INTRODUCTION

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In the Millennium Declaration, adopted in 2000, world leaders made a promise to children to help them fulfill their human potential. The children born in that milestone year are now adolescents. It is time to review whether the promise is being kept for these 'Millennium children' and for all adolescents (UNICEF, 2012).

Adolescence is the period when a growing child experiences a linear growth 'spurt' to attain his or her fullest potential of adult height, shape, body composition, physical and sexual function. Although there is no internationally accepted definition of adolescence, the United Nations defines adolescents as individuals aged 10-19 years (WHO, 2002).

The proportion of adolescents in the global population peaked around 1980 and is now on the decline almost everywhere, a trend expected to continue through 2050. The absolute number of adolescents, however, is expected to rise during the same period (Figure 1.1.1) (UNICEF, 2012).

In 2009, there were 1.2 billion adolescents aged 10–19 in the world, forming 18 per cent of world population. Adolescent numbers have more than doubled since 1950. More than half of the world's adolescents live in either the South Asia or the East Asia and Pacific region, each of which contains roughly330 million adolescents. India has the largest national population of adolescents, nearly 243 million (UNPD, 2010) (Figure 1.1.2).

Adolescents – A Neglected Group

Adolescence though is a time of enormous physiological, cognitive and psychological change, WHO, acknowledges that adolescents remain "a neglected, difficult-to-measure and hard-to-reach population" (WHO, 2006).

In the Millennium Development Goal, adolescents are not specifically mentioned, although they are the future adults. Health information on adolescents is not widely available in many developing countries, apart from indicators on sexual and reproductive health collected by major international health surveys.

Figure 1.1.1: Adolescents' share of a growing world Population (Source: UNICEF, 2012)

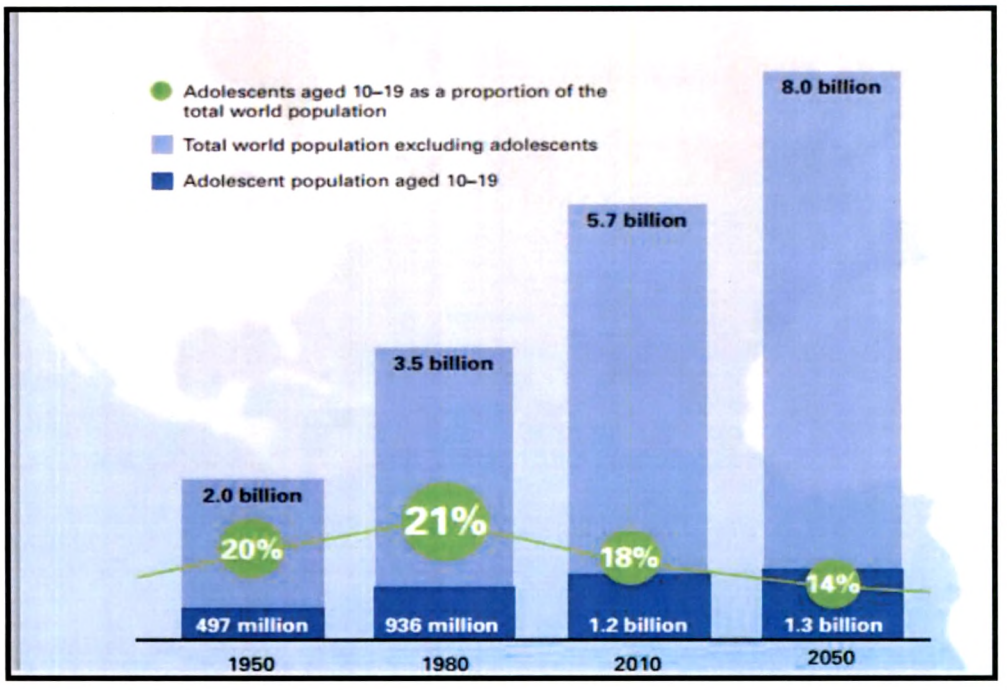
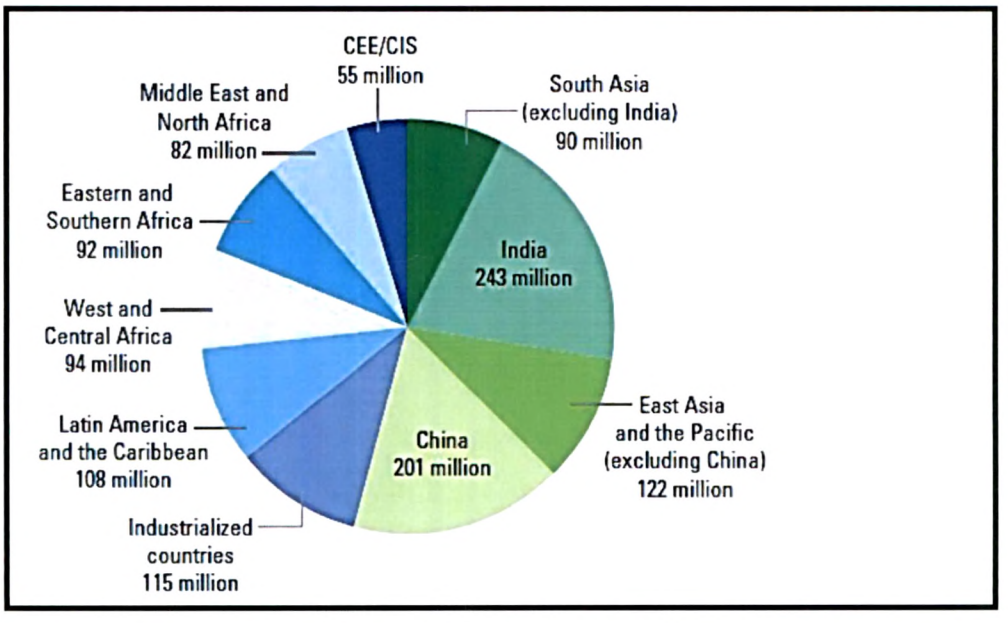


