II REVIEW OF LITERATURE

The literature pertaining to the study entitled, “Dietary Practices of Irula Tribes and the Impact of Intervention Programmes among Target Groups”, is reviewed under the following headings:

A. Tribes of India – A demographic profile
B. Dietary pattern, lifestyle practices and health status – Need for improvement
C. Contributing factors for vulnerability of nutritional deficiency disorders in adolescence and adult women
D. Prevalence of anaemia and prevention – An urgent call for action and
E. Intervention programmes – Sustainable outlook for good health.

A. Tribes of India - A Demographic Profile

India is a home of almost more than half of the world’s tribal population. Over 84 million people belonging to 698 communities are identified as members of scheduled tribes (http://tribal.nic.in/final content.pdf).

India is an amazing amalgamation of various races and cultures, with a landscape as diverse as its population. Among the 2,596 people groups in the nation, 88 per cent are considered unreachable living in isolation in natural and unpolluted surroundings far away from civilization with their traditional values, customs, beliefs and myth intact and are commonly known as tribals. They are considered to be autochthonous people of the land. About half of the world’s autochthonous people, comprising 635 tribal communities including 75 primitive tribal communities live in India (Sharma, 2014).

Tribals are found in all states except Jammu and Kashmir, Punjab, Haryana and Orissa, the most picturesque state in Eastern India, occupies a unique place in the tribal map of the country with largest number of tribal communities (62 tribes including 13 primitive tribes) comprising a population of 8.15 million constituting 22.3 per cent of state’s population (Census of India, 2001). The primitive tribal communities have been identified by the Government of India in 15 states/union territories on the basis of pre agricultural level of technology, extremely low level of literacy and small, stagnant or diminishing population (Basu, 1994).
According to India’s most recent census in 2010, the term “indigenous has prevailed as a generic terms for many years. In some countries, there may be preference for other terms including tribes, first people, aboriginals, ethnic groups, adivasi and fanafati. The tribal areas in India can be broadly divided into three zones (North Eastern, Central and Southern zone) each having a different agricultural, climatic, demographic, linguistic and cultural characteristics (Selvakumar and Sivakumar, 2014).

India has more than 250 different tribal groups and many more sub groups. The nine major or large tribes are the Bhil, Gond, Ho, Khond, Mina, Munda, Woga, Oraon and Santhal. The above constitute more than 25 per cent of the total tribal population. The three predominant of the above are the Bhils, Gonds and Santhals. The small tribal communities comprising less than 100 people include the Andamanese, Onge, Shamphen and Toda, whereas the Bhil, Santal, Oraon, Munda, Mina, Khond and Saora had more than one million people each (Maiti et al., 2005).

The smaller tribes are mainly found in Arunachal Pradesh, Andaman, Nicobar and South India. Within the country the largest number of tribals are found in Madhya Pradesh with a total of 12 million population. The state also accounts for 23 per cent of the total tribal population in India. The other predominant tribal states are Orissa, Bihar, Maharashtra each with over five million tribal population (Ragupathy, 2009).

According to India’s census in 2001, there are 84.3 million scheduled tribes which is 8.2 per cent of the population. The distribution of scheduled tribe’s population varies widely across the states of India and its territories (Office of the Registrar General and Census Commissioner, 2001).

The total Indian population according to World Bank (2005) was 1112 million, the number of females stood at 536.14 million which accounted for about 48.2 per cent of the tribal population. The total tribal female population which stood at 44.34 million accounted for 8.27 per cent of the total female population in the country, but they accounted for only four per cent of India’s total population (male and female) (Census, 2011).

The Indian Ministry of Tribal Affairs (2004) had revealed that in Mizoram and Lakshadeep the scheduled tribes represent close to 95 per cent of population.
whereas in Kerala and Tamil Nadu they represent only one per cent of population. Among the total tribal population the highest proportions were found in Madhya Pradesh (14.5%), Maharashtra (10.2%) and Orissa (9.7%). There are around 700 different tribes living across India predominantly in remote areas, forests, hills and rough terrain in plateau areas. There is great heterogeneity across different tribal group including a sub category of particularly vulnerable Schedule Tribes known as primitive tribe. Due to the derogatory nature of this term these groups are being renamed by the Government of India as particularly vulnerable tribal groups (tribal.nic.in/writereaddata/CMS/201212030510337890625file785).

Kshatriya (2014) has noted that the lifestyle and tradition of each indigenous community is unique and is related to the utilisation of particular natural resources and particular type of work. They had been collecting resources from forest without causing any damage. The forest provides them security of food and livelihood. Since tribal communities live in close proximity with biodiversity rich landscape, they have evolved local specific and novel livelihood strategies based on their indigenous knowledge. Thus, there always existed an organic unity between human and their surrounding environment in the traditional societies and an intricate relationship between their culture and nature. Social and cultural diversity coupled with the environmental complexity have generated diverse approaches and technologies in the management and use of different natural resources.

Mukherjee et al. (2012) found out that the natural environmental surrounding the people provides several foods, services and amenities to them, but using the environmental resources for a purpose always reduces its ability to supply them with other services with this limited natural resource base surroundings, the tribal societies being scarce along with many conflicting demands placed on it from other sectors of society reduces their availability to the tribal communities and affect their livelihood.

Mahajan et al. (2000) reported that during the last 50 years the planning process in India has failed to reduce the disparity between the tribal and non-tribal populations. Today, the first and foremost problem for tribal communities in India is to earn and sustain livelihoods. There are varieties of livelihood practices by the tribal communities in different parts of India and elsewhere such as by the hunter – gatherers, pastoralist, shifting cultivators, who live in different environment.
A number of changes have taken place with regard to the land use, access, control and utilisation of their resource and these changes in term have largely affected the sustainable livelihood of the people without any sustainable replacement.

Mishra (2012) stated that the tribals are exploited since colonial days which got worse since pre independence period. Their social and economic status became a casualty for the 'civilization and development'. Out of the 234 Tribes scheduled in India, six of them are present in Tamil Nadu, viz., Kothas (Artisans), Thodas (herdsmen esp with buffalos), Kurumbas (Hunter tribes), Paniyas (Food gatherers and bonded labourers), Katunaickas (forest dwellers) and Irulas (hunters and gatherers). They have been known to maintain their teams and live with the vagaries in their dwellings. They are left to feed for themselves without any systematic or structured or holistic support from the Government or from the philanthropic world.

ICMR (2003) revealed that the demographic status of the primitive tribes has shown a declining or static trend. The demographic data of Juanga primitive tribe of Orissa revealed a marital family rate of about six and life expectancy at birth 35.9 years.

Turner et al. (2013) identified that Oraon is one of the major tribal groups in India, spread across the states in central and eastern India, including Jharkhand, Madhya Pradesh, Orissa, Chhattisgarh and West Bengal. Traditionally, they depended on the forest for their ritual and economic livelihood, but in recent times they have settled as agriculturists. These are procured from the forest. The Oraons speak their own language Kurukh, which belongs to the Dravidian linguistic family. Though Oraons have their own religion, a considerable number of these people are Christians. The Oraon people have a rich and vast range of folk songs, dances and tales, as well as traditional musical instruments.

In the explorative study done by Kumar et al. (2007), the nutritional status of tribes in their traditional setting has been positive. India has 45,000 plant species and 550 tribal communities. The tribals belong to 227 linguistic groups and they inhabit varied geographic and climatic zones with diversified plant species, varied culture, rich traditional knowledge and wisdom. Indigenous communities by virtue of their dependence on species gathered from the wild and maintenance of useful species under shifting cultivation, subsistence farming and backyard collection are
a rich source of useful wild species. It not only helps to evaluate commonly used plant species by tribals for economic utilization of various plants in terms of construction material, cash crops and making of agricultural tools and implements, but also to enumerate various plants for fuel wood, fodder, fiber and forage.

The most striking geological feature of Rajasthan are the Aravalli ranges – the oldest mountain range in the world, which runs from Khetri in North East to Khed Brahma in South West, a length of about 550 kilometres. The variability in climate, edaphic, and topographic conditions causes diversity of vegetation in the Aravalli ranges. These hill range possess an abundant population of various tribes. Ethnobotanical survey of Aravalli hills revealed that the tribal communities belonging to Bhil, Meena, Garasia and Kathodi used a number of tuberous plants, which are commonly available in and around their habitat and also cultivate such plants in their agricultural fields (Shweta et al., 2008).

Saxena (1996) explored that tribals constitute an important segment of the population of India, representing about eight per cent of the total population; it is about 22 per cent of the total population of Orissa. Orissa is the home of as many as 62 different tribal communities and in terms of concentration of tribal population, it ranks second in the country. Majority of the tribal population of Orissa live in forest ecosystem and has its own socio cultural pattern, tradition and typical food practices. Most of these tribals have small or marginal land holdings. They grow food grains for 8 to 10 months, however, for rest, they depend on the forest. Mostly their diet comprises variety of unconventional foods, namely edible forms of flowers, fruits, tubers, leaves, stems, seeds and wild mushrooms.

The Chenchus of Andhra Pradesh are one of the ethnic splinter groups, which were left behind by the material advance of the great majority of the South Indian population. Their present habitat is confined to the rocky hills and forested plateaux of the Nallamalai Range, extending on both sides of the Krishna River. Until 1947, this river formed the border between the princely state of Hyderabad, officially known as His Exalted Highness the Nizam's Dominions, and the Madras Presidency of British India. At that time Chenchus were found both in Hyderabad and in British territories, but today their entire habitat lies within the state of Andhra Pradesh, which contains the overwhelming majority of the speakers of the
Dravidian tongue of Telugu, the language spoken also by the Chenchus (Fürer, 1982).

Fifty four edible plants from 39 different families were identified from the study conducted by Oak et al. (2015). Efforts are being taken by NGOs to conserve the traditional knowledge about the wild edible plants and also encourage their use, thereby reducing the problem of malnutrition in tribal areas.

The Irulas are small tribal community in Tamil Nadu who occupy the lower slopes and forests at the base of the Nilgiris hills. The Irula is a South Dravidian primitive aboriginal tribal community spread over the three Southern states of Tamil Nadu, Kerala and Karnataka. They are divided into several endogenous subgroups mainly based on their linguistic variations and recognized as scheduled tribe by Government of India (Revathi and Parimezhalagan, 2010).

The Irulas are generally considered to have drifted to the Nilgiris from the hilly terrain of Attappadi and Siruvani valleys in Kerala and the adjoining Anaikatti and Karamadai area in Coimbatore (www.indianforest.com).

Irulas are one of the poorest tribal communities with a population of 2.1 lakhs concentrated mainly in North Eastern Tamil Nadu. They constitute the second largest group of tribes after the Badagas and are similar to the Kurumbas in many ways. They produce honey, fruits, herbs, roots, gum, dyes and trade them with the people in the plains. In the recent times the Irulas help in catching snakes and collect the snake venom (www.indianetzone.com).

Sasirega (2010) reported that Irulas are one among the six primitive tribal groups in Tamil Nadu. The name Irulas are derived from the Tamil word “Irul” meaning dark which refers to their skin tone. In Nilgiris region, Irulas are well spread in four taluks namely Ooty, Coonoor, Kotagiri and Kundah. Irula people have their own language which is again called as “Irula”. This language is a mix of Tamil and Malayalam and it has its own dialect. They follow joint family system. Basically Irula people are non vegetarians. They follow cross cousin marriage system among themselves. Also child marriages are very common among them. In earlier days they were snake and rat hunters and depending on forest products for their day-to-day food and medicinal needs. They are the ultimate jungle folk, and their knowledge of plants and animals is a data bank of immense value. The areas

Friedman and Somani (2002) stated that the Irula tribals are mainly Non Timber Forest Produce (NTFPs) collectors and depend on forest resources for their survival. Most of their daily needs are met by the forest and very often they barter forest produce in the market. They also engage in agriculture which provide for some part of their food security. There are several honey gathering villages in the area. Villages like Poochamarathur and Neeradi have the highest number of honey gatherers. Most of the elderly in this area possess immense knowledge on forest plants. They use a wide variety of plant species for their daily sustenance and livelihood. Now they work in tea estates and other daily wages job.

