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ORIGINAL ARTICLE

PREVALENCE AND RISK FACTORS OF NEONATAL STUNTING AMONG NEONATES AT TIKUR ANBESSA SPECIALIZED HOSPITAL

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ABSTRACT

Introduction: *Stunting is widely used to assess nutritional status of children but not in neonates. Neonates with fetal growth restriction are at risk of being stunted at 24 months and development of non-communicable diseases during adulthood. Under-nutrition during the first 1000 days post conception cause wasting of human potentials. The objectives of this study were to determine the prevalence and associated risk factors for neonatal stunting.*
Methods: *A cross-sectional study was conducted on newborns at Tikur Anbessa Hospital from July - August 2018. Exposures were maternal socio-demographic characteristics, behavioral risk factors, and medical illnesses during pregnancy. Main outcomes were stunting defined as birth length for sex and gestational age below 3rd centiles of the INTERGROWTH-21st standard and admission to neonatal intensive care unit.*
Results: *The study included 392 singleton live births with reliable gestational age by first trimester ultrasound, last menstrual period, and Ballard scores. Stunting affected 15.1% of all newborns. In bivariate analysis, maternal socio-economic, and obstetric variables were not risk factors for stunting in a neonate, except use of biofuel for cooking ($p \leq 0.049$ 95% CI 0.586, 1.956) and parity ($p \leq 0.011$, 95% CI 1.181, 3.837). Though birth weight and birth weight for gestational age were significant factors, on multiple regression analysis only low birth weight was found to be significant determinant of neonatal stunting.*
Conclusions: *The first 1000 days post-conception is an important period to overcome intergenerational malnutrition. Prevalence of newborn stunting is high in the setting and birth weight determined stunting at birth. Further study is recommended to determine the risk factors for stunting at birth.*
Key words: *Newborn, stunting, prevalence, risk factors,*

INTRODUCTION

Undernutrition is a major public health problem that increases the global health burden of premature mortality and morbidities during childhood. According to a UNICEF report, in 2018, stunting was found to be most widespread affecting an estimated 149 million children worldwide; more than half of all stunted children under-5 more than one third lived in Africa (1). It is estimated that 45% of all deaths in children under-5 years of age are linked to malnutrition (2).

The World Health Assembly calls for 40% reduction in the prevalence of stunting in under-5 children by the year 2025 from the baseline of 2010. This implies reducing the number of stunted children from 171 million to about 100 million in 2025 (3). The national prevalence of under-five stunting is 38.4%, which is greater than the developing country average of 25% (4).

Stunting is intergenerational problem that passes on from the mother to children. Neonates with fetal growth restriction are at substantially increased risk of being stunted at 24 months and of development of some type of non-communicable diseases during adulthood (2).

Prevalence of stunting is the conventional anthropometric measure that reflects long-term chronic under-nutrition, multifactorial social deprivation, and a long-term response to the prolonged deprivation of food and/or presence of disease. Early detection of neonates who are stunted is important to take appropriate interventions at individual family level and policy making for country at large. Although stunting and its complication are rampant in developing countries, there is paucity of data on the extent of the problem in neonates. This study attempted to determine the prevalence and risk factors associated with neonatal stunting among neonates born at Tikur Anbessa Specialized Hospital.

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MATERIALS AND METHODS

Study setting

The study was conducted in obstetric department of Tikur Anbessa Specialized Hospital (TASH) in Addis Ababa, Ethiopia. TASH is the largest referral hospital in Ethiopia with several specialties and sub-specialties. It has 800 beds capacity and serves over 300,000 patients as outpatients annually. The number of average deliveries per month is about 500 deliveries.

Study design

It is an institution based cross-sectional study conducted among neonates delivered between July and August 2018.

Study population

All neonates born during the study period at TASH were taken as source population. The study participants were all singleton live birth neonates in TASH. Neonates with following conditions were excluded from the study: all preterm less than 33 weeks, post term neonates greater than 42 weeks plus 6 days, multiple deliveries, neonates requiring urgent resuscitation and admission, and those with recognizable congenital anomalies. All neonates born to TASH during the study period were included in the study using continuous sampling.

