Public Health Nutrition: 17(9), 2010–2015 doi:10.1017/S1368980013002280

Mother's education is the most important factor in socio-economic inequality of child stunting in Iran

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Submitted 11 January 2013: Final revision received 7 July 2013: Accepted 25 July 2013: First published online 4 September 2013

Abstract

Objective: Malnutrition is one of the most important health problems, especially in developing countries. The present study aimed to describe the socio-economic inequality in stunting and its determinants in Iran for the first time.

Design: Cross-sectional, population-based survey, carried out in 2009. Using randomized cluster sampling, weight and height of children were measured and anthropometric indices were calculated based on child growth standards given by the WHO. Socio-economic status of families was determined using principal component analysis on household assets and social specifications of families. The concentration index was used to calculate socio-economic inequality in stunting and its determinants were measured by decomposition of this index. Factors affecting the gap between socio-economic groups were recognized by using the Oaxaca–Blinder decomposition method.

Setting: Shahroud District in north-eastern Iran.

Subjects: Children (n 1395) aged <6 years.

Results: The concentration index for socio-economic inequality in stunting was −0·1913. Mother's education contributed 70 % in decomposition of this index. Mean height-for-age Z-score was −0·544 and −0·335 for low and high socio-economic groups, respectively. Mother's education was the factor contributing most to the gap between these two groups.

Conclusions: There was a significant socio-economic inequality in the studied children. If mother's education is distributed equally in all the different groups of Iranian society, one can expect to eliminate 70 % of the socio-economic inequalities. Even in high socio-economic groups, the mean height-for-age Z-score was lower than the international standards. These issues emphasize the necessity of applying new interventions especially for the improvement of maternal education.

Keywords
Malnutrition
Inequality
Socio-economic factors
Iran

Currently, one in every three children in the world suffers from malnutrition. This situation is especially prevalent among the poor and those who do not have access to adequate health education, healthy water and good sanitation[(1)]. A reduction in child and infant malnutrition is an essential step to reach the Millennium Development Goals, specifically the first and fourth ones. More than 70 % of all children diagnosed with undernutrition live in Asia[(1)] and more than 90 % of the world's children with stunting live in Africa and Asia[(2)]. In 2011 approximately 165 million children below 5 years of age (26 % of under-5s) were stunted, a 35 % decrease from 1990 estimates[(2)]. In the Eastern Mediterranean region, malnutrition is the most serious and major contributor of death among children. On the other hand, the burden of disease resulting from insufficient nutrition is increasing[(3)]. Iran is classified as a country with low stunting prevalence; a national study conducted in 2004 found that the prevalence of stunting is 4·7 %. However, the stunting prevalence in the rural areas of some of its provinces is so severe that these regions need immediate intervention[(4)]. Our previous reports in Shahroud District showed that the prevalence of stunting was 10·3 % in children below 6 years of age and as high as 22 % in some regions of the district[(5)]. These data indicate considerable disparities in the extent of stunting. Research conducted in other parts of the world, especially in developing countries, also provides evidence of economic and socio-economic

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inequalities related to malnutrition[6–13]. Despite this, to the best of our knowledge, no study in Iran has examined the role of socio-economic inequality in child malnutrition and its determinants.

The present study aimed to describe the socio-economic inequality in stunting and its determinants in a community-based study in Shahroud, which can further be generalized to the entire country. Understanding the factors that affect inequality in stunting can lead to proper policy making and elimination of this inequality, the ultimate goal in health issues of all countries.

Methods

The present cross-sectional study was conducted with a sample of 1395 children aged below 6 years in Shahroud District, which is located in Semnan Province in north-eastern Iran. Shahroud, with an average socio-economic status, represents a typical Iranian population. The literacy rate in the over 6 years population is 84·5%, which is slightly higher than the national average (79·5%). Health-care services are delivered mainly by the Shahroud University of Medical Sciences, which is similar to other province centres. Previous studies have reported that the prevalence of stunting in Semnan Province is 4·2%[4]. Thus, for the present study, the desired sample size was calculated to be 1380, considering a sampling error of 1·5%, α of 0·05 and a design effect of 2. Following a multistage cluster sampling design, we divided Shahroud District into thirteen different geographic areas, which served as strata. We used 130 clusters of ten children each. Clusters were divided in proportion to the population of each stratum. The sampling frame was the complete list of all households for each stratum. Index households were selected using a systematic sampling procedure. Then skilled interviewers approached other households in the cluster by moving from the right side of the index household until ten children were sampled.