The literacy rate among Irula people is just 34.3 per cent. Now they are aware of education schemes which are given to children through various schemes. Women are given opportunities in the panchayat elections and to take part in temple committees. They belong to Hindu religion and are again divided into different sub groups such as Kasabas, Mudumars and Uralliirulas. They do not burn the dead body but bury the dead in a seated posture. Each grave is demarcated by an earth mound (Emmanual and Rajan, 2013).

Sinu and Mahadevan (2013) observed that of the world’s 6.1 billion population in 2000, over the billion people (19.1%) belonged to the age group 10 to 19 years. The Asian region comprises 712 million people in this age group. In the world as a whole the number of persons in the age group 10 to 19 will continue to grow reaching 1,253 million by the year 2025. In 2000, there were 554 million adolescents living in the world of which 48.5 per cent were females. Over three fifths (62%) of these adolescents belong to Asia. There are about 105 million adolescent girls in the age group of 10 to 19 years in India.

Irula women have minimal to no power in the decision making process and are discriminated and exploited virtually at every level of society. They experience violence within their homes and prejudice when entering local politics or community initiatives. Many women suffer awful health conditions as a result of early marriage and child birth and a lack of trained assistance being available (Nijila, 2008).
Tribal society is a medley of socio-cultural milieu by traditional customs and practices. Tribals are vulnerable to the fast paced global development ideology. Majority of the people of hill areas are tribals of different origin and culture. Their economic culture, however, remain quite universal (Chakrapani, 2005).

B. Dietary Pattern, Lifestyle Practices and Health Status – Need for Improvement

Tribal population still largely depend on agriculture and forest products for their livelihood and they follow a relatively homogenous lifestyle with their food habits, dietary practices and general pattern of living (Sinha and Lakra, 2005).

The nutritional value of traditional wild plants is higher than several known common vegetables and fruits (Sundriyal and Sundriyal, 2001). Aryal et al. (2009) stated that in addition to providing food directly uncultivated plants provide an opportunity for cash generation.

The overall health of the tribal population is inferior to that of the people elsewhere in India and poor environmental sanitation and unhygienic personal practices pre dispose tribal populations to high risk of infection (www.studentplus.com/..healthandnutritionalstatusoftheindiantribes).

A study by Kapil et al. (2003) evinced that the most frequently used cereals are maize millet or rice and these form part of a major meal atleast once daily.

Singh and Patla (2004) identified that the food intake of Abujhmarias tribe was dependent mainly on availability of food. As they live in forest ecosystem their diet comprises of variety of unconventional foods viz., edible forms of flowers, fruits, tubers, reptiles, rodents and other flesh foods available from the forest.

Xaxa (2011) noted that caloric intake of many of the traditionally food gathering tribes is entirely from collections made by them from the forest. Even settled tribal agriculturist derive a substantial amount of nutrition from jungle products.

The tribals in Orissa enjoy the sour taste of mango or tamarind. They dry and store the mango kernel to be consumed more as a pickle than as staple food. But when there are no food grains in a home and hunger stalks its inhabitants,
naturally anything will be consumed like mango kernel, tamarind seeds, bamboo
shoots and even wild grass (Rasheeda, 2006).

The tribals of Vishakapatnam included pulses like Konda-Kandi and leafy
vegetable like efummadi (pumpkin) leaves, gongura gurugu, thotakura and veduru
chingurlu in rainy season. Vegetables like brinjal, pumpkin, cucumber, tomato,
bittergourd and soybeans were also consumed. They ate all kinds of wild animals
like deer, wild boar antelope and birds like peacock, wild doves and fowls. Unlike
the other tribal groups, the khone ate monkeys also. The cereal flour or broken rice
is cooked with a large quantity of water and consumed simply with salt. The tribals
of this region also ate another kind of dish called putty which is a steam cooked
preparation. Jowar is consumed in the form of Roti (Bhowmik, 1998).

Findings by Anuforo et al. (2004) revealed that tribals were found to have
distinct attitudes and beliefs towards food they use or avoid in certain physiological
conditions when compared to non-tribals. Existence of similarities and differences
in the cultural meanings, beliefs, and practices among the tribes. Religion,
education and occupation were significant factors influencing informants’ attitudes
toward continuation of the practice. Government sponsored public education and
influence by the media were found to increase informants’ awareness of
complications of female circumcision. Changes in attitudes toward the practice and
use of alternative practices were evident.

Women in Garo tribal community avoided certain kinds of foods, which
according to them were harmful for the infant. They avoided food believed to have
laxative properties, food considered to be cold, food that caused skin rash and
acidic food. Foods generally avoided were certain varieties of green leafy
vegetables, fibrous vegetables, melons, gourds, pumpkin, papaya, eggplant, shell
fish, limes, oranges, grapes, chillies, bell peppers, spices, bananas, yoghurt and
oily foods. Women consumed special foods like milk, ghee, butter and certain types
of fish which are believed to increase the quantity of breast milk and to improve
their health. During this period mothers are encouraged and allowed to eat lots of
garlic, which is believed to enhance the process of “drying of the womb” (Measham
and Chatterjee, 2000).

According to Das and Bose (2012), the Mannans take their chief meals twice
a day. The diet of Mannans includes rice, ragi, millet, pulses, tapioca, wild tubers,
vegetables, green leaves, meat, fish, crab and mushrooms. The staple food was rice and taken with a side dish prepared with some vegetables or flesh.

A study conducted among the Sugali, a tribal population indicated that they consumed vegetables such as brinjal, egg, papaya and locally available green leafy vegetable (Pandilla and Benny, 2001).

Dheki Saag, fermented left over rice and locally grown leafy vegetables formed the major diet of the Oraon tribal groups (Mittal and Srivastava, 2006).

The nutritional status of the tribal people is poor because their diet is insufficient in quantity and poor in quality. The eating habits of tribal people depend on various factors like availability of different foods in different seasons, cultural patterns, habits of cooking, eating, ideas about health, beliefs, food taboos, customs, traditions and practices of the community which leads to the poor nutritional status (Indira and Chattopadhyaya, 2001).

Tribes, in fact, subsisted for generations with a reasonable standard of health, because the forest provided them with food, such as fruits, leafy vegetables, nuts, berries, tubers, mushrooms, honey and fish, materials for shelter, fabrics, medicines, and medicinal plants that they have been using for treatment of diseases and maintaining health, and are today the source of modern medicine. Tribal children were not only familiar with all the biological species around them, but they also understand perfectly well, the ecological and symbiotic relationship between the various forest components (Tosh and Dube, 2004).

According to a study conducted under All India Co-ordinated Project on Ethnobiology (AICRPE)-(1992-1998), over 10000 wild plant species are reported to be used by tribals for meeting their primary healthcare, food and other material requirements (Pushpangeden and George, 2010).

The traditional diet of the tribes of the Great Andamanese consists of fish, dugong, turtle, turtle eggs, crabs, roots and tubers. They also ate pork, Andaman water monitor lizard etc. As coastal people they relish octopus, molluscs taken out from shell of marine animals like turban shell, scorpion shell, sundial, helmet trochus and screw shell besides various types of crabs and fish. Some of the tribes were cultivating vegetables and also established poultry farms. Onges one of the most primitive tribes in India, ate turtle, fish, roots and jackfruits (Abbi, 2009).
The tribal diet was monotonous, lacking variety and they cared more for the bulk rather than quality of the diet. The common meal pattern included cereal (millet) gruel either fermented or unfermented for breakfast and rice with vegetables or dhal for dinner (Milton, 2000).

The consumption of wild food plants seem to be one of the important local survival strategies and many of these species are not just consumed during periods of drought, food scarcity and other hardships but also forms a part of their regular dietary intake (Yasodaran and Sujana, 2007).

Ram et al. (2010) reported that several edible fleshy fungi grow wild in Eastern Uttar Pradesh forest during the rainy season on dead and decaying plant or animal remains. Local tribes collect a number of mushrooms and eat during rainy season. The traditional identification knowledge among the tribes are followed from generation to generation. The bio-diversity in the mushrooms is least documented in India. The germ plasm collection of such mushrooms is very poor. These fleshy fungi are obviously nontoxic as these have been intimate human consumption since antiquity.

The study by Sprent et al. (2009) revealed that legumes were popular throughout West Africa. Peanuts were especially valued and were eaten raw, boiled, roasted or ground into meal, flour or paste. Starchy vegetables including yams, plantains, cassava, sweet potatoes and potatoes were often boiled and then pounded into a paste (called fufu).

Samydurai et al. (2012) identified that *dioscoreaceae* plant species are consumed maximum than any other wild edible roots and tuber species by ethnic communities and other inhabitants. They consume these plants either raw or after cooking, roasting or frying. These easily available plant species are the chief source of their essential nutrients such as proteins, vitamins, fats and carbohydrates.

Banik (2008) observed that in past, ecological balance between nature and Oraons was well maintained. Due to deforestation the food resources are also declined. The number of plants, animals and birds are also declined. Their usual diet consisted of rice, pulses and vegetables. Fish and meat are occasionally consumed. The striking feature is that leaves, flowers, seeds, roots and fruits are an integral part of the Oraon diet.
Sujith et al. (2014) in their study noted that dietary intake of the tribal girls was found to be very poor and much below the Recommended Daily Allowances (RDA). Rice was consumed as staple food and pulses consumption was found to be meagre. Milk intake was absent in majority of the cases. The vegetable intake was significantly less than RDA. But intake of green leafy vegetables was fairly good among the tribal female children. Fat and oil intake was also found to be very less than RDA. Seasonal fruit consumption was better. Though intake of meat and chicken was poor; consumption of snail, small fish, dry fish was observed to be better than any other food stuff. It is observed that socio-economic variables have profound influence in the dietary intake of the tribal girls.

The tribal population is recognized as socially and economically vulnerable. Their lifestyle and food habits are different from that of their rural neighbours. They depend on minor forest produce some are manual labours and hence may not have adequate income. Their food consumption pattern is dependent on the vagaries of nature and varies from extreme deprivation in the lean seasons to high intakes in the post-harvest period (Bala and Thiruselvakumar, 2009).

Layout of tribal hamlet varies from tribe to tribe. The Katkarir tribes of Maharashtra prefer to build house in a line opposite to each other houses, so as to create a lane in the centre. The Thakars build their houses close to each other, so as to form a clustered hamlet. On the other hand Bhils of Satpuda who live on the mountains and hills and in the villages live in scattered houses (Robin, 2005).

The land occupies a very central place in the tribal world. Tribal people perceive the land as sacred and co-creator with god. Indeed for the tribals, it is the land that owns people and gives them an identity (Robin, 2005).

Alcoholism is very much prevalent among the tribal people. The tribal women take the intoxicating drinks like sara (arrack), Jecluge, kallu (sage palm extract) and Maddi (rice beer). The intake of intoxicating drinks are more in Gadaba, Khond, Nooka, Dora and Konada, Kammara when compared with that of Bagata and Valmiki tribes (Kalla and Joshi, 2004).

Liquor consumption was very common at the time of rituals and festivals of tribals. Mostly country liquor will be consumed. Studies estimate that there are 15.1 million alcohol abusing or alcohol dependent tribal people; approximately 4.6 million
are women. Risk factors for alcohol use and abuse among women include age, marital status and race. Younger women report more drinking related problems than older women (Lesslie, 2000).

Alcohol and oral tobacco use were common among the tribal women of Assamese. Major non-communicable disease like hypertension, stroke, were emerging in the community and were associated with modifiable risk factors like alcohol and tobacco use (Medhi et al., 2006).

Superstitious belief prevalent among the tribals was human sacrifice. While this form of murder is declining, nevertheless Mising, Khonds, Oraons and Marias still believe in this to secure food crops and freeing the village from grip of epidemics (Kaman, 2013).

