# Multidemensional Ecology Index a Tool to Assess Ecological Factors Influencing Nutritional Status

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**Abstract:** ***To study the influence of ecological variables on nutritional status a multi-dimensionalecology index (MEI) was developed after doing a pilot study in the area. MEI has 4 sub-indices- economic, housing, sanitation and food choice and nine other ecological variables namely income, land holdings, livestock, food diversity, family type, family size, protein, calorie and iron intakes constituting 14 variables. Diet survey by weighment was conducted to assess the nutrient intake. Weight of children below 12 years was taken. 100 Scheduled caste rural families of Telangana (50Mala and 50 Madigas - the two major scheduled castes) were randomly selected. Multiple regression analysis was carried out to find the relationship of all the 13 independent variables with the dependent variable, Weight. The total contribution of the 13 ecological variables and MEI to the weight status among Mala children is 34.37 percent; the total contribution of all variables in Madiga children accounted to 27.15 percent .MEI has indicated a positive and significant relation to weight of SC children. The findings suggest that improvement of theecological setting of SC families can have a positive impact on their nutritional status***

**Keywords:** Mala, Madiga , Multi-dimensional ecology Index( MEI), weight, multiple regression analysis

## 1. Introduction

Nutritional status is considered complex and multidimensional. Several ecological variables like social, economic and cultural factors can influence and intervene on nutritional status. Earlier studies focused on one or more of the many ecological variables, each on its own merit as influencing nutritional status. The influence of a composite of ecological variables has not been studied though in life situations several ecological variables operate simultaneously and contribute to nutritional status. It was therefore, felt necessary to study nutritional status in the ecological perspective. Most of the socio- economic indices developed in various parts of the world derive social status from economic criteria (1-10). India's socio cultural milieu is such that while economic .factors play a predominant part in ones' life, they still do not determine the individuals social status exclusively, even though there are no racial factors of discriminatory significance in India, there is the much discredited caste system that cannot be overlooked (11).A few castes and occupations are looked down on in the society and are a source of great social strife. Like- wise, food consumption is affected due to cultural inhibitions – taboo of beef consumption among Hindus. As all these factors of ecology collectively influence nutritional status, it is essential to consider them collectively while assessing nutritional status. Previous studies and theoretical models (1-10) have demonstrated that ecological factors bear a significant relationship to nutritional outcome (BMI, height, weight/height 2 , hemoglobin) therefore assessment of nutritional status cannot ignore effect of ecology on the nutritional outcomes . Local applicability of any index is an asset for any research program. Therefore keeping these factors in view the study aims:

1) To develop Multi-dimensional Ecology Index. (MEI) suitable to the group.
2) To study its applicability on identifying the ecological variables which are directly related to nutritional status – weight

## 2. Methodology

**Development of Multi-Dimensional Ecology Index**

MEI was developed and used in the present study contains specific details unique to the community. The socio economic scale earlier developed has been the basis for developing MEI (11). Modifications of the scale were done based on the local conditions. The MEI consists of 4 sub-indices- economic, housing, sanitation and food choice – and nine ecological variables namely income, land holdings, livestock, food diversity, family type, family size, protein, and calorie and iron intakes. Diet survey by 3 day weighment method was done to calculate protein, iron and calorie intake. Information on other parameters is obtained through a coded Schedule

**Components of Indices**

1) Economic Index has: income from all sources, land holdings, livestock, and assets.
2) Housing Index has type of roof, type of flooring, soak pit in the house, type of lighting, location of cattle shed, place for bathing, and type of ventilation
3) Sanitation Index contains: Source of water for drinking and cooking, mode of transporting water, distance from home to source of water, open drain near the house, disposal of waste, solid waste, cow dung and disposal of garbage, place of defecation.
4) Food Choice Index choice of energy yielding foods in the diet, choice body building foods, choice of protective foods:

**Construction of MEI**

A multi-dimensional ecology index was constructed using 13 independent variables. Each of the above items is categorized as low, medium and optimum levels based on local conditions. The corresponding weightage given is 1, 2 and 3 respectively. The total number of responses that scored as one, two or three are then added to give the total score of the index. The total score coming above the two point level is considered as optimum or positive level. Those at the two point and below are considered being moderately optimum level. Those at one point level and below are classed as low. This method was developed and followed because there are no readymade standards or norms for comparison and could serve as a measure for future research

