REVIEW OF LITERATURE

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Adolescence has been described, by Anthony Lake (Executive Director UNICEF), not only as a time of vulnerability but also as an age of opportunity (UNICEF, 2011). Adolescents form 18% of the world's population. The vast majority of adolescents (88%) live in developing countries. More than half of world's adolescents live in South Asia or the East Asia and Pacific region. India has the largest national population of adolescents (243 million) (UNPD, 2010).

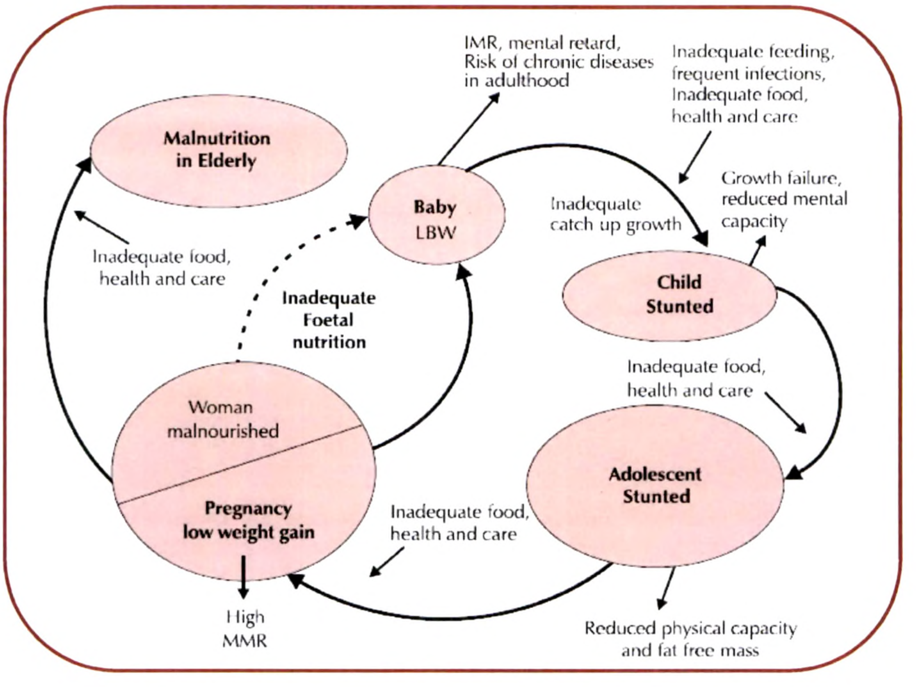
Adolescence is a time of rapid growth, second only to infancy. It is the only period in an individual's life when growth velocity increases. This rapid growth is accompanied by an increase in nutrient demand (Heald and Gong, 1999; Rees et al, 1999). During this period, body proportion, including height and weight measurements change substantially. Adolescent boys generally build more muscle mass, gain weight at a faster rate, have larger skeleton, and deposit less fat than girls. Boys also tend to grow for a longer period of time. For adolescent girls the greatest gain in height and weight normally occurs in the years preceding menarche (Heald and Gong, 1999; Allen and Gillespie, 2001) and the growth spurt continues for two years after menarche (Travis, 2003).

Adolescents and their Nutritional Needs

Adolescents are the future generation of any country and their nutritional needs are critical for the well being of society.

Addressing the nutrition needs of adolescents could be an important step towards breaking the vicious cycle of intergenerational malnutrition and chronic diseases (Figure 2.1.1). Epidemiological evidence from both the developed and developing countries indicates that there is a link between foetal under-nutrition and increased risk of various chronic diseases during adulthood (ACC/SCN, 2000).

Figure 2.1.1: Vicious Cycle of Intergenerational Malnutrition (ACC/SCN, 2000)



Studies conducted in different countries in the region, reveal that nutritional deprivation affects almost all growth parameters and final adult body size resulting in thinness and stunting. However, nutritional status of both boys and girls improves with age, showing that the effect of malnutrition is more pronounced at the time of peak growth (WHO 2006).

Malnutrition during Pre adolescence and Adolescence

Malnutrition in all its forms refers to both underweight and overweight. Underweight is defined by a low weight for age; Stunting refers to low height for age independent of their weight for age; Overweight refers to excess weight for length/ height, measured by BMI for age (SCN, 2006).

Along with the growth spurt of adolescents, nutrition transition due to increased economic development and market globalisation, leading to rapid changes in life style and dietary practices, makes them more vulnerable to dual burden of malnutrition.

In SEAR, a large number of children suffer from chronic malnutrition and anaemia, which adversely impacts their health and development (WHO, 2006). India ranks first with 39% of underweight children globally and a prevalence of 47% of underweight among children (UNICEF, 2006).

Almost one-third of all the children in developing countries are stunted, thereby increasing the risk of illness and death, reduced cognitive ability and school attendance in childhood and lower productivity and lifetime earnings as adults (FAO, 2004).

Vidal et al. (2008) reported that the prevalence of thinness (BMI $\leq$ 18.5) increased with age amongst European (Portugal) adolescents. In girls (10-18 yrs) it increased from 1.5% to 7.6% and in boys the corresponding trends were from 0% to 7.3% for thinness.

In Nigeria, a study among the adolescent girls (Brabin et.al., 1997) showed that under nutrition was more widespread both in urban and rural areas: 10% of rural and 8% of urban adolescent girls were stunted (<2nd percentile, British reference values of 1990) and 16% in rural vs. 12% in urban could be considered thin (<9th percentile BMI).

A study conducted in Iran (Janghorbani et. al.1998) reported that 54.6% and 1.6% of affluent adolescent (13-14 yrs) school children were underweight (BMI 15-19.9) and very underweight (BMI < 15) respectively.

Two surveys conducted, namely National Health Survey of Pakistan (1990-1994) and the Karachi survey(2004-2005), to determine trends in nutritional status of school aged (5 – 14 yrs) children in urban Pakistan, reported that 29.7% v/s 27.3% and 16.7% v/s 14.3% children were underweight (weight-for-age less than- 2 SD) and stunted (height-for-age less than -2 SD) and overweight and obesity was3.0 v/s 5.7 ($p<0.001$) in the two surveys, respectively (Jafar et al. 2008).

In 2004, a study was conducted to assess the nutritional status of 8-12 years old school children from middle to high socio economic status in an urban area of Sri Lanka. The result of the study showed the prevalence of thinness in 24.7% in boys and 23.1% in girls. About 5% and 7% of both boys and girls were stunted and underweight respectively (Wickramasinghe et al, 2004).

Kapil and Shethi (2004), reported that undernutrition amongst school going children 6-9 years of age in National Capital Territory (NCT) of Delhi, 52.5%, 45.1% and 11.1% children were underweight, stunted and wasted respectively. It was observed that 9.7, 15.3, and 2.8% of the children were severely (<-3SD) underweight, stunted and wasted respectively.

However, a study conducted in Kerala on 3886urban adolescents (10-15 years), reported a very low prevalence of underweight among boys - 8%, while none of the girls were found to be underweight.

Coming to the trends in the Eastern Region (West Bengal) of the country as reviewed by Das and Bisai (2009), the prevalence of underweight among middle to high income school going adolescent children (10 – 13 years) was 28.6 % and undernutrition was significantly higher among boys (37.59%) than girls (19.43%).

Another study (De Onis et al. 2001) in the eastern region (Calcutta), assessed the prevalence of undernutrition among affluent adolescent boys (10-16 yrs). The study reported the prevalence of thinness and stunting to be51% (BMI <5th percentile i.e. thinness) and 11% (height for age <5th percentile i.e. Stunting) respectively.

Studies carried out over the years by Munshi (2008), Iyer, Venugopal, and Gandhi (2006) reported the prevalence of under nutrition in young children and adolescents (6-18 years) ranging from 7.3 to 33.8%. Table 2.1.1 shows prevalence of undernutrition in various parts of India.

Though limited data on malnutrition among school age children is available, it is enough to establish the need for strengthening the school health activities and creating awareness among parents about the nutritional requirements of their children.

The highest prevalence rates of childhood obesity have been observed in developed countries (Table 2.1.2), however, its prevalence is increasing in developing countries as well (James, 2004)

There is dearth of published data on growth pattern of Indian affluent adolescent children. In contrast to extensive data available for children from low socio-economic backgrounds, information on nutritional status of children among middle and high-income groups is limited (Toteja et al. 2004).

Table (2.1.3) shows the prevalence of overnutrition among adolescents in India. A study conducted by Kapil et al (2002) in India, showed the prevalence of obesity in affluent adolescent school children was 7.4%, and higher in males than females. The maximum prevalence of obesity was found during the pubertal period (between 10- 12 years).

A recent study on urban adolescents (10-19y) from 10 schools and colleges in Ahmedabad revealed that 20% of the subjects were overweight while none was obese (Prajapati et al, 2011). Parekh et al (2012) stated that there was a significantly higher risk of being overweight and obese in urban than rural areas, after adjusting for age and gender. A local study conducted by Mani et al (2008) on 2374 adolescents from four schools of urban Vadodara in the age group of 12-18 years reported 16% of overweight and obesity along with aberrations in lipid profile.

Anemia and Prevalence among Adolescents

Malnutrition in children often leads to micronutrient deficiency like iron deficiency anemia. Adolescence is a time of increased iron requirement because of the expansion of blood volume and increase in muscle mass. During adolescence, requirement for growing boys also jumps up significantly due to muscle mass development (Mittal, 2007). One-third of the world's population suffers from anemia.

The International Center for Research on Women (ICRW) studies documented high rates of anemia in Nepal (42%), Cameroon (32%) and Guatemala (48%). In India also more than 55% of the adolescents population has been reported to be suffering from Iron Deficiency Anemia (Adolescent Nutrition, 2003).

Table 2.1.1:Prevalence of Undernutrition in various parts of India

Author	Year	Place	Age	Prevalence
Das and Bisai	2008	West Bengal	13- 18	UN: 29%
Unnithan and Syamakumari	2008	Urban Thiruvanathapuram, Kerala	10-15	UW – Boys 8% Girls 0% Severe UW – 0%
Deshmukh et al	2006	Wardha	6-14	UW - 54%
Mukhopadhyay et al	2005	West Bengal	11-14	UN – 37%
Rao et al	2003	Madhya Pradesh	11-19	UN: 62% Stunting – 52% Wasting – 33%
Kapoor and Aneja	1992	Delhi	10-18	Stunting Girls – 36%

UN – Undernutrition UW - Underweight

Table 2.1.2: Changes in Prevalence of Obesity in children of various countries

Country	Year	Age (years)	Prevalence
USA	Bogalusa 1973- 1994	5-24	Twofold increase in the prevalence of Obesity
	NHANES I 1971-1974	6-19	Relatively Stable
	NHANES II 1976-1980	6-19	Relatively stable
	NHANES III 1988-1994	6-19	Doubled to 11%
	NHANES IV 1999-2000	6-19	Increased by 4%
Japan	Kaotani et al 1974-1993	6-14	Doubled (5% to 10%)
UK	Labstein et al 1984-98	7-11	Changed from 8% to 20%
Spain	Moreno et al 1985/6-1995/6	6-7	Changed from 23% to 35%
France	Rolland-Cachera 1992-1996	5-12	Changed from 10% to 14%
Greece	Krassas 1984 – 2000	6-12	Increased by 7%

Table 2.1.3: Prevalence of Overnutrition in various parts of India

Author / Year	Place	Prevalence
Prajapati et al, 2011	Ahmedabad	OW 20%
Parekh et al, 2012	Surat	OW 26.3% OB 14.6%
Mani et al, 2008	Vadodara	OW 13.4% OB 2.6%
Misra et al, 2006	New Delhi	OW + OB 29%
Kapil et al, 2002	New Delhi	OB 7.4%
Iyer and Parikh, 2002	Vadodara	OW 7% OB 0.7%
De Onis et al, 2001	West Bengal	OW 4.2%
Jayshree S, 2001	Dharwad	Children(OW)16.3% Adolescents(OW)2.8%

OW –Overweight OB - Obesity

Table 2.1.4 shows prevalence of anemia among adolescents. High rates of anemia have been observed in other developing countries, like Indonesia, Brazil, Egypt and India within the range of 24% to 60% (WHO 2003, Anjali 2000, Verster et al 1998, Mashauri et al 1998, Sichieri et al 1996). Prevalence of iron deficiency anemia amongst Turkish adolescents between 11- 18 years, was found to be 4.2% (Mine et al, 2002).