The roots of Decalepis hamiltonii and Hemidus indicus are very popular in the Kolli hills and are generally used as pickles. These are used by local traditional healthcare practitioners as stimulants, tonics, carminatives and expectorants. Decalepis oppositilifolia is given along with horsegram for women once in a day for nearly a month after giving birth to revive their strength. Decalepis puber with black taro was given for lactating mother to increase the milk flow. Boiled Decalepis hamiltonii had relief from piles while Decalepis bulbifera enhanced appetite (nopr.niscair.res.in/bitstream/.../14826 /1/IJNPR%203(3)%20432-437.pdf).

Chellaiah et al. (2006) reported that 85 species of ethnomedicinal plants distributed in 76 genera belonging to 41 families were noted in Kancheepuram tribal area. Ricinus communis - juice extracted from leaves was used to increase secretion of milk and oil obtained from seeds was used to treat stomach ache; Azadirachta indica – leaf paste was used to treat small pox, rheumatism and skin disease and young twigs were used as tooth brush; Ficus benghalensis – stem latex was used to treat heel cracks and young twigs were used as tooth brush; Moringa oleifera – boiled leaves were used to reduce body heat, to treat indigestion and eye diseases and flowers were used to cool the eyes and increase sperm production; Zizyphus mauritiana – decoction of leaf was used to get relief from body pain and bark powder was used to treat wounds; Solanum torvum – juice extracted from the leaf is used to reduce body heat and unripe fruits were used to strengthen the body.
In Binpur area, one small populace was taking 21 tulsi leaves per day. Tulsi is known for its antidiabetic potentials. In Jhargram area some villagers used banyan bark and leaves about 12 per day. A decoction of bark was prepared and consumed twice daily in a dose of 40 to 80ml. The decoction was prepared by taking around 25 to 50g of bark to which 4 cups of water are to be added (100ml of 10% solution). It is heated to make one cup, which has to be consumed. In Jhargram area selective people use flax oil as edible oil and salad oil. Flax oil is rich in omega-3 and omega-6 fatty acids and is beneficial among diabetics (Mitra, 2007).

In different areas of rural Bengal some people, particularly young ladies take young buds of China-rose (hibiscus) three to four per day and it is as a religious practice daily before worship. China-rose contains Cyanidin diglucoside, carotene, thiamin, riboflavin, niacin and ascorbic acid. Fasting blood sugar and serum insulin values of these group was low with increased insulin sensitivity as observed on experimental testing of these bio-chemical values maintaining identical conditions with control. Some people use Putranjibi leaves (Putranjiva roxburghii). It is observed that both fasting blood sugar and serum insulin values were reduced with increased insulin sensitivity (Pradhan et al., 2009).

Taid et al. (2014) accounted that plants have been used in traditional medicine for several thousand years in different parts of the world. The knowledge of medicinal plants has been accumulated in the course of many centuries based on different medicinal systems such as Ayurveda, Unani and Siddha. In India, it is reported that traditional healers use 2500 plant species and 100 species of plants serve as regular sources of medicine.

According to Perumalsamy and Ignachimuthu (2000) herbal remedies are considered the oldest firms of health care known to mankind on their earth. Prior to the development of modern medicine, the traditional systems of medicine that have evolved over the centuries within various communities are still maintained as a great traditional knowledge base in herbal medicines.

The forest resources are also not available as comparison to the past due to various forest policies and loss of forest. In the past people got food in the form of fruits like sihel, amla, harda, bahada, kendu, mahua, tamarind, berry, black berry, wood apple, dimri, kusum, mango and jack fruit in huge quantity from the forest.
Many types of leafy vegetables, roots and shoots were also available. In the past, the forest was full of trees such as shal, pia-shal, bamboo, bija, bamben, ludhi, piria, and other valuable trees. The reasons perceived by the people for diminishing of flora are: deforestation for industrial purposes for example collection of mahua flowers for burning the small plants and collection of tender kendu leaves for burning the old kendu plants and the nearby plants (Saute, 2002).

Deka (2011) studied that the major contributing factors for high prevalence of micro nutrient deficiency among tribes were low intake of micronutrient dense foods, poor purchasing power resulting from ever increasing food prices and ignorance of nutritional problems. Due to cultural reasons and poverty, the majority of people in developing counties had low dietary intake of animal products rich in micronutrients such as vitamin A, and iron.

The studies undertaken in the country by Nair (2001) indicated that the primitive tribes of Orissa have distinct health problems, mainly governed by multidimensional factors like their habitat, difficult terrain, ecologically variable niche, illiteracy, poverty, isolation, superstition and deforestation. Hence an integrated multidisciplinary approach has been adopted by different researchers to study the tribal health problems (www.rmrct.org/files _rmrc_web/centre’s/NSTH06_22RS. Balgir.pdf).

According to FAO (2010) more than half of the adults had a BMI less than 18.5 indicating adult malnutrition in the states of Gujarat, Odisha, Arunachal Pradesh, Karnataka, Maharashtra, Madhya Pradesh and Andhra Pradesh.

Ray et al. (2000) observed that prevalence of malnutrition was 62.97 per cent and prevalence of severe degree of malnutrition was 6.65 per cent. More so amongst 12-23 months of age and amongst females. Average calorie intake was 2271 kcs and nearly half (47.8%) of the studied females were getting less than 2400 Kcals. Seventy five per cent were having different degrees of malnutrition and it was significantly (p<0.05) higher than the overall prevalence rate (62.97%). Prevalence of severe degree of malnutrition was also more than double (14.58%) in children who suffered from diarrhoea than the overall prevalence of severe degree of malnutrition (6.65%) which was also statistically significant (p<0.05). Among the children with acute respiratory tract infection, 69.98 percent were suffering from malnutrition with 8.32% having severe
degree of malnutrition and both were significantly higher than the overall prevalence (p<50.05).

Prevalence of malnutrition among the children of literate mothers was comparatively lower (54.93%) than the illiterate mothers (69.55%) and the difference was also statistically significant (p<0.05). These findings were indicative of a strong association between parental literacy and nutritional status of children (Sandip, 2000).

Balgir (2004) reported that tribal communities in general particularly primitive tribal groups are highly disease prone and they do not have required access to basic health facilities. Santhosam and Samuel (2013) viewed that tribals are most exploited, neglected, and highly vulnerable to diseases with high degree of malnutrition, morbidity and mortality. The poverty, illiteracy, ignorance of causes of diseases, hostile environment, poor sanitation, lack of safe drinking water and traditional beliefs and customs add to malnutrition among tribal children. Widespread malnutrition expose these children to infection and infectious diseases, resulting in high mortality. Infant mortality among tribals was 84.2 in comparison to 67.6 per 1000 for the general population in 2002.

Short birth intervals are associated with higher levels of undernutrition. The percentage of children who are severely underweight is almost five times higher among children whose mothers have no education than among children whose mothers have 12 or more years of schooling. Undernutrition is more common for children of mothers who are undernourished themselves with a body mass index below 18.5 than for children whose mothers are not undernourished (UNICEF, 2012).

The study done by Adak et al. (2006) showed that the prevalence of chronic energy deficiency (CED) among the Kathudi (90.0%) of Maharashtra was the highest. However, it should be kept in mind that the sample size of the studied tribals from Maharashtra was very small (n=50) and with the increase of sample size (N= 200 or 300) the prevalence of CED also declines. Several recent studies from India have utilised BMI to study the nutritional status of tribal population. Therefore, the use of BMI based cut-off points for the evaluations of CED are valid for use among tribal population of India.
Rodriguez et al. (2011) indicated that malnourished children grow at a slower rate than adequately nourished ones and they are prone to infections and are more likely to have mental and developmental problems.

The study of Nagda (2004) revealed that childhood diarrhoea, anaemia and fever are major causes of infant mortality in tribal areas. Diarrhoea for instance leads to reduced intake of dietary zinc as a result of anorexia and increased loss of body zinc as a result of malabsorption or rapid gut transit time, since the main route by which zinc is lost from the body is through the gastrointestinal tract. Another highly prevalent infection that may negatively affect zinc status in tribal areas is intestinal helminthes.

Children and their well being are the basic concerns of every nation. The quality of human resources of any country is largely determined by the quality of its child development which in turn is a reflection of health and nutritional status. Today India has the highest level of child malnutrition after Bangladesh in South Asia (Mitashree et al., 2007).

ICMR Bulletin (2003) reported that the primitive tribes have distinct health problems, mainly governed by multi-dimensional factors like their habitat, difficult terrain, ecologically variable niche, illiteracy, poverty, isolation, health problems, superstition and deforestation.

Annual Report (2002-2003) Regional Medical Research Centre for Tribals showed vitamin A deficiency in the form of Bitot's spot, conjunctival xerosis and night blindness was observed in 8.9, 25.9 and 11.4 per cent Bondo; 13.7, 24.2 and 27.6 per cent Dida; 14.9, 17.9 and 7.4 per cent Juanga; and 3.4, 12.6 and 6.9 per cent Kondha tribes, respectively. However, other micronutrient deficiencies like iodine deficiency (goiter), vitamin B complex deficiency (in the form of angular stomatitis) were not encountered. Similarly a high percentage of vitamin A deficiency was observed in 24.4 per cent of Birhor tribes and 53.3 per cent of Sahariya tribes of Madhya Pradesh. Goitre was also observed in 3.4 per cent of these tribes (www.icmr.nic.in. 00051/ann2002.pdf).

Mitra (2007) used a composite with Gurmur and tested it in newly diagnosed type 2 diabetes patients between 45 and 60 years of age for a period of four weeks. Of the three cardinal symptoms for diabetes, a marked reduction was observed for
polyuria (the production of large volume of urine). The other two symptoms are polyphagia (gluttonous excessive eating) and polydipsia (abnormally intense thirst), initially observed were disappeared by 12 weeks. Control of both fasting and postprandial blood glucose was achieved in about 55 per cent of patients. Only seven per cent of the patients attained control of HbA1c by 4 weeks. None of the patients reported any side effects.

Child mortality was 46.3 per cent in comparison to 29.3 per cent for the general population. The figure for under-five mortality among tribals was as high as 126.6 per cent as compared to 94.9 per cent for the general population. The per cent of undemourished children (weight for age) was 64.9 in case of tribes; the figure being 51.8 for the general population. Childhood vaccination (full immunisation) reached a mere 26.4 per cent in comparison to 42 per cent for the general population (ibid.). Tribal people also scored low on health indicators. Health indices like birth-weight, life-expectancy at birth, infant mortality rate, prevalence of various diseases have been pointers to it. The tribal population is also affected by chronic energy deficiency in school going children, adolescent boys and girls and women of reproductive age. Around 70 to 80 per cent of the tribal population suffered from various stages of anaemia – mild, moderate or severe (Rao et al., 2005).

Budhathoki et al. (2008) studied that as 81 per cent children practice open defecation they are at risk of hookworm infestation, the most common cause of iron deficiency anaemia. Arlappa (2011) reported that it is essential to subject them to periodic deworming, which improves the absorption of micronutrients and lowers the risk of micronutrient malnutrition.

The chief causes of high maternal mortality rate are found to be poor nutritional status, low haemoglobin (anaemia), unhygienic and primitive practices for parturition. Average calorie as well as protein consumption is found below the recommended level for the pregnant as well as lactating women. Some of the preventable diseases such as tuberculosis, malaria, gastroenteritis, filariasis, measles, tetanus, whooping cough and skin diseases (scabies) are also high among the tribals. Some of the diseases of genetic origin reported to be occurring in the Indian tribal population are sickle cell anaemia, alpha and beta-thalassemia and glucose-6-phosphate dehydrogenase (G6PD) deficiency. Night blindness,
Sexually Transmitted Diseases (STD’s) are well known public health problems of tribals in India (Balgir et al., 2002).

