IMPACT OF DIETARY INTERVENTION ON NUTRITIONAL STATUS OF ANEMIC ADOLESCENT GIRLS OF KANGRA DISTRICT (HP)

THESIS

By

PREETI CHAUDHARY
(H-2013-40-001)

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CHAUDHARY SARWAN KUMAR
HIMACHAL PRADESH KRISHI VISHVAVIDYALAYA
PALAMPUR – 176 062 (H.P.) INDIA

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Dr. Radhna Gupta
Associate Professor

Department of Food Science, Nutrition and Technology
CSK Himachal Pradesh Krishi Vishvavidyalaya
Palampur-176062 (HP) India

CERTIFICATE – I

This is to certify that the thesis entitled **"Impact of dietary intervention on nutritional status of anemic adolescent girls of Kangra district (HP)"** submitted in partial fulfillment of the requirements for the award of the degree of **Doctor of Philosophy (Home Science)** in the discipline of **Food Science and Nutrition** of CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur is a bonafide research work carried out by **Ms. Preeti Chaudhary (H-2013-40-001)** daughter of **Shri Onkar Chand** under my supervision and that no part of this thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of this investigation have been fully acknowledged.

Place : Palampur
Dated : 25th July 2017

[Dr. Radhna Gupta]
Major Advisor

CERTIFICATE- II

This is to certify that the thesis entitled **“Impact of dietary intervention on nutritional status of anemic adolescent girls of Kangra district (HP)”** submitted by **Ms. Preeti Chaudhary (H-2013-40-001)** daughter of **Shri Onkar Chand** to the CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur in partial fulfillment of the requirements for the degree of **Doctor of Philosophy (Home Science)** in the discipline of **Food Science and Nutrition** has been approved by the Advisory Committee after an oral examination of the student in collaboration with an External Examiner.

(Dr. Radhna Gupta)
Chairperson
Advisory Committee

External Examiner
(   )

(Dr. Y. S. Dhaliwal)
Member

(Dr. Nageswer Singh)
Member

(Dr. Promila Kanwar)
Dean’s Nominee

Head of the Department

Dean, Postgraduate Studies

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Every foot print of mine,
Found beside one of thine,
Escorting every move of mine,
Towards the destination You defined,
Which once, twinkled a far,
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LIST OF ABBREVIATIONS USED

cm	:	centimeter
m	:	meter
kg	:	kilogram
g	:	gram
mg	:	milligram
dl	:	deciliter
BMI	:	Body mass index
TFS	:	Triceps Skin fold thickness
RDA	:	Recmmended Daily Allowances
SDI	:	Suggested Dietary Intake
Kcals	:	Kilocalories
Fig.	:	Figure
hr	:	hour
min	:	Minutes
e.g.	:	For example
i.e.	:	that is
viz.	:	videlicet (namely)
et al.	:	and others
PFI	:	Physical Fitness Index
KAP	:	Knowledge Attitude Practice
CD	:	Critical Difference
S.E.	:	Standard error
t- value	:	student ‘t’ test

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Department of Food Science, Nutrition and Technology
College of Home Science
CSK Himachal Pradesh Krishi Vishvavidyalaya
Palampur- 176 062 (H.P.)

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ABSTRACT

The present study was planned and executed with the specific objective to study the impact of dietary and nutrition intervention on moderately anemic adolescent girls. A total of 300 adolescent girls aged-12-18 years were selected from Panchrukhi, Baijnath and Bhawarna blocks of Kangra district, Himachal Pradesh. Their socio-economic profile, dietary pattern, nutrient intake, anthropometric profile, hemoglobin level and knowledge/perceptions regarding anemia and related aspects were examined. Analysis of these indicators gave evidence of a better socio-economic status in terms of education, type of house and accessibility to drinking water. The intake of cereals, pulses, fruits and green leafy vegetables was less than suggested dietary intake thereby lowering their mean daily intake of energy, protein, vitamin and minerals in comparison to RDA. Majority of subjects irrespective of age group met standard height above 90 per cent and in range of 75.31-85.86 percent for weight when compared with ICMR and NCHS standards. Based on their hemoglobin level, 77.33 % of the adolescent girls had moderate anemia,12.33 % mild anemia,6.33 per cent had severe anemia and only 4 per cent were having normal hemoglobin. Soaking, drying and roasting of garden cress seeds reduced its pungency and increased the total iron, ionisable iron, soluble iron and percent bio-availability of iron and other minerals. Among various developed recipes, variant -2 of *ladoo* and *mathri* that constituted processed garden cress seeds was highly acceptable. Based on hemoglobin values, 90 moderately anemic adolescent girls were screened out and divided into three groups for intervention programme. Group I received sweet and savoury preparations on alternate days of 20 g of *ladoo* and *mathri* each that provided 100 per cent of RDA for iron. Group II received nutrition counselling only and Group III was control as it did not receive any type of intervention. A very positive impact of intervention was observed in experimental groups i.e. group I and group II as assessed by extent of improvement in knowledge, attitude and practices score and gain in aerobic capacity and physical fitness. Significantly increase was calculated for dietary and nutrient intake. After receiving intervention for a period of 120 days, 13.33 per cent of group-I subjects were not anemic at all, while 76.66 fall into mild anemic category. 86.66 per cent of respondents in group-II remained in the same category of moderately anemic and 13.33 shifted to mild anemic category. No change was observed in control group for any parameter post intervention. Thus, the present study concluded with a positive and strong impact of diet and nutrition intervention on eradicating anemia in adolescent girls.

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Preeti Chaudhary	**Dr. Radhna Gupta**
Student	**Major Advisor**
Date: 25th July, 2017	**Date:** 25th July, 2017

Head of the Department

1. INTRODUCTION

Anemia is the most common nutritional deficiency disorder worldwide. According to World Health Organization, anemia is a condition in which the haemoglobin (Hb) content of blood is lower than normal i.e. hemoglobin level is under 13 g/dL in men (>15 years old), under 12 g/dL in non-pregnant women (>15 years old) and below 11 g/dL in pregnant women (WHO 2001). Anemia is associated with symptoms that include skin pallor, weakness, easy fatigability, paresthesia and reduced work capacity. Cheilosis, glossitis, loss of appetite and loss of gastrointestinal tone with accompanying symptoms of distress are seen in severe anemia (Robinson et al. 1991).

It has been reported that 30 per cent of world's population is anemic due to iron deficiency (WHO 2013). The prevalence is highest in preschool children i.e. 47.4 per cent and lowest in men i.e. 12.7 per cent. Pregnant women are also greatly affected with anemia with recorded percentage of 41.8. In India, more than half of women (55%) have anemia, including 39 per cent with mild anemia, 15 per cent with moderate anemia and 2 per cent with severe anemia (NFHS III 2005-06). Anemia is also a major health problem in Himachal Pradesh, especially among women and children. According to DLHS-IV (2012-13) report, 43 per cent women, 19 per cent men and 55 per cent children were recorded to be suffering from anemia.

Iron deficiency anemia (IDA) is one of the common forms of anemia affecting millions of people in both developing and developed countries. There is substantial evidence that iron deficiency anemia in children is associated with decreased physical and mental development, impaired immune function and reduced capacity of leucocytes to kill microorganisms. World Health Organization lists IDA as one of "Top Ten Risk Factors" contributing to death.

Preschool children, pregnant women, lactating mothers and adolescents are vulnerable groups of iron deficiency anemia (WHO 2009). Adolescence is a vulnerable period in human life cycle when nutritional requirements increase due to rapid growth spurt. Adolescence has been defined by World Health Organization as

"the life spanning the ages between 10-19 years". It is a formative period of life when the maximum amount of physical, psychological and behavioral changes takes place. In adolescent girls, there is expansion of the lean body mass, total blood volume and onset of menstruation that creates a greater risk of iron deficiency (Jolley and Abel 2000). Iron deficiency not only reduces work productivity but also accentuates the problem further during pregnancy because, they are just on threshold of marriage and motherhood (Gwatkin et al. 2003). Thus, nutritional pattern in these years has special significance.

The main reasons for iron deficiency anemia (IDA) have been determined to be inadequate intake of iron, low bioavailability (1-6 per cent) of dietary iron from plant foods due to inhibitory factors (Narasinga et al. 1983), low levels of absorption enhancers in diet, repeated pregnancies, increased needs during growth and development among children and adolescents, parasitic infestations and chronic blood loss. Poverty compounds these factors through inadequate access to dietary diversity, safe water, knowledge and awareness about proper feeding practices.

Strategies for improving anemia include supplementation, fortification and improvement in the diet. Therefore, it is essential that locally available materials which are inexpensive but highly nutritious be used as a vehicle to improve the nutritional status of adolescent girls. India is a country with diverse agro-climatic conditions which favors the cultivation and availability of wide array of foods. The diverse agro climatic conditions of India have blessed it with a wide variety of inexpensive foods rich in micro nutrients. Garden cress is one of them and considered as an important nutritional and medicinal plant in India since the Vedic era (between 500-1700 B.C.).

Garden cress (*Lepidium sativum*) is an annual herb, belonging to Brassicaceae family, which is native to Egypt and Asia (Malleshi and Guo 2004). The best crop is obtained in the winter season (Wealth of India 1962). Garden cress is also known as *Asalio* or *Chandrasur* in local languages in India (Tiwari and Kulmi 2004). In India, it is mainly cultivated in UP, Rajasthan, Gujarat, Maharashtra and Madhya Pradesh (Kirtikar and Basu 2004). It is also cultivated in Himachal Pradesh but awareness regarding its health and nutritional benefits is very less and therefore, the crop is mainly raised as fodder crop for animals.

Garden cress seeds are brownish red in colour and oval in shape. Garden cress is an important source of iron, folic acid, calcium, vitamin C, E and A. It is the richest source of iron containing 100mg of iron for 100g of seeds (Gopalan et al. 2009; Elizabeth and Poojara 2014). Seeds contain 25 per cent protein, 14-24 per cent lipids, 33- 54 per cent carbohydrates and 8 per cent crude fiber (Arkroyd et al. 1960; Mathews et al. 1993). Garden cress bran can be used as a rich source of dietary fibre (Gokavi et al. 2004). Garden cress oil has natural antioxidants viz., tocopherols and carotenoids which protect the oil from rancidity (Diwakar et al. 2010).

Garden cress has many health promoting properties. Garden cress helps to purify blood and stimulate appetite. It also helps to alleviate anemia due to its high iron content. The edible whole seeds can serve as raw material for functional foods (Patel et al. 2009; Sood et al. 2011). It helps to regulate menstrual cycle, increases milk production and secretion in lactating mothers and prevents post-partum complications. It is an effective medicine for general weakness in girls (Doke and Guha 2014). Garden cress seeds are largely used for the treatment of many diseases such as hypertension, renal diseases, gastrointestinal disorders like diarrhea and dysentery and asthma. Garden cress seed mucilage is used as a substitute for gum arabic and tragacanth (Patel et al. 1987). Garden cress seeds are therefore packed with the power of nutrients which can combat malnutrition, anemia and other micronutrient deficiencies. So, the idea of incorporating this crop (seeds) into sweet and salty food preparations for supplementation also catches attention.

India’s experience with decades of iron supplementation programmes has been less satisfactory. The challenge, therefore, is to increase the intake, bioavailability and absorption of iron in the system. It is high time to prevent and control anemia through supplementation coupled with nutrition education (Gopalan 2014). Dietary intervention is a safer and more feasible solution to combat anemia. The intervention requires nutrition education to improve knowledge and practices that support positive health outcomes. Nutrition education therefore plays a vital role in improving knowledge leading to long-term beneficial health effects. Creating and improving knowledge of adolescents regarding nutrition and health aspects will help to improve their awareness and their future families’ awareness too.

The present study on “Impact of dietary intervention on nutritional status of anemic adolescent girls of Kangra district (H.P.)” was planned with hypothesis that supplementation of adolescent’s diet with iron rich foods will help in alleviating anemia in adolescent girls. Keeping in view the above perspectives and in light of available evidences, the present study has been undertaken with the proposed objectives.

Objectives

1. To assess the nutritional status of adolescent girls of Kangra district.
2. To examine the prevalence of iron deficiency anemia in selected adolescent girls.
3. To study the impact of nutritional intervention on health and nutritional status of anemic respondents.

2. REVIEW OF LITERATURE

A comprehensive review of literature is an essential part of any scientific investigation. The literature having direct and indirect bearing on different aspects of the study entitled "Impact of dietary intervention on nutritional status of anemic adolescent girls of Kangra district (H.P.)" is reviewed. A brief account of literature reviewed has been presented under the following heads:

2.1 Prevalence of anemia

- 2.1.1 Global prevalence of anemia
- 2.1.2 Prevalence of anemia in India
- 2.1.3 Prevalence of anemia in Himachal Pradesh

2.2 Nutritional Status of adolescent girls

- 2.2.1 Food and nutrient intake
- 2.2.2 Anthropometric status of adolescent girls
- 2.2.3 Hemoglobin assessment of adolescent girls
- 2.2.4 Clinical assessment of adolescent girls

2.3 Standardization and product development

- 2.3.1 Nutritional composition of garden cress seeds
- 2.3.2 Development of products and their sensory evaluation
- 2.3.3 Nutritional evaluation of garden cress seeds and developed recipes

2.4 Nutrition intervention for improved nutrition

- 2.4.1 Nutritional knowledge, attitude and practice score
- 2.4.2 Food and nutrition intake pattern
- 2.4.3 Activity pattern
- 2.4.4 Elemental iron and hemoglobin level

2.1 Prevalence of anemia

2.1.1 Global prevalence of anemia

WHO (2005) global database on anemia covering almost half of the world's population estimated the prevalence of anemia worldwide at level of 25 per cent. Although the prevalence of anemia was estimated at 9 per cent in countries with high development, in countries with low development, the prevalence was 43 per cent. In absolute numbers, anemia affects 1.62 billion people globally with about 293 million children of preschool age, 56 million pregnant women, and 468 million non-pregnant women were estimated to be anemic.

Children and women of reproductive age are most at risk, with global anemia prevalence estimates of 47 per cent in children younger than 5 years, 42 per cent in pregnant women and 30 per cent in non-pregnant women aged 15–49 years. Africa and Asia account for more than 85 per cent of the absolute anemia burden in high-risk groups and India is the worst hit (WHO 2005).

According to Cooper (2007) poor dietary iron intake and iron deficiency exist in Canada, particularly in women of reproductive age. He suggested that the prevalence of inadequate iron intakes (and low intakes of absorbable iron) among women under 50 years of age is over 10 per cent, which may reflect poor iron status. Teenage girls are at risk for low iron stores because of the adolescent growth spurt and the onset of menstruation, those who were vegetarian are at even greater risk.

Abdelrahim et al. (2009) conducted a cross-sectional study to investigate the prevalence of iron deficiency anemia amongst adolescent school girls in New Halfa, Eastern Sudan. Out of 187 adolescent schoolgirls investigated, 181 (96.8%) had anemia and of which 21 per cent had mild anemia; 66.81 per cent moderate anemia, and 12.1 per cent had severe anemia.

Iron deficiency anemia is widely prevalent all over the world affecting about 700 to 800 million people in less developed countries and 60 to 70 million in developed countries (Sabah et al. 2010).

Ayoya et al. (2010) revealed that the prevalence of anemia among pregnant and non-pregnant women is higher in all countries. Several factors contribute either

alone or jointly to the high rates of maternal anemia. These include widespread nutritional deficiencies, high incidence of infectious diseases, low access to and poor quality of health services, low literacy rates, ineffective design, implementation and evaluation of anemia control programmes and poverty.

Al-Sayes et al. (2011) determined the prevalence of iron deficiency and iron deficiency anemia among apparently healthy Saudi young female university students studying at King Abdulaziz University in Jeddah. Three hundred ten blood samples were collected from the students. Their age ranged between 18 and 23 years and it was found that 25.9 per cent of students had deficient iron stores and 23.9 per cent of students had iron deficiency anemia.

Ramzi et al. (2011) analyzed anemia and iron deficiency in adolescent school girls in Kavar Urban Area of Southern Iran. Twenty-one cases of non-anemia (5.8%), 31 (8.5%) of anemia and 61.7 per cent cases of iron deficiency anemia were reported. Most of the anemic girls (85.7%) had mild anemia. Age and BMI had a statistically significant relationship with hemoglobin. Only parasitic infestation in the last three months had more risk of anemia than those without this history.

