HUMAN BIOLOGY AND PUBLIC HEALTH JOURNAL OF THE AUXOLOGICAL SOCIETY

ISSN 2748-9957 | Vol. 1 2023 | pp. 1–9

Impact of maternal education on the growth of children in a patriarchy

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Citation:

Dorjee, B./Debnath, M./Bogin, B. (2023). Impact of maternal education on the growth of children in a patriarchy, Human Biology and Public Health 1. https://doi.org/10.52905/hbph2023.1.60.

Received: 2022-11-17
Accepted: 2023-04-11
Published: 2023-07-21

Conflicts of interest:

There are no conflicts of interest.

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Keywords:

Bengali Hindu caste, HAZ, BAZ, social-economic-political-emotional environment, patriarchy

Abstract

Aim To assess the association of father's education and occupation with child growth measured by height-for-age z-scores (HAZ) and BMI-for-age z-scores (BAZ) in a patriarchal culture where the father's social position is considered more important than the mother's. We hypothesized that in a patriarchy, paternal socio-economic status (SES) influences child growth more than maternal SES.

Sample and methods Cross-sectional study consisting of 387 school girls aged 9–14 years residing in Matigara, Siliguri sub-division of Darjeeling District, West Bengal, India. Information on age, mother's education, father's education, ethnic affiliation, mother's occupation, father's occupation, house type, household monthly income and family size were recorded. Associations between variables were assessed using Spearman correlation, St. Nicolas house analysis (SNHA), and one-way analysis of variance (ANOVA) with box plots.

Results The hypothesis that in a patriarchy paternal SES influences children's growth more than maternal SES was not supported. The observed correlations between mother's education and measures of BAZ and HAZ were 0.15 and 0.13, respectively. SNHA showed a direct connection between HAZ of girls and mother's education. Further, using ANOVA, significant differences in HAZ of adolescents was observed between the least educated mothers and those moderately educated ($F=6.593$; $p<0.01$). No difference between the maternal education levels was observed for BAZ.

Conclusion Maternal education is an important factor influencing children's linear growth even in a patriarchy. The association was independent of nutrition. Common explanations are functional literacy, decision making, access to information and health infrastructure, and lower domestic violence. Mother's education may influence perceived future prospects of the daughters and could be an important stimulus for growth.

Take-home message for students Maternal education indicates women's empowerment which influences child growth.

Introduction

It has become common wisdom that stunting is nutritional. Yet, the associations between nutrition and growth, and also those between water, sanitation, hygiene (WASH) and growth, are anything but obvious (Ahmad and Bhattacharya 2019). Recent evidence rather suggests mechanisms in the regulation of human growth that involve aspects of group behavior and social status, with maternal education being among the primary stimuli for child and adolescent growth. Contrasting common perception that considers stunting "the impaired growth and development that children experience from poor nutrition, repeated infection, and inadequate psychosocial stimulation" (height for age z-score < -2.0 according to WHO), even very stunted children appear to lack clinical evidence of malnutrition (Amaya 2002). Social disadvantages can be understood better in terms of the overall Social-Economic-Political-Emotional environment (SEPE) (Bogin 2021). Further, perception of social disadvantage and deprivation may vary with culture. In other words, culture may provide the context for social disadvantage. As a result, the growth of children may be under the influence of traditional beliefs and folk norms of that society. Therefore, in a patriarchy children's growth may be under the influence of the father's social status. Patriarchy is defined as a form of social organization in which power and authority are vested in the males and in which decent is usually in the male line (Lerner 1986; Ortner 2022; Walby 1989). These factors can shape children's perception of social status. Anthropology emphasises that in a patriarchy power rests in the hands of men, who have a greater access to, and control of, resources and rewards both in the domestic and non-domestic spheres. Wives and children depend on the men and inheritance is through the male line (Ortner 2022). Recent studies have observed the presence of such patriarchy in India (Evans et al. 2022; Singh et al. 2022; Sivakumar, I., Manimekalai, K. 2021). In patriarchal settings, fathers can have ease of access and control over resources like nutrition, education, earnings, and health. Studies have reported an association of father's socioeconomic status with growth of children (Bann et al. 2018; Lasker and Mascie-Taylor 1989; Rona et al. 1978; Whincup et al. 1988). More recently, researchers reported associations between growth and the level of a mother's education and occupation (Matijasevich et al. 2012). In India there are a number of programs and policies to encourage women's participation in education, jobs, and decision making from the household level to the greater societal level. This suggests possible challenges to existing structures of patriarchy, which may result in societal transitions to new forms of power organisation.