Prevalence of anemia was reported to be around 13% among subjects living in high socio economic areas as compared to 18% amongst the subjects in low socio economic areas of Baghdad (Shatha et al, 2003).

Sen and Kanani, 2006, in their study stated very high prevalence (67%) of anemia in adolescent girls of Vadodara, in India. Though no case of severe anaemia was found; 32.6 % girls were mildly anemic (Hb = 11.0-11.9 g/dL) and 34.7 % girls were moderately anemic (Hb = 7.1-10.9 g/dl).

Consequences of Malnutrition and Anemia

Under or overnutrition during the school years can inhibit a child's physical and mental development. Stunting is associated with long term consequences, such as impaired intellectual achievement and school performance (Frongilo, 1999; Martorell et al, 1992). Stunting also lead to reduction in adult body size and, subsequently, reduced work capacity and obstetric complications (Martorell et al, 1992).

Thinness in school aged children can result in delayed maturation, deficiencies in muscular strength and work capacity, and reduced bone density later in life. Underweight in young children is highly correlated with an increased risk of morbidity and mortality (WHO, 1995).

Table 2.1.4: Prevalence of Anemia in Adolescents

Author / Year	Year	Place	Prevalence (%)
Sudhagandhi et al	2011	Tamil Nadu	Boys 37.6 Girls 67.8
Kotecha et al	2009	Vadodara	Girls 75
Agarwal et al	2003	Delhi	45
Basu et al	2003	Chandigarh	25.4
Soekarjo et al	2001	Indonesia	Boys 12.1 Girls 25.8
Family Health Bureau	2000	Sri Lanka	Boys 31.6 Girls 40
Ahmed et al	2000	Bangladesh	Girls 27
Mehta et al	1998	Mumbai	64

Undernourished children 10-12 years of age demonstrated the following when compared to normal nourished children (Agarwal et al, 1995):

- A relative deficit of memory quotients assessed by Wechsler memory scale.
- Lower scores for abilities related to personal and current information, orientation, mental control, logical memory, digit span, visual reproduction and associative learning.
- Impaired set formation and flexibility in attention as assessed by the card sorting test.
- Impairment in conditional learning on maze and conditional associative learning tests.

The overweight or obese school child also faces increased risks of high blood pressure, metabolic syndrome, non- insulin dependent diabetes and psychological disorders as an adult (WHO, 2003).

Overweight and obesity during adolescence have some immediate consequence, particularly as they relate to body image and self-esteem, and become a risk factor for overweight and obesity as an adult. One-fourth to half of the individuals who are obese in adolescence remain obese in adulthood (Must 1999, Whitaker et al, 1997)

Overweight and obesity in childhood have significant impact on both physical and psychological health; for example, overweight and obesity are associated with Hyperlipidaemia, hypertension, abnormal glucose tolerance, and infertility. In addition, psychological disorders such as depression occur with increased frequency in obese children (Daniels et al, 2005). It has been reported that overweight children, who had been followed up for40 (Mossberg, 1989) and 55 years (Must et al, 1992), were more likely to have cardiovascular and digestive diseases, and die from any cause as compared with those who were lean.

Data from Bogalusa(USA) show that adolescents with a BMI >75th percentile were more than eight times as likely to have hypertension in adulthood as compared with leaner adolescents (Srinivasan et al., 1996).

Iron deficiency anemia can lead to reduced muscle function and work capacity (Haas and Brownlie,2001; Sharp,2005) and less explorative behaviour in school aged children (Zimmermann et al, 2000). Iron deficiency or iron deficiency anemia is also consistently associated with impaired cognitive function and lower school performance in school-aged children (Granthom and Ani, 2001; Sungthong et al, 2002; Halterman et al, 2001, Otero et al, 2008). Severe anemia negatively impacts work capacity, intellectual performance and cognitive development (De Benoist et al, 2008).

In developing countries, micronutrient deficiencies do not occur in isolation but in combination with malnutrition. This is because the main underlying cause of malnutrition is a poor-quality diet (Ramakrishnan and Huffman, 2008).

Nutritional Needs of Adolescents

Studies conducted in different countries in South East Asia, reveal that nutritional inadequacy affects almost all growth parameters and final adult body size resulting in thinness, underweight, and stunting. However, nutritional status of both boys and girls improved with age, showing that the effect of malnutrition is more pronounced at the time of peak growth (WHO 2006).

Both muscle and fat mass increases during adolescence, girls gain more fat and boys gain more muscle. Therefore, the energy and protein requirements increase considerably during this period. Energy and protein needs correlate more closely with the growth pattern than with the chronological age. The peak in energy and protein requirements coincides with the peak in growth of adolescents. If energy intake is limited, dietary protein may be used to meet energy needs and be unavailable for synthesis of new tissues or tissue repair. This may lead to a reduction of growth rate and muscle mass despite an apparent adequate protein intake (Spear, 2002).

Iron requirements peak during adolescence due to rapid growth with sharp increase in lean body mass, blood volume and red cell mass which increases iron needs for myoglobin in muscles and haemoglobin in blood (Beard,2000).After the growth spurt and sexual maturation, there is a rapid decrease in growth spurt and need for iron(Dallman,1989).Iron requirements in adolescence are greater in developing countries because of infectious diseases and parasitic infections that can cause iron loss, and because of low bio-availability of iron from diets (Brabin andBrabin,1992).

At the peak of the growth spurt, the daily deposition of calcium can be twice that of the average between 10 to 20 years. In fact, 45% of the skeletal mass is added during adolescence (Spear 2002, Sentipal et al, 1991)

Inadequate diets of adolescents

A longitudinal study in New Jersey (Videon and Manning, 2003) showed, that a large percentage of adolescents reported eating less than the recommended amount of vegetables (71%), fruits (55%), and dairy foods (47%). The results showed that almost one in five adolescents skipped breakfast regularly. In Australian adolescents, along with the skipping breakfast inadequate consumption of fruits, vegetables and dairy products was also observed (Nowak and Speare, 1996).

Diet related data was collected from adolescent girls for 3 consecutive days by means of 24 hr dietary recall method along with FFQ in a study among adolescents in Delhi, the findings revealed that the food intake was grossly inadequate with poor intake of vegetables, fruits and milk (Agarwal et al. 2000).Fast foods with soft drinks, burgers and pizzas are more popular among the adolescents, and this can contribute to high intake of calorie and saturated fat and less amount of micronutrients (Srihari et al. 2006; Misra et al. 2006).

Gupta et al (2006) conducted a study on food habits of adolescents and adults between 13- 25 years, in two public schools of New Delhi and found that intake of cereals, pulses, milk and green leafy vegetable was inadequate compared to visible fats, roots and tubers. SHAHN Survey (2002) among Delhi students revealed that 30% of boys and 40% girls skipped one meal everyday and consumed junk food in the last 24 hours preceding the survey and breakfast was the commonest casualty. These foods spoil the appetite for regular meals and are high on calories and low on nutrients.

Consequences of Inappropriate Dietary Intakes during Adolescence

Inappropriate dietary intakes during adolescence has several consequences. **Firstly**, it can potentially retard physical growth, reduce intellectual capacity and delay sexual maturtion, as rapidphysical growth creates an increased demand for energy and nutrients (Story, 1992).

Secondly, inappropriate dietary intakes affect young people's risk for a number of immediate health problems such as iron deficiency, undernutrition, stunting, bone health, eating disorders and obesity (CDC, 1996). It may also affect concentration, learning and school performance in school going adolescents.

Thirdly it also has long term implications, like low bone density and an increased risk of osteoporosis caused due to low calcium intakes during adolescence (CDC, 1996). **Fourthly**, high fat intakeduring adolescence and into adulthood is associated with an increased risk of heart disease (CDC, 1996).

Fifthly, the compromised nutritional status and poor growth in adolescent years affects the reproductive role. Stunting and underweight among girls during adolescence, if continued into adulthood may lead to increased obstetric risk for women in case of an early pregnancy (Gopalan, 1989).undernutrition, iron deficiency, obesity, poor bone health and eating disorders are some of the consequences of inappropriate dietary intakes. In addition, to these concentration, learning and school performance of the school children also gets affected due to inappropriate dietary intakes (CDC, 1996; WHO, 2005).

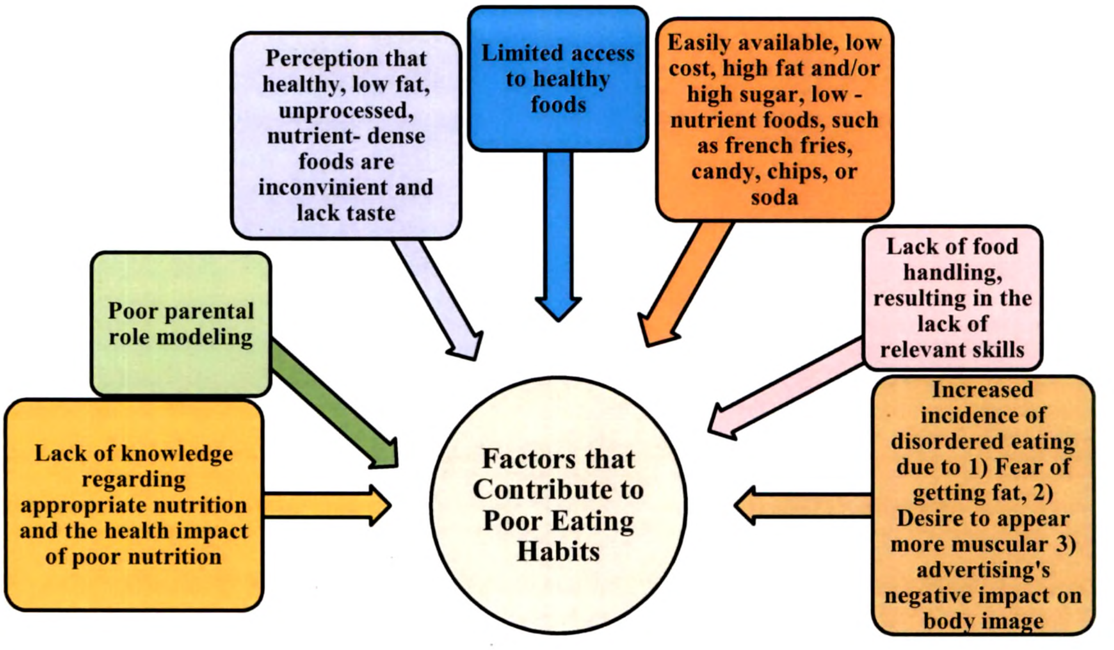
Causes of Poor Eating Habits of Adolescents

Adolescence is seen as a transitional stage for diet and eating patterns. The diets of young people often undergo substantial change as a result of body growth and development and as newly developed independence and diminished family influence gives young people more control over their eating habits. Young people are more likely to suffer from binge eating, restrained eating, fear of fatness and purging than adult population (NHMRC, 1995). California Department of Public Health has listed down factors contributing to poor eating habits among adolescents as shown in Figure 2.1.2.