Ray et al. (2000) observed that 56.07 per cent children with two or less member of siblings, were malnourished. On the contrary 71.33 per cent children were malnourished when number of siblings were three or more. Among the children with sibling interval of less than 36 months, 68.7 per cent children were malnourished. However, the prevalence rate was significantly less (—0.05) in children with sibling interval of 36 months or more. Higher prevalence of malnutrition was more in families having more than three siblings. The prevalence of severe degree of malnutrition among children aged one to six years was also found to be highest in tribal area (9.26%) followed by Calcutta urban slum area (8.10%) and lowest at Gosaba rural area (4.33%).

Black et al. (2003) reported that more than 60 per cent preschool children of Gond tribal community in Madhya Pradesh were underweight. Micronutrient deficiency disorders such as anaemia and vitamin A deficiency were common among them. Unhygienic personal habits and adverse cultural practices relating to child rearing, breast-feeding and weaning were also prevalent among them.

C. Contributing Factors for Vulnerability of Nutritional Deficiency Disorders in Adolescence and Adult Women

Adolescence is a dynamic period of development, with rapid changes in body size, shape and composition. Along with physical changes, cognitive, psychological and social development occurs, making this a very important period in a person’s life (Huebner, 2009).

Physical development includes rapid gain in height and weight, development of secondary sex characteristics, and continued brain development, with respect to physical development, during a one year growth spurt, boys and girls can gain an average of 4.1 and 3.5 inches in height respectively. This spurt typically occurs about two years earlier in girls than boys (Ge et al., 2001). Weight gain results from greater than before muscle development in boys, and an increase in body fat in girls (McDaniel et al., 2009).

During puberty, changing hormonal levels play a role in activating the development of secondary sex characteristics. These include growth of pubic hair,
menarche (first period for girls) or penis growth (for boys), voice changes (for boys), growth of under arm hair, facial hair growth (for boys), increased production of oil, increased sweat gland activity and the beginning of acne (Ray et al., 2011).

Physiological changes of strength and size of the heart and systolic blood pressure and blood volume increase during puberty. The pulse rate and basal heat production decrease. Boys have a higher blood volume than girls, which may be related to boys having a greater muscle mass. All formed elements of the body reach adult levels. Respiratory volume and vital capacity are increased, but respiratory rate and the basal metabolic rate decrease (Rabbia et al., 2002).

Cognitive development during adolescence results in increased self-awareness, self-direction and self-regulation. The recent study on Intelligence Quotient and cortical thickness highlights, the role of individual differences in cognitive skills (Choudhry et al., 2006 and Shaw et al., 2006).

Emotional development during adolescence involves establishing a realistic and coherent sense of identity in the context of relating to others and learning to cope with stress and manage emotion processes that are life-long issues for most people. Researchers have discovered that pubertal change is associated with an increase in negative emotions (Dishion, 2012).

Adolescence is also an important period for social development. Teens learn to negotiate friendships and romantic relationship. A disruption in this healthy development process caused by out-of-control anxiety can have a lifelong impact on a teen’s social and occupational functioning. During adolescence, people move from dependence on parents to becoming more independent and establishing peer relationship and perhaps intimate relationship (Hazen et al., 2009).

As adolescents begin to exert their independence from family life, peer influence becomes more significant and may influences food choices, characteristic patterns include irregular meals, meal skipping, frequent snacking, vending machine use, fast food purchases, high sugar-sweetened, carbonated, and/or caffeinated beverage intake and mindless eating (Moreno et al., 2010).

Food habits are characterized by an irregular meal pattern; many adolescents skip breakfast and also the school lunch, whereas most of them have dinner. However, snacking and light meals are very common, contributing
25-35 per cent of the daily energy intake. Overweight and obesity are becoming more prevalent in all the Nordic countries, even though the prevalence figures are far below those in the USA. On the other hand, dieting girls are common, which might be a factor behind their irregular meal pattern and food choice. In a perspective, overweight and diseases attributable to obesity will be an immense challenge in the coming decades for both the individuals and the society as well. At this stage of the lifespan, adolescents are confronted with body weight problems and pressure concerning eating (both with respect to the type of food they are eating and amount of food). Despite the irregular food patterns for adolescents, it is still a crucial time as dietary patterns established during childhood and adolescence continue into adulthood and have implications for the development of chronic disease, both at present and in the future (Samuelson, 2000).

In Nigeria, Brabin et al. (2008) found that adolescent girls who had low haemoglobin (<10g/dl) were more likely to have lower BMI than those who had higher haemoglobin levels, suggesting that overall malnutrition is associated with anaemia. Heavy menstrual blood loss may be an important factor of iron deficiency anaemia, as observed in Nigerian girls and it might also be related to vitamin A deficiency.

Calcium requirements for skeletal development appear to be even greater during adolescence than childhood or young adulthood. Because maximum bone mass is acquired during adolescence, calcium deposited during that period determines the risk of osteoporosis in adulthood. Adverse effects of calcium deficiency have also been observed at adolescence. For instance, it was reportedly associated with bone demineralization in lactating adolescents and increasing calcium intake reversed the condition. Regular consumption of dairy products during adolescence was found to be related to lower levels of post-menopausal bone loss, as shown in a retrospective study of Caucasian American women aged 49 to 66 years old (Lee and Jiang, 2008).

Protein Energy Malnutrition (PEM), vitamin A deficiency, Iodine Deficiency Disorders (IDD) and nutritional anaemia mainly resulting from iron deficiency or iron losses are the most common serious nutritional problems in almost all countries of Asia, Africa, Latin America and the Near East. In addition, diet related
non-communicable diseases such as obesity, cardiovascular disease, stroke, diabetes and some forms of cancer exist or emerging as public health problems in many developing countries. Even in countries like the USA and Canada, adolescents are considered as nutritionally vulnerable subgroup because of their eating behaviours’ (Muller and Krawinkel, 2005).

Adolescent girls tend to miss more meals than their boy counterparts (Vereecken et al., 2005). Meal skipping has been found to be higher among overweight adolescents than among their normal weight peers, with breakfast being the most common meal skipped (Savige et al., 2007). Both skipping breakfast and eating fast foods lead to weight gain (Ma et al., 2003).

Casey et al. (2010) in their study noted that adolescence is a significant period of human growth and malnutrition. Adolescence is the most vulnerable stage from the point of view of health. In a country like India, adolescent girls face serious health problems due to socio-economic, environmental conditions, nutrition and gender discrimination. A vast majority of girls in India were suffering from either general or specific morbidities. Diet and health are synonymous with the well-being of an individual. In the absence of proper and adequate nutrition a person can develop several developmental malformations.

Adolescents remain a largely neglected and hard to reach population especially girls. Thus it is not surprising that adolescent girl population who are mothers to be is considered as the most important section on which the future of nation depends. The study has documented that malnutrition affects body growth and development, especially during the crucial period of adolescence (Dasgupta et al., 2010).

An early marriage and child birth is a major determinant of women’s health and is also responsible for the prevailing wide variation in the socio-economic status. Inadequate and improper utilization of health facilities and widespread anaemia among all the reproductive age women, leading to high maternal mortality (540 maternal deaths per one lakh live births) (Dhingara, 2011).

Poor health has repercussions not only for women but also for their families. Women with poor health and nutrition are more likely to give birth to low weight infants. They are also less likely to be able to provide food and adequate care for
their children. Finally, a women’s health affect the household economic well-being and as a women with poor health will be less productive in the labour force. While malnutrition is prevalent among all segments of the population, poor nutrition among women begins infancy and continues throughout their lifetime (Kumar and Khan, 2010).

Vitamin D deficiency is an important public health problem among older women living in the community but is a preventable disorder and is readily alleviated with dietary supplementation. Calcium and Vitamin D supplementation may help slow bone desorption and increase bone formation (Semba et al., 2000).

The health status of tribal population groups is as such a function of the interaction between socio-cultural and socio-biological properties, the genetic attributes and the environmental conditions. The widely varying prevalent health practices, use of indigenous herbal drugs, taboos and superstitious are also responsible for determining the health behavior and health status of the tribal groups. In India, the general health status of the tribal population is known to be poor (Varadarajan et al., 2009).

Poor nutritional status and greater incidence of anaemia among tribal women is noted. Malnutrition is a tragedy for tribal women. The nutritional status of the women is always related to the economic status of the family and here the poverty has played havoc on the health and nutritional status of tribal women (Bentley and Griffiths, 2003).

It is found that the post and neonatal mortality rate is higher among the tribals than that of the overall mortality rate of the non-tribals (Niswade et al., 2011).

Nutrition knowledge also contributes to better health status (Leonard, et al., 2014) which is found lacking in the tribal groups. Negligence of health and nutritional care of children is yet another factor which has been responsible for poor health and even deaths among children in such areas.

Das and Bose (2012) stated that nutrition is an integral component of health and well-being of an individual. Good nutrients enable one to lead a socially and economically active life and improve the quality of life as evidenced through
enhanced nutritional status of population groups, better work, efficiency rate, reduced mortality and morbidity rate by raising the standard of living.

Nutrition is the science of food and its relation to people. The science of nutrition is based on the chemical constituents of foods called nutrients, which function to provide fuel, support tissue growth and maintenance and regulate body processes (http://www.nutrition-and-you.com/).

Nutrient intake depends on actual food consumption which is influenced by factors such as economic situations, eating behavior, emotional climate, cultural influences, effects of various diseases on appetite and the ability to consume and absorb adequate nutrients (Galloway, 2002).

Adequate nutrition of any individual is determined by factors like the adequate availability of food in terms of quantity as well as quality and also on the ability to digest, absorb and utilize the food which can be hampered by infection and by metabolic disorders (WHO, 2006).

In order to obtain optimal nutritional status adequate nutrients have to be consumed. This enhances normal growth and development, maintain general health and protect against chronic diseases (McCullough and Willet, 2006).

For positive health, functional efficiency and productivity, food and nutrition are the fundamental requirements. Nutrition science, thus, provides abundant evidence on the importance of nutrition, not only in promoting proper physical growth and development but also ensures adequate immunocompetence, cognitive development and work capacity (Rao, 2001).

Chaudhari and Chaudhari (2005) indicated that good nutrition is essential for life time health, strength and intellectual vitality, beginning with prenatal life and extending through old age. A lifetime of good nutrition is evidenced by a well-developed body, the ideal weight and height for body composition and good muscle development.

Studies by Iyengar (2002) revealed that the nutritional requirements of the healthy child vary widely according to their age, sex, weight and rate of growth as well as environmental factors. Deficient intake of nutrient signals the start of nutrition related disorders in adulthood.
John et al. (2005) emphasised that proper nutrition at the growing stage of life not only helps to promote health but also prevent the occurrence of deficiency diseases and other health hazards. Infesting too much or too little of a nutrient can interface with health and well-being. Thus malnutrition occurs when body cells receive too much or too little of one or more nutrients.

Nancy (2003) expressed malnutrition as a state in which a prolonged lack of one or more nutrients retards physical development or causes the appearance of specific clinical conditions. Thus, malnutrition includes under nutrition, which may be related to an individual’s inability to obtain foods that contain essential nutrients, failure to consume essential nutrients, body’s inability to use the nutrients, disease condition that increase the body’s need for nutrients and disease process that causes nutrients to be excreted too rapidly from the body.

Wahlquist et al. (2003) underlined the consequences of under nutrition which includes death, disability and stunted mental and physical growth. She further warns that poor nutrition often commences in utero and in many cases extends.

Iodine deficiency in children and adolescents is often associated with goiter. The incidence of goiter peaks in adolescence and is more common in girls. The goiter rate increases with age and reaches a maximum at adolescence. Girls have a higher prevalence than boys. Iodine deficiency results in a variety of disorders including goitre (thyroid enlargement), impaired learning ability and reduced mental function and reproductive complications such as still births, abortions and infant deaths. The iodization of salt is considered a proven intervention for the elimination of IDD and to ensure Universal Salt Iodization (USI), which is both a preventive and a corrective measure vis-à-vis iodine deficiency (Kapil et al., 2007).

Teenage mothers are at increased risk of having pre-term deliveries, still births, maternal mortality, morbidity and neonatal deaths (Debiec et al., 2010).

