REVIEW OF
LITERATURE...
Adolescence: "No longer children, not yet adults"

2.1 ADOLESCENCE:

Adolescence, a period of transition between childhood and adulthood, occupies a crucial position in the life of human beings. This period is characterized by an exceptionally rapid rate of growth. The peak rates of growth are exceeded only during the fetal life and early infancy (Tanner, 1978).

The World Health Organization (WHO) defines adolescents as young people aged 10-19 years. As they grow they feel a sense of independence, but depend on adults for their material needs. And as they change, so do their needs change with them.

Unfortunately, assessment of nutritional status of adolescent girls has been the latest explored area of research particularly in rural India. The findings of studies on school children can not be extrapolated to adolescent girls, as their school enrollment as well as sustenance are less than that of boys. It is likely that girls not attending schools belonged to disadvantaged section of society and contribute significantly in domestic and peri-domestic activities, thereby jeopardizing their health (Seema et al., 2003).
2.1.1 Phases in adolescence

1. Early adolescence (10-12 years): It is characterized by a spurt of growth, and the beginning of sexual maturation. Young people start to think abstractly.

2. Mid-adolescence (13-15 years): The main physical changes are completed, while the individual develops a stronger sense of identity, and relates more strongly to his or her peer group, although families usually remain important. Thinking becomes more reflective.

3. Late adolescence (16-18 years): The body fills out and takes its adult form, while the individual now has a distinct identity and have more settled ideas and opinions.

2.1.2 Special characteristics of Adolescence

Adolescence is a period of rapid development when young people acquire new capacities and are faced with many new situations. Over 80% of adolescent growth (attained weight and height) is completed in early adolescence (10-15 years), with a marked deceleration in weight and height velocity in the post-pubertal phase. This adolescent growth spurt is also associated with cognitive, emotional and hormonal changes. This phase of life cycle is marked by special characteristics which include--

1. Rapid physical growth and development.

2. Physical, social and psychological maturity.
3. Sexual maturity and onset of sexual activity.

4. Beginning of menstruation in girls and onset of reproduction cycle.

5. Experimentation.


7. Transition.

2.2 NUTRITIONAL STATUS

There are about 1.2 billion adolescents in India, a fifth of the world's population and their number is increasing. Adolescents constitute about 23% of population in India. In India, girls constitute 5.1% of adolescents in 10 - 14 years age group and 4.8% in 15 - 19 years age group (UNICEF, 2011).

2.2.1 ANTHROPOMETRIC MEASUREMENT OF ADOLESCENT GIRLS

Anthropometric measurements such as height and weight are useful not only for growth and nutritional studies but are useful also for adaptation studies. Poor growth of children of low income groups in the technically under developed countries is to a large extent believed to be due to malnutrition.
In a study conducted by NNMB (1996-97) in 120 villages from each state, overall prevalence of stunting (< median height-2 SD) was similar in both the sexes, boys: 39.5% and girls: 39.1%. Under nutrition (< median- 2SD of NCHS weight for age) in males was more (53.1%) as compared to females (39.5%) in case of body weight. The mean daily intakes of different foods according to sex were almost similar in both the sexes. The percentage of under nutrition was less in adolescents belonging to extended families (40.7%) as compared to joint families (48.6%) (NNMB, 2000).

A study conducted in an urban slum of Varanasi depicted that 70 per cent of the adolescent girls had BMI < 20; 51.43 percent of the study subjects were suffering from Chronic Energy Deficiency while stunting was present in 10 percent of the adolescent girls (Singh and Mishra, 2001).

In a study conducted in adolescent rural girls of Varanasi, two-third of study subjects were undernourished (BMI < 18.5 kg/m2), nearly one-third had chronic energy deficiency grade-III (BMI<16 kg/m2).53.33% adolescent girls had normal built. Vitamin A, B, C and D deficiencies were present in 13.70%, 4.07%, 15.92% and 10% study subjects respectively. Bitot’s spots were seen in 3.33% subjects and 25.90%, 13.33% and 4.44 % girls had anaemia, dental caries and Iodine Deficiency Disorders (IDDs) respectively. Nearly one-third girls were anaemic (Hb < 12 g/dl). Anaemia was significantly more in non-menstruating girls and subjects not using footwear during defecation (Choudhary et al., 2003).

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In a study conducted in two PHC areas of Wardha district in adolescents, 53.8% were thin, 44% were normal, and 2.2% were overweight. The mean BMI for boys and girls was 16.88 kg/m² and 15.44 kg/m² respectively (Deshmukh et al., 2006).

In a study of growth parameters and prevalence of overweight and obesity in school children from Delhi, a total of 21,485 children in the age group 5 to 18 years were evaluated for height, weight and BMI. The prevalence of overweight and obesity among the lower socio-economic status school girls was 2.14% and 0.28% as compared to 19.01% and 5.73% respectively among girls from upper socio-economic status. There is a significant disparity in anthropometric parameters of children belonging to the upper and lower socioeconomic strata, with upper socio-economic status children being significantly taller and heavier (Marwaha et al., 2006).

In a cross-sectional study carried out in tea gardens of Dibrugarh district of Assam, in 605 adolescents aged 10-18 years, the prevalence of thinness in boys was 59.49% and in girls 41.32%. Mean BMI values of both boys and girls were far below the NCHS median. Overweight was present in 0.33% (Medhi et al., 2007).

Varsha et al. (2008) stated that the rural adolescent girls of Marathwada region were consuming all nutrients below the recommended, revealed gross deficiency of nutrients. Compared to other nutrients, fat intake was found to be slightly satisfactory as the intake was almost one-third of the requirement. The
anthropometric measurements were not satisfactory in the selected girls and these were the reflection of less nutrient intake.

