

Determinants of Stunting in School-Aged Children of Tehran, Iran

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ABSTRACT

Background: Limited data are available indicating associates of stunting among Iranian children. This study was conducted to investigate determinants of stunting in first grade primary school children of Tehran in 2007.

Method: In this case-control study, 3147 school children were selected by multistage cluster random sampling method from 5 districts of Tehran. Anthropometric measurements were done and stunting was defined as height for age less than the 5th percentile of CDC2000 cut-off points. Eighty six stunted children were identified and considered as case group. After matching for age, sex and residence area, 308 non-stunted children were randomly selected as control group. Required data were collected by trained nutritionists using questionnaires.

Results: Stunting was prevalent among 3.7% of the study population (girls 4.4% vs. boys 2.8%, $P < 0.05$). Mean age of the studied children was 82.3 month. Children with a birth weight of >3000 g were less likely to be stunted (OR: 0.25; 95% CI: 0.11-0.54) compared with those with a birth weight of <3000 g. Being born to older mothers (>35 years) was associated with greater odds of being stunted (3.01; 1.19-7.60) compared with being born to younger mothers (<35 years). Those with fathers' height of >160 cm were less likely to be stunted (0.04; 0.005-0.37) than those whose fathers' height was less than 160 cm.

Conclusions: We found that birth weight, maternal age and fathers' height are the major contributing factors to stunting in this group of Iranian children. Taking into account the determinants of stunting might help policy makers designing appropriate interventions.

Keywords: Birth weight, breast feeding, children, stunting

INTRODUCTION

Linear growth retardation, or stunting, which is a manifestation of chronic malnutrition, is highly prevalent in under-developed and developing countries.^[1-4] According to the World Health Organization, 215 million children were stunted in 2000 throughout the world. The national data from "Iranian

National Study of Malnutrition Prevalence” in 2005 has indicated that 4.7% of Iranian children are affected by stunting.^[5] Earlier studies have shown that child’s stunting is associated with concurrent, and possibly later, delayed mental and motor development.^[6,7] The adverse effects of stunting could affect the adulthood by limiting work capacity owing to reduced muscle mass^[8] and increasing obstetric risks in women.^[9]

Height is influenced by genetic, socioeconomic, and dietary factors.^[1] Although, several studies have identified determinants of stunting in different populations,^[5,10-15] limited data are available indicating its associates among Iranian children. Earlier studies have identified low birth weight, inadequate child care, feeding practice and birth order as a probable correlates of stunting^[16,17] #94; Wamani, 2007 #82). It also has been shown that birth weight, breast feeding status, mothers’ age, family size, socio-economic status and birth order are associated with a higher prevalence of stunting among Iranian children.^[5,18-22] Previous studies have been limited in sample size^[20,22,23] and their sampling procedure; ^[18,19,21] such that their findings cannot be easily extrapolated to other parts of the country. Furthermore, most have reported the prevalence of stunting, not its determinants.^[5,10,24,25] It remains unknown if the determinants of stunting in a metropolitan area like Tehran are different from those in deprived regions of the country. This study was, therefore, conducted to investigate determinants of stunting in first grade primary school children of Tehran.

METHODS

Participants

In this case-control study, participants were selected by multistage cluster random sampling method from 5 districts of Tehran in 2007. (Northern, Southern, Western, Eastern and central parts). First, 42 public schools (19 schools for girls and 23 for boys) were randomly selected based on proportional to size method in each district. In each selected school, all first grade pupils aged 7 years old were invited to participate in the study ($n = 3147$, 1343 boys and 1804 girls). Stunting was defined as height for age less than the 5th percentile of CDC2000 cut-off points.^[1] Based on

this definition, 86 stunted children were identified and considered as case group in the current study. After matching for age, sex and residence area, 308 non-stunted children (height for age more than the 5th percentile of CDC2000 cut-off points) were randomly selected as control group. The study was approved ethically by Research Ethics Committee of National Nutrition and Food Technology Research Institute, Tehran, Iran and all participants provided informed written consent forms.

Data collection

Required data about children’s birth weight and height, duration of breastfeeding and family demographic characteristics (including family size, parity, parents’ job, parents’ education, marital status, mothers’ age, and home ownership) were collected by trained nutritionists using questionnaires. Anthropometric measurements were done in all participants by two trained nutritionists and were randomly re-checked by a senior investigator (FE). Weight was measured by means of a portable calibrated digital scale (Breuer, Germany) to the nearest 0.1 kg in light clothing without shoes. Height was measured according to a standard protocol to the nearest 0.1 cm using Height Measure (Seca 214, Germany). Body mass index was calculated afterwards. Mothers’ weight and height were measured by standard methods^[26] and fathers’ weight and height were collected through self-reporting.

Statistical analysis

Data were analyzed using statistical package for social science (SPSS Inc, version 14). To ensure normal distribution of variables, Kolmogorov-Smirnov test was applied. Continuous variables were compared using independent samples *t*-test between stunted and non-stunted children. Distribution of participants in terms of categorical variables was examined through the use of Chi-square test. Multivariate logistic regression analysis was applied to identify the determinants of stunting. In these analyses, first the continuous variables were entered into the models and then these variables were treated as categorical variables. $P < 0.05$ was considered as statistically significant.