Figure 1.1.2: Population of Adolescents 10-19 years old by region, 2010 (Source: UNPD, 2010)



During adolescence, the growth velocity increases, individuals can gain 15% of their ultimate adult height and 50% of their adult weight. Approximately 45% of skeletal mass is also added during adolescence (SCN, 2006).

Thus, appropriate dietary intakes and healthy food choices are very critical during this period and inadequate dietary intakes (mainly energy, protein and micro nutrients) and inappropriate food choices may lead to undernutrition among the adolescents or prevent them from attaining their full potential for growth and development.

State of Adolescent Health

According to National Nutrition Monitoring Bureau, (2002), in India, the prevalence of undernutrition tends to increase from about 63% among 6-9 year age group to 78% in 10-13 years and then decrease to 66% in 14-17 year age group of children. Though no significant sex difference in the prevalence of undernutrition were observed in 6-9 and 10-13 year age groups, however, a relatively higher proportion of boys (73%) in 14-17 year age group were found to be undernourished as compared to their female counterparts (60.4%).

Thinness reported as 'Undernutrition' by ICRW, was prevalent only in 3 countries out of the 11 studied. India reported the highest prevalence with 53% of the subjects having low BMI for age (Kurz, 1996).

There is also a large inter - state variation in the patterns and trends in underweight. In six states, at least one in two children are underweight, namely Maharashtra, Orissa, Bihar, Madhya Pradesh, Uttar Pradesh and Rajasthan. Gujarat has a prevalence of 50% underweight which is higher than the national prevalence. Undernutrition is more prevalent in rural than urban areas. Even in urban areas 40% of children are stunted and 33% are underweight (NFHS III, 2007). Undernutrition (BMI <18.5 kg/m^2) among adolescent girls between 15- 19 years of age was found to be 47% (UNICEF, 2012).

Shah, 2005 reported the prevalence of under nutrition in Vadodara as 34% according to Must et al standards (1991) and 19% according to Agarwal standards (1992). According to both the standards, undernutrition was higher in boys (41.2% and 19.9%) than girls (24.7% and 17.6%) in the age group of 10-18 years.

Kanade et al (1998) reported a delay of 18 months in the peak height and weight velocities for children who were stunted at 10 years of age.

