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Social Determinants of Linear Growth among under Five Years Children in Nepal

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ABSTRACT

Linear growth faltering is a chronic form of malnutrition which is more serious in children due to its irreversible nature. The aim of this study is to investigate socioeconomic and demographic determinants of linear growth among children under the age of five in Nepal. The 2011 data were obtained from the Nepal Demographic Health Survey (NDHS). The linear growth (Height for Age Z score) of 2,330 children was examined. Multiple linear regressions were used to determine associated factors of linear growth. Results indicated that the children's linear growth was affected negatively due to various contextual factors including varied socioeconomic status, the mother's educational attainment and height, geographical region and place of residence. The poorest households, older children, mother's illiteracy and living in a rural area were found to be negatively associated with linear growth.

Keywords: Height for Age Z score, Linear growth, Nepal, Under-five years of age

INTRODUCTION

Malnutrition is a major public health concern which is threatening the world's sustainable development goals (Osborn et al., 2015). Children's nutritional status is one of the key indicators in achieving this goal. In developing countries, malnutrition is commonly regarded as undernutrition (World Food Program, 2005). Undernutrition in children is one of the leading causes of morbidity and mortality, especially in developing countries (Egata et al., 2013). About 90% of growth retarded children in the developing world are found in Asia and Africa (UNICEF, 2009).

Nepal has one of the highest growth-faltered child populations in the world. It

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was ranked in the top 20 countries with the highest burden of linear growth faltering among children under five years of age (UNICEF, 2009). Nepal has the third highest child linear growth faltering among South Asian countries after India and Afghanistan (United Nations Children's Fund, 2015). Linear growth faltering affects 41% of children below the age of five in Nepal in 2011 (MOHP & New ERA, 2011). Though Nepal has achieved the Millennium Development Goal target for child mortality its target to reduce infant mortality has not been achieved, mainly due to the high prevalence of malnutrition (Malla et al., 2011).

Nepal is one of the poorest countries in the world. More than 25% of the population live under the poverty line with earnings of less than USD1 a day. The hunger index score of Nepal is also very high, especially in remote regions (Hollema & Bishokarma, 2009; UNICEF, 2010). Socio demographic determinants play an important role in human development and may also affect linear growth.

There are various measures for calculating anthropometric indices. Height for age Z (HAZ) score shows linear growth, weight-for-height Z (WHZ) reflects body proportion, and weight-for-age Z (WAZ) represents combination of both linear growth and body proportion (Onis et al., 1993; Onis & Blossner, 1997). The aim of this study is to explore whether social determinants have any association with of children under age five in Nepal.

METHODOLOGY

Data were retrieved from the 2011 Nepal Demographic Health Survey, a two-stage stratified cluster survey. In the first stage, primary sampling areas were selected with probability proportionate to size and in the second stage, households were randomly selected. A total of 1,780 households were selected for anthropometric measurement of children under age five and out of that 2,392 children were selected.

The outcome was HAZ score which was calculated using Anthro software (WHO, 2006). Based on the definition provided by WHO, HAZ score conveys a child's height in terms of the number of standard deviations above or below the median height of healthy children from a reference group. Children whose HAZ score is below two standard deviations and below three standard deviation of the median of the reference population are classified as moderately or severely linear growth faltered respectively.

HAZ score is calculated using the following:

$$HAZ\ score = \frac{Observed\ value - median\ reference\ value}{Standard\ deviation\ of\ reference\ population}$$

The determinants included characteristics of the child, mother, household, and geographic location. Household wealth index was calculated as a score of household property such as having means of transport, durable goods, and other facilities in the household. Household index was divided into quintiles. Child's size at birth was based on the

mother's estimation at the time of birth and categorised as very large, larger than average, average, smaller than average and very small.

Statistical methods

The outcome of the study is continuous and determinants are categorical. T- tests and Analysis of variance (ANOVA) were used to compare the mean of the outcome. Multiple linear regression models were used to assess the independent association between all determinants and HAZ score. A stepwise backward elimination method was used for the selection of the best model. The normality assumption of the model was also checked. The linear model takes the form:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + ..., \beta_n x_n + \varepsilon \quad [1]$$

Where Y is outcome variable, $\beta_0, \ldots, \beta_n$ are the regression coefficients, $x_1, \ldots, x_n$ are the determinants and ε is the error term. Sum contrasts were used to compare and interpret the results (Tongkumchum & McNeil, 2009). R language and environment version 3.1.1 was used for analysing data (R Core Team, 2012).

RESULTS

Among the 2,392 children, 32 were excluded from the study due to their mothers' refusal to allow measurements; 27 twins were also excluded while three children were omitted due to missing outcomes. The final sample size was down to 2,330 children.

The mean and standard deviation of HAZ scores was -1.73 ± 1.48, (range -9.71 to 5.61). Table 1 shows the distribution of the demographic and socio-economic characteristics of the study sample. About 52% of boys and 48% of girls were aged less than 5 years. Approximately, 62% of children were of average size whereas 14% were smaller than average and 17% were larger than average. More than half (56%) of the mothers were aged between 15 and 24 years at delivery, and 8% of the mothers were aged above 35. About half (46%) of the mothers had no formal education and among the educated group, about one fifth (19%) had only primary education and one third (34%) had secondary and higher education. More than one fourth (30%) were from the poorest households according to their wealth index. About 40% of children were from secure households followed by 39% from moderately insecure households. The majority (80%) of children were from rural areas.