Adolescent age group is more susceptible to iron deficiency anemia because of their rapid growth and associated higher iron requirement. On account of the practice of early marriages and potential exposure to a greater risk of morbidity and mortality, adolescent girls constitute a vulnerable group. Adolescents constitute about 20 per cent population in South - East Asian Countries. In all South - East Asian Countries, except Thailand, more than a quarter of girls are anemic, though there is a great disparity within the region. Irrespective of severity of anemia, prevalence among adolescent girls ranged between 17 to 90 per cent within the region. The National data from India, Nepal and Myanmar also showed that adolescent anemia was prevalent as moderate to severe leading to a public health problem (WHO 2011).

The investigation of Oliveira et al. (2013) on a global basis estimated that 2 billion people are iron deficient and/or anemic with small children and women of childbearing age most likely to be the ones affected. They emphasized that iron salts which are low-priced, water soluble, effective, easily and locally prepared should be known and accepted as a rational, practical and effective locally community preventive solution for iron anemia, which is still a great problem of developing and underdeveloped countries of the world.

2.1.2 Prevalence of anemia in India

Nutritional anemia is a major public health problem in India and is primarily due to iron deficiency. The National Family Health Survey (NFHS-III 2005-06) data suggests that anemia is widely prevalent among all age groups, and is particularly high among the most vulnerable – nearly 58 per cent among pregnant women, 50 per cent among non-pregnant and non-lactating women, 56 per cent among adolescent girls (15–19 years), 30 per cent among adolescent boys and around 80 per cent among children under 3 years of age.

The prevalence of anemia among the vulnerable groups is alarmingly high as per the reports of NFHS-III (2005-06) and the National Nutrition Monitoring Bureau Survey (NNMB 2006).

Data from National Nutrition Monitoring Bureau (NNMB 2002), Indian Council of Medical Research (ICMR 2004) and District Level Household Survey (DLHS-III 2008-09) have shown that prevalence of anemia is very high (ranging between 80->90%) in preschool children, pregnant and lactating women and adolescent girls. Low birth weight infants, young children and women of childbearing age are particularly at risk of anemia. That way, anemia that begins in childhood, worsens during adolescence in girls and gets aggravated during pregnancy.

DLHS-II (2002-04) reported as prevalence of anemia in adolescent girls (10-19 years) in different states whereby, 49 per cent and 27 per cent of adolescent girls were moderately and severely anemic. The state of Chattisgarh had the highest percentage of adolescent girls who were either moderately or severely anemic (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 anemia among adolescent girls was in the range of 70-80 per cent. The states where this percentage was between 50-70 per cent included Karnataka, Tamil Nadu, Uttaranchal, Arunachal Pradesh, Tripura and Nagaland. In the rest of the states in India, the percentage of adolescent girls who were either moderately or severely anemic was less than 50 per cent. Among them, the low percentages in Jammu and Kashmir (26%) and Kerala (32 %) are noteworthy.

Punjab is known as a prosperous state of India but the status of anemia among young girls and women is alarming. 70.57 per cent young girls of Amritsar, Punjab were observed as anemic (Sidhu et al. 2005).

Mehnaz et al. (2006) reported that a very high overall prevalence of iron deficiency anemia (98.87%) was found to be in urban area of Aligarh. The level of anemia was categorized as 14.8 per cent with mild, 72 per cent with moderate and 13 per cent with severity.

Gupta et al. (2007) conducted a study on prevalence of anemia among female adolescents (11-17 years) of different income ranges and studying in government and public educational institutions in District Kurukshetra (Haryana). Anemia was highly prevalent in the subjects of early adolescence as compared to late adolescence period. Maximum subjects in both early and late adolescence period were suffering from moderate (58.08 %) followed by mild anemia (33.85 %) and minimum (5.77 %) with severe anemia.

Srimani et al. (2008) did a comparative as well as correlational study on the prevalence of anemia among rural and urban school going adolescent girls (16 to 18 years). Non-probability convenience sampling technique was used to obtain 96 samples from class X and 48 each from rural and urban schools. Prevalence of anemia in 56 per cent adolescent girls was identified. Rural prevalence was high (81%) than urban prevalence (31%).

Mehta (2009) reported that 1.5 crore women in India are suffering from anemia. Every year 50 lakh women death occur due to anemia. 82 per cent of 6-20 years of school and college girls are suffering from anemia. 93 per cent of women and girls are suffering from anemia from lower income group in India.

Anemia is more commonly prevalent among adolescents, preschool children, pregnant and lactating mothers. Micronutrient deficiency, especially iron deficiency in adolescent girls can seriously affect their health. 8 per cent of adolescent girls of 10-19 years of age were suffering from iron deficiency anemia as reported by Avashia (2010).

A study on prevalence of iron deficiency anemia (IDA) was assessed by Ajgonkar et al. (2010) among adolescent girls (11-21 years) residing in urban slum areas of Dharavi, Mumbai. The study was carried out in the 100 adolescent girls (11-21 years) who were the beneficiaries of ICDS and Kishori project from slum areas of Dharavi, Mumbai using purposive sampling technique. The prevalence of IDA was found to be 50 per cent, despite majority of the subjects (42%) being non-vegetarians.

Siddharam et al. (2011) conducted a cross-sectional survey in selected Anganwadi centers of rural area of Hassan district. 314 adolescent girls (10-19 years) were included in the study. It was seen that among the 45.2 per cent of anemic adolescent girls, 40.1 per cent had mild anemia, 54.92 per cent had moderate anemia and 4.92 per cent had severe anemia.

Premlatha et al. (2012) conducted a study to estimate prevalence of iron deficiency anemia among adolescent schoolgirls in the age group of 13-17 years in Chennai and to study the associated factors. A cross-sectional survey was carried out among 400 selected school students and the prevalence of anemia was found to be 78.75 per cent.

Koushik et al. (2014) assessed the prevalence and the severity of the anemia in 150 adolescent girls of Guntur, Andhra Pradesh, India. The prevalence of anemia was 77.33 per cent (with that of severe anemia being 12.06 % that of moderate anemia being 50.86 % and that of mild anemia being 37.06 %) majority of the girls had the moderate anemia.

Devi et al. (2015) determine the prevalence of anemia among school going 320 adolescent girls of Government Secondary Schools of District Rohtak (Haryana). The overall prevalence came out to be 73 per cent among study subjects. On the basis of severity, nearly half of subjects (54%) were found with mild anemia, 18 per cent of girls had moderate anemia while 1 per cent girls were severely anemic.

Anemia affects the overall nutritional status of adolescent females. A study undertaken by Dhokar and Ray (2016) to determine the prevalence of anemia among adolescent girls studying in urban and rural schools of Pune city. Results showed that 56 per cent of the adolescent girls from urban schools were suffering from anemia; 26 per cent were suffering from moderate anemia, 25.3 per cent from mild anemia and

4.7 per cent from severe anemia. 63 per cent of adolescent girls from rural schools were suffering from anemia. Out of which, 33.3 per cent were suffering from mild anemia, 24.7 per cent from moderate anemia and 4.7 per cent from severe anemia. The overall prevalence of anemia among adolescent girls from urban and rural schools was 59.5 per cent.

2.1.3 Prevalence of anemia in Himachal Pradesh

Sharma (1993) worked on respondents residing in six blocks of Kangra district namely Rait, Baijnath, Bhawarna, Panchrukhi , Nagrota and Lambagaon studied their food consumption pattern and anthropometric measurement. The data stated that selected respondents had poor eating habits and unsatisfactory anthropometric results.

NFHS-III (2005-06) Himachal Pradesh report on anemia stated that anemia is a major health problem in Himachal Pradesh, especially among women and children. Among children between the ages of 6 and 59 months, more than half (55%) were assessed as anemic. This includes 26 per cent who were mildly anemic, 27 per cent who were moderately anemic, and 2 per cent who suffered from severe anemia. Girls were slightly more likely to have anemia than boys. Over two-fifths of women in Himachal Pradesh had anemia, including 32 per cent with mild anemia, 11 per cent with moderate anemia, and 1 per cent with severe anemia. Anemia was particularly high among rural women, and women belonging to other backward classes. The prevalence of anemia declined among children aged 6-35 months over the past seven years from 70 per cent in NFHS-II to 62 per cent in NFHS-III.

Agarwal et al. (2006) did a parallel investigation to study of NFHS-II who reported a reduction in prevalence of anemia. The objective was to assess whether the reduction was due to health and nutrition inputs or due to a different method for haemoglobin estimation. They selected seven states (Himachal Pradesh and Haryana in North; Assam and Orissa in East; Kerala and Tamil Nadu in South and Madhya Pradesh in Central India) and used the same districts and villages studied in the NFHS-II. The results showed that prevalence as well as severity of anemia was significantly higher in their study as compared to the NFHS-II study data. The difference could be due to haemocue method, which gives higher haemoglobin values. The data reported the state of Himachal Pradesh with anemia prevalence rate of 68.1 and 65.8 per cent in periods of pregnancy and lactation respectively.

DLHS-IV (2012-13) state fact sheet data of Himachal Pradesh revealed that in children (6-59 months) total prevalence of anemia was 58.6 per cent in which 60.4 per cent rural and 45.9 per cent urban children were involved. The prevalence of severe anemia in same age group was 14.1 per cent. Children (6-14 years) were reported to have anemia of 45.3 per cent with 60.4 per cent and 45.9 per cent distribution in rural and urban children respectively. Adolescent girls (15-19 years) were reported to have total anemia of 45.0 per cent with distribution of 46.1 per cent for rural and 35.7 per cent for urban adolescent girls. The prevalence of severe anemia among adolescent girls was 8.5 per cent.

Bhardwaj et al. (2013) found that the deficiency of both folic acid and vitamin B_{12} decreased the level of hemoglobin and increase the level of 5-MTFH and homacysteine. Thus deficiency of both folate and vitamin B_{12} caused anemia in females. Vitamin B_{12} may be one of the prominent reason for recurrent anemia in females of Himachal Pradesh.

Bhardwaj et al. (2013) assessed prevalence of iron, folic acid, and vitamin B_{12} deficiency among adolescent males and females in this northern Himalayan state in India. The total 885 adolescents (11 to 19 years) were surveyed from 30-cluster villages from two community development blocks of Himachal Pradesh. Serum ferritin, folic acid, and vitamin B_{12} were estimated among randomly selected 100 male and 100 female adolescents. The results of assessment showed that anemia was prevalent among 87.2 per cent males and 96.7 per cent females. A mild form of anemia was observed to be the most common (53.9%) form followed by moderate (29.7%) anemia. Strikingly, it was found that all the adolescents were deficient in vitamin B_{12} and none of the adolescents was observed to be deficient in folic acid.

The food and nutrition intakes are positively correlated with Hb level of girl students. A study by Kumar (2015) was designed to examine the prevalence of anemia among girl students of Abhilashi College, Distt Mandi Himachal Pradesh. Hemoglobin (Hb) level of 87 girl students was determined. Prevalence of anemia was detected to have been quite high at 55 per cent. 53.6 per cent of girls in age group 20-25 years, 42.85 per cent in 25-35 years and 66.6 per cent having age more than 35 years were detected to be anemic.

2.2 Nutritional status of adolescent girls

2.2.1 Food and nutrient intake

Templeton (2005) examined the effects of school's physical environment on nutrition of students which showed that the availability of snack foods and soft drinks i.e. carbonated drinks such as cola at school have a significant impact on overall child nutrition. The frequencies of consumption of meat (11.8 vs 4.5), vegetables (9.5 vs 3.9), cereals (16.5 vs 11.9), milk products (5.74 vs 0.8) and junk food (24.2 vs 8.7) was significantly higher in urban than in rural adolescents. The frequency of in-between meals was higher in urban than in rural adolescents (4.9 vs 0.9, respectively).

Rao et al. (2006) concluded that the average intake of cereals and millets among tribal adolescents was lower than in rural adolescents, except for 16-18 years age group. The intake of qualitative foods such as pulses, milk and milk products, oils and fats and sugar and jaggery was lower among tribal adolescents of all age groups. However, the average intake of green leafy vegetables was relatively higher among the tribal adolescents compared to their rural counterparts, while that of other vegetables were similar. The consumption of milk and milk products among tribes was grossly inadequate. The average intake of all the nutrients by adolescent boys and girls of the tribes was below the RDA in all the age groups. The extent of deficit in the intake of micronutrients such as vitamin A (80-85%), iron (70-80%), folic acid (50-55%) and riboflavin (40-50%) was relatively more, compared to that of energy (10-40%) and protein (20-30%). Compared to their rural counterparts, the intake of all nutrients except for vitamin A and vitamin C were lower.

Promotion of healthy eating habits and education about junk foods needs be strengthened as per the study of Kumar et al. (2006). They found that *samosa,* a deep fried Indian snack was the most preferred (99.2%) fast food item and pizza (22.8%) came out to the least preferred item, despite heavy doses of advertisement in favour of pizza. *Chaat* also came out to be the most common fast food item preferred by 99.2 per cent respondents. Change of routine was the most common reason for consuming fast food given by 68.3 per cent respondents. The majority of the respondents (73.2%) were occasional consumers of fast food.

A similar study was conducted by *Rao* et al. (2007) among urban adolescents in Hyderabad and reported that about 51 per cent of the adolescents consumed instant foods 3-4 times a week, nearly 68 per cent reported daily consumption of bakery items and 48 per cent of them consumed aerated drinks 1-2 times a week.

Pande et al. (2008) studied the correlation between iron-deficiency anemia and changing dietary behaviors among adolescent girls in Maharashtra. Around 58 per cent of the subjects were anemic (Hb < 12 g/dl), 1.3 per cent severely anemic (Hb < 7 gm/dl) and 40 per cent of them were eating two or fewer meals daily. Logistic regression of baseline data showed that anemia was significantly more likely among girls who ate two or fewer meals in a day, had been sick in the past year and consumed few iron rich foods.

The knowledge and practice of school going adolescents regarding diet and nutrition was assessed by Puri et al. (2008) who reported that a large number of government (63.3%) and private (53.2%) school students were not bringing tiffins in the schools. Most common food items consumed by adolescents in canteens were hotdog (42.9%), cold drink (11.6%), *samosas* (37.3%) and patties (16.3%). Nearly one fifth of adolescent students liked to eat from the vendors outside the school and 11.6 per cent of adolescents did not take lunch at home. Half of the adolescents usually visit restaurants/eating joints after school hours. Among the junk food items, *samosa* (42.4%), *tikki/chat* (39.7%), noodles (25.4%), burger (24.5%) and pizza (23.3%) were preferred most by the adolescents.

Ahmad et al. (2009) assessed the nutritional status of adolescents in Islamabad city and revealed that three main meals were taken by adolescents per day. 79.51 per cent took breakfast regularly all days of the week and had an excellent bearing on their nutritional status. 82.8 per cent took lunch regularly in the days of week and enjoyed better nutritional status. Dinner was the main meal of day and 83.8 per cent dined regularly. Junk food consumption was quite high, as 95.4 per cent consumed these regularly.

Ignorance about micronutrients and protective foods in adolescents and was prevalent as per the investigation done by Hejazi and Mazloom (2009). Results of the study showed that soft drink consumption was high among the subjects with an

average of 360 ml/day. Consumption of fat (37 % energy, 566 Kcal with 12 % saturated fat; 183 Kcal) was high as compared to recommended 20-35 per cent of calories (306-535 Kcal) from fat and less than 10 per cent of calories (153 Kcal) from saturated fat. Fruit and vegetable intakes were low (1.82 serving per day, 109.2 Kcal and 1.45 servings per day, 36.25 Kcal respectively); 5-9 servings of fruit is recommended according to the United States Department of Agriculture Food Guide Pyramid. Furthermore, the youth consumed 1 serving of whole grains (30 g), 11.6 g fibre and 180 ml of milk per day.

Leal et al. (2010) observed that most adolescents have all three main meals: breakfast (79%), lunch (93%) and supper (94%). As for snacks, 42 per cent had a morning snack, 78 per cent had an afternoon snack, and 16 per cent had an evening snack. 21 per cent of the adolescents did not have breakfast. Regarding the other two main meals, the study verified that 7 per cent of the adolescents did not have lunch, and 6 per cent did not have supper. The most common replacements for a meal were milk, chocolate milk, french bread, margarine, and soft drinks.

Olumakaiye et al. (2010) studied association between nutritional status of adolescents and food consumption pattern and elucidated that 66.1 per cent of adolescents ate three meals daily; this percentage was higher among rural (75.4%) than urban (61.4%) children. About 33.0 per cent consumed snacks daily but to a varying degree, which was higher among urban than rural adolescents.

Bharmoria (2011) studied the nutritional status of 120 elderly residents of Baijnath and Panchrukhi blocks of Kangra. From the collected information it was found that dietary and nutrient intake of selected respondents were less than recommended intake.

