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An Exploratory Study on Risk Factors of Malnutrition in Children: A Cross-Sectional Study based on Slummy Areas of Lahore

Ifrah MH*

Department of Statistics, Lahore College for Women University, Lahore, Pakistan

Abstract

This study focuses on the most important hazards of malnutrition (specifically related to underweight in this study) among the children resident in slummy areas of Lahore. It includes children of 6 months to 5 years of age randomly selected from localities of Lahore. It includes 361 children of both genders. Assessment of malnutrition was done by anthropometric measures; z-scores and percent of median. The cases are defined as any child below -2 SD from median weight for his/her age and the controls are defined as any child above -2 SD from median weight for his/her age as plotted on the growth chart by WHO. Multiple Logistic Regression (MLR) is applied for evaluation of significant risk factors of malnutrition. Father's education, health condition of child at time of birth, starvation, feeding practices and sanitary system were found to risk factors of malnutrition. The problem should be addressed and should be spread among people. Government should take some steps by facilitating people with fundamental needs such as hygienic water, vaccination, health facilities, etc.

Introduction

Malnutrition is defined as the pathological state resulting from insufficiency of one or more essential elements in diet. The term malnutrition refers to both overweight and underweight but in this study it is specifically related to underweight. In Pakistan, 38% children of below five years of age are undernourished and 14% are wasted yearly (WHO). The prevalence of stunting appears to be associated with the overall level of development of the provinces, lowest in Punjab and highest in Baluchistan. The anthropometric deficits are systematically higher in rural areas probably due to the lower socio-economic condition and to very poor access to fundamental health services. Malnutrition is responsible as underlying factor for 55% of deaths in children under 5 years of age.

Effects

One of the most central undesirable effects of malnutrition is that the body becomes unable to preserve itself. It increases the body's exposure to infection and decreases its ability of immune system. When there is infection in body, loss of appetite occurs. Malnutrition may cause deficiency of many essential vitamins such as B1, B2, C, D and E and also the deficiency of iron, calcium, iodine and magnesium and at the most mortality.

Causes

Literature review showed poverty, feeding practices, dietary practices, hunger and starvation, inadequate care of women and children, poor sanitation and unhealthy drinking water, illiteracy of parents and no proper vaccination are causes of malnutrition. Although it remains with no answer regarding the precise mechanism and magnitude of effects, there is now considerable evidence that malnutrition has effects on growth, morbidity, mortality, cognitive development, reproduction, physical work capacity and risk for several adulthood chronic diseases. There may be some rare causes such as discrimination against females, wars and disasters or agriculture productivity.

Clinical/physical signs and symptoms

Clinical symptoms include poor weight gain, slowing of linear growth and behavioral changes such as irritability, decreased social responsiveness and anxiety. Physical symptoms of malnutrition includes edema, dry peeling skin, nails become fissured or ridged, hair are thin and easily pulled out and hyper-pigmented plaques over areas of trauma.

Objectives of study

The objectives of the study are

- To identify the most important hazard(s) of childhood malnutrition in children resident in slummy areas among 6 months to 5 years of age.
- To assess for gender bias.
- To know people's awareness about basic hygiene regarding children health.

Literature Review

Anderson [1] concluded that nutrition education for encouraging breastfeeding and proper provision of animal protein to preschool children is important in semi-rural and farming communities, especially of developing countries such as Ghana in order to fight the prevalence of childhood malnutrition. Alvarez JO et al. [2] found that 49 percent of the children were chronically malnourished (stunted) and stunted children showed a delayed exfoliation of primary teeth as compared to well-nourished children.

Ghaleb T [3] found that 89 percent of the parents were not educated so it was interpreted that lack of education of parents is the cause of malnutrition. Also more than 40 percent of the children who stopped breastfeeding before reaching one year of age were found to be malnourished. It was declared that this is the main cause of

***Corresponding author:** Ifrah MH, Department of Statistics, Lahore College for Women University, Lahore, Pakistan, E-mail: ifrahhanis@gmail.com

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malnourished and inadequate nutrient intake. Badar S et al. [4] found that 39.45 percent of children had first degree malnutrition, 37.10 percent second degree and 23.4 percent had third degree malnutrition. The significant causes of malnutrition were found to be illiteracy, food fads, poverty, lack of breast-feeding, improper weaning, diarrhea and respiratory diseases [5-7].