A community-based cross-sectional study was carried out by Prashant and Shaw (2009) an urban slum of South India. Where they concluded that there is a high prevalence of under nutrition among adolescent girls in this slum community. Health education and nutrition interventions are needed on priority basis.

Banerjee et al. (2009) conducted a study on growth & nutritional status of Bengali girls in India and found that the adolescent girls in the current study were significantly (p<0.0001) taller than Indian girls and heavier than both Indian and urban Bengali girls but slightly shorter than urban Bengali girls. They were significantly (p<0.0001) shorter and lighter than American girls, which also corresponded to 50th percentile curves. Age specific nutritional assessment showed different grades of malnutrition among them. About 60 % to 70 % adolescent girls showed either moderate to mild malnutrition during their growth period.

Jalja Kumari and Sri Hari Krishna (2011) reported an overall prevalence of overweight among adolescents as 8.4% among girls and 6.9% among boys in Guntur city of Andhra Pradesh. Adolescents who bought lunch at school were at increased risk of being overweight and obese (95% CI: 1.441 and 1.19–1.64). Parents and schools provide opportunities for public-health initiatives for reducing childhood and adolescent overweight and obesity.

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Parimalavalli and Sangeetha (2011) used anthropometric measurements to assess the nutritional status of adolescent girls of Tamilnadu. They found that anthropometric measurements of the selected girls were lower when compared with National Centre for Health Statistics as a reference population. A significant difference was observed between selected girls and Indian adolescent girls with respect to weight, except girls in the age group between 15 and 16 years from matriculation school. Mean nutrient intake of the selected government school girls was significantly lower when compared with Recommended Dietary Allowance of Indians. Nutritional inadequacy is one of the main causes of prevalence of malnutrition that can lead to higher incidence of diseases among adolescents.

Saxena and Saxena (2011) conducted a study on nutritional status of rural adolescent girls of Garhwal hills. In this study 34.61% of adolescents' girls were found to be stunted. The stunting was more (33.33%) in 16 to 19 years of age group. The overall prevalence of thinness was 43.47%. However percentage of thinness was higher (56.25%) in the lower age group (12-15 years). Under nutrition was prevalent in similar proportions in both the age groups with > 50% of the rural adolescent girls having less than 3rd percentile of weight for age by NCHS standards. The prevalence of stunting, thinness and underweight was high among adolescent girls living at high altitudes. In this regard special attention should be paid to the girls of hills and specific strategies should be formulated for meeting their nutritional demands.
In a study, Bovet et al. (2011) compared two growth references for BMI and found that at any given age, boys tended to be taller than girls, particularly in the upper school grades, whereas girls tended to have higher BMI than boys. The prevalence of thinness was 21.4%, 6.4% and 2.0% based on the three IS cut-offs and 27.7%, 6.7% and 1.2% based on the WHO cut-offs. The prevalence of thinness categories tended to decrease according to age for both sexes for the IS reference and among girls for the WHO reference.

Shivramakrishna et al. (2011) conducted a community-based cross-sectional study to assess the nutritional status of adolescent girls in rural area of Kolar district. The study comprised of 230 adolescent girls of age 10–19 years. The prevalence of wasting and stunting was 54.79% and 32.17% respectively as per water lows classification and the trend of wasting and stunting declines with the age. The prevalence of thinness was found to be 73.5% as per Indian standards.

Verma (2012) studied the nutritional status of Gadaba girls in Bastar district of Chhattisgarh; where he found the heights of Gadaba girls to be almost equal to the ICMR standards. He found that the 50th percentile of his sample was between 50th percentile of Indian Council of Medical Research (ICMR) and National Centre for Health Statistics (NCHS).

Maiti et al. (2012) studied the nutritional status of tribal adolescent girls in Paschim Medinapur district of West Bengal and
found the mean heights (cm) to be 124.86 ± 8.39; 131.95 ± 9.47; 137.5 ± 9.52; 137.31 ± 9.46; 145.15 ± 10.89; 144.92 ± 8.18; 147.81 ± 8.43; 149.28 ± 4.47 and 147.80 ± 6.46 for the girls of 10; 11; 12; 13; 14; 15; 16; 17 and 18 years respectively. In their study, they found the BMI to be 13.94 ± 3.08; 14.23 ± 2.28; 15.29 ± 3.66; 16.14 ± 3.70; 16.27 ± 2.92; 16.72 ± 2.92; 16.36 ± 2.15; 16.03 ± 1.93 and 17.47 ± 2.89 for the girls of 10; 11; 12; 13; 14; 15; 16; 17 and 18 years respectively.

2.2.2 Z-SCORES:

Anthropometric assessment for children and adolescents involves the use of growth standards and/or growth references for assessing their growth, nutritional status and well being (Wang et al., 2006; WHO, 1995). A growth standard reflects optimal growth, suggesting that all children have the potential to achieve that level, while a growth reference is simply the distribution used for comparison (WHO MGRSG, 2006).

Percentiles and Z-scores in anthropometric measures have been widely used to help assess young people’s nutritional status and growth, such as under nutrition (e.g., underweight, stunting and wasting) and over nutrition (i.e., overweight and obesity. Often, percentiles (such as the 5th, 85th, 95th, 97th, 99th percentiles) and Z-scores (e.g., -2 and +2) are used to classify various health conditions, and sex-age-specific anthropometric measures cut-points (based on Z-scores or percentiles) are provided in tables and as smoothed curves on growth charts.
For the past four decades, the World Health Organization (WHO) has recommended the use of growth reference (or “growth chart”), mainly based on $Z$-scores of anthropometric measures, to assess children's nutritional status and growth. These growth charts were developed based on data collected in the United States (Wang et al., 2006).

