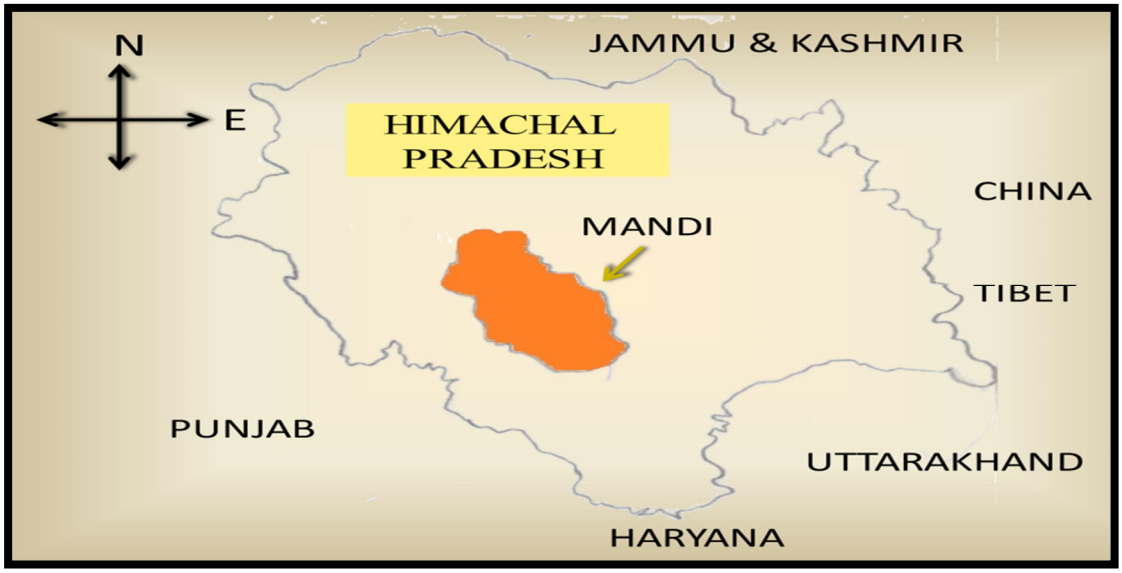
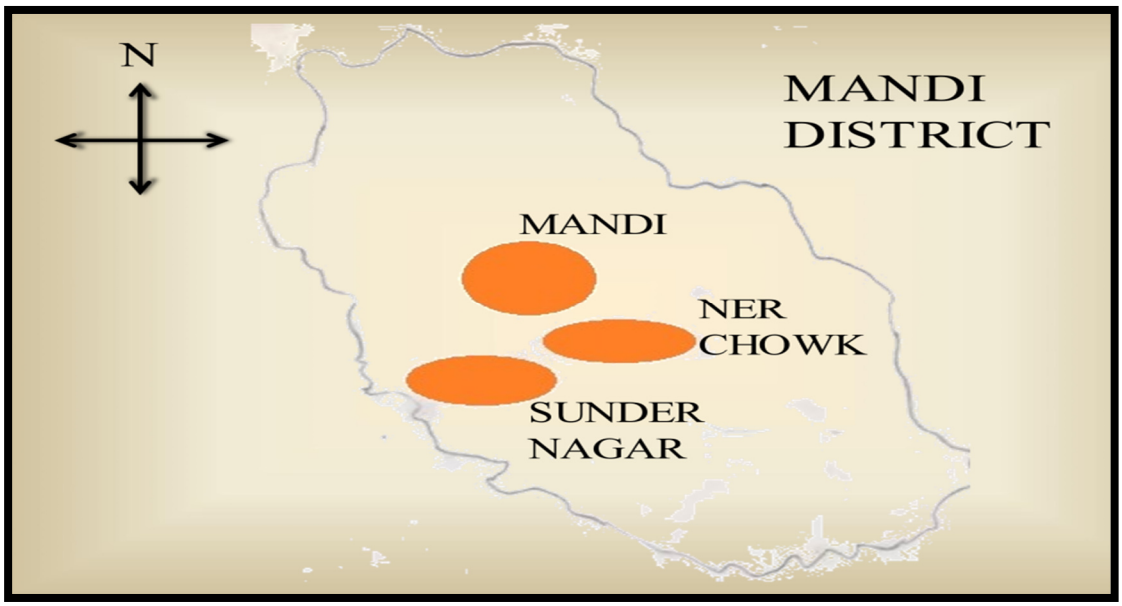
.1 PLACE OF STUDY

This study was conducted in the Mandi district of Himachal Pradesh (HP). To avail the logistic advantage, a wider range of geographical locations including hilly regions of the districts were excludedand only the non-hilly zones and valley regions of the districts were selected. This includes three subdivisions of the Mandi district; MandiSadar, Balh, and Sundernagar. These zones cover urban, peri-urban, and as well as rural areas.