Sample size determination

Because proportion was studied, single population proportion formula was used to calculate sample size**.**

$$N = \frac{(Z\alpha/2)^2 PQ}{E^2}$$

Because the prevalence of neonatal stunting in neonates in hospital deliveries is not known, we used P=50%, Q=50%, Z=1.96, and E=5%. Using the above formula, the sample size was 384. The final sample size was 422 after adding 10% for non-respondents.

Data collection and analysis

Gestational age was determined based on order of priority.

1) Early ultrasound before 20 weeks of gestation
2) Calculated from stated last menstrual period (LMP)
3) Estimated by Ballard's score

If the mother had early obstetric ultrasound, we took it to calculate the gestational age. If the mother didn't have early ultrasound, stated LMP was used to calculate gestational age (GA). If both are not available Ballard score was used to estimate GA. The GA was stated in weeks and days as appropriate.

Socio-demographic and clinical data were collected soon after delivery by trained data collectors. The supine newborns length was measured using Infantometer and length was recorded by centimeter with one decimal. The length was measured as early as possible after delivery within 12 hours of delivery. The length was standardized using INTERGROWTH-21st tables for gestational age and sex (5). Neonates lying below the third centile were classified as having neonatal stunting (6). The newborn weight and head circumference were also measured and standardized.

During the data collection, regular and periodic supervision was made to assure data quality and completeness.

Data analysis

After data entry and cleaning, analysis was done using the Statistical Package for Social Sciences (SPSS) version 20.0. Descriptive and analytical statistics were used as applicable. Statistically significant association was taken for *p* values <0.05. Independent variables included maternal socio-demographic data, obstetric and fetal factors. Significant factors in the bivariate analysis were subjected to multiple logistic regression analysis.

Ethical considerations

Ethical clearance was obtained from the Pediatrics and Child Health Department's Research and Publications Committee of the School of Medicine, College of Health Sciences, and Addis Ababa University. The clearance letter was submitted to obstetric department for approval. Verbal consent was obtained from parents.

RESULTS

There were a total of 422 newborns with gestational age between 33 weeks and 42 weeks and 6 days. There were 30 twin deliveries which were excluded from analysis making 392 singleton newborns as the study population.

The mean maternal age was 26.51 (SD 4.65) years, 96.41% were married and 174 (44.50%) were housewives both of which had no association with stunting. Maternal educational status, occupation and house ownership were not associated with neonatal stunting (table 1). Biofuel use as source of cooking energy was found to be significant factor for stunting ($p \leq 0.049$, 95% CI 0.59, 1.96).

Gestational age ascertainment was made using early obstetric ultrasound in 284 (72.4%) newborns, LMP in 99 (25.3%) newborns and Ballard score was used on 9 (2.3%) of newborns.

There were 190 (48.5%) male and 202 (51.5%) female newborns. Preterm newborns accounted for 43 (11.1%) while 300 (77.7 %) and 43 (11.1%) were term and post-term newborns respectively. Majority, 205 (52.3%), of the mothers were primiparous followed by multiparous 177 (45.2%) and 10 (2.6%) grand multiparous (Table 1).

The mean birth weight was 3224.04 (SD 541.2) grams and mean length was 47 (SD 2.52) centimeters. Newborn classification by birth weight showed that 331 (84.4%) were normal birth weight (NBW), 9.2% low birth weight (LBW), 6.1% macrosomic and 0.3% very low birth weight (VLBW). Majority of the newborns, 347 (88.5%), were appropriate for gestational age (AGA), 26 (6.6%) large for gestational age (LGA) and 19(4.8 %) were small for gestational age (SGA) (Table 2).

Table 1: Distribution of subjects by neonatal

Classification	Number	Percent
Classification by gestational age		
Preterm	43	11.1
Term	300	77.7
Post term	43	11.1
Total	392	100.0
Classification by birth weight		
VLBW	1	0.3
LBW	36	9.2
NBW	331	84.4
Macrosomic	24	6.1
Total	392	100.0
Classification by birth weight and gestational age		
SGA	19	4.8
AGA	347	88.5
LGA	26	6.6
Total	392	100.0

VLBW=Very low birth weight. LBW = Low birth weight. NBW = normal birth weight classification

