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The study was planned and the design of the research was formulated after reviewing a vast range of existing literature both national and international. Relevant literature was examined to look at how variables of interest were defined and measured, how the data were collected, and the possible ways adopted by eminent scholars of the field in analyzing the data. An effort was also made to discover not only what has been already done, but also what has not been done and what might be worth doing in the area of impact of mid day meal on nutritional status and academic achievement of school children. The researcher has examined almost all the major studies and appropriate journals, scholarly texts, conference papers, textbooks, books, magazines, other mass media and internet. Personal interactions with eminent scholars of the field were also done.

3.1 Locale Of The Study

The present research study is carried out on school children aged 6 to 14 years in Aligarh city of Uttar Pradesh. Uttar Pradesh is the most populous state of India with a population of over 150 million, 16% of the country population. Aligarh is situated at a distance of 133 km of south east of Delhi. It comprises of 68.97 sq. km and has a population of 6,58,165 (Census Department of Aligarh City Corporation, 2001). Recently, the Aligarh district has been declared as the head quarter of a commissionary comprising 5 districts. Aligarh is famous for its lock industries and Aligarh Muslim University. The population of Aligarh is of mixed nature representing people of different religion, occupation and
Figure: 3.1.1 Map of India showing location of Uttar Pradesh
Figure: 3.1.2 Map of Uttar Pradesh showing location of Aligarh City
socio-economic levels. Wheat and millets form the staple diet and the water sources for drinking and cooking purpose are from the suburbs water tables in wells and tube wells. The climate of Aligarh is of extreme nature very hot from April to August and very cold during December to February. It is well connected by roads and railways with its neighboring states.

The geographical boundaries of Aligarh district includes district Mathura in the south west, Mahamaya Nagar in south, Etah in south east, Badayun in north east, Bulandshahar in north and Faridabad (Haryana) in north west.

The major considerations for the selection of the locale are:

a) Studies have not been done to check the impact of mid day meal on nutritional status and academic achievement of school children in this region so far.

b) The city represents population of mixed nature different socio-cultural and economic background.

c) Easy accessibility and ease of approach.

3.2 Research Design

As per the information obtained from the Office of District Basic Education, Aligarh, 60 government primary schools were functioning in Aligarh city. Five schools were selected randomly out of 60 government primary schools situated at begpur kanjau, dodhpur, kelanagar, jiwangarh and jauharbagh (fig. 3.2.1). These schools were named as Mid Day Meal (MDM) school in present study. Furthermore, there were around 72 public primary schools in which children of same socio-economic status were studied. Full attempt had been made to select the public primary
Figure 3.2.1: Location of selected **Mid Day Meal Schools** and **Non-Mid Day meal Schools** in Aligarh city
school of same area from where mid day meal school has been selected. Five public primary schools were selected randomly for the purpose of study and named as Non-Mid Day Meal (NMDM) schools (fig.3.2.1).

Each school was formally contacted for seeking necessary permission from school authorities like principals, headmaster. Based on the consent and active cooperation of the school authorities, five schools where mid day meal has been provided regularly and five another school where no noon meal was provided by school catering to class I to VIII were selected to include in the study.

### 3.3 Sample Selection

School children in the age group of 6 to 14 years studying in various classes ranging from class II to class V in all the selected schools were included as population. A total 600 school children—300 Mid Day Meal (MDM) school children and 300 Non-Mid Day Meal (NMDM) school children were selected. Random sampling technique was used to select the sample from these schools.

The chronological age at the time of sampling was the criterion for inclusion in the sample. The age at the last birthday (i.e. age in complete year) was used for computation of data. The other eligibility criteria for the study group were:

- a) apparent normal health of children;
- b) children in the age group of 6 to 14 years;
- c) who were attending the school for at least last one year;
- d) who do not have any chronic disease of any organ; and
- e) who have a regular attendance.
Using the above eligibility criteria a total of 600 eligible children were surveyed. Children were interviewed based on pre-tested questionnaire for age, sex, ordinal position, number of siblings, number of family members, type of family, religion, occupation of parents, family income, education of parents, standard of living, personal hygiene. Anthropometric measurements i.e. height and weight were recorded with detail clinical examination for symptoms of various nutritional deficiency symptoms. The academic achievement of school children was assessed from their school result cards. Further information regarding quality and quantity of mid day meal was collected by students and through self observation of the researcher.