3.2 STUDY DESIGN

A cross-sectional survey design was adopted in the present study.

3.3 SUBJECT SELECTION

To avail subjects from all socio-economic strata, both private and government schools were selected. A multistage sampling approach was adopted in the present study. This

was followed by a stratified sampling procedure. The government and private schools were treated as independent sampling domains. The government and private school network lists in MandiSadar, Balh, and Sundernagar subdivisions of Mandi district were obtained from the school list of the Himachal Pradesh Board of School Education. The total number of government and private schools in these regions were found to be 7 and 16 respectively.

Within each school category domain, a multistage systemic design technique was adopted. 3 government schools (42.8%) and 6 private (37.5%) schools were selected. The students of two categories of school, studying in class seven to twelve standards within the age group of 10-17 years served as the sampling frame and each class was considered as a stratum. Next, random sampling was conducted from each class (stratum) as a part of the stratified sampling technique.

This approach of subject selection not only helps to control the district-wise variations. Furthermore, restricting the subject selection from non-hilly zones also allowed to control of the effects of lifestyle and food patterns of the subjects which vary greatly between the hilly and non-hilly regions. Moreover, selecting both government and private schools was based on the fact that it will allow comparing subjects across different socio-economic criteria as mentioned earlier.

3.3.1 INCLUSION CRITERIA

All the children with in the age group of 10-17 years who consented to participate in the study as per the design of the experiment were included.

3.3.2 EXCLUSION CRITERIA

The children suffering from any type of chronic disease or those who reported any illness during the last one month before the study date were excluded from the study.

3.4 SAMPLE SIZE CALCULATION

The study aimed to estimate the prevalence of malnutritional conditions in the target population. For a more conservative approach, a 50 % prevalence rate was selected for different categories of malnutrition; viz, stunting, thinness, and overweight. The following formula was used for calculating the adequate sample size for a prevalence study[1].

$n=Z^2P(1-P) / d^2$

Where n is the sample size, Z is the statistic corresponding to the level of confidence, P is expected prevalence, and d is precision (corresponding to effect size).

In the present study, the sample size was estimated from the following values:

z- The Z score at 95% confidence interval = 1.96

p - the assumed prevalence = 50 %

1- p = 50 %

d = precision level or margin of error = 5%

$$n = (1.96*1.96*0.5*0.5) \text{ X } 100$$

$$(0.5*0.5) = 385$$

However, presuming an attrition rate of 20%, the number of students that this study will coverwill be approximately 385 + (20 % of 385) = 385 + 77 = 462. The minimum number was rounded to 470. The final sampling frame consists of a total of 940 subjects.Considering this number individually for boys and girls, the final sampling frame consists of a total of (470 ×2)= 940 subjects, which was considered as the minimum number of subjects required for the study. Furthermore,to allocate equal proportion of students for each age groups from 10 – 17 years, a minimum of 58 children were required for each age group category.

3.5 ETHICAL APPROVAL

The ethical approval for this survey was obtained from the Institutional Ethics Committee (IEC) of Himachal Dental College, Sundernagar, District Mandi, Himachal Pradesh, IEC number 2017-24, dated:19.12.2017.

3.6 CONSENT FOR THE STUDY

Before the study, detailed explanations were given to the students about the purpose of the study and the extent of their involvement in presence of the respective class teachers. The same was also conveyed to their parents through the class teachers. The students were also informed about the informed consent letter. The parents of the subjects and the class teachers provided informed consent. Consents were obtained for the participation in anthropometric measurements, interviews, and discussions through questionnaires as required by the design and protocol of the study. Questionnaires were presented both in English and Hindi. Translations of the questions were done by an expert..