The experience of childhood is increasingly urban. Over half of the world's people, including more than a billion children, now live in cities and towns. An increasingly urban world is also contributing to the rising incidence of non-communicable diseases and obesity (WHO 2010).

In developing countries also, especially in cities, some of the following methods are common (Dennison et al., 1995, Spear, 2000) -

Figure 2.1.2: Factors contributing to Poor Eating Habits of Adolescents (CDPH, 2012)



- The meal pattern of adolescents becomes more disorganized, and they tend to miss their meals at home as they get older, often skipping breakfast.
- Some dietary patterns like snacking, usually on energy dense foods, wide use of fast foods that are low in iron, calcium, riboflavin, vitamin A, folic acid and fibres, low consumption of fruits and vegetables and faulty dieting are more common among the adolescents of industrialized countries.
- The search for identity, the struggle for independence and acceptance, and concern about appearance, tend to have a great impact on lifestyle, eating patterns and food intake among adolescents.

Adolescent eating is conceptualized as a function of individual and environmental influences. Four levels of influence are described: Individual or intrapersonal [psychosocial, biological]; social environmental or interpersonal [e.g., family and peer]; physical environmental or community settings [e.g., schools, fast food outlets] and macro system or societal [e.g., mass media, marketing and advertising, social and cultural norms] (Story,2002).

A study on Nepalese school children showed that fast foods (ready to eat snacks, chips etc) were preferred by more than two-third of adolescents. Advertising, probably TV and magazines, influenced preferences in 80% of these Nepalese adolescents (Sharma, 1998).

Although dietary habits of adolescents have changed over a period of time yet little has been documented. It has been recommended that research should be conducted to find new and innovative ways with which the nutritional problems of adolescents can be approached. Qualitative studies should be carried out on adolescent's diet and eating behaviours (WHO, 2006).

Estimation of Dietary Intake

Dietary intake data may be collected at the national, household or the individual level. Food supply data, which are normally collected at national level, are useful for purposes, such as tracking trends in the food supply. Food supply data are not useful for identifying individual or subgroups of the population at risk of inadequate nutrient intakes. Data at these levels allow disaggregated analysis to identify vulnerable groups, in line with human rights focused approach there is a wide array of methods of dietary assessment (Pao and Cypel, 1994).

Dietary intake estimation involves the collection of information of foods eaten by individuals and computation of the energy and nutrient contents of these foods by using values from food composition tables. The choice of method in each case should be guided by the purpose of the monitoring, the need for data accuracy and the availability of the resources. Dietary assessment methods should also be adapted to the target population and be culturally sensitive (Pao and Cypel, 1994).

Individual Surveys

Dietary surveys among individuals provide information that can be used to describe differences in intake of food and nutrients between subgroups. These methods depend on the ability of the subject to provide accurate information. Main methods for assessing present or recent diet include records, 24-hours (or 48-hours) recall, and food frequency questionnaires. In order to quantify the intake of foods, some estimate of the weight of consumed food is required. To convert food intake into nutrient intake, the availability of a food composition database/food table is essential. By combining the information of dietary intake and food composition databases/tables one can determine whether the diet is nutritionally adequate or not (Pao and Cypel, 1994).

Food records (Food Diary)

Food intake is measured at the time of eating. Food intake is quantified by weighing and using household measures (Kim et al, 1984). Household members themselves usually record their food intake, although a fieldworker might keep the record. Prospective methods are associated with the fewest number of errors and are generally thought to be the most accurate methods available. However, the data collection and processing are time consuming and expensive. These methods require a high degree of cooperation from the subjects, which can lead to poor response rates. Also, the need to weigh and record food, or the act of being observed, may alter the intake (Calkins et al, 1986). Table 2.1.5 shows the strengths and weaknesses of food record methods.

24-hour recall

This widely used method involves asking subjects to recall and describe all intakes of foods and drinks in the previous 24 hours. Large national dietary intake surveys, diet health studies as well smaller studies use this method to estimate dietary intakes by individuals. This method usually requires a trained fieldworker / dietician / nutritionist to interview subjects, to assess portion weights and make appropriate enquiries about types of food and drinks consumed and possible omissions of, for example, snacks (Pao and Cypel, 1994).

It is a much used dietary assessment method because it is simple, quick and inexpensive, but it is prone to reporting errors, including biased or inaccurate recalls of food intake and portion sizes. It requires a good methodological knowledge in order to transform the interview data of the dietary intake to nutrients. Applied once, it yields no information on day-to-day variation on food or nutrient intake. Table 2.1.6 shows the strengths and weaknesses of 24- hour recall.-

Food frequency questionnaires (FFQ)

As noted by Sampson (1985), usual dietary intake over an extended period is more pertinent in assessing the relationship of nutrition to chronic disease than is diet on a recent specific day or week.

These questionnaires provide information about how often certain foods or foods from given food groups, were eaten during a time interval in the past, usually day, by either the household or an individual. The questionnaire can be self-administered or be administered through a short personal interview. The food list may range from a few questions to capture intake of selected foods and nutrients, to a comprehensive list to assess the total diet. The frequency responses can be open-ended or multiple choice, ranging from several times per day to number of times per year, depending on the type of food (Axelson and Csernus, 1983).

FFQ can be qualitative with no information on portion size (Axelson and Csernus, 1983), semi-qualitative with standardized portion size estimates (as predetermined by the interview team), or

Table 2.1.5: Strengths and Weaknesses of food record methods (Pao and Cypel, 1994)

Strengths	Weaknesses
1. Respondent does not rely on memory`	1. Respondents must be literate
2. Time period is defined	2. Respondents must be highly cooperative
3. Portions can be measured to increase accuracy	3. Food consumed away from home may be less accurately reported
4. Omission of foods is minimal	4. Habitual eating pattern may be changed or influenced by the recording process
5. For elderly people, records may be more accurate than recalls	5. Requirement for literate respondents may introduce bias as a result of overrepresentation of more highly educated individuals
6. Food intakes are quantified so nutrient contents can be calculated	6. Record keeping increases respondent burden
7. Multiple days may yield a measure of usual intake of a group	7. Increased respondent burden may adversely affect response rates
8. Multiple days provide reliable information about less frequently eaten foods	8. Self- administered records require more callbacks and editing than interviewer administered records
9. Two or more days provide data on intra and inter-individual variation in dietary intakes	9. One day records provide an inadequate indication of usual intake for groups or individuals
10. One day records kept intermittently over the year may provide an estimate of usual intake by an individual	10. Validity of records may decrease as number of days increases

Table 2.1.6: Strengths and Weaknesses of 24 hour Dietary Recall method (Pao and Cypel, 1994)

Strengths	Weaknesses
1. Respondent burden is small	1. Respondent recall depends on memory.
2. Administration time is short	2. Portion size is difficult to estimate accurately.
3. Reliance on memory is minimal	3. Intakes tend to be underreported compared with other methods.
4. Time period is defined	4. Dietary adequacy of an individual's intake cannot be assessed from one day's intake.
5. Food intake can be quantified	5. Trained interviewers are required.
6. Procedure does not alter individuals habitual dietary patterns	6. One-day intakes do not represent usual intake for groups or individuals.
7. Interviewer administration allows probing for omitted foods on incomplete information and fewer callbacks	
8. Response rates are relatively high	
9. A single contact is required	
10. Procedure is often used to evaluate dietary intakes of large groups	
11. Two or more days provide data on intra and inter individual variation in dietary intakes.	
12. Multiple days are necessary to provide reliable data on less frequently eaten foods.	
13. Multiple days may yield a measure of usual intake.	
14. Repeated recalls over a year may provide an estimate of usual intake by an individual.	

quantitative where the respondents estimate portion size (Flegal et al, 1988). When portion sizes are described by the respondents themselves, different measurement aids have been used, such as photographs, drawings or household measures. Portion size information is necessary to quantitatively assess the intake of foods and nutrients. Standard portion sizes greatly simplify the administration and processing of the FFQ.

FFQs have been widely used in large epidemiological studies or to calculate a dietary diversity score which is simply the sum of the number of food groups consumed during the reference period. The larger this number, the more diversified the food intake is. Either the total score or the frequency of intake of foods by standardized food groups can be reported, or both. There is some evidence that the household dietary diversity score is positively correlated with household dietary energy availability, and that the individual dietary diversity score is positively correlated with the adequacy of micronutrient intake of the individual (Pao and Cypel, 1994). Table 2.1.7 shows the strength and weaknesses of food frequency questionnaire.

Validity of Dietary Assessment Methods

Each dietary assessment method has its advantages and limitations, and none of them measure food intake without errors. Independent tests of validity are therefore necessary to understand the relationship between what the method actually assesses and what it intends to measure. This is important for the interpretation of the assessment results. The general model of validation for dietary assessment methods is to compare one method (test method) with another, which is considered more accurate (reference method).

The purpose of validation studies is to identify errors in collected dietary data and to assess their potential impact on assessment findings. A questionnaire's instruction, contents and wording, the skill of the interviewer, and the research setting may all introduce response errors, including inaccurate recalls by the respondent (intentional or unintentional) of foods eaten, of frequency of consumption, and of portion size. Errors can also arise from coding errors and errors in food composition tables. Errors and day-to-day variability in dietary assessments will affect the validity and reproducibility of the measurements (Pao and Cypel, 1994).