2.2.2 Anthropometric status of adolescent girls

Chaudhary and Mishra (2003) assessed nutritional status of adolescent girls in rural area of Varanasi and examined anthropometric measurements of weight, height and mid arm circumference (MAC) and hemoglobin. Two-third of studied subjects were undernourished (BMI < 18.5 kg/m^2) and nearly one-third experiencing chronic energy deficiency grade-III (BMI < 16 kg/m^2). Nearly one third girls were anemic (Hb < 12 g/dl); anemia was significantly more in non-menstruating girls and subjects not using footwear during defecation.

Deepa et al. (2004) conducted a study on the seasonal variations in anthropometric measurements of adolescent girls. The anthropometric measurements recorded were higher during winter than summer and rainy season. The girls irrespective of locality were taller and heavier (149.32 cm and 36.2 kg) during winter compared to rainy (148.21 cm and 35.45 kg) and summer (148.02 cm and 34.90 kg). However, these differences were statistically not significant. Similarly, irrespective of age and locality, the waist and hip circumferences were higher during winter (56.84 and 72.76 cm, respectively) than rainy (56.71 and 72.42 cm, respectively) and summer (56.46 and 72.39 cm).

Shekhar (2005) conducted a study on iron status of adolescent girls and its effect on physical fitness. The age of selected subjects was 17-18 years of age. The mean height was found to be 156.6 cm, and mean weight was 51.5 kg. The mean BMI of the subjects ranged from 16.8 to 20.8.

A study conducted by Deshmukh et al. (2006) on nutritional status of adolescents in rural Wardha showed that 53.8 per cent of the adolescents were thin, 44 per cent were normal and 2.2 per cent were over weight.

Anthropometry reflects, both health and nutritional status and predicts performance, health and survival. Zanvar et al. (2007) compared 500 adolescents (13-18 years) from urban, rural and tribal areas of Marathwada region and found that urban adolescent girls had better height (152.26 ± 8.6 cm) than rural and tribal counterparts (150.19 ± 7.11, 145.51 ± 9.38 cm respectively). A similar trend was observed in weight and body mass index, which ranged from 35.61 ± 3.41 to 42.79 ± 5.02 kg and 16.76 ± 2.31 to 18.18 ± 2.00 kg/m^2 respectively.

A study conducted by Kowsalya et al. (2008) on the iron nutrition of 100 adolescents (13-18 years) in Manipur found that the mean height and weight of the selected adolescent girls were below the standard value.

Gharib and Rasheed (2009) conducted a study on the anthropometric status of school children (6-18 years) enrolled in the primary, intermediate and secondary government schools in populated regions of Bahrain. The sample size included 2594 students (1326 girls and 1268 boys). Compared to WHO reference standards, the median height of Bahraini children and adolescents in the age range of 6 to 18 years

was close to the 25th percentile or lower, while the median BMI during adolescent years was comparable in boys but higher than WHO standards in girls, reaching the 75th percentile. The cut-off values of BMI for overweight/obesity status (85th and 95th percentile) were higher by 3-6 kg/m^2 compared to WHO standards.

Silva et al. (2010) assessed the nutritional status of Caboclo adolescents living in two areas of the Amazon Basin. Two cross-sectional studies, the first in the dry and the second in the wet season, was carried out in two Amazonian ecosystems: the forest and black water ecosystem, and the flood plain and white water ecosystem. Measurements of weight, stature, arm circumference and triceps, subscapular and suprailiac skinfolds were performed on 247 adolescents (10–19 years). During the wet season, the prevalence of overweight among girls was higher in the forest (42%) than in the floodplain (9%). Longitudinal linear regression models showed that the arm circumference measurement was influenced both by seasonality and location, revealing that the increment between dry and wet seasons was less pronounced in the floodplain.

2.2.3 Haemoglobin level of adolescent girls

Haemoglobin assessment is an indicator of iron status in individuals. By analyzing the level of haemoglobin in blood, one can diagnose whether the individual is anemic or not. The haemoglobin content of the normal adolescent girls is 12 and more than 12 g/dl is categorized as non-anemic and haemoglobin level less than 12 g/dl are anemic based on the cut-off points given by WHO (2005).

Leela and Priya (2002) studied iron status and morbidity pattern among 120 school children in Coimbatore. The results revealed that mean haemoglobin level was 12.5, 11.03 and 9.17 g/dl for the non-anemic, mild and moderate anemic respectively.

Gowarikar et al. (2002) reported that the mean haemoglobin was 9.80 g/dl and overall prevalence of anemic was 96.5 per cent in 459 girls of 10-18 years of age in Ujjain.

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 anemic (<12 g/dl), 12.6 and 46 per cent were found to be moderately and mildly anemic respectively. None of them were severely anemic.

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 anemia was 0.6 per cent (<7 g/dl), 20.8 per cent (7-10 g/dl) and 38.4 per cent (10-12 g/dl) respectively.

An early intervention of dietary supplements brings the haemoglobin level in the normal range. Suguna and Nymisha (2016) assessed prevalence of anemia in adolescent girls of Khammam district and reported that average haemoglobin level in the study was 11.62±2.85 g per cent. The number of adolescent girls having mild anemia (Hb level between 10 to 11.9 g%) was 244 (81.3%), whereas 39(13%) were having moderate anemia (Hb level between 7 to 9.9 g%), whereas girls with severe anemia were 4 (1.33%) in number. However, 13(4.33%) adolescent girls had no reporting of anemia.

Prevalence of anemia among adolescent girls was assessed by Gupta et al. (2017) in rural population of Rajnandgaon, Chhattisgarh, India. The prevalence of anemia among adolescent girls was found as 76.29 per cent. Out of 232 anemic girls, 118 girls were suffering from mild degree of anemia and 58 girls were having moderate degree of anemia and only one girl was found severely anemic.

2.2.4 Clinical assessment

Clinical examination has always been and remains an important practical method for assessing the nutritional status of a community (Jelliffe, 1966).

IIHFW (2001) conducted a study on prevention and control of anemia in rural adolescent girls. Signs and symptoms of anemia like pallor (eyes, tongue and nails), fatigue, breathlessness, poor appetite and lack of concentration in studies were reported by 12.5 per cent, 14 per cent, 9.2 per cent, 26.5 per cent and 86 per cent of girls respectively.

Clinical signs and ill effects of anemia are common. A clinical examination was conducted by Kumari and Singh (2003) on 100 scheduled caste adolescents from deprived section of society in Pusa. Clinical symptoms were more prominent among females than males. This might have been due to better nutritional status of males as compared to female adolescents.

Deepa et al. (2004) reported the prevalence of symptoms of anemia in adolescent girls during different seasons. The fatigue was the common symptom among both rural (70.0%) and urban (75%) adolescent subjects in all the three seasons studied and none of the rural subjects experienced lethargy during any of the seasons. A higher percentage of urban subjects experienced anemia symptoms like giddiness (40.0%), anorexia (40.0%), pale nails (15.0%) and lethargy (5.0%) as against 2.5, 10.0, 5.0 and 0.0 per cent in rural subjects during all the three seasons.

Devi and Uma (2005) studied the clinical symptoms of anemia 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 anemia were observed and none of them was affected by koilonychia and poor stamina.

Kumar et al. (2006) did clinical examination of 80 adolescent girls from Allahabad and observed various signs and symptoms of anemia among adolescents like breathlessness, tiredness and pale nails.

To assess the impact of iron, vitamin A and vitamin C supplementation on anaemic adolescent girls, clinical examination was carried out by Swarnalata and Yegmmai (2006) 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 conjunctive was greater.

The low frequency intake of green leafy vegetables showed prominent clinical symptoms among adolescent girls. Sajjan (2008) reviewed consumption pattern of green leafy vegetables and impact of nutrition education on haemoglobin status of rural adolescent girls from the transitional and dry zone of Dharwad. When dry zone was considered, majority of the subjects had fatigue and paleness (28% each), followed by giddiness and breathlessness (6.66 and 3.33% respectively), while 34 per cent of the girls were free of symptoms. About 23 per cent of subjects in transitional zone had fatigue followed by giddiness (8.00%), paleness (6.66%) and 4.66 per cent of the subjects had breathlessness, 57.33 per cent of the subjects had no clinical symptoms.

The most common symptoms of anemic women are weakness, fatigue, breathlessness, palour and palpitations. In severe conditions, it is associated with fainting, dizziness and sometimes even heart attack, and the patient may experience circulation disturbances (WHO 2011).

2.3 Standardization and product development

2.3.1 Nutritional composition of garden cress seeds

Garden cress is commonly referred to as *chandrashoor* in local Indian language. In India, it is mainly cultivated in Uttar Pradesh, Rajasthan, Gujarat, Maharashtra and Madhya Pradesh (Kirtikar and Basu 2004).

Garden cress is an annual herb which is native to Egypt and Asian but is widely cultivated in hot temperate climates throughout the world for various culinary and medical uses (Malleshi and Guo 2004).

The health benefits of garden cress seeds have been recognized for decades now. It is an important source of iron, folic acid, calcium, vitamin C, E and A. It is the richest source of iron containing 100mg of iron for 100g of seeds (Elizabeth and Poojara 2014; Gopalan et al. 2010).

Garden cress seed (*Lepidium sativum Linn)* is categorized under nuts and oil seeds by ICMR. Nutritive value of the seeds show protein 25.5g, fat 24.5g, carbohydrate 33.0g, calcium 377 mg, phosphorous 723 mg, iron 100 mg, fibre 7.6g, carotene 27 mg, thiamine 0.59 mg, riboflavin 0.61mg, niacin 14.3 mg per 100g of weight (Gopalan et al. 2010).

Garden cress seeds also provide good amount of carbohydrates, calories and protein containing 33g, 454 kcals and 25.3g respectively and contain good amounts of PUFA. Garden cress seeds are loaded not just with protein, but also linoleic and arachidic fatty acids. Since they contain phytochemicals that resemble estrogen to some extent, intake of these seeds helps to regulate menstruation and stimulate milk production in lactating mothers. Garden cress seeds have the ability to speed up the metabolism and increase thermogenesis (Gupta and Singhal 2011). Studies by the authors showed that supplementation of seeds for 1-2 months increased hemoglobin levels of the subjects. Garden cress seeds are used for treating patients suffering from

iron deficiency anemia. It is one of the richest vegetarian sources of iron with good bioavailability. 100g of garden cress seeds provides 100mg of iron. Consumption of up to 2 tsp or 10 g of soaked garden cress seeds along with vitamin C helps to boost the hemoglobin level over time. Incorporation of garden cress seed in foods has shown marked increased in the iron and protein content also (Nathiya and Nora, 2014).

Agarwal and Sharma (2013) studied garden cress seeds and quantitatively analyzed whole, husk removed, husk, roasted and microwave processed forms for proximate principles. Their results reported that moisture content was highest in husked garden cress seeds powder i.e. 6.01 per cent, protein and fat content was highest in husk removed garden cress seeds powder i.e. 27.61 per cent and 25 per cent respectively. Ash in value of 6.50 per cent and total carbohydrates of 38.11 per cent were found highest in micro waved processed garden cress seeds powder while fibre in value of 15.11 per cent found highest in roasted garden cress seeds powder. The total iron content of 127.10 mg/100g in roasted garden cress seeds followed by husk removed (121.46 mg/100g), microwaved (117.65 mg/100g), whole (112.66 mg/100g) and husked seeds (73.03 mg/100g).

2.3.2 Development of products and their sensory evaluation

(i) *Ladoo*

Sood et al. (2002) who supplemented iron rich *ladoo* using locally available foods like jaggery, processed rice flakes, garden cress seeds and amaranth seeds (45: 40: 10: 5) and was liked very much by school going children aged 7-9 years.

Supplementation of garden cress seeds incorporated *ladoo* have shown improvement in the haemoglobin level and clinical signs and symptoms of the selected moderately anemic adolescent girls. Garden cress seeds have shown to boost milk production in nursing mothers. Often they are advised to have garden cress seed kheer or the aliv *laddoo*. Because of its high iron and protein content, it is often given post-partum to lactating mothers (Angel and Devi 2015).

Kaur and Sharma (2015) worked on enrichment of traditional Indian food preparations namely *atta besan ladoo, shakarpara, chikki, mathri and matrey* with roasted garden cress seeds. In *atta besan ladoo,* the most acceptable level of incorporation of garden cress seed was 10 per cent and the mean scores for overall acceptability was 7.4 ± 0.52. In *atta besan ladoo,* the 8, 10 and 12 per cent level of incorporation of roasted garden cress seeds caused significant difference($p<0.05$) that later appeared in scores for color and taste.

The *ladoo* gained highest scores for all sensory attributes when 10 g garden cress flour was incorporated against the 15 g incorporation (Uma and Sucharitha 2016).

Rana and Kaur (2016) prepared supplemented products viz. biscuits, *ladoo* and *namakpare* with garden cress seeds using different proportions. *Ladoo* prepared without use of garden cress seed flour (control) was “desirable” in all attributes. As for proportion, 5 and 10 per cent were “desirable” in term of texture, taste, and over all acceptability but tasted was almost similar compared to control. 15 per cent supplementation brought down the scores as compare to control and was rated as “moderately desirable”.

(ii) *Mathri*

Agarwal and Sharma (2013) performed an experiment on garden cress seeds with different processing methods (roasted, microwaved and whole) and used them for incorporation in *mathri.* Addition of 5 per cent level of all treated garden cress seed powder was rated “desirable” by the panel of 15 judges.

The *mathri* scored highest with regard to all sensory attributes when 20 per cent incorporation of amaranth seeds and 10 per cent watermelon seeds was done by Virginia et al. (2014).

Kaur and Sharma (2015) worked on enrichment of traditional Indian food preparations by using soaked and roasted garden cress seeds. The results indicated that at 20 per cent level of incorporation of roasted garden cress seeds in *mathri* was most acceptable as compared to 15 and 25 per cent incorporation level and scored 5.7 ± 1.42 for its overall acceptability on a 9- point hedonic scale.

(iii) *Shakkarpare*

Singh and Srivastava (2012) formulated iron rich *namakpare* mixes and found that finger millet up-to 60 per cent can be successfully incorporated. The *shakkarpare* were liked very much when the formulations of wheat flour, sesame seed, soybean, peanuts and drumstick leaves (100: 5: 5: 5: 2) were used in their experiment Verma et al. (2014).

Kaur and Sharma (2015) worked on enrichment of traditional Indian food with treated garden cress seeds. The 10, 12 and 15 per cent roasted garden cress seeds incorporated levels were used in *shakarpara*. The results showed that *shakarpara* was most acceptable at 12 per cent and 5.5±1.41, 6.7±0.94 and 5.2±1.1 scores reported for overall acceptability at 10, 12 and 15 per cent level of incorporation.

Rana and Kaur (2016) prepared supplemented products viz. biscuits, *ladoo* and *namakpare* with garden cress seeds using 5, 10 and 15 per cent proportions level. The scores of *namakpare* showed that control sample was “desirable” in all attributes. Addition of garden cress seed flour brought down the score in term of colour, aroma and over all acceptability, but appearance, texture, and taste were almost similar as compared to control and highest at 10 per cent level of incorporation.

(iv) Biscuits

Mridula and Gupta (2008) prepared biscuits with similar and slight variations using blends of soybean flour (SF) and cassava flour (CF) on a replacement basis (CF/SF, 100:0, 90:10, 80:20, 70:30, 60:40, 50:50, 40:60, 30:70, 20:80 and 0:100). Sensory evaluation indicated that there were no significant differences in colour, texture, flavour, taste and overall acceptability of the flour blends biscuits.

Nathiya and Nora (2014) prepared cookies by using, oats, wheat flour, wheat germ, soy flour and garden cress seeds. The addition of garden cress seeds per 100 g of cookie dough was 0g, 10 g, 20 g, and 30 g. They concluded that sensory aspects such as appearance, taste, colour, texture, flavour and overall acceptability graded the cookies as good by panelist. The panelists also expressed that though different quantities of garden cress seeds were used in the preparation (10, 20 and 30 g), none of the samples had a bitter after taste and their taste was as acceptable as the control cookies that did not contain any garden cress seeds. However, they spelt out that the texture of the cookies was a little hard in samples that contained 30 g garden cress seeds than the ones that contained 10 g. The colour of the control and experimental group was almost the same i.e. light brown.

Sharma (2015) studied the acceptability of germinated garden cress seeds by incorporating into the food consumed daily like sandwich, raita, soups and salads. The incorporated level of germinated seeds varied from 7-30 per cent of seeds into the above recipes, and stated that samples prepared with 10-15 per cent of garden cress seeds was most acceptable.