Agarwal et al (1992) carried out a multi-centric study in eight states of India on affluent school children and found that Indians were shorter and lighter as compared to NCHS standards.

A study by Gandhi (2004) in 10 schools of urban Vadodara covering 4808 children of 8^{th} to 12 h standards from middle to high socio economic status indicated the high prevalence of both undernutrition and overnutrition. Overall prevalence of underweight varied from 34% to 36% while that of overweight ranged from 4.6% to 24.9% and obesity ranged from 0.6% to 5.3%.

Stunting was prevalent amongst both the sexes in 9 out of 11 studies conducted by International Center for Research on Women (ICRW) ranging from 27 to 65%, in India it was reported around 32%. (Kurz, 1996)

Srihari et al (2006) reviewed twelve studies carried out between 1995 and 2006 on nutritional status of Indian school children 6- 18 years from middle and high socio economic status. Out of the 12 identified studies, eight reported on the prevalence of overweight and obesity. The range of prevalence of overweight (8.5- 29%) and obesity (4.5 – 7.4%) was large.

Srihari et al (2006) reported that anemia prevalence with haemoglobin concentration <12 g/ dl ranged from 19% - 88%among middle to high socio economic status adolescents across five different cities in India.

Anemia and stunting in this age group is of public health importance because adolescence can be the second opportunity to catch up growth if environmental conditions are favourable (NFI, 1989).

Inappropriate Dietary Intakes during Adolescence

For many adolescents, inadequate quality and quantity of food and lack of nutrition knowledge are the main determinants of nutritional problems. In high socio economic status as well, due to faulty dietary food habits, in conjunction with over nutrition, under nutrition is also prevalent (Kaya, 2006).

Pre-adolescence is a period when nutritional requirements increase on account of rapid growth. There is widespread prevalence of dietary and nutrient inadequacy among adolescents as evident from research by several investigators (Kapil et al, 1993; Seshadri et al, 1999; Vijayapushpam et al, 2003).

Inadequate intake of micronutrients can adversely influence growth and development, cognitive performance and increase susceptibility to infections (Halterman et al, 2001; Benton, 2001; Caulfield et al, 2004).

Healthy eating patterns in childhood and adolescence promote optimal health, growth, and intellectual development, prevent immediate health problems, such as iron deficiency anaemia, obesity, eating disorders, and dental caries and may prevent long-term health problems such as coronary heart disease, cancer and stroke (SCN, 2006).

In view of the present unsatisfactory nutritional status of the school going children, particularly adolescents as highlighted above, there is a strong need to evaluate the dietary quality and behaviours of these subjects. Also there is a need to assess their current dietary and physical activity practices and to educate these children, so that their dietary and physical activity practices (behaviours) improve.

Dietary Assessment

Various qualitative and quantitative methods have been developed for dietary assessment. The most commonly used methods are Food frequency questionnaire and 24 hour recall method. However, these methods have their own limitations, which affect the validity of these tools for dietary assessment.

Administering a 24 hour recall in a group setting is cumbersome. Underreporting or overreporting the dietary intakes and an inability to recall accurately the types and amounts of food eaten are two main weaknesses of 24 hour recall methods. Single 24 hour is not representative of habitual intake but may be useful for group means. Multiple averaged 24-hour recalls are needed to estimate the usual food or nutrient intake of individuals. Moreover, detailed quality control for achieving accuracy involves a protocol for administering the recall and for the training and periodic retraining of the interviewers and data coders. Data coding, data entry, and

data analysis are usually more expensive than those entailed with the food frequency method (Thompson and Byers, 1994).

An alternative to the 24 – hour recall, food frequency questionnaire (FFQ) is also difficult and time consuming to administer in a group (Kristal et al, 1998). Since FFQs are designed to assess the ranking of intakes within a population, they cannot be relied on to produce reliable estimates of absolute intake. Over- estimation is common, particularly for foods eaten lees often or for foods perceived as 'healthy' such as fruit and vegetables (Day et al, 2001)

Neither the dietary recall nor the FFQ assess the behaviours and practices related to diet and physical activity.