After interviewing the mothers and asking about demographic, nutritional and socio-economic status, the interviewers measured the weight and height of all children aged below 6 years old in the household. The height of all children aged below 2 years old was measured at the supine position with an infantometer. For children over 2 years of age, height was measured in the standing position using a portable stadiometer. Both the infantometer and the stadiometer had a digit counter reading precise to 1 mm. Their accuracy was tested with a metal tape every week. Weight was measured using an electronic flat scale for children over 2 years old and with an infant scale for children below 2 years old. Scales were calibrated with control weights every week. Anthropometric indices were calculated according to the latest growth reference data from the WHO (WHO Multicentre Growth Reference Study). This standard is suitable for children worldwide[14].

The Anthro software from the WHO[15] was used for the calculation of anthropometric indices. The status of these indices has been published previously[5]. To calculate the height-for-age *Z*-score (HAZ), the height of a particular child was subtracted from the median height of a child of same sex and age in the reference population of the WHO, and was divided by the standard deviation of the reference population. If HAZ for a child was below −2, the child was considered stunted.

The effects of independent variables on stunting were investigated using simple and multiple logistic regression analyses. To determine the socio-economic status of children, a principal component analysis was conducted on fifteen questions about social factors and home assets, and a new variable of asset index was constructed, as a proxy for socio-economic status. This variable, if calculated correctly, is considered to be a robust tool for grouping a population[16]. It was divided into three tertiles in the simple and multiple logistic regression models and into two quantiles in the investigation of socio-economic gap. Then, the HAZ variable at different levels of this variable was assessed and the amount of inequality was calculated.

Inequality was calculated using the concentration index (C). This index was obtained from the concentration curve, where the society is ranked according to social groups and then the cumulative percentage of the population is plotted against its share of the entire disease or outcome[17]. The concentration index is equal to twice the area between the concentration curve and the line of equality (45° line). The value of this index ranges from −1 to +1. In the case of no inequality in the distribution of a variable, C is zero, and as the value of C moves away from zero, the heterogeneity in the distribution of this variable among various social groups increases. C is negative when the curve is above the line of equality, indicating that the desired variable is concentrated in the unprivileged group. When C is positive, the curve is placed under the line of equality, indicating that the variable is concentrated in the privileged group[18].

The concentration index was calculated using the convenient covariance method, with the following formula:

$$C = 2\,\mathrm{cov}(y_i, R_i)/\mu,$$

where y is a variable for which the inequality is to be measured, μ is the average of this variable, R_i is the fractional rank of the ith person in the distribution of socio-economic status and cov is the covariance[19]. For the decomposition of C, we followed the procedure described by O'Donnell *et al.*[19]. First, in a logistic regression model, the HAZ was fitted against the independent variables. Then, the β coefficients of every independent variable were multiplied by the mean of that variable and the result was divided by mean HAZ. The resulting number was defined as elasticity. Next, for each of the independent variables, C was calculated. Multiplying C by elasticity gives the contribution of that variable in the total concentration index.

To better understand the role of factors that affect economic inequality in HAZ, we used the Oaxaca–Blinder decomposition method. This method was used for the first time in 1973 in research on labour market discrimination, where the gap between whites and blacks in terms of wages was divided into two different parts[20,21]. One part was attributed to the differences in education, work experience and other factors that influenced the difference in wages between the two groups, and the second part was attributed to discrimination. In other words, this technique separates into two parts the gap in the means of an outcome variable between two groups of the population: (i) the 'explained' portion that arises because of differences in the groups' characteristics, such as education or insurance status; and (ii) an 'unexplained' portion, which can be attributed to the differential effects of these characteristics[19]. The main advantage of this method is its ability to make this kind of distinction between the determinants of any type of inequality, and it is therefore very helpful for policy making[19]. In the present study, the first quantile of the asset index variable was considered the group with high socio-economic status and the second quantile was considered the group with low socio-economic status.

In order to calculate the explained and unexplained components, we used the Oaxaca command in the STATA statistical software package version 10[22]. In calculating the confidence level of intervals, we took the cluster sampling effect into account.

