

Level and Determinants of Malnutrition among Primary School-Aged Children in India:

A National Representative Cross- Sectional Study

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Background

Malnutrition i.e. stunting, underweight, thinness, overweight and obesity refers to a pathological state resulting from deficiency or excess of one or more essential nutrients. Malnutrition in children may lead to physical and psychological instability and suffering (Sasikala, 2016). Few studies have reported a significant increase in overweight and obesity in developing countries (Bhurosy & Jeewon, 2014; Chopra et al., 2002; Ogden et al., 2016; Pienaar, 2015). The rate of increase in childhood obesity in many countries has been greater than the rate of increase in adult obesity.

The prevalence of malnutrition in general population is higher in India compared to the other developed countries and remains one of the India's major public health problems. India is still struggling with high rate of underweight and stunting in children under-five with the proportion of stunted and underweight children being 38 per cent and 36 per cent respectively (International Institute for Population Sciences and ICF, 2017). The probability for anthropometric failure increases by age, birth-order, female sex and activity of the child other than schooling. Whereas few studies suggested that higher the level of the mother's education, the lower the level of child's underweight (Malpani et al., 2014). Malnutrition is positively related with congestion in the household, while provision of electricity, safe drinking water and underground drainage turns out to be negatively affecting children's malnutrition. Growing children by and large are deprived of proper nutrition on account of their poor socio-economic status, ignorance and lack of health promotional facilities. A school based cross-sectional survey in Egypt found that the prevalence of stunting was 34.2% while obesity 14.9% among the children (6-17 years). Obesity was significantly higher in younger age group (6-9 years) as compared to older age. Males are in high risk of obesity as compared to females (Wahed et al., 2017). Food consumption is also directly affecting the nutritional status of school-going children. Reduced poultry consumption and escaping breakfast are associated with stunting (Wahed et al., 2017).

Previous studies in Indian context have not collected nationally representative data on children's nutritional status between the age of 5 and 19 years. These populations received lack of attention than those who are considered to be more vulnerable (pre-school children and adolescents). Data from the Comprehensive National Nutrition Survey (CNNS) offer a unique opportunity to investigate the severity and distribution of malnutrition among school going children at the national level, according to urban and rural areas, and according to state and region. The CNNS data can also be used to assess the trends and socioeconomic determinants of the prevalence of malnutrition. Therefore, the present study was undertaken to explore the prevalence of malnutrition among school going children according to socioeconomic and demographic variables taking into account the individual, household and community level characteristics. The results of analysis may cast some light on the attention and efforts to be paid to the health and wellbeing of school going children in the education sector planning. School-age children are beneficiaries of the world's largest school feeding programme i.e., Mid-Day Meal Scheme. Against this backdrop the present study aims to identify level of malnutrition and its possible risk factors among primary school-aged children (aged 5-10 years) in India.

Study Setting, Data and Methods

Data sources and Sample size

The present study utilised the Comprehensive National Nutrition Survey (CNNS). The CNNS is one of the largest micronutrient survey ever implemented globally and is the first ever nationally representative large-scale nutrition survey of children and adolescents in India. The CNNS is conducted by the Ministry of Health and Family Welfare (MoHFW), Government of India, in collaboration with the United Nations Children's Fund (UNICEF). The CNNS covered 2035 PSUs (village/urban block) covering 122100 households. The total sample size of children was 38,060 and 38,355 children aged 0-4 years and 5-9 years, respectively. Adolescents numbered 35,830 aged 10-19 for the household survey and anthropometric measurements and 20,350 individuals for biological samples for each of the three age groups. The present study, pertaining to children 5-10 years (Primary school-aged children) is extracted from CNNS country data which contains of a total of 38355 children. It adapted a multi-stage sampling design to select a representative sample of households and children

Variable descriptions

Outcome Measurements: The present study used the following outcome measures:

Stunted: stunted if their height-for-age is more than two standard deviations below ($< 2SD$) the WHO Child Growth Standards median (WHO, 2007b).

