2 REVIEW OF LITERATURE

2.1 OVERVIEW OF ADOLESCENT PHASE

2.1.1 Adolescence - A Phase of Exceptional Consideration

Adolescence is predominantly a complicated moment for the young girls, particularly from nutritional as well as physical and mental perspective. Adolescence in girls is considered as a special period in their life cycle that requires special considerations. There is a direct correlation between poverty and adolescent girl's health. Also, the majority of these poor girls who are caught in this vicious circle are the to-be mothers of coming generation and they are deprived of their basic rights to educations, health services. In other words, health and nutritional needs of adolescent girls are majorly ignored (www.bihartimes.com). Chatterjee (2005) has also added that adolescents were usually getting few health care resources and very less attention as they are considered as low-risk health group. She has mentioned that this attitude tends to ignore the fact that many of the health problems in adult life can be avoided by adopting healthy lifestyles during adolescence period. She further mentioned that the world's adolescent population of 1.2 billion of age between 10-19 years and in developing nations making up 20-25 percent of their country's population, faces lots of severe health issues not only affecting their growth but also their livelihood as future adults. Even then, adolescents remain a largely neglected in which the needs of the adolescent girls, in particular, were often ignored. Passi & Malhotra (2002) also supported by stating that adolescent girls, constituting nearly 10 percent of the population, were forming a crucial segment of the society and they needed special care given their role in shaping the health and well-being of the present as well as future generations. They further added that this negligence of young girls not only had a bad effect on their health status but also increased gender discrimination, resulting in a low social status of these girls.

At the Global Conference on Population and Development (1994), it was urged to the government collaborate with non-government organisations (NGOs) to meet the social needs of adolescents. The Fourth World Conference on Women (1995) has also been key in drawing the attention of governments, towards young girls besides developing policies for them (Passi & Malhotra, 2002).
Adolescent girls' health played an important role in determining the health of future
generations and the cumulative impact of bad health situation of girls, in India, has been
reflected in the high Maternal Mortality Rate (MMR), high prenatal deaths and the
incidence of low birth weight babies. About 15 percent of deaths in the reproductive age
group (15-44 years) were maternal deaths, made up 1.1 percent of the total reported
deaths in 1990, due to excessive bleeding and anemia followed by toxemia and abortion
(Kumar-www.bihartimes.com)

2.1.2 Adolescence - A Stage of Development and Growth

2.1.2.1 Physical Development and Growth

Adolescence has been rated as the next most critical time in the life cycle after the first
year and becomes demanding due to physical escalation and psychological development.
Physical growth is affected by various factors like hereditary and environmental,
nutritional and behavioral. These changes over a period have to be met with special
nutritional requirements as adolescents gain upto 50 percent of their adult weight, over
20 percent of adult height and almost 50 percent of their adult skeleton mass (Chatterjee,
2005).

Adolescence usually begins at the age of 10 to 12 years in girls with several physical
changes due to sexual hormones being released, thereby shifting their body composition
by increasing the percentage of body fat and adding body curves. During this period,
girls may put on 13 to 18 pounds and grow 3 to 4 inches yearly and the main years of
growth are between ages 11 to 16 years (Haas, 2004). Therefore, adolescence may be
regarded as a significant period of human growth and persons’ maturity because it
commenced with pubescence which is the time for a final growth (www.whosea.org).
Adolescence, as a period of development and growth was considered the best period to
intervene, to assist in the mental and physical development and to prevent later maternal
anemia, which can lead to adverse pregnancy outcomes and severe anemia can result in
maternal deaths (Kapadia and Khale, 2004).

Passi and Malhotra (2002) have also termed adolescence as a period of rapid growth,
with a gain of 35 percent weight and 11 to 18 percent height of an adult. An assessment
of 421 girls at Varanasi in Uttar Pradesh in the age group of 8.5-14 years was made for
their physical growth characteristics and it observed an increase in height (15.93 cm),
weight (9.80 kg) and sitting height (7.92 cm) in the age interval of 10-14 years (Gupta et al., 1990). They further observed that the most increase in these parameters was after 13 years of age. Similarly, the mid-arm circumference and chest increased by 3.20 cm and 14.70 cm respectively. However, they did not observe a rapid increase in these parameters up to 14 years of age, whereas head circumference showed a modest increase of 2.22 cm.

In female adolescents, menarche is preceded by the characteristic body changes. Breast development usually took place first, though not in all cases, a slight enlargement of the areola and the elevation of the breast as a small mound called breast-buds around at 10.5 years and completion of mature breast is approximately 4-5 years after the start of growth (Brooks-Gunn and Elliott, 1992). Other growth changes occurred with the increase in body hair and weight gain; their hips become fuller, sweat glands become more active and finally paralleling these outside changes with those occurring internally, including the growth of uterus and vagina (Golub, 1992).

The gains in physical growth characteristics in the rural girls were slower and delayed than prosperous urban girls (Gupta et al., 1990). The add-on effect of poverty and undernourishment was reflected by their poor body size and narrow pelvic as they grow into adolescence thereby making childbearing a significant risk (Dalsky, 2006). The study also revealed that 23 percent of Indian rural adolescent girls got married before the age of 18 years, putting them at a greater risk of nutritional status (Venkaiah et al., 2002). Kumar (2003) also supported this fact by stating that about 50 percent of poor adolescent girls were married below the age of 20 years in many states, thereby leaving little or no period of adolescence as they shifted from childhood to adulthood and soon become a pregnant adult. He further stated that majority of adolescent girls from low-income families bearing their babies between the ages of 14 to 18 years were at obstetric risk, subsequently resulting in low birth weight infants and perinatal issues. The timing of physical changes in puberty and environmental effects depend on interactions between genetic and environmental factors such as nutrition, social attitudes and family size thereby influencing pubertal processes (Robinson and Cole, 1993).

2.1.2.2 Adolescent Health

Adolescence is the time to adopt healthy habits so as to avoid many health and nutritional problems later in life. Several studies have confirmed that an unhealthy diet
and physical inactivity are risk factors for diet-related diseases. Regular exercising at least three times a week is also recommended for healthy living. Most NCDs are diseases of the lifestyle and they kill more people than any other disease annually and can easily be avoided by the adopting a healthy lifestyle (Keller and Lang, 2007). Furthermore, these lifestyle diseases are expensive to treat and put a huge burden on a country’s health budget. Hossain et al., (2007) also stated that approximately 1.56 billion people are expected to have hypertension by the year 2025. Findings quoted by Naidoo, Coopoo, Lambert and Draper (2009) indicated that physical inactivity was the leading cause of non-insulin dependent diabetes mellitus in the Western Cape. (Keller 2007)

Adolescents account for almost 33 percent of India’s population. They are more prone to suffer from reproductive and sexual health, mental, nutritional and behavioral problems. Health services which cater specially to their needs are few and concentrated in mostly urban areas. Adolescent Friendly Health Services (AFHS) which provides a broad range of curative, preventive and promotive services under single roof can help in ensuring improved availability, and accessibility of health services. AFHS was initiated by governmental, NGOs and private organization. Ways to improve the quality of AFHS could be further identified from evaluation of pilot projects done and the success stories of similar initiatives in many other countries (Nath A, 2008)

In a study conducted in urban slums of Lucknow in Uttar Pradesh on 400 adolescent girls aged between 10 and 19 years, the various morbid conditions that were found are inadequate oral hygiene (55.4 percent), cold & cough (25.8 percent), pediculosis (39.2 percent), scabies (16.2 percent), lymphadenopathy (22.2 percent), inflamed tonsils (7.8 percent) and ear discharge (7 percent) of girls (Singh et al., 2006). A study conducted in tribal children of Orissa in the age group upto 15 years, the various types of morbidities were fever 24.4 percent, goiter 14.4 percent, acute respiratory infections 35.4 percent and diarrhea 5 percent. As it is a tribal area, 14.4 percent girls suffered from malaria as well (Behera et al., 2008).