3.7 PHYSICAL MEASUREMENT

3.7.1 DETERMINATION OF AGE

The Date of Birth (DOB) was obtained from the school register which is based on the birth certificate presented at the time of admission. From this DOB, the exact age at the time of examination was obtained, using the survey date (vide questionnaire survey section) as reference and expressed as year, month and day. If the day was less than or equal to 15, the previous month was considered, and if the number of days was16 or more, the next month was considered to calculate the age in years and month. From the age, the participants were further grouped as early adolescents (10–14 years) and late adolescents (15–19 years).

3.7.2 DETERMINATION OF HEIGHT

Height was measured with an anthropometric rodwith shoes removed and head aligning in the Frankfurt plane. Readings were taken to the nearest 1 cm.

3.7.3 DETERMINATION OF WEIGHT

Weight was measured in kg by using a bathroom room-scale with minimum clothing and shoes removed to the nearest 500 grams.

3.7.4 DETERMINATION OF BMI

BMI was obtained as the weight in kg divided by the square of height in meter and expressed as $kg/m^{2.}$

3.8 ANTHROPOMETRIC ASSESSMENT OF NUTRITIONAL STATUS

Classification of nutritional status was made according to public health criteria recommended by a World Health Organization expert committee[2]. For analytic purposes, both undernutrition and overnutrition conditions were determined based on five outcome variables; 1) stunted 2) thin or wasted, 3) coexistence of both, or thin and stunted, 4) overweight, and 5) obese.

These conditions were assessed from the WHO recommended z-scores of two nutritional indices. The z-scores of the Height - for - age index were used to assess stunting while the z-scores of the BMI - for - age index were used to assess the other three categories, i.e., thinness, overweight, and obesity.

3.9 CALCULATION OF Z-SCORES

The HAZ-z score for an individual subject of the study population belonging to a particular age was calculated as:

(Measured height – Median height of the reference population of the same age) / SD of the ref population

For calculating the z-scores of BMIAZ, the Body Mass Index values of the study population were converted to exact z scores from the L, M, and S values of the reference charts of the corresponding age groups, using the following formula

- Z – score = ([BMI score of study population /M]^{L} – 1) / LS

Where L, M, and S are Box-Cox power, median, and coefficient of variation of the corresponding age of the reference population respectively[3].

3.9.1 CUT OFF VALUES OF Z-SCORES FOR DEFINING MALNUTRITION

Categories of malnutrition were defined according to the cut-off values of z scores presented in the WHO growth reference data for 5 – 19 years old adolescents[4-5].The following cut-offs for the Z-score of HAZ were used to define different categories of undernutrition as per HAZ:

Stunted = z-score < - 2SD to ≤ - 3SD,

Severely stunted = z-score < - 3SD

The following z scores cut-off values of BMIAZ were used to define the different conditions of under and overnutrition:

- Thin = z-score is < - 2SD to ≤ - 3SD,
- Severely thin= z-score = < - 3SD,
- Overweight = z-score > 1 SD
- Obese= z-score is > 2 SD

A subject was considered normal if the z-scores for both HAZ and BMIAZ were found to be > -2SD.

3.10 QUESTIONNAIRE SURVEY

A questionnaire was prepared to collect all necessary information as required by the study design. The primary questionnaire was initially prepared in the English language. Next, the questions were thoroughly checked and were translated into the local language (Hindi), and then back-translated into English to ensure translations were accurate. The initial question was pretested in a small sample of 64 male and female children within the age group of 10 – 17 years and necessary modifications were made as required according to their responses. The final questionnaire was again

translated into Hindi and back-translated once again into English to check the accuracy before administration.