Child- related factors associated with linear growth included gender, age and size at birth while mother-related factors included age at delivery, education, and height. Household factors included household wealth index, household food security, region and place of residence.

Table 2 shows the results of the multiple linear regression model assessing the association of all determinants with HAZ score. Older children had a negative growth coefficient compared with younger children. Perceived small child size at birth had greater negative coefficient compared with the other groups. Non-educated mothers had a negative coefficient while educated

Table 1
Distribution of children by socio-demographic characteristics and geographic affiliation, Nepal Demographic Health Survey-2011 (n=2,330)

Determinants	Number	Percent
Child's gender		
Male	1,210	51.94
Female	1,120	48.06
Child's age		
0-11 months	452	19.39
12-23 months	444	19.10
24-35 months	491	21.07
36-47 months	496	21.29
48-59 months	447	19.18
Size at birth		
Very large	52	2.23
Larger than average	393	16.87
Average	1,447	62.10
Smaller than average	342	14.67
Very small	96	4.12
Mother's height		
<= mean height	1,117	47.94
> mean height	1,213	52.06
Mother's age at child birth		
15-24 years	1,306	56.05
25-34 years	843	36.18
35+years	181	7.76
Mother's education		
No education	1,075	46.13
Primary school	454	19.48
Secondary school and higher	801	34.37
Wealth Index		
Poorest	715	30.68
Poorer	473	20.30
Poor	438	18.79
Richer	355	15.23
	349	14.97
Household food security		
Secure	921	39.52
Mild	147	6.30
Moderate	909	39.01
Severely	353	15.15
Place of residence		
Urban	472	20.32
Rural	1,858	79.67
Region		
Eastern Mountain	147	6.30
Central Mountain	107	4.58
Western Mountain	194	8.31
Eastern Hill	190	8.15
Central Hill	151	6.48
Western Hill	177	7.60
Mid-western Hill	217	9.31
Far western Hill	215	9.22
Eastern Terai	200	8.57
Central Terai	230	9.86
Western Terai	153	6.56
Mid-western Terai	210	9.04
Far western Terai	139	5.96

mothers had a positive coefficient. Similarly, children from poor households had negative coefficients compared with those from richer households while children from rural areas had a negative coefficient compared with those from urban areas. Children from the Western Mountain region had the highest negative coefficient compared with the other regions.

Table 2
Results from multiple linear regression model of linear growth among under five children, Nepal Demographic and Health Survey-2011

Characteristic	Coefficient	Standard error	P-value
Child's age			
0-11 months	0.97	0.05	0.00
12-23 months	0.06	0.05	0.23
24-35 months	-0.38	0.05	0.00
36-47 months	-0.44	0.05	0.00
48-59 months	-0.21	0.00	0.00
Size at birth			
Very large	0.41	0.14	0.00
Larger than average	0.21	0.07	0.00
Average	0.03	0.05	0.49
Smaller than average	-0.23	0.07	0.00
Very small	-0.42	0.11	0.00
Mother's height			
<= mean height	-0.26	0.02	0.00
> mean height	0.26	0.02	0.00
Mother's education			
No education	-0.09	0.04	0.02
Primary school	-0.05	0.05	0.27
Secondary school and higher	0.14	0.04	0.00
Wealth index			
Poorest	-0.27	0.06	0.00
Poorer	-0.14	0.05	0.01
Poor	0.04	0.05	0.37
Richer	0.16	0.06	0.00
Richest	0.20	0.07	0.00
Place of residence			
Urban	0.12	0.03	0.00
Rural	-0.12	0.03	0.00
Region			
Eastern Mountain	0.03	0.10	0.72
Central Mountain	-0.06	0.11	0.56
Western Mountain	-0.31	0.09	0.00
Eastern Hill	-0.09	0.09	0.28
Central Hill	0.27	0.11	0.00
Western Hill	0.20	0.09	0.02
Mid-western Hill	-0.11	0.08	0.19
Far western Hill	-0.23	0.08	0.00
Eastern Terai	0.20	0.09	0.02

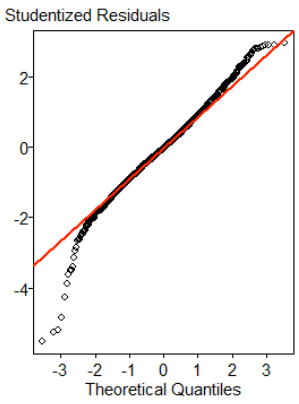

Figure 1. Normal scores plots of residuals from the linear regression model

A normal scores plot of residuals from the multiple linear regression model is shown in Figure1. Most of the HAZ values lie on the diagonal line except some values at the extremes of the distribution.