Table 2: Parental socio-economic characteristics among study neonates

Variables	Number Births	Stunted	Not Stunted	OR (95% CI)	P Value
Maternal age (Years)					
<30	300	50	250	1.848 (0.848, 3.821)	2.396
≥ 30	90	9	81		
Maternal height (cms)					
<150	20	6	14	2.571 (0.946,6.993)	0.056
≥150-159	364	52	312		
Paternal Height (cms)					0.101
<170	176	20	156	0.612 (0.339, 1.105)	
≥170	202	35	167		
Marital status					
Married	377	57	320	1.069 (0.233, 4.902)	0.932
Not married	14	2	12		
Maternal education					
No formal education	86	15	71	1.253 (0.659, 2.389)	0.490
Formal education	305	44	261		
Maternal occupation					
Housewife	174	22	152	0.696 (0.394, 1.232)	0.212
Working	215	37	178		
Home ownership					
Self owned	55	5	50	0.522 (0.199, 1.370)	0.186
Not own	336	54	282		
Cooking fuel					
Charcoal/wood	114	18	96	1.070 (0.586, 1.956)	0.049
Gas/electricity	275	41	234		

VLBW=Very low birth weight. LBW = Low birth weight. NBW = normal birth weight
SGA= small for gestational age. AGA= Appropriate for gestational age. LGA = large for gestational age

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Parental demographic and health related factors including height, maternal age, parity, inter-pregnancy interval, pregnancy induced hypertension and anemia during pregnancy did not show significant association with stunting. Only 49 (12.5%) of the mother had medical conditions.

Of these, 33 (8.4%) had pregnancy induced hypertension (PIH); among the the rest, five (1.3%) maternal diabetes, three (0.8%) cardiac illnesses, two (0.5%) HIV/AIDS, three (0.8%) thyrotoxicosis, and three (0.8%) had other diseases. Anemia in pregnancy and iron supplementation did not show significant relation with stunting (table 2, 3).

More than two-third (68.4%) of newborns who were SGA were stunted compared to only 12.4% of AGA and LGA. Newborns born to primiparous mothers were twice more affected than multiparous mothers 19.4 % against 10.2% ($p \leq 0.011$, 95% CI 1.181, 3.837) (table 3). Prevalence of newborn stunting was 21.2% among mothers with PIH compared to 14.8% among mothers without PIH ($p=0.304$).

Infant sex and gestational age did not show significant relation with stunting; however, weight for gestational age and LBW were found to be significant factors for stunting in bivariate analysis (table 3). However, on multiple logistic regressions, only LBW was found to be a predictor of stunting in newborns at birth ($p\leq 0.001$, 95% CI 0.027,0.194).

Table 3: Maternal obstetric and fetal factors for stunting among neonates at birth

Variables	No. births	Stunted	Not Stunted	OR (95%CI)	P value
Maternal PIH					
Yes	33	7	26	1.584 (0.654, 3.838)	0.304
No	358	52	306		
Parity					
Primiparous	201	39	162	2.129 (1.81,3.837)	0.011
Multi/grand multiparous	187	19	168		
Inter-pregnancy interval					
<24 months	51	6	45	1.125 (0.415, 3.049)	0.817
≥24months	151	16	135		
Gestational age					
Preterm	43	9	34	1.546 (0.699, 3.419)	0.279
Term/Post-term	342	50	292		
Birth weight for GA					
SGA	19	13	6	15.365 (5.562, 42.387)	0.000
AGA/LGA	372	46	326		
Maternal hemoglobin (gm/dl)					0.406
<11	18	4	14	1.621 (0.513, 5.117)	
≥11	347	52	295		
Iron supplementation					
< 3 months	269	34	235	0.689 (0.365, 1.300)	0.249
> 3 months	98	17	81		
Sex of neonate					
Male	188	32	156	1.337 (0.767, 2.331)	0.304
Female	203	27	176		
Birth weight					
LBW	37	24	13	16.826 (7.87, 35.97)	0.000
Not LBW	354	35	319		

Although multiple pregnancies were excluded from final analysis, the 30 twin deliveries during the study period were analyzed. Using the same curves for the 30 twins, 15 (50%) were stunted; more than 5.6-fold risk of being stunted as compared to singletons where the rate of stunting was 15% (OR was 5.64, 95%CI 2.52-12.15) *P value <0.01* (table 4).

Table 4: Comparison of prevalence of stunting singleton and twin deliveries at birth

Deliveries	Total number	Stunted	Not stunted	OR (95%CI)	P value
Singleton	392	59	333	1 (Reference)	<0.01
Twin	30	15	15	5.64 (2.62-12.15)	

DISCUSSIONS

Recent estimates suggest that stunting, wasting, and intrauterine growth restriction are responsible for 2.2 million deaths and 21% of disability-adjusted life years lost among children younger than 5 years (7). Until recently, the idea that newborns also get stunted was non-existent.