The study was conducted according to the Declaration of Helsinki. All procedures involving human subjects/patients were approved by the ethics committee of the Shahroud University of Medical Sciences. Verbal informed consent (in the presence of a witness) was obtained from all parents.

Results

In the present study, 1395 children aged below 6 years (female 50·2 %; male 49·8 %) were selected and all participated in the study (response rate = 100 %).

In the principal component analysis, four factors had eigenvalues >1 and accounted for 50·5 % of the variables' variances: having a computer at home, smoking habits of the head of the family, opium usage by the head of the family and having a dishwasher at home. The asset index variable was constructed by summation of asset variables weighted by the first factor from the principal component analysis.

HAZ was calculated for 1390 children. The mean HAZ for the studied group was −0·4136 (95 % CI −0·4827, −0·3445). HAZ is described in more detail in Table 1, which also shows the effect of independent variables

Table 1 Height-for-age *Z*-score (HAZ) and stunting at different levels of independent variables among children (*n* 1395) aged <6 years, Shahroud, Iran, 2009

Variable		*n*	HAZ Mean	HAZ 95 % CI	OR for stunting Crude†	95 % CI	Adjusted‡	95 % CI
Socio-economic status	High	454	−0·243	−0·375, −0·111	1·00	–	1·00	–
	Medium	456	−0·458	−0·581, −0·335	1·169	0·735, 1·860	0·803	0·468, 1·379
	Low	453	−0·568	−0·718, −0·418	1·671	1·015, 2·752*	0·863	0·417, 1·785
Gender	Male	691	−0·455	−0·562, −0·348	1·361	0·961, 1·931	1·460	1·012, 2·107*
	Female	699	−0·373	−0·493, −0·252	1·00	–	1·00	–
Monthly income ($US)	<200	632	−0·530	−0·665, −0·396	1·720	0·869, 3·406	1·473	0·627, 3·461
	200–299	456	−0·405	−0·517, −0·294	1·064	0·526, 2·151	0·941	0·433, 2·048
	300–400	174	0·189	−0·424, 0·046	1·023	0·479, 2·187	0·910	0·388, 2·135
	>400	127	−0·177	−0·403, 0·048	1·00	–	1·00	–
Mother's education	Illiterate	203	−0·587	−0·846, −0·328	2·602	1·041, 6·504*	3·690	1·362, 10·001*
	Primary	477	−0·614	−0·757, −0·470	2·637	1·219, 5·703*	3·257	1·317, 8·052*
	Guidance	274	−0·283	−0·442, −0·125	1·678	0·742, 3·798	2·057	0·806, 5·248
	Diploma	317	−0·228	−0·385, −0·071	1·126	0·537, 2·359	1·242	0·544, 2·835
	>Diploma	124	−0·141	−0·335, 0·054	1·00	–	1·00	–
Father's education	Illiterate	164	−0·555	−0·799, −0·311	1·616	0·662, 3·943	0·612	0·260, 1·441
	Primary	461	−0·516	−0·659, −0·372	1·352	0·657, 2·785	0·587	0·266, 1·297
	Guidance	313	−0·407	−0·542, −0·272	1·418	0·682, 2·951	0·897	0·408, 1·973
	Diploma	293	−0·386	−0·563, −0·209	1·278	0·629, 2·597	0·984	0·463, 2·091
	>Diploma	139	−0·065	−0·306, 0·176	1·00	–	1·00	–
Age (months)	0–5	89	0·183	−0·136, 0·502	1·00	–	1·00	–
	6–11	134	0·060	−0·163, 0·284	0·536	0·161, 1·782	0·548	0·163, 1·826
	12–23	249	−0·319	−0·520, −0·118	1·753	0·719, 4·269	1·855	0·739, 4·655
	24–35	248	−0·605	−0·819, −0·390	2·349	0·994, 5·550	2·398	1·002, 5·740*
	36–47	229	−0·615	−0·757, −0·472	1·772	0·762, 4·118	1·897	0·799, 4·505
	48–59	231	−0·538	−0·712, −0·364	1·456	0·566, 3·747	1·566	0·583, 4·207
	60–71	210	−0·499	−0·648, −0·350	1·456	0·587, 3·615	1·482	0·566, 3·881

*$P < 0·05$.
†In univariate logistic regression model.
‡In multivariate logistic regression model, adjusted for all variables in the table.

such as age, mother's education, father's education, family income, socio-economic status and sex on stunting, as investigated using univariate and multivariate regression. In the multivariate regression model, sex and, in some of the groups, age and mother's education had a statistically significant association with stunting. As seen in Table 1, the mean HAZ decreased with a change in socio-economic status from high to low, and the odds of stunting in the low socio-economic group was 1·67 times greater than that in the high socio-economic group. The value of *C* for this inequality was −0·1913 (SE 0·0506). The concentration curve in Fig. 1 and the value of *C*, which is negative, show that this inequality was in favour of the high socio-economic group. The decomposition of *C* showed that among all investigated socio-economic factors, mother's education was the most important, accounting for 70 % of *C* (Table 2).