A descriptive cross-sectional study was conducted in Nellore city on 542 adolescent girls’ socio demographic profile and morbidity pattern. Majority of the girls (83.58 percent) were from rural background, 35.79 percent were in middle school, 86 percent of girls stayed less than 5 years in the hostel. The major prevalent morbid conditions among
these girls were Dysmenorrhea 43.6 percent, Pediculosis 83.21 percent, Dental cares 28.04 percent and Skin disorders 26.4 percent. Pediculosis, dysmenorrhea and poor personal hygiene were found to have significance across the age groups. High morbidity was also found in 11-13 years age group (KM Susmitha, 2012)

A Cross-sectional study was conducted from June, 2010 to September, 2010 among Children living in 2 social welfare hostels for scheduled caste girls. A total of 420 girls formed the study subjects. Height, weight, BMI of these 420 girls was recorded. 37.4 percent were in the age group 13 years, 26.9 percent were in age group 14 years, 18.6 percent were in age group 12 years, 9.8 percent were in age group 15 years, 5 percent and 2.4 percent were in the age group 11 and 10 years., 56.4 percent girls were undernourished (i.e. BMI less than or equal to 18.5). The Girls suffering from chronic energy deficiency grade I, II, III were 25.2 percent, 15.2 percent and 16 percent respectively. 12.9 percent were found to be overweight but none of the girls was found to be obese. According to the new guidelines issued by the Government of India, as per the diagnostic cut-off values, 56.4 % girls were found to be undernourished while 5.8 % were found to be overweight (Vinod Wasnik, 2012).

The information relating to adolescent school-going children was collected from leading schools in Chennai city of Tamil Nadu. A total of 50 school going boys and girls of the adolescent age 13 to 18 years represented the sample size of the study. Each school represented 25 respondents. Major findings of the study suggested that about 42 percent of school going children are having underweight problem and about 2 percent of school going children were affected with overweight problem. Furthermore, the study revealed the fact that about twenty percent of respondents have said that lack of time was one of the main reasons for skipping meal (Dr. R. Balasubramaniyan, 2013).

A cross sectional study was undertaken in Block Beri of district Jhajjar (Haryana). A sample of 320 adolescent students of 9th to 12th class were selected from four randomly chosen large Government Senior Secondary Schools each having a strength of more than 250 students (2 girls and 2 boys/co-ed senior secondary schools). Proportions, percentages, Chi-square test, Chi-square test with Yate's correction, t-test were applied. 66.3 percent adolescents were aware of at least one adolescent change whereas when further asked to detail the changes taking place in them, 85 percent adolescents could narrate at least one such change (Ram Bilas Jain 2013).
A study was conducted in 3 urban schools which are in the field practice area of department of community medicine in the year 2010. A team of doctor, school teachers and social workers examined all 210 adolescent children in the age group of 10 – 19 years studying in these schools. Out of them 34.3 percent were girls and 65.7 percent were boys. According to weight for age criteria, 53.3 percent of the adolescents were found to be normal and 46.7 percent were malnourished. By applying height for age criteria, it was found that 32.86 percent of adolescents were stunted with the boys suffering more (66.67 percent) as compared to the girls (33.3 percent). The dental caries was the most common (41.90 percent) among all health problems. (Pravin N Yerpude, 2013)

A study was conducted on 200 adolescent girls of age group between 16 to 18 years, of which 100 belonged to rural area and 100 were from urban area. The tools used were Health Anxiety Inventory formulated by Lucock and Morley (1996) and Health Problem Inventory devised by the Investigator (2013) to find out the health anxiety and health problem among adolescent girls. It was found that there is no major difference in the health anxiety of adolescent girls belonging to rural and urban areas. There existed a relationship between health problem and health anxiety among adolescent girls (Muhamed Mariam M, 2014)

2.1.2.3 Behavioral changes
Transition from a young girl to womanhood brought changes in the behavior of adolescence towards parents and peers. Girls seek out greater autonomy from their parents and often conflict intensifies. Adolescents pretend to act older and want to be treated like adults. Thus they started engaging in adult behavior like wearing makeup, shaving their legs and dating. The girls who began to menstruate and mature earlier, looked older than their peers do. They looked for and were sought by older adolescents as friends (Horjatschun, 2001). According to Brooks-Gunn et al., (1992), early maturing females might have troubles with their change as well as they may not be well prepared for these pubertal changes.

Mid-adolescence was associated with the assertion of freedom when peer groups dominate social life. Hence, there is an increase in risky behaviors whereas late adolescence might bring uncertainties in them about sexuality, relationships and career options (College of Family Physicians of Canada, 1993).
Adolescent girls were believed to be more emotionally focused and lesser individuated from their mothers and many of them spoke with their mother about the pubertal changes (Brooks-Gunn et al., 1992). In the United States of America, their fathers reported being uneasy about the discussion of the subject related to girls while mothers, though have some shame and uneasiness about their menarche but do discussed puberty with their daughters (Feldman, 1990).

Many tribes viewed puberty as a cultural event. However, no literature is presently available regarding the Indian culture about puberty in adolescence. In Arapesh tribe of New Guinea, menstrual huts were created where the girls in early puberty stayed for six days without food or water. They were rubbed with stinging nettles and told to roll a nettle leaf in a tube and then thrust it into her vulva. This was to ensure larger and stronger breasts (Robinson, 2001). Adolescent girls were also given tattoos in their late puberty as preparation for acceptance as an adult (Mahdi, 1987). During early days in China, by the time a girl reached puberty, she accepted the position of being inferior and this lowly status was shown by the infamous bound-feet or lotus-feet, but this process has ow completely stopped (Frisch, 1980). Studies regarding the starting of menstruation showed that the girls in higher socio-economic class began to menstruate earlier than girls from low socio-economic class (SES Frisch, 1978).

Physical appearance has been considered the high motivational factor in eating pattern of the adolescents because during this period, the desire to be slim was observed very high. Thus, low energy diets consumed by adolescents in trying to lose weight or to remain thin were unlikely to provide adequate level of proteins and other nutrients (Kapur, 2001). Body image perception prevalent among affluent adolescent girls was a possible reason leading to inadequate and unbalanced dietary intake by them (Narula et al., 1996). Increasing prevalence of eating disorders and obesity during adolescence had been found a matter of great concern (Anderson & Farthing, 1991). The difficulty in changing teenagers’ eating habits and lifestyle might be related to inadequate consideration of issues that they considered important. Thus, increased body fat in early adolescence lead to rise in preoccupation with their body image. These significant changes in physical development and growth over a period have to be met with special nutrition needs.
2.2 NUTRITIONAL STATUS OF ADOLESCENTS

2.2.1 Anthropometric Measurements

The physical development of an individual is directly affected by his or her dietary intake (Garrow, 1979). The process of normal growth and development is also dependent on adequate and regular supply of nutrient. Under-nutrition is reflected in the impairment of growth and it is an important quantifiable manifestation of under-nutrition (Gopalan and Chatterjee, 1985). Measurement of growth has always been considered most convenient and a practical tool for the assessment of nutritional status of children which can be measured through anthropometry. Thus anthropometry has been a valuable instrument in any nutritional survey. Growth assessed by anthropometric measurements is considered one of the most sensitive indicators of the nutritional status of the subject. Though the nutritional status of children can also be evaluated by clinical or biochemical assessment, these methods have some limitations as many clinical signs of malnutrition do not appear unless the child is severely malnourished. Anthropometric Measurements is hence a technique of quantitatively expressing the form of body (Cameron, 1984). Nutritional anthropometry is related to the measurement of the variations physical dimensions and composition of the human body at different ages and varying degrees of nutrition. Physical dimensions of the body are affected by the nutrition, especially during the period of faster growth. Selected measures of the body can provide significant information about types of malnutrition (Jelliffe, 1966). Anthropometric measurement varied in the amount of complexity but can help in detecting the sub-clinical stages of malnutrition. For community studies, the main aim is to identify and select a minimum number of relatively simple methods that can give maximum practical information, hence anthropometry has been recognized as a reliable and easy to use tool in identification of nutritionally vulnerable groups (Rao & Vijayraghavan, 1996.)