As studied in other social mammals, non-human primates as well as in humans (Sapolsky and Spencer 1997; Bogin et al. 2018), social-emotional effects caused by hierarchies of social dominance and subordination can be primary causes of skeletal growth (Bents et al. 2018; Bogin et al. 2018; Hermanussen et al. 2014; Özer and Scheffler 2018). In the patriarchal cultures of India, a father's social identity is frequently regarded as more important than a mother's social identity. If true, then this social environment of male dominance and female subordination could influence children's perception about their own social identity which in turn may influence their physical growth. Social status of the father can be reflected by levels of education and occupations which are the most widely used proxies for assessing socioeconomic status (SES). Therefore, the present study hypothesized that in a patriarchy paternal

SES influences children growth more than maternal SES.

Sample and Methods

Like most other Hindus of India, the Bengali Hindu caste of the Darjeeling foothills is a patriarchal culture. The present cross-sectional study was conducted among 387 school girls belonging to the Bengali Hindu Caste Populations (BHCP) aged between 9–14 years residing in the areas of Matigara Block under Siliguri sub-division of Darjeeling district, West Bengal. Ethnically, the BHCP is a Bengali-speaking endogamous caste group of West Bengal and faithful to Hinduism comprised of different castes (Das Chaudhuri et al. 1993).

A total of three secondary schools were selected for the collection of the data. The schools were selected based on the preponderance of BHCP students. Age was recorded from school records and birth certificates. Necessary study permissions were obtained from the schools prior to data collection. Verbal consent was taken from parents and girls prior to collection of data. Participation was purely voluntary in nature. Those suffering from any physical or limb deformities and presenting with any clinical signs of malnutrition or disease (e.g. hyperkeratosis, dermatosis, skin pigmentation, dull and dry hair, rusty reddish hair, goiter, spoon nail shape, brittle nails, ridged nails, swelling of mouth and lips, angular fissures and scars at the corner of the mouth, spongy gums, bleeding gums, and Bitot's spot) at the time of data collection were excluded. However, children suffering these conditions were rare (<2%) of prospective participants. Further, in the present study boys were excluded because i) historically boys are favoured over girls in India, ii) boys spend more time with their father and outside the home, and iii) to avoid the influence of sex differences in growth.

Ethical statement

The study was conducted according to the ethical guidelines for human experiments as laid down in the Helsinki Declaration of 2000. Data were anonymised for further processing. Prior ethical clearance to conduct the research was obtained from the Institutional Review Committee of the Department of Anthropology, University of North Bengal.

Data Processing

The socio-economic data obtained were abbreviated for analyses: father's education (Fedu), mother's education (Medu), father's occupation (Foccu), mother's occupation (Moccu), household monthly income (Income), family size (FMsize), and drinking water source (Dwater). For the variables income, father's education, mother's education, birth order, family size, levels increase in parallel with given coding. Families not having a reliable source of income and illiterate parents were coded 0. The drinking water was coded as 1 if participants have privately managed source of drinking water in their house, or as 2 if the family had a government supply source of drinking water. In all cases, quality or condition increases with the number given as codes. Further, to conduct ANOVA, father's education and mother's education were categorized into three levels. The first category denoted by number 1 comprised people with below 4 years of education and the illiterates. The next category denoted by number 2 is people with 5 to 10 years of education and the final category was of people with above 11 years of education.

Assessment of Growth

Z-score values of height-for-age and BMI-for age were calculated using WHO Anthro plus software. These two variables were used as indicators of growth.