Deka (2011) has stated that although scheduled tribes are accorded special status under the fifth/sixth schedules of the Indian Constitution, their status on the whole, especially their health still remains unsatisfactory.

Zekri and Obreza (2002) reported that deficiencies of micronutrients such as iron and zinc often occur together. Hence the high rates of anaemia among tribal
population provide additional evidence of the possibility of marginal zinc deficiency in tribal areas. This is further supported by the high prevalence of stunting and the highly deficient dietary energy intake in the tribal population since intake of both zinc and iron are known to be highly correlated with dietary energy intake.

Kapil et al. (2003) noted that most tribes still rely on their indigenous foods which usually consists of wild unconventional forest products although some cultivate grains and other farm products for subsistence. Since the tribal diet is usually plant based with significant amounts of anti-nutritional factors which limit the absorption and bioavailability of zinc and because very limited amounts of animal source foods are consumed, these population are at high risk of zinc deficiency.

Brown et al. (2001) stated that zinc is lost from the body through urine, menstrual flow, semen and sloughed skin, nails and hair, but the quantity lost through these routes are small and may not significantly contribute to zinc deficiency.

Beck and Mishra (2010) has reported in his study that the standard of life of tribes who lived within their traditional social system may have been low on quality but poverty in the form of hunger deaths was generally absent. If at all there was starvation and hunger, deaths were mere on account of natural calamity and the community as whole suffered.

Adolescence is one of the nutritional stress period of life with profound growth comes with increased demand of energy, protein, minerals and vitamins. Poor nutrition, early bearing and reproductive health complications compound the difficulties of physical development in adolescent girls in India. Increased physical activity combine with poor eating habits and the onset of menstruation contribute to accentuating the potential risk of adolescent’s poor nutrition (Crews et al., 2007).

According to a survey report of the National Nutrition Monitoring Bureau (NNMB). It is reported that highest percentage of stunted tribal children (64-65%) with Odisha and highest percentage of severely stunted tribal children (35%) among the nine tribal states (Sarkar, 2015).

Vyas and Choudhry (2005) have recognised that iron deficiency is the major cause of anaemia in tribal communities.
Apart from low haemoglobin count, there are several other indicators of health which vary with nutritional status. The age of onset of menarche has also been found to vary according to nutritional status. As the nutritional status improves, the age at menarche is lowered (Acharya et al., 2006).

Iron Deficiency Anaemia (IDA) is very common amongst Indians due to several reasons like low dietary intake of malabsorption, excessive sweating and its prevalence varies from 75 per cent among children, women and 45 per cent among adult males (Rao, 2003).

Christina et al. (2012) regards adolescence as one of the most exciting yet challenging periods in human development, generally thought of as a period of tremendous physiological, psychological and cognitive transformation during which a child becomes a young adult. Adolescents are tomorrow’s adults and 80 per cent of them live in developing countries. India has one of the fastest growing youth population in the world.

Adolescence is a transitional stage of physical and mental development, involving biological, social and psychological changes occurring between 10 and 19 years (Choudhry et al., 2006).

Guiseppina (2000) putforth the fact that adolescence is an intense anabolic period which requires all nutrients increases. During adolescence, 20% of final adult height and 50% of adult weight are attained, bone mass increases of 45% dramatic bone remodeling occur and soft tissue, organs and even red blood cell mass increase in size. This situation is further complicated when adolescents are often exposed to infection and parasite that can compromise nutritional status.

Adolescents are a nutritionally vulnerable group for a number of specific reasons, including their high requirements for growth, their eating patterns and lifestyle, their risk-taking behavior and their susceptibility to environmental influences. Adolescents are exposed to under nutrition, micronutrient malnutrition as well as obesity. Their lifestyle and eating behaviour along with underlying psychosocial factors are particularly important threats to adequate nutrition (Belperio, 2004).

Inadequate nutrition in adolescence can potentially retard growth and sexual maturation, although these are likely consequences of chronic malnutrition in early
infancy and childhood. It can affect adolescent’s current health and put them at high risk of chronic disease as well, particularly if combined with other adverse lifestyle pattern even if the detrimental effect may take long to slow (Devaney, 2005).

Among adolescents and adults, under-nutrition is also associated with adverse pregnancy outcomes and reduced work capacity. Underweight was estimated to cause one in 15 deaths globally in 2000 (Stang and Story, 2005).

In undernourished population, growth rate during adolescence is slower. Using maximum growth spurt or menarche as an indicator, maturation may be delayed in malnourished girls by an average of two years. Iron deficiency is far most prevalent amongst micronutrient deficiencies in adolescents. Adolescents (both boys and girls) are at risk of developing iron deficiency anaemia because of the increased iron requirements (Kilegman and Sharma, 2007).

Disease such as malaria and hookworm affect both boys and girls, contributing to anaemia by iron status, whereas girls may continue to be or become more deficient because of the increased requirements for iron due to menstruation, pregnancy and lactation. Iron deficiency and anaemia may be common among adolescent athletes, owing to chronic urinary and gastrointestinal blood loss and to intravascular hemolysis that are associated with strenuous exercise combined with endurance events (Parimalavalli and Sangeeth, 2011).

Malnutrition or undesirable disease conditions related to nutrition can be caused by eating too little, too much or an unbalanced diet that does not contain all nutrients necessary for good nutritional status. Inadequate dietary intake and disease, particularly infections are immediate cause of malnutrition. Poor diet and disease are often the result of insufficient household food security, inappropriate care and feeding practices and inadequate health care practices (Taylor, 2001).

Several studies conducted by Beutler (2011) revealed that deficient intake of calories and protein among tribal population relative to the Indian RDA which may be an explanation for the high rates of stunting among this group.

The overall nutrition status among the adolescent girls of poor rural group in India (Rajasthan), was shown to be very poor. Seventy nine per cent suffered severe Chronic Energy Deficiency (BMI <16), 74 per cent from anaemia and
44 per cent had signs of vitamin B complex deficiency. In India, poor nutrition, early bearing and reproductive health complications compound the difficulties of physical development in adolescent girls (Manford et al., 2000).

Poor eating habits common to adolescents place young females at risk for such immediate health problems (Mayer et al., 2004). The major nutritional problems of adolescent girls in India include chronic energy deficiency, iron deficiency anaemia, iodine deficiency disorders (Rashid et al., 2009).

Eating disorders are the third most common chronic illness in adolescents (Kollataj et al., 2011). They are increasingly being diagnosed and are more frequent in girls than boys (Morris and Katzman, 2003). These disorders include anorexia nervosa, bulimia and a side range on unhealthy food restriction practices, such as dieting and other patterns of binging behaviour. Binge eating disorder is characterized by eating large quantities of food and feeling distressed about binge eating. Bulimia nervosa is characterized by over eating, engaging in methods of control shape and weight, specific behaviour (binge and compensate) to control weight and pre occupation with body shape and weight. Anorexia nervosa is characterized by a refusal to maintain body weight over minimal normal weight for age and height, intense fear of gaining weight or becoming fat, disturbances in the way one’s body, weight or shape is experienced, and amenorrhoea in post menarcheal girls. Primary prevention combined with early recognition and treatment help decrease the rate of morbidity and mortality in adolescents suffering from these illnesses (Bailey et al., 2014).

Brahmbhatt and Oza (2012) carried out a study at Ahmadabad Municipal Corporation area and included 900 adolescents aged 10-19 years. Out of 900 study population, 439 (48.8%) were females and 461 (51.2%) were males. Total 120 (13.3%) adolescents were found overweight, while 49(5.4%) were found obese. Overweight-obesity was significantly associated with higher socio-economic status, inadequate sleep duration at night, lack of physical activity, consumption of junk foods. Interventions should be done at adolescence period to prevent the obesity in adulthood. Life style modification can play very important role not only in preventing obesity among adolescents but also inculcating good habits for adulthood.
Overweight children and adolescents may be at increased risk of fractures, possibly because of increased load on a developing skeleton. The adolescent growth spurt is a period of particularly high calcium requirement. Greater than 90 per cent of peak adult bone mass is typically achieved by the end of the second decade of life, and 45 per cent of this bone mass is acquired during the adolescent growth spurt. Maximizing peak adult bone mass is one critical protective factor in the prevention of osteoporosis (Bonjour and Chevalley, 2014).

Feskanich et al., (2003) studies adds to the evidence that adequate vitamin D intake is associated with a lower occurrence of osteoporotic hip fractures in postmenopausal women. A high-calcium diet appears to be of less importance. Although fortified milk is one of the few food sources of vitamin D, high consumption does not appear to substantially reduce the risk of hip fracture, perhaps because of other nutrients in the milk, such as vitamin A, that do not support bone health. Because women commonly consume less than the recommended daily intake of vitamin D and additional exposure to sunlight can increase the risk of skin cancer, use of supplements or more frequent consumption of dark fish may be prudent.

Sugar found in soft drinks, sports drinks and confectionary, and the acids found in some fruits and drinks can provide the substrate for enhancing acid production and bacterial growth that can lead to dental caries (Decker and Loveren, 2003).

Agrawal et al. (2015) examined the health status of women in relation to their body mass indices and waist-to-hip ratio (WHR) by analyzing data from a follow-up study of 325 women, selected from the Indian National Family Health Survey (NFHS-2/1998–99) Delhi samples, reinterviewed after 4 years (2003). Obese women were five times more likely (OR= 4.87; p <.0001) and women with a higher WHR (> 0.90) were two times more likely (OR = 1.70; p =.050) to perceive their health condition as worse than others. Arthritis, hypertension, and shortness of breath were found to be higher among obese women and women with a high WHR. Healthy lifestyle choices must be promoted to contain the growing burden of obesity-related health problems among Indian women.

Nagamani (2014) carried out a study to assess clinical nutritional and micronutrient status profiles, a sample of 362 girls from six rural communities...
(n= 120) including scheduled castes (harizan n=90) and tribes (n= 152) were examined. Heights, weights, food intakes and serum micronutrient status were assessed using standard anthropometric, diet survey and biochemical methods. Findings indicate that all the girls studied are far below the ICMR and NCHS standards for heights and weights. Rural girls are better than tribal and harizan girls. Harizan girls are worst affected. Food intakes of the girls in all the three communities are far below the ICMR Recommendations. Significantly low values are recorded for serum protein and albumin. The findings suggest that there is an urgent need for nutrition intervention and education programmes for rural and other socially deprived adolescent girls to support the growth and safe guard the mother child life cycle.

According to the study by Kulasekaran (2012), the chronic energy deficiency women produce more number of anaemic children than the counterparts. Around forty percent of the low weight babies are born to the chronic energy deficit women. The burden of chronic energy deficiency indicates that there is a need for special public health programs that are able to address chronic energy deficiency. It is can be concluded that women of the EAG states are facing higher degree of nutritional disorder. It is found from the study that CED is a more severe problem in the EAG states than the obesity problem. The prevalence rate of CED is nearly equal to (33.9%) to the national average (35.6%). Also socioeconomic and demographic variables have a significant influence on the odds of CED in EAG states women. There is a strong association between maternal nutritional status and children's nutritional status and birth weight.

Inadequate consumption was noted for all food groups especially for green leafy vegetables, roots and tubers, fruits and milk among 4207 adolescents (14-19 years) of urban and rural areas of Perunambuco state. Adolescent students living in rural areas had a higher prevalence of low consumption of natural fruit juices while those residing in urban areas had a higher prevalence of daily consumption of soda drinks (Xavier et al., 2014).

Kabir et al. (2010) conducted a study on influence of family’s vegetables consumption on prevalence of anaemia among 80 adolescent girls in Allahabad and results showed that intake of all the nutrients were comparatively less than the recommended dietary allowances except for fat.
Tatia and Taneja (2003) studied the dietary intake of 256 tribal adolescent girls of Dhar district in Madhya Pradesh. Results revealed that consumption of cereals and pulses was 70 per cent and 25 per cent respectively of Recommended Dietary Allowances. The intake of green leafy vegetable was very low, while fruit intake was almost negligible. Hence the intake of nutrient was deficient in almost all the nutrients.

