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Study on the association between Physical growth and Socio-economic condition of North-West and South-West Khasi children in the State of Meghalaya.

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Abstract
This Paper makes an attempt to understand how the under-nutrition of children is associated with age, sex and certain socio-economic factors. In the study we include 495 girls and 557 boys aged 3 to 18 years in which their weight and height were taken and their socio economic status was recorded. Certain socio-economic variables were collected and classified arbitrarily into different groups or categories with a view to understanding their influence on demographic variables i.e. base on income group, educational level and family size. The data collected for the present study were quantified and analyzed statistically, using SPSS Window software. These variables were considered as risk factors of under-nutrition as indicated by odds ratios derived from logistic regression analysis. The present study has revealed that the prevalence of under-nutrition, especially underweight, is significantly associated with household income and parental education. It is evident that household income is an important factor in influencing the prevalence of stunting in the present population. Unlike in the case of underweight and stunting, the effects of socioeconomic factors on wasting are not statistically significant in the present population.

Keyword: - Income group, Under-nutrition, Stunting, Wasting, Sex differences.

Introduction

Under-nutrition affects all sexes and ages. What makes the situation more serious is that children under 5 years of age are the most vulnerable victims. Under-nutrition predisposes an individual to infection and *vice versa*. It is one of the major risk factors for infections and diseases (WHO, 2000a). About 50% of the total annual deaths in children under 5 years of age are associated with under-nutrition in developing countries (Rice *et al*., 2000; WHO, 2000b). Under-nutrition is attributable not only to poor access to food but also to other poor environmental conditions, such as poor housing and hygienic conditions, unsafe drinking water, heavy workloads, lack of preventive and control measures of locally endemic diseases and infections. These poor environmental conditions are the common characteristics of population groups belonging to the lower socio-economic strata of the society, especially in developing countries (de Onis *et al*., 2000). In other words, the major cause of under-nutrition is poverty compounded by other poor environmental conditions that predispose an individual to morbidity and mortality. There is considerable evidence that children in the lower socio-economic groups especially in developing countries are often the victims of malnutrition and its associated morbidity and mortality (WHO, 2000a). Since human growth and development is also largely influenced by socio-environmental factors like nutrition, infection, occupation, income and religion, it is very vital to understand the bio-cultural variation and evolution of human populations (Tanner, 1988: Eveleth and Tanner, 1990).

Several studies have revealed the association between physical growth and socioeconomic condition of populations (Lindgren, 1976; Garn *et al*., 1984; Johnston, 1986; Lasker and Mascie-Taylor, 1989; Visweswara Roa *et al*., 1990; Terrell and Mascie-Taylor, 1991; Hauspie et al., 1992; Khongsdier, 1993 Misuraca *et al*., 1995; Mockus *et al*., 1995; Post *et al*., 1997; Milani *et al*., 1999) Some studies suggest that

within a given country children from economically advanced areas are taller and heavier than children belonging to the economically underprivileged areas (Ferro-Luzzi, 1967; Ferro-Luzzi *et al*., 1979) It is generally agreed on the basis of data from different continents, that variation in growth pattern of children in developed countries of Europe and North America on one hand and in the developing countries of Asia, Africa and Latin America on the other are mostly due to differences in their socio-economic status, and not because of genetic differences (Habicht *et al.*, 1974;Stephenson et al., 1983; Eveleth and Tanner, 1990; Gopalan, 1992). Thus growth and development of children may also be considered an indicator of socio economic status of a given population. In the present study; we shall also consider the variation between populations in respect of growth pattern as mainly due to variation in nutritional status which is greatly influenced by the socioeconomic condition of an individual or a population.

Some studies in India also revealed that children from the well to do sections of the same community are heavier and taller than their counterparts belonging to the poor socio-economic groups (Mitra, 1939; Dutta Banik *et al.*, 1970; Bharati and Basu, 1990) Rajyalakshmi (1981) has also observed that the children of higher income groups are heavier and taller than those of lower income groups. Indian Council of Medical Research (ICMR 1972) has also reported that the height, weight subcutaneous tissue and other anthropometric variables are positively associated with socioeconomic status. Similarly Vijayaraghavan *et al.* (1974) and Visweswara Rao *et al*. (1980) reported that the arm economic groups were considerably smaller than those of well to do children of corresponding ages. The effect of socio economic condition on growth pattern of Indian children also been revealed in other studies (Roa and Sastry, 1977; Satyanarayana *et al*., 1980; National Nutrition Monitoring Bureau 1980; Bharati and Basu 1990).