Anthropometric examinations include measurement of body weight, height and bicipital, tricipital, sub-scapular, and mid-axillary skin folds. Nutritional anthropometry prevails over the other methods of nutritional assessment. Emphasis on the importance of Body Mass Index (BMI) is considered to be an index of nutritional assessment (Kapoor and Aneja, 1992 and Rao, 1996).
2.2.1.1 Height and Weight

Average height and weight of adolescent in the USA was 118 pound and 65 inches, respectively (Vickery et al., 1985) and it had been further observed that most of the teenagers had an appropriate weight for height (Hernon et al., 1986). Moreover, it was noticed that mean body-weight of Indian teenagers in North Carolina (USA) was found significantly more than national reference data (Story et al, 1986).

Gender differences have also been identified in many studies where boys were found to be taller and heavier than girls (Sharma & Vali 1991; Devi et al., 2001). On the other hand, girls were reported to be heavier and taller with higher MUAC than boys and their anthropometric measurements were also higher than ICMR standards (Bisati, et al., 2005). However, Schoenbaum et al., 1995 did not find any standard gender difference in anthropometric measurements of Gaza infants.

Khan and Ahmed (2005) reported that the adolescent girls working in a factory in urban areas of Bangladesh had a prevalence of shorter physical structure which was higher in older girls. They further stated that among 509 girls aged 14 to 19 years, 65 percent were found short with body weight of 38 kg when they were 14 years old which progressively increased across the age groups to approximately 42 kg for the 18 and 19 years old. On the other hand, the mean weight and height of children aged 5-18 years in Pacific Islands was very high as compared to international standards, especially in the 5-12 years age group (Salesa, et.al, 1997). Whereas, Anderson et. al., (1994) reported weight and height of Scottish adolescents of both the sexes were within the normal range.

At Chittoor in state of Andhra Pradesh of India, it was observed that height of urban and rural girls was same (Sathyavathi et al., 1979). While in another study, it has been found that rural girls were lighter and shorter than their urban counterparts because of rural background and they also have delayed and slower gain in physical growth characteristics than urban prosperous girls (Gupta et al., 1990). They further observed a gain in height, weight and sitting height of 5.93 cm., 9.80 kg. and 7.02 cm. respectively in the age interval of 10-14 years. The highest increase was observed after 13 years of age which indicated the onset of the growth spurt. A study at Varanasi, India indicated a gain in weight and height during adolescence was 15.1 kg and 17.5 cm respectively (Pereira et al., 1983). However, not much of a difference was observed in wright and
height from rural areas of Haryana (Dahiya and Kapoor, 1992), Coimbatore (Devadas et al., 1999) and the slums of Nagpur (Sharma and Vali, 1991).

A report from Bangladesh indicated the prevalence of undernutrition as it noticed stunted growth in 10 percent of all the subjects assessed. Among them, 2 percent of younger girls and 16 percent of matured girls were found stunted (Ahmed et al., 1998).

Height for age was found normal in 86 percent of the adolescent boys and girls of Rajasthan, while in rest of the subjects, the height was found more than the expected values and only 4.2 percent of the subjects had normal body weight when compared to ICMR standards (Sarupriya and Mathew, 1987). Wight and Height of the adolescents from Haryana state was significantly lower than the standard values of ICMR (Susheela, 1992). Similarly, a study conducted at Hisar district of Haryana state and Delhi also showed that mean weight and height of teenagers was significantly lower than the reference values (Sethi, 1996). While, in a comparative study of anthropometry at Hisar, it was observed that the height of science and home science students was non-significantly different than the reference values. However, height of all students was considerably lower than the reference values and weight of all the subjects was considerably lower than the reference values except home science students, who had normal weight (Karwasra, 2000).

Adolescent girls from Punjab state were taller and heavier as compared to ICMR standards whereas the anthropometric measurements of adolescents which belonged to lower income-groups were significantly lower than those of high-income groups (Verma and Bajaj, 1985). A study conducted at village Gogunda in Rajasthan indicated that the tribal adolescents were shorter and lighter alongwith nutritional deficiency symptoms (Smitha & Mathew, 1988). A study in India found that 41.1 percent of rural adolescents belonging to schedule caste community were found with stunted growth (Venkaiah, et al., 2002). Regional differences with respect to socio-economic class and growth pattern of well-to-do children of pre-school age were observed. However, the children from Delhi and Punjab had achieved levels of growth when compared to NCHS standards (Gopalan, 1992). Affluent children of the better socio-economic class had high body measurements than children of lower socio-economic class (Vjayaraghavan, 1971; Rao and Satyanaryan, 1975; Shinde et al., 1980; Gopalan et al., 1993; Venkateswarlu et al., 2004).
2.2.1.2 Body mass index

BMI of Scottish girls’ and boys’ in adolescent age were within the normal range (Anderson et al., 1994). In one other study, 71 percent of the teenagers were within the acceptable range of BMI (normal), 23 percent were overweight and 6 percent of them were marked underweight, irrespective of social class (Maurafox, 1991). Boeck and Neuspiel (1987) reported that 10 percent of girls and 11 percent boys were found to be obese.

Studies done in India revealed that BMI of teenagers from Delhi and Hisar was significantly lower than the reference values (Sethi, 1996). The BMI of art students was significantly higher than the science and home science students (Karwasra, 2000). High degree of nutritional deficiency in adolescent girls was found in rural Varanasi with a high prevalence of under-nutrition as one-third of all the studied subjects were found to be having chronic energy deficiency grade III (Choudhary et al., 2003).

2.2.2 Dietary Status and Nutrient Intake of Adolescence

2.2.2.1 Eating Habits

Eating out with friends at restaurants and fast food joints is considered fashionable and trendy by adolescence these days. This period can also be termed as carefree eating period. Most of the food tastes and preferences appeared to be key factor in determining their food habits. Adolescents’ different eating styles can lead to various problems in later stages for them. The survey report about the dietary problems showed further that the other reasons for adolescent's nutritional problems with the diet were fat phobia, time limitations, skipping one or more meals, inappropriate choice of snacks; limited consumption of milk etc. The other influences that affect eating behavior were the freedom of being on their own, being able to buy more of their food themselves, the easiness of getting ready-to-eat foods and the nutritional limitations of fast foods (Charterjee, 2005). The nutritional problems of adolescents were probably also related to their rebellious nature as they what they want and when they want and hence it’s hard to influence dietary changes in them. They often have high intake of food high in sweets and refined foods, fried and junk foods, leading to deficiency diseases (Haas, 2004).

A study revealed that reasons for skipping the breakfast as stated by adolescents were lack of time, simply not feeling like eating. not being hungry (Shaw, 1998). Adolescents
often consumed more meals later in the day because they skip breakfast in the morning. This snacking included mainly junk foods and fruits containing high amounts of sugar, fats and sodium (Robert Musso, 2002). Brown et al., (1980) reported that Home Economic students in Rhode Island was more inclined to snacks and breakfast and it contributed 23 percent of their total diet. Adolescents were often influenced by their peer groups for eating habits (Croll et al., 2001). In the NFI study (1989), 78 percent of Delhi girls had the habit of eating fast foods i.e., burgers, sandwiches, pizzas, chaat etc. at the school canteen. These foods are rich in calories but lack in other most of the essential nutrients. Among fast foods; aerated beverages, pizzas, burgers and chowmein ranked high on the list of food eaten. Many studies reported that fast foods especially pizzas, burgers, sandwiches, chaat, gol gappes alongwith cakes and other aerated drinks were liked by adolescent girls (Boyal et al., 1995). Narula et al., (1996) further reported that well-to-do adolescent girls eat out more often than the low-income group.

In one of the studies on adolescents in country of Switzerland, it was observed that milk products were taken daily by less than 50 percent of the total subjects sampled. 53 percent girls and 33 percent of boys consumed one piece of fruit item everyday whereas one vegetable portion was taken daily by around 17 percent girls and 8 percent boys (Cavadini et al., 1999). However, when compared the intake of adolescents from Nebraska and Morocco, reports showed that Americans ate more cheese, milk, ice cream and snacks whereas Moroccan had more of sheep meat, bread, fish, vegetables and drank more sweetened mint tea resulting in high level of cholesterol, fasting glucose, haematocrit and blood urea in Americans than Moroccans. It was further concluded that greater intake of the bread by the Moroccans may have contributed to decrease in their cholesterol level (Cast and Kies, 1980).

