Early Pregnancy and Maternal Malnutrition as Precursors of Stunting in Children under Two Years of Age among Bhutanese Refugees, in Nepal Maternal Precursors in Stunting of Children

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Abstract

The purpose of this study was to determine the association between early pregnancy of mothers and stunting in children less than two years of age as well as the association between early pregnancy and maternal malnutrition among Bhutanese refugees in Nepal. A sample of 216 mothers, with their children below 2 years of age was selected from secondary data obtained from Bhutanese refugees in Nepal. Descriptive statistics were used to determine frequencies and proportions. Logistic Regression was used to determine the statistical relationship between early pregnancy and the stunting of their children under 2 years old, adjusting for mother's age, hemoglobin level, gestational age, and body mass index (BMI) of mothers. The same technique was applied to determine association between early pregnancy and maternal malnutrition adjusting for maternal BMI and hemoglobin levels. Results indicated a significant increased risk of stunting in children with decreasing maternal age with adjusted ratios of 9.26 (95% CI =2.55-33.69) and 2.12 (95% CI = 1.01-4.44) for maternal age of 14-16 years and 17-19 years, respectively, compared with maternal age ≥ 20 years. After adjustment for mother's age, hemoglobin level, gestational age, and body mass index, mothers of young age were more likely to experience stunted children. In conclusion, when mothers are at an age of still growing themselves, stunting of their children is a risk. In order to rectify the predominantly nutrition related problems, more attention should be paid to improving maternal nutrition status, and especially pre-conceptual nutritional status.

Keywords: Early pregnancy, maternal malnutrition, stunting, children

1. Introduction

Maternal and child under-nutrition are increasingly reported in developing and developed countries as likely precursors of stunting in poorer segments of the populations [1]. Stunting is known to be a key indicator of long-term child malnutrition, a failure to reach one's biological potential for growth, resulting in low height for age [2]. Studies revealed that stunting mostly occurs within the first two years of life [3], [4]. The primary period of malnutrition in early childhood is during fetal development brought on by malnourished mothers [5]. Therefore, maternal nutrition during pregnancy plays a major role in a child's growth and survival. Moreover, as discussed by Kramer [6], poor nutrition of a woman is a known cause of Low Birth Weight (LBW); specifically, short maternal stature, low pre-pregnancy Body Mass Index (BMI), and low weight gain are among the most important determinants of LBW. When adolescent growth and pregnancy coincide, the mother and fetus compete for nutrients [7]. If the woman has a child at an early age this further reduces her opportunity to reach an optimal body size with adequate nutrient stores before pregnancy, and thereby giving birth to LBW infants [8]. Stunting as well as LBW can result from inadequate nutrient intake of the mother [6], low pre-pregnancy BMI [9], and adolescent pregnancy [7]. Because of these reasons, it can be assumed that stunting, and its related factors, is likely associated with adolescent pregnancy. This study aimed to determine the association between early pregnancy and stunting in children to determine the association between early pregnancy and maternal malnutrition.

2. Materials and methods

This study was based on a set of secondary data compiled by Shrimpton et al. [10] for his study on maternal nutrition, birth weight, and infant growth among Bhutanese refugees in Nepal. This study reanalyzed Shrimpton's data with the purpose to identify precursors of stunting in children < 2 yrs among the Bhutanese refugees. This analysis, using a two year follow up of pregnant women data on their pregnancy outcome in terms of stunting in children up to two years after birth, was conducted to investigate association between early pregnancy and stunting in infants, as well as to investigate the association between early pregnancy and maternal nutrition.

Original data on mothers and their children were separated into three date sets, namely Antenatal Care (ANC), birth records, and infant growth records totaling 11,195 subjects. These three datasets were combined into one data set linking mothers with their children and cleaned for missing entrees to arrive at a single data set suitable for analysis. A second cleaning took place to select only those subjects for which age of pregnant mothers, their Body Mass Index (BMI), their hemoglobin level, and their gestational age were available as well as entrees on the height for age of their children, to arrive at a data set of 216 mothers and their children suitable for analysis.

3. Ethics

Permission to use the 2003 secondary data was obtained from Shrimpton [10]. Confidentiality of information on subjects was maintained by: (a) removal of personal identifiers and (b) maintaining password protected electronic datasets. Institutional Review Board (IRB) approval, reference 040/2553, was obtained from the Thammasat University Ethics Committee.

4. Statistical Analysis

Logistic Regression was used to calculate the adjusted odds ratio (OR) and 95% confidence interval for the association between early pregnancy and stunting as well as maternal nutritional status. Adjustment of maternal age, gestational age BMI, and hemoglobin levels was made for the stunting model, and maternal age and gestational age for the maternal nutritional status model.

In the analysis, age of mothers at first pregnancy was classified into four groups: (a) 11-13 years defined as rapid growth [11], [12]; (b) 14-16 years defined as still growing [13]; (c) 17-19 years defined as cessation growth; and ≥20 years.