In 1995, WHO recommended the use of the sex-age-specific percentiles of some anthropometric measures for adolescents (WHO 1995). Historically, the WHO international growth references focused more on under nutrition problems, including wasting, stunting and underweight, even as the need to address a growing obesity problem in many countries has risen over the past two decades. The earlier versions of WHO standards; growth references were based on US data, whereas the new 2006 WHO Growth Standards for preschool age children have been developed based on data collected from several countries. Paediatric growth charts have been widely used globally by researchers, paediatricians, nurses and parents to assess the growth and nutritional status of children, but often users might not be aware of their limitations (Wang et al., 2006). For example, growth charts were not designated as a sole diagnostic instrument. Instead, they contribute to forming an overall clinical impression of the child being measured (CDC, 2000). In addition, many users are not aware of the differences between “growth standard” and “growth reference” as these two terms are often used interchangeably.
The use of $Z$-scores is recommended for several reasons. First, $Z$-scores are calculated based on the distribution of the reference population (both the mean and the standard deviation [SD]); thus, they reflect the reference distribution. Second, as standardized measures, $Z$-scores are comparable across age, sex and measure (as a measure of "dimensionless quantity"). Third, a group of $Z$-scores can be subject to summary statistics such as mean and SD and can be studied as a continuous variable. In addition, $Z$-score values can quantify the growth status of children outside of the percentile ranges (WHO, 1995). However, the major limitation of $Z$-scores is that they are not straightforward to explain to the public and may be of limited use in clinical settings.

The WHO and US Centers for Disease Control and Prevention (CDC) have ever developed statistical software to help researchers to calculate $Z$-scores based on the 1978 WHO/NCHS (National Center for Health Statistics) references.

In statistical terms, $Z$-scores are a special application of transformation rules. The $Z$-score for a measure (e.g., height or BMI), indicates how far and in what direction (positive vs. negative) a measured value deviates from the population mean, expressed in units of the population SD. It is a dimensionless quantity derived from dividing the difference between individual value ($x$) and the population mean ($\mu$) by the population SD ($\sigma$). The transformed $Z$-scores' distribution will have a mean of zero and a SD of one (i.e., mean = 0, SD = 1). This conversion process is called standardizing or normalizing.

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Z-scores are sometimes called “standard scores”. The Z-score transformation is especially useful when seeking to compare the relative standings of different measures (e.g., height vs. BMI, or the measures of boys’ vs. girls’) from distributions with different means and/or different SDs. Z-scores are especially informative when the distribution to which they refer is normal. In every normal distribution, the area under the curve between the mean and a given Z-score value corresponds to a fixed proportion of the total area. Based on this characteristic, statisticians have created tables indicating the value of these proportions for various Z-scores.

2.2.3 PERCENTILES:

A percentile is the value of a variable below which a certain percentage of observations (or population) falls, i.e., the percentile refers to the position of an individual on a given reference distribution. Percentiles are easier to understand and use in practice, both by health professionals and the public. For normal distribution, the Z-score of 0 divides the total area into two equal halves. Thus, the Z-score of 1 corresponds to the 84th percentile (=0.5 + 0.34), i.e., 84% of the population are measured lower than z-score of 1. A Z-score is calculated as dividing the difference between measured value (x) and the mean (μ) by standard deviation (σ).

In addition, a percentile dictates the expected percentage of a population should be above (or below) it. Often age-sex-specific c percentiles are recommended to assess children’s growth and
nutritional status based on anthropometric measures as well as other health conditions such as blood pressure. During recent years, there is a growing consensus on using sex- and age-specific BMI percentiles as cut-offs instead of weight-for-height $Z$-scores (WHZ) for assessing overweight and obesity as well as thinness/underweight in children over 2 years old (Kuczmarski et al., 2002; Wang et al., 2006; WHO, 2006). The widely used percentiles include the 3rd, 5th, 50th (median), 85th, 95th, 97th, 99th.

In statistics, the term percentile and the related term percentile rank are often used in descriptive statistics as well as in the reporting of scores from norm-referenced tests. Percentiles are often represented graphically, using a normal curve. A normal curve is always represented with some key features. The peak or the center of the bell-shaped curve stands the point of the mean of the distribution. The mean ($z = 0$) halves the normal distribution into two equal and symmetric areas. On both the right and left sides each, the graph can be shown as divided into three parts, according to $Z$-scores of 1, 2, and 3 SD to the right and -1, -2, -3 SD to the left, respectively. At each point of these SDs, the corresponding percentile (or cumulative probability) is fixed. In other words, as long as the distribution is normal, every SD unit on the $x$-axis has a specific percentile which is always paired with them. Therefore, on a normal curve, 34.13% of the data lies between 0 and -1 (or +1), 13.59% between -1 and -2 (or between +1 and +2), and 2.14% between -2 and -3 (or between +2 and +3). The remaining 0.14% of the data lies below -3 (or above +3).
A limitation of using percentiles is that the same interval of percentile values corresponds to different ranges in absolute values for different measurements. For instance, increments from 85th to 90th percentile correspond to different ranges in sub scapular and in triceps skin fold thickness. Even within the distribution of one measurement, same increments at different percentile levels could correspond to different changes in both Z-scores and absolute measures. In addition, it does not allow for quantifying the change in percentile values near the extremes of the reference distribution (e.g., people in the uppermost 1st percentile can have very different absolute values). For these reasons, it is suggested that percentiles should not be used to assess change in status over time, while change in Z-scores is a better measure. Z-scores are more useful in research while percentiles are easier for use in clinical settings and by the public.