Patil et al. (2015) prepared biscuits by the using garden cress seeds at 5, 10, 15 and 20 per cent level. On the basis of overall sensory attributes, colour of sample 100: 10 per cent had better appearance as compare to 100:05 per cent and 100: 15 per cent levels because of dark brown colour of garden cress seed biscuits. Flavour, aroma, taste, after taste and overall acceptability of 100: 10 per cent sample had also higher score than 100:05 per cent sample and 100:15 per cent sample.

Rana and Kaur (2016) prepared supplemented products viz. biscuits, *ladoo* and *namakpare* with garden cress seeds using proportions level of 5 per cent, 10 per cent and 15 per cent. They reported that biscuits prepared without use of garden cress seed (control) were "desirable" in term of color, appearance, aroma, texture, taste, and over all acceptability. Mean scores for overall acceptability of 5 per cent and 10 per cent level were in the category of "moderately desirable" whereas 15 per cent level of biscuits were better than compared to control in term of all attributes and rated as "desirable".

2.3.3 Nutritional evaluation of garden cress seeds and developed recipes

(i) Proximate content

Singh and Srivastava (2012) formulated iron rich *namakpare* mixes. The mixes were studied for proximate composition. These *namakpare* mixes were nutritious (crude protein 9.34-23.68 per cent, crude fat 0.85-4.57 per cent, crude fibre 0.30-3.51 per cent, total ash 0.60-4.51 per cent, carbohydrates 54.90-59.79 per cent, physiological energy 355-370 Kcal/100 g) and were of low cost.

Nathiya and Nora (2014) formulated and assessed the nutrient content of cookies (nutricookies) prepared by incorporating oats, wheat germ, wheat flour, soybean flour and garden cress seeds. They observed an increase in nutritional content in nutricookies when an amount of garden cress seeds was added to the samples. The

average range of carbohydrate was calculated as 65 to 75 g per 100g, protein 17 to 22g per 100 g, fat 13 to 14.8g per 100g and moisture 2.75 to 3.76 per cent per 100g.

Elizabeth and Poojara (2014) conducted a study with the objectives of identifying snacks that are suitable for the adolescent population and modifying them with the incorporation of garden cress seed at different levels of 5, 10, 20 and 30 grams. The prepared snacks were evaluated for nutrient content. The nutrient profile of prepared snacks revealed a direct relationship i.e. with the increase in garden cress seed incorporation there was an increase in iron, protein and calcium content of the snacks.

Sharma (2015) worked on incorporation of germinated garden cress seed in commonly consumed food preparations-sandwich, *raita*, soup, salad and *bhujia* for improving anemia in anemic adolescent girls. The nutrient analysis of prepared food revealed that the energy content of the developed products was highest of *bhujia* 300.5 Kcal per 100 g and lowest in *raita* 99.4 Kcal per 100 g. Protein content varied from 5.29 g per 100 gm (*raita*) to 8 g per 100 g (*bhujia*). Fat content ranged between 5.02 g in salad to 16.2g per 100g in *bhujia*. Carbohydrate content of germinated garden cress seeds incorporated food preparations varied from 6 g of *raita* to 36.1 g per 100g of sandwich.

Kaur and Sharma (2015) worked on enrichment of five traditional Indian food preparations namely, *atta besan ladoo, shakarpara, chikki, mathri and matrey* with treated garden cress seeds. The nutritional analysis results showed that the energy content of the food preparations prepared by incorporating roasted garden cress seeds varied from 491.6 Kcal (*atta besan laddoo)* to 319.2 Kcal (*mathri and matrey)* per 100gm . Protein content was highest in *chikki* (9.2 g/ 100gm) and lowest in *shakarpara* (6.78 g/100gm). Fat content ranged between 85.5 g (*chikki)* to 12.9 g (*shakarpara*) per 100gm Carbohydrate content of roasted garden cress seeds incorporated food preparations varied from 18.6 g (*mathri* and *matrey)* to 83.2 g (*shakarpara)* per 100gm. Nearly 53.7 per cent of carbohydrate content increased in *mathri and matrey* and only 4.9 per cent increased in *shakarpara*. The highest ash content was found in *mathri and matrey* (3.36 g/100gm), with per cent increase of 46.08 per cent.

Patil et al. (2015) prepared biscuits by the using garden cress seed at 05, 10, 15 and 20 per cent level and investigated them for moisture, fat and protein content. The moisture content of garden cress seed biscuits with levels of 05, 10, 15 and 20 per cent was 1.74, 1.87, 1.98, 2.12 and 2.20 respectively, which was higher than those control biscuits because garden cress seed powder is hygroscopic in nature . The protein content (%) of garden cress seed biscuits of 05, 10, 15 and 20 per cent was 5.19, 5.98, 6.25, 6.60 and 6.90 respectively, again higher than those of control biscuits**.** The fat content (%) of same formulations was17.48, 17.44, 17.46, 17.38 and 17.30 respectively that decreased with increase in the garden cress seed powder in biscuits and decrease in the quantity of wheat flour.

Rana and Kaur (2016) prepared supplemented products viz. biscuits, *ladoo* and *namakpare* with garden cress seeds using proportions of 5, 10, and 15 per cent. The moisture content of control and supplemented biscuit was 1.56 and 3.06 per cent respectively, whereas that of control *namakpara* and *ladoo* was 6.12 and 0.81 per cent respectively. The protein content of supplemented and control biscuits was 6.99 per cent and 6.05 per cent and of control *namakpara* and *ladoo* was 9.95 per cent and 14.82 per cent respectively. The fat content of supplemented biscuit, *namakpara* and *ladoo* was recorded as 27.32, 17.28 and 23.37 per cent respectively. The fibre content of supplemented biscuit was 0.14 per cent and of *namakpare* 0.19 per cent and *ladoo,* 0.82 per cent. The ash content of control biscuit was 0.45 per cent, and 1.37 per cent in supplemented biscuits. The ash content of control *ladoo* was 1.43 per cent and supplemented *ladoo* 2.13 per cent. The ash content in control *namakpara* was 2.48 per cent and 1.93 per cent in supplemented *namakpara*.

Uma and Sucharitha (2016) standardized and developed iron rich *ladoo* from garden cress. The major nutrients viz. carbohydrate, protein and fat were reported on calculation basis. Two formulation subscripts samples named S_I and S_{II} having 10 and 15 per cent garden cress incorporation level were used for *ladoo*. The total calories for S_I and S_{II} were calculated as 236 and 39.55Kcal and protein 7.85 and 9.09 respectively. There was very much difference in carbohydrate and protein content between S_I and S_{II}. The iron content of S_{II} was more than S_I, because more garden cress seeds were added in the recipe.

(ii) Mineral content and *in-vitro* iron bioavailability

Singh and Srivastava (2012) formulated iron rich *namakpare* mixes. The mixes were studied for calcium, iron, phosphorus, *in-vitro* iron bioavailability. These namakpare mixes were nutritious with ionizable iron content of 878.00-1342.00 µg per cent, in-vitro iron bioavailability of 28.67-42.00 per cent, calcium level 22.00-517.37 mg per cent and phosphorous level 119.00-434.90 mg per cent.

Nathiya and Nora (2014) formulated and assessed the nutrient content of cookies (nutricookies). The calcium and iron content of all the samples was significantly higher than the control. The control provided 87.33 mg of calcium whereas the experimental samples provided more than 120 mg. The iron content of the control was 14.58 mg. Samples with 10g, 20g and 30g garden cress seeds provided 24.58, 34.58 and 44.58 mg of iron per 100g.

Kaur and Sharma (2015) worked on enrichment of five traditional Indian food preparations namely, *atta besan ladoo, shakarpara, chikki, mathri and matrey* with treated garden cress seeds. The nutritional analysis showed that iron and calcium content of *shakarpara* and *chikki* was the highest whereas *atta besan laddoo* had minimum iron and calcium content amongst all developed food preparations.

Rana and Kaur (2016) prepared supplemented products viz. biscuits, *ladoo* and *namakpare* with garden cress seeds using proportions of 5, 10 and 15 per cent. A significant increase in the iron content of supplemented biscuits, *namakpara*, and *ladoo* as compared to control was observed. The iron content of supplemented biscuit was 13.60 mg and hat of control was 5.20 mg. The iron content of control *namakpara* was 2.70 mg which increased to 7.61 mg in supplemented *namakpara.* Iron content of control *ladoo* was 6.49 mg which significant increased in supplemented *ladoo* to13.37 mg.

2.4 Nutrition intervention for improved nutrition

2.4.1 Nutrition Education

Assessment and the enhancement of health education for adolescents in rural areas can lead to improved health behaviours and help reach the goals set for health (Misra and Aguillon 2001).

Impact of single vs. combination of media on nutrition knowledge and haemoglobin status was observed by Upadhyay et al. (2002). The subjects were exposed to short lectures, and other visual aids such as folder, flash cards, posters and display of raw foods which showed a significant rise in post exposure knowledge scores. After a period of 60 days, a significant rise in post exposure knowledge scores was observed. Between the groups, multimedia group scored significantly higher than print media group.

Meenakshi and Vyas (2003) used a questionnaire method to assess the nutritional knowledge of adolescent girls which contained 100 multiple choices questions. By comparing the scores of pre and post test on the same questionnaire for seven days interval indicated that about 30 per cent gain in knowledge as against to pre score (>23) by the subjects in the post tests of study.

Dutta et al. (2004) study on knowledge regarding anemia revealed that 60 per cent of the girls (17-19 years) had correct knowledge about signs of anemia and the cheapest source of iron, 72 per cent of them knew about the dietary cause of the disease. Their knowledge regarding the prevalence of anemia among Indian women and the normal haemoglobin level of them, however, was poor as only 26 per cent and 37 per cent of the girls could correctly answer in this respect.

Rao et al. (2007) conducted a study on adolescent girls (11-18 years) in schools of old city of Hyderabad. A significant improvement was found in the knowledge levels of both the experimental and control groups after the nutrition eduction intervention. The extent of improvement in the mean scores of the experimental group (3.09 ± 0.19) was significantly higher than the control group (1.65 ± 0.21) indicating positive impact of intervention.

John and Narasimhan (2008) conducted nutrition education programme on 50 breakfast consumer and 50 breakfast skipper school children. A pre and post test on knowledge and awareness was done on subject using a checklist. Children had a good knowledge and awareness in terms of nutrition, but after teaching basic nutritional needs, it helped to reinforce the ideas already known. The nutrition education programme thus served to be a vital tool in driving the children to put into practice their knowledge and awareness.

Jeong et al. (2009) found that class-based nutrition intervention combining traditional lecture and interactive activities was successful in decreasing soft drink consumption. Total milk consumption, specifically fat free milk, increased in females and male students changed milk choice favouring skim milk over low fat milk (1% and 2%).

Role of nutrition education in improving the nutrition awareness among adolescent girls was studied by Guptha and Kochar (2009). The author identified certain gaps in their knowledge, attitudes and practices. Hence nutrition education was imparted through lectures, audio-visual aids and demonstrations and result revealed for organizing such need based awareness programmes to increase the knowledge level of adolescents.

Sharma et al. (2009) studied the health awareness of rural adolescent girls of 13 to 19 years and found that they had lack of knowledge pertaining to social and health aspects and also a limited influence on decisions. The intervention was given for nine months to girls through lecturers, discussions and demonstrations. The post test was done on the girls after the period of intervention and found that the knowledge of girls on health was improved. The result also revealed that the educational intervention has a positive effect on awareness and knowledge level of adolescent girls.

Das et al. (2010) studied awareness on psychosomatic health among adolescent girls of three schools in North Kolkata. They used audio-visual teaching materials and handouts during health intervention. The result revealed that health education intervention showed a significant improvement in knowledge on adolescent's health in the aspects of sex differences in pubertal spurts and psychological problems.

Savita et al. (2013) conducted a study on impact of education intervention on nutritional knowledge of iron deficiency among post-adolescent girls. Nutrition knowledge intervention was carried out through short lectures using the visual aids (flash cards, posters and display of raw foods such as rich sources, enhancers and inhibitors of iron absorption) followed by discussion. The percentage of correct response ranged from 39-69 per cent previously followed by 71 per cent to 96 per cent at immediately after education intervention and 70 per cent to 91 per cent at one month after education intervention. The response improved after education intervention that could help to combat micronutrient malnutrition.

2.4.2 Food and nutrient intake

Anderson et al. (2003) assessed the impact of school-based education intervention aimed at increasing the consumption of fruits and vegetables. It was found that children in the intervention programme had an average increase in fruit intake (133 ± 1.9 to 183 ± 17.0 g/day) that was significantly ($P<0.05$) greater than the increase (100 ±11.7 to 107 ± 14.2 g/day) estimated in subjects in control groups. Increase in scores for variables relating to knowledge about fruits and vegetables and subjective norms were also greater in the intervention than in control groups.

The effectiveness of nutrition education intervention by using a flip chart, information leaflet, a calendar and a video program focused on food-based strategies promoting consumption of iron-rich foods and foods that increase absorption of iron (vitamin C rich foods) was assessed by Kapur et al. (2003). The intervention brought about significant changes in intake of nutrients (energy, protein, iron and vitamin C). The adequacy of cereals, pulses, other vegetables, fruits, oil/fats intake was high in groups where nutrition education was a component as compared to control and supplementation group. Although the intake of green leafy vegetables was low among children, the high vitamin C intake attributed to the high intakes of fruits and other vegetables recorded in the food intake data specific to nutrition education group may have also contributed in terms of better absorption of iron from the diet.

Koon et al. (2006) aimed to report the outcome evaluation of the nutrition education programme in terms of nutritional status, nutrition knowledge, attitudes and practices. Nutrition knowledge increased significantly from 64.6 ± 19.8 marks during

baseline to 69.6 ± 20.8 marks at follow up in school students. More students were aware of the importance of breakfast, whereby 53.9 per cent agreed that breakfast was important for health and not just to curb hunger in the morning and encouraging change in the dietary habits was demonstrated by reduction in snacking practice as well as fast food consumption.

Kaur et al. (2007) assessed the nutritional awareness of 60 school going adolescents of 13-19 years age in rural area of district Kurukshetra before and after imparting nutrition education regarding healthy nutrition and dietary habits. The nutrition education was imparted through lectures, audiovisual aids and demonstrations for three months. After providing nutrition education, a significant improvement in their nutritional knowledge was viewed and quantum of improvement was 1.67 times.

Mihas et al. (2010) assessed the short-term (15 days) and long-term (12-month) effects of a school-based health and nutrition education intervention on diet, nutrition intake. It was found that twelve months after the intervention, students of the intervention group reduced their weekly consumption of red meat and non-home-made meals and increased their frequency of fruit and breakfast cereal consumption.

2.4.3 Physical fitness index

Physical activity has been shown to be markedly affected by iron status, and improved by iron supplementation in developing countries where anemia is common and severe. Bhatia and Seshadri (1987) described poorer work capacity in a group of 8-12-year-old anemic Indian boys compared with non-anemic controls.

In UK, there is evidence of short-term effects of anemia on performance capacity and recovery from physical activity, assessed by heart rate (Nelson et al. 1996). Girls aged 12-14 years with haemoglobin levels < 12.0 g/dl were analysed for heart rate test and compared test scores with non-anemic girls showed that anemic girls had poor scores of heart rate test.

Solon et al. (2003) determined the effect of a multiple micronutrient-fortified beverage on the micronutrient status, physical fitness, and cognitive performance of school children. The 16 weeks post-intervention period showed that fortified beverage

significantly improved iron status among the subjects, which had hemoglobin levels < 11 g/dl at baseline. The proportion of children who remained moderately to severely anemic was significantly lower among those given the fortified beverage. The effect of the fortified beverage on changes in heart rate was dramatic and consistent. Interestingly, the fortified beverage also showed significant and more dramatic effect in reducing heart rate among the children with hemoglobin levels > 12 g/dl and UIE levels > 20 to < 50 μg/L, hemoglobin levels > 12 g/dl and UIE levels > 50 to <100 μg/L, and UIE levels > 20 to < 50 μg/L at baseline. The increases in fitness index scores in the subjects who received the fortified and nonfortified beverage were 1.25 and 0.29, respectively.

Gopal et al. (2012) carried out a study on effect of exercise on physical fitness with an aim to find out the effect of exercise and nutrition on growing children with scientific records. The results of the study revealed that maximal oxygen consumption (VO_2) max in residential children was 66.03 ± 7.06 and in non-residential school children was 55.24 ± 7.53. Physical fitness index in residential children was 54.96 ± 8.38 and in non-residential school children was 44.75 ± 5.05. So, VO_2 max and PFI were significantly higher in residential as compared to that of non-residential school children.

