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Original Research Article

Effect of maternal height on neonatal outcomes in tertiary care hospital: a retrospective study

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ABSTRACT

Background: Global or regional evidence showed maternal height as a strong predictor of child survival. However, there is limited information that confirms the intergenerational effect of short maternal height on the risk of offspring mortality in Bangladesh. Therefore, this study aimed to examine the association of maternal height with neonatal morbidity and outcome.
Methods: In this analysis authors took data of 100 women who delivered in Kempegowda Hospital in the year 2018 including anthropometry of the mother at admission, anthropometry of the newborn, NICU admissions. Neonatal outcome was assessed by birth weight, anthropometry and NICU admissions against maternal stature which was stratified into 4 groups.
Results: Comparison of mean birth weight, head circumference and length showed significant relation with maternal height ($p<0.001$).
Conclusions: Findings should draw the attention of the programme and policymakers to focus on improving maternal nutrition for better offspring nutrition, health and survival.

Keywords: Maternal stature, Neonatal outcome

INTRODUCTION

Globally, there has been substantial progress in child survival in the last two decades. Despite such advances, disparities exist in neonatal, infant and under-five mortality across regions and countries. More than 80% of global under-five deaths occur in South Asia and sub-Saharan Africa.[1] Maternal and child undernutrition are important underlying causes of neonatal and under-five mortality. Prior research revealed that nearly 45% of all under-five deaths were attributable to fetal growth retardation, stunting, wasting, vitamin A and zinc deficiencies and suboptimal breast feeding in low-income and middle-income countries (LMICs) in 2011.[2] However, more than 1 in 10 of these under-five deaths was caused by fetal growth retardation (FGR) that is associated with maternal undernutrition and short stature.[2] In LMICs, short maternal stature is associated with about 6.5 million term or preterm, small-for-gestational age (SGA) births, caused by FGR annually.[3]

Recently, two large studies that pooled data showed maternal height as a strong predictor of under-five mortality in LMICs.[4,5] One of these studies showed that reductions in maternal height from the average of 155cm gradually increased the risk of under-five mortality.[4] Another study showed that children of mothers with short stature (<145 cm) had about 1.6 times higher risk of neonatal mortality and nearly 1.4 times higher risk of under-five mortality compared with those with taller mothers (≥160 cm).[5] Recently, a few studies have assessed the determinants of child morbidity mortality

but none of these studies considered to measure the association between maternal height and risk of mortality among neonates, infants and under-five children.[6,7]

METHODS

In this analysis we took data of 100 women who delivered in Kemoegowda Hospital in the year 2018 including anthropometry of the mother at admission, anthropometry of the newborn, NICU admissions.

Inclusion criteria

Included mothers aged 21 to 42 years, delivered in Kempegowda Hospital in the year 2018, single gestation.

Exclusion criteria

If any co morbid conditions in mothers like Diabetes Mellitus or hypertension or Epilepsy that could significantly alter the neonatal outcome, multiple gestation.

Neonatal outcome was assessed by birth weight, anthropometry and NICU admissions against maternal stature which was stratified into 4 groups.

RESULTS

100 singleton live births delivered in Kempegowda Hospital in 2018 were included in this study. Statistical software SPSS 18.0 and R environment version 3.2.2 were used for analysis.

Table 1: Comparison of neonatal and maternal variables according to NICU admission.

Variables	NICU admission		Total	p value
	No	Yes		
Age of Days	3.53±1.10	3.43±1.03	3.49±1.07	0.622
Maternal age	26.55±3.88	27.48±3.19	26.92±3.63	0.213
Maternal Weight (kg)	64.20±7.02	56.30±6.06	61.04±7.68	<0.001**
Maternal Height (cm)	154.42±5.03	148.83±5.01	152.18±5.71	<0.001**
Birth Weight (kg)	2.95±0.26	2.60±0.20	2.81±0.29	<0.001**
Head Circumference	33.72±0.67	33.05±0.64	33.45±0.73	<0.001**
Length	50.28±1.84	48.28±1.63	49.48±2.01	<0.001**

Table 2: Pearson correlation.

	r value	p value
Maternal Height (cm) vs Birth Weight (kg)	0.721	<0.001**
Maternal Height (cm) vs Head Circumference	0.625	<0.001**
Maternal Height (cm) vs Length	0.611	<0.001**

In this study, neonates aged 2 to 5 days were evaluated. In our study, NICU admissions were more in those neonates born to mothers of shorter stature and weight (p<0.001) (Table 1).

Table 3: Pearson correlation.

	r value	p value
Maternal weight (kg)vs Birth Weight (kg)	0.841	<0.001**
Maternal weight (kg) vs Head Circumference	0.714	<0.001**
Maternal weight (kg) vs Length	0.732	<0.001**

Pearson correlation done between maternal height and weight against neonatal birth weight, length and head circumference showed significant relation (p<0.001) (Table 2, 3). Comparison of mean birth weight, head circumference and length showed significant relation with maternal height (p<0.001) (Table 4,5).

DISCUSSION

The findings of this study are important because they provide evidence for child survival programmes and policies of the need to focus on maternal undernutrition as an underlying cause of child morbidity. Our study showed maternal height was a strong predictor of neonatal outcome and in turn infant and under five morbidity and mortality. A large national survey (NFHS, 2005-2006) in India reported that each centimeter increase of maternal height was inversely associated with under-five mortality (RR=0.978, 95% CI 0.970 to 0.987).[8] Our study showed maternal height was a strong predictor of neonatal outcome and in turn infant and under five morbidity and mortality. A large national survey (NFHS, 2005-2006) in India.