Z-scores and percentiles can be converted to each other, but the commonly used cut points of each are not at exactly comparable levels. For example, Z-scores of 2 and -2 correspond to the 97.7th and 2.3rd percentiles, while the 85th and 5th percentiles correspond to Z-scores of 1.04 and -1.65, respectively.

2.2.4 OVERWEIGHT, STUNTING AND THINNESS

In a Study of growth parameters and prevalence of overweight and obesity in school children from Delhi, total of 21,485 children in the age group 5 to 18 years were evaluated for height, weight and BMI. The prevalence of overweight and obesity among the lower
socio economic status school girls was 2.14% and 0.28% as compared to 19.01% and 5.73% respectively among girls from upper socio economic status. There is a significant disparity in anthropometric parameters of children belonging to the upper and lower socioeconomic strata, with upper socio economic status children being significantly taller and heavier (Marwaha et al., 2006).

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stunting was 54.79% and 32.17% respectively as per water lows classification and the trend of wasting and stunting declines with the age. The prevalence of thinness was found to be 73.5% as per Indian standards.

Maiti et al. (2012) in a recent study reported the overall (age combined) rate of stunting and thinness to be 50.5% and 45.1%, respectively in tribal adolescent girls of Paschim Medinapur district of West Bengal.

2.3 NUTRIENT INTAKE AMONG ADOLESCENT GIRLS

In a study conducted in orphanages located in Udaipur city, the average amount of cereals consumed by the boys of different age group was 76.2% - 91.5% of the requirements, whereas intake of pulses was only 30% of the suggested quantities. The leafy vegetables were rarely supplied to the children but intake of other vegetables was more than the recommended. Intake of fats and oils was observed to be 30-45% less than what it is suggested. The milk intake by children was insufficient. Food items like fruits, meat, fish and eggs were never included in the diet provided in the orphanages. All the children received significantly less than the recommended intake of iron (Khan et al., 1996).

In the study conducted by ICRW on the Nutrition of Adolescent Girls in five developing countries including India, which was done in Bombay urban slums in 69 Males and 69 Females of 10-19 years, 55% were anaemic, 32% were stunted and 53% were
under nourished (Kathleen, 1996).

In a study conducted in 454 girls, of 11-18 years age group in Delhi, it was observed that 35.5% were under nourished, 3.1% were obese. Anaemia was found in 56% and dental caries in 23.3% (Kapoor and Aneja, 1996).

Malhotra and Passi (2007) studied the diet quality and nutritional status of adolescent girls in Delhi, Haryana, Rajasthan and Uttar Pradesh. They found that the subjects followed a two meal pattern and their diets were monotonous and cereal-based. Around 49.3% of them were found to have energy intake less than 75% of RDA while a substantial proportion of them had inadequate nutrient intake (NAR <0.66) with respect to most of the micronutrients especially iron (84.7%), folic acid (79.4%) and vitamin A (73.2%). The mean daily intake of milk and milk products, pulses, green leafy vegetables, other vegetables and fruits was grossly inadequate meeting only 47%, 36%, 26%, 34% and 3% of the suggested allowances; that of fats/oils and roots/tubers was somewhat adequate meeting 65% and 72% of the allowances while the intake of cereals and sugar was almost adequate revealing a deficit of only 7% and 3%. The study reveals not only a high incidence of under-nutrition but also an inadequate energy/micronutrient intake among the beneficiaries of Adolescent Girl scheme. Therefore, sustained efforts are needed to strengthen the scheme for improving its field-level implementation.
Varsha et al. (2008) stated that the rural adolescent girls of Marathwada region were consuming all nutrients below the recommended, revealed gross deficiency of nutrients. Compared to other nutrients, fat intake was found to be slightly satisfactory as the intake was almost one-third of the requirement. The anthropometric measurements were not satisfactory in the selected girls and these were the reflection of less nutrient intake.

Amongst rural adolescent girls of Wardha; Maliye et al. (2010) found that the average energy intake, which was 1239.6±176.4 kcal/day, was deficient of RDA by 39%. The average protein intake was 39.5 ± 7 gm/day. Protein was deficient by 36% and the average iron intake, which was 13.2 ± 2.5 mg/day, was deficient by 48%.

Parimalavalli. and Sangeetha (2011) used anthropometric measurements to assess the nutritional status of adolescent girls of Tamilnadu. They found that anthropometric measurements of the selected girls were lower when compared with National Centre for Health Statistics as a reference population. A significant difference was observed between selected girls and Indian adolescent girls with respect to weight, except girls in the age group between 15 and 16 years from matriculation school. Mean nutrient intake of the selected government school girls was significantly lower when compared with Recommended Dietary Allowance of Indians. Nutritional inadequacy is one of the main causes of prevalence of malnutrition that can lead to higher incidence of diseases among adolescents.
2.4 NUTRITIONAL DEFICIENCY SIGNS AMONG ADOLESCENT GIRLS

Ensuring that nutritional deficiency diseases are monitored as part of the health information system is an important part of effective surveillance. Specialist approaches may be required to accurately identify and quantify the extent of a deficiency problem. However, high rates of acute malnutrition often indicate the presence of micronutrient deficiencies within the adolescent population. Proxy indicators may also be used. For example, Vitamin A deficiency initially presents as night blindness, which if untreated may progress to bitots spots and gradually to xerophthalmia. Night blindness can be roughly assessed through interviews and the progressive symptoms through the clinical signs. When such micronutrient-related deficiencies become widespread they can present themselves as epidemics within the population group.