RESULTS

Stunting was prevalent among 3.7% of the studied population ($n = 3147$). It was more prevalent in girls (4.4%) than boys (2.8%, $P < 0.05$). Characteristics of the studied population are provided in Table 1. Mean age of the studied children was 82.3 month with no significant difference between cases and controls. Stunted children were more likely to be thin compared with non-stunted children (weight: 17.9 ± 1.8 vs. 24.8 ± 6.3 , $P < 0.001$). Mean birth weight (2860 ± 570 vs. 3230 ± 530 g, $P < 0.001$) was also lower in stunted children than non-stunted counterparts; however, their mean birth length was not significantly different (48.9 ± 4.0 vs. 49.8 ± 4.6 cm, $P = 0.19$). Stunted children were less likely to be exclusively breastfed for the first 6 months of their life (83% vs. 91%, $P = 0.045$) and less likely to be first born in terms of birth order (36.7 vs. 56.8%, $P = 0.002$) compared with non-stunted children. They were

born to older mothers and to parents with lower weight and height than non-stunted children. Most stunted children were from families with more than 4 people per household. No significant differences were found between cases and controls in terms of parental education.

Multivariate adjusted odds ratios of stunting for different contributing factors are presented in Table 2. All variables in these models were treated as continuous. It has been found that birth weight (odds ratio: 0.31; 95% CI: 0.14-0.66) and fathers' height (odds ratio: 0.89; 95% CI: 0.84-0.95) were protectively associated with stunting. No significant associations were seen between other factors and stunting when these factors were treated as continuous variables.

When the variables were treated as categorical [Table 3], we found that children with a birth weight of >3000 g were less likely to be stunted (OR: 0.25; 95% CI: 0.11-0.54) compared with those with a birth weight of <3000 g. Being

Table 1: Characteristics of the study participants¹

Variables	Overall	Cases (n=86)	Controls (n=308)	P ²
Family size (people per household)	3.9±0.9	4.2±1.1	3.8±0.8	0.001
Children				
Age (month)	82.4±4.1	83.0±4.6	82.2±3.9	0.10
Girls (%)	63.1	64.6	62.7	0.80
Weight (kg)	23.3±6.4	17.9±1.9	24.8±6.4	<0.001
Height (cm)	118.9±6.8	110.4±2.9	121.3±5.7	<0.001
Birth weight (kg)	3.1±0.6	2.9±0.6	3.2±0.5	<0.001
Birth length (cm)	49.7±4.5	48.9±4.1	49.9±4.6	0.20
Exclusive breastfeeding till 6 mo (%)	89.3	82.9	91.1	0.045
Birth order (first born, %)	52.4	36.7	56.8	0.002
Parents				
Mothers' age (y)	32.9±5.3	34.1±5.5	32.5±5.2	0.02
Mothers' weight (kg)	68.4±11.4	65.7±11.8	69.0±11.2	0.03
Mothers' height (cm)	159.8±6.6	157.5±6.7	160.4±6.5	0.001
Fathers' age (y)	38.4±5.4	38.4±4.7	38.4±5.5	0.90
Fathers' weight (kg)	77.4±12.0	70.9±10.7	78.9±11.8	<0.001
Fathers' height (cm)	171.4±7.7	167.0±7.7	172.5±7.4	<0.001
Fathers' education				
Diploma or under (%)	86.9	89.7	86.1	0.45
University graduates (%)	13.1	10.3	13.9	
Mothers' education				
Diploma or under (%)	93.3	94.9	92.9	0.62
University graduates (%)	6.7	5.1	7.1	

¹All values are means±standard deviations unless indicated ²Obtained from student's *t* test for continuous variables and Chi-square for categorical variables

Table 2: Determinants (continuous variables) of stunting among school-aged children

Continuous variables	OR	95% CI	P
Family size	1.20	0.55-2.62	0.65
Birth weight	0.31	0.14-0.67	0.003
Exclusive breastfeeding	0.98	0.94-1.03	0.43
Birth order	1.50	0.66-3.41	0.33
Mothers' age	1.03	0.94-1.12	0.52
Mothers' BMI	1.003	0.91-1.10	0.96
Mothers' height	0.98	0.92-1.05	0.65
Fathers' BMI	0.95	0.84-1.06	0.35
Fathers' height	0.90	0.85-0.95	<0.001
Fathers' education	0.90	0.51-1.56	0.70
Mothers' education	1.38	0.72-2.64	0.32

born to older mothers (>35 years) was associated with greater odds of being stunted (3.01; 1.19-7.60) compared with being born to younger mothers (<35 years). Those with a fathers' height of >160 cm were less likely to be stunted (0.04; 0.005-0.37) than those whose fathers' height was less than 160 cm. No overall significant associations were found between stunting and other factors.

DISCUSSION

In this study, we found that the prevalence of stunting was 3.7%. Birth weight, fathers' height and maternal age were the main contributing factors to stunting in the studied population.