Statistical Analyses

Statistical analyses were undertaken using R software environment for statistical computing (R Core Team 2022). R packages used for visualization were corrplot (Wei and Simko 2017), snha (Groth 2023), ggpubr, rstatix, and datarium (Kassambara 2019, 2020, 2021). Associations between variables were assessed using Pearson correlation, St. Nicolas' House Analysis (SNHA) (Hermanussen et al. 2021).) with threshold value $r > 0.1$, and one-way analysis of variance (ANOVA) with box plots. The SNHA technique is a novel, non-parametric statistical method that translates a correlation matrix into network graphs by tracing "association chains". Series of coefficients of determinants that are characterized by the symmetry of ranks of R^2 both in forward and in backward direction are named "association chains". The association chains formed by the SNHA are ranked according to the magnitude of correlation coefficients (R2), e.g. c[A*B], c[B*C], c[C*D], with the property c[A*B]>c[A*C]> c[A*D], and c[D*C]> c[D*B]> c[D*A]. Essentially, St. Nicolas' House Analysis produces a network graph, consisting of "nodes" and "edges". Edges direct the associations from one node to the next one. Hence, SNHA is a directed graph that has a topological ordering from earlier to later associations.

This technique is suitable for handling multiple correlations usually encountered in anthropometric, various socio-economic and socio-demographic datasets (Groth et al. 2019). It translates correlation matrix into network graph which is a useful visual aid and beneficial for data exploration. SNHA has been used by researchers to document the associations of various growth, socio-economic and socio-demographic variables (Martin et al. 2020; Dorjee et al. 2020). SNHA has been shown to be superior to other methods, using sophisticated correlation value thresholds and partial correlations, in terms of its performance measures, balanced classification rate and the F1-score for analyzing bands and hubs (Groth et al. 2019).

Results

Descriptive statistics of age, socio-economic and growth variables of BHCP girls are presented in Table 1. We calculated the correlation matrix between all variables (Figure 1). The correlation coefficient between HAZ and BAZ was 0.26, which is sufficiently low to accept these two variables as independent indicators of growth. The correlation coefficient of HAZ and BAZ with mother's education level (Medu) had values of 0.15 and 0.13, respectively. These values were relatively low and not significant statistically, but they were the next highest correlation values of all the variables measured. The SNHA confirmed that mother's education had the most direct association with HAZ and BAZ (edges from node of mother's education connecting nodes of BAZ and HAZ in Figure 2). There was also a direct edge between the nodes of mother's education and father's education, and these in turn were connected with father's occupation. Unlike mother's education, mother's occupation was directly linked to family monthly income. Finally, there was a direct edge from family size to BAZ.

ANOVA was conducted to assess the association of mother's education level with the growth of their children. The result of the ANOVA is visualised as box plots in Figure 3 and 4. There were significant difference in the HAZ of participants between the 1st and 2nd level of maternal education ($F=6.593$; $p<0.01$). This meant that the linear growth of children differed between mothers who were illiterate or had less than four years of education and mothers who had 5 to 10 years of education. There was no difference in BAZ between maternal educations at any level (Figure 4).

Discussion

The present study does not support the hypothesis that in a patriarchy father's SES, measured by education and occupation, is the most important factor influencing the growth of girls. Instead, a relatively higher correlation was observed between HAZ, BAZ, and maternal education. The SNHA confirmed these findings.

The ANOVA results indicated that the association of maternal education with HAZ was significant whereas BAZ was not. The fact that maternal education is related to HAZ, but not BAZ, suggests that the effect of maternal education is not mediated via nutrition. However, resource sharing within a family can influence weight (direct edge between BAZ and family size). Previous studies also reported that even in a traditional horticultural group, educated mothers and mothers who can speak two languages, including English, besides their own local language had taller children (King and Mascie-Taylor 2002). The association of maternal education with physical growth in height of the children could be a universal marker of social advantage of a family in societies embracing norms of greater education for females.