Parmar and Modh (2013) did a cross-sectional study on 105 physiotherapy students and physical fitness index was measured using modified Harvard Step Test. The result showed that physical fitness index of females was excellent when compared to male counterparts. 45 per cent of female subjects had excellent physical fitness whereas only 12 per cent of males studied had excellent physical fitness. Pulse rate variability (pre and post exercise) was minimum among subjects who had excellent physical fitness and it was maximum among subjects who had poor physical fitness index.

In a field study, the impact of anemia and iron deficiency (ID) on physical and cardio respiratory fitness on young women was evaluated by Kalasuramath et al. (2015) using(mild-moderate anemic, ID and control) the modified Queens College step test (QCT) in field study. Three groups of 200 respondents were assessed for physical fitness index. Results revealed 100 per cent of women could perform this test

but the striking fact was that 95 per cent of the individuals could not complete in the 5 min duration of the test. The mean VO_2 max in ID women was 40.24 ml/ kg/min and there were statistical significant differences between the anemic and control groups. The mean PFI (%) for anemic, ID was significantly higher than that of control group ($p<0.05$).

2.4.4 Elemental iron and hemoglobin level

Ricardo et al. (2002) concluded that iron fortification is a methodology utilized worldwide to address iron deficiency. Fortification of foods with iron has been a commonly used strategy to combat iron fortification through the world. Iron fortification of staple foods: wheat, maize, rice and cereal flours are currently the most common vehicles for iron fortification to reach the general population.

Agarwal and Milana (2007) studied the effect of frequency and dosage of iron folic acid supplementation on blood haemoglobin status of anemic adolescent girls in Delhi. Group I received the supplement thrice a week while group II received it once every week for twelve weeks. Data indicated a significant impact of iron folic acid supplementation on the blood haemoglobin levels in both the groups. However, the mean increase in haemoglobin levels was not significantly different (1.42g/dl in Group I and 1.33g/dl in Group II).

Mittal et al. (2011) conducted an intervention study among 104 unmarried adolescent girls.The girls were administered iron folate and calcium tablets on alternate days for three months. Results showed there was increment of 19.55 per cent haemoglobin in the group of girls receiving IFA supplements where as haemoglobin decreased slightly in girls of the control group.

Nutrition intervention is one of the appropriate, effective and sustainable approach to combat iron deficiency anemia. Angel and Devi (2012) found the effect of garden cress seeds incorporated health mix among anemic adolescent girls in the age group of 12-15 years. The supplement contained 10 mg of iron. The mix (50g) was supplemented daily for a period of six months for 100 anemic adolescent girls. After supplementation, the mean haemoglobin level raised from 8.23 ± 0.49 to 11.11 ± 0.4614 and there was a significant improvement in all the parameters. It was concluded that supplementation of the garden cress seeds incorporated health mix had a good effect.

Jain (2013) standardized iron rich recipes and studied the comparison of impact of supplementation of iron enriched food product and intermittent medicinal iron as well as their sustainability. Anemic subjects were divided into three groups-Group1: iron folic acid syrup twice weekly; Group 2: daily supplementation of four niger seed and defatted soyflour biscuits plus two lemons and Group 3: remained un-supplemented. Post intervention data was collected after an intervention period of 120 days. Among developed iron rich recipes viz. biscuit, *idli*, *handwa* and soy chat, niger seed added soy biscuits had the best acceptability and contained 10.8 mg per cent iron. Twice weekly medicinal iron supplementation was effective in raising Hb and building iron stores. Iron rich food supplementation also improved haematological profile but to a lesser extent. The impact of iron rich food supplementation on Hb sustained for four months while that of medicinal iron did not. The author concluded that effect of food supplementation was sustainable; therefore, this strategy seems to hold more potential to control anemia in school girls.

Prevalence of anemia among adolescent girls was assessed by Patil et al. (2014) and studying impact of nutritional education, therapeutic intervention and supplementary intervention for the control of anemia amongst these girls. The adolescent girls in the age group of 11-18 years were contacted. Out of the total 103 adolescent girls 88 (85.4%) were anemic of which 52 (50.48%) had mild anemia, 34 (33%) moderate anemia and 2 (1.9%) had severe anemia. Fifty-two mildly anemic girls were selected for intervention study and divided into three groups in size of 17, 17 and 18 girls in each group. Interventions of nutritional education, distribution of iron and folic acid tablets and supplementary nutrition by giving iron rich preparations was done in the above three groups for a period of one month and Hb was rechecked. The results showed rise in the Hb level in group 2 who received iron and folic acid tablets. No change in Hb level was seen in group 1and 3.

Angel and Devi (2015) assessed the therapeutic impact of garden cress seed *ladoo* among the selected anemic adolescent girls in the age group of 12-15 years. Two hundred moderately anemic adolescent girls (each 100 in the experimental group and the control group) were chosen for further study. The *ladoo* that contained 10 mg of iron was given for a period of 6 months along with 5g amla powder. After 6 months of supplementation, improvement was observed in the clinical signs of the experimental group. The haemoglobin level (g/dl) gradually increased from 8.67±0.59 to 12.43±0.70. There was no specific change in the control group.

3. MATERIALS AND METHODS

This chapter describes the methodology used for research investigation selected to assess the "Impact of dietary intervention on nutritional status of anemic adolescent girls of Kangra district (HP)". The investigation was carried out during 2014-2016 in three phases which has been discussed under the following headings:

Phase-I Assessment of nutritional status of adolescent girls and prevalence of anemia

3.1 Locale of study

3.2 Selection of subjects

3.3 Development of interview schedule

3.4 Collection of data

3.4.1 General and socio economic information

3.4.2 Dietary assessment

3.4.3 Anthropometric measurements

3.4.4 Clinical assessment

3.4.5 Hemoglobin assessment

3.4.6 Health status

3.4.7 Academic record

3.4.8 Mass media information

3.4.9 Preception and knowledge regarding anemia

Phase-II Formulation and nutritional evaluation of value added products from garden cress seeds

3.5 Procurement of raw material

3.6 Development of value added products

3.6.1 Preparation of value added products

3.6.2 Sensory acceptability of value added products

3.8 Nutritional evaluation of garden cress and value added products

3.8.1 Proximate composition

3.8.2 Mineral content

3.8.3 *In-vit*ro iron content

Phase-III Impact of diet and nutrition education intervention on moderately anemic adolescent girls

3.9 Locale and selection of subjects

3.10 Intervention of moderately anemic adolescent girls

3.10.1 Nutritional and health knowledge, attitude and practice test

3.10.2 Diet and nutrient intake

3.10.3 Hemoglobin level

3.10.4 Physical fitness index

3.11 Development of educational package

3.12 Implementation of nutrition intervention

3.13 Impact assessment of nutrition intervention

3.14 Data analysis

3.14.1 Tabulation of data

3.14.2 Statistical analysis

Phase-I (Baseline survey and data collection)

Assessment of nutritional status of adolescent girls and prevalence of anemia

3.1 Locale of study

The study was conducted in three blocks of Kangra district, Himachal Pradesh viz. Baijnath, Panchrukhi and Bhawarna (Plate 3.1). One hundred subjects from each block were selected randomly for the purpose. The research investigation was carried out during 2014-2016.

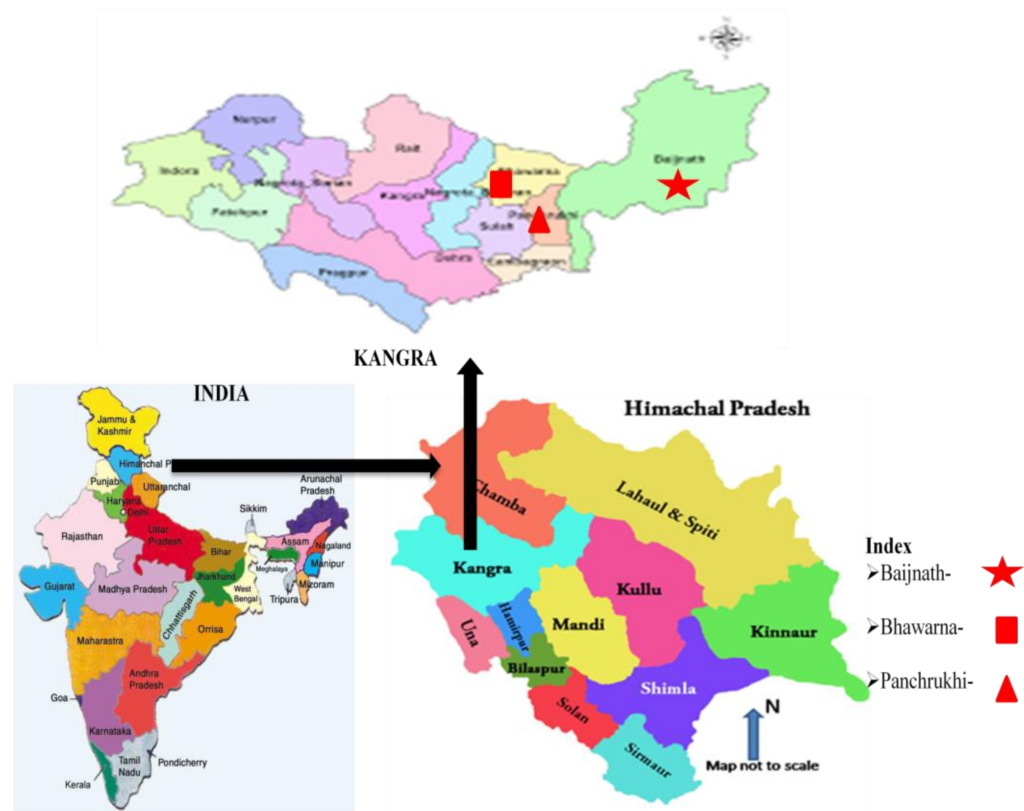


Plate 3.1 Map of District Kangra (Himachal Pradesh)

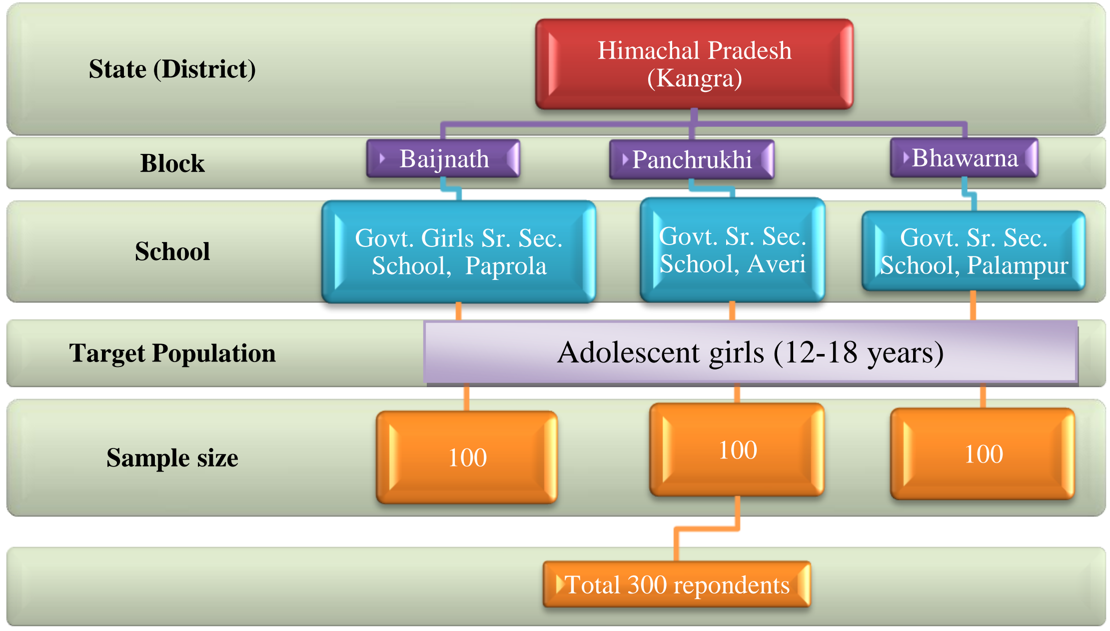


Fig. 3.1 Sampling Procedure

Of the twelve districts of Himachal Pradesh, Kangra is the most populated district of the state having a population of 1,510,075 of which male and female were 750,591 and 759,484 (Census 2011). It has a population density of 263 inhabitants per square kilometer with sex ratio of 1013 females for every 1000 males.

3.2 Selection of subjects

A total sample of three hundred adolescent girls in the age group of 12 to 18 years, willing to participate in research study were selected randomly for study from Government Girls Senior Secondary School, Paprola, Government Senior Secondary School, Averi and Government Senior Secondary School, Palampur situated in Baijnath, Panchrukhi and Bhawarna blocks, respectively of Kangra district (Figure 3.1).

3.3 Development of interview schedule

Based on the objectives of the study, a structured interview schedule was developed to obtain the desired information on various aspects of nutritional status and anemia. The reliability and feasibility of the schedule was worked out by pre-testing the schedule on non-sampled subjects i.e.10 respondents selected randomly from local schools. Based on the response received during pre-testing, certain necessary changes were incorporated in the schedule. Hence, the pre-tested and reconstructed schedule was used to collect the final data required for the present study (Appendix-I). Prior permission and approval to conduct the investigation in selected schools was taken from the Principal as well as from the parents of the respondents (Appendix-II and III). They were apprised of the need and scope of research.

3.4 Collection of data

The required data were collected through personal interaction from the selected respondents as well as from their parents using the specially structured interview schedule (Plate 3.2). Importance of the present investigation was explained to all the girl students of 6th -12th standard (12-18 years) and they were encouraged and motivated to participate in the study. A separate class room was provided by the school authorities to conduct the study. The school administration facilitated the conduct of investigation by providing physical facilities, organizing group of children for various measurements and giving free time for children to participate in the investigation.

Plate 3.2: Collection of general data and clinical assessment

Plate 3.3 Measurement of anthropometric parameters

3.4.1 General and Socio Economic Information

i) Background information

This section included the baseline profile and demographic variables of the studied population pertaining to age, present class of study, family size and type, birth order, number of sibling, religion, community, educational level of parents, parent's occupation, monthly income, pattern and type of house and source of drinking water.

ii) Agricultural background

This aspect included land holding pattern and size, types of agriculture and horticulture crops grown and utilization of land produce.

iii) Animal rearing information

Information on rearing of milch and other domestic animals, number of animals, types, yield per day, amount for consumption and sale was collected.

3.4.2 Dietary assessment

i) Dietary information

Food habits, meal taking and skipping trend, mode and time for taking meal, fast food intake pattern, consumption of beverages, fasting trend, fuel used for cooking and cooking methods and utensils used by the subjects was included.

ii) Food frequency pattern (Singh 2014a)

Information regarding the frequency of consumption of foods for the last two seasons (winter and summer) was collected by using food frequency pattern. The frequency of food consumption was quantified by a score system i.e. 9-thrice in a day, 8-twice in a day, 7-daily, 6-thrice in week, 5- twice in a week, 4- weekly, 3- thrice in month, 2- twice in monthly, 1- monthly, and 0- never. The mean frequency was calculated for each food item consumed by each subjects.

iii) Diet and nutrient intake (ICMR 2010)

Food and nutrient intake is an important component of nutritional status assessment. Information regarding the dietary intake of respondents was collected by using 24 hrs Dietary Recall Method, for three consecutive days. The food consumed was converted into their raw equivalents and the average daily intake of food and nutrients was calculated by using 'Diet Cal' software. The food and nutrient intake

was compared with Suggested Dietary intake (SDI) and Recommended Dietary Allowances (RDA) as given by ICMR. The per cent nutrient adequacy was also calculated.

$$\text{Per cent diet adequacy} = \frac{\text{Diet intake of subjects}}{\text{SDI of food groups}} \times 100$$

$$\text{Per cent nutrient adequacy} = \frac{\text{Nutrient intake of subjects}}{\text{RDA of nutrients}} \times 100$$

3.4.3 Anthropometric measurements

i) Height (Jelliffe 1966)

Height is a linear measurement of body. Low height-for –age is an indicator of long term growth deficit. It is associated with chronic insufficient food intake and frequent infections. Height measurement was taken with the help of an anthropometric stadiometer (Plate 3.3). The subjects were asked to remove their shoes and stand erect against the wall, with feet parallel and heels together, back of the head touching the wall. The head was held comfortably erect and the arms were hanging at the sides. The head piece of the stadiometer was lowered so that the hair are pressed flat then, height was recorded.