Underweight: Underweight if their weight-for-age is more than two standard deviations below ($< -2SD$) the WHO Child Growth Standards median (WHO, 2007b).

Overweight and obesity: Overweight and obesity are defined as BMI-for-age $> +1SD$ and $> +2SD$ above the WHO Child Growth Standards median (WHO, 2007b).

Predictor variables

To study the socio-demographic determinants of malnutrition, the selection of predictor variables was guided by relevant variables that have been identified in previous studies as being determinants of malnutrition. They are sex of the child, schooling status of child, consumption of junk food from child, current mothers age, mothers schooling, mass media exposure of mothers, religion of households, social groups of households, economic status of the households, place of residence and regions of residence in order to access their significance in predicting the malnutrition among children based on theoretical and observed status applied in literature and information availability in CNNS data set (Assemie et al. 2020; UNICEF and Population Council 2019; Bogale et al. 2018; Syahrul et al. 2016). Explanation of each predictor variables and scale of measurements are given in table 1.

Statistical analysis

To meet the objectives of the study, we the statistical analysis is carried at five levels. In the first part of the analysis, descriptive estimates were calculated to know the socio-demographic characteristics of the study population. In the second part, bivariate estimates were carried out to examine the socio-demographic differences in malnutrition and Chi-square tests were done to observe the statistical significance of differences. In the third part of analysis, we did spatial analysis to know the geographical variations in malnutrition according to the states of India. While in the fourth part, multivariable binary logistic regression analysis was carried out to measure the adjusted association between socio-demographic characteristics and malnutrition among school going children.

Results

State-wise variations in Malnutrition among school-going children in India

According to **figure 1**, the percentage of Stunted children were higher in Meghalaya (35.2%) followed by Bihar (28.5%), Tripura (27.9%), Gujarat (26.5%), Assam (26.1%), Jharkhand (24.9%), and Maharashtra (24.7%) while lowest in Tamil Nadu (9.7%), Kerala (11.2%), Punjab (12.3%), Jammu and Kashmir (13.3%), Goa (14.2%), and Telangana (15.5%). The percentage of underweight were found higher in Jharkhand with 45.4% followed by Assam (41.3%), West Bengal (40.8%), Gujarat (39.9%), Bihar and

Karnataka (39.5%), Odisha (36.9%) and Maharashtra (36.3%), while lowest in Jammu & Kashmir, Arunachal Pradesh, Sikkim, Manipur, Nagaland, Punjab and Mizoram. Coming to the BMI, the most thinness children were found in West Bengal, Telangana, Jharkhand, Karnataka, Uttar Pradesh, and Assam while Mizoram, Manipur, Nagaland, Sikkim, Arunachal Pradesh and Meghalaya were contributed less than 10 or less than 10 per cent. More than 10 per cent of children were found overweight or obese in Nagaland, Goa, Tripura, and Sikkim. Whereas lowest in Jharkhand and Bihar with less than 1 per cent.

Prevalence of Multiple form of malnutrition

About 50 per cent of school-going children were malnourished in India. The overall percentage of stunting, underweight and thinness were 21.9 per cent, 35.2 per cent, and 23.3 per cent respectively (**Table 2**). While 3.8 per cent of children were overweight or obese and 0.8% were having double burden of malnutrition. Out of total children assessed in this study, 29.5 per cent suffered from multiple forms of malnutrition.