Stunting of children was determined by height for age using the World Health Organization (WHO) Growth Chart 0-59 months (Z scores) and divided into following categories: (a) within -1 SD below WHO standard (normal variation); (b) within -2 SD below WHO standard (stunting); within ≤-3 SD below WHO standard (severe stunting).

Maternal nutritional status was measured by hemoglobin level, gestational age, and BMI as follows:

Hemoglobin level: < 7 severe anemia, 7-10.99 moderate anemia, and 11 as anemia [14].

Gestational age since pre-pregnancy BMI was not available; BMI determined during the 1st ANC visit up to gestation age of 14 weeks, was used [15].

BMI based on Lui and Grandinetti [16] Asian BMI cut-off points for mother's weight below 45 kg or height below 148 cm (BMI < 18.5) required weight gain to be defined as: BMI <18.5 (underweight) weight gain 28-40; BMI 18.5-22.9 (normal weight) weight gain 25-35; BMI 23-24.9 (overweight) weight gain 15-25; and BMI >25 (obese) weight gain 11-20.

Descriptive statistics such as frequencies and proportions and Logistic Regression, including crude and adjusted odd ratios with 95% confidence interval, are given.

5. Results

As presented in Table 1, the percentage of stunting in children is slightly higher than non-stunting in children. Among all stunted children, 11.3% are classified as severely stunted (≤-3 HAZ), 29.6% are classified as stunted (-2.99 to -2 HAZ), and 59.1% are classified as showing a normal variation.

As shown in Table 2, among mothers of stunted children, 15.2% are in the age group of 14 and ≤16 years, 37.0% are between 17-19 years of age, and 47.8% are ≥ 20 years of age. It is of interest to note that for both mothers of stunted and mothers of not stunted children, the majority show moderate levels of anemia, 80.4% and 79.4%, respectively, while the majority for both mothers of stunted (82.6%) and mothers of not stunted (77.1%) children, the gestational age is over 14 weeks. A similar pattern is seen for mothers' BMI, namely the majority of mothers of stunted children (76.1%) and of mothers of not stunted children (80.0%), show a normal BMI range between 18.5 and 24.9.

Table 1. Distribution of Non-Stunting and Stunting among Children < 2 Years of Age as Measured by WHO Growth Chart.

HAZ Measure	Classification		Total
	Non-stunting (%)	Stunting (%)	
Severe Stunting ≤ -3	0 (0)	13 (11.3)	13
Chronic Malnutrition (-2.99 to -2)	0 (0)	34 (29.6)	34
Normal Variation (-1.99-1)	0 (0)	68 (59.1)	68
Normal Child (.99 and above)	101	0 (0)	101
Total	**101 (46.8%)**	**115 (53.2%)**	**216**

Table 2. Distribution of Maternal Factors by Non-Stunting and Stunting of Children < 2 Years of Age.

Maternal Factors	Classification < 2 Yrs Age		Total
	Non-stunting (%)	Stunting (%)	
Age of mother in years			
≤ 16 years*	5 (2.9)	7 (15.2)	12
17-19 years	45 (26.5)	17 (37)	62
≥ 20 years	120 (70.6)	22 (47.8)	142
Hemoglobin level of mother			
Severe Anemia (< 7)	3 (1.8)	0 (0)	3
Moderate Anemia (7-10.99)	135 (79.4)	37 (80.4)	172
Borderline Anemia (11)	32 (18.8)	9 (19.6)	41
Gestational age of mother			
≤ 14 weeks	39 (22.9)	8 (17.4)	47
> 14 weeks	131 (77.1)	38 (82.6)	169
BMI of mother (kg/m^2)			
< 18.5	24 (14.1)	7 (15.6)	31
Between 18.5 and 24.9	136 (80.0)	35 (77.8)	171
Between 25 and 30	10 (5.9)	3 (6.7)	13

**Age groups 11-13 and 14-16 were combined because the frequencies for these age groups were too small for analysis*

As presented in Table 3, results indicate a significant increasing risk of stunting with decreasing maternal ages with a crude ratio of 7.64 (95% CI =2.22-26.24) and 2.06 (95%CI = 1.00-4.23 for maternal age of 14-16 years and 17-19 years, respectively, compared with maternal age ≥ 20 years old. After adjustment for mother's age, hemoglobin level, week of gestational age, and BMI of the mother, the ratios increased to 9.26 (95% CI 2.55 to 33.69) for maternal age between 14 and 16, and 2.12 (95% CI 1.01 to 4.44) for maternal age between 17 and 19 years. Compared with the reference group (20 years of age and above), mothers of young age are more likely to experience stunted children. No other statistical significant association was found for hemoglobin level, gestational age, and BMI of the mother.

Table 3. Association between Early Pregnancy and Stunting in Children.