Table 3.1 National standard for height, weight and BMI for specific age groups

Age (years)	ICMR (2010)		
	Height (cm)	Weight (kg)	BMI
12	150.20	39.00	17.30
13	153.80	43.40	18.30
14	157.00	47.10	19.10
15	158.80	49.40	19.60
16	159.70	51.30	20.10
17	160.20	52.80	20.60
18	161.10	53.80	20.70

ii) Weight (Jelliffe 1966)

Weight is a key anthropometric measurment of body mass. Low weight for age is the best indicator for the detection of protein energy malnutrition and growth failure in children. The body weight was taken using portable weighing balance machine. The subjects were asked to remove their shoes before weighing and to stand

in the centre of the platform without touching anything (Plate 3.3). The weighing scale was recalibrated frequently by taking weight of the subjects and also zero error of the scale recalibrated after every use. Height and weight of the respondents were compared with NCHS (2007) and ICMR standards (ICMR 2010).

Table 3.2 International standard for height and weight for specific age groups

Age	NCHS (2007)	
	Height (cm)	Weight (kg)
12	151.50	41.50
13	157.10	46.10
14	160.40	50.30
15	161.80	53.70
16	162.40	55.90
17	163.10	56.70
18	163.70	56.60

iii) Body Mass Index (WHO 2004)

BMI has been recommended by WHO (2004) as an indicator of choice for measuring undernutrition among adolescents. Among adolescents, BMI slowly increases with age. Body Mass Index was calculated by using the following formula:

$$\text{Body Mass Index (kg/m}^2\text{)} = \frac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$$

Table 3.3 Classification of Body Mass Index (WHO 2004)

Interpretation of BMI Category	BMI (kg/m^2)
1. Underweight a. Severe thinness b. Moderate thinness c. Mild thinness	1. <18.5 a. <14.00 b. 14.00-16.99 c. 17.00-18.49
2. Normal	2. 18.50-24.99
3. Over Weight	3. 25.00-29.99
4. Obese a. Obese I b. Obese II c. Obese III	4. ≥30.00 a. 30.00-34.99 b. 35.00-39.99 c. ≥40.00

iv) Tricep skin fold thickness (Jelliffe 1966)

The harpender skin fold caliper was used to measure triceps skin fold thickness. The measurement taken half way down the left arm between the tip of acromain process of scapula and olecranon process of ulna. The measurement was done while the arm was hanging freely at the sides. The skin fold parallel to the long axis was picked up between the thumb and the fore-fingers of the left hand and was picked away from the underlying muscle (Plate 3.3). The caliper was applied to the fold little below the fingers and reading was noted to the nearest of 0.1 mm. Measurement was recorded in millimeters (mm).

3.4.4 Clinical examination (Jelliffe 1966)

Information on various signs and symptoms of malnutrition and nutritional deficiency disorders was observed by visual examination in superficial epithelial tissues especially the eyes, skin or organ near the surface of body.

3.4.5 Hemoglobin assessment (WHO 2001)

Hemoglobin (Hb) level of the subjects was determined using the Sahli's hemoglobin method (Plate 3.3). The reading taken was compared with WHO standards for classification of anemia. The adolescent girls were classified into four groups based on the hemoglobin content (WHO 2001).

Table 3.4 Classification of anemia (WHO 2001)

Classification (g/dl)	Category
≥12	Normal (Non anemic)
<12 i. 11 – 11.9 ii. 8 – 10.9 iii. <8	Anemic i. Mild anemic ii. Moderate anemic iii. Severe anemic

3.4.6 Health status

i) Physical activity

This component included the information about the activity pattern. Activity pattern of the adolescent girls was recorded from their daily routine like physical exercise, frequency and time spent on physical exercise and time spent on watching television and internet.

ii) General health

In this section, information regarding family history of metabolic diseases (diabetes, hypertension, cardiac problem etc) and nutritional deficiency (protein energy malnutrition, iodine deficiency disease, anemia etc) were recorded. General illness and its frequency in the respondents for the last one year was also recorded.

iii) Information on intake of medicinal supplements

Information regarding intake/frequency of minerals and vitamins supplements, their composition and a reason for intake of supplements was recorded. Deworming history was also recorded for the respondents.

iv) Menstruation history

This section pertained to the menstrual history of the respondents. The questions included in this section were age of menarche, duration of the blood flow, interval between the next menstrual cycle and problems associated with it.

3.4.7 Academic record

In this section, information was gathered from adolescent girls regarding academic grade, achievements or reasons for failure, participation in extra circular activities, peer group pattern and frequency of playing with friends.

3.4.8 Mass media exposure

The information regarding sources of availability of mass media at home, preference of mass media language, mode (electronic or printed) of mass media preference and interested area on viewing mass media was collected.

3.4.9 Perception and knowledge regarding anemia

This aspect included the questions formulated to compile information regarding anemia such as its awareness, sources of iron rich foods, inhibitory and enhancing factors of iron absorption, symptoms and sign of anemia, complication of anemia was collected. The data was also obtained regarding the type of measures used to control or prevent anemia and schemes lanched for anemia prevention.

<u>Phase-II (Development and standardization of products)</u>

Development and nutritional evaluation of iron rich value added products from garden cress seeds

3.5 Procurement of raw material

Raw materials such as garden cress seeds, amaranth seeds, sesame seeds, wheat flour, refined flour and other raw materials were collected in bulk from local market.

3.5.1 Processing of samples

i) Unprocessed garden cress (UP) - Garden cress seeds were sorted and cleaned to remove impurities and were ground in mixer and stored in airtight container.

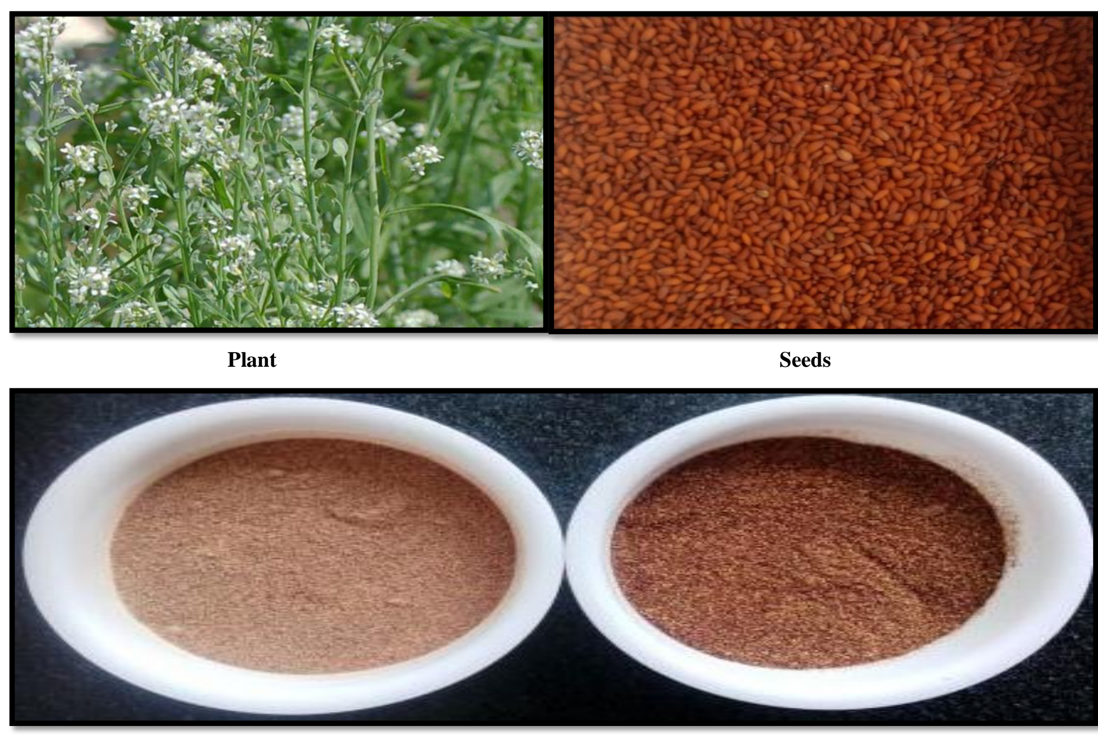
ii) Processed garden cress (P) - Garden cress seeds were sorted and cleaned to remove impurities. Seeds were soaked in water for 3 h and drained the superficial water. After that, seeds were dried in tray drier at 60^0C temperature and kept for drying until they were completely dried. Then, they were ground in mixer. Grounded garen cress flour was roasted and stored in airtight container (Plate 3.3).

Amaranth seeds were popped and made into coarse flour and also stored in airtight container. Sesame seeds were roasted and coarsely grounded at the time of preparation of recipes. Other raw material was also cleaned and stored in jars for further use.

3.6 Development and standardization

After trials of various recipes enrichment and prototypes, development was taken up for the recipes with higher acceptability. Three iron enriched variants each of sweet and savoury recipes viz. *ladoo, mathri*, *shakkarpare* and biscuits were prepared. The first recipe of each product was control i.e. garden cress was not incorporated and was developed for comparison. Variant-1 was incorporated with un- processed garden cress seeds. Variant-2 was subjected to incorporation of processed garden cress seeds.

After a series of trials using ingredients in various proportions and adopting different processing methods, the concept of the enriched products took shape. These recipes were prepared in Food Science, Nutrition and Technology laboratory at CSKHPKV, Palampur.



Plant Seeds

Un-processed flour Processed flour

Plate 3.4 Garden cress plant and seeds

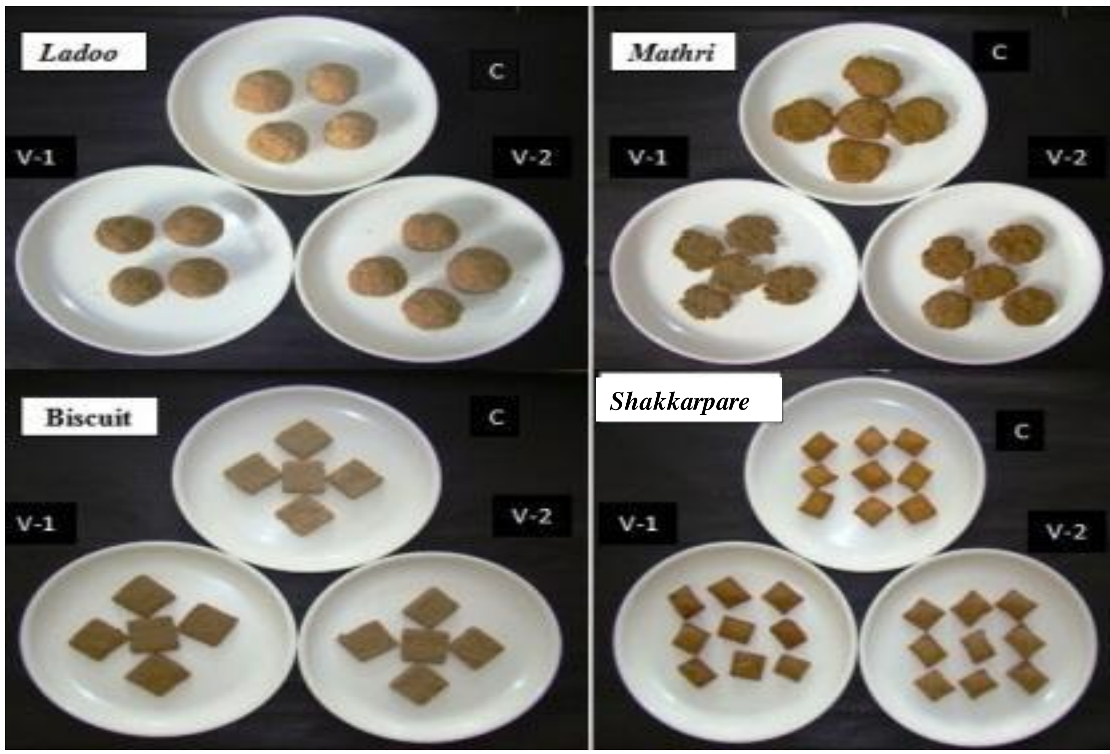


Plate 3.5 Iron rich developed products (C: Control, V-1: Variant-1, V-2 : Variant -2)

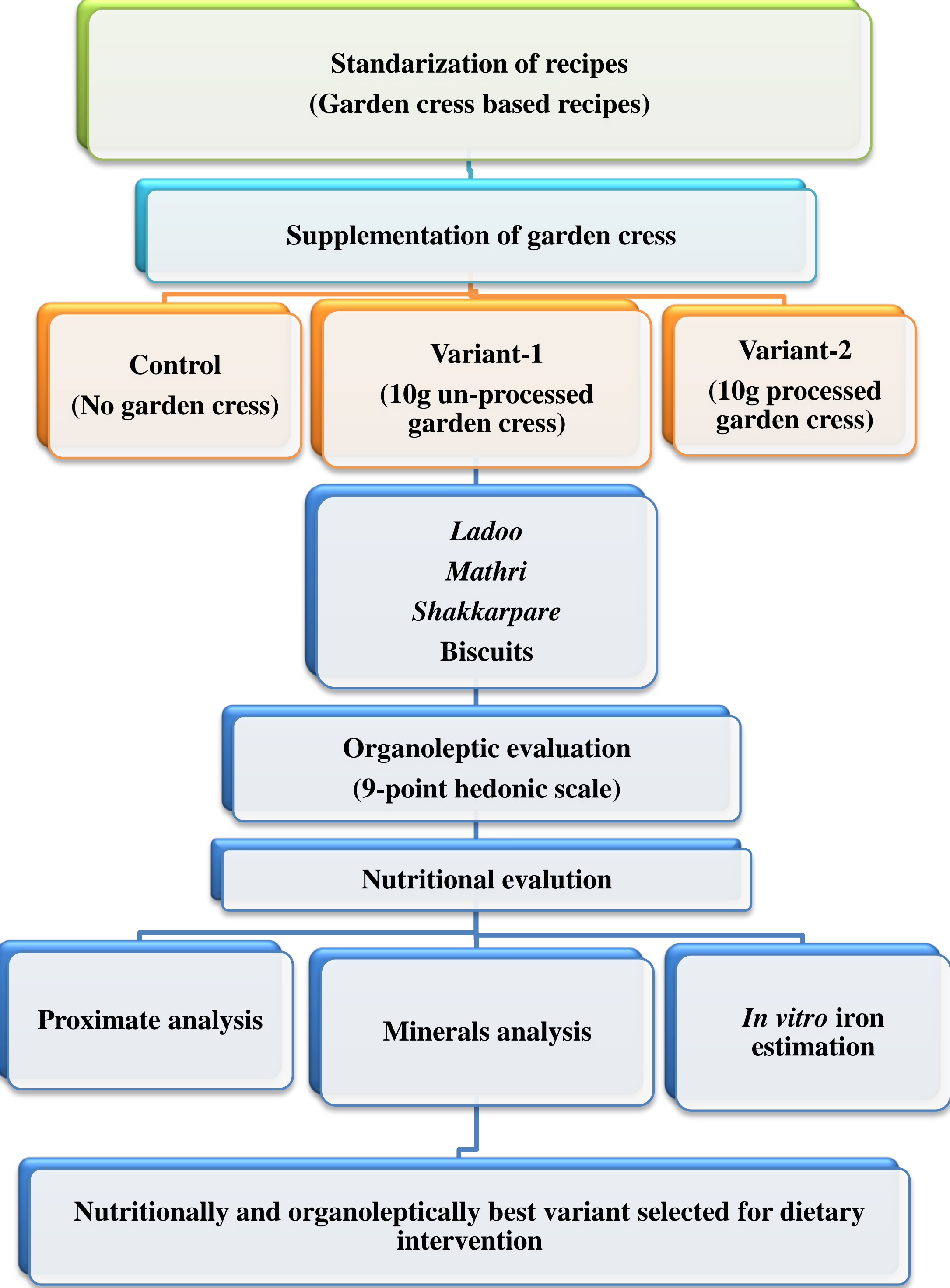


Fig. 3.2 Schematic presentation of development of recipes for dietary intervention

Garden cress seeds were chosen for iron enrichment along with other ingredients viz. amaranth seeds and sesame seeds to prepare *ladoo, mathri, shakkarpare* and biscuits and to find out the best iron rich recipe among developed products by sensory acceptability (Table 3.5).