Assessment of food intake by Gowrikar (2002) showed that the diet of adolescent girls of Ujjain city, Madhya Pradesh was basically cereal based with wheat as a staple food. Frequency of consumption of pulses, milk and milk products and fruit was low.

Deepa (2002) showed that irrespective of the locality, the selected 80 adolescent girls had inadequate intake of energy and blood forming nutrients compared to ICMR recommendations, in all the seasons except folic acid (113.9µg), ascorbic acid (55.9mg) and copper (2.9mg) during rainy season, which exceeded the recommendations.

D. Prevalence of Anaemia and Prevention – An Urgent Call for Action

Anaemia is a global public health problem affecting population in both rich and poor countries with major consequences for human health as well as social and economic development. The definition of anaemia has attracted considerably interest recently because of epidemiologic studies that suggests that anaemia may be associated with poorer outcomes in a variety of disorders (Siddharam et al., 2011).

Iron deficiency anaemia is a condition in which the body has too little iron in the blood stream. Folic acid deficiency anaemia is characterized by a lack of folic acid. This is usually caused by an inadequate intake of folic acid found in vegetables or by the overcooking of the vegetables. Pernicious anaemia usually affects people between the ages of 50 and 60 and is a result of a lack of vitamin B₁₂. Aplastic anaemia is caused by an absence of reduction of red blood cells. This can happen through injury where the blood forming tissue in the bone marrow is destroyed. Sickle cell anaemia is of a hereditary nature and is a result of an abnormal type of red blood cells. Thalassemia is genetically inherited types of anaemia. It is where body genes are destructed and damaged (Patel et al., 2009).
Generally defined, anaemia is present when the haemoglobin concentration is below a normal value based on the reference population. Haemoglobin is a protein contained in Red Blood Cells (RBC) that carries oxygen to and carbon dioxide away from the body's cells. The mean normal value of haemoglobin is dependent on age, gender, race and altitude (Choudhary and Dhage, 2008).

Prevalence of anaemia in Africa and South Asia is among the highest in the world, mirroring overall high rates of malnutrition (Alene and Dohe, 2014).

Globally, iron deficiency anaemia affects four to five billion people. In India, it is a major public health problem among the pre-schoolers, adolescent girls, pregnant and lactating women. The overall prevalence of anaemia among 12 to 14 year adolescent girls is 69 per cent and for older adolescent girls (15-18 years) is 70 per cent (WHO/UNICEF/UNU, 2001).

Iron deficiency anaemia remains the most distressing problem facing the Indonesian adolescents. The available data from National Health and Household Survey revealed that 57.1 per cent of the females and 58.3 per cent of the male in the age group of 10 to 14 years and 39.3 per cent of the aged 15 to 44 years were suffering from iron deficiency anaemia (Baig et al., 2008).

Among the rural population of Bangladesh, the prevalence of anaemia is 43 per cent in adolescent girls, 45 per cent in non-pregnant women and 40 per cent in pregnant women. The rates in the urban population are slightly lower compared with rural areas, but are high enough to pose a considerable problem. It appears that severe anaemia in the Bangladeshi population is less frequent, possibly present among only two to three per cent of the population which points out that the overall prevalence of anaemia among the Bangladeshi population is still very high, but the rates of severe anaemia are almost non-existent. A half of all pre-school children and pregnant women in rural Bangladesh are anaemic, a prevalence that indicates a severe public health problem, according to new data from the Nutritional Surveillance Project. The study revealed that 23 million children in rural Bangladesh and nine million women of reproductive age are anaemic (Ahmed et al., 2012).

In the Eastern Mediterranean Region (EMR), a total of 149 million people are estimated to be anaemic according to World Health Organisation. Globally more than two billion people were affected by iron deficiency anaemia resulting from
inadequate iron intake, reduced bioavailability of dietary iron, increased need for iron, chronic blood loss and parasitic infections (WHO, 2008).

Based on the haemoglobin cut-off levels, the overall prevalence of anaemia among adolescents in Egypt was estimated at 46.6 per cent. The mean haemoglobin level among boys less than 14 years was 12.04 g/dl and for those above 14 years it was 13.14g/dl for girls, the mean haemoglobin level was 11.97g/dl of girls less than 14 years and 11.97g/dl for those above 14 years (Galal, 2000).

Ansari et al. (2008) revealed that anaemia prevalence in pregnant women in area of Pakistan was 90.5 per cent. Of these 75 per cent had mild anaemia (haemoglobin from 9.0 to 10.9g/dl) and 14.8 per cent had moderate anaemia (haemoglobin from 7.0 to 8.9g/dl) and only 0.7 per cent were severely anaemic (haemoglobin <7.0g/dl).

World Health Organization has estimated the prevalence of anaemia in pregnant women as 14 per cent in developed and 51 per cent in developing countries and 65-75 per cent in India. About one third of the global population (over 2 billion) were anaemic (Shaw and Friedman, 2011). In the developing world alone 370 million women suffer from anaemia (Mohanram et al., 2002).

Africa has the highest prevalence of anaemia for all groups of population, but the greatest numbers of people affected are in Asia, where 58 per cent, 56 per cent and 68 per cent of the anaemia burden in pre-school aged children, pregnant women and non-pregnant women respectively exists. The majority of these people live in South Central Asia (Dim and Onah, 2007).

A study revealed that low consumption of diets, such as red meat, vegetables, fruits, and cereals has been reported to be associated with iron-deficiency anaemia. Iron/iron-rich food intake frequency was statistically insignificant for the anaemic subjects (p=0.487, 95% CI 0.7-1.4) while it was significant in case of non-anaemic subjects (p<0.0001, 95% CI 1.9-4.6) (Al-Quaiz, 2001).

According to Mikki et al. (2011) anaemia still persists among children in the age range of 13 to 15 years and women of child bearing age in Palestine. Based on the haemoglobin level the prevalence of anaemia was significantly higher in Hebron
than in Ramallah among boys (22.5 per cent versus 6 per cent respectively), while among girls the figures were similar (9.2 and 9.3 per cent respectively).

Other nutritional deficiencies certainly play a role in the occurrence of anaemia, but the global prevalence data for these deficiencies are limited (Jamil et al., 2008).

Anaemia is still one of India’s major public health problems, especially among adolescent girls. The highest prevalence of anaemia (99.9%) was observed in Jharkhand in eastern India. The prevalence in the north eastern states was relatively low. The highest prevalence rates were observed among older girls (15 to 19 years), illiterate girls living in rural areas, girls in illiterate households, girls from households with a low standard of living, non-christian girls, girls from scheduled tribes, girls living in West India and married girls. The highest percentage of girls with normal haemoglobin were reported among Christian Scheduled Tribes (39.4%) and among girls in north eastern India (40.1%) (Gupta et al., 2011).

Vemulapalli and Kumaresa Rao (2014) conducted a study at Vizianagram, Andhra Pradesh and revealed that nine hundred eighty-six subjects were enrolled for the study of whom all the study subjects did not meet the criteria of WHO standards of normal grade i.e >11gm/dl. One hundred per cent anaemic condition was seen in which 52.73 per cent has a mild degree of anaemia, 40.97 per cent have moderate degree of anemia and 6.28 per cent of population has severe degree of anaemia. Pregnant women in 1st trimester of their gestation period has higher prevalence rate than in 2nd and 3rd trimesters. Parity has not showed any significant relation with anaemia.

Kulkarni et al. (2012) study revealed that the overall prevalence of anaemia among adolescents girls in an urban slum area of Nagpur was found to be very high (90.1%). Majority of the girls were having mild or moderate anaemia (88.6%). A significant association was found between adolescent girl’s education, mother’s occupation and anemia. No association was found between menstrual factors and anaemia. Nutrition education along with nutritional supplementation and iron folic acid tablets should be provided to all girls.

A study conducted by Medhi et al. (2007) among adolescent girls of tea garden workers in Assam, the prevalence of stunting was found to be more among
girls than among boys, but prevalence of thinness was higher among boys than among girls. The mean body mass index was higher among girls of all ages than among boys. Overall, half of the adolescents were stunted and most of them were thin.

The state Chattisgarh has the highest percentage of adolescent girls who are either moderately or severely anaemic (88) followed by Haryana (86). In the states of Andhra Pradesh, Bihar, Delhi, Gujarat, Himachal Pradesh, Jharkhand, Madhya Pradesh, Maharashtra, Orissa, Punjab, Uttar Pradesh and West Bengal, the combined prevalence of either moderate or severe anaemia among adolescent girls in the range of 70 to 80 per cent. The states where the per cent is between 50 and 70 per cent included Karnataka, Tamil Nadu, Uttarakhand, Arunachal Pradesh, Tripura and Nagaland. In the rest of the states in India, the per cent of adolescent girls who are either moderately or severely anaemic is less than 50. High concentration of anaemic adolescent girls is found in the districts of EAG states, Gujarat, Maharashtra, Punjab, Haryana, Orissa and Assam. Prevalence of anaemia among adolescent girls is relatively low in South India, Jammu and Kashmir and in north east, excluding Assam (Toteja et al., 2006).

Jondhale et al. (2001) reported the prevalence of anaemia as 14 per cent in adolescent girls where the household income was more than ₹5000 per month and as 26 per cent where the household income was less than ₹5000 per month. The prevalence of anaemia was found to be decreased with an increase in the socioeconomic status. It was 96.3 per cent among the low socio-economic group males, 86.9 per cent among the middle socio-economic group males and 84.6 per cent among the high socio-economic group males, whereas the prevalence was 98.8, 87.6 and 89.8 per cent among females of the low, middle and the high socio-economic group.

Study on prevalence of anaemia in 100 adolescent girls (13-18 years) in Manipur revealed that among the total subjects, 30 were moderately anaemic (7-10g/dl) and 25 girls were mildly anaemic (10-12g/dl) while ten girls were severely anaemic (<7.0g/dl) (Champaneri et al., 2014).

In Assam, 97 per cent of adolescent girls had anaemia. Sixteen per cent of them are mildly anaemic, 41 per cent are moderately anaemic and 40 per cent are having severe anaemia. Except mild and severe anaemia, the
occurrence of anaemia in all other categories was found to be higher in urban areas than in rural areas (Singh et al., 2008).

Iron deficiency anaemia can cause reduced work capacity in adolescents and adults and impact motor and mental development in children and adolescents (Mittal and Srivastava, 2006). Iron deficiency anaemia may affect visual and auditory functioning and is weakly associated with poor cognitive development in children and adolescents (Killip et al., 2007).

Adolescents are vulnerable to iron deficiency because of increased iron requirements related to growth. Sugali boys and girls showed larger deficiencies in their nutrient intakes. Inadequacy in protein and calories (P-C) is high both among males (47.0%) and females (41.6%). Caloric deficiency (C-) is higher in Sugali males (66.9%) and females (59.3%) than is protein deficiency (P-), which is 48.2% in males and 43.5% in females (Reddy et al., 2000).

In children anaemia affects physical growth and mental development. Other consequences including reduced levels of energy and productivity and impaired immune system function – develop as children mature. Girls often enter their active reproductive years in late adolescents with poor iron status. Many girls in the world (at least 25%) had their first child by age 19 and great more shortly afterward. Because pregnancy requires more iron for increased blood production, an iron deficit can result in negative reproductive consequences; an estimated 47 per cent of women of reproductive age in developing countries are anaemic. During pregnancy, 59 per cent are estimated to be anaemic. Anaemia during pregnancy is associated with prematurity, low birth weight, still birth, neonatal infection and maternal mortality. Besides these, anaemia in pregnancy may be associated with a higher risk of hypertension and heart disease in the offspring of anaemic mothers. Anaemia is also related to perinatal and maternal mortality (Batra and Sood, 2005).

Iron deficiency anaemia also reduces physical work capacity, as suggested by positive impact of iron supplementation on work productivity of women tea pickers in Indonesia, and Chinese women working in factories (Sen and Kanani, 2006).