In light of the above review this study is conducted with an objective to

1. To find out the effect of socio economic condition on growth pattern of khasi children
2. To understand the influence of parental education, family income and family size on the risk of under-nutrition, Stunting and wasting of the study population.

Methodology

Study Area and Population

The present study was conducted on North and South West Khasi Hills District of the State of Meghalaya, which is predominantly inhabited by the Khyriam Khasis (i.e. about 235 villages). In the present study the term 'Khasis' will be used to refer to the Khynriam Khasis inhabited in the North and South West Khasi hills district of Meghalaya.

Data on Growth of Children: The present study was based on a cross sectional sample of Khasi boys and girls aged between 3-18 years. The weight and height of 557 boys and 495 girls were taken and their socio economic status was recorded.

In this study, certain socio-economic variables were classified arbitrarily into different groups

Income groups: Data on household income were collected directly from the heads of the households and they were cross-checked taking into consideration some aspects of socio-economic conditions like housing condition, types of occupation, land holding, and monthly expenditure. The per capita monthly income of the households was classified as follows:

Above 75^{th} percentile (Rs.500) = High income group (HIG)
50^{th} to 75^{th} percentile (Rs.333-500) = Middle income group (MIG)
Below 50^{th} percentile (Rs. 333) = Low income group (LIG)

Educational Level: Data on educational attainment of individuals in the present study were arbitrarily classified as follows: The category **illiterate** includes those individuals who were unable to read and write and those who had no education but could read or write their names**.** The individuals who attended school up to standard VII were grouped into **Primary** level of education. The individuals with educational level from VIII and above were grouped into **Secondary level** of education.

Family Size: The family size was classified into three categories. The individuals who lived in a household with less than 5 family members were considered as having a **Small Family Size.** The **Average/Medium Family Size** includes those individuals who lived in a household with 5-6 family members. The individuals who lived in a household with more than 6 family members were grouped in the category of **Large Family Size**.

Statistical Analyses

For assessing the nutritional status of children, we have adopted three anthropometric indices, that is, weight-for-age, height-for-age and body mass index (BMI)-for-age, which ones considered as good indicators of nutritional status.

For classifying the children into different grades of nutritional status, we have calculated the Z – Scores of the individuals relative to the CDC revised growth references (Kuczmarski *et al*., 2000). The Z-score of - 2 was considered as the cut-off point for screening the individuals who are likely to be malnourished. On the basis of Z-scores for weight-for-age, height-for-age and BMI-for-age, the nutritional status of children was categorized as follows:

Z-score	**Nutritional status**
≥ + 2 score	Above normal
≤ -2 to +2 Z-score	Normal
-2 to -3 Z-score	Moderate
< -3 Z-score	Severe

Then we used logistic regression method for analyzing the relationship between under-nutrition and socio-economic factors, using SPSS 15 for Windows. The individuals who were below – Z score of the anthropometric indices were categorized as under-nourished (coded as 1) and those with a Z score of – 2 and above were considered as not under-nourished (coded as 0).The odds ratio (OR) with 95% confidence interval (CI) was derived as an exponent of the regression coefficient. Logistic regression analysis was carried out in order to understand how the under-nutrition of children is associated with age, sex and certain socio-economic factors. Two models were considered in carrying out the logistic regression analysis. In model 1: the unadjusted odds ratio (OR) with 95% confidence interval (CI) was computed as an exponential of the coefficient of logistic regression for all the covariates under consideration. In model 2: the OR was adjusted for those variables that are significantly associated with under-nutrition.