Generally, it has also been noticed that lack of variety in food emerged due to low consumption of fruits and vegetables by the children because they tried to avoid eating food before starting to school or college. It was being replaced often with a low nutrient density food like chips, crisps, samosas, bread pakora, snacks etc. along with sugary foods and drinks taken between meals and mealtime. Lunch and dinner was usually skipped or best reduced to smaller protein sizes of food items thus typically avoiding adequate and healthy dietary sources (Kapur, 2001). Sharma et al., (1999) stated that the
consumption of breakfast by the adolescents of age 6 to 15 years from middle and high-income groups in Delhi was irregular and very little to meet the day's total requirement. Another study reported the phenomenon of skipping meals in female adolescents was happening more frequently in high-income groups. Most often missed meals were the breakfast and dinner which was followed by lunch (Narula et al., 1996). Skipping of meals by adolescent girls of Delhi was a common trend (81 percent) in the dietary pattern of affluent with breakfast being the most common missed meal (Boyal et al., 1995).

Teenagers' food choices were influenced by the social pressures to achieve cultural trends of thinness, to gain peer acceptance or asserting independence from parental authority. The young women gave the impression of being especially vulnerable to pressure from advertising and the frequent promotions of low nutrient density foods on television (Ostbye et al., 1993). A U.S. study found that 49 percent female high school students were already underweight and still among those, 81 percent girls wanted to lose weight. When they were asked to give one or more reasons for losing weight, 95 percent listed cosmetic reasons while only 25 percent spoke of health-related reasons (Whitaker et al., 1989). A report by Health and Welfare of Canada (1993) has revealed that out of 35 percent girls aged 15-19 years cited that the best ways to lose weight were being more active (85 percent), eating a balanced diet (53 percent), and eating less food (21 percent). Out of 50 percent of the young females in British Columbia, the most common strategies adopted to lose weight were exercising (46 percent), followed by exercise and diet together (30 percent), then dieting alone (13 percent) (www.cfc.efc.ca/docs/minut).

Some teenage girls tended to eat less to lose their weight, thus consuming a diet which was deficient in nutrition. Obesity in adolescents usually resulted from bad food choices, laziness or lack of exercise. Watching televisions with more snacks also restricted their activities leading to weight gain (Haas, 2004). Brownwell and Stunkard (1978) mentioned that many obese adolescents, who were already feeling ineffective, further damaged their self-esteem by becoming more inactive and withdrawn whereas many of them ran to eating as a form of some comfort. It has also been observed that most teens consumed junk food and drink lots of coffee and soda. About 60 percent of the older boys and girls and 17 percent of young 11-14 years olds were reportedly drinking
alcohol whereas 56 percent boys and 60 percent of girls were spending less than one hour a day in moderate activities (Sarojini and Vijayalakshmi, 1989).

2.2.2.2 Food intake

The dietary patterns of adolescent girls offer us an opportunity to address their health status. Nutritional problems carried over from childhood tend to set the stage for health of the adulthood. Adolescence period needs extra nutrition to attain potential growth. Also, during these years, there is the busy and hectic activity of playing, studying and in some case, working for various household jobs. Thus, an adequate amount of food in good quantity and quality is required. Good nutrition is one of the essential components of good health and is linked to various other factors such as the nutritional status of adolescent girls, their nutrient intake and dietary pattern, nutritional knowledge and practices, nutritional awareness and dietary supplementation etc. According to FAO report (1998), food consumption in India was varied and influenced by regional, ethnic, income, cultural and agricultural production differences. The amount of animal foods i.e. meat, eggs and fish varied from 0 g (Haryana & Tamil Nadu) to 193 g, (Arunachal Pradesh) which showed the wide discrepancy among the population with respect to dietary sources of the bioavailable iron.

Surveys conducted on food and nutrient intake showed that the cereals constituted the primary staple food and majority of the diet of individuals in all the states of India, i.e. 389 g which was around 95 percent of the recommended dietary intake of 410g. Whereas barring roots and tubers, consumption of all other foods was lower than the recommended intakes (Sharma, 2003). Malhotra and Passi (2007) also reported the not sufficient intake of milk and milk products (47 percent), pulses (36 percent), green leafy vegetables (26 percent), other vegetables (34 percent) and fruits (3 percent) out of suggested allowances. They further observed, somewhat sufficient intake of fats (65 percent) and roots & tubers (72 percent) and almost adequate intake of cereals and sugar. A study about food intake of adolescent girls also revealed that the amount of cereals consumed by girls ranged from 200 to 350 g/day (Sankhla and Goyal, 1985) whereas in a comparative study about the diets of men and women, Menon and Rau (1983), found that the women consumed substantially lower amount of cereals than men. Mathew and Bhatnagar (1985) in their study showed that food consumption in adolescent girl students
of various colleges of Udaipur in state of Rajasthan was low in quantity as well as in quality. Their diet contained 65 to 125 g cereal, 60 to 80 g vegetable and 20 to 39 g pickles. The intake of cereals and vegetables was found to be far below the RDA standards. Similar reports of low intake of various food items have been found by Bansal and Mehta (1985). In Bangladesh, another study on adolescent female factory workers revealed that cereal grains were the major source of energy whereas intake of eggs, meat, milk and green leafy vegetables was found to be very low (Khan and Ahmed, 2005).

Similarly, low intake of cereals, pulses, milk, green leafy vegetables, fats and oil etc. had been reported by several other workers from various parts of the country & abroad (Harel et al., 1998; Bhatia, 1996; Sethi, 1996). While conducting the survey on nutrient and food intake and nutritional status of adolescents in state of Andhra Pradesh, it was found that the intake of green leafy vegetables, fats, animal protein and milk was limited in rural population (Pushpamma et al., 1982).

The relationship between the education and family income of the parents with the nutritional status of the adolescent girls was also noticed. The majority of the poor adolescent girls who were the future young mothers remained deprived of their basic and important right to health and education, independence and development (Kumar-www.bihartimes.com).

It has also been observed that the girls of low-income group consumed only two meals per day and it comprised mainly of wheat or millet chapatti, rice, tea, pickle, onion and chillies in the morning meals and second meal included some vegetable or pulses. Whereas middle and high-income group consumed three meals a day having all variety of food items and with the increase in income, intake of rich diets has also increased (FAO/WHO, 2002).

Impact of education on the food consumption pattern was also observed by various workers. However, age did not play an important role in women's consumption pattern. Illiterate women had poor and less varied diets than educated women irrespective of their ages. Similarly, women living in the urban areas were more likely to consume healthy foods than those living in rural areas (MOHFW, 1999). Similar findings on the dietary pattern of adolescent school girls in Bangladesh also indicated that in urban regions of Bangladesh, family income and education of parents had an effect on nutritional status of
the girls as the diet of these girls was insufficient, both for macro and micronutrients with significant health implications (Ahmed et al., 1998). A survey showed that out of 109 adolescents among boys and girls, majority of females (70 percent) of them were illiterate because of ignorance and tradition and most of them had been forced to work in the field to earn their daily bread while rest worked as labourers in building constructions and collection of wool (Kumar et al., 2002).

Dietary pattern of adolescent girls from low socio-economic background at Coimbatore city in Tamil Nadu showed that approximately half of them spent 56 percent of their total food spending on cereals while rest of them spent around 21 to 40 percent on cereals. 78 percent of them spent 21-30 percent on pulses whereas less than 10 percent of them spent on leafy, green vegetables and protective foods like milk, fruits and meat products. However, intake of milk and milk products, fruits and vegetables and sweet preparation was found to be more in high-income group (Sarojini and Vijayalakshmi, 1989). Studies from urban Bangladesh showed similar results as adolescents belonging to poor families and having less educated parents had lesser intake of milk, egg, fruits and meat and were found to be more thin and short for their age (Ahmed et al., 1998).

It was further noticed that foods intake in homes were deficient in most food groups except cereals. Among the adolescence girls doing heavy activities, highest deficits of 89 to 100 percent were noted in the intake of milk and fruits products whereas highest deficit of 95 percent for green leafy vegetables was observed in the case of those doing moderate activities. However, both the groups were found to be deficient in energy, calcium, vitamin C and iron consumption (Sarojini and Vijayalakshmi, 1989).