Thus clinical examination provides an important tool for nutritional assessment; as it reflects the result of long term nutritional status, whereas the dietary survey is indicative of current food intake and biochemical analysis of relatively recent food intake.

In a community-based survey carried out by NNMB (2000) on rural males and females, up to 22 years of age from eight states, showed the prevalence of Bitot's spot in females (12-21 years) declined from 1.8 to 1.3%. The prevalence of goitre reduced from...
5.8% to 3.0% during 1998-99 when compared to 1985-87 surveys in respect of all states, as revealed by the pooled data. Overall dietary intake of iron had declined in all age groups (1-3, 4-6, 7-9, 10-12 and 13-15 years) as per 1998-99 surveys when compared with 1985-87 surveys (NNMB, 2000).

In a study among 504 adolescent Girls in rural Areas of District Meerut (UP), 174 (34.5%) adolescent girls were anaemic. The prevalence of mild, moderate and severe anaemia among adolescent girls was 19%, 14.1% and 1.4%, respectively. The proportion of mild, moderate and severe anaemia was 55.2%, 40.8% and 4.0% respectively. The significant association of anaemia with socio-economic status, type of family, father’s occupation, mother’s education and family size stressed the need to develop strategies for intensive adult education, nutrition education and dietary supplementation, including anaemia prophylaxis (Rawat et al., 2001).

Indian Council of Medical Research (ICMR) had undertaken a multicentre, Community-based study “District Nutrition Project” in 18 districts from 13 states of the country including rural and urban children (< 12 years), adolescent girls (11-18 years) and pregnant women. Prevalence of anaemia among 4,332 non-pregnant adolescent girls from 16 districts was 90.1%. The range was 58.2% to 100%. Average prevalence of anaemia in the eight districts of northern India was 89.4% and in the six districts of eastern (including north-east) India, it was 91.7%. Mild and moderate anaemia is more prevalent than severe anaemia (ICMR, 2001).
In a study carried out among 1295 girls of school going age (6-18 years) residing in 15 randomly selected slums of the north Ahmedabad city, 81.8% of girls were anaemic, out of which 55.2% were mildly anaemic, 0.6% severely anaemic and the rest were moderately anaemic. No significant relationship of anaemia was observed with socio-economic class, knowledge about anaemia, and parent’s education, status of menstruation and daily consumption of lemon/ sour fruits. Anaemia was found to be significantly higher among girls with a habit of post meal consumption of tea / coffee (94.4%), whose fathers were working as semi-skilled/skilled workers (77%), those having a BMI of 18.5 or lower (82.4%), as compared to those with BMI more than 18.5(79.7%). The prevalence of anaemia was significantly lower in girls consuming green leafy vegetables (Verma et al., 2004).

In a study conducted in a rural area of West Bengal, in 143 adolescent girls of 10-19 years, prevalence of thinness was 14.7%, 37.8% were stunted, 44.8% were anaemic, dental caries in 25.9% and 15.4% with angular stomatitis, goiter in 1.4%. The prevalence of stunting was significantly higher among the late adolescent age group than in early adolescent age group (Das and Biswas, 2005).

Kaur et al. (2006) studied epidemiological correlates of nutritional anemia in rural adolescent girls of Wardha. The prevalence of anemia was found to be 59.8%. In univariate analysis, low socioeconomic status, low iron intake, vegetarian diet, history of worm infestation and history of excessive menstrual bleeding showed significant association with anemia. While...
Multivariate logistic regression analysis suggested that strongest predictor of anemia was vegetarian diet (OR=5.83, CI=3.73-9.13) followed by history of excessive menstrual bleeding (OR=5.65, CI=1.26-25.38), iron intake <14mg (OR=4.16, CI=2.08-8.31) followed by 14-20mg (OR=2.07, CI=1.06-4.05) and history of worm infestation (OR=4.11, CI=1.70-9.93). However age, education, socioeconomic status, BMI and status of menarche did not contribute significantly.

In a study conducted in 360 school going adolescent girls of 13-18 years age group of Raipur city, the prevalence of anaemia was 82%. The subjects of the experimental group were provided with different types of supplementation. The study revealed that role of Iron and Folic acid twice a week supplementation is important in improving the level of anaemic adolescent girls (Trivedi and Palta, 2007).

In a community-based cross-sectional study by Prashant and Shaw (2009) in an urban slum of South India; overall prevalence of stunting was found to be 47% and 28.3% as per NCHS and Indian standards respectively. Prevalence of underweight was 42.6% and 22.9% as per NCHS and Indian standards respectively. Prevalence of thinness was 20.6% as per Indian standards.

Ara et al. (2010) assessed the knowledge and practice on iodized salt uses among Bangladeshi adolescent girls and pregnant women. They found that half of the households of both adolescent girls and pregnant women used inadequately iodized salt. The
overall prevalence of iodine deficiency was 37% in adolescent girls and 56% in pregnant women.

Shivramakrishna et al. (2011) conducted a community-based cross-sectional study to assess the nutritional status of adolescent girls in rural area of Kolar district. The study comprised of 230 adolescent girls of age 10–19 years. Prevalence of Anemia was 34.8% percent and it was more among menstruating girls than compared to non-menstruating girls. Anemia prevalence was less among adolescent girls using footwear during defecation than girls not using foot wear.