Methodology

This is a cross-sectional study which includes children of both genders. Assessment of malnutrition is done by using anthropometric measures and two method; z-scores and percent of median are used. The cases are defined as any child among 6 months to 5 years of age who was below -2 SD from median weight for his/her age as plotted on the growth chart (weight-for-age) and the controls are defined as any child under 5 years of age who was above -2 SD from median weight for his/her age as plotted on the growth chart (weight-for-age) by WHO (World Health Organization). Measurements such as weight and height were quantified. The questionnaire was filled by researcher in a face-to-face interview which was taken from the available parents (any) of all children. The questionnaire included question related to all study variables such as about income, health condition of child, food intake and drinking water resource, disease, vaccination, sanitary system condition, meal count per day etc. The information was collected related to all variables included in the study which were thought to be potential risk factors of malnutrition.

Sample and sampling technique

The sampling technique applied in the study is cluster sampling. The sample has been collected in two stages. In the first stage, by using systematic random sampling, every 7th locality from the list of 37 localities was selected and total 5 localities were included in the sample. In second stage, from five randomly selected localities, one block/area on random bases was selected and studied at whole. All selected areas were completely studied including all the children among 6 months to 5 years old. The total number of children is 361; 45.70% girls and 54.29% boys. Assessing the subjects, the no. of children who were identified as cases are 238 and the children who were identified as control are 123. The study period is from June to October, 2010. Following is the figure 1 showing the sampling procedure.

There were 21.88% children of age 6 month to 1 year, 29.37% children of age 1-2 years, 24.65% children of age 2-3 years, 13.30% children of age 3-4 years, 10.80% children of age 4-5 years.

Measurement of Malnutrition

There are three methods for measurement of malnutrition, the Z-score or standard deviation, percent of median and percentiles. The Z-score or standard deviation unit is most commonly used method defined as the difference between the value for an individual and the median value of the reference population for the same age or height, divided by the standard deviation of the reference population. This can be written in equation form as:

$$z-\text{score}\left(\text{or SD score}\right)=\frac{\text{observed value}-\text{median reference value}}{\text{standard deviation of reference population}}$$

A child's measurement (weight/height) is compared with the average measure for children at the same age and gender to standardize a child's measurement. For analytic purposes, this study used those cut-off points recommended by WHO for defining malnutrition. The general approach adopted in the analysis is to differentiate among children who were relatively well-nourished (Z-scores ≥ -2SD), those who were moderately or severely malnourished (Z-scores < -2SD). The following three kind of measurements were made:

- Weight for height is a measure of acute (recent) malnutrition as a measure of wasting. This index helps to identify children suffering from current or acute under-nutrition or wasting and is useful when exact ages are difficult to determine.
- Height for age is a measure of chronic (past) malnutrition as a measure of stunting moderate growth failure. This index is an indicator of past under-nutrition or chronic malnutrition.
- Weight for age is a measure of underweight, which combines both acute and chronic malnutrition. It is a valuable index for use in very young children or when length/height measurements are difficult to do accurately.

The reference standards most commonly used to standardize measurements were developed by the US National Center for Health Statistics (NCHS) and are recommended for international use by the World Health Organization. The reference population chosen by NCHS was a statistically valid random population of healthy infants and children. Available evidence suggests that until the age of approximately 10 years, children from well-nourished and healthy families throughout the world grow at approximately the same rate and attain the same height and weight as children from industrialized countries. The NCHS/WHO reference standards are available for children up to 18 years old but are most accurate when limited to use with children upto the age of 10 years.