The mean HAZ scores with corresponding 95% confidence intervals by age of child, child's size at birth, mother's height, mother's education, household wealth index, place of residence and region obtained from the model is presented in Figure 2. The horizontal line symbolises

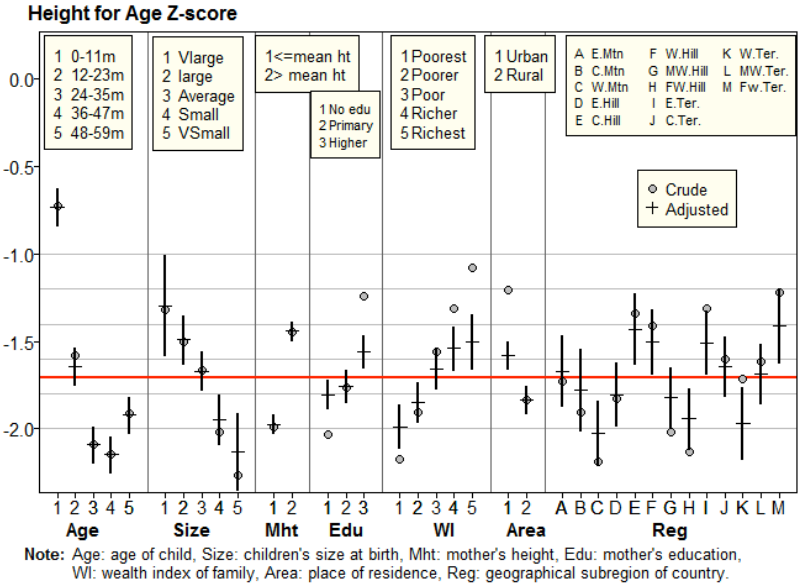

Figure 2. 95% confidence interval of linear growth of under five children in Nepal by associated variables

the overall mean HAZ score. Children in age groups 24-35 months, 36-47 months and 48-59 months had significantly lower HAZ scores than the overall mean. Children who, at birth, were perceived by their mother to be small and very small or children whose mother was non-educated or children from poorer and poorest socioeconomic households had lower HAZ scores than the overall mean. Children from rural areas or from the Western Mountain, Eastern Terai, Western Terai and the Far western Hill had lower HAZ score than the overall mean.

DISCUSSION

The mean value of HAZ score of children from Nepal was -1.73. The negative value shows that the distribution of HAZ score was below the mean which signifies that in the majority of children, linear growth has been adversely affected. Use of the mean HAZ score as an index of malnutrition in the children's population instead of using a cut off value (below -2SD) facilitates easier interpretation, i.e. if more than half of the children's linear growth is faltered, then an urgent intervention is needed for the whole community, not only for the growth faltered children.

This study explored the association of demographic and socio-economic factors with HAZ score among children under five years of age in Nepal. Older aged children (age > 24-35 months) had a higher risk of linear growth falteration than those in the age group (0-23 months). A similar finding was reported in a recent study on linear growth faltering (Tiwari et al., 2011) in Nepal. This could be related to improper timing and variety of food during weaning (Khanal et al., 2013; Marquis et al., 1997). However, one study revealed that linear growth faltering starts from infancy, not only when the child is older (Espo et al., 2002). This might due to differences in socio-economic conditions, geographic locations, breastfeeding and other health related practices (Khanal et al., 2013; Marquis et al.,1997; Rayhan & Khan, 2006).

Children who, at birth, were perceived by their mother to be small had negative linear growth and this finding was supported by previous studies conducted in Bangladesh and Brazil (Rayhan & Khan, 2006; Vitoloet al., 2008). Non-educated mothers had children with negative linear growth and this result is also consistent with the findings of a study from Bangladesh (Rayhan & Khan, 2006). Genetic factors of the mother such as height also had an impact on linear growth. Small height of the mother was also associated with negative linear growth which is similar to a finding from a study conducted in Thailand (Mongkolchati et al., 2010).

Children from poorer households had a negative linear growth. A possible explanation for this is that 69% of Nepalese children are severely deprived of at least one basic necessity (sanitation, information, water, shelter, food, education, health) and 38% are severely deprived of one or more basic necessities, which is an indicator of poverty (UNICEF, 2010). Previous studies confirm that lower socioeconomic status of the household is one of the causes of linear growth faltering in children (Hien & Hoa, 2009; Vitolo et al., 2008; Zottarelli et al., 2007; Egata et al., 2010).

Children from the Western Mountain region had lower HAZ scores. This has a probable association with Hunger Index scores in those sub-regions of Nepal. Hunger Index scores of children from the Far Western and the Mid-Western Mountain regions are very high compared with the national average (Hollema & Bishokarma, 2009). A similar finding was reported by a previous study that there is geographical inequality in children's nutritional status (Cesarea et al., 2015; Rader et al., 2012).

CONCLUSIONS

In conclusion, individual characteristics such as child's age, mother's height, household characteristics such as wealth index, mother's education and geographic area including region and place of residence are associated with linear growth of children. Faltered linear growth will have an adverse effect on the affected children throughout their lives. Hence, appropriate interventions are vital to prevent linear growth faltering among children under the age of five in Nepal.

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