2.5 NUTRITIONAL KNOWLEDGE OF ADOLESCENT GIRLS

Kapil et al. (1991) assessed knowledge regarding the nutritive value of food, diet during diseases and antenatal and postnatal period in adolescent girls of Delhi. They found that a total of 23.69% and 55.93% students had incorrect knowledge that pulses and non-vegetarian foods should be avoided during later half of the pregnancy. A total of 63.82, 66.45 and 71.72% of subjects had incorrect knowledge that almonds have more nutritive value than groundnuts, fruits are rich sources of calories and desi ghee has more nutritive value than vanaspati, respectively. Majority had correct knowledge that obesity is caused due to excess intake of calories than required by an individual and low iron content and poor availability of iron from food is a major cause of anemia in mothers and children.

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A study was conducted by Gracey et al. (1996) to determine nutritional knowledge and behaviours including stage of change; health beliefs and values; barriers to change; self-efficacy; locus of control; dietary patterns; alcohol and smoking habits; television-watching; weight, height and body image. Highest ranking beliefs and values regarding healthy diets were improving health, feeling energetic, feeling good about one self, controlling weight, lowering cholesterol, testing willpower and improving appearance. Important barriers to healthy eating were lack of suitable foods at home and school, inability to influence food choices at home, and ignorance about nutrients. Nutritional knowledge, particularly concerning fat, was deficient. Healthy eating related negatively to television watching and alcohol, and positively to self-efficacy, nutrition knowledge, considering weight control and well-being as important, and having influence over foods at home. Of the 28% of boys and girls who drank alcohol, 20% reported intake above 'safe' limits. Twenty-four percent of boys and 22% of girls smoked. Fifty-four percent of girls and 21% of boys considered themselves overweight including 20% of the leanest girls and 8% of the leanest boys. Nutrition education for adolescents should incorporate self-efficacy, relevant health values and barriers-to-change, education about nutrients, and improved access to healthy foods.

In a study, Ara et al. (2010) assessed the knowledge and practice on iodized salt uses among Bangladeshi adolescent girls and pregnant women. They found that half of the households of both adolescent girls and pregnant women used inadequately...
iodized salt. The adolescent girls had better knowledge on cause and prevention of goiter than pregnant women.

Around two-thirds of the mothers of adolescents did not have any nutritional knowledge in socially backward communities of Guntur, Andhra Pradesh (Jalja Kumari and Sri Hari Krishna, 2011). In their study, prevalence of overweight and obesity (2.7%, $P < 0.001$) was significantly lower among adolescents who participated in household activities ($\geq 2$ h/day) and was highly significant among those who did not play any indoor games (6.6%, $P < 0.001$).

A study was conducted by Khalid et al. (2011) to analyze the students' daily intake of balanced diet in female respondents of two Universities in Faisalabad, Pakistan. Almost both of the students of universities knew about balanced diet. They used to take fruit and vegetable salad in the form of 1/2 cup in a day and 3-4 times in a week. Correspondingly, half of the university students either used to eat vegetable like fried potato, chat, vegetable roll, sandwich, burger or fruit juices and fruit shake at lunch time in university. Both university students agreed that inclusion of fruit and vegetable in junk food would convert the food into healthy food which can help to reduce the obesity and used in weight management programs for youth.
2.6 HEALTH OF ADOLESCENT GIRLS

Adolescent girl's health covers morbidity, mortality, nutritional status and reproductive health and linked to these are environmental degradations, violence and occupational hazards, all of which have implications for adolescent girl health. Adolescent girl's health plays an important role in determining the health of future population, because adolescent girl's health has an intergenerational effect. The cumulative impact of the low health situation of girls is reflected in the high MMR, the incidence of low birth weight babies, high perinatal mortality and foetal wastage and consequent high fertility rates. A transitional period between childhood and adulthood, adolescence provides an opportunity to prepare for a healthy productive and reproductive life, and also to prevent the onset of nutrition related chronic diseases in adult life, while addressing adolescence-specific nutrition issues and possibly also correcting some nutritional problems originating in the past.

Nutrition influences growth and development throughout infancy, childhood and adolescence; it is, however, during the period of adolescence that nutrient needs are the greatest. Nutritional and health needs of the adolescents are more because of more requirements for growth spurt and increase in physical activity. They need more of all nutrients particularly calcium, iron and iodine. The need for more of iron in adolescents is due to growth spurt and the onset of menstruation. Inadequate iron stored during adolescence and before conception is a major cause of iron deficiency anaemia during pregnancy, which aggravates the risk of...
pregnancy (Kishor, 2009).

Poor nutrition starts before birth, and generally continues into adolescence and adult life and can span generations. Chronically malnourished girls are more likely to remain undernourished during adolescence and adulthood, and when pregnant, are more likely to deliver low birth-weight babies.

Adolescents are the best human resources. But for many years, their health has been neglected because they were considered to be less vulnerable to disease than the young children or the very old. Their health attracted global attention in the last decade only (Kalhan et al., 2010).

2.6.1 HEALTH STATUS OF ADOLESCENT GIRLS

The health of adolescent girl is intricately related to the socioeconomic status of the households to which they belong and their age and kinship status within the households. India has traditionally been a male dominated society; so there is a strong son preference in most parts of India, and girls tend to be discriminated by their families. It is not enough, therefore, to highlight adolescence in general; a larger focus of the girl child also must be addressed. Demographic trends indicate deep-rooted gender discrimination which begins with female feticide and prenatal sex determination. Given the predominantly patriarchal setup, girls get a lesser share in the household distribution of health, goods and services compared to men and boys. There is
data to show that in a situation of extreme food and scarcity, the adverse effect on the nutritional status is greater on girls than on boys. Girls in the 13 to 16 years of age group consume less food than boys. However, in the intra-household distribution of labour, adolescent girls get the major share of economic, procreative and family responsibilities. Due to the competing demands on their time and energy as well as their socialization, girls tend to neglect their health. The lesser access to food coupled with neglect invariably leads to a poor nutritional status and a state of ill health for most of the adolescent girls' health. As malnutrition among the child population in the country is widely prevalent, it follows that a moderate to severe degree of malnutrition would persist among girl child too. As a consequence, the malnutrition persists throughout adolescence and in pregnancy. As a result, the growth and development of unborn child is affected, giving rise to low birth weight.