Table 4: Comparison of birth weight, head circumference and length according to maternal height.

Variables	Maternal height (cm)				Total (n=100)	p value
	<147cm (n=26)	147-152cm (n=23)	152-158cm (n=25)	>158cm (n=26)		
Birth Weight (kg)						
<2.5	9(34.6%)	0(0%)	1(4%)	0(0%)	10(10%)	<0.001**
2.5-3.5	17(65.4%)	23(100%)	24(96%)	26(100%)	90(90%)	
>3.5	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	
Head Circumference						
<33	7(26.9%)	3(13%)	1(4%)	0(0%)	11(11%)	<0.001**
33-34	19(73.1%)	19(82.6%)	20(80%)	17(65.4%)	75(75%)	
>34	0(0%)	1(4.3%)	4(16%)	9(34.6%)	14(14%)	
Length						
<48	11(42.3%)	6(26.1%)	4(16%)	1(3.8%)	22(22%)	0.002**
48-52	15(57.7%)	16(69.6%)	20(80%)	19(73.1%)	70(70%)	
>52	0(0%)	1(4.3%)	1(4%)	6(23.1%)	8(8%)	
NICU Admission						
No	6(23.1%)	14(60.9%)	17(68%)	23(88.5%)	60(60%)	<0.001**
Yes	20(76.9%)	9(39.1%)	8(32%)	3(11.5%)	40(40%)	

Chi-Square/Fisher Exact Test

Table 5: Comparison of birth weight, head circumference and length (Mean) according to maternal height.

Variables	Maternal height (cm)				Total	p value
	<147cm	147-152cm	152-158cm	>158cm		
Birth Weight (kg)	2.56±0.17	2.73±0.22	2.84±0.22	3.10±0.26	2.81±0.29	<0.001**
Head Circumference	32.88±0.53	33.33±0.56	33.48±0.68	34.10±0.57	33.45±0.73	<0.001**
Length (cm)	48.04±1.46	49.15±1.83	49.54±1.92	51.15±1.48	49.48±2.01	<0.001**

ANOVA test reported that each centimeter increase of maternal height was inversely associated with under-five mortality (RR=0.978, 95% CI 0.970 to 0.987).[8] Similarly, another large study that pooled data from 54 low-income countries showed that each centimeter increase of maternal height significantly reduced the risk of neonatal mortality (RR=0.982, 95% CI 0.981 to 0.983) and under five child mortality (RR=0.988, 95% CI 0.987 to 0.988).[5]The linkage between short maternal height, socioeconomic status and the offspring's health can be explained by the four possible mechanisms as suggested in earlier research: (1) biomechanical(i.e., narrower pelvic size, placental insufficiency or abruption); (2) biological (i.e., poor nutrition stock, altered fetal metabolic programming); (3) genetic and (4) psychosocial (i.e., low socioeconomic status or poor living standards).[9] New research on human development and epigenetics in human and animal studies has revealed that maternal undernutrition could impact on fetal programming through several pathways: (1) impaired placental growth; (2) insufficiency of placental to transfer essential nutrients to the fetus; (3) oxidative stress in both placenta and fetal; (4) epigenetic modification (i.e., DNA methylation) to adapt with the adverse fetal environment; (6) altered genome activity and gene expression for fetal programming; and (7) alerted fetal programming causing impaired growth, development and immune function of the fetus through hormonal imbalance, metabolic disorder, organ dysfunction and defects in cell signalling.[10,11] Evidence from an epidemiological study has reported an association between short maternal stature and placental abruption, pre-eclampsia, preterm birth and SGA.[12] Also, mothers who were SGA at birth due to her adverse environment, like low socioeconomic status, were more likely to deliver SGA babies and thus leading to an intergenerational transfer of poverty.[13] Evidence from LMICs has revealed that SGA increases the risk of deaths by more than double for the term neonates and by about 15 times among the preterm neonates compared with the term appropriate for gestation age (AGA) babies.[14,15] Moreover, low birth weight or SGA infants are also more likely to be stunted and wasted which increases their risk of cause-specific mortality due to a synergistic interaction between undernutrition and infections like pneumonia or diarrhoea.[16,17]

Thus, short maternal height leads to an increased risk of

child mortality through preterm birth, fetal growth retardation and child undernutrition. there has been little progress in addressing the intergenerational effect of undernutrition to improve child health and survival. Recently, the United Nations System Standing Committee on Nutrition recommended improving maternal nutrition, even for short-statured women, through improvements

in preconception or conception diet quality, to break the intergenerational cycle of growth faltering in utero leading to poorer child survival.[18] Therefore, the current study findings draw attention to the programme and policymakers to focus on improving maternal nutrition for better offspring nutrition, health and survival. We also recommend evidence-based approaches of nutrition promotion and improved water and sanitation practices that have the potential to improve growth and break the vicious cycle of growth faltering in childhood.[19] Although nutrition interventions have long-term consequences on adult height, improving the growth of girls is essential to reduce short maternal stature. Therefore, these current study findings should draw the attention of the programme and policymakers to focus on improving maternal nutrition for better offspring nutrition, health and survival.

Possible shortcoming of this study is the lack of consideration of confounding factors like socioeconomic status and parental education status.

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