Current dietary concerns, among populations as a whole, include overconsumption of calories, added sugars and saturated fats; underconsumption of whole grains, fruits and vegetables (USDA ERS, 2013)

New Tools for Assessing Dietary Quality

Healthy Eating Index (HEI) was developed by United States Department of Agriculture (USDA) in 1989, which was released in 1995 (Kennedy et al, 1995).

HEI measures the dietary quality of subjects age 2 and older. It assesses the level to which the Americans conform to the Dietary Guidelines. HEI has been revised over time in 2005 and in 2010 to adhere to the revised dietary guidelines (Guenther et al 2007 and 2013).

HEI -89 consisted of 10 dietary components. Five components assessed the nutrient adequacy of the diet by using the five major food groups of the original Food Guide Pyramid: Fruit, Vegetable, Grains, Milk and Meat (USDA CNPP, 1996). Four components assessed aspects of the diet that should be limited or consumed in moderation: Total Fat, expressed as a percentage of total calories; Saturated Fat, expressed as a percentage of total calories; Cholesterol; and Sodium. The tenth component was a measure of Variety in food choices regardless of food group.

The release of the 2005 Dietary Guidelines for Americans, necessitated a revision of the HEI because of the increased emphasis on important aspects of diet quality, such as whole grains, various types of vegetables, specific types of fat, and the introduction of "discretionary calories."

The HEI 2005 (Guenther et al, 2007) has twelve components. Total Fruit; Whole fruit; Total vegetable; Dark Green and Orange vegetables and Legumes; Total Grains; Whole Grains; Milk; Meat and Beans; Oils; saturated Fat; Sodium; and Calories from Solid Fats, Alcoholic beverages and Added Sugars (SoFAAS).

The components of HEI 2005 were of two types. The food group and oils components were the "adequacy components" because the recommendations on which they are based were established to ensure adequacy of nutrient intake. The "moderation components" were saturated Fat, Sodium, and Calories from Solid Fats alcohol and added sugar (SoFAAS).

USDA's Center for Nutrition Policy and Promotion (CNPP) assesses the dietary quality of Americans using HEI from the dietary data available through National Health and Nutrition Examination Survey (NHANES) and the Continuing Survey of Food Intakes by Individuals (CSFII).

Aust- HEI was developed in Australia to provide a measure of the total dietary quality based on food choices and whether recommended foods are being chosen. Aust – HEI used a Short Dietary Questionnaire (SDQ) and a Food Frequency Questionnaire (FFQ). It included 7 components namely, Measures of variety, Measures of 'Healthy Choices', Fruit consumption, Vegetable consumption, Low fat milk chosen, Trim fat off meat and Consumption of high saturated fat and low nutrient density foods (AIHW,2007)

Another important tool that was developed by Blackburn et al (2006) is a Food Behaviour Checklist (FBC) to evaluate the 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).

Nutrition Communication

To combat the double burden of malnutrition, various school based programmes and interventions have been initiated by governments, national and international organizations. Programmes like Health promoting Schools or Global School Health Initiative (WHO), School Food and Nutrition Education Program (FAO) etc.

WHO Information Series on School Health (1998) also justifies the decision to support school based interventions among adolescents. Improving the nutritional status of school age children and adolescents is an effective investment for the future generation, as well as for combating the development of obesity and other nutrition related chronic diseases later. Nevertheless schools can be an important setting to address the problems of under nutrition and anaemia also.

Evidence supports the effectiveness of school- based health promotion strategies with a focus on healthy eating (Rodrigo and Aranceta, 2001).

School settings are appropriate for carrying out studies on school aged children in India as, according to NFHS III, 90.1% of the 6-10 years and 74.2% of the 11-14 years old children attended primary school in 2005-2006 in India (NFHS III, 2007).

Nutrition health education is an effective strategy for behavioral change to improve home diets. Nutrition health education is a process of formulating and disseminating messages that make individuals and communities aware about health and other related issues, strategies and behavior that enable them to make informed choices (Nandi and Bhattacharjee, 2005).