About 30 % of the total births in the country constitute low birth weight and this in turn leads to high infant and child mortality and morbidity. According to the NNMB data (National Nutrition Monitoring Bureau), a very high proportion of girls are at obstetric risk as they enter the 14th -15th year of life with a height less than 145 cm and weight less than 38 Kg. However, not much attention has been paid to adolescents by nutrition-related programmes in developing countries. In order to break the intergenerational transfer of anaemia and cycle of malnutrition, anaemia control will find a high place in the action plan for the...
Adolescent Girls year. Women Development & Child Welfare Department declared the year 2003 as the "Year of the Adolescent Girl."

The collaborative study done in Hyderabad, New Delhi, Calcutta and Madras showed that amongst girls between 6-14 years of age, the prevalence of anaemia was 63.8%, 65.7%, and 98.7% respectively. A study in rural area showed that 65.5% parents of adolescent girls never spoke about the physical changes during puberty, like menarche, with their daughters.

2.6.2 HEALTH KNOWLEDGE/ AWARENESS AMONG ADOLESCENT GIRLS

Awareness includes knowledge of individual regarding a particular thing. The general health and reproductive health are part of this.

2.6.2.1 GENERAL HEALTH AWARENESS

In a study on Health Status of School Children in Ludhiana City 776 students of both sexes (462 boys and 314 girls), in the age group 5-16 years, from a secondary school in Ludhiana were examined. The health and nutritional standards of the school children were found to be low, more so in girls than in boys. The extent of malnutrition in this group was high, with the children in nearly all ages, both boys and girls, being deficient in both weight and height as compared to the ICMR standards. The prevalence of
wasting and stunting in these children was high (52.2% wasted and 26.3% stunted) with boys and girls suffering almost equally. The prevalence of anaemia was high in both sexes of adolescents, though significantly more so in girls (30.5%) than in boys (22.9%). Malnutrition and anaemia make the adolescents more susceptible to infection (Benjamin, 2000).

For many years, the health of adolescents has been neglected as they are less vulnerable to disease than young children or the very old (Ackard and Neomark, 2001).

In a study conducted in social welfare hostels of Tirupati town on 598 children aged 6-17 years, the common morbid conditions found were skin disorders 25.7%, dental caries 21.5%, history of passing worms in stool 21.6%, vitamin B deficiency 3.2%, ARI 1.7% and diarrhea 1.2%. The prevalence of anaemia and helminthiasis was found to be 79.6% and 39.3% respectively. In the follow up study, the major health problems reported were ARI, skin disease, injuries, vitamin B complex deficiency, diarrhea and eye diseases (Srinivasan and Prabhu, 2006).

In a study conducted in slums of Lucknow on 400 adolescent girls aged 10-19 years. 233 (58.2%) girls had attained menarche and the mean age at menarche was 13.3 years. The mean height and mean weight in all age groups was less than ICMR standards. The mean hemoglobin was 10 gm%. Deficiency signs of vitamins were found in 28.7%; 22.2% showed Iron deficiency signs and 3% had signs of vitamin A deficiency. The various morbid conditions...
found among girls were inadequate oral hygiene (55.4%), pediculosis (39.2%), cold & cough (25.8%), lymphadenopathy (22.2%), scabies (16.2%), inflamed tonsils (7.8%) and ear discharge (7%) (Singh et al., 2006).

A study was done by Sharma et al. (2009) to see the awareness of adolescent girls in Himachal Pradesh regarding health aspects through an intervention study. An intervention package was developed on the aspects of health including general health, reproductive and child health, environmental health and nutritional aspects. The intervention was given for nine months to the girls though lectures, discussions and demonstrations. Post testing was done on the girls after the period of intervention. Their results showed that the knowledge of girls regarding health aspects improved significantly after intervention. There was a considerable increase in the awareness levels of girls with regard to knowledge of health problems, environmental health, nutritional awareness and reproductive and child health. Thus informative and educable interventions seem to have a positive effect on awareness levels which would eventually encourage expansion of knowledge and positive health habits.

2.6.2.2 REPRODUCTIVE HEALTH AWARENESS

Reproductive health is a crucial part of general health and a central feature of human development. It is a reflection of health during childhood and crucial during adolescence and adulthood, sets and stage for health beyond the reproductive years for both
women and men, and affects the health of the next generation. The extent and severity of the problems that adolescents encounter during this phase of their life include many reproductive health issues.

Reproductive health need includes needs for reproductive health care, family planning, HIV/AIDS information, safer sex, unwanted pregnancy, early pregnancy, sexually transmitted diseases (STDs), safe abortion and safe motherhood. Specific sources of information and contraceptive advice are rarely available or accessible to them. In India, there is poor knowledge of sexual and reproductive health among adolescents. Furthermore, illness relating to sexual and reproductive health may receive inadequate attention as these problems are shrouded in a culture of silence, embarrassment and shame (Huq et al., 2005).

To increase knowledge of modern contraceptives and encourage visiting health clinics, a 13-week television drama was produced in Bangladesh in 2000 (Do & Kincaid, 2006).

