non-significant, suggesting that the incidence of these conditions among the three neonatal groups were not different.

Besides hypothermia, perinatal asphyxia, respiratory distress, jaundice and sepsis, morbidity patterns for other conditions were omitted from the analysis because of collinearity.

Mortality

Table 3 shows results for mortality. Mortality was minimal with no statistically significant difference among the three neonatal age categories (*P*=0.649). When expressed per 1,000 live births, LPN, ETN and FTN had neonatal mortality rate of 0, 13.6 and 17.86, respectively. These results thus suggest that gestational age does not have significant influence on immediate mortality rates in the Garissa context.

Table 2: Morbidity patterns associated with LPN, ETN and FTN.

	OR	Std. error	Z	P value	(95% CI)		OR	Std. error	Z	P value	[95% CI]	
	LPN						FTN					
Hypothermia day 1	-10.5485	913.6469	-0.01	0.991	-1801.264	1780.167	1.783678	1397.396	0	0.999	-2737.062	2740.63
Perinatal asphyxia day1	0.465533	0.870846	0.53	0.593	-1.241293	2.172358	-0.78043	0.906122	-0.86	0.389	-2.5564	0.995533
Respiratory distress day 1	-1.68896	0.675202	-2.5	0.012	-3.012335	-0.365593	-0.32472	0.77559	-0.42	0.675	-1.844853	1.195406
Respiratory distress day 3	-0.72846	0.96817	-0.75	0.452	-2.626037	1.16912	-0.92122	0.996111	-0.92	0.355	-2.873564	1.03112
Jaundice day 3	-1.53997	0.978105	-1.57	0.115	-3.457024	0.3770753	-0.71823	1.085101	-0.66	0.508	-2.844991	1.408527
Jaundice day 7	0.132218	1.136174	0.12	0.907	-2.094642	2.359078	1.263218	1.428096	0.88	0.376	-1.535798	4.062234
Sepsis day 1	-14.5059	913.6459	-0.02	0.987	-1805.219	1776.207	-0.1805	1397.395	0	1	-2739.025	2738.664
Reference outcome=ETN												

CI= Confidence Interval; Log likelihood = -184.04233, LR $chi^2(14)$ = 31.70, Prob > chi^2=0.0044, Pseudo R2=0.0793
Ordered logistic regression between outcome variable (LPN, FTN and ETN) and morbidities at different time points within neonatal period

Table 3: Comparison of neonatal outcomes among LPN, ETN and FTN.

Neonatal outcome	Gestational age categories			P value
	LPN (n=53)	**ETN (n=77)**	**FTN (n=57)**	
Alive; N (%)	53 (28.3)	76 (40.6)	56 (29.9)	0.649
Died; N (%)	0 (0.0)	1 (1.5)	1 (1.5)	

Data presented as n (%). Statistical significance determined by Pearson Chi-Square tests

DISCUSSION

To the best of our knowledge, this is the first study to report the prevalence of three distinct categories of neonates namely: late preterm, early term and full-term neonates in Kenya. Notably, the prevalence of LPN in the present study is higher than those that have typically reported in high-income countries.[6,8,9] However, it is consistent with a study by McIntire and colleague.[10] On the other hand, the prevalence for ETN is lower than what has been reported in previous studies.[6,8,9] Further, the findings differ from the global pattern that show that ETN births outnumber LPN birth by approximately five times.[6,9] These observed disparities could partly be attributed to the potential differences in maternal and neonatal care, socioeconomic factors, healthcare policies and infrastructure in different contexts. Additionally, they depict the heterogeneity in birth outcomes across the different geographical regions. For instance, Brazil and China which falls within LMIC have reported high rates for ETN births.[11,12] Nonetheless, given the paucity of data/information on the prevalence of LPN and ETN in LMIC, more so in the sub-Saharan Africa, this study makes an important contribution to the existing literature.

Evidence from past studies show that trends in LPN and ETN births vary across countries and regions largely influenced by the health care policies, interventions, and practices. For instance, between 2007 and 2015 a decline in LPN births was reported in the USA.[13] This decline was partly attributed a decrease in indicated preterm deliveries.[13] On the other hand, some countries in Europe reported a stable or reduction in preterm birth rates.[6] Similarly, disparities have been observed in ETN birth rates across developed countries between 2006 and 2014. Countries such as Denmark, Sweden, Norway, and the USA recorded a reduction, while it remained stable in Canada and Finland.[9] These differences bring to the fore the potential influence of healthcare policies, practices, and strategies on birth outcomes.