Results

Table 1: Results of logistic regression analysis on risk factors of underweight

Parameters	N	Prevalence %)	Model 1*		Model 2**	
			OR (95% CI)	P-level	OR (95% CI)	P-level
Age groups (years)						
3-9	429	169 (39.39)	-	-	-	-
10-18	627	253 (40.35)	1.03 (0.80-1.32)	0.849	-	-
Sex						
Girls	557	218 (39.14)		-	-	-
Boys	495	204 (41.21)	-	0.493	-	-
Income group			1.09 (0.85-			

High			1.40)			
Middle	202	57 (28.22)		-	-	-
Low	292	116 (39.73)	-	0.009	1.59 (1.08-2.35)	0.02
Maternal education	558	249 (44.62)	1.68 (1.14-2.47)	0.000	1.92 (1.34-2.74)	0.001
Secondary	288	96 (33.33)	2.05 (1.45-2.91)	-		-
Primary	543	227 (41.80)		0.017	-	0.118
No education	221	99 (44.80)	-	0.009	1.28 (0.94-1.74)	0.097
Paternal education			1.44 (1.07-1.94)			
Secondary	254	85(33.46)		-	1.37 (0.94-1.99)	-
Primary	588	247 (42.01)	1.62 (1.13-2.33)	0.020		0.147
No education	210	90 (42.86)		0.038	-	0.074
Family size			-		1.26 (0.92-1.73)	
Small	259	100 (38.61)	1.44 (1.06-1.96)	-		-
Medium	659	268 (40.67)		0.567	1.42 (0.97-2.09)	-
Large	134	54 (40.30)	1.49 (1.02-2.18)	0.745		-
					-	
			-		-	
			1.09 (0.81-1.46)		-	
			1.07 (0.70-1.64)			

*Unadjusted odds ratio, **Adjusted odds ratio

Risk Factors of Underweight

Table 1 shows the prevalence of underweight according to age, sex and socio-economic conditions. The ORs showing the risk of underweight to these factors were derived from logistic regression models. It is found that underweight is significantly associated with household income and parental education, but it is not significantly associated with age, sex and family size, although the prevalence of underweight is greater in boys as well as in the older age group.

As for household income, **Table 1** shows that children from low income group had about 2 times greater in risk of being underweight as compared to children belonging to the high income group (OR = 2.05, 95% CI: 1.01-2.30, $p < 0.0001$). Also, middle income group children had about 1.68 (95% CI: 1.14-2.47, $p< 0.009$) times greater in risk of being underweight as compared to those in the high income group. Adjusting for maternal and paternal education in model 2, the effect of household income is still significant ($p < 0.02$). It is found that the children belonging to the low and middle income groups had respectively about 1.9 and 1.6

times greater in risk of being underweight as compared with those belonging to the high income group. This indicates that household income is the very important factor in regulating the weight status of children in the present population.

With respect to maternal and paternal education, **Table 1** shows that children of illiterate mothers had about 1.6 (95% CI: 1.13-2.33, $p < 0.009$) times greater in risk of being underweight than those children whose mothers were educated up to secondary and above. What interesting is that even children of mothers with primary education (lower and upper primary) had a greater risk of underweight when compared with those children whose mothers were educated up to secondary or higher secondary. The same is true with paternal education. Children of illiterate fathers had about 1.5 (95% CI: 1.02-2.18, $p < 0.04$) times greater in risk of being underweight than those children whose fathers were educated up to secondary and above. However, when household income is included in the model (Model 2), the effect of maternal and paternal education disappeared. This reveals that household income is more important than parental education in patterning the weight status in the present population. Thus, we may conclude that although parental education does exerts its influence on the prevalence of under-nutrition among children, household income seems to be more important. This clearly reveals, as normally expected, that economic condition is very important in regulating the nutritional status of children in the present study.

Risk Factors of Stunting

Table 2 Results of logistic regression analysis on risk factors of stunting

Parameters	N	Prevalence %)	Model 1*		Model 2**	
			OR (95% CI)	P-level	OR (95% CI)	P-level
Age groups (years)						
3-9	429	162 (38.12)	-	-	-	-
10-18	627	388 (61.88)	2.64 (2.05-3.40)	0.000	2.60 (2.01-3.25)	0.000
Sex						
Girls	557	251 (53.68)		-		-
Boys	495	251 (50.71)	- 0.89 (0.70-1.13)	0.335	- -	-
Income group						
High	202	85 (42.08)		-		-
Middle	292	147 (50.34)	-	0.027	- 1.30 (0.89-1.89)	0.175
Low	558	318 (42.08)	2.41 (1.11-5.24)	0.006		0.002
Maternal education					1.71 (1.22-2.41)	
Secondary	288	144 (50.00)	2.58 (1.32-5.05)	-		-
Primary	543	277 (51.02)		0.781		-
No education	221	33 (58.37)	-	0.061	- -	-
Paternal						