Stunting is a cumulative process, often apparent by birth but worsening until around the age of 2 years when growth becomes canalized (8). It was noted by an earlier study that height-for-age at 2 years was the best predictor of human capital and that undernutrition is associated with lower human capital (9). In this study, it has been attempted to determine the extent of stunting of neonates at birth and its determinants.

There are few data on the extent of stunting at birth; most of the studies focused on under-five children. Recently, a study on newborn stunting at birth was published from Gondar, Ethiopia (9). However, the Gondar study used 10th percentile as a cut-off for defining stunting as opposed to 3rd centile in this study.
In this study, the prevalence of stunting was higher than the finding in a previous study where multinational study from eight centers in the world found prevalence of stunting of 3.8% (6) and 6.5% in Brazil using the INTERGROWTH-21st and BRISA chart (11). This may be expected because the previous study was done among high, middle, and low income countries to develop the centile curves for newborn standardization.

On the other hand, the prevalence of stunting at birth is lower than the 30% of Gondar study (10) which is probably due to the difference in the cut-off for stunting and that of study in Guatemala which was 33% (12). The difference from the Guatemalan study is that it included all infants up to 6 weeks of age and also used a different criterion. Even though it is smaller than the two studies mentioned above, the high rate in Ethiopia, Addis Ababa is very much concerning to address as it might lead to huge economic and social burden on an already deprived society.

A number of maternal, fetal, and placental factors are known to affect the growth of the fetus. In this study, none of the socioeconomic factors significantly affected stunting in a neonate at birth. Earlier, it was shown that socioeconomic factors (income, education, and occupation) appeared to be of little importance as determinants of growth (13). In this study, biofuel use for cooking has been found a significant factor for stunting at birth.

In developing countries, most mothers depend on biofuel especially in rural settings. Indoor air pollution from solid fuel use is a confirmed risk factor for acute lower respiratory tract infections, especially in children in developing countries (14). Earlier studies have found association of biofuel pollution to affect birth outcomes (15,16) but not in the Gondar study (10). This study has shown that biofuels are harmful to the fetus as well.

In this study, maternal factors such as stature and age were not identified as factors for stunting. Other studies found that short maternal stature and young age affects length (6,10) and it is an important determinant of intrauterine growth restriction and low birth weight, especially in developing countries (17). In a study that examined the association between maternal stature and offspring mortality, underweight, stunting, and wasting in infancy and early childhood in 54 low- to middle-income countries a 1-cm increase in height was associated with a decreased risk in stunting (RR,0.968;95%CI,0.967-0.968) (18). This discordance with our results requires further study for further interventions to curb the intergenerational malnutrition.

This study has attempted to identify fetal factors associated with stunting. Sex of the neonate does not seem to affect stunting in newborns similar to what has been found earlier in among under-five children. However, study from Gondar found that males were more at risk of stunting at birth than females (10).

At the moment from these studies, no apparent reason for discordance in the report and the sex as a risk factor. Weight for gestational age and birth weight were found to be associated factors in bivariate analysis but when subjected to multiple logistic regression, only low birth weight was found as significant risk factor (95% CI 0.027, 0.194) in concordance to the Gondar study (10).

The strength of the study is that it used recently developed standards for fetal growth restriction to explain fetal growth restriction beyond sole reliance on birth weight. In addition, it is among few studies that determined stunting at birth. Possible limitation of the study is that included hospital deliveries where most maternal illness were few especially chronic diseases which might affect fetal growth.

In conclusion, prevalence of newborn stunting was 15.1% in neonates born at Tikur Anbessa Specialized Hospital. We recommend to measure length at birth and standardize the length using newborn growth standards to identify the stunted newborns to deliver appropriate health interventions to halt the long-term consequences of newborn stunting.

Furthermore, identification of the risk factors for stunting at birth is required with a larger sample size. To avert the high rate of stunting, there is a need for prenatal and early-life interventions to prevent the growth failure that mainly happens during the first 2 years of life, including the promotion of appropriate infant feeding practices as it has been proposed (19).

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Conflict of interest
None

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