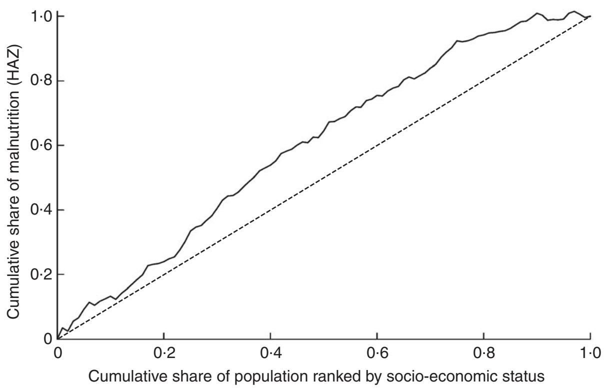

Fig. 1 Concentration curve of height-for-age *Z*-score (HAZ) and socio-economic status among children (*n* 1395) aged <6 years, Shahroud, Iran, 2009 (——, HAZ; – – –, 45° line)

Decomposition of the gap between the two socio-economic groups showed that their mean HAZ differed by 0·208. This gap was mainly due to the differences in the independent variables *per se* (the explained part of the gap) and, in this component, mother's education played the most significant role. The unexplained part included −53·8 % of the gap. Despite the value assigned to this section (−0·112 of the entire gap), it was not statistically significant. Its negative sign indicates that this part of the gap was in favour of the low socio-economic group. This implies that the low socio-economic group is more sensitive to improvements in the investigated variables, such as father's education and family income (which has a meaningful effect in this section; Table 3).

Table 2 Decomposition of the concentration index (*C*) of height-for-age *Z*-score (HAZ) and socio-economic status into its contributing factors among children (*n* 1395) aged <6 years, Shahroud, Iran, 2009

	HAZ			
Independent variable	*C*	Elasticity	Contribution to *C*	% Contribution to *C*
Gender	0·0046	0·3335	0·0015	–0·81
Age	–0·0039	0·6701	–0·0026	1·36
Mother's education	–0·1548	0·8652	–0·1339	70·01
Father's education	–0·1631	0·0418	–0·0068	3·56
Breast-feeding deprivation	0·0294	0·0082	0·0002	–0·13
Income	–0·1271	0·5389	–0·0685	35·79
Residual			0·0188	–9·78
Total			–0·1913	100·00

Table 3 Oaxaca decomposition of the height-for-age *Z*-score (HAZ) gap between socio-economic groups, children (*n* 1395) aged <6 years, Shahroud, Iran, 2009

HAZ		Prediction	95 % CI	*P* value
Mean in high socio-economic group		–0·335	–0·441, –0·229	<0·001
Mean in low socio-economic group		–0·544	–0·668, –0·420	<0·001
Difference		0·208	0·591, 0·358	0·006
Due to endowments	Gender	0·001	–0·004, 0·006	0·744
(Explained)	Age	0·001	–0·015, 0·018	0·865
	Mother's education	0·188	0·081, 0·295	0·001
	Father's education	0·030	–0·101, 0·160	0·656
	Breast-feeding deprivation	–0·0002	–0·003, 0·002	0·842
	Income	0·101	–0·008, 0·210	0·069
	Total	0·320	0·159, 0·481	0·007
Due to coefficients	Gender	0·021	–0·120, 0·162	0·843
(Unexplained)	Age	0·070	–0·187, 0·327	0·591
	Mother's education	–0·132	–0·278, 0·013	0·074
	Father's education	0·292	0·420, 0·542	0·022
	Breast-feeding deprivation	–0·005	–0·096, 0·086	0·914
	Income	–0·179	–0·350, –0·007	0·041
	Constant	–0·179	–0·680, 0·321	0·483
	Total	–0·112	–0·318, 0·095	0·289