Table 2.1.7: Strengths and Weaknesses of Food Frequency methods (Pao and Cypel, 1994)

Strengths	Weaknesses
1. An indication of usual dietary intake may be obtained.	1. Memory of food patterns in the past is required.
2. Highly trained interviewers are not required.	2. Recall period may be imprecise.
3. Method can be interviewer administered or self-administered.	3. Quantification of food intake may be imprecise because of poor estimation of recall of portions or use of standard sizes.
4. Administration may be simple.	4. Respondent burden is governed by number and complexity of foods listed and quantification procedure
5. Customary eating patterns are not affected.	5. Recall of past diets may be biased by current diets
6. Individuals may be ranked or classified by food intake.	6. Heterogeneity of populations influences the reliability of the method
7. Response rates are high.	7. Suitability is questionable for certain segments of the population, such as individuals consuming a typical diets or foods not on the list
8. Respondent burden is usually light.	8. Intakes tend to be over-estimated compared with some other methods
9. Relationship between diet and disease may be examined in epidemiological studies.	9. Validation of the method is difficult

Validity measures the degree to which a method measures what it supposed to measure. Validity is associated with systematic (i.e. non-random) measurement errors, or the tendency of a measurement to produce an average over- or underestimation of what the method is intended to measure, due to systematic response bias. Reproducibility is associated with random error. Random error can be due to random bias in reporting by the same individual on different days. Random errors may cancel each other out, but will increase the variance of estimated mean intake and reduce statistical power (Pao and Cypel, 1994).

High reproducibility of a method does not imply high validity, but a method with lower producibility will also have low validity.

Validity and Reliability of Food Records

Krall and Dwyer (1987) assessed the validity of food diaries by comparing diary reports with weighted portions of foods served in a metabolic research unit and found that ~9% of all food items were omitted. However another study found that the burden of having to weigh foods eaten resulted in a 13% decrease in caloric intakes, on average, compared with intakes from weekly diary records (Kim et al, 1984).

Reliability test by Todd et al (1983) found no significant differences in mean energy or protein intakes derived from data collected by two methods- weighted intakes recorded on tape and estimated food records. Similarly in another study, four sets of 7-d records kept by 173 female nurses during 1 year showed little tendency to change over time period (Willet et al, 1985).

Validity and Reliability of 24 hour Food Recall

Validity of 24 hour dietary recall has been assessed in numerous studies. These studies provide evidence that reporting errors occur, but indications of their direction and extent are not consistent from study to study or from nutrient to nutrient. Investigators found that recalled intakes compared with weighted intakes tended to be overestimated when intakes were low and underestimated when intakes were high (Madden et al, 1976; Linusson et al, 1974). Mean nutrient intakes estimated from 24 hour recalls and 3 day food records were highly correlated and not statistically different (as measured by t test) in a study of vegetarians and non vegetarians (Calkins et al, 1984).

Reliability of 24 hour dietary recall was examined by examining intra and inter-individual variation. Sources of error that affect reliability of this survey method have been pointed out by these researchers (Beaton et al, 1979). The first source of error is inaccuracy in the measurement of dietary intake for a particular day that is due to error in estimating quantities of food eaten or the omission (or inclusion) of food items. A second source of error arises because of a small sample of daily observations is used to estimate the usual or typical intake.

Validity and Reliability of Food Frequency Questionnaire (FFQ)

Willett et al (1985) compared results obtained with a 61 item FFQ with data from four 1 week food records for calorie adjusted intakes of nine nutrients. They concluded that the food frequency method was useful in measuring intake for a variety of nutrients. Pietinen et al (1988) found some nutrient values derived from a 44 item FFQ and from 12 diet records for 2-day periods were generally comparable.

Reliability of food frequency method was assessed in terms of the correlation between two administrations of the instrument. Axelson and Csernus (1983) found a significant correlation of 0.89 between two tests, 6 months apart involving 15 university students. Pietenin et al (1988) demonstrated good reproducibility (correlations of 0.46 – 0.86) for nutrients in three administrations of a food frequency questionnaire to a fairly homogenous group.

Dietary diversity has been used as a simple measure of diet quality, for which there is no standard definition. More comprehensive diet quality indexes have been developed for monitoring the population's adherence to national dietary guidelines.

Healthy Eating Index (HEI)

U.S. Department of Agriculture has developed a healthy Eating Index (HEI), to find out how well the Americans follow the recommended dietary guidelines. The overall index has a total possible score ranging from zero to 100. Each of the 10 dietary components has a scoring range of zero to 10. Individuals with an intake at the recommended level received a maximum score of 10 points. A score of zero was assigned when no foods in a particular group were eaten. Intermediate scores were calculated proportionately. The healthy eating index was applied to the 1989 and 1990 USDA data from the continuing Survey of Food Intake by individuals.

Food Group Components of the Healthy Eating Index (1989)

The healthy eating index examines dietary intake in relation to the five major groups in the Food guide pyramid. A range of servings is shown for the grain group, vegetable group, fruit group, milk group and meat group. The number of recommended servings depends upon an individual's caloric requirements. Recommended servings for calorie levels of 1,600, 2,200 and 2,800 are presented in Table 2.1.8.

For each of the five food group components of the index, individuals who consumed the recommended levels of the servings received a maximum score of 10. A score of zero was assigned to any food group where no items from the category were consumed. Intermediate scores were calculated proportionately to the number of servings consumed. For example, if the recommended level of serving was eight and an individual consumed four servings, the component score for the individual was 5 points. A score of 7.5 points was assigned if six servings were eaten.

In developing the index, serving recommendations from food guide pyramid were interpolated to individuals with other food energy requirements. For example, food energy RDAs for children between 1 and 3 years of age are less than 1,600 kilocalories. The recommended number of servings were retained at the minimum serving level for these children, but the serving size was scaled down to be proportionate with their energy requirements. This approach was consistent with the guidance contained with the food guide pyramid. In contrast adult males between the ages of 15 and 50 years have food energy RDAs slightly greater than 2,800 kilocalories. Instead of slightly increasing the serving sizes, it was decided that food portions for these individuals would be truncated at the maximum levels recommended in the food guide pyramid (Table 2.1.9). It should be noted, based on the preliminary analysis, none of the results from the index were shown to be significantly affected even if a slightly larger serving size were used (USDA, 1992).

Table2.1.9 shows the serving recommendations (USDA) for various age/gender categories.

Table 2.1.8: Recommended Numbers of servings Per Day at Energy Levels Discussed in the Food Guide Pyramid Bulletin (USDA, 1992)

	Number of servings				
Kilocalories	**Grains**	**Vegetables**	**Fruits**	**Milk**	**Meat**
1600	6	3	2	2	2
2200	9	4	3	2	2.4
2800	11	5	4	2	2.8

Table 2.1.9: Recommended Numbers of servings Per Day for Age/Gender Categories at Energy Levels Discussed in the Food Guide Pyramid Bulletin (USDA, 1992)

Age/ Gender Category	Kilocalories	Grains	Vegetables	Fruits	Milk	Meat
Children1-3	**1300**	**6**[a]	**3**[a]	**2**[a]	**2**[a]	2[a]
	1600	**6**	**3**	**2**	**2**	2
Children 4-6	**1800**	**7**	**3.3**	**2.3**	**2**	2.1
Females 51+	**1900**	**7.4**	**3.5**	**2.5**	**2**	2.2
Children 7-10	**2000**	**7.8**	**3.7**	**2.7**	**2**	2.3
Females 11-50	**2200**	**9**	**4**	**3**	**2**[b]	2.4
Males 51+	**2300**	**9.1**	**4.2**	**3.2**	**2**	2.5
Males 11-14	**2500**	**9.9**	**4.5**	**3.5**	**3**	2.6
	2800	**11**	**5**	**4**	**2**	2.8
Males 19-50	**2900**	**11**	**5**	**4**	**2**[b]	2.8
Males 15-18	3000	11	5	4	2	2.8

[a] Portion sizes are reduced for children age 1-3
[b] is 3 for persons age 11 to 24.
RDA levels included in the Food Guide Pyramid Bulletin

Other components of the Healthy Eating Index:

Total Fat

Fat intakes less than and equal to 30 percent of the total calories were assigned a score of 10 points. The scored declined to zero when the proportion of fat to total calories reached 45 percent. Intakes between 30 percent and 45 percent were scored proportionately.

Saturated fat

A score of 10 points was assigned to saturated fat intakes at less than 10 percent of total calories. Zero points were assigned when the saturated fat intake reached a level of 15 percent of the total calories. Scores between the two cutoff values were calculated proportionately.

Cholesterol

A maximum point value for cholesterol was assigned when intake was at the level of 300 milligrams or less. Zero points were assigned when intake reached a level of 450 milligrams or more. Values between the two cutoff points were scored proportionately.

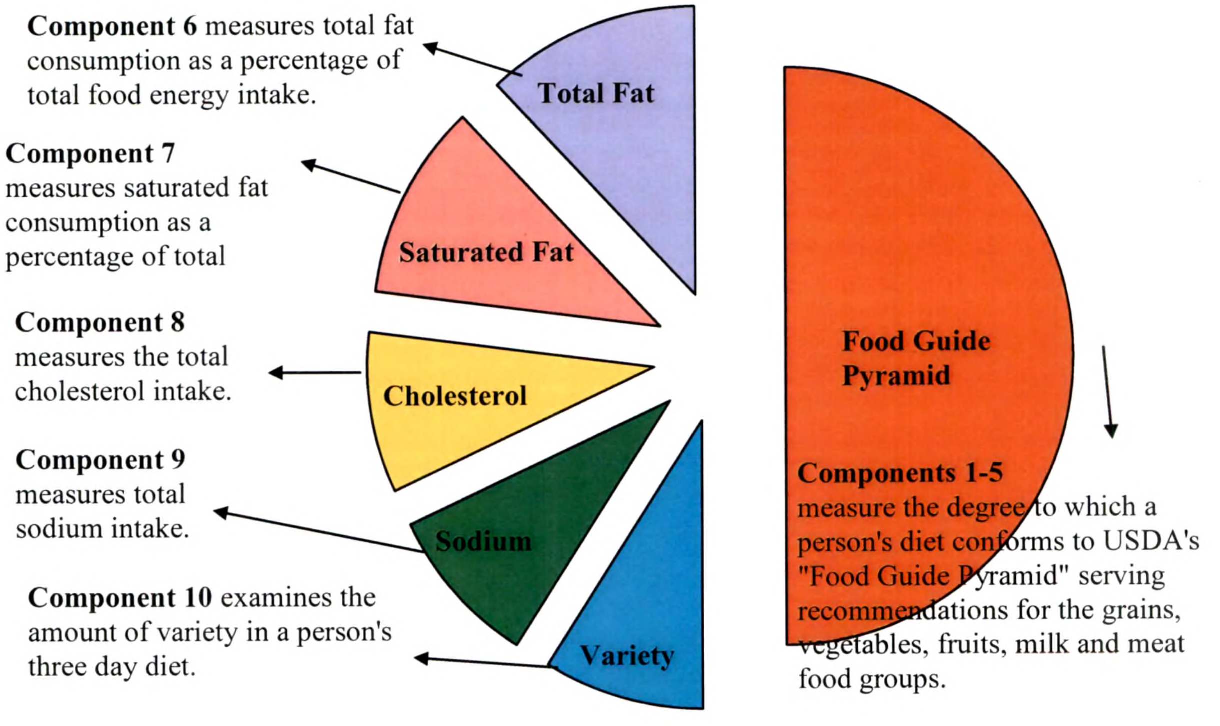
Sodium

A maximum score for sodium was assigned at an intake level of 2,400 milligrams or less. Zero points were assigned at a level of 4,800 milligrams or more. Scores between the two levels of intake were scored proportionately.