Gupta and Sinha (2006) studied the awareness about reproduction and adolescent changes among school girls of Gorakhpur. In their study, source of information on adolescent physical changes and menarche varied significantly in the two groups (P =0.02). Majority of girls have only incomplete knowledge on these topics (P = 0.10). Major source of information was television in both the groups without any significant difference (P = 0.50) but significantly more girls had clear concept of reproduction...
(P < 0.05) and AIDS, Hepatitis B and sexually transmitted diseases (P=0.02) in Group A. Socioeconomic factor significantly influences source of information and level of awareness on menarche and reproduction among adolescent girls.

In a study conducted at Chhattisgarh regarding the knowledge of adolescent girls towards reproductive health; it was found that about two-third (75.6%) of the girls were aware about all the signs of adolescence and 88.8% were aware about the need of healthy life. Majority had idea about various aspects of sex education. About 80.4% girls had sex education. Most of the girls (90.4%) wanted sex education to be included in the curriculum and 52.8% wanted it to be started at 13-15 years of age. About one third (32.8%) thought doctors to be the best person to discuss such issues. Around 65.2% girls were aware about at least one contraceptive. Emergency contraceptives were known to only 19.6% girls. Most of the girls (91.6%) were aware that STDs could be prevented by the use of condoms. Only 51.2% were aware about right legal age of marriage (Agrawal et al., 2007).

Bearinger et al. (2007) recognized that boys and girls needed equal knowledge concerning reproductive health to reduce risk behaviors and to promote sexual health. However, the number of studies including boys is limited.

In a study conducted by McManus and Dhar (2008) among urban adolescent girls of South Delhi; they found that more than one third of students had no accurate understanding about the
signs and symptoms of STIs other than HIV/AIDS. About 30% of respondents considered HIV/AIDS could be cured, 49% felt that condoms should not be available to youth, 41% were confused about whether the contraceptive pill could protect against HIV infection and 32% thought it should only be taken by married women.

Kotwal et al. (2008) studied about reproductive health awareness among rural adolescent girls of Jammu. The results of the study revealed that majority of both school going girls and school drop out girls scored well in the identification of reproductive system. The areas where both school going girls and school dropout girls scored low were-Female reproductive organs, conceivable age and reproductive age of men, Unsafe abortion, legal and illegal abortion and its harmful effects, Clinical symptoms and biological symptoms of AIDS and the relationship between AIDS/HIV/STD's. Knowledge of teenage pregnancy and mode of pregnancy was lower in school going girls than dropout girls. The difference in the knowledge level of reproductive system, teenage pregnancy STD’s, HIV in the two groups were insignificant but the knowledge level related to mode of pregnancy AIDS/HIV in the two settings was significant. The Results of the study revealed that the School Dropout Girls had more scientific information, than the School Going Girls. It was due to the fact that teachers hesitated to discuss such topics in the school.

Mudey et al. (2010) conducted a study regarding safe and hygienic practices among rural adolescent girls of Wardha. Majority
of the girls received the information regarding menstruation from their mothers (41%), followed by Media (24%) and friends (19%). Of the girls who developed genital tract infections, 66% used cloth. 37% girls do not disclose about their menstruation. Cleanliness of external genitalia was unsatisfactory. Hence it is important to educate the girls with scientific knowledge and dispelling their myths and misconceptions thereby encouraging safe and hygienic practices for safeguarding themselves against various infections.

In a study, Zaman et al. (2010) found that seventy two percent of the respondents had average knowledge about puberty. Among the respondents, 47% had average knowledge regarding adolescent reproductive health problems and 77% of respondents had average knowledge about safe motherhood. Regarding the complication of unsafe abortion, 73% had average knowledge and 70% had average knowledge about consequence of early pregnancy. Fifty seven percent of the respondents had good knowledge about Sexually Transmitted Diseases. Sixty one percent of the respondents had good knowledge regarding the high risk behaviour of the adolescents. Significant statistical association was found between knowledge and education, knowledge and occupation, and knowledge and source of information of reproductive health (p<0.05).

In a recent study Shah et al. (2011) studied about the attitudes of rural adolescent girls towards contraceptive methods and their reproductive awareness. From this study it was clear that majority (60.36%) of the respondents had inadequate knowledge of

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contraception. The education level of respondents was also significant in determining their level of knowledge towards contraception. As lowest knowledge was observed in respondent with only formal education while strikingly highest knowledge was there in arts stream student (50.48 %). There was least (10.4%) information about emergency contraception as it is not so popular in India. Correct information regarding AIDS was present highest in science student as it is taught to them in their curriculum during science education at school level or in college while it was lowest in arts and high school student. Respondent Regarding the method of contraception preferred, this Study found that the difference in preference for OCP and condom was 25.8% and 19.3% respectively.

In a study, Madeni et al. (2011) used a quasi-experimental pre-test and post-test research design to evaluate adolescents’ knowledge, attitude, and behavior about reproductive health before and after the program. The girls mean score in the knowledge pre-test was 5.9, and 6.8 in post-test, which increased significantly (t=7.9, p=0.000). The mean behavior pre-test score was 25.8 and post-test was 26.6, which showed a significant increase (t=3.0, p=0.003). The boys’ mean score in the knowledge pre-test was 6.4 and 7.0 for the post-test, which increased significantly (t=4.5, p=0.000). The mean behavior pre-test score was 25.6 and 26.4 in post-test, which showed a significant increase (t=2.4, p=0.019). However, the pre-test and post-test attitude scores showed no statistically significant difference for either girls or boys.