Discussion

The results of the present study showed considerable socio-economic inequality in malnutrition among children below 6 years of age in Shahroud District, north-eastern Iran. This finding was expected because other studies have also emphasized the role of socio-economic inequality in malnutrition, especially in developing countries[12]. In fact, in the present study we could determine the extent of inequality and the role of factors affecting this inequality. Other studies have also had similar results. For example, a study in Guatemala showed that economic inequality in stunting persisted in children aged 6–60 months with a C value of $-0{\cdot}22$[9]. A study of children below 5 years old in South Africa found evidence of socio-economic inequality in stunting with $C = -0{\cdot}215$[13]. This inequality was also reported in Nigeria ($C = -0{\cdot}147$)[10], India ($C = -0{\cdot}126$)[7] and Bangladesh ($C = -0{\cdot}155$)[6]. When comparing the values of C, it must be noted that, in developing countries, the methods for measuring socio-economic status are different and these differences affect the reported inequalities[23].

The results of multiple logistic regression analysis indicated the role of mother's education and child's sex on stunting (Table 1), but in this model, the effect of socio-economic status on stunting was not significant, despite an inequality in stunting between different socio-economic groups. The contribution of mother's education to this inequality was 70 %, which is almost twice that of family income. These factors are the most important determinants associated with socio-economic inequality in stunting. However, in contrast to our findings, a study of malnutrition in Ghana found that wealth had the maximum contribution (31 %) to malnutrition inequality and the share of mother's education was 5·5 %[11]. This contradiction may be primarily due to differences in the distribution of wealth among the studied populations, in investigated variables, and in methods used to divide the community into socio-economic groups. Other studies have also emphasized the role of mother's education in malnutrition, either by measuring inequality[7,10] or by investigating malnutrition and its associated factors[24,25].

The present results showed that HAZ was normal up to 11 months of age, but significantly below normal by 12–23 months of age (Table 1). The mean HAZ even in the high socio-economic group ($-0{\cdot}355$) was less than the WHO standard value. Therefore, it is necessary that policy makers resolve this problem by developing effective interventions. On the other hand, the mean HAZ in the low socio-economic group was 0·208 less than that in the high socio-economic group. Decomposition of this gap showed that the explained part, caused by differences in independent variables, was the main reason for this gap and differences in mother's education between the two groups was the most important factor, contributing 59 % of the explained part. Father's education and family income were effective factors in the unexplained part. In fact, these factors indicate the extent of the effect of the independent variables on the mean HAZ. Few studies have identified factors influencing malnutrition by using the Oaxaca–Blinder decomposition method[26–28]. In these studies, the role of each investigated factor on malnutrition has been specified according to the investigated racial or socio-economic groups, and often educational status of the father or mother has been found to be one of the factors influencing malnutrition.

The strengths of the present study include its use of appropriate methodology in both sampling and measurement of the height and weight, along with the measurement of inequality and its associated factors. We also employed the latest standard prescribed by the WHO to measure malnutrition in this community-based study. However, given the study's cross-sectional nature, it is not possible to make causal inferences between malnutrition and the factors that were found to affect inequality. Longitudinal studies on a broader scale need to be carried out to confirm causality.

In summary, we showed a considerable socio-economic inequality in stunting in Shahroud and that maternal education was the most important factor associated with it. These data suggest that interventions to improve the educational status of women should be implemented as an important contributor to decreasing stunting in children and improving their nutritional status. Improved maternal education might reduce inequalities in this regard by as much as 70 %.

Acknowledgements

Sources of funding: The study was funded by Shahroud University of Medical Sciences, which had no role in the design, analysis or writing of this article. *Conflicts of interest:* None declared. *Ethics:* This study, No. 8706, was an approved proposal in the Shahroud University of Medical Sciences and was approved by the ethics committee of this university. Before measuring the weight and height and questioning the families, we explained about the study and verbal consent was obtained. *Authors' contributions:* M.H.E. contributed in preparation of the study design, conceptualized and conducted all statistical analyses, drafted the manuscript and was the primary author of the article. M.F. and N.G. contributed in conceptualization of the paper, were involved in data collection supervision, and critically revised the manuscript and approved it. A.F. conceived and designed the study, contributed in conceptualization of the paper and the statistical analyses, and critically revised the manuscript and approved it.

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