The prevalence of stunting in this study was in agreement with the one reported by National Study of Malnutrition Prevalence in Iranian children. It seems that the prevalence of stunting has been decreased in the past decade in the country. The decreasing trend of stunting has been reported in South East Asia, where the stunting has reduced in elementary school children from 52.4% in 1998 to 32.8% in 2000.^[27] Worldwide stunting prevalence has also decreased from 48.8% in 1980 to 39.9% in 1995.^[28,29] This can be explained by improved primary health care during pregnancy and early childhood, breastfeeding and growth monitoring.

In this study, the prevalence of low birth weight and short duration of breastfeeding (<6 mo) was higher in cases than that in controls. The same findings have been reached by Lwambo *et al.*,^[30] Marshall *et al.*^[31] and Ricci *et al.*^[13] Low birth weight infants have inadequate nutrient stores required for height growth. Due to increased

Table 3: Determinants (categorical variables) of stunting among school-aged children

Categorical variables	OR	95% CI	P
Gender (ref: boys)	0.63	0.29-1.39	0.25
Family size (ref:<4)	0.83	0.26-2.66	0.76
Birth weight (ref:>3 kg)	0.25	0.12-0.55	0.001
Exclusive breastfeeding (ref:>6 mo)	0.36	0.12-1.14	0.08
Birth order (ref: first)	2.08	0.64-6.74	0.22
Mothers' age (ref:<35 y)	3.01	1.19-7.61	0.02
Mothers' BMI (ref:<25)	1.07	0.45-2.58	0.87
Mothers' height (ref:>150 cm)	6.05	0.39-92.79	0.20
Fathers' BMI (ref:<25)	0.75	0.35-1.63	0.47
Fathers' height (>160)	0.04	0.005-0.37	0.004
Fathers' education (ref: university graduates)			
Illiterate	0.43	0.002-77.46	0.75
Primary	3.01	0.47-19.34	0.24
Secondary and Under Diploma	0.80	0.19-3.28	0.75
Diploma	1.002	0.31-3.25	0.10
Mothers' education (ref: university graduates)			
Primary	0.53	0.06-4.72	0.57
Secondary and Under Diploma	1.002	0.19-5.37	0.99
Diploma	0.83	0.21-3.22	0.79

requirements in these infants, additional amounts of nutrients are needed for these babies to reach normal height growth.^[32] Findings of the current study about breastfeeding are in agreement with those of Marquis *et al.*, in Peru^[33] and Semba *et al.*, in Indonesia and Bangladesh which indicated that short duration of breastfeeding was positively related to prevalence of stunting. Short duration of breastfeeding would prohibit adequate dietary intakes of energy, protein and micronutrients required for normal height growth.^[34]

Low birth weight was found as a contributing factor to stunting in this study. This finding is in line with earlier studies among Brazilian,^[35] Mexican^[36] and Pakistani children.^[37] Birth weight has also been reported as a strong predictor of child size in later life among children with Intra-Uterine Growth Retardation (IUGR). Most IUGR infants do not catch-up to normal size during childhood. Low birth weight and subsequent stunting could be induced by maternal under-nutrition during pregnancy. In the current study, we did not collect data about dietary intakes of mothers during their pregnancy. Adequate nutrition during pregnancy

would result in increased birth weight and in turn would improve child growth in later life.

Another determinant of stunting in the current study was maternal age. This finding is in agreement with previously reported ones. In Egypt, children born to mothers aged ≥ 35 years showed a higher prevalence of stunting than children born to mothers in other age groups.^[15] Maternal age has also been reported as a determinant factor of stunting in South African children.^[38] The effect of the age of the mother on child health outcomes has also been explored in several studies.^[39,40] In the case of India, Raj *et al.*, showed that children born to mothers who were married below the age of 18 were at a higher risk of stunting and underweight compared to children of women who had married at age 18 or older. Although, several studies have reported the importance of mothers' young age at pregnancy on health outcomes of children, limited data have focused on older age. The current findings highlight the importance of old age of mothers as a contributing factor to stunting.^[41]

As we all know socioeconomic status and dietary intakes are two important contributing factors to stunting.^[42] We tried to collect data on economical status of the households; however, after completion of the study, we found that these data are not reliable. So, we used educational status of parents as a proxy of socioeconomic status. One might suggest the use of living district as a proxy of socioeconomic status. In the current study, when we explored the frequency of stunting in different districts of Tehran (5 districts were selected in this study), we failed to find a significant difference. Due to the inclusion of children from different socioeconomic status in the current study, the findings can easily be extrapolated to the Tehrani children, however, more caution are required about the generalizability of the findings to the whole country.

CONCLUSIONS

We found that birth weight, maternal age and fathers' height are the major contributing factors to stunting in this group of Iranian children. Stunting, an irreversible situation, is an important index of chronic malnutrition. Therefore fetal, infant and child growth monitoring is necessary to

prevent stunting. Furthermore, taking into account the determinants of stunting might help policy makers designing appropriate interventions.

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