3.4 Methodology

The present study was an intensive research to assess the impact of mid day meal on nutritional status and academic achievement of school children. It also examined the magnitude of nutritional diseases prevailing among both school children aged 6 to 14 years. In order to get a realistic picture, the technique adopted for obtaining data and information was intensive and time consuming. Multiple options were exercised to collect the required details from the subjects. It includes an oral questionnaire that comprised of an interview-cum physical examination, anthropometric measurements, clinical observation and academic achievement result cards.

The questionnaire was developed to collect the required information. It was prepared carefully in consultation with medical experts and improved over several administrations. Each question was examined before finalizing for its relevance to the study and for its objectivity.
3.4.1 Pilot Survey

Initial version of questionnaire and all the techniques for measurement of anthropometrical and clinical examination test adopted were piloted on a set of 50 Mid Day Meal (MDM) school children and 50 Non-Mid Day Meal (NMDM) school children from all the age groups irrespective of gender under medical staff supervision. Consequently the content of the questionnaire was modified and minor changes were made in the method of gathering information on anthropometric measurements and clinical examinations with these changes, tools were then used to study different sets of children and the results were found to be fairly satisfactory.

3.4.2 Data Collection

Examination/interviews based pre-designed and pre-tested questionnaire (annexure I) were carried out during the year 2009 to 2011. Questionnaire was specifically developed by the researchers for the purpose of this study. The questionnaire included multiple choice questions about the impact of mid day meal on nutritional and academic achievement. The children of the study group were both physically examined and interviewed for family history background and other information in their respective schools. The subjects under study group were assembled separately and were told about the purpose and objectives of the study. They were also explained about the procedures of the study. In all the schools children under study were examined class wise and efforts were made to cover all the children of a particular class through repeated visits before shifting out to other class units. Each subject was called alone in a separate room, interviewed and examined personally by the investigator to avoid passing of information to other
members of the study group and to ensure privacy as well as to avoid embracement situation to the respondent if asked in front of the other children and to enable the child to give answer and respond freely to the investigator. All the work relating to data collection and physical examination were conducted by the investigator to maintain the uniformity. About 20 to 30 minutes were spent on each child for the physical examination during the school hours. The academic achievement of the study group was assessed from their school result cards. Results of previous passed class and preceding class were taken as to determine the progress in academic achievement. The process of data collection and physical examination was time intensive. But the efforts were worth while, as it secured reliability of data.

The questionnaire was based on:

1. Individual profile
2. Family background
3. Standard of Living Index (SLI)
4. Personal hygiene of the child
5. Anthropometric measurement
6. Clinical examination
7. Academic achievement
8. Mid Day Meal Scheme

While the first section deals with the name of the child, date of study, age, date of birth, sex, class, name of the school, type of school, number of siblings, religion, residential address etc. The second section deals with complete family background to include name of parents, occupation of parents (annexure II), education of parents, mother working status, type of family, total family members, monthly family income (annexure III),
total earning members etc. in detail to ascertain the socio-economic status of the family.

The third section of the questionnaire includes information about family living standard. A scale of Standard of Living Index (SLI) developed by National Family Health Survey (NFHS), District Level Household Survey (DLHS) has been adopted (annexure IV). The SLI is calculated by adding the scores for source of drinking water, type of house, fuel for cooking, toilet facility, source of lighting, ownership of items etc.

The fourth, fifth and sixth section of the questionnaire includes information of child’s nutritional status i.e. child personal hygiene, anthropometric measurements (height and weight) and clinical examination, respectively. The child personal hygiene was assessed on the basis of cleanliness of teeth, hair, nails, mouth etc. and bath habits of the respondents. The anthropometric measurements like height and weight was recorded by researcher for each child of the study group on the spot and noted down simultaneously on space provided for it on the questionnaire. The clinical examination of different parts of the body of the subjects for symptoms of various nutritional deficiencies was analyzed. The questions were set to the symptoms for normal to various categories of particular nutritional deficiency disease. The various categories of symptoms found were noted down in the appropriate space to compute later.

The seventh section of the questionnaire deals with child’s academic achievement. The school performance was obtained on the basis of average percentage of total marks obtained in previous and successive class examination.
The eighth section of the questionnaire includes information about mid day meal like do children get mid day meal everyday? Do they like mid day meal? Do they eat mid day meal every day? And do they feel full stomach after eating mid day meal? The quality of mid day meal was personally observed by the researcher as well as observations/views of teacher were also taken in this regard. The quantity of mid day meal provided to children and nutrient content in it was calculated by Nutritive Value of Indian Food by ICMR (NIN, Hyderabad, 1990) (annexure v).