Adolescent school girls in Nagoya (Japan) were observed to be irregular in their breakfast and most of the food items consumed by them was lacking in beans, potatoes, green and leafy vegetables. It had high intake of soft drinks which may be the main reason for anemia in them (Ishigaki, 1979). A study conducted on adolescent pregnant women in Alexandria also showed that there was a high prevalence of risk factors for dietary practices. The results indicated that nearly 50 percent of them were uneducated and belonged to low-income group alongwith low body weight than the recommended values, i.e. below 50kg, whereas about 62 percent (mainly housewives) had poor knowledge about nutrition and their food intake did not meet all the nutritional
requirements of pregnancy (Yassin et al., 2004). Another study conducted on children and women of child-bearing age, the typical diets in Peru were based on roots, cereals, legumes and was lacking in various other essential nutrients thereby making them more vulnerable (Zavaleta et al., 1996).

The other factors such as caste, religion and educational level of parents were also found to influence the intake of various nutrients in adolescent girls. Pandey et al., (1986) conducted a survey of 394 families for food intake pattern in rural and urban areas of Haryana and showed that urban population consumed 39.4, 4.5, 11.8 and 11.5 percent cereals, pulses, vegetables and sugar respectively whereas in rural population, the corresponding values were 41.1, 411, 11.5 and 3.3 percent. A study in Andhra Pradesh state also reported that intake of green leafy vegetables, fats, animal protein, milk by the adolescent girls of the rural population was much less than the recommended values (Pushpamma et al., 1982). In the tribal population of nine states of India, it was noticed that adolescents’ intake of all the food stuffs especially income elastic foods like pulses, milk and milk product, fats, oils, sugar and Jaggary were lower than the ICMR recommended levels. It was further noticed that their intake of all the food stuffs except green leafy vegetables was lesser than their rural counterparts (Rao et al., 2006) In case of schedule tribes, the diet of adolescents was poor in quantity as well as quality with the intake of 625 g of maize as staple food (Sarupriya and Mathew, 1987). In the year of 1988, they again observed that both the boy and girl adolescents consumed mostly maize made chapattis and green chilies for lunch whereas cereal and pulse preparation was done for dinner. As a result, the intake of cereals was high while the intake of roots, pulses and vegetables were lower than the recommended levels. Similar observations were noticed in the intake of different foods being taken daily by the adolescents from urban and rural areas of Hisar and Sonipat districts of Haryana and it was found to be lower than the recommended RDA values (Susheela, 1992). Chandana (1993) also found that the daily intake of all the important components of diet was substantially lower than RDA recommended levels in the school children of Panipat District of Haryana. The subjects with heavy activities were consuming adequate dietary allowances as compared to the subjects with moderate activity (Sarojini and Vijayalakshmi, 1989).
2.2.2.3 Nutrient intake

Adolescence is a crucial period of human's life with unique changes in growth and during this period, many life patterns are often established. Adolescents have to go through physical and biochemical changes, thereby increasing the requirement for certain vitamins like folacin and vitamin-Bn for rapid tissue synthesis, vitamin B6 and vitamin D for tissues and skeleton growth (Guthrie, 1989). He further mentioned the need for vitamin A, E & G for the proper functioning of newly formed cells. Vitamins, minerals and other nutrients play a significant role in the growth processes of adolescence. Additional calcium is required for a bone mass increase. Hence in short, adolescence is a period of high nutritional risk in which there is an increased demand for nutrients. Often adolescents make wrong choices of foods and unhealthy eating habits leading to deficient intakes of calories, vitamins, proteins and minerals as well as micronutrient's malnutrition and chronic energy deficiency which resulted in thinness (Haas, 2004).

According to NNMB (2002), the intake of Iron, Riboflavin, Vitamin A and folic acid by the adolescent girls was 46 to 60 percent of RDA whereas intake of vitamin C by them was 32 to 40 mg which was very near to RDA recommended values. Nutrient intake data of adolescent female workers in urban areas of Bangladesh revealed a deficit intake of protein, iron, calcium as well as vitamin A, riboflavin, thiamin, niacin along with vitamin C which was below the recommended dietary allowance (Khan and Ahmed, 2005). However, Runyan (1976) reported that the protein intake in the diet of adolescents was much higher than the RDA but calcium intake was found to be inadequate. In a study conducted on teenage girls, it was shown that intake of three nutrients namely vitamin A, niacin and riboflavin was adequate but intake was low in proteins, iron, calcium and thiamine (Backman and Wharton, 1979). A significant number of young women in Canada were reported to be consuming inadequate amounts of calcium, iron and foliate though these were very important during their reproductive years while intake of energy and fat was near to recommended values (Gray-Donald, 2000).

With the increased eating among adolescents, mean intake of energy, carbohydrates and sugars also increased. However overweight were more likely to skip breakfast, eat fewer meals and had lesser energy intake than their peers (Dwyer et al., 2001). In some other study on malnutrition among pre-school children in Malaysia, Wan (1991) noticed that a
large number of children were malnourished due to poor intake of various essential nutrients in diet. Horwath (1991) studied the dietary intake of undergraduate students and found high intake of proteins in both female and male adolescents. Intake of most of the other nutrients by the boys was above the recommended standards but the intake of vitamin B, Calcium, Iron, Magnesium, Zinc and Copper was found to be low in girls. Rabiee et al., (1992) in Birmingham (England) also reported low energy intake of about 86 and 83 percent of RDA in boys and girls, respectively. The intake of protein, calcium and vitamin C was found to be adequate for both the sexes but intake of iron was adequate for boys and marginally adequate for girls at 108 percent and 94 percent of RDA respectively. Strain et. al., (1994) observed not much of a difference in the intake of protein, total sugar and carbohydrates between both the sexes of adolescents in Northern Ireland. Kersting et al., (1998) reported almost similar intake of macronutrient pattern across the age and sexes among German children and adolescents. From Russia, Obryankova (1998) mentioned that the nutritional status of pupils of athletic classes in non-specialized schools of St. Petersburg in the age group 15-17 years was below the standard recommended by the Institute of Nutrition of the Russian Academy of Medical Sciences. Lesser intake of various nutrients by adolescent boys and girls was also reported by various workers from Denmark (Harel et al., 1998) and Bangladesh (Ahmed et al., 1998).

Bigler and Jenkins (1987) found that 80 percent of adolescents across males and females were consuming 1 to 7 snacks daily and the meals and snacks were providing an equal amount of Mg and vitamin C and their nutrient consumption was almost equal. However, in Nigeria, Oguntona, et. al., (1987) observed the energy intake among boys was more than girls but the intake of calcium and iron in both the sexes was lower than the FAO standard.

A report of scientific review committee has mentioned that the dietary intake of teenage girls' ranges from 1850 Kcal per day to 2200 Kcal per day (Absolon et al., 1988) in comparison to the RNI 2200 Kcal per day and 2100 Kcal per day for 10-15 and 16-18 years old females respectively (Health & Welfare Canada, Nutrition Recommendations 1990).

A study conducted to see the diet quality and nutritional status of beneficiaries of rural adolescent girls scheme showed that their diets were cereal based and monotonous and
their (49.3 percent) energy intake was lesser than 75 percent as recommended by RDA. Nutrient intake was also noticed to be inadequate especially for iron (84.7 percent), folic acid (79.4 percent) and vitamin A (73.2%) (Malhotra and Passi, 2007). Many workers from the state of Haryana also reported inadequate intake of nutrients by adolescents. Low intake of energy, iron, protein, riboflavin, niacin, vitamin A, iron and zinc was observed (Bhatia, 1996; Shusheela, 1992; Sethi, 1996; Karwasra, 2000; Chandna and Bhatt, 1984). High intake of calcium (Bhatia, 1996), and Vitamin C (Semi, 1996) was noticed, whereas low intake of calcium and Vitamin C by science, home science and arts students was also observed (Karwasra, 2000). It was further noticed that intake for all the nutrients by hostel girls was within the acceptable limits of RDA except for iron and vitamin C (Jain and Bhat, 1988; Sarojini and Vijayalaxmi, 1989).