education			1.04 (0.78-1.39)	-	-	
Secondary	254	127 (50.00)		-		-
Primary	588	308 (52.38)	1.40 (0.99-2.00)	0.526	-	-
No education	210	115 (54.76)		0.307	-	-
Family size			-		-	
Small	259	135 (52.12)	1.10 (0.82-1.48)	-		-
Medium	659	356 (54.02)		0.659	-	-
Large	134	59 (44.03)	1.21 (0.84-1.75)	0.098	-	-
					-	
			-			
			1.08 (0.81-1.14)			
			0.72 (0.48-1.10)			

***Unadjusted odds ratio, **Adjusted odds ratio**

Table 2 shows the risk factors of stunting as indicated by odds ratios like in the case of underweight shown above. It is found that the unadjusted odds ratios are significant with respect to age and household. Other covariates like sex, parental education and family size are not significantly associated with the prevalence of stunting. With respect to age, it is found that risk of stunting was 2.64 (95% CI: 2.05-3.40, $p < 0.0001$) times greater among children in the older age group 10-18 years when compared with those in the younger age group 3-9 years. The OR was significant even after adjusting for household income and parental education (CI = 2.60, 95% CI: 2.01-3.25, $p < 0.0001$). Therefore, it is likely that age of children plays a very important role in regulating the height-for-age in the present population.

As for household income, Table 4.9 shows that children in the low income group had about 2.58 (95% CI: 1.32-5.05, $p < 0.006$) times greater in risk of being stunted when compared with those in the high income group. Similarly, the risk of stunting was about 2.41 (95% CI: 1.11-5.24, $p < 0.027$) times greater among children in the middle income group when compared with the children in the high income group. Adjusting for age, the effect of income is still significant even after removing the effect of age. It is found that children in the low income group had about 1.71 (95% CI: 1.22-2.41, $p < 0.002$) times greater in risk of being stunted when compared with those in the high income group. However, the OR for the children in the low income group was not significant as compared with the children in the high income group (OR: 1.30, 95% CI: 0.89-1.89, $p > 0.05$). Nevertheless, it is evident that household income is an important factor in influencing the prevalence of stunting in the present population.

Risk Factors of Wasting

Table 3: Results of logistic regression analysis on risk factors of wasting

Parameters	N	Prevalence %)	Model 1*		Model 2**	
			OR (95% CI)	P-level	OR (95% CI)	P-level

Age groups (years)						
10-18	627	51 (8.13)	-		-	-
3-9	429	59 (13.75)	1.82 (1.22-2.71)	0.003	1.83 (1.23-1.73)	0.003
Sex						
Girls	557	59 (10.59)		-	-	-
Boys	495	51 (10.30)	-	0.878	-	-
Income group			0.97 (0.65-1.44)			
High	202	19 (9.41)		-	-	-
Middle	292	31 (10.62)	-	0.661	-	-
Low	558	60 (10.75)	1.14 (0.63-2.09)	0.591	-	-
Maternal education						
Secondary	288	29 (10.07)	1.16 (0.67-1.99)	-	-	-
Primary	543	57 (10.50)		0.847	-	-
No education	221	24 (10.86)	-	0.772	-	-
Paternal education			1.05 (0.65-1.68)			
Secondary	254	28 (11.02)		-	-	-
Primary	588	57 (9.69)	1.09 (0.61-1.93)	0.557	-	-
No education	210	25 (11.90)		0.767	-	-
Family size						
Small	259	29 (11.20)		-	-	-
Medium	659	73 (11.08)	0.87 (0.54-1.40)	0.659	-	-
Large	134	8 (5.97)	1.09 (0.62-1.94	0.098	-	-
			-			
			0.99 (0.63-1.56)			
			0.51 (0.22-1.14)			