3.4.3 Filling up the Questionnaire

The questionnaire-cum-interview schedule was prepared in English language and explained to the subject in Hindi also, as the children belong to the low socio-economic group and were studying in either government primary or Hindi medium public primary schools. The researcher read out the questions and filled in the response given. The responses in interview scheduled were filled in by the researcher irrespective of their age to maintain uniformity in the procedure with in that age group.

3.5 Anthropometrical Examination

For anthropometric measurements efforts were made to secure accuracy of high order by employing standardized equipment like weighing machine, and anthropmeter, to get information on all the anthropometric measurements. WHO recommends the use of vertical board with attached metric rule and a historical head bound for measurement of height and a leveled platform scale for the measurement of weight in adults. Standard techniques were used in respect of all the anthropometric measurements.
3.5.1 Age

This was determined from the school register. The school insists on a birth certificate at the time of admission and thereafter the age is increased by one every year. Only those children who were listed in register to be in the age group of 6 to 14 years were included.

The anthropometric indicators recommended by WHO child growth for standards (2007) 5 to 19 years children are stunting (height-for-age <3rd percentile) and thinness (BMI-for-age <5th percentile) that studied in this analysis/study. These were calculated separately for boys and girls for each year of age, as the WHO reference norms vary by age and sex.

3.5.2 Weight

Weight was taken with the help of a Crown Victoria DX bathroom scale to the nearest of 0.5 kg reading. The instrument used was easily portable, sturdy, inexpensive and light to be carried for the field study. To ensure the accuracy, it was checked daily with standard weight and by taking repeated weight of the same individual. The subject was weighed preferably before the mid day meal in minimal clothing. The subject was asked to empty the bladder before weighing by a standard procedure as suggested by Jelliffe (1966).

3.5.3 Height

Height was measured in centimeters nearest to 0.2 cm. The subject was asked to stand without shoes but with heels together and with the shoulder, buttocks, and heels, touching the scale. The subject looked straight and the head was held comfortably erect. The arms hung naturally on the sides. The subject was asked to take a deep breath and stretch without raising the heels. The height was recorded when the
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anthropometer beam was brought down firmly on the vertex. In the case of girls it was necessary to remove any impediment like combs, ribbons, clips or bands etc.

3.6 Grading Growth Status

There are several ways of combining weight and height data to construct of fatness (obesity) or thinness (under nutrition). The growth status of the children was assessed by expressing their weight and height as per CDC standard (2000) (annexure VI) and categorizing them into various grades of nutrition status according to WHO standards (2007) (annexure VII (height-for-age) and annexure VIII (BMI-for-age)). Height-for-age indices reflect long term nutritional status. Inadequate height-for-age indicates a chronic condition 'stunting'. The indices Body Mass Index-for-age reflect 'thinness' (under nutrition) or an indicator of current nutritional state. Such combination of indices could be used to assess whether the child is fatter or thinner than is usual for a child of that sex, age and background.

The children were grouped into different grades of nutrition status by WHO child growth standards (2007). Anthropometric data were analyzed using the World Health Organization’s (WHO) Anthroplus Version 3.2.2 statistical software. Stunting was defined as a height-for-age z score <-2SD (severe stunting, <-3SD), thinness as a BMI-for-age z score <-2SD (severe thinness, <-3SD), and overweight as >+1SD (obesity, >+2SD).

3.7 Clinical Examination

Detailed clinical examination of the subject was carried out. Clinical signs suggesting various nutrient deficiencies were examined by a standard procedure documented by Jelliffe (1966). The children were
examined particularly for iron, vitamin C, vitamin B, vitamin A deficiencies and dental caries.

3.8 Energy and Protein Estimation

The quality of raw material used in the preparation of mid day meal had been differentiated into good, average and poor category by the researcher after keen observation of food items.

For calculating calorie and protein content in food items of mid day meal, one week menu has been followed in each school and quantity provided to each child was weighed. An average of calorie and protein content in each cooked items has been calculated by Nutritive Value of Indian Foods by ICMR, 1990 (NIN, Hyderabad) (annexure V).