Binary logistic regression

Table 4 depicts the unadjusted and adjusted effect of selected covariates on stunting and underweight among school-aged children. There is a significant relationship between gender and underweight. Children who were currently attending the school were significantly less likely to be stunted and underweight as compared to who had not going ($p=0.000$). As compared to mother's age 15-24 years, the stunting, and underweight children were significantly less likely among those mother's whose age is more than 25 years. Malnutrition was also found to be less likely among children with mother having higher secondary or above education [Odds Ratios (ORs) with CI: Stunting= unadjusted 0.33(0.294-0.370), adjusted 0.615(0.537-0.703); Underweight=unadjusted 0.352(0.319-0.389), adjusted 0.599(0.533-0.673)]. Stunted children [ORs with CI: 1.144(1.069-1.225)] were more likely to belong other religion. Children who belong to other caste were less likely stunted [ORs with CI: unadjusted 0.507(0.467, 0.550); adjusted 0.812(0.714-0.923)] and underweight [ORs with CI: unadjusted 0.737(0.684-0.793); adjusted 0.820(0.731-0.920)] as compared to scheduled tribes children while underweight were more likely in scheduled castes. The relationship of wealth quintile between stunted and between underweight were also found statistically significant. Children whose mother had exposure of mass media found less likely to have stunted [ORs with CI: unadjusted 0.526(0.495-0.559)] and underweight [ORs with CI: 0.534(0.505-0.564)] among those children. Children belonging to North-east region had significantly more likely and South had less likely stunted as compared to North region. However, underweight children were less likely in North-east region and more likely in Central and West region.

Multinomial logistic regression

Table 5 reveals the outcome of the multinomial logistic results for the association between the category of the BMI (Normal, Thinness and overweight/obese) which was dependent variable and selected socioeconomic and demographic characteristics as independent variables. The relative risk ratios (RRRs) were for a unit change in the predictor variables, the relative risk ratio of outcome (BMI) relative to the referent group (Normal BMI) is expected to change by a factor of the respective parameter estimate given the variables in the model are held constant. The chance of thinness [RRRs with CI: unadjusted 0.766(0.726-0.809; adjusted .802(0.750-0.858)] and overweight [RRRs with CI: unadjusted 0.755(0.699-0.816); adjusted 0.744(0.681-0.813)] were less likely among female as compared to male. Children who were currently in school were significantly more likely to have risk of thinness and overweight as compared to those were not in school. Overweight were mostly significant among mothers who were more than 24 years of age and having higher secondary education and above. The risk of having thin [RRRs with CI: unadjusted 0.433(0.397-0.473); adjusted 0.609(0.535-0.692)] and overweight [RRRs with CI: unadjusted 1.394(1.273-1.527); adjusted 1.164(1.012-1.338)] were less likely and more likely among children who were other than Hindu and Muslim respectively. Considering castes, the risk of thinness children were 1.2 times significantly higher in scheduled caste, while overweight children were 1.27 times significantly higher in children who do not belong to SCs/STs/OBCs. Children who were residing in urban areas, the relative risk for a normal BMI relative to thinness BMI expected to decrease by 0.86 times as compared to their rural counterparts. There were about 2 times (CI = 1.325-3.471) higher risk of overweight among

richest children as compared to poorest children. Children who belong to western region of India were significantly more likely and less likely thinness in north-east region as compared to north region. However, children who belong to East and North-east region were more likely overweight.

The age of children was significantly associated with malnutrition. The **figure 2** illustrated that the percentage of stunted children were declining with increasing age from 26.3 per cent to 19.1 per cent in age from 5 to 9 years. However, the percentage of underweight children were slightly increased with increasing age and the percentage of thinness and overweight/obese were accelerate by 8.4 per cent and 2 per cent respectively.

Interaction effects of Place of residence by socioeconomic status

The adjusted multivariable models with interaction in terms of urban/rural with wealth status, mother's education geographical region and children's schooling status suggested some statistically significant associations with stunting, underweight and overweight/obese. Rural children from poor households, whose mothers had below primary/middle/secondary education, from the Central/East/West/North-east regions and children who were currently not in school were statistically significantly more likely to be stunted and underweight than their counterparts from wealthier households, born to higher secondary educated mothers, from the South regions, and children who were currently in school (Figure 3). While, rural children from rich households, among mother with higher education, from the North/South/North-east regions and children who were currently in school were significantly higher than their counterparts. The interaction effects illustrated a **promising approach** to highlighting comprehensive rural-urban inequalities in school-aged malnutrition.

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