According to Toxqui and Vaquero (2015) iron deficiency has shown to reduce endurance among athletes. There is evidence of short term effects of
anaemia on performance capacity and recovery form physical activity, as assessed by heart rate in British adolescent’s girls from different ethnic backgrounds. If even mild anaemia affects physical activity, it may in the long term affect bone and heart health since it may prevent a healthy pattern of physical activity from being established in adolescence. Risk of osteoporosis and bone fracture is inversely proportional to exercise levels, and activity levels in adolescents may be reflected in activity levels at middle age. Similarly, physical activity is a protective factor in relation to heart disease.

Although nutritional iron deficiency anaemia has declined in industrialized nations, it affects an estimated two billion people worldwide. Even in the U.S iron deficiency is most prevalent nutritional deficiency. It is highly associated with poverty. People in lower socioeconomic groups had double the risk of those who are middle or upper class. Maternal hemoglobin level, family wealth and food insecurity were also important factors. Strategies for minimizing childhood anaemia must include optimized iron intake but should simultaneously address maternal anemia, poverty and food insecurity (Pasricha et al., 2010).

Few studies had examined the risk factors associated with anaemia and iron deficiency in aboriginal population in Canada. Results of the current study suggest that infection with H.Pylori, consumption of cow’s, evaporated milk and prolonged breastfeeding are major contributing factors. Evaporated milk is low in iron and nutritionally incomplete cow’s milk contains only a small quantity of bioavailable iron and its consumption in young infants may lend to occult blood loss and resulting anaemia (Zlotbin et al., 2005).

Research shows that there are some risk factors associated with the development of anaemia. The pathophysiologic bases for some chronic anemias with low reticulocyte production are reviewed in terms of the bone marrow (BM) events that reduce normal rates of erythropoiesis. These events include: apoptosis of erythroid progenitor and precursor cells by intrinsic and extrinsic factors, development of macrocytosis when erythroblast DNA replication is impaired, and development of microcytosis due to heme-regulated eIF2α kinase inhibition of protein synthesis in iron-deficient or thalassemic erythroblasts (Koury and Rhodes, 2012).
Djokic et al. (2010) studied on risk factors associated with anaemia among Serbian school age children 7 to 14 years old. Anaemia among School Aged Children (SAC) is known to be a significant global problem affecting 305 million SAC. In developing countries in population group of SAC for school age children and adolescents prevalence rates from 29.2 per cent to 79.6 per cent, respectively, had been reported. This may reflect inadequate nutritional iron intake, generalized malnutrition or low iron bioavailability of the diet. Furthermore, it is well confirmed that increased risk of iron deficiency in SAC of 12-14 years old adolescents is associated with increase in iron demands because of the rapid growth.

The consequences of iron deficiency are many and seriously affect net individuals health but also the development of societies and countries. Therefore preventive and control measures need to be performed when the prevalence of anaemia in the population varies between five per cent and 19.9 per cent. Nutritive deficiencies cause 50 per cent of all types of anaemia and is the most common cause of isolated chronic anaemia occurring more often in SAC originating of low income families. Likewise, socio- demographic and physical activity underlying factors, as mother’s formal education, race, nutritional practices, knowledge and decreased physical activities respectively, were additional risk factors associated with lower haemoglobin levels. The goals of treating iron deficiency anaemia are to treat its underlying cause and restore normal levels of red blood cells, haemoglobin, and iron (Berber et al., 2014).

Dietary modification to improve iron status include increasing total iron intake and encouraging dietary and lifestyle practices that favour enhanced iron absorption. Increasing total food intake has been shown to increase Iron intake in studies conducted in India. In addition, bioengineered foods may offer another means for dietary modification in the near future. Genetically engineered high iron rice, bio engineered high phytase rice, low phytic acid maize and rice containing soybean ferritin gene are a few examples. Bioavailability studies are underway to examine the potential contribution for reducing IDA by these means. Higher cost, yield considerations and sustainability of the genetically modified seeds in various environments may need to be considered (Moretti et al., 2013).

Dietary modification involves increased iron intake, by increasing total food intake and consumption of locally available iron rich food and dietary practices
favouring iron absorption. One way to improve the absorption of iron food is to increase the intake of vitamin C. This enhances the absorption of non-haem iron if the two nutrients are consumed within an hour of each other. The efficacy of vitamin C in vitamin C rich foods is the same as that of the synthetic form. However, these are few data on the feasibility, and effect on iron status, of increasing intake of vitamin C from locally available foods (Patil et al., 2014).

The prevalence rates of iron deficiency anaemia in female university students of Tehran aged 18 to 25 years were 40.9 per cent and 3.8 per cent, respectively (Shams et al., 2010). A study by Thankachan et al. (2007) showed that the prevalence rates of anaemia was 62 per cent in young women of low socio-economic status in Bangalore, India. The majority of these anaemic women were iron deficient and the primary factors responsible for this high prevalence rate in this population were inadequate intake of dietary iron, poor bioavailability and a concurrent inadequate intake of dietary micronutrients.

Chang et al. (2009) highlighted that anaemia is a common disorder of the haemopoietic system commonly found in the developing countries. They observed that the prevalence of anaemia amongst adults (41.7 per cent) was higher than adolescents (28.3 per cent). Nutrient intake of anaemic adolescents was lower than non-anaemic adolescents but they also stated that the prevalence of anaemia in adolescent girls and reproductive age women could be helpful in combating this common disorder in the urban population.

Studies of Srihari et al. (2007) showed that anemia prevalence (hemoglobin concentration <120 g/L) ranged from 19 to 88 percent across five different cities in India. Other micronutrient deficiencies including, folate, riboflavin, niacin, vitamin C, vitamin A, and vitamin B_{12} were also present based on biochemical parameters in one study and clinical signs of deficiency in three other studies.

A study by Kakkar et al. (2010) revealed that overall prevalence was 58.4 per cent among adolescent schoolgirls. Prevalence of anaemia was dependent on the knowledge about prevention of anaemia, literacy level, food habits, birth order and also frequency of inclusion of iron rich sources like, green leafy vegetable and non-vegetarian diet. While there was no significant relation of anaemia with duration of menstrual flow but there was significant (P<0.05) difference in number of anaemic cases with age at menarche i.e. with higher age at
menarche; there was more chances of anaemia. Level of anaemia was higher (p<0.05) in early adolescent (10-13 years) age group (81%) as compared to middle (58.3%) and late adolescent (17-19 years) age group girls (48.7%).

During adolescence, iron requirements are increased, reaching a maximum at peak growth and remaining almost as high in girls after menarche to replace menstrual loss. Iron requirements for adolescents are even higher in developing countries because of infectious diseases and parasitic infestation that cause iron loss (Pattnaik et al., 2013). Iron deficiency adversely affects thyroid metabolism by reducing iodine prophylaxis efficacy in regions with endemic goiter (Rosenzweig and Volp, 2000).

Anaemia in adolescent girls revealed that greater than 70 per cent of adolescent girls in low income communities had haemoglobin levels less than 10g/dl. When WHO cut off 12g/dl was compared, the prevalence was even higher (80-90%). Prevalence of anemia is very high with 78.75 percent in vulnerable groups even in higher socioeconomic status. It is more in public school participants (43.5%) than that of private school respondents (35%) (Premalatha et al., 2012).

Assessment of status of anaemia among pregnant women by Nagaraj (2003) explored that the etiology of severe anaemia in pregnancy is multifactorial and can be expected to vary by geographical region.

Bulliyy et al. (2007) revealed that the mean haemoglobin concentration was 9.7±1.4g/dl (range, 4.5-13.4 g/dl). Significant positive associations were found between haemoglobin concentration and pre-menarch, community, education levels of girls and their parents’ family income, Body Mass Index and mid-upper arm circumference. The study revealed that prevalence of anaemia was extremely high in non-school going adolescent girls (most were moderately anaemic).

Choudhary et al. (2003) stated that in India, a large number of adolescents suffer from chronic malnutrition and anaemia, which adversely affect their health and development. Clinically one out of four adolescent girls suffered from anaemia.

A study conducted by Goyle and Prakash (2009) in Jaipur city, India revealed that 96.3 per cent of the adolescent girls suffered from anaemia, 31.2 per cent of whom had mild deficiency and 65.1 per cent had moderate deficiency. About 31 per cent of the subjects had normal levels while the rest
69 per cent had low levels of serum iron. Conclusively, anaemia was highly prevalent in the studied population and the adolescent girls had low haemoglobin, serum iron and serum ferritin levels.

Shahabuddin et al. (2000) conducted a study on nutritional status of adolescents in a rural community of Bangladesh. It is reported that 98 per cent (1453 out of 1483) of adolescent girls suffered from anaemia.

The prevalence of anaemia in 504 adolescent girls (10-18 years) representing 24 subcentres of village of Daurala block of Meerut was 34.4 per cent. The prevalence of mild, moderate and severe anaemia among adolescent girls was 19 per cent, 14 per cent and 1.4 per cent respectively. Majority (55.2%) had a mild anaemia and only 4.0 per cent had severe anaemia (Rawat, 2001).

Swarnalatha and Yegammai (2006) assessed the impact of iron, vitamin A and vitamin C supplementation on anaemic adolescent girls on 100 school adolescents girls (13-15 years) of Coimbatore. Prevalence of pale conjunctiva was greater (60%) in both experimental and control groups. After supplementation of iron, vitamin A and vitamin C, there was remarkable reduction observed in experimental group, while in control group, prevalence of pale conjunctiva was greater.

Devi and Uma (2005) studied the clinical symptoms of anaemia in 100 adolescent girls (14-16 years) from Sri Avinashilingam higher secondary school for girls in Coimbatore. The results revealed that almost all the signs of iron deficiency anaemia were observed and none of them was affected by koilonychia and poor stamina.

Handa et al. (2008) observed the various signs and symptoms of anaemia among adolescent girls from Allahabad like breathlessness, tiredness and pale nails by the clinical examination.

Srihari et al. (2007) Studies showed that anaemia prevalence (hemoglobin concentration <120 g/L) ranged from 19 to 88 percent across five different cities in India. Other micronutrient deficiencies including, folate, riboflavin, niacin, vitamin C, vitamin A, and vitamin B12 were also present based on biochemical parameters in one study and clinical signs of deficiency in three other studies.
Gawarika et al. (2006) reported that the mean haemoglobin was 9.80g/dl and overall prevalence of anaemia was 96.5 per cent in 459 girls of 10-18 years of age in Ujjain.

A study conducted by Kaur et al. (2006) on 630 adolescent girls (13-16 years) in four villages of Sevagram, revealed that prevalence of severe, moderate and mild anaemia was 0.6 per cent (<7 g/dl), 20.8 per cent (7-10g/dl) and 38.4 per cent (10-12g/dl) respectively.

Shekhar (2005) undertook a study on iron status of 150 adolescent girls to evaluate their physical fitness. Haemoglobin level estimation showed that 45 per cent of girls were non-anaemic (<12g/dl), 12.6 and 46 per cent were found to be moderate and mild anaemic respectively. None of them were severely anaemic.

Healthy eating can prevent childhood and adolescent health problems such as obesity, eating disorder, dental caries and iron deficiency anaemia (Daniels et al., 2005). Nutritional requirements are greatly increased during period of rapid growth in adolescence. Adolescent boys need more calories than do girls throughout the growth period (Dwyer, 2009).

E. Intervention Programmes – Sustainable Outlook for Good Health

Nutrition interventions are planned actions that introduce new goods and services into the existing food system for the explicit purpose of improving the nutritional well-being of designated groups. The potential effectiveness of nutrition interventions can best be realised if they are planned and designed within a larger conceptual framework. Although individual nutrition interventions can be and have been mounted as separate activities, nutrition intervention has been most successful where it was viewed as an integral part of a country’s overall development efforts aimed at improving the well-being and productive potential of the poorer groups (Sinha and Sharma, 2013).