3.9 Analysis Of Data

All the data obtained through questionnaire cum interview schedule were coded and entered into computer taking into consideration all the parameters of the relevance and importance of the study. Mean, standard deviation and percentiles were calculated for various anthropometric parameters for each age group for boys and girls separately as well as combined for analysis and comparison. The mean and percentile for various parameter were utilized for analyzing the relationship with nutritional status and academic achievement and for comparison with the others standard percentile studies. Normal ‘z’ test or student ‘t’ test were tested for comparing observed mean for various parameter. WHO (World Health Organization) child growth standard for assessing nutritional status was calculated from measured height and weight to classify children into group i.e. normal, stunting, and severe stunting and normal, thinness and severe thinness category of malnutrition. Chi-test was
applied to find out the difference in the distribution of various parameters. The detail calculation methods have been described below:

### 3.9.1 Percentage

Single comparisons were made on the basis of the percentage. For drawing percentage the frequency of a particular cell was multiplied by 100 and divided by total number of respondents in that particular category.

### 3.9.2 Arithmetic Mean

Arithmetic mean was the average used in the present study. Arithmetic mean of a series was the figure obtained by dividing the total values of various items by their number.

\[ \bar{X} = A + \frac{\sum fx}{\sum f} \times i \]

where,

- \( \bar{X} = \) Arithmetic Mean
- \( A = \) Assumed Mean
- \( \sum fx = \) Product of frequency and deviation from the assumed mean
- \( \sum f = \) Total frequency
- \( i = \) Class interval

### 3.9.3 Standard Deviation (SD)

Standard deviation was the square root of the arithmetic mean (average) of the squares of the deviation measured from the mean or assumed mean.
\[ \sigma = \sqrt{\frac{i \left( \sum fx^2 - \left( \sum fx \right)^2 / n \right)}{(n-1)}} \]

where,

\( \sigma \) = standard deviation

\( \Sigma fx^2 = \) sum of the product of frequency and square of deviation from assumed mean.

\( \Sigma fx = \) sum of the product of frequency and deviation from assumed mean.

\( n \) = number of observations

\( i \) = class interval

### 3.9.4 Test of Significance

t-test was expressed as-

\[ t = \frac{|\bar{X}_1 - \bar{X}_2|}{\text{C.S.E.}} \]

Where, \( \bar{X}_1 \) and \( \bar{X}_2 \) were the means of the first and second group. C.S.E. mean combined standard error. It was calculated by the following formula:

\[ \text{C.S.E.} = \text{C.S.D.} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}} \]

where, \( n_1 \) and \( n_2 \) were the number of observations in the first and second group respectively. C.S.D. is the combined standard deviation. It was calculated by the following formula:

\[ \text{C.S.D.} = \frac{\sqrt{(n_1 - 1) \sigma_1^2 + (n_2 - 1) \sigma_2^2}}{n_1 + n_2 - 2} \]
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\[
\text{C.S.D.} = \sqrt{\frac{n_1 \sigma_1^2 + (n_2 - 1) \sigma_2^2}{n_1 + n_2 - 2}}
\]

if \( n_1 \leq 30 \)

\( n_2 \leq 30 \)

if \( n_1 > 30 \)

\( n_2 \leq 30 \)

\[
\text{C.S.D.} = \sqrt{\frac{(n_1 - 1) \sigma_1^2 + n_2 \sigma_2^2}{n_1 + n_2 - 2}}
\]

if \( n_1 \leq 30 \)

\( n_2 > 30 \)

if \( n_1 > 30 \)

\( n_2 > 30 \)

\[
\text{C.S.D.} = \sqrt{\frac{\sigma_1^2 + \sigma_2^2}{n}}
\]

\( \sigma_1 \) and \( \sigma_2 \) were standard deviations of first and second group respectively.

3.9.5 \( \chi^2 \) Test

\( \chi^2 \) test describes the magnitude of the discrepancy between theory and observation. It is defined as:

\[
\chi^2 = \sum \frac{(O - E)^2}{E}
\]

where,

\( O = \) Observed frequencies
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\( E = \text{Expected frequencies} \)

Expected frequencies were calculated by:

\[
E = \frac{RT \times CT}{N}
\]

where,

\( E = \text{Expected frequency} \)

\( RT = \text{the row total for the row containing the cell.} \)

\( CT = \text{the column total for the column containing the cell.} \)

\( N = \text{the total number of observation.} \)

3.9.6 Coefficient of Correlation

It determines the degree of relationship between two or more variables – it does not tell about cause and effect relationship.

\[
r = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (\sum Y)^2]}}
\]

where,

\( r = \text{stands for correlation coefficient.} \)

\( N = \text{Number of observations.} \)

\( \sum xy = \text{Sum of the product of deviation of } x \text{ and } y \text{ variables with their frequencies.} \)

\( \sum x = \text{Sum of the product of deviation of } x \text{ variable with the frequency.} \)

\( \sum y = \text{Sum of the product of deviation of } y \text{ variables with the frequency.} \)