Table 3.5 Ingredients used in recipes

Recipe	Control	Variant-1	Variant-2
Ladoo	Amaranth flour-25g Wheatflour-25g Jaggery-40g Fat-10g	Amaranth flour-25g Wheat flour-20g Jaggery-40g Fat- 10g Garden cress powder(UP)-10g	Amaranth flour-10g Wheat flour-10g Jaggery-40g Fat- 10g Garden cress powder (P)-10g Sesame seeds-15g Grated coconut-5g Raisin-5g
Mathri	Refined flour-50g Amaranth flour-30g Fat-20g Salt-1.50g Fat for frying	Refined flour-40g Amaranth flour-30g Garden cress powder (UP)-10g Fat-20g Salt-1.50g Fat for frying	Refined flour-30g Amaranth flour-20g Garden cress powder (P)-10g Sesame-16g Dry Fenugreek leaves-2g Fat -20g Black pepper-2g Salt-1.50g Fat for frying
Shakkarpare	Refined flour-60g Sugar-30g Amaranth flour-10g Fat for frying	Refined flour-40g Amaranth flour-10g Garden cress powder (UP)-10g Sugar-30g Fat for frying	Refined flour-30g Amaranth flour-20g Garden cress powder (P)-10g Sugar-30g Sesame seeds-10g Fat for frying
Biscuit	Refined flour-50g Amaranth flour-10g Fat-30g Salt-1g Sugar-4g Omum2g Cumin-2g Baking powder-0.30g	Refined flour -45g Amaranth flour-5g Garden cress powder (UP)-10g Fat-30g Salt-1g Sugar-4g Omum-2g Cumin-2g Baking powder-0.30g	Refined flour -40g Amaranth flour-10g Garden cress powder (P)-10g Fat-30g Salt-1g Sugar-4g Omum-2g Cumin-2g Baking powder-0.30g

3.6.1 Preparation of value added products

Four value added products viz. *ladoo, mathri, shakkarpare* and biscuits were prepared (Plate 3.5) and the methodology for their preparation is discussed below.

i) *Ladoo*- Roasted wheat flour till light brown. Added all the measured ingredients in wheat flour and simultaneously prepared jaggery syrup of one thread consistency. Added syrup in prepared mixer and made small rounded *ladoos.*

ii) *Mathri*- In refined wheat flour, added all the measured ingredients and rubbed with melted ghee (shorting). Kneaded stiff dough and prepared small flattened rounded *mathri*, deep fried till light brown in colour.

iii) *Shakkarpare*- Added all measured ingredients in refined wheat flour. Kneaded stiff dough and rested the dough for 20 min covered with damp cloth. Rolled it and cut into diamond shaped s*hakkarpare*. Deep fried in medium flame till golden brown.

iv) Biscuits- Mixed and stifted thrice all the measured ingredients. Creamed ghee and folded the flour into it. Prepared dough and rested for 20 minutes covered with damp cloth. Rolled and cut in squares with the help of cutter and baked at 175 ºC for 15 min.

3.6.2 Sensory evaluation

All the developed food recipes were presented to a panel of ten semi-trained judges comprising faculty members and post graduate students, who evaluated organoleptically the presented products using nine point Hedonic scale (Annexure-IV) with corresponding descriptive terms ranging from 9 (like extremely) to 1 (dislike extremely).

3.8 Nutritional evaluation of garden cress and its value added products

All the chemicals/reagents used in chemical analysis were of AR grade.

3.8.1 Proximate composition

Proximate principles were determined and computed on dry weight basis according to AOAC (2010). The moisture content of samples was determined by drying the samples at 105 °C until a constant weight was obtained. Dried samples were analyzed to determine the total nitrogen content using micro Kjeldahl method. A conversion factor of 5.71 was used to calculate protein content. The ash content was

determined by burning 3 g of oven-dried sample in a crucible in a muffle furnace at 550°C for 8 hrs. The total lipids were isolated using the Soxhlet method. Crude fiber was measured by digestion with 1.25% sulphuric acid followed 1.25% of sodium hydroxide. Carbohydrates content was determined by the difference method.

Total carbohydrates were calculated by the following formula:

Total carbohydrate (%) = 100- (Moisture + crude ash + crude protein +crude fat)

The per cent deviation indicated the per cent more or less of a nutrient found in the treated garden cress seeds as compared to the untreated seeds and was calculated as per the following formulae (Worthington 2001).

% Difference= (Treated seeds-untreated seeds) / Untreated seed × 100

3.8.2 Minerals content

The dried samples were wet digested in 25 ml of diacid mixture (nitric acid and perchloric acid: 9:4) as per method given by Ranganna (2007). The digested samples were analyzed for sodium, potassium and calcium by using Flame Photometer, (Model-Mediflame 128) and for iron, zinc and copper, Atomic Absorption Spectrophotometer, (AAS – 4129) was used. Phosphorus was determined by spectrophotometeric method. All the estimations were done in triplicate and reported on dry weight basis.

3.8.3 *In-vit*ro availability of iron content (Narasinga and Prabhabati 1982)

For iron estimation, 2g of sample was mixed with 25 ml of pepsin HCl (5% pepsin in 0.1 N HCl) solution. The pH of mixture was adjusted to 1.35 with HCl and incubated in 100 ml conical flask at 37ºC in metabolic shaker cum water bath for 90 min. After incubation, the contents of the flask were filtered through Whatman No.44 filter paper. Then the pH of the solution was adjusted to 7.5 with NaOH and again centrifuged at 3000 rpm for 45 min and supernatant were filtered through Whatman filter paper No.44 and again incubated at 37ºC in metabolic shaker cum water bath for 90 min. The supernatant was filtered again and used for determination of ionizable iron.

Ionizable iron

Free form of iron in the filtrate, which reacts with alpha-alpha- dipyridyl to yield colour, and obtained after incubation of samples with pepsin HCl at pH 1.35 and 7.5 was digested as per method 3.8.2. Ionizable iron was then determined by atomic absorption spectrophotometer (AAS-4129). This form of iron corresponds to the ionizable iron. The percentage of iron absorption was determined by regression equation of Rao and Prabhavati (1978) as given below:

$$Y=0.4827+0.4707X$$

$$X= \frac{\text{Ioizable iron}}{\text{Total iron}} \times 100$$

Reagents

1. **Alpha-alpha-dipyridyl solution:** Dissolved 0.1g of alpha –alpha dipyridyl in distilled water and diluted to 100 ml in volumetric flask.
2. **Acetate buffer solution:** Dissolved 8.3g of anhydrous sodium acetate in distilled water followed by the addition of glacial acetic 12ml and made the volume to 100 ml. Filtered the contents through Whatman filter paper No.1.
3. **Hydroxylamine HCL solution:** Dissolved 10g of hydroxylamine hydrochoride in distilled water and made the volume 100ml.

Procedure

From the aliquot, pipetted 1.0 ml into 10 ml volumetric flask and added 1ml of hydroxylamine hydrochloric solution. In few minutes, added 5ml of buffer solution and 1ml of α,α-dipyridyl solution and made the volume to 10 ml. Read the intensity of colour against reagent blank in spectrophotometer at wavelength of 510 nm.

Standard curve

Dissolved 3.512g of ferrous ammonium sulphate [Fe $(NH_4)_{2.4}H_2O$] in distilled water to which 1ml of conc.H_2SO_4 was added and volume was made to 1 litre. Diluted 10 ml of this solution to 1 litre (10µg/ml) and used as working solution. Standard curve was prepared in the range of 25 to 125µg. Added 10, 20, 30, 40 ml of working standard solution to 100 ml of volumetric flasks. Add 2 ml of concentrated

HCl to each flask and volume was made to 100ml. Proceeded as in case of sample solution and standard curve was plotted (Figure 3.3).

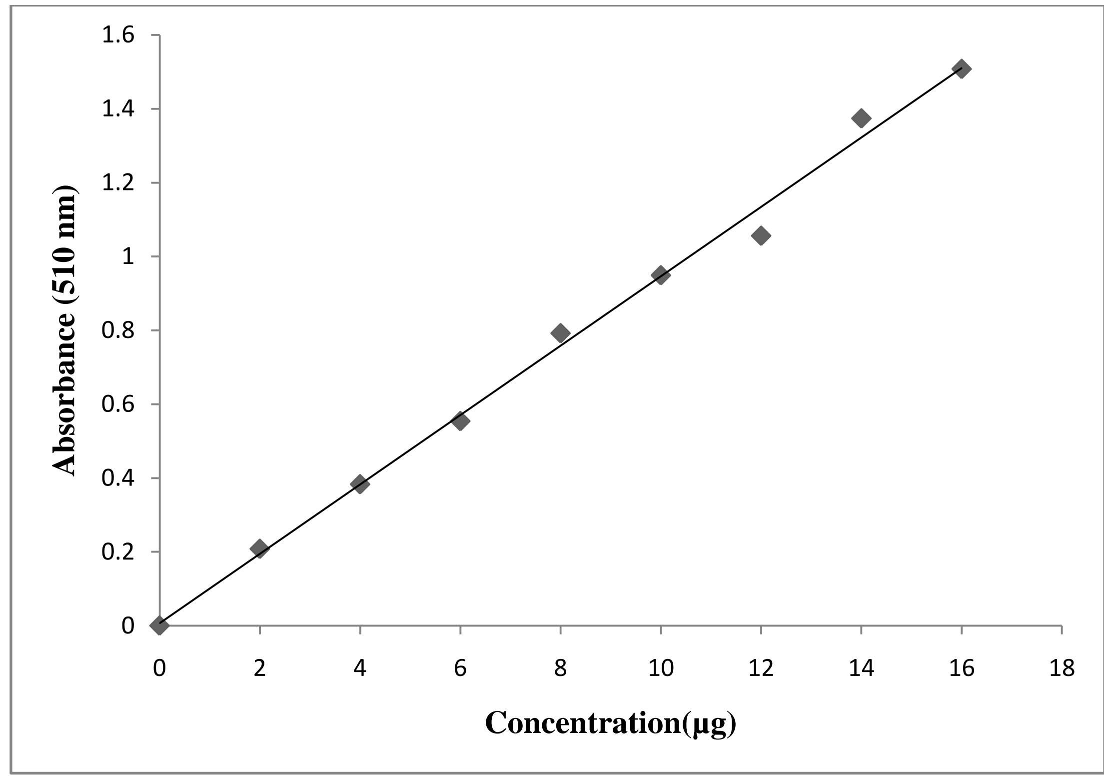


Fig 3.3 Standard curve for ionisable iron

Estimation of soluble iron (Narasinga and Prabhabati 1982)

To 1g of sample, added 50 ml of 0.03 N HCl. Incubated the mixture at 37ºC in shaker cum bath for three hours to stimulate the conditions that occur in human stomach. Filtered the mixture through ash less filter paper (Whatman No. 42). The filtrate was oven dried, digested in diacid mixture (nitric: perchloric acid, 5:1 v/v) and processed for determination of soluble iron by atomic absorption spectrophotometer. The extractability was determined as

$$\text{Extractability (\%)} = \frac{\text{HCL extractable minerals (mg)}}{\text{Total iron (mg)}} \times 100$$

Phase-III (Impact evaluation –Pre and post intervention data collection)

Impact of diet and nutrition education intervention on moderately anemic adolescent girls

3.9 Locale and selection of subjects

The study was conducted in selected Government Senior Secondary Schools of three blocks of Kangra district viz Baijnath, Panchrukhi and Bhawarna in the year 2014-2016. Based on the assessed hemoglobin level, 90 moderately anemic subjects (Hb-8–10.9 gm/dl) were purposively selected to study the impact of nutrition intervention (spread over a period of 4 months) on their nutritional status and hemoglobin profile. These subjects were divided into three groups.

i. Group 1 (n=30) received iron rich garden cress products along with nutrition education for four months.

ii. Group 2 (n=30) were imparted nutrition education for four months.

iii. Group 3 (n=30) were the control group. No nutrition intervention in any form was provided to this group.

Before the initiation of intervention, one orientation session was conducted to each group to sensitize the moderately anemic adolescent girls regarding the causes, consequences and treatment of anemia. All the girls of the group were gathered at one place in the school premises along with the class teachers and were explained about the importance of iron during adolescence and the rich dietary sources of iron and vitamin C. They were motivated and encouraged to actively participate in the program (Figure 3.4).

3.10 Intervention of moderately anemic adolescent girls

Intervention schedule of moderately anemic adolescent girls consisted of estimating their diet and nutrient intake, level of hemoglobin and physical fitness index. A nutritional knowledge schedule was developed to assess the level of knowledge of respondents in the field of nutrition and health (Plate 3.5).

Plate 3.6 Knowledge, attitude and practics test (KAP) before and after intervention

Hemoglobin estimation

Step stool test

Plate 3.7 Haemoglobin assessment and step-stool test (PFI) before and after intervention

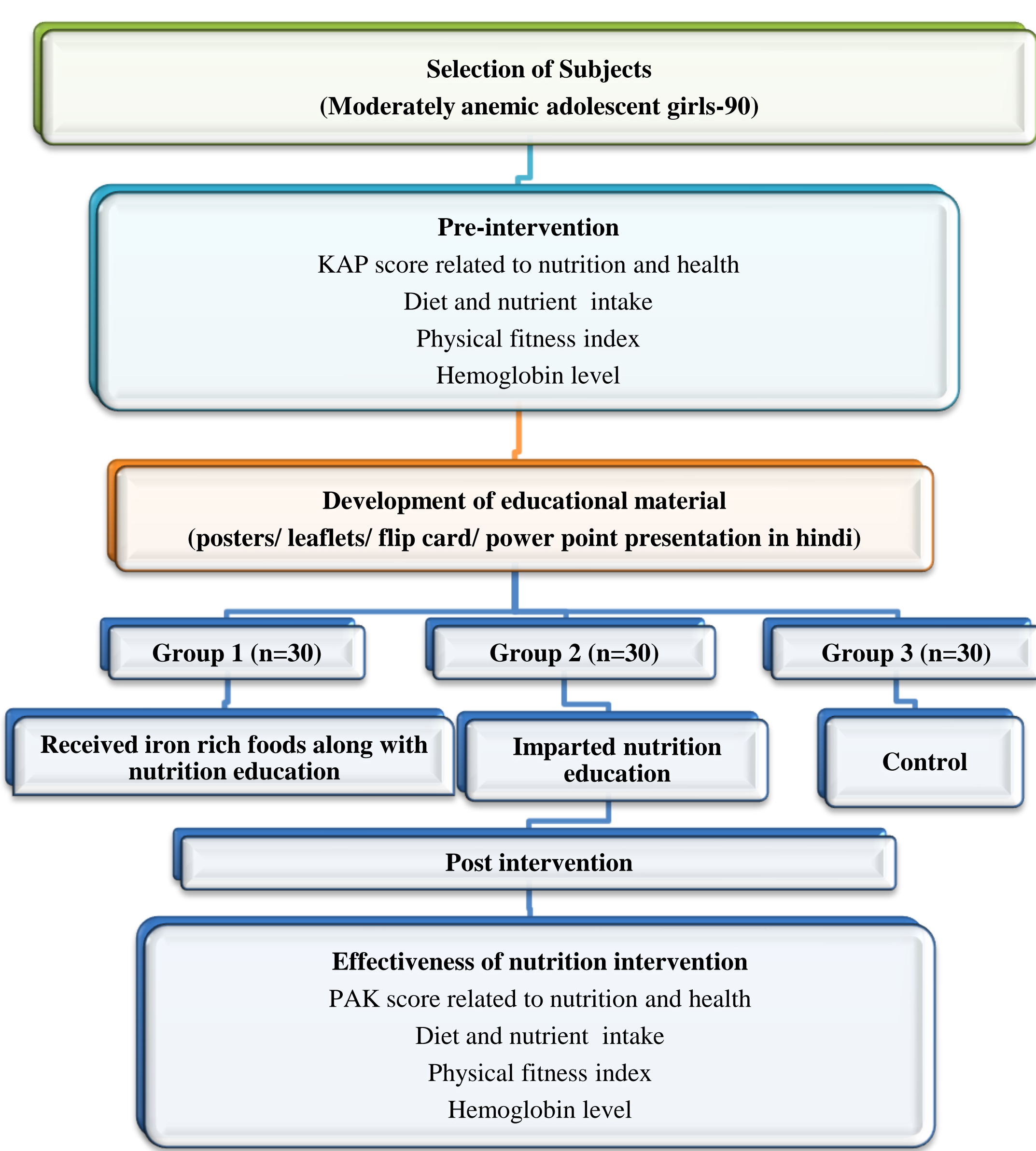


Fig. 3.4 Schematic presentation of evaluating effectiveness of nutrition intervention

3.10.1 Nutritional and health knowledge, attitude and practice test

The schedule consisted of three parts: a) knowledge b) attitude c) practice test. Total fifteen statements per part which were closed ended type questions were included in the inventory schedule for finding out attitude of the selected subjects and assessment of practices and knowledge regarding nutrition and health. For practice test, practices regarding nutrition and health were asked from the subjects. In attitude testing, subjects were asked about the extent of their agreement with the statement ranging from agree, disagree and don't know and in knowledge test, subjects were asked multiple choice questions and allowed to tick any one correct answer. Each question carried one mark and one mark was awarded for each correct answer. Maximum possible score of practice, attitude and knowledge was 45. (Appendix-V) Knowledge test of all the 90 subjects was measured before and after nutrition intervention. The reliability and feasibility of the schedule was worked out by pre-testing on 10 randomly selected respondents which were non-sampled subjects. Based on the response received during pre-testing, certain necessary changes were incorporated in the schedule. Hence, the pre-tested and reconstructed knowledge schedule was used for intervention program (Plate 3.6).