Percentage of Median

The percentage of the median is defined as the ratio of a measured or observed value in the individual to the median value of the reference data for the same age or height for the specific sex, expressed as a percentage (Table 1). This can be written in equation form as:

$$\text{Percent of Median}=\frac{\text{Observed value}}{\text{Median value of reference population}}\times 100$$

For measurement of malnutrition both z-score method and percentage of median method were used.

Study variables

By reviewing the literature and some citation such as WHO,

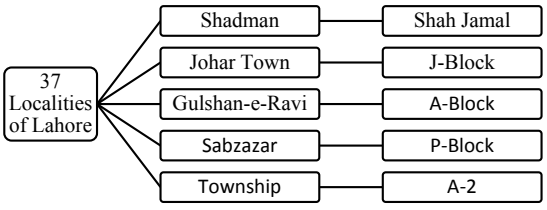

Figure 1: Sampling Procedure.

Classification of Malnutrition for weight-for-age based on percentage of the median	
Classification	**Weight-for-age**
Adequate	
Mildly Malnourished	
Moderately Malnourished	60-80
Severely Malnourished	<60

Table 1: Percentage of the Median Method.

UNICE and some discussion papers (reference available), the following variables were selected as study variables.

*Gender	*Age	*Weight
*Height	*No. of children	*Sanitary system
*Father education	*Income	*Starvation
*Mother education	*Feeding practice	*Vaccination
*Feeding duration	*Food quality	*Mother job
*Storing method (proper/ improper)		*Gender preference
*Daily milk consumption		*Stored food consumption
*Any disease		*Daily meal consumption count
*Available drinking water source		*Health condition of mother at time of birth
*Health condition of child at time of birth		

Logistic Regression

The statistical technique; multiple logistic regression is applied for the assessment of most important hazards of malnutrition. In Multiple logistic regression there is a set of predictor variables, x_1, x_2,..... x_p that are related to Y and, therefore, provide additional information for predicting Y. Consider a collection of p independent variables, which will be denoted by the vector $x = x_1, x_2,..... x_p$. Let the conditional probability that the outcome is present be denoted by $P(Y = 1/x) = \pi(x)$. The logit of the multiple logistic regression models is

$$g(x) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots\ldots\ldots + \beta_p x_p$$

A positive regression coefficient means that the explanatory variable increases the probability of the outcome, while a negative regression coefficient means that the variable decreases the probability of that outcome; a large regression coefficient means that the risk factor strongly influences the probability of that outcome; while a near-zero regression coefficient means that the risk factor has little influence on the probability of that outcome. In this case:

$$\pi(x) = \frac{e^{g(x)}}{1 + e^{g(x)}}$$

Where β_0 is called the intercept and β_1, β_2,....., β_p are called the regression coefficients of x_1, x_2,..... x_p. The intercept is the value of g(x) when the value of all independent variable is zero. The dependent variable in logistic regression variable can take the value 1 with a probability of success q, or the value 0 with probability of failure 1-q. This type of variable is called a Bernoulli (or binary) variable. The logistic regression makes no assumption about the distribution of the independent variables. They do not have to be normally distributed, linearly related or of equal variance within each group. The relationship between predictor and response variable is not a linear function in logistic regression.

Analysis and Conclusions

For analytical analysis, Multiple Logistic Regression (MLR) model was fitted which included all variables which were assumed to be potential hazard of malnutrition. The stepwise likelihood ratio method was used to determine the predictive strength of most considerable factors contributing significantly towards malnutrition. The results are shown in the table 2 and the fitted model is:-

Z=1.178-1.054 FE (1)-0.722 FE (2)-0.720 HCC (1)-0.880 HCC (2)+0.846 Feeding (1)+1.057 Starvation (1)+0.920 Starvation (2)-0.620 Sanitary (1)-0.743 Sanitary (2)