Nutrition education is a multifaceted factor. It involves a combination of educational strategies consciously constructed for learning accompanied by environmental supports, designed to improve knowledge, develop life skills, influence attitudes, beliefs facilitate voluntary adoption of food and nutrition related behaviour conducive to health and well-being (Contento, 2008).
Nutrition education is defined as “any set of learning experiences designed to know about the essentials of nutrition, to facilitate the voluntary adoption of eating and to take steps to improve the quality of their diets, thus their well-being and have a healthy life (Seibel, 2012). It has the potential to play an important role in ensuring food security and improving nutritional status of an individual and community (Paul et al., 2011).

Nutrition education refers to any communication system that teaches people to make better use of available food resources. Most of the other approaches to nutrition intervention require an educational component. However, education also may be the primary form of intervention. Nutrition education works to change both simultaneously, and it should make use of a number of principles that have been proved to promote the change process (Stang and Story, 2005).

Nutrition education presents some unique challenges in the health education area. While the origin of all human behaviours is complex, nutrition education has the additional problem that good nutrition involves the capacity to discriminate among many different foods. On this basis, it can be seen that face to face methods are likely to be the most effective for nutrition education (Kelishadi et al., 1999).

Nutrition education is the behaviour approach and systematic influence exerted by a mature person upon the immature, through instruction or supporting the harmonious development of physical, intellectual, aesthetic, social and other abilities of human beings by providing appropriate stimulation and environment (Escamilla et al., 2008).

Nutrition education is the process by which beliefs, attitudes, environmental influences and understanding about the food lead to practices that are scientifically sound, practical and consistent with individual needs and available food resources. Nutrition education about personal food and health practices will lead to eat the kinds and amounts of foods that will make a maximum contribution to health and social satisfaction. Health education is the process that bridges the gap between health information and health practices (Sajjan et al., 2011).
There is need for providing information to youth so that they are better informed and better adjusted to their changing physical, biological and health needs (Rabe et al., 2006).

Nutrition education should be centered more on giving adequate information about food, nutrition and prevention of nutrition problems than on helping people make decisions. Thus there has been an increase in the importance of information and communication fields with respect to strategies for the production, circulation and control of information about food and nutrition (Santos and Silva, 2005).

Among the existing health and nutrition programmes, the education component is known to be weakest link. Hence, it is essential that all the health personnel are armed with necessary information regarding every health and nutrition programme (Sinha et al., 2012).

Economic independence, leadership qualities and skills to change and adopt technologies along with education is vital for the development of women in nation (Umezinwa and Chigbata, 2013).

Nutrition education is the vital aspect of health care. For delivering health and nutrition messages any modern media as well as traditional media like radio, television, folk song, drama, puppetry and story telling and printed materials like handouts, booklets, posters and pamphlets can be used (Pattanaik, 2004).

Sakamaki et al. (2005) suggested that the university and college arenas represent the final opportunity for nutritional education of a large number of students from the educator's perspective. Their findings suggested the need for strategies designed to improve competence in the area of nutrition, especially with respect to information relating to sources of nutrition and healthy weight management.

A cross-sectional study conducted by Kapur et al. (2003) suggested that nutrition education did have a positive effect on the iron status possibly by improving the dietary iron intake. Long-term community-based approaches involving dietary education emphasizing optimum feeding schedules and adequate diets for children may possibly reduce the risk of anemia and raise iron status.

Most important determinants of the women's nutrition knowledge were educational level, age and their kind of occupation. Women who had better
knowledge of nutrition also exhibited better dietary behaviour, thus underlying the importance of nutrition education for improving dietary behaviour (Vriendt et al., 2009).

Nutrition education offers a great opportunity to individuals to learn about the essentials of nutrition for health and to take steps to improve the quality of their diets, their well-being and have a healthy life (Dodds, 2009).

The most common types of intervention are breast feeding promotion, growth for monitoring and promotion, communications for behavioural change (including improved complementary feeding), nutrition education, supplementary feeding and micronutrient supplementation. These are primarily community based interventions, although they may or they may not be community driven. Food fortification and food based approaches are the most effective measures to control micronutrient deficiency like iron (Butte et al., 2002 and Tulchinsky, 2010).

Supplementary feeding consist of supplementing the normal diets of vulnerable groups (preschoolers, pregnant and lactating women) with the types of food needed to alleviate their nutrition deficits. Nutrition education intervention is aimed at improving the utilisation of existing good quality food for the nutritional betterment of vulnerable groups. It shines to alter purchasing, preparation and feeding behaviour to counter certain deleterious food related habits that have been found to exist among varying income levels. Fortification intervention attempts to overcome specific nutrient deficiencies in the diet by adding the missing nutrients to a commonly consumed food when it is processed (Diehr et al., 2007).

According to a study on weekly supplementation of iron on tribal girls of Nashik district, Maharashtra, India the decline of anaemia was statistically significant (P<0.001, 48.6% from 68.9%) and a significant rise in the mean haemoglobin levels was seen thereby concluding that weekly supplementation of iron was effective (Deshmukh et al., 2008).

Haldar et al. (2015) revealed that Parental involvement for life style and dietary modification may curb childhood anemia and also parental involvement in nutrition education process leads for the improvement of the dietary habits of the children. Although the teachers knowledge of symptoms, causes and prevention of anaemia was the highest of the groups, the reliability of their knowledge was
doubtful. Based on these facts, it is evident that there is a need to develop activities which will ensure that parents and children are provided with adequate education in order to raise their knowledge of anaemia. The results of the study suggest the need for review of current anaemia education programme in the country.

Kaur and Singh (2001) revealed that a coordinated communication strategy is required to improve anaemia prevention practices in the community. A health education strategy based on gentle persuasion is likely to be more successful by involving all the family members in the nutrition education activity. Participatory activities such as role-play allow the women to express many difficult situations that they encounter in their families. It not only helps in problem identification but the group can also find a suitable context specific solution. Social marketing and education is vital strategy to bring about desired change in feeding behaviour. Improved production, availability and access to foods at affordable prices is another important component.

Nutrition signboards and posters have high visibility in rural areas because of a general scarcity of visual materials. Small posters and calenders are often treasured in village homes. Comic books have been used effectively for nutrition education. Photo novels are potentially more effective than comics because of their greater realism, but they have not yet been used widely. Reading materials such as leaflets, booklets and texts are important for the more educated segments of the population who act as opinion leaders and for field workers. Newspaper articles and advertisements, direct mail and product labels and package inserts also reached influential groups (Pennington and Hubbard, 2002).

Kumar (2001) evaluated the effectiveness of nutrition education through comic book and audio cassette in Uttarakhand and they concluded that comic book was found to be better nutrition education material than the audio cassette.

Interventions to address anaemia include nutrition education, increased access to and consumption of nutritious foods, increased physical activity and targeted weight loss programmes (Savita et al., 2013).

Children spend the majority of their days in schools. Schools provide a perfect place for teaching children about healthy eating. Increasingly schools are
interested in innovative programmes that focus on improving student nutrition (Arnold and Schreiber, 2012).

Nutrition education through the schools has wide potential coverage. The same visual materials produced for non-formal education of mothers may be used for teaching in the elementary school. Nutrition probably is best incorporated into other subjects, such as health, agriculture, art and arithmetic rather than taught in separate nutrition classes. School should have a tape measured and scale so that children can record their own growth. Secondary school students also should learn about nutrition, although they represent an elite minority. Secondary school girls, in particular should learn the benefits of breast feeding. School lunch programmes should contribute to nutrition education by involving children in growing foods for the school lunch and planning and cooking the meals (Merlo et al., 2012).

Interventions using an integrated approach for the development of the whole adolescent are required. The most effective and sustainable health programmes reportedly offer a variety of services, including counseling family life education, training in job skills as well as physical examinations, treatment of diagnosed conditions (Hendriks et al., 2012).

Comprehensive programmes directed at multiple risk behaviours are more likely to be successful than those targeting single specific behaviour as concluded from studies on adolescents’ risk behaviours in general or related to health. It is widely recognized that eating and other lifestyle behaviours are associated with health. There is mounting evidence in developed countries that programmes targeting youth are not effective when they are too short, single focused, too late and when they stress negative behaviours to avoid, rather than promoting positive behaviours, whereas others, school based or community based, most probably had positive outcomes because of the holistic approach (Burt, 2002).

The common adolescent health agenda of WHO, UNEPA and UNICEF provides a useful framework for integrated and successful programme which should be designed to provide accurate knowledge, build skills, provide counseling, improve access to health services and create safe and supportive environments. The challenges guiding concepts, interruption settings, key players and key to success are mapped. At the centre of the model, promotion, prevention and response to problems and needs are in interaction under ‘programming’. Anaemia,
obesity and dental caries are the identified nutrition related key health problems along with reproductive health, infection, cancer, violence, accidents and disabilities. This framework is well adapted to country programming for adolescent nutrition, as long as improving access to food is emphasized as part of the supportive environment whatever the setting and provided some context-specific adaptations are made. In order to devise coherent nutrition strategies, prioritize, the need should be integrative and effective in addressing malnutrition, micronutrient deficiencies and diet related chronic diseases (WHO, 2003).

Kaur et al. (2007) reported that nutrition education is an effective measure to bring about the favorable and significant change in adolescent nutrient intake. Mass information and awareness programmes are needed to alert government and communities about the importance of health and nutrition.

The Government of India has been implementing several programmes for overall development of the tribal communities. Scheduled Tribal Welfare Department is committed for all round development of Scheduled Tribes through formulation of policies and programmes in the state of Andhra Pradesh (Ravinder, 2014). In spite of vulnerable segment of population adolescent girls of many indigenous communities have suffered higher degree of undernutrition and lack of adequate attention. The nutritional status of Kora-Mudi children in West Bengal is critical. Appropriate measures should be taken by the respective authorities to improve childhood health and nutritional status (Bisai and Mallick, 2011).

An investigation was undertaken by Sajjan et al. (2011) with an objective to determine the impact of nutrition education intervention on the hemoglobin status of 60 anemic rural adolescent girls aged between 13-16 years. The nutrition education intervention by using “Child to Child nutrition education technique” for three months. The pre and post scores of the experimental and control groups were assessed. The student t-test showed significant difference between the mean knowledge within the experimental group. When their haemoglobin level was considered after three months of education intervention, the communicators group, a significant increase (7.70%) in the hemoglobin level was observed. A marked increase in communicatees group was also observed but was statistically not significant. Thus nutrition education is one of the appropriate, effective and sustainable approach to combat iron deficiency anemia.
Kaur et al. (2011) study revealed that 62 per cent of girl students had mild anemia (Hb>12gm/dl), and 14 per cent of them had anemia of moderate degree (Hb>12gm/dl) at baseline which was significantly improved by nutrition education intervention in the follow up study after 12 months. Nutrition education is one of the appropriate, effective and sustainable approach to combat iron deficiency anemia.

Statistical analysis revealed a positive correlation between hookworm infestation and anaemia possibly due to indiscriminate defecation, bare foot and lack of health awareness. An appropriate intervention resulted in the reduction of worm infestation and improvement of anaemia status in 51.2 and 34.8 percent of individual respectively (Hotez et al., 2004).

Bhushanam and Rani (2013) studied the impact of nutrition messages were studied in a phased manner on 100 farm women (20 each from 5 villages) using a pre-tested questionnaire in the operational villages of All India Coordinated Research Project (AICRP) on Home Science, Ranga Reddy District, Andhra Pradesh. There is a significant impact of nutrition messages on the gain and retention of knowledge among the farm women culminating in healthy practices by 44 per cent.

The study by Meti et al. (2006) revealed that nutrition education and carbohydrate supplementation to 30 male adolescent football players in Dharwad district for a period of three months improved their nutrition knowledge and practice, physical and field performance during the competition.

The studies by Kaur et al. (2007) indicated that the mean score on nutrition knowledge has been increased significantly (P≤0.01) from 11.17±1.42 to 19.6±1.8 among the 60 adolescent girls in the age group of 13-19 years after the nutrition education. The nutrition education also significantly raised the mean nutrient intake of carbohydrate, protein, fat, vitamins and minerals.