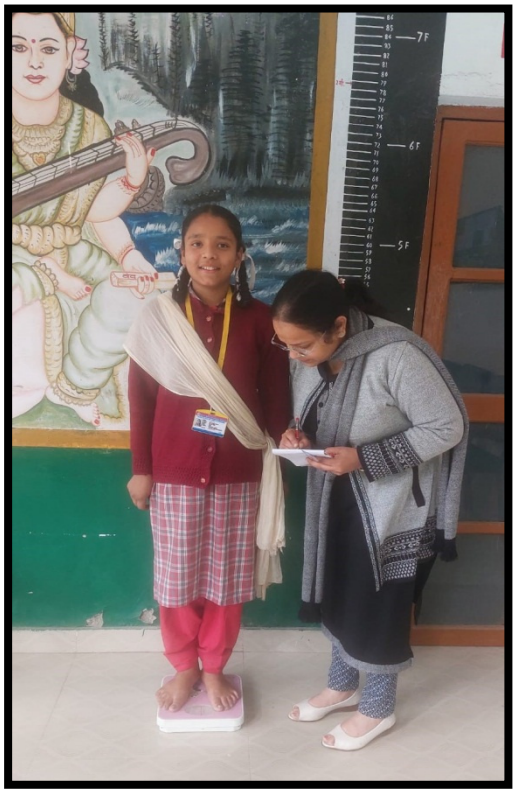
The survey questionnaire comprised of the following sections;

1. **Reference Number** – The reference number is used to identify the schools, gender and serial number.
2. **Date and Place of the Survey** - This section includes the name, address, location and type of the school where the survey has been conducted and the date of survey. The date of survey was used to calculate the exact age in years and month according to DOB.
3. **Personal Information** – This section includes name of the student and contact details.
4. **Physical Parameters** – This section includes age, height, weight, BMI and Z score for stunting, thinnessand overweight, and nutritional status.
5. **Questionnaire on Dietary Pattern** – This section includes a standard food frequency questionnaire. The questionnaires were prepared to examine the self-reported intake frequency of seven categories of healthy and six categories of unhealthy food items consumed during the last two weeks before the study. Healthy or essential food groups included milk, fruit, dairy products, cooked vegetables, green leafy vegetables, salads, and pulses. Unhealthy food groups or junk food comprises savory snacks, fast foods, sweets, cake/pastry, candy/chocolates, soft drinks, and other type sweetened beverages.

The pattern of the questionnaire was adopted from the already validated questionnaire used for food frequency consumption[6-7]. The frequency of consumption of both healthy and unhealthy types of foods was obtained according to four response options; 1) daily, 2) most or ≥ 4days a week, 3) few or 1- 3 days per week, 4) never or once over 14 days. The responses were further dichotomised as high consumption (daily and most days a week), and low consumption (few days a week and never). Breakfast Pattern – Breakfast consumption pattern was assessed as regular intake (daily or 4 or more days a week), or irregular, i.e.≤ 3 days a week.

MEASUREMENT OF HEIGHT OF BOYS &GIRLS

MEASUREMENT OF BODY WEIGHT OF BOYS &GIRLS



EXPLAINING STUDENTS ABOUT THE STUDY IN FRONT OF CLASS TEACHERS

STUDENTS FILLING UP THE QUESTIONNAIRE FORM UNDER THE SUPERVISION OF THE RESEARCHER AND TEACHERS

3.11 STATISTICAL ANALYSIS

Descriptive statistics including measures of central tendencies (mean and median) and dispersion (standard deviations, standard errors, and 95% CI were used to describe continuous variables like height, weight and BMI, and z scores.

Student's t-test and one-way ANOVA were computed for mean comparison between two or more groups respectively. The level of significance was set at $p < 0.05$ level. Pearson's Chi-square test was used to compute the level of association between the different proportions, particularly to demonstrate the association of malnutrition categories with dietary patterns, according to the aims and objectives of the study. Statistical analysis was done using Microsoft excel (office 2019 version) and SPSS (version 16).

Statistical parameter such as mean, standard deviation, t- statistics and F- statistics are calculated as:

$$\textbf{Mean} = \frac{\text{Sum of all the observations}}{\text{Totol Number of observations}}$$

Standard deviation $$\sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{N}}$$

$\boldsymbol{\sigma}$ = Standard deviation,

N = Size of Population,

$\boldsymbol{x_i}$= Each value from the population, and

μ = Population Mean

t - statistics $$t = \frac{\bar{x} - \mu_o}{S/\sqrt{n}}$$

$\bar{\boldsymbol{x}}$ = Sample Mean,

$\mu_{\boldsymbol{o}}$= Population,

S = Standard Deviation of the sample, and

n = Stands for the size of the sample

F - statistics F = Variance 1/variance 2

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