Table 1 Descriptive statistics of age, socio-economic variables and growth parameters of Bengali Hindu caste girls (n=387) of Matigara, Darjeeling, India

Variables	Mean	Median	±SD	Minimum	Maximum
Age (in years)	11.83	11.9	1.59	9	14.9
BMI-for-age z scores (BAZ)	-0.33	-0.30	1.23	-4.66	2.93
Height-for-age z scores (HAZ)	-1.22	-1.17	1.05	-5.17	1.88
Mother's years of school (Medu)	4.67	5	4.48	0	19
Fathe'sr years of school (Fedu)	4.42	4	4.71	0	19
Mother's occupation (Moccu)	2.84	2	1.42	1	7
Father's occupation (Foccu)	3.94	3	1.38	1	7
Household monthly income (Indian Rupee) (Income)	7371	7000	2300	0	30000
Family size (FMsize)	4.95	5	1.64	2	16
Drinking water (Dwater)	2.8	3	1.02	1	4
	Categories for ANOVA			N (%)	
Mother's education	< 4 years of school			190 (49.1)	
	5-10 years of school			172 (44.4)	
	> 11 years of school			25 (6.5)	
Father's education	< 4 years of school			211 (54.5)	
	5-10 years of school			145 (37.5)	
	> 11 years of school			31 (8)	

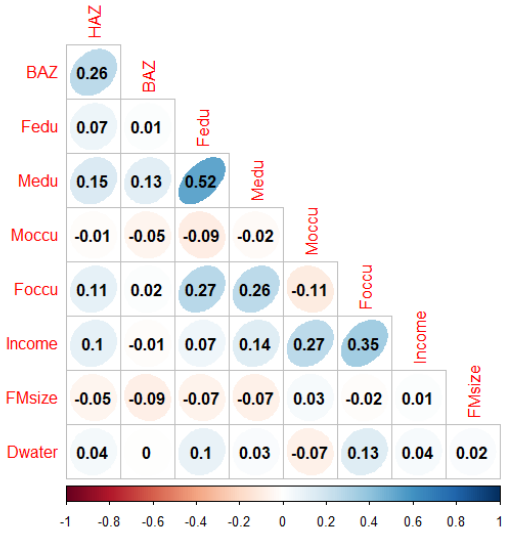

Figure 1 Correlation plot of the socio-economic variables and growth of children using Spearman method. Growth is represented by BMI-for-age z-scores (BAZ) and height-for-age z-scores (HAZ). Socio-economic variables are father's education (Fedu), mother's education (Medu), father's occupation (Foccu), mother's occupation (Moccu), family monthly income (Income), family members (FMsize), and drinking water (Dwater).

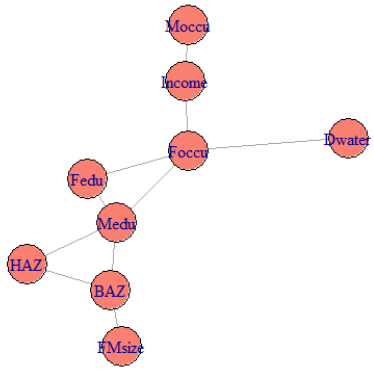

Figure 2 St. Nicolas House Analysis based on the socio-economic variables and growth of children represented by BMI-for-age z-scores (BAZ) and height-for-age z-scores (HAZ). Socio-economic variables are father's education (Fedu), mother's education (Medu), father's occupation (Foccu), mother's occupation (Moccu), family monthly income (Income), family members (FMsize) and drinking water (Dwater). Spearman method for correlation was used with alpha=0.05, and threshold=r> 0.01.

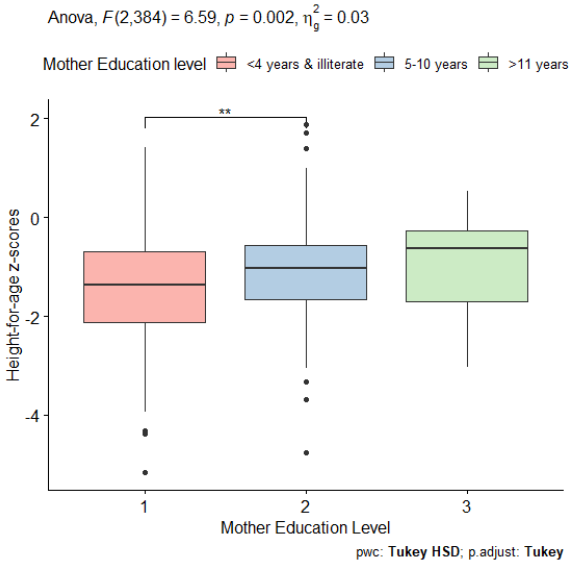

Figure 3 Box plots showing height-for-age z-scores (HAZ) of children of different levels of mother's educations.