The table 2 provides Wald's test for all the variables included in the model. The parameter estimates (log odds) are given in the column labeled 'B' and the standard error of these estimates have been in column labeled 'S.E'. According to the results, the factor father education was found to be significant factor (p-value=0.002); the fathers whose education level was less than matriculation (OD=0.349, C.I=0.192-0.634) and the father's whose education level was above matriculation level (OD=0.486, C.I= 0.249-0.950). The factor health condition of child at time of birth was also found to be significant risk factor of malnutrition (p-value=0.009); average health condition (OD=0.487, C.I=0.246) and good health condition (OD=0.415, C.I=0.234-0.735) which means that as health condition at time of birth is improved, the odds of suffering from malnutrition are being decreased by 51.3% and 58.5% respectively. Feeding is found to be significant (p-value=0.013) risk factor contributing toward malnutrition (OD=2.330, C.I=1.193-4.551) i.e. the children who did not have breastfeeding have 2.330 times more chances of suffering from malnutrition. The factor starvation is also found to be significant (p-value=0.001). The children who suffer from semi-starvation had 2.878 odds of suffering from malnutrition (OD=2.878, C.I=1.6161-5.130) and the children who have starvation had 2.510 odds of suffering from malnutrition (OD=2.510, C.I=1.344-4.688). The factor sanitary system was found to be major factor contribution towards malnutrition (p-value=0.045); the children who had average sanitary system (OD=0.538, C.I=0.308-0.939) and the children who had good sanitary system (OD=0.476, C.I=0.223-

Variable	B	S.E	Wald	D.f	Sig	Exp(B)	95.0% C.I for Exp(B)	
FE			12.337	2	0.002			
FE(1)	-1.054	0.305	11.952	1	0.001	0.349	0.192	0.634
FE(2)	-0.722	0.342	4.457	1	0.035	0.486	0.249	0.950
HCC			9.324	2	0.009			
HCC(1)	-0.720	0.348	4.281	1	0.039	0.487	0.246	0.963
HCC(2)	-0.880	0.292	9.086	1	0.003	0.415	0.234	0.735
Feeding(1)	0.846	0.342	6.137	1	0.013	2.330	1.193	4.551
Starvation			14.236	2	0.001			
Starvation(1)	1.057	0.295	12.879	1	0.000	2.879	1.616	5.130
Starvation(2)	0.920	0.319	8.342	1	0.004	2.510	1.344	4.688
Sanitary			6.221	2	0.045			
Sanitary(1)	-0.620	.284	4.754	1	0.029	0.538	0.308	0.939
Sanitary(2)	-0.743	0.387	3.682	1	0.055	0.476	0.223	1.016
Constant	1.178	0.330	12.708	1	0.000	3.247		

Table 2: Wald test for all variables in the equation.

Hosmer and Lemeshow Test H0:observed value=predicted value		Omnibus Test (Significance of the Model)	
Chi-Square	P-Value	Chi-Square	P-Value
χ^2 (8)=2.628	0.956	χ^2 (9)=198.901	0.000

Table 3: Hosmer and Lemeshow test.

0.016) shows that as sanitary system was being improved the odds of suffering from malnutrition was being decreased by 46.2% and 52.4% respectively.

Some results about the model

The Hosmer and Lemeshow test (approximately chi-square test) which is considered to be more reliable test in logistic regression, is used to test the hypothesis that the observed data are significantly different from predicted values from the model (goodness of fit; H_0: observed value=predicted value) that is the adequacy test. According to the results p-value-0.956 (Table 3) which is insignificant, indicates that the model does not differ from the observed data significantly and hence model is appropriate and it fits the data adequately.

The Omnibus tests are measure of how well the model performs. They provide a test for the all explanatory variables effect simultaneously. It resulted in significant p-value=0.000 indicating that the predictors included in the model have significantly improved by the power of the predictive model. Therefore, we can say that we are 95% confident that fitted model is appropriate.

Recommendations

Since the problem of malnutrition is a widespread issue especially in third countries like Pakistan, it should be surmounted by spreading knowledge in people about the phenomenon and by facilitating them with fundamental needs. There is need to improve sanitary system, awareness about breastfeeding practice, improve basic health facilities and educate parents about the health awareness regarding child's health. Nation-wide researches should be conducted and policies should be made in order to eradicate the problem of malnutrition.

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