**Step Wise Multiple Regression Analysis**

Stepwise multiple regression analysis is conducted to examine the effects of 13 independent variables and multi-dimensional ecology index on nutritional status using weight for age as dependent variable Weight was selected as it reflects the current nutritional status. Weight was chosen as representative of nutritional status since it is a sensitive indicator of any nutritional deprivations .Weight is particularly affected by calorie, protein and vitamin A deficits. It is also a popular measure to assess change in nutritional status brought about by nutritional intervention programs to monitor growth in children. Therefore, weight is considered as the dependent variable. The various ecological factors are considered as independent variables. The tool to assess the contribution of ecological factors to nutritional status among the scheduled caste must be applicable to the region, taking into account the cultural practices and the existing social realities (11) .use of a general ecology index becomes meaningless. Multiple regression analysis was done to study the relationship between nutritional status indicator's i.e. weight, and 13 ecological variables and MEI with the dependent variable weight of children belonging to Mala and Madiga communities separately. The general form of the prediction equation is:

$X_1$= K+ $b_1$ $X_1$+$b_2X_2$+$b_3$ $X_3$+$b_4X_4$ +…$bnx_n$ (X1=the predicted score of the dependent variable weight)
K = constant
$b_1$,$b_2$, $b_3$, $b_4$, …..bn = partial regression coefficients
$X_1$,$x_2$, $x_3$, $x_4$ ….Xn obtained values on different independent variables

The summary of the first and the last step of the multiple regression analysis (which is the output of computer analysis) are presented along with the variables removed at each step.

The analysis is a part of a major study to project the applicability of MEI the data related to a sub group of 200 children belonging to two major scheduled castes in Telangana (Mala and Madiga community) aged 1-12 years is presented.

## 3. Results and Discussion

Malnutrition among children in developing countries is rampant (Gopalan 1987). Although every effort is on to improve the nutritional status of pre- school children, malnutrition continues to persist in this age group and it leads on to malnutrition in the school age even today ( 2018). It was therefore, felt necessary to identify and delineate the ecological variables influencing the weight (growth) of children 1-12 years of age.

The thirteen independent variables along with Multidimensional Ecology Index were identified to study the extent of contribution of these 14 ecological variables to the weight of Mala children (Table 1). The relationship of the14 variables to weight is explained in the following equation.

Weight:= 16.22 constant – 2.617 income + 1.671 land + 0.707 livestock + 0.732 economic index + 9.0812 housing index + 0.217 sanitation index – 1.402 food diversity + 0.654 food choice index+ 0.498 protein intake + 0.347 calorie intake + 2.974 iron intake +1.337 type of family +2.873family size + 4.821 MEI

The total $R^2$ value indicated in the equation is 0.3437 the percentage variation in the dependent variable is 34.37. The most significant ecological variables contributing to the weight as shown by the regression analysis are income, land, protein, iron intake and the MEI. These five variables account for 31.93 percent of the variation (R2= 0.3193) . The variability explained is found to be significant at 0.5 percent level. The final equation is given below

Weight = 16.626 constant – 2.379 income +2.206 land – 1.509 protein intake – 3001 iron intake + 4.538 MEI

Food diversity, calorie intake, livestock, and food choice index are the next set of variables contributing to weight of children. The least contributing ones are type of family, family size, economic index, sanitation index and housing index. Of the five significant variables contributing to weight three variables indicate a negative relationship to weight. They are income, protein intake and iron intake.

In the normal course of events, increase in protein intake can contribute to an increase in body weight .but in the Mala women a negative relationship is indicated. The diet survey of this community highlights a low calorie intake. Under such circumstances a part of the protein intake could meet the calorie deficit. Therefore, increase in protein intake may not necessarily contribute to increase in weight, if the calorie gap is not met. Moreover, protein is derived mostly from cereals and millets, the other protein rich foods are seldom consumed. The protein intake even if it is increased through cereal consumption it may not contribute to an overall increase in weight. This may be the situation with the mala children.

The negative impact of iron intake to weight status is probably due to the fact that iron as a micronutrient does not directly contribute to weight as would be the case with bulk nutrients like calories and protein. Increase in land holdings can lead to a greater availability of foods to the family Therefore, land holdings can have a positive relationship to weight. The MEI also predicts a better weight status if the environmental factors can be improved. With regard to Madiga children the stepwise multiple regression analysis is given in Table2. The Contribution of the independent variable to weight is Weight : 14.146 constant – 2.046 income + 0.822 land – 2.797 livestock + 0.008 economic index + 1.747 housing index + 4.892 sanitation index + 3.336 food diversity – 1.587 food choice index – 0.093 protein intake + 0.347calorie intake – 1.204 iron intake – 4.231 type of family – 1.084 family size + 4.446 MEI

The coefficient of the multiple determinations ($R^2$) disclosed that 27.15 percent variance accounted for these 8 variables. The $R^2$ is found to be significant at 0.5 per cent level.

Among the other variables in the regression analysis calorie intake, housing index, iron intake and protein are the next set of closely related variables to weight. However, the land, family size, economic index, has not indicated any significant contribution to weight.