Variety

Dietary variety was assessed by totaling the number of "different" foods eaten by an individual in amounts sufficient to contribute at least one-half of a serving in a food group. Similar foods were grouped together and counted only once in measuring variety. Food mixtures were broken down into their component ingredients and assigned to the relevant food groups. Index scores for variety were calculated in a manner analogous to the method used for the other index components. Cutoff scores for variety were defined based on 3 days of recorded data. A maximum score was given if 16 or more different food items were consumed over a 3 day period. A score of zero was given if six or less different items were eaten. When based on 1 day of reported data, the cutoff scores for variety were reduced by a factor of two. Intermediate intakes were calculated proportionately. Figure 2.1.4 shows the components of HEI- 89.

Figure 2.1.3: Food group components of the Healthy Eating Index (1989)



Advantages of the HEI (1989)

- **The index provides a standard for assessing overall dietary quality**

  Based on the most current scientific information available, including the Dietary Guidelines for Americans published by USDA and DHHS, and the Food Guide Pyramid, the Index was developed to provide a single summary measure of dietary quality. The Index was based on the five major food groups from the Food Guide Pyramid and the Dietary Guidelines. The Index is a practical standard for assessing dietary quality. The Index correlates well with other conventional measures of diet quality.

  Comparisons with RDA levels confirm a positive correlation between the Index and individual nutrient intake levels. Higher Index scores are associated with improved nutrient intakes.

- **The Healthy Eating Index reflects the complexity of dietary patterns**

  Ten dietary components comprise the Index. All 10 components contribute evenly to the overall Index score. Doing well on one component does not ensure a high score on the overall Index. Overall dietary quality is reflected in the total Index score and is not determined based on any individual component score. Using one component score, such as percent of calories from fat, as an indicator of dietary quality can result in misclassifications.

- **The results of the index are useful in targeting nutrition education and health promotion activities.**

  Results of the Index provide insights into the types of dietary changes needed to improve eating patterns. The Schools Meals Initiative for Healthy Children ensures that the nutrition standards for school meals meet the dietary guidelines. This is complemented by Team Nutrition (USDA) which focuses on empowering children to make food choices for healthful diets. Targeted strategies for nutrition promotion are also needed. Results of CSFI – HEI research suggest that individuals from low-income households and less-educated people are more likely to score lower on the Healthy Eating Index. Therefore, USDA tries to integrate nutrition into all of the food assistance programs.

- **The Healthy Eating Index is a single summary measure of diet quality that can be used to monitor changes in food consumption patterns over time.**

  The Index was applied to the 1989 and 1990 CSFII (Continuing Survey of Food Intake I) data to evaluate the overall quality of American diets. Average scores for the overall Index for both years were approximately 64 percent, a score judged as "Needs Improvement." HEI values were similar for both years, indicating that dietary intake does not vary greatly from year to year. USDA uses the Index as one method to monitor changes in dietary patterns in the United States population over time. The Index is periodically published.

- **The index could provide the basis for development of a variety of additional tools.**

  The Healthy Eating Index provided one instrument that has been useful in monitoring trends in U.S. consumption patterns over time. This provided policy makers with the capability of revising and fine-tuning specific programs in a more timely manner to be responsive to the changing nutrition profile of the population. Based on HEI, the IHEI (Interactive HEI) was developed by USDA to increase awareness of diet quality and to promote healthful eating habits. The IHEI provides an immediate feedback via scoring options and targeted nutrition education messages. It was the intention of the USDA Center for Nutrition Policy and Promotion to begin developing a consumer-oriented, self-assessment guide following the public release of the Healthy Eating Index (Hiza and Gerrior, 2002).

The Index scores for weighted 1989 and 1990 CSFII data were stratified by selected indicators. The mean Index scores for the five indicators analyzed were sex, age, head of household, educational level, and income.

Results showed that females had a higher average Index than males. People in the younger and older age groups had a higher Index than those in the middle age groups. Individuals living in either joint family or female-headed house- holds had a higher Index than individuals living in male-headed households. Index scores generally increased with increasing levels of education. Average Index scores were highest for individuals having 4 or more years of college education. The Index generally responded more to increases in education than increases in income. People who had a better Healthy Eating Index score were more likely to have a better nutrient intake (USDA 1995).

Trends in the Healthy Eating Index 1990, 1996 and 2000

The diets of Americans have slightly, but significantly, improved since 1989 to 1999-2000, but have not changed since 1996. In all three periods, the average HEI score indicated that the diets of most Americans needed improvement. In 1989, the HEI score for all people 2 years old and over was 61.5, compared with 63.8 in 1996 and 1999-2000 a 4 percent increase (Basiotis et al 2002). Scores increased for all HEI components from 1989 to 1996, except for milk, meat, and sodium. Scores improved the most for the saturated fat and variety components of the Index (Bowman et al 1998).

A comprehensive model was developed to measure the extent that nutrition knowledge and diet-health awareness, among other factors, influence an individual's HEI. This was the first study that rigorously attempted to examine variation in the index across population groups by controlling for personal and household characteristics and nutrition information levels, as well as test for the endogeneity of nutrition information. Results indicated that one's level of nutrition information has an important influence on one's HEI and that nutrition information and the HEI are simultaneously determined. Other factors explaining variations in HEI's across individuals were income and education levels, race, ethnicity, and age. Evidence supports the hypothesis that higher education promotes more healthful food choices through better acquisition and use of health information (Variyam et al 1998).

HEI scores generally increased as the level of income and education increased. People with household income 50 percent of the poverty threshold or below had an average HEI score of 60. By comparison, people with household income over three times the poverty threshold had an average HEI score of 65. Whites had a higher average HEI score than African Americans had for 1994-96 (64 vs. 59). By region, people who lived in the Northeast had the highest HEI score, an average of 65 for 1994-96, and those who lived in the South had the lowest score, an average of 62. People who lived in an urban area (a Metropolitan Statistical Area in or outside a central city) also had a slightly higher HEI score. This could be because average income, which is an indicator of one's ability to purchase food, is lower in nonurban than in urban areas (Bowman et al 1998).

School-age children did better in meeting the recommendations for dairy, grains, meats, and variety than for fruits and vegetables. They scored 3.7 on fruits and 4.4 on vegetables, compared with 7.2 on dairy and 7 on grains. Children of different income levels scored similarly their consumption of food components, with the exception of the meat component. Meat-component scores for the lowest income children were higher than the meat-component scores for other children. Looking at the four nutrient components, children scored best in cholesterol (8.3 HEI score) and worst in saturated fat (5.5 HEI score). The only significant difference was found in total-fat consumption, with the higher income children scoring higher than the lowest income children (6.9 vs. 6.5) (Biing- Lin 2005).

Both HEI and Youth Healthy Eating Index (YHEI) scores from a food frequency questionnaire were calculated by Feskanich et al (1996). Girls (n=8,807) and boys (n=7,645) 9 to 14 years of age who resided across the United States were the participants. Mean HEI and YHEI scores were calculated by sex and age, and associations with age, body mass index, activity, inactivity, energy intake, and several nutrients were assessed with Pearson correlations. Linear regression was used to examine the contributions of the individual HEI and YHEI components toward the total scores. Results showed that HEI score were highly correlated with total energy intake (r =0.67), indicating a strong association with quantity of food consumption. In contrast, the YHEI was not strongly correlated with energy intake (r =0.12) but was inversely associated with time spent in inactive pursuits (r =-0.27). The HEI component for variety in food selection accounted for 60% of the variation in the total score and several HEI components were highly correlated with each other, particularly those for total and saturated fat (r =0.78).

Weinstein et al 1995, assessed the HEI, as a measure of dietary status through its correlation with nutritional biomarkers and to identify those biomarkers most associated with diet quality and healthful food intake patterns in >17 years adults. Results showed that HEI score were positively correlated with serum (r=0.25) and red blood cell (r=0.27) folate, serum vitamins C (r=0.30) and E (r=0.21), and all serum carotenoids except lycopene (r=0.17 to 0.27).

Guo et al (2004) found that a low HEI score was associated with overweight and obesity. There was a graded increase in the odds ratio of obesity across the HEI category after adjusting for age, gender, race/ethnicity, physical activity, smoking, alcohol use, income, and education.

McCullough et al (2000) stated that the HEI-f (HEI based on food frequency questionnaire) was weakly inversely associated with risk of major chronic disease (comparing highest with lowest quintile of the HEI-f, relative risk (RR = 0.89; $P < 0.001$). The HEI-f was associated with moderately lower risk of cardiovascular disease (RR = 0.72; $P < 0.001$) but was not associated with lower cancer risk in men.

Development of the HEI – 2005

Center for Nutrition policy and Promotion (CNPP) convened an interagency Working Group to begin the process of revising the HEI. The working group reviewed the original HEI and its uses.

The Working Group decided to base the revised index on the food patterns found in USDA's food guidance system, now called MyPyramid, which translates key recommendations in the 2005 Dietary Guidelines for Americans into specific, quantified dietary recommendations (Britten, Marcoe, Yamini, & Davis, 2006). Collectively, these documents specify amounts to consume from each of the major food groups and from oils and provide recommended limits for sodium, saturated fat, and discretionary calories. In addition, they advise that at least half of grain intake should be whole grain, recommend specific amounts of several vegetable subgroups, and suggest that less than half the fruit consumed should be juice. A subgroup of the HEI Working Group further developed the components of the index, constructed the scoring and weighting protocol, developed the evaluation plan, conducted the analyses, presented findings to the full Working Group, and held briefings for wider audiences.

The components of the HEI-2005 represent all of the major food groups found in MyPyramid- Total Fruit; Total Vegetables; Total Grains; Milk, which includes soy beverages; and Meat and Beans, which includes meat, poultry, fish, eggs, soybean products other than beverages, nuts, seeds, and legumes.

Additional components represent Whole Fruit (i.e., forms other than juice); Dark Green and Orange Vegetables and Legumes; Whole Grains (which must include the entire grain kernel, bran, germ, and endosperm); Oils (non-hydrogenated vegetable oils and oils in fish, nuts, and seeds); Saturated Fat; Sodium; and Calories from Solid Fat, Alcohol, and Added Sugar (SoFAAS). Whole Fruit was added because the 2005 Dietary Guidelines suggest limiting juice to less than half of total fruit intake. A new component was added for Dark Green and Orange Vegetables and Legumes because those are the three subgroups of vegetables for which current intake is furthest from recommended levels. The Whole Grains component was added because the2005 Dietary Guidelines specify that at least half of grain intake should be whole grain. New components were added for Oils to reflect the recommendations for oil found in MyPyramid and for Calories from SoFAAS, which serves as a proxy for discretionary calories and is described further below. Like the original, the HEI-2005 also includes components for Saturated Fat and Sodium (Table 2.1.10).

The components do not necessarily directly represent foods as eaten. For example, all components include foods that are ingredients in mixed foods. Whole Grains include only the whole-grain portions of foods that contain both whole and refined grains. Only the lowest fat portions of milk and meat products are included in the Milk and Meat components, respectively. The fatty portions of milk and meat products count as Solid Fat; whereas, the fatty portions of fish, nuts, and seeds count as Oils as do non-hydrogenated vegetable oils. Alcohol includes beer, wine, and distilled spirits consumed as beverages, but not as ingredients in mixed dishes.