According to studies in India, maternal education is associated with greater access and utilization of health care facilities, earning, and autonomy (Das et al. 2020; Shroff et al. 2009; Vikram and Vanneman 2020). Another study has emphasised the functional literacy of the mother which may have positive effect on children's growth even if maternal education is low (Jarosz and Gugushvili 2020). A recent study concluded that the decision making power of women in the family is an important predictor of early child growth in India (Das et al. 2020). Similar studies from other parts of the world observed association of maternal education and SES with health outcomes in children (Davey et al. 2015; Ngandu et al. 2021; Patel et al. 2022; Yu et al. 2018).

Remarkable growth has been shown by studies among migrant children. Migration usually takes place from Low and Middle Income Countries to high-income countries and may also lead to significant improvements of SEPE conditions (Özer and Scheffler 2018; Bogin et al. 2018) which are subsequently reflected in improvements of physical growth (Cernerud 1995; Koziel

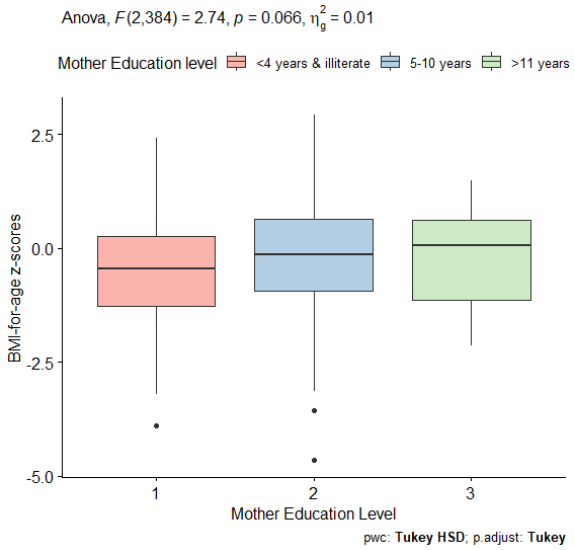

Figure 4 Box plots showing BMI-for-age z-scores (BAZ) of children of different levels of mother's educations.

et al. 2019). The general trend towards better maternal education that again is associated with better growth of their female offspring suggests a number of recent changes of female living conditions within the modern patriarchies, and a general perception of improving future prospects for girls. Support for this interpretation comes from China, where more and more often the mothers tend to pass their surnames to the children indicating a turning away from the father's social dominance toward greater autonomy for women. In parallel with the increasing use of the mother's surname, children's growth in height-for-age and weight-for-age has improved (Li et al. 2021).

In India, surnames are inherited from the father's line, with some exceptions. However, there are some other signs of increasing female autonomy: women are encouraged to take part in local, regional, and national democratic processes in all walks of life through various government schemes and sponsored programs (Raj 2014; Singh and Singh 2021).

Limitations

Pubertal hormonal changes influence both height and body composition (BMI). The present study lacks information on the maturation status of the girls and as a result cannot adjust height and BMI accordingly.

Conclusion

Maternal education influences girls' growth to a greater extent that paternal education or occupation. This is also true for patriarchies. The reason could be functional literacy, decision making, access to information and health infrastructure, autonomy, and less exposure to domestic violence. This association between mother's education and improved HAZ of girls was not mediated via nutrition. With the turning away from male dominance in the traditional patriarchy, the perceived improvements of future prospects could have effectively stimulated the growth in height of girls.

Acknowledgements

The authors dedicate this paper to the memory of Dr Jaydip Sen. He was with us in the initial stage of writing draft of this paper. The children, as well as their parents and teachers, are acknowledged for their participation in the study.

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