For Madiga children (Table 2) negative relationship exists between weight – the dependent variable and income, livestock, food choice index, and type of family. As indicated earlier an increase in income , livestock and better food choices need not contribute to weight gain mainly because a better status in some of these life aspects need not be reflected in a better status for food and nutrient intake. Even if there is a better food choice in a limited array of foods available to the SC families the quantity of these foods may be limiting. Weight may therefore remain unaffected. With regard to the variable, type of family and its negative contribution to the weight status of Madiga children it can be explained as follows:

Transition from joint family system to nuclear family is said to indicate a higher status of the family. However in the present context, the mother in the nuclear family goes to work and leaves children to the care of older siblings. The children are observed to find for themselves with whatever food is available. They can be left in a state of neglect with regard to food intake, which would affect the weight of children in a negative fashion

Food diversity is said to improve dietary intake and thereby weight. This statement was found to hold good in the present context of the Madiga families which were surveyed for dietary intake with an increase in number of food items, an increase in weight status of these children was observed. Hence the positive contribution of food diversity to weight status of Madiga children.

Comparing the status of Mala and Madiga children only two variables namely income and MEI are found as common factors. Income has a negative bearing on weight in both the communities. MEI on the other hand has a positive relationship.

The greater number of variables predicted to influence the weight in Madiga children compared to that observed in Mala children indicate a lower socio economic status of Madigas as against that of Malas. With an improvement in the ecological status of Madigas it is presumed that weight status could improve. In both the communities MEI indicated significant positive contribution to weight. Therefore, improvement of the environment of both the communities can change weight status (nutritional status) of children as well as that of their mothers in the positive direction.

## 4. Conclusion

This study supports the various theoretical models and framework (12-18) which indicates that several ecological factors together contribute to nutritional status.

Testing the multi-dimensional ecology index on higher income groups and in urban setting with modifications apt to the group will be a better tool to assess the overall influence of the ecology on nutritional status .

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**Table 1:** Ecological Determinants of Weight as a Measure of Nutritional Status in Mala Children

| Step | Independent Variable In Each Step | $R^2$ | Standard Error Of Multiple Regression | F Value (D.F) Level of Significance | D.F Value | Constant | % Variance in dependent V explained by Independent Variable |
|---|---|---|---|---|---|---|---|
| | Total Contribution | 0.3437 | 4.806 | 2.992 | 14,80 | 16.225 | 34.37 |
| 1 | Housing Index | 0.3437 | 4.776 | 3.263 | 13,81 | 19.784 | 34.37 |
| 2 | Sanitation index | 0.3436 | 4.747 | 3.577 | 12,82 | 20.133 | 34.36 |
| 3 | Economic index | 0.3432 | 4.721 | 3.943 | 11,83, | 21.094 | 34.32 |
| 4 | Family Size | 0.3425 | 4.694 | 4.376 | 10,84 | 21.185 | 34.25 |
| 5 | type of family | 0.3421 | 4.668 | 4.91 | 9,85,, | 21.009 | 34.21 |
| 6 | Food choice Index | 0.3407 | 4.646 | 5.557 | 8,86 | 20.549 | 34.07 |
| 7 | Livestock | 0.3391 | 4.625 | 6.374 | 7,87 | 20.962 | 33.91 |
| 8 | calorie Intake | 0.3306 | 4.628 | 7.244 | 6,88 | 19.423 | 33.06 |
| 9 | Food Diversity | 0.3193 | 4.641 | 8.348 | 5,89 | 16.627 | 31.93 |

Variable retained in the equation : income, land, protein , iron intake and MEI
** Not significant * Significant

**Table 2:** Ecological Determinants of Weight as a Measure of Nutritional Status in Madiga children

| Step | Independent variable in each step | $R^2$ | Standard error of multiple regression | F Value(df) level of significance | d. f value | Constant | % Variance in the dependent variable explained by independent variable |
|---|---|---|---|---|---|---|---|
| | Total Contribution | 0.2873 | 5.948 | 2.706 | 14,94 | 14.146 | 28.73 |
| 1 | Economic Index | 0.2872 | 5.917 | 2.945 | 13,95 | 14.146 | 28.72 |
| 2 | Family Size | 0.2864 | 5.889 | 3.211 | 12,96 | 14.176 | 28.64 |
| 3 | Land | 0.2852 | 5.864 | 3.517 | 11,97 | 13.651 | 28.52 |
| 4 | Protein Intake | 0.2836 | 5.84 | 3.88 | 10,98 | 13.363 | 28.36 |
| 5 | Iron Intake | 0.2771 | 5.837 | 4.215 | 9,99 | 12.633 | 27.71 |
| 6 | Calorie Intake | 0.2715 | 5.831 | 4.659 | 8,100 | 12.558 | 27.15 |

Variable retained in equation: Income, livestock, sanitation index, food diversity, food choice index, Type of Family and MEI
** Not significant * Significant