Standards for the development of HEI – 2005

Density Standards

HEI – 2005 was chosen to represent intakes of foods and nutrients on a density basis, that is, as amounts per 1,000calories of intake. In MyPyramid, the recommendations for the amounts of food groups, oils, and discretionary calories were expressed in terms of absolute amounts that vary according to energy level (Britten et al., 2006). Thus, if an HEI standard were an absolute amount, that amount would also have to vary according to energy level. However, on a density basis, many of the recommendations are similar across energy levels (Table ()). For saturated fat and sodium, a density standard was easy to derive. The saturated fat recommendation in the Dietary Guidelines is the same for all individuals and is given on a density basis—less than 10 percent of energy. The sodium recommendation in the Dietary Guidelines is derived from the Dietary Reference Intakes(DRI) (Institute of Medicine [IOM], Food and Nutrition Board, 2004)

Table 2.1.10: Original Healthy Eating Index (HEI) and Healthy Eating Index-2005 (HEI-2005) components and standards for scoring

Component	Score 0	5	8	10	20
Original HEI					
Total Fruit	0 ↔			2-4 servings (approx. 1-2 cups[1])	
Total Vegetables	0 ↔			3-5 servings (approx. 1.5-2.5 cups[1])	
Total Grains	0 ↔			6-11 servings (approx. 6-11 oz eq[1])	
Milk	0 ↔			2-3 servings (2-3 cups[2])	
Meat (and Bens)	0 ↔			2-3 servings (approx. 5.5-7.0 oz eq[1])	
Sodium	≥4.8 ↔			≤ 2.4g	
Saturated Fat	≥ 15 ↔			≤ 10% energy	
Total Fat	≥ 45 ↔			≤ 30% energy	
Cholesterol	≥ 450 ↔			≤ 300 mg	
Variety	≤ 6 ↔			≥ 16 different foods in 3 days[3]	
HEI-2005[4]					
Total Fruit	0 ↔	≥ 0.8 cup eq/1000 kcal			
Whole Fruit	0 ↔	≥ 0.4 cup eq/1000 kcal			
Total Vegetables	0 ↔	≥ 1.1 cup eq/1000 kcal			
Dark G & O veg & legumes*	0 ↔	≥ 0.4 cup eq/1000 kcal			
Total Grains	0 ↔	≥ 3.0 ozeq/1000 kcal			
Whole Grains	0 ↔	≥ 1.5 ozeq/1000 kcal			
Milk	0 ↔			≥ 1.3 cup eq/1000 kcal	
Meat and Beans	0 ↔			≥ 2.5 ozeq/1000 kcal	
Oils	0 ↔			≥ 12 g/1000 kcal	
Saturated Fat	≥ 15 ↔		10 ↔	≤ 7% energy	
Sodium	≥ 2 ↔		1.1 ↔	≤ 0.7g/1000 kcal	
Calories from SoFAAS[5]	≥ 50 ↔				≤20%energy

[1]According to gender and age.
[2]According to age.
[3]In 1994-96 and 1999-2000, 8 or more different foods in 1 day.
[4]See Appendix 1: Foods included in components of the Healthy Eating Index-2005.
[5]Solid Fat, Alcohol, and Added Sugar.
* G – Green & O-Orange

and, although the sodium DRIs are stated as absolute amounts that varies by age group, they were derived by using a density approach. That is, recommendations for younger and older persons were set at proportionately lower levels because their average energy intakes are lower. Each of these recommendations was sufficiently similar across levels of energy intake, when expressed on a density basis, thus a scoring system based on densities was the best approach.

Density standards have the advantage of being independent of an individual's energy requirement, which is difficult to measure precisely. Consequently, this obviates the need to assign individuals to one of the 12 calorie levels found in MyPyramid (Britten et al., 2006). In effect, the density approach to setting standards allows the assessment of the quality of the mix of foods consumed, rather than the absolute amounts of foods consumed.

Food-group-based Components

For the nutrient adequacy components (food groups and oils), focus was on the 1,200- to 2,400-calorie patterns because they were used to ensure nutrient adequacy when MyPyramid was constructed. Among these, the lowest amount per 1,000 calories (that is, the least restrictive or easiest to achieve) was selected as the standard for the maximum score for each of these components. For the discretionary calories component, the least restrictive amount across all the patterns was selected; but in this case, that was the greatest amount on a per calorie basis.

For Fruits, Vegetables, Grains, Whole Grains, Milk, Meat and Beans, and Oils, the standards are the lowest amounts recommended in the patterns, expressed on a per 1,000 calorie basis. For Whole Fruit, the standard is simply half the standard for Total Fruit because the 2005 Dietary Guidelines for Americans suggest that the majority of fruit intake should be whole fruit rather than fruit juice. For Dark Green Vegetables, Orange Vegetables, and Legumes, the recommendations found in MyPyramid are expressed on a weekly basis. To develop the standards, it was converted to a daily basis. The standard is the sum of the daily recommendations for those three subgroups of vegetables, expressed on a per 1,000 calorie basis. Any combination of them counts toward meeting the vegetable subgroup standard with one exception. As is the case in MyPyramid, legumes are counted as vegetables only after the Meat and Beans standard has been met (USDA, CNPP, 2005).

Saturated Fat and Sodium Components

In the Dietary Guidelines, the recommendation for saturated fat is not expressed as a single value, but rather as less than 10 percent of energy intake. This does not clearly indicate which, if any, value less than 10 percent might be the optimal level, so other guidance was looked for where to set the standard. The Dietary Guidelines for Americans 2005 highlights two exemplary food guides as being consistent with its guidance, MyPyramid, developed by CNPP, and the Dietary Approaches to Stop Hypertension (DASH) Eating Plan, developed by the National Heart, Lung, and Blood Institute (NHLBI). The examples of these guides in this report have saturated fat levels of 7 to 8 percent of energy (HHS & USDA, 2005). Both the Dietary Guidelines Advisory Committee and the Food and Nutrition Board of the Institute of Medicine (IOM) have recommended that saturated fat consumption be as low as possible, suggesting that lower is better (Dietary Guidelines Advisory Committee, 2004) (IOM, Food and Nutrition Board, 2005). The DASH plan aims for 7 percent, and the 2006 American Heart Association (AHA) guidelines call for 7 percent or less (Lichtenstein et al., 2006). Based on these sources, 7 percent of calories were chosen as the standard for the maximum score of 10 for the Saturated Fat component. It was decided to recognize the Dietary Guideline by assigning a score of 8 to the level of 10 percent of calories.

The Dietary Guidelines recommendation for sodium for most individuals is "less than 2,300 mg/day," but for individuals with hypertension, blacks, and middle-aged and older adults, the recommendation is "no more than 1,500 mg/day." These values represent the Upper Limit (UL) and Adequate Intake (AI) levels, respectively, set by the Food and Nutrition Board (IOM, Food and Nutrition Board, 2004). In light of these recommendations, 1,500 mg was chosen as the basis for the maximum score of 10 and 2,300 mg as the basis for the relatively good score of 8 for the Sodium component (Table 2.1.11).

To express the sodium standard as a density, the same approach used to set the DRIs (Dietary Reference Intakes) for older adults and children was used. The DRI panel divided the DRIs that was set for young and middle-aged adults by the estimated median energy intake for that age group (2,150 calories per day) and then used those same densities (mg of sodium per calorie) to set the DRIs for younger and older individuals. The density standards were calculated the same way. The highest possible score of 10 is assigned to diets that have less than 700 mg of sodium per 1,000 calories (1,500 mg sodium (AI)/2,150 calories), and a score of 8 is assigned to 1,100 mg of sodium per 1,000 calories (2,300 mg sodium (UL)/2,150 calories).

Discretionary Calories Component

The 2005 Dietary Guidelines Advisory Committee presented the concept of "discretionary calories," defined as the "difference between total energy requirements and the energy consumed to meet recommended nutrient intakes" (Dietary Guidelines Advisory Committee, 2004). The Dietary Guidelines further explain, "At each calorie level, individuals who eat nutrient-dense foods may be able to meet their recommended nutrient intake without consuming their full calorie allotment. The remaining calories—the discretionary calorie allowance—allow individuals flexibility to consume some foods and beverages that may contain added fats, added sugars, and alcohol" (HHS & USDA, 2005). Added fats or sugars per se are not directly limited. Rather, the allowance is a defined number of discretionary calories, and these calories may come from any mix of solid fat, added sugar, alcohol, or additional amounts of nutrient-rich foods beyond the recommended levels.

Nonetheless, the population generally consumes more calories from solid fat, added sugar, and/or alcohol than the allowance permits (Basiotis, Guenther, Lino, & Britten, 2006). In effect, these calories displace those needed to obtain the recommended amounts of the food groups and oils. Because of this imbalance, it was decided by the Technical committee to develop a component that captured specifically the Calories from Solid Fat, Alcohol, and Added Sugar (SoFAAS). This approach is consistent with the objective to capture the mix of foods eaten (Guenther, 2007).

Calories from SoFAAS is not intended to be a measure of solid fat, alcohol, and/or added sugar per se, but rather a measure of the calories in the diet that are obtained from dietary constituents other than nutrient-dense foods. The standard for the maximum score is the least restrictive, or easiest to achieve, of all the discretionary calorie allowances found in MyPyramid, 20 percent of calories.

Table 2.1.11: Recommended amounts of Food Groups, expressed per 1,000 Kcal, and discretionary calorie allowances, expressed as a percentage of total calories, found in MyPyramid

Food Group	Calorie Level											
	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
Fruits (cup eq/1000Kcal)	1	0.8	1.1	0.9	0.8	1.0	0.9	0.8	0.8	0.9	0.8	0.8
Vegetables (cup eq/1000Kcal)	1	1.3	1.1	1.2	1.4	1.3	1.4	1.3	1.4	1.3	1.3	1.3
Dark Green Vegetables	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1
Orange Vegetables	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Legumes	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Starch Vegetables	0.2	0.3	0.3	0.2	0.2	0.2	0.4	0.4	0.4	0.4	0.4	0.4
Other Vegetables	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.4	0.5	0.4	0.5	0.5
Grains	3	3.3	3.6	3.1	3.3	3	3.2	3.3	3.5	3.6	3.3	3.1
Whole Grains (ozeq/1000Kcal)	1.5	1.7	1.8	1.9	1.7	1.5	1.6	1.7	1.7	1.8	1.7	1.6
Other Grains	1.5	1.7	1.8	1.3	1.7	1.5	1.6	1.7	1.7	1.8	1.7	1.6
Milk (cup eq/1000Kcal)	2	1.7	1.4	1.9	1.7	1.5	1.4	1.3	1.2	1.1	1	0.9
Meat and Beans (ozeq/1000Kcal)	2	2.5	2.9	3.1	2.8	2.8	2.7	2.7	2.5	2.5	2.3	2.2
Oils (g/1000Kcal)	15	14.0	12	14	13	14	13	13	13	13	15	16
Discretionary Calories (%)	16.5	14.3	12.2	8.3	10.8	13.4	13.2	15.1	15.8	15.2	17.1	20.3

Application of HEI - 2005

The HEI-2005 can be used for a variety of purposes, including population monitoring; nutrition education; evaluation of nutrition interventions; epidemiologic research; economic research; and other types of research. USDA's major application is to monitor the diet quality of the U.S. general and low-income populations (USDA, 2006). CNPP plans to include the HEI-2005 in a future update of MyPyramid Tracker, the Center's dietary assessment and nutrition education tool (USDA, CNPP, 2006).