Maternal Factors	Crude OR	95% CI	Adjusted OR	95% CI
Age of mother				
14-16 years	7.64	2.22-26.24	9.26	2.55-33.69
17-19 years	2.06	1.00-4.23	2.12	1.01-4.44
≥ 20 years	1	1	1	1
Hemoglobin level of mother				
Severe anemia	0.95	0.42-2.17	0.79	0.33-1.93
Moderate anemia	1	1	1	1
Gestational age of mother				
≤ 14 weeks	0.71	0.30-1.64	0.57	0.23-1.40
> 14 weeks	1	1	1	1
BMI of mother (kg/m^2)				
< 18.5	0.73	0.17-3.06	0.83	0.18-3.80
Between 18.5 - 24.9	0.64	0.19-2.17	0.67	0.18-2.49
Between 25 and 30	1	1	1	1

As presented in Table 4, no significant increased risk of malnutrition is observed for maternal age 14-16 years odd ratios (OR =1.15; 95% CI= 0.29-4.48), compared to age ≥ 20. The OR was increased to 1.17 (95% CI=0.30-4.65) after adjustment for gestational age.

However no meaningful statistical significance is found between the malnutrition of mothers with mothers' age and week of gestational age of mothers. Thus, the age and gestational age of mothers do not explain the risk of malnutrition in this study.

Table 4. Association between Early Pregnancy and Maternal Malnutrition.

Maternal Factors	Crude OR	95% CI	Adjusted OR	95% CI
Mother's age				
14-16 years	1.15	0.29-4.48	1.17	0.30-4.65
17-19 years	0.58	0.26-1.31	0.58	0.26-1.31
≥ 20 years	1	1	1	1
Gestational age				
< 14 weeks	0.91	0.40-2.05	0.89	0.39-2.03
≥ 14 weeks	1	1	1	1

6. Discussion

This study was done with the expectation that adolescent pregnancy and maternal malnutrition are risk factors in having stunted children and would, therefore, be a useful contribution to monitor adolescent pregnancy at individual, national, regional, and global level. Although related studies were recently undertaken in developing countries, the significance of the study lays in the focus on adolescent girls in vulnerable settings such as Bhutanese refugee camps in Nepal.

Adolescent pregnancies have a higher risk than the pregnancies of healthy adult women. Still-growing adolescents are more likely to give birth prematurely or have a baby with low birth weight than a mature woman of the same nutritional status. Pregnancy puts adolescent women at increased risk of malnutrition by diverting nutrients from the mother to the fetus with pregnancy complications, and poor pregnancy outcomes. While testing the correlation relationship between the height of mother and the stunting, this study shows that they are negatively but weakly related. This means that the more the mothers are below the median height, the more there is stunting of their children at 13.6 %.

This is in line with earlier findings [17], revealing that many women who are below the median height are also stunted and such maternal stunting is a known risk factor for having stunted children. The gestational weight gain and birth weight is influenced by maternal pre-pregnancy BMI [16]. This study confirms this statement by showing that the mothers' weight and BMI, by using Spearman rho, were strongly and positively related (57%) at 0.01 significant levels.

Findings in this study also support UNICEF's point of view that the period where nutritional deficiencies can adversely impact a child's survival and growth starts from the mother's pregnancy until the child is 2 years old [2]. Since the combination of hemoglobin level and BMI were used to define maternal nutrition, we used Spearman ρ (rho) correlation relationship, and results indicate that the lower the level of hemoglobin of pregnant mothers, the more severe stunting in children is seen. However, the BMI of mothers failed to explain the stunting level of children.

It is acknowledged that this study faced various limitations. Firstly, secondary data were collected for different purposes and therefore did not allow for controlling unmeasured potential problem factors, which may bias the findings. Secondly, selection bias is possible due to substantial missing data; Only 216 respondents could be selected for the analysis. These limitations may have affected study outcomes. Due to the relatively small number of respondents that comprised the sample group, the findings cannot be generalized to all adolescent mothers and children among Bhutanese refugees living in Nepal.

Finally, this study examined adolescent women and their children in a refugee camp only, and therefore results cannot be generalized to all adolescent women. It should also be mentioned that in the Bhutanese Refugee population, women who got pregnant in adult age showed relative positive outcomes and relative low complication rates for both their children and themselves. As indicated by Shrimpton's [18], findings show that the prevalence of stunting in children of less than five years in Bhutanese refugees in Nepal was 33%, compared to the national and regional rates of 54% and 48%, respectively.

Based on our findings, we can conclude that when mothers are at an age of still growing themselves, stunting of their children is a risk. However given the divided nature of the literature it is clear that further research is needed on adolescent pregnancy outcomes in different socio-cultural settings. As well as the potential for residual problems by factors unknown such as women's life style and other potentially important confounding factors such as pre-pregnancy BMI. The ability to adjust for additional

problem factors such as women's life style, maternal pre-conceptual nutritional status, and nutrition sufficiency such as an iron supplement program could lead to future research. Considering the alarming effects of stunting at individual, national, regional, and global levels, further research on these additional issues is recommended.

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