2.3 PREVALENCE OF MALNUTRITION IN ADOLESCENCE PHASE

2.3.1 Micronutrients Deficiency Trends in Adolescent Age

Chakravarty and Sinha (2002) opined that even though vitamins and minerals are required in tiny amounts, the micronutrients found in food are of great significance for physical growth and mental development. Average Indian diet, especially those of the people from poor socioeconomic groups are often deficient in some vitamins like vitamin A and C, riboflavin, folic acid as well as essential minerals such as iron, calcium and iodine. Stang and Story (2005) stated that nutrient intakes of adolescents in the USA suggest that many youngsters consume inadequate amounts of minerals and vitamins. This trend is more visible in females than males. On an average, adolescents consume diets that are insufficient in several vitamins and minerals, including folate, vitamins A and E, zinc, iron, magnesium and calcium.

As per Gleason and Suitor (2001), US adolescents take more than adequate amounts of protein. National data suggested that on average, teens consume about around twice the recommended level of proteins and 31 percent of adolescent boys in 14 to 18 years of age group consume more than double the RDA for protein.

Grover (2009) noted that the protein energy malnutrition has the potential to affect all organ systems in the body badly. Initially, clinical findings included lack of adiposity and subcutaneous tissue, irritability, poor muscle bulk and oedema. As malnutrition progresses, the growth is delayed which leading to stunting and other systems also
become involved with changes noticeable in hair, nails, skin, mucous membranes, and other organs. Micronutrient deficiencies, particularly deficiencies of minerals and vitamins are common in malnourished patients.

Based on an analysis of dietary intakes of preschool and school going children and adolescents belonging to poor income groups in India, Narasinga Rao (2002) concluded that dietary intakes of adolescents showed a 20 to 50 percent deficit of several nutrients which also included protein. As in the case of the other age groups, the other deficient nutrients were fat, calcium, zinc, iron, vitamin A, riboflavin, and folate while rates of dietary deficiencies of vitamin A, iron and riboflavin among the adolescents was as high as among preschool and school children.

Kotecha (2008) noted that the intake of micronutrients in daily food is far from satisfactory and lesser than 50 percent of RDA recommended intake is consumed by over 70 percent of the Indian population. The loss due to this micronutrient deficiency costs India one percent of its GDP and causes loss in terms of productivity, illness, increased health care costs and death.

Sivakumar et al., 2006 conducted a study based on biochemical analysis on 328 middle-income children from a residential school in Hyderabad. It was noticed that folate deficiency was present in almost all the children while deficiency of vitamin A, B2, B6, B12 and C were reported in 44-66 percent of the children. Vitamin B1 (12 percent) and zinc (0.7 percent) deficiency was a bit lower. Assessment of clinical signs of micronutrient deficiencies in the same study confirmed the presence of micronutrient deficiencies.

Muzammil et al., 2010 concluded that these nutritional deficiencies play a major role in the overall health status of adolescents and are typically different from those of older adults. Due to lack of correct information and proper guidance, adolescents are prone to all kinds of nutritional morbidities. Vitamin B2 deficiency was observed in 2.5 percent adolescents and Vitamin A deficiency was almost double in boys at 1.7 percent than in girls which was at 0.9 percent.

Bose and Mukhopadhyay (2004) have stated that it is generally acceptable worldwide that anthropometry is highly sensitive to under-nutrition and has been used for assessment of nutritional status among adolescents. According to WHO (1995), the basic
intention of nutritional assessment is to find the shortcomings in diet and to improve human health. Body Mass Index (BMI) has been found to be the most appropriate and cost-effective variable for determining nutritional status among adolescents.

About 33 percent of adult men and about 36 percent of women have a BMI below 18.5 level which indicates Chronic Energy Deficiency (CED). In a study conducted by Mondal (2010) in Darjeeling among 806 adolescents aged 10 to 18 years, a higher prevalence of stunting was found among girls (50.2 percent) than among boys (45.6 percent).

2.3.1.1 Iron deficiency

Nutritional Anemia is defined as a medical condition in which the haemoglobin content of the blood is lesser than normal which can be due to deficiency of one or more essential nutrients. Anemia is considered to be a later manifestation of nutritional deficiency and even milder anemia is not the earliest sign of such a deficiency. WHO (2001) suggested that anemia is present in a population when haemoglobin (Hb) concentration is lesser than 12 g/dl for children between 12-14 years. Classification of anemia into different grades was done by WHO in 1989. The same criterion for grading anemia has also been used in the NFHS (2008) report.

ICMR (2010) revealed that nearly 75 percent of women in India are anaemic with the prevalence of moderate to severe anemia being found highest (50 percent) among pregnant women. Toteja et al., 2006 conducted a study on anemia in 4,337 unmarried adolescent girls (11-18 years old) from 16 districts in India. The results indicated that 90.1 percent of the girls were anaemic. The prevalence of anemia varied from 58.2 percent in Dehradun district to 100 percent in Badaun district. The average prevalence of anemia was 89.4 percent in the 8 districts of Northern India, 91.4 percent in the 6 districts of Eastern India, and 91.8 percent and 87.0 percent in the single districts from Southern India (Mehboob Nagar) and Western India (Raigarh) respectively. The overall prevalence of severe anemia was 7.1 percent, with the highest prevalence (24.3 percent) found in Bikaner District. The average prevalence of severe anemia was 7.4 percent in the eight Northern India districts, 5.7 percent in the six Eastern India districts, 9.2 percent in the single Southern India district, and 11.1 percent in the single Western India district. The overall prevalence of moderate and mild anemia was 50.9 percent and 32.1 percent, respectively.
A study by Rajaratnam et al., 2007 showed the prevalence of anemia was about 41 percent in pre-menarcheal girls as compared to about 45 percent in post-menarcheal girls in rural areas of Tamil Nadu. The mean Hb of pre-menarcheal girls was 11.63 g/dl and that of post-menarcheal girls was 11.52 g/dl.

**2.3.1.2 Calcium deficiency**

Shatrugna et al., 2006 conducted a randomized and placebo-controlled clinical trial on middle income and semi-urban Indian school going children and then measured the bone mineral content and densities after a 14-month supplementation study. A plot of bone mineral content with age clearly showed that it increases with the age in two phases; one slower phase below 11 years and another steeper phase between 12 to 15 years, indicative of the growth spurt.

Joanna et al., 1997 revealed that deficiency of calcium in adolescence would lead to poorer bone structure and fewer calcium reserves in the body. Calcium deficiency in adolescence can predispose women for Osteoporosis later in life. Osteoporosis is considered to be a major public health problem. 40 percent of women would sustain an osteoporotic fracture. Maximizing peak bone mass at skeletal maturity age may be one of the most important protective measures against fracture in later life. This period is a ‘window of opportunity’, especially for the girls to build healthy calcium reserves and reduce the chance of developing osteoporosis in adulthood. An increase in milk consumption among adolescent girls had resulted in significant gains in bone mineral.

**2.3.2 Effects of Malnutrition in Adolescence**

Li et al., 2005 stated that obese and overweight children are not only at risk for insulin resistance syndrome, dyslipidemia, hypertension and hypertriglyceridemia but also for poor micronutrient status. Halterman et al., 2001 revealed that micronutrient deficiencies appear to be prevalent even among well-nourished, non-obese school aged children. Frary et al (2001) reasoned that it is likely to be caused by a higher intake of energy-dense foods that do not contain essential vitamins and minerals. Halterman et al., 2001 and Benton (2001) reviewed that inadequate intake of micronutrients adversely influenced growth and development, cognitive performance and increased susceptibility to infections.
Hamiel et al., 2003 and Nead et al (2004) quoted reports from countries like the United States, Israel and Canada which have shown that obese and overweight children have a higher prevalence of iron deficiency than normal weight children.

Gills and Gills (2005) summarized that intakes of micronutrients such as vitamin D, folate, calcium, magnesium and vitamin E are below optimal levels among obese children. In their study across 5 different cities in India, they observed that micronutrient deficiencies appeared to be prevalent even among well-nourished, non-obese school-going aged children and are likely to be caused by a higher intake of energy-dense foods that do not contain vitamins and minerals.