Other measures of interest may be used in conjunction with the HEI-2005 for research purposes. Anthropometric measures, such as BMI and waist circumference, can be used to evaluate the appropriateness of the level of longer term energy intake and to provide a more complete picture of nutritional status.

The HEI-2005 is a measure of diet quality as described by the key diet-related recommendations of the 2005 Dietary Guidelines. It has a variety of potential uses such as firstly, monitoring the diet quality of the US population and subpopulations, secondly, evaluation of interventions, and research. (Guenther et al 2005).

Validation of HEI - 2005

The psychometric analysis confirmed that the individual components of the HEI provide additional insight to that of the total score. The HEI-2005 has several types of construct validity, as demonstrated by the ability to distinguish between groups with known differences in diet quality, the independence of diet quality and diet quantity as measured by energy intake, and the ability to detect differences among individuals as shown by the distributions of scores. Most important, the HEI-2005 has content validity, including face validity. It is a valid reflection of the key recommendations of the 2005 Dietary Guidelines for Americans (Guenther et al, 2007).

USDA report 2008 on Healthy Eating Index (HEI- 2005)

The quality of diets consumed by Low-Income and Higher Income Americans in 2003-04 was determined using the Healthy Eating Index-2005. The HEI-2005 assesses the quality of the relative proportions of foods consumed rather than the quantity of foods consumed (Guenther, Reedy & Krebs-Smith 2008; Guenther, Reedy, Krebs-Smith & Reeve 2008).

The HEI-2005 scores were estimated using 1 day of dietary intake data provided by 8,272 participants in NHANES 2003-04. Dietary components assessed by the HEI-2005 were estimated using the population ratio method; that is, the total amount of each dietary component consumed by the population was divided by the population's total energy intake and the HEI scores were then calculated.

Differences in estimated scores between income levels were considered to be significant when the probability that the true scores were actually the same for both groups was less than .05. Results showed that in 2003-04, HEI-2005 component scores for the U.S. population ages 2 and older were below the maximum possible score for every component, except for Total Grains and Meat and Beans. The total score was 57.5 out of a possible 100. Scores were particularly low (less than half the maximum score) for Dark Green and Orange Vegetables and Legumes, Whole Grains, Sodium, and Calories from SoFAAS.

Although the average HEI-2005 total scores of the low-income and higher income populations were not significantly different (56.5 and 57.8, respectively), important differences were found in several component scores. People in low-income families had significantly lower component scores for Total Vegetables, Dark Green and Orange Vegetables and Legumes, and Whole Grains than did higher income families. People in low-income families, compared with their counterparts, however, had a significantly higher component score for Sodium, which indicates lower intakes of sodium and, thus, greater compliance with the dietary guideline. There also was no significant difference in total HEI-2005 scores for children ages 2 to 18 years old by family income level (56.4 for children in low-income families; 55.4 for children in higher income families).

The only significant difference between children in the two groups was that low-income children had a higher score for Total Vegetables. This may reflect low-income children's greater participation in the National School Lunch Program. However, for both income groups of children, HEI-2005 component scores were below their maximums for all components except Total Grains.

The Youth HEI (YHEI) is an adaptation of the HEI for use with children and adolescents. Hurley, et al 2008 compared HEI and YHEI scores among adolescents at risk for chronic disease and compared associations between the scores and health indicators. This cross-sectional study included 2 low-income, urban African American adolescent samples. HEI and YHEI scores were calculated from a FFQ and compared with BMI, body composition, and micronutrient, energy, and dietary intakes. Result showed that YHEI scores were lower than HEI scores across adolescent samples.

Females had higher HEI scores than males(P< 0.05), but there was no gender difference in YHEI scores.HEI and YHEI scores were associated with higher micronutrient and total energy intakes. In conclusion, many adolescents were consuming diets that placed them at risk for developing chronic disease. Although both the HEI and YHEI are useful in assessing diet quality, the HEI was inversely associated with body composition, a predictor of chronic disease, and accounts for gender differences in the Dietary Guidelines, whereas the YHEI discounts nutrient-poor, energy-dense foods.

Based on Spearman's correlation, significant inverse associations were found between dairy, cholesterol, fruit, grain, sodium, variety, and total HEI's with DFS and DFT for permanent teeth. In contrast, a significant positive association was found between meat HEI and both DFS and DFT for permanent teeth in children between 2 to <17 years of age (Nunn et al, 2004).

Nunn et al (2009) reported that children (2-5 years) with the best dietary practices (uppermost tertile of the HEI) were 44% less likely to exhibit severe early childhood caries (ECC) compared with children with the worst dietary practices (lowest tertile of the HEI).

After examining the diets of children aged 2 to 17 years, by analyzing their Healthy Eating Index-2005 (HEI-2005) component and total scores, as estimated from the National Health and Nutrition Examination Survey, 2003-04 (NHANES), Fungwe et al (2009)concluded that the diets of children ages 2 to17 years need improvement. Particularly, children need to increase the consumption of whole fruit, whole grains, and dark green and orange vegetables and legumes. On the other hand, children need to decrease their consumption of saturated fat, sodium, and extra calories from solid fats and added sugars.

Food Behaviour Checklist

Blackburn et al (2006) developed a short food behavior checklist (FBC) to evaluate the impact of nutrition education on fruit and vegetable intake among ethnically diverse women in the Food Stamp Nutrition Education Program (FSNEP)and the Expanded Food and Nutrition Education Program (EFNEP). To validate the FBC, interviewers collected three 24-hour dietary recalls as well as responses to 11 FBC behavioral questions about fruits and vegetables from 100 English-speaking, low-income women at baseline. A randomly selected subgroup (n = 59)provided a blood sample for analysis of total serum carotenoids at baseline and follow-up. After 6 hours of nutrition education, the treatment group reported significant improvements in three of the seven FBC questions related to fruit and vegetable intake, while no significant changes occurred in the control group. All seven FBC questions were significantly correlated with total serum carotenoids.

This short, culturally neutral FBC is a valid and reliable indicator of fruit and vegetable consumption. Compared with the 24-hour dietary recall, it is also less time-consuming to administer code and analyze, with a reduced respondent burden.

Strategies to Combat Malnutrition

Undernutrition, vitamin and mineral deficiencies, obesity and diet-related chronic diseases exist side by side in many countries. Whether food supplies are scarce or abundant, it is essential that people know how best to make use of their resources to ensure nutritional wellbeing. To be adequately nourished, individuals need to have access to sufficient and good quality food and they need an understanding of what constitutes a good diet for health, as well as the skills and motivation to make good food choices (FAO, 2010).

The causes of malnutrition are predictable and preventable and can be addressed through affordable means. Practical measures that address the immediate causes of child under nutrition include a health, hygiene, nutrition education and promotion, fortification, micronutrient supplementation, parasite control measures; and situation-specific household food security interventions (Stephenson et al 1993).

Fungwe et al (2009) stated that nutrition education efforts for children should focus on increase in the consumption of whole fruit, whole grains, and dark green and orange vegetables and legumes, preferably starting at a young age.

Nutrition education is a key element to promoting lifelong healthy eating and exercise behaviours and should start from the early stages of life. Food habits are complex in nature and multiple conditioning factors interact in their development. Young children do not choose what they eat, but their parents decide and prepare the food for them. As children grow and start school, teachers, peers and other people at school, together with the media and social leaders, become more important. Progressively children become more independent and start making their own food choices. The peer group is very important for adolescents and has a major influence in developing both food habits and lifestyles. Community trials suggest that nutrition education is an accessible effective tool in health promotion programmes with a focus on the development of healthy eating practices (Rodrigo and Aranceta, 2001).

Nutrition Communication – History and Definition

Nutrition communication evolved from primarily face to face instruction in non-formal health clinic settings in the 1950s and 60s, to a social marketing approach in the 1970s that incorporate market research methodologies and mass media. In the 1980s, new research techniques were incorporated that have proved to be especially useful in identifying behaviours susceptible to modification and in formulating specific messages (Lediard, 1991).

Defining Nutrition Communication

Gillespie (1981) defined nutrition communication as persuasive communication that attempts to change nutrition knowledge, attitudes and practices. According to Gussow and Contento (1984) nutrition communication is a process which, through education, communication and education related research, tries to promote the nutritional well being of people.

General Considerations for Nutrition Education

Nutrition education involves teaching the client about the importance of nutrition, providing educational materials that reinforce messages about healthy eating, teaching adolescents skills essential for making dietary change, and providing information on how to sustain behavior change. Information gathered during nutrition screening or assessment will provide the necessary information on which nutrition issues need to be addressed during nutrition education and counseling sessions. Prior to beginning the education process, it is helpful to assess what the adolescent already knows about nutrition, how ready they are to adopt new eating behaviors, and if there are any language or learning barriers that may need to be addressed in order to facilitate the nutrition education process (Stang and Story, 2005).

Stages of Change

There are eight stages in behaviour change (Figure 2.1.5) that will help the people change from being an uninformed person to becoming someone who may even be able to teach or influence others about their behaviour (AED, 2005)

Step 1 Pre-awareness: At this stage people are not even aware of the changes that they need to make. In order to help them become a person who has awareness, information is needed.

Nutrition education would stop at this stage without making sure that the person being educated has changed their action, practice or behaviour.

Stage 2 Awareness: At this stage, the person has heard about the need to change their behaviour, but needs extra help and persuasion to start to actually bring about the changes.

Stage 3 Contemplation: This person is contemplating (thinking) about changing their behaviour, but needs more information and continued support and persuasion about the advantages and disadvantages of changing their behaviour.

Stage 4 Intention: At this stage the person has understood the advantages and disadvantages of changing their behaviour but is not sure how they can bring about the new behaviour for themselves. The person needs encouragement to overcome obstacles of how to do the new behaviour.