***Unadjusted odds ratio, **Adjusted odds ratio**

The risk factors of wasting in terms of odds derived from logistic regression models are presented in **Table 3**. Unlike in the case of underweight and stunting, the effects of socioeconomic factors on wasting are not

statistically significant in the present population. However, the prevalence of wasting was significantly greater among children in the lower age group (14%) than that in the higher age group (8%). In other words, it is found that children in the age group 3-9 years had about 1.82 (95% CI: 1.22-2.71, p< 0.003) times greater in risk of wasting as compared with those in the age group 10-18 years. Adjusting for household income, the OR was still significant (OR: 1.30, 95% CI: 0.89-1.89, p > 0.05). The household income was adjusted because it is likely that children in the low and middle income groups had greater risk of wasting when compared to those in the high income group, although the OR was not statistically significant. Thus, it cannot be totally ruled out the role of household income in regulating the prevalence of wasting in the present population.

CONCLUSION

Our study found that underweight is significantly associated with household income It is found that the children belonging to the low and middle income groups had respectively about 1.9 and 1.6 times greater in risk of being underweight as compared with those belonging to the high income group. This indicates that household income is the very important factor in regulating the weight status of children in the present population With respect to maternal and paternal education, it is found that children of illiterate mothers had about 1.6 (95% CI: 1.13-2.33, p < 0.009) times greater in risk of being underweight than those children whose mothers were educated up to secondary and above The same is true with paternal education. Children of illiterate fathers had about 1.5 (95% CI: 1.02-2.18, p < 0.04) times greater in risk of being underweight than those children whose fathers were educated up to secondary and above. However, when household income is included in the model (Model 2), the effect of maternal and paternal education disappeared. This reveals that household income is more important than parental education in patterning the weight status in the present population. Thus, we may conclude that although parental education does exert its influence on the prevalence of under-nutrition among children, household income seems to be more important.

When it come to stunting it was found that risk of stunting was 2.64 (95% CI: 2.05-3.40, p < 0.0001) times greater among children in the older age group 10-18 years when compared with those in the younger age group 3-9 years. Therefore, it is likely that age of children plays a very important role in regulating the height-for-age in the present population. As for household income, shows that children in the low income group had greater in risk of being stunted when compared with those in the high income group. Similarly, the risk of stunting was about 2.41 (95% CI: 1.11-5.24, p < 0.027) times greater among children in the middle income group when compared with the children in the high income group Nevertheless, it is evident that household income is an important factor in influencing the prevalence of stunting in the present population.

Unlike in the case of underweight and stunting, the effects of socio-economic factors on wasting are not statistically significant in the present population. However, the prevalence of wasting was significantly greater among children in the lower age group (14%) than that in the higher age group (8%). In other words, it is found that children in the age group 3-9 years were about 1.82 (95% CI: 1.22-2.71, p< 0.003) times greater in risk of wasting as compared with those in the age group 10-18 years. Adjusting for household income, the OR was still significant (OR: 1.30, 95% CI: 0.89-1.89, p > 0.05). The household income was adjusted because it is likely that children in the low and middle income groups had greater risk of wasting when compared to those in the high income group, although the OR was not statistically significant. Thus, it cannot be totally ruled out the role of household income in regulating the prevalence of wasting in the present population.

The present study has revealed that the prevalence of under-nutrition, especially underweight, is significantly associated with household income and parental education. Therefore, the present study confirms the earlier observation that socioeconomic factors like income and parental education play a very important role in regulating the nutritional status of children (Eveleth and Tanner, 1990; Bogin, 1999).

Last but not least, the present study has also certain policy implications. Overall, it is evident that there is a high prevalence of under-nutrition among the Khasi children, which is also consistent with the recent report by the NFHS-3 (IIPs and Macro International, 2009). Therefore, nutrition policies like the nutrition supplementary programme should be intensified in the state. Growth retardation is not only because of poor socioeconomic condition, but it has a vicious circle. It may affect the socioeconomic condition of an

individual, or a population as well, because of the poor earning capacity due to poor health status. It may be suggested that efforts to improve agricultural activity or food availability, dietary quality, hygiene, supply of safe-drinking water, and prevention and treatment of infectious diseases are likely to improve the health and nutritional status of the Khasi population over time.

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Compliance with Ethical Standards:
The author declares that I have no conflict of interest as it was not funded by any source.

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