### 2.4 NUTRITIONAL AWARENESS AMONG ADOLESCENTS

#### 2.4.1 Prevalence of Nutritional Knowledge Among Adolescents

Various experts have done an assessment of the nutritional knowledge of adolescents. Kapil et al., (1991) found that 90.8 percent of respondents knew that excess in-take of energy causes obesity. They knew that low and poor iron availability is the major cause of anemia, 63.8 percent, 66.5 percent, 71.7 percent and 57.2 percent of subjects believed that almonds are more nutritional than groundnuts, fruits are rich source of energy, desi ghee is more nutritious than vanaspati, cow milk is more nutritious than buffalo milk respectively. Wan, (1991) pointed out that the malnutrition in younger children was prevalent in the lower socio-economic group of society. It was mainly due to the little awareness about nutrition in parents as well as in children. It has also been observed that nutrition knowledge of older women was lower than the other middle-aged women and young adults.

Malnourishment in children was mainly due to lack of micronutrients which was associated with the lack of awareness among parents and children (Brown et al., 1997). In a similar study, more than 50 percent of the respondents consumed a low amount of vegetables and fruits with the thinking that they were eating the right amount of these foods (Anderson et.al., 1993). They further suggested that the public health programs might benefit in increasing awareness in the public about nutritional adequacy and deficiency. It was also apparent that there were clear differences in awareness of the use of vegetables and fruits in the different socio-economic strata of society (Anderson et al., 1997).
One study observed that there was a lack of knowledge and negative attitudes for exclusive breastfeeding among adolescent girls despite their positive attitudes to breastfeeding. The reasons for not wanting to breastfeed exclusively were not to feeds human milk alone, that it would not satisfy the infant, the infant fed with human milk alone would be thirsty and therefore needed additional water and exclusive breastfeeding would be too tiring for them (Walker, 1998).

A study done on the nutritional status of adolescent girls of urban slums and the impact of IEC (Information, Education and Communication) on their nutritional knowledge found that the weights and heights of girls at any given age were far below the standards and that the deficit increased with age. Iron deficiency anemia was found most common nutritional problem. After IEC intervention, a significant proportion of girls could rightly identify the food rich in various nutrients (A Saibaba, 2002).

A study was conducted on the impact of nutrition education on nutrition knowledge of the parents of obese children. A group of 30 males and 30 females were selected from II, III and IV class of a public school in Ludhiana city based on the criteria of 20 percent above the normal weight for age. Based on the pre-test nutrition knowledge score of the parents of obese children, nutrition education was imparted for one month. A significant difference ($P < 0.01$) was noticed in the scores of pre and post-test of nutrition education intervention. (Sanghaet al., 2006).

A study on the influence of nutrition education and carbohydrates supplementation on the performance of 30 high school football playing boys (14-15 years) in Dharwad district was carried out by Meti and Saraswati (2006). The study revealed that nutrition education and carbohydrate supplementation for three months improved their nutrition knowledge and practice, physical and on-field performance during the competition.

A study was conducted, on 200 adolescent girls between 16-18 years of age. Their nutritional knowledge was checked with the help of a questionnaire. Compared to males, these females had greater responsibility in household duties, especially in improving the nutrition of family members. In the study, it was seen that the imparting of nutrition education had a significant impact on nutrition knowledge among girls. So it can be determined that nutrition education plays a major role in improving the nutritional knowledge which in turn improves the nutritional status of the respondents and their family members (Ms. B. Thanuja 2007).
A study conducted on the impact of nutrition education on the nutrient adequacy of 60 adolescent girls (13-19 years) for 3 months was imparted to the subjects after assessing their basic nutrition knowledge. It was found that nutrition education improved their mean nutrition knowledge scores significantly (P < 0.01) from 11.17±1.42 to 19.16±1.8. The average contribution of carbohydrate, fats, protein, vitamins and minerals increased significantly after imparting nutrition education (Kaur 2007).

A study was conducted to find out the awareness of 112 adolescent girls in the age group of 14-18 years regarding health aspects through an intervention study. The study adopted a pre-test and post-test design with an intervention for 9 months. The intervention was given to the girls through lectures, discussions and demonstrations. Post-testing results showed that the knowledge of girls regarding health aspects improved significantly after the intervention. There was a significant increase in the awareness levels of girls with regards to the knowledge of health problems, nutritional awareness, environmental health, reproductive issues and child health. Thus informative and educable interventions seemed to have a positive effect on awareness levels which would eventually encourage the increase of nutrition knowledge and positive health habits (Shubhangna Sharma 2009).

A research work was undertaken to find out the knowledge of adolescent girls about health care, reproduction and nutritional awareness. About 240 adolescent girls of the age group 11-15 years were selected at random, divided into 12 batches of 20 girls each. The nutrition education was provided to these subjects. It is clear from the results that majority of the sample adolescent girls were found out to be having either poor or fair levels of awareness about the component included on reproductive health care and nutritional awareness before getting the nutritional education. However, after receiving training regarding reproductive health care and nutritional awareness for two months, a considerable improvement was seen in their awareness and behavior towards to the components studies in training (Gaikwad, 2013).

A study was conducted to assess the nutritional awareness of the adolescent girls participating in the nutritional knowledge programs in Anganwadis of Kottayam district and to educate the girls and their parents about the importance and the ways to achieve optimal nutrition during adolescence. Data on their dietary pattern and anthropometric
assessments like weight and height were collected through a pre-structured interview schedule. It is evident from the results that majority of the subjects were found out to be having either poor or fair levels of awareness about the importance of nutrition in their diets which increased considerably after getting nutrition education (Renjini M R 2014).

2.4.2 Effects of Poor Eating Habits and Eating Disorders Due to Lack of Nutritional Knowledge

Eating habits of adolescents are influenced by various factors that can be physical and psycho-social factors. Despite higher nutrient requirements, adolescents usually have a lower intake due to poor nutritional knowledge and also because of eating disorders. Teenage girls are likely to skip meals especially breakfast. Szajewska and Marek (2010) suggested that eating breakfast was associated with a reduced risk of becoming overweight and reduction in the BMI in children and adolescents in Europe.

Agaras and Hamner (2007) indicated that most of the eating disorders begin in adolescence during puberty. Eating disorder includes dieting, binge eating, food restriction and purging behaviors. Disorders in eating patterns fall into 3 broad categories; namely Anorexia Nervosa, Binge Eating Disorder and Bulimia Nervosa. According to Veeraraghavan (2006), it can have its onset at any age and is often not recognized until adulthood. Rosenberg (1965) revealed that the most common underlying psychological factors in each of these eating disorders are loneliness, low self-esteem, moodiness, stress, emotional withdrawal, anxiety and depression. Paxton et al., 2006 suggested that having negative perceptions of one’s body and low self-esteem have been linked to certain levels of body image disturbance and eating problems.

Minuchin et al., 1978 proposed that dysfunctional family relationships and styles of interaction within the family environment are often identified as higher factors in the development of eating problems.

Dietz and Robinson (2005) indicated that increasing number of American children and adolescents regularly eat food away from home and were likely to consume soft drinks, salty snacks and pizza. Briefel and Johnson (2006) observed that adolescents do not consume the recommended amount of servings of fruits, vegetables and dairy products and they consume excessive amounts of fats and added sugar. In a study by Vasanthamani and Devi (2009) involving 2765 students in Coimbatore, India; around 73
percent students were found to be consuming fast foods regularly. The most preferred fast foods were ice-creams, chocolates, cold drinks, chaat items, puffs, pastries and candies.

2.5 NUTRITION EDUCATION

The nutritional deficiencies can be prevented or handled more effectively if nutrition education is imparted. In India, the National Plans of Action for the SAARC through Decade of the Girl Child has given particular emphasis to the needs of adolescent girls and has called for programs targeted this group and providing nutrition and health education. It is expected that such approach to the growth of adolescent girls will slowly improve their nutritional status as well as it will enhance their nutrition knowledge and social awareness. Equipped with skills for to generate income, these girls will become empowered to take decisions regarding themselves and their family, especially the children (Passi and Malhotra, 2002). Building awareness in the medical fraternity, parents, paramedical staff and educationalists through a series of seminars, visits and workshops in the community to promote interaction with the local community is required. Media and NGOs should help Indian medical associations to create nationwide awareness and bring together all stakeholders directly involved in the fight against anemia (Jain, 2006). Nutrition education programs should also challenge young women's understanding of foods as either a healthy food or a junk food and the feelings and associative that goes along with each, as part of the diet (Chapman, 1996).