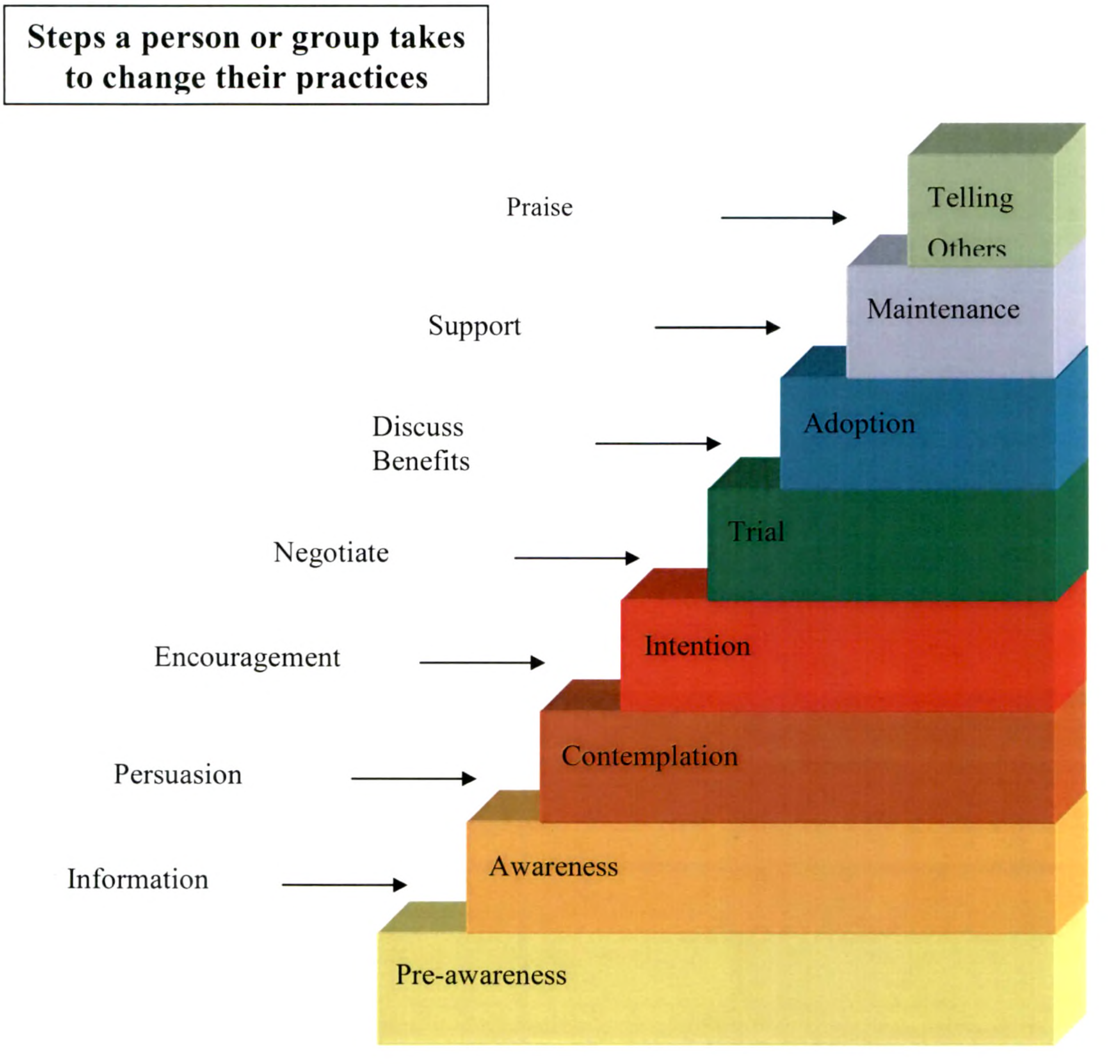
Stage 5 Trial: The person has tried the behaviour or action required, but has faced difficulties. At this time the skills of negotiating the different options will be important.

Stage 6 Adoption: At this stage, the person is demonstrating the new behaviour. They now need discussion to reinforce their behaviour and sustain the change they have made. They can be helped by encouraging and praising for the change in behaviour.

Stage 7 Maintenance: The person's behaviour by this stage has changed and they understand the benefits of the change. Now they just need support for overcoming any difficulties faced.

Stage 8 Telling others: The person has done the behaviour for a considerable length of time, it has become routine behaviour and now leads to the person convincing others about the benefits of their health related behaviour. What the person needs at this stage is praise.

Figure 2.1.4: Stages of Behaviour Change. (Linkages Project/ AED Ethiopia, 2005)



Role of Nutrition Communication Program in Behaviour Change

Singhal et al (2009) reported significant improvements in the several domains of knowledge among the intervention group in a study on adolescents in North India. In the intervention group, significantly lower proportion of children consumed aerated drinks (15.1%; P<0.001) and energy-dense unhealthy foods (8.9%; P=0.03), whereas significantly higher proportion brought tiffin (packed lunch) to school (14.9%; P=0.004) and brought a fruit in their tiffin (30.7%; P<0.001) as compared with the control group. Thus, a multi-component model of nutrition and lifestyle education was successful in improving the nutrition-related knowledge, eating habits and lifestyle practices of the Asian Indian adolescents.

Significant increase in the daily intake of all nutrients especially vitamins and minerals was observed by Kaur et al (2007) among adolescents in Punjab, after a series of lecture cum discussions in classrooms, using charts leaflets, poster and demonstrations.

Iyer and Venugopal (2004) reported improvements in physical activity levels, knowledge scores, dietary intake pattern and breakfast consumption among adolescents in urban Vadodara after imparting nutrition health education through posters and leaflets.

Improved nutrition knowledge and increased intake of nutrient rich food items was reported after a nutrition health education programme using interpersonal communication, posters and information booklets among adolescents girls in Hyderabad and Secunderabad (Saibaba et al, 2002).

Ramanna et al (2001) found improvement in nutrition knowledge of adolescent girls as well as behavioral pattern envisaged by better cooking methods after imparting knowledge through interpersonal communication, posters, information booklets, innovative games and nutritious meals.

Agarwal and Kanani (1998) reported a commendable impact of NCP on not only knowledge gain and behavioral changes, but on improvement in the nutritional status as well. Primary school age provides an ideal time to prepare children to assume primary responsibility for their own and their community's health. School children in India are most often first generation learners and can be trained to be 'change agents' of the community (Vir, 1987).

In India, a health education program was carried out in Tamil Nadu covering 10,000 children and 120 school teachers in 1984. The program was found effective in imparting a basic understanding to school children regarding health and practices conducive to health and in inculcating healthy habits in children. Many parents reported that their children showed significant improvement in their personal hygiene and in their concern for a healthy environment (Saminathan, 1986).

Integrating Qualitative and Quantitative Research for Nutrition Communication Programs

Both qualitative and quantitative tools are valuable for designing, implementing and evaluating nutrition communication programs. Pope and Mays (1995) have stated that the goal of qualitative research is the development of concepts, which help us to understand social phenomena in a natural setting, giving due emphasis to the meaning, experiences and views of all participants. Further, they also pointed out the many ways in which qualitative methods compliment quantitative ones:

- Firstly qualitative work can be conducted as an essential preliminary to quantitative research, e.g. to understand the most comprehensible terms or word to use in a subsequent survey questionnaire.
- Qualitative techniques such as observations, in depth interviews and focus group discussions can be used to provide a description and an understanding of a situation or behavior.
- Qualitative methods can be used to supplement quantitative data. This can be part of the validation process, as in triangulation where three or more methods are used and the researcher examines a particular phenomenon at several a different levels and from different perspective. (Pope and Mays 1995).

Steckler et al (1992), elaborating on the strengths of the two approaches, have said that if quantitative methods produce factual reliable outcome data that are usually generalizable to some larger population, on the other hand the qualitative methods generate rich, detailed, valid process data that usually leave the study participants', perspectives intact.

For formulating comprehensive nutrition communication programs, quantitative methods give nutrition indicators related data (anthropometric indicators, biochemical parameters), which reflect the magnitude of the problem and etiological factors. In contrast, qualitative methods give insight into perceptions and reasons underlying dietary and health related behaviors in the target groups.

Scrimshaw (1990) stated that a combination of quantitative and qualitative research techniques is needed in order to understand the process being studied in culturally appropriate terms, to obtain accurate information on behavior and to interpret the meaning behind the behaviors.

Figure (2.1.6) illustrates four ways that qualitative and quantitative methods might be integrated in health education research and program evaluations. In the first possible approach, (Model 1) qualitative methods are used initially to help develop quantitative measures. In the second approach (model 2), a study or evaluation is pre dominantly quantitative and qualitative methods help explain numerical data. The third approach is the reverse model 2 in that quantitative results are used to help interpret predominantly qualitative findings. The final possible approach (model 4) is when the two methodologies are used equally and parallel and are used to cross – validate the study findings. That is, researchers and evaluators analyze the results of each method separately and then decide if the results from each method suggest the same conclusions. If they do, then the researchers', confidence in the results and conclusion is strengthened. If they do not, then the researcher tries to understand why, and tries to determine which results are the most valid (Steckler et al 1992).

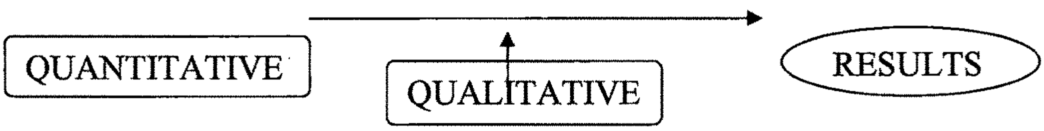
Figure 2.1.5: Four possible ways that qualitative and quantitative methods might be integrated (Steckler et al, 1992)

Model 1

Qualitative methods are used to help Quantitative measures and instruments

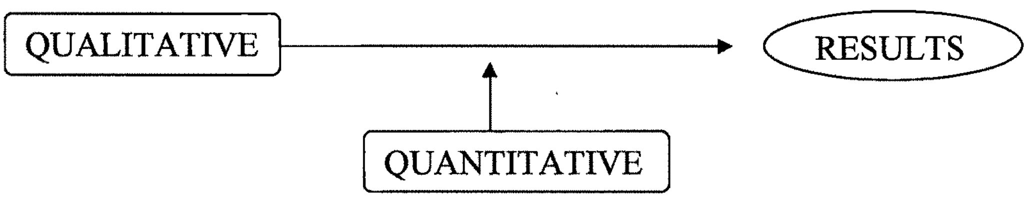
Model 2

Qualitative methods are used to help explain the Quantitative findings



Model 3

Quantitative methods are used to embellish a primarily Qualitative study



Model 4

Qualitative and Quantitative methods are used equally and parallelly

Very few studies have been carried out using both qualitative and quantitative methods together. However, some of the studies which have tried to integrate these two methods have shown that in nutrition communication research, qualitative anthropological research tools could be effectively integrated with quantitative epidemiological method (Kanani and Zararia, 1996; Agarwal and Kanani, 1998).

Justification of the Present Study

The above review amply reveals that there is a wide nutrition gap among adolescents. The dual burden of malnutrition needs to be tackled with great care so that both can be reduced. There is an urgent need for tools like HEI and FBC to be developed for adolescents in Indian context, as dietary patterns in India and USA differ a lot. Till date no such tool has been developed in India. An evaluation of dietary quality and practices would reveal the shortfalls in the healthy behaviour of adolescents.

A very few studies have been conducted in India to see the effect of a Nutrition Communication Programme on the dietary practices of adolescents. Adolescence is a stage where behavioural changes are very important as they go a long way in life. NCP are critically important for school children in view of their enhanced nutritional needs, their vulnerability to malnutrition, their central role in ensuring their own nutritional well being and that of their families in future as adults.

Thus, the present study was designed to develop a Healthy Eating Index and a Food Behaviour Checklist for adolescents in Indian context and to implement a Nutrition Communication Program to improve their dietary practices in selected schools of urban Vadodara.