A cost effectiveness study conducted on the Nutrition Communication and Behavior Change Component (NCBC) of the first World Bank loan to Indonesia for community nutrition showed that the successful nutrition communication component, significantly improved the nutritional status of 40% of the children. It cost about 0.15% of the national budget. This would be one-tenth the cost of an institutional feeding program and one twentieth of the cost of consumer food subsidies (Ho and Teresa, 1983; Berg, 1987). Thus, Nutrition Communication Programme is a cost effective strategy aimed at behaviour change.

In India, as in most developing countries, the bulk of nutritional problem lies in mild and moderate malnutrition. Half or more of young children in many countries are affected by these

forms of malnutrition (Pelletier, 1994). In most families, mild and moderate malnutrition can be eliminated or controlled through simple changes in dietary and food hygiene practices that are amenable to change through well planned and executed behaviour change strategies.

Integration of qualitative and quantitative methods is a very important in designing and assessing a Nutrition Communication Program (NCP). Qualitative methods produce factual reliable data that are usually generalizable to larger population while qualitative methods generate rich, detailed valid process data that usually leaves the study participants' perspective intact (Steckler et al, 1992).

For a nutrition communication program, quantitative methods help to obtain nutrition related data such as magnitude of the problem and etiological factors and help in understand the nutritional problems of the subjects. The qualitative methods in the formative research give insight into perceptions and reasons underlying dietary and health related behaviour in the target groups which helps in the development and implementation of a nutrition communication program.

Rationale for the Present Study

Although dietary inadequacies have been highlighted by many investigators, so far no attempt has been made to evolve a Healthy Eating Index scoring system or to develop a Food behaviour checklist to assess the dietary inadequacies/practices of school children in India, unlike western countries where HEI has been developed and validated to assess the quality of diet. This under researched area needs to be focused on and explored and attempt should be made to validate the tool developed and to test its reliability in the Indian context.

The challenge for India is clearly to counteract the seeming inevitability of the degenerative phase of the nutrition transition. This must be done while continuing the efforts to address the additional burden of undernutrition. Considerable headway needs to be made in nutritional knowledge and practice among health professionals and public (Vaz et al, 2005).

In India not many researches have been focused on nutrition communication for school children based on the quantitative and the qualitative aspects of dietary and physical activity practices.

In view of the above, the present study was undertaken with the **Major Objective** to develop a Healthy Eating Index and Food Behavior Checklist for adolescents in Indian context and to implement a Nutrition Communication Programme to improve their dietary practices in selected schools of urban Vadodara.

The study was divided into **four phases** with the following specific objectives:

Phase I: Assessment of the Nutritional status of the subjects

- To assess the nutritional status of the children aged 7-18 years in selected schools of urban Vadodara by anthropometric measurements and perform biochemical estimations on a subsample.
- To assess the cognitive development among children aged 7-18y in selected schools of urban Vadodara.
- To assess the daily dietary intake by 24 hour Dietary Recall method and Food frequency method among children aged 7-18y in selected schools of urban Vadodara.
- To evaluate the knowledge, attitude and practices (KAP) of the students regarding health, diet, healthy eating practices, physical activity etc. among children aged 7-18y in selected schools of urban Vadodara.

Phase II: Healthy Eating Index and Food Behaviour Checklist – Development, Assessment and Validation

- To develop a Healthy Eating Index and Food Behaviour Check List for adolescents in the Indian context.
- To review the dietary quality of the study subjects with the help of the developed Healthy Eating Index.
- To evaluate the behaviour pattern of the subjects regarding dietary and physical activity practices.

- To assess the validity of Healthy Eating Index and Food Behaviour Check List as a tool for assessing dietary quality and the quality of dietary and physical activity practices respectively.

Phase III: Development of Nutrition Communication Programme (NCP) and its implementation

- To plan and develop a Nutrition Communication Programme based on the assessed knowledge attitudes and practices, focused on bringing about improvements in their knowledge, dietary practices and physical activity pattern

- To implement the Nutrition Communication Programme developed for the study subjects in one selected school of urban Vadodara.

Phase IV: Assessing the impact of Nutrition Communication on the Subjects

- To assess the impact of the Nutrition Communication Programme (NCP) on the knowledge and practices of the study subjects after a period of six months in the selected schools of urban Vadodara.