The main focus of nutrition education is to improve knowledge among girls and boys, school teacher, parents and community members about nutrition and also to the nutritional deficiencies such as anemia and symptoms of eating disorders through health education programs in schools, media, health facilities and public information campaigns. Focus should be on working with adolescents and their families to improve dietary intake in such a way that adolescents can meet a majority of their nutritional requirements through locally and easily available and culturally appropriate foods (Chatterjee, 2005). Adolescent girls need to be considered as a specially targeted group by schemes and development programs. Literacy in girls and women will also improve their participation in the developmental processes. Furthermore, an educated mother seeks out medical attention much sooner and provides much better nutrition, education and care to her children and herself (Passi and Malhotra, 2002).
Anemia has been recognized as a public problem for years in India. Although a little progress has been reported; however, even then the prevalence of anemia in India is still unacceptably high. Indian Medical Association (IMA) along with WHO and UNICEF, therefore, re-emphasized the need to fight anemia and stressed the criticality of recognizing its multi-factorial etiology for developing effective control programs. There is a need for social mobilization campaigns, implementation of national level nutritional plans and participation of public health and education sectors, media and food industries to fight and eradicate iron deficiency (Refger and Dillon, 2002). Along with these, promotion of healthy eating pattern and selection of appropriate foods was also suggested by Cooper et al., (2006).

Project Description of National Nutrition Programs as stated by the Institute of Public Health & Nutrition revealed that the majority of rural adolescents from Bangladesh nation were lacking in awareness of the nutritional value of different food items. Among them, 35 percent did not know that adolescents need to take additional nutrients to achieve potential growth. Considering their future roles in maintaining the health and nutrition of their family members; female adolescents should be the focus of nutrition awareness programs aimed at promoting nutrition knowledge and practices. Sufficient intake of iron by the adolescents is limited due to the lack of knowledge and available household resources. Despite the high prevalence (17 percent) of depleted iron stores (SF less than 12 ug/l); intake of iron supplements with only 8 percent in areas without intervention. However, community-based nutrition education and distribution of iron pills free of charge had brought about a change in use of iron supplements to 21 percent in BINP area (www.icddrb.org/pub). WHO (1974) found that there were no noticeable differences in scores for knowledge and practices between wife and husband, but in respect of practice of other health related concepts relating to smoking, beverages and alcohol consumption; husbands obtained significantly lower scores than wives. Not much difference was found in respect of the scores for knowledge, but it was low for both the workers and wives.

National Institute of Population Research and Training (2004) reported that adolescents’ undernutrition can be handled by community-based health and nutritional counseling which should be backed by basic medical services to bring about changes in their
nutritional knowledge. Because adolescents are not the sole decision makers and parents often make decisions on their behalf, therefore parents particularly mothers need to be provided information on the need for adolescent nutrition for healthy growth and survival (www.icddrb.org/pub). In a comparative study regarding the level of nutritional knowledge of Home Science, Art and Science graduate students, it was found that the level of nutritional knowledge of Home Science students regarding conservation of nutrition, human nutrients, food fads and fallacies, therapeutic nutrition and nutritional practices was considerably higher than Art and Science students and the level of Art students was significantly greater than Science students (Karwasra, 2000).

Bangladesh Integrated Nutrition Project (BINP) from 1995 to 2002 had emphasized in their report on health and nutrition education of adolescent girls. For that, trained female interviewers visited adolescents in their homes to obtain data on the nutrition knowledge and practices. Based on the data about their education levels, 70 percent were found to be under matric, 6 percent had passed grade tenth and 4 percent had never attended the school. By occupation, 68 percent were students and 29 percent were doing household work and about 4 percent were earning some income. Also, their knowledge regarding the nutritional value of different types of food items was considerably lower. When asked to name major energy house foods, 31 percent mentioned rice and 12 percent mentioned wheat which was the correct response. Less than 50 percent correctly identified high protein foods. 32 percent stated meat, 20 percent of them stated dal and 42 percent fish. Their knowledge about vitamin and mineral rich foods was also better. About 75 percent mentioned vegetables and about 51 percent mentioned fruits as vitamin and mineral rich foods (www.icddrb.org/pub).

Assessment of mother’s awareness about the nutrition of children in different age groups was done and it was found that the mothers from the higher socio-economic group had better knowledge than those from the lower socio-economic group (Abbi et al., 1988). In another study, about 90 percent women replied about nutrition questions correctly, knowledge and attitude towards nutrition were found positively correlated (Kumar et al., 1989). A significant increase in knowledge of mothers was observed after implementation of the programs in Delhi areas (Vatsa et al., 1989). Both mother and children from lower strata of society were usually less aware of the nutritional
importance of various kinds of meals. Adolescence in girls is a significant period. Therefore the parents should be cautious about their nutritional status and health at this stage of growth.

Subbarao (2010) opined that the goal of nutrition awareness for students is to acquire and evaluate health-related information, make decisions to improve their health and apply their knowledge to better their physical, mental and social well-being including that of their family, peers and community. Health education programs must promote the voluntary application of health knowledge to health enhancing actions in daily life.

Many studies measuring the effectiveness of nutrition education has confirmed that education is one of the best methods to break the vicious cycle of under-nutrition and underdevelopment. Among these methods, nutrition education will play an important role in India’s fight against malnutrition. A dietary study of knowledge, practices and attitudes by FAO (2000) revealed that malnutrition was not recognized as a disease, except in acute cases, and the general idea of a good diet preventing illness was not widespread. In a study conducted in China nation to assess the nutrition knowledge of university students, the nutrition knowledge was found to be lacking. Linya et al., (2009) has suggested that nutrition education should be imparted to students to increase nutrition knowledge and help them form good nutrition habits.

Srikulchayanonta (2010) suggested that among the different groups, schoolchildren represent a potentially most significant constituent as they influence the attitudes of their parents. If they learn right nutritional principles and practice them when they become adults, nutrition education imparted in the school will greatly help towards preventing malnutrition in the next generation. To be effective, nutrition education must tackle the school environment, classroom environment, the family and community. Nutrition education on healthy eating habits in the curriculum combined with social support from families and teachers may help in sustaining healthy eating behaviors.

Adolescents can lower the risk of becoming obese and lead a healthier lifestyle by improving their nutrition awareness and attitudes towards nutrition and health. Watson et al., 2009 used a quasi-experimental design to find out the nutrition knowledge, attitudes and food consumption behaviors of students 14-19 years old before and after nutrition course in a North Texas high school. This group showed significantly improved nutrition
knowledge, significant improvement in attitude scores and better milk and breakfast consumption behaviors. Findings of this study indicate that nutrition education can positively influence the attitudes, knowledge and eating behaviors of high school students.

A study conducted by Shrivaster et al., 2010 on 702 adolescent girls in Delhi area revealed inadequate consumption of various nutrients. However, after getting nutrition education, the girls showed positive changes in dietary behavior and a significant improvement in intake of nutrients.

In a study by Vazir et al., 2006 by the National Institute of Nutrition (NIN), Hyderabad, it was found that school children from middle-income groups showed a higher prevalence of sub-clinical micronutrient malnutrition. The study also found that up to 98 percent of apparently healthy looking school children had insufficient food intake and lower levels of many of the essential micronutrients. In fact, assessment of the dietary intake of micronutrients showed that many children were not even getting adequate quantity daily. They reported that the vital purpose of the study was to understand the impact micronutrient supplementation had on cognitive functions in school going children and thereby give baseline assessment showing the overall effect of such supplementations on the mental functions. It revealed that a micronutrient enriched group did well in the concentration and attention parameters. The study also proved that there was a strong relationship between nutrient intake and the mental state of a person.