3.10.2 Diet and nutrient intake

Information regarding the diet intake of selected subjects was collected as per method reported in 3.4.2. Nutrient intake pattern of all the 90 subjects was calculated from their dietary intake before and after conducting nutrition intervention. The per cent adequacy of diet and nutrient intake was also calculated.

$$\text{Per cent diet adequacy} = \frac{\text{Diet intake of subjects}}{\text{SDI of food group}} \times 100$$

$$\text{Per cent nutrient adequacy} = \frac{\text{Nutrient intake of subjects}}{\text{RDA of nutrients}} \times 100$$

3.10.3 Hemoglobin level

Hemoglobin level of all the 90 selected subjects was measured before and after nutrition intervention using Sahli's hemoglobinometer (Plate 3.7).

3.10.4 Physical fitness index (Varghese et al.1995)

Anemia impairs the physical work capacity and work out put. Physical fitness/ efficiency of adolescent girls was measured using step-stool ergometer (Plate 3.7).

Specification of step-stool ergometer (wooden) used in the experiment.

i. Length- 45 cm
ii. Breadth- 30 cm
iii. Height- 24 cm

Duration of stepping: Minimum 3 minutes and maximum 5 minutes

Stepping rate: 30 steps/min

Methodology for step-stool test:

Selected adolescent girls were allowed enough resting time and then their resting heart rate was measured with heart rate monitor (polar RS 400). After 5 min rest, the subjects were asked to perform the stepping activity on step stool ergometer for maximum of 5 min with a uniform stepping rate of 30 steps/min. During the stepping activity, the heart rate was recorded for every minute with heart rate monitor. After 5 min of stepping activity, the subjects were asked to stop and sit comfortably and then their recovery heart rate was recorded after every 1 min for a period of 5 min. Physical fitness Index (PFI) was calculated by using the following formula:

$$\text{Physical Fitness Index} = \frac{\text{Duration of stepping (sec.)}}{\text{Sum of } 1^{st}, 2^{nd} \text{ and } 3^{rd} \text{ min recovery heart rate}} \times 100$$

Table 3.6 Interpretation of health status of the girls as per the PFI scores given by (Edward et al. 1973)

Scores	Physical Fitness of the women
<77	Poor
77-83	Fair
84-91	Good
>91	Excellent

Aerobic Capacity was calculated by using formula as below.

$$(VO_2 \text{ ml/kg x min.}) = 0.377 \times \text{Step-stool test score (PFI)} - 12.767$$

Table 3.7 Interpretation of health status of the girls as per the aerobic capacity values given by (Anonymous 2000)

Scores	Physical Fitness of the women
Upto 15	Poor
16.00-25.00	Low average
26.00-30.00	High average
31.00-40.00	Good
41.00-45.00	Very good
Beyond 45.00	Excellent

3.11 Development of educational package

The information obtained from knowledge score of the subjects during pre-intervention was utilized for preparing the educational package. Combined package of audio-visual aids including posters/ leaflets/ flip card/ power point presentation in Hindi was prepared for conveying message and information regarding nutrition education to the selected respondents (Appendix -VI) covering various aspects of food and nutrition science such as food and nutrients, balanced diet, nutrients preservation, right ways to cook food, anemia, iron rich foods, junk food, sanitation and hygiene.

3.12 Implementation of nutrition intervention

3.12.1 Educational intervention

Subjects were imparted nutrition education through lectures-cum-discussion using audio-visual aids viz. posters/ leaflets/ flip card/ power point presentation. The lectures were delivered to n=30 (Group-1 and Group-2) for period of 120 days (4 months) at weekly interval on selected topics. The pamphlets or leaflets were distributed to the subjects. Extra copies were also provided to school staff and parents (Plate 3.8).

3.12.2 Dietary intervention

Dietary intervention was carried out with one sweet and one savoury preparations (*mathri and laddoo*) which were highly acceptable and had highest analysed iron content among developed recipes were used for dietary intervention to n=30 (Group-1) for period of 120 days (4 months). 20g of each preparation per day provided 100per cent RDA for iron need of the adolescent girls. So, weekly package of 4 day for *laddoo* and 3 day for *mathri* were provided to selected moderately anemic adolescent girls (Plate 3.9). The respondents were supervised for regular intake of dietary preparations. The composition of dietary preparations is as below.

Plate 3.8 Imparting nutrition education through different audio-visiual aids

Plate 3.9 Distributing iron rich garden cress developed products and nutrition educational material

Table 3.8 Composition of dietary preparations

Recipe	Daily Supplement	RDA meet for iron
Laddoo (Variant-2)	20g	100 per cent
Mathri(Variant-2)	20g	100 per cent

3.13 Impact assessment of nutrition intervention

To study the impact of nutrition intervention trial, the schools were revisited for follow-up of all the three represented groups after four months of intervention. For assessing the effectiveness of nutrition intervention, information on knowledge, attitude and practice was again collected for the same subjects. In addition to knowledge schedule, diet and nutrient intake, physical fitness index and hemoglobin level of all the groups was analyzed per as methods discussed in 3.10.1, 3.10.2, 3.10.3, 3.10.4. The pre and post intervention was done to evaluate the impact of intervention in terms of analysed parameters. The scores of pre and post exposure stage were compared and impact of nutrition intervention was studied by using the following formula.

Gain in score= score of post test - score of pretest

Quantum of improvement=Post test score / Pretest score

3.14 Data analysis

3.14.1 Tabulation of data

After collection of field data, the information was coded on the master sheets and then tabulated into master tables. Depending upon the objectives, different modes of classification were made to get maximum information from the data.

3.14.2 Statistical analysis

The tables were quantified by using frequency tables and the percentages, standard errors and means for studying variables were calculated. Data of nutritional and organoleptic evaluation of developed products were subjected to statistical analysis for analysis of variance (ANOVA) in a completely randomized design. For analysing the differences between more than two groups as per different factors was subjected to factorial CRD. The data obtained in study were subjected to different

statistical analysis. The differential gain in knowledge over the period of four months was assessed through the pre- and post-exposure survey. Paired 't' test was used to compare pre- and post exposure mean scores of experimental groups. Correlation coefficient between various variables was also determined to check the relationship of associated risk factors with hemoglobin and anthropometric parameters.

4. RESULTS AND DISCUSSION

This chapter present the findings of research study entitled "Impact of dietary intervention on nutritional status of anemic adolescent girls of Kangra district (HP)" done in the selected three blocks of Kangra district, Himachal Pradesh viz. Panchrukhi, Baijnath and Bhawarna. The research was done in three phases and the results therefore have been reported and discussed in three sections. Prior to studying the major objective, the baseline profile and nutritional profile of three hundred adolescent girls was assessed through an interview schedule and the results reported in section-I. Section-II constituted standardization and development of iron rich recipes using garden cress as the main iron source and nutritional as well as sensory evaluation of developed products. Section-III involved evaluation of the major objective i.e. dietary intervention of moderately anemic adolescent girls and its impact assessment. Thus, this chapter presents the results of the investigation organised and discussed in three major sections as below.

Section-I Assessment of nutritional status of adolescent girls and prevalence of anemia

4.1 Background information

4.1.1 General profile

4.1.2 Socio-economic status

4.1.3 Land holding, agriculture crops and horticulture plantation

4.1.4 Milch and other domestic animals rearing pattern

4.2 Dietary pattern

4.3 Cooking techniques

4.4 Dietary and nutritional status

4.4.1 Frequency of consumption of foods

4.4.2 Food intake

4.4.3 Nutrient intake

4.4.4 Anthropometric measurement

4.4.5 Clinical assessment

4.4.6 Biochemical assessment for hemoglobin

4.5 Physical activity pattern

4.6 Mass media information

4.7 General health record

4.8 Information on supplementation

4.9 Information regarding menstrual history

4.10 Academic profile and social behavior

4.11 Preception and knowledge regarding anemia

Section-II Formulation and nutritional evaluation of value added products from garden cress seeds

4.12 Nutritional evaluation of garden cress whole and treated seeds

4.12.1 Proximate composition

4.12.2 Mineral content

4.12.3 *In-vitro* iron content

4.13 Nutritional evaluation of developed iron rich products

4.13.1 Sensory acceptability of value added products

4.13.2 Proximate composition

4.13.3 Mineral content

4.13.4 *In-vitro* iron content

Section-III Impact of diet and nutrition education intervention on moderately anemic adolescent girls

4.14 Impact assessment of nutrition intervention

4.14.1 Knowledge, Attitude and Practice (KAP)test for nutrition and health

4.14.2 Physical fitness activity

4.14.3 Hemoglobin level

4.14.4 Dietary intake

4.14.5 Nutrient intake

4.15 Correlation coefficient (r) between different variables

Section-I: (Baseline survey and data collection)

Assessment of nutritional status of adolescent girls and prevalence of anemia

A total sample of three hundred adolescent girls in age group of 12-18 years were selected randomly from Senior Secondary Government schools situated in Baijnath, Panchrukhi and Bhawarna blocks of Kangra district, Himachal Pradesh.

4.1 Background information of subjects

Before assessing the dietary and nutritional status and compiling information on various aspects of respondents, a baseline survey of selected adolescent girls was done to document the general profile of girls in addition to recording of socio-economic indicators like land holding pattern, income, education, occupation and animals rearing pattern etc done by selected families. The objective behind this, was to assess the quality of lifestyle of families and to study the influence of these demographic and socio economic factors on health and nutritional status of selected moderately anemic adolescent girls.

4.1.1 General profile

The analysis of general profile of the selected subjects is presented in Table 4.1. The distribution of the subjects on the basis of age revealed that 49, 30 and 34 per cent of the adolescent girls from Panchrukhi, Baijnath and Bhawarna blocks were in the age group of 12-14 years, 34, 41 and 35 per cent belonged to age group of 15-16 years and 17, 29 and 31 per cent were in the age group of 17-18 years respectively. Mean age calculated for different age groups revealed that 37.66 per cent subjects were in age group of 12-14 years, 36.66 per cent in 15-16 years and remaining 25.66 per cent subjects were in age group of 17-18 years. The data inferred that maximum adolescent girls (47.33 %) were studying in IX-X class and remaining 32.00 and 20.66 per cent were in XI-XII and VI-VIII class respectively. Block wise, 24, 54 and 22 per cent adolescent girls from Panchrukhi, 18, 45 and 37 per cent from Baijnath and 20, 43 and 37 per cent from Bhawarna were in VI-VIII, IX-X and XI-XII standards respectively.

With the change in pace of time and urbanization, the nuclear family system is taking over joint family system as depicted from the data regarding family type placed in Table 4.1. Majority (61.00%) of the subjects came from nuclear families however, 39 per cent were still living in joint family system. Kaur and Kaur (2011) in their study observed that 58 per cent of female subjects belonged to nuclear families.

Sachan et al. (2012) found that majority of anemic adolescent girls (56.7%) belonged to nuclear families while rest of anemic adolescent girls were living in joint family system. The results of present study are also supported by the study of Pattnaik et al. (2013) who reported that 60.92 and 39.07 per cent girls were living in nuclear and joint family respectively. In whole, maximum numbers of adolescent girls (68%) were in nuclear families in Baijnath block followed by Panchrukhi (60%) and Bhawarna (55%) block respectively. The study done on socio-economic status by Singh (2014 b) on schedule caste community of Kangra district, Himachal Pradesh revealed that out of 250 respondents,133 belonged to joint family and 117came from nuclear family.

Table 4.1 General profile of selected adolescent girls (N=300)

Particulars	Blocks			
	Panchrukhi (n=100)	**Baijnath (n=100)**	**Bhawarna (n=100)**	**Total (N=300)**
Age (years)				
12-14	49	30	34	113(37.66)
15-16	34	41	35	110(36.66)
17-18	17	29	31	77 (25.66)
Mean age±SD	14.73±1.61	15.30±1.80	15.29±1.94	15.10±1.34
Standard				
VI-VIII	24	18	20	62(20.66)
IX-X	54	45	43	142(47.33)
XI-XII	22	37	37	96(32.00)
Family Type				
Joint	40	32	45	117(39.00)
Nuclear	60	68	55	183(61.00)
Size of Family				
<4	3	1	8	12 (4.00)
4-6	71	65	64	200(66.66)
>6	26	34	28	88(29.33)
Mean family size±SD	5.23±1.76	5.29±1.91	4.68±1.56	300(100.00)
Ordinal position				
1	32	38	37	107(35.66)
2	41	35	58	134(44.66)
>2	27	27	5	59(19.66)
Mean position±SE	1.93±0.76	1.83±0.80	1.68±0.56	300(100.00)
No. of siblings				
None	1	2	0	3(1.00)
1-2	77	56	76	209(69.66)
>2	22	42	24	88(29.33)
Religion				
Hindu	99	97	99	295(98.33)
Sikh	1	3	1	5(1.66)
Community				
General	8	10	18	36 (12.00)
OBC	29	34	21	84(28.00)
ST	18	23	7	48(16.00)
SC	45	33	54	132(44.00)

#Figure in parentheses represents percentage

Information on the family size of subjects revealed that most of the families (66.66 %) comprised of four to six members, whereas 29.33 per cent comprised of more than 6 members and only 4 per cent of families had less than four members. Block wise, 71, 65 and 64 per cent of families had 4-6 family members, 26, 34 and 28 per cent had less than 6 members and only 3, 1 and 8 per cent had less than 4 family members in Panchrukhi, Baijnath and Bhawarna blocks respectively. Family size is one of the factors which affects the nutritional status of an individual, thereby the entire family and the society. A large family ultimately leads to low levels of education, income, health and economic status. The findings are in line with reports of Mahajan (2011) who revealed that family size of 50 and 79 per cent of urban and rural adolescent girls family size comprised of 5-8 members followed by 43 and 21 per cent of them having a up to 4 members. Singh (2014a) reported that most of the adolescent girls belonged to family size of 4 members i.e. 76.7 and 86.7 per cent in rural and urban area and only 23.4 and 13.3 per cent of rural and urban subject's family had 5-10 members.

With respect to the birth order, majority of the subjects (44.66 %) were at the second ordinal position while 35.66, 19.66 per cent were at first and third and above positions respectively. Blockwise data revealed that 41, 35 and 58 per cent of adolescent girls were in second birth order, 32, 38 and 37 per cent were in first order and 27, 27 and 5 per cent were in birth order greater than two for Panchrukhi, Baijnath and Bhawarna blocks respectively. Sehgal and Kawatra (2002) observed that most of the respondents (72.58%) were of the first to third birth order and the rest i.e.27.42 per cent were in birth order of more than 3. The observation of Koon et al. (2006) stated that majority of the adolescents (51.3%) were from families with 3-4 children and most of them (63.3%) were either first born or second child. Sachan et al. (2012) exhibited third and fourth place birth order for school going anemic adolescent girls.

Majority of respondents had one to two siblings (69.66%) whereas 29.33 per cent had more than two siblings and only one per cent was single child. When compared at block level, 77, 56 and 76 per cent of adolescent girls had 1 or 2 siblings, 22, 42 and 24 per cent had more than two siblings in Panchrukhi, Baijnath and Bhawarna blocks respectively. Single child data was almost negligible. Pattnaik (2013) reported that 23.84 per cent respondents had one sibling and 76.15 per cent respondents had two or more siblings.

Majority of subjects (98.33%) belonged to Hindu religion and only negligible percentage i.e. 1.66 was Sikh. Blockwise distribution revealed that 99, 97 and 99 per cent girls belonged to Hindu religion and remaining 1, 3 and 1 per cent of the subjects were Sikh in Panchrukhi, Baijnath and Bhawarna blocks respectively. Goswami et al. (2009) reported that higher proportion of the subjects in Ludhiana city were Hindu (52.2%) followed by Sikh (44%). 100 per cent respondents in the study residing in Kangra district (HP) were Hindu as reported by Singh (2014b).

The distribution of the adolescent girls on the basis of community revealed that majority of the subjects belonged to schedule caste (SC) (44.0