In terms of sociodemographic and economic characteristic, a significant association between maternal age categories and gestational age, supported by a moderate Cramér's Phi was observed in the present study. Mothers aged between 20-29 years had a high likelihood of giving birth to FTN compared to LPN and ETN, which is consistent with findings from previous studies that have linked extremes of maternal age (younger <20 years or older >31 years) to increased risk of LPN birth.[14,15] Contrary to the study not finding significant association between older mothers and gestational age, several studies have reported that advanced maternal age (≥31 years) is significant risk factor for delivery of preterm.[16,17] Younger mothers aged <20 years were more likely to give birth to LPN, corroborating findings from previous studies.[15,18] This increased risk could largely be attributed to biological immaturity and lower socioeconomic status, as such interventions focusing on this age group could be particularly beneficial.[19]

Apart from maternal age, all other sociodemographic and economic parameters that were investigated did not show significant relationship with gestational age, a finding which is not consistent with previous results and align, thereby highlighting the contextual nature of such relationships.[20-22]

In terms of morbidity, surprisingly LPNs had decreased odds of being diagnosed with respiratory distress on day 1 compared to their ETN counterparts, a finding which is contrary to evidence from previous studies which have reported that LPNs are more susceptible to respiratory distress than their term counterparts.[15,23] Similarly, the study did not find significant differences in the morbidity pattern of hypothermia, perinatal asphyxia, sepsis, and jaundice among LPN, ETN and FTN, contrary to previous studies. In the past, several studies have reported that LPNs have higher risk of jaundice and to be readmitted for jaundice and non-jaundice related complications compared to their term counterparts.[24-26] Moreover, numerous studies have reported that LPNs have higher likelihood of being diagnosed with perinatal asphyxia, temperature instability, apnea and sepsis compared to their term counterparts.[10,15] The observed discrepancy between the findings of the current and past studies could partly be attributed to study design, sample size, geographical and health care practices in the context of Garissa. For instance, Wang and colleagues conducted electronic medical record database sorting of 7, 474 neonatal records and subset analyses of near-term (n=120) and full-term (n=125) neonatal records.[25] In their study, they did not define the cut-off points for near- term and full-term neonates in terms of weeks of GA, but they found that near-term infants had more medical problems and increased hospital costs compared to their full-term counterparts.

Regarding neonatal mortality, the study did not find significant differences across the three gestational age categories. A finding that stands in stark contrast to available evidence from existing literature, that show that LPNs have higher risk for both short-term and long-term mortality compared to their term counterparts.[27,28] A study investigating the gestational age-specific infant mortality rates in the United States from 2000 to 2013 found that neonates born in late preterm period had approximately four times higher mortality rate, while those born in the early term period had approximately 50% mortality compared their full-term counterparts.[29] Our results suggest that while gestational age is an important factor, it is not the only factor that influences neonatal mortality rates.

While the study provides valuable insights into the prevalence, morbidity pattern and mortality, particularly in the context of Kenya, it had some limitations. The focus on a single county referral hospital may not make the results universally applicable. Additionally, the study's design only involved observational measures without any interventions. The convenience sampling method used can introduce biases, and gestational age estimation based on the last menstrual period can sometimes be inaccurate, as it is prone to error in maternal recall.[5] Lastly, the calculation of preterm birth estimates was based on livebirths as recommended by WHO which excluded still births.[30]

CONCLUSION

Late preterm and early term births are considerably prevalent in Garissa County Referral Hospital. Of the sociodemographic and economic factors assessed, only maternal age showed a significant association with gestational age, highlighting the need for targeted interventions, particularly for younger mothers. Additionally, the findings revealed the intricate relationship between gestational age categories and specific neonatal morbidity outcomes, thereby providing critical insights for healthcare interventions and future research. Public health interventions in Garissa County should prioritize younger mothers, providing them with comprehensive care and support to reduce the risks of late preterm births. Future research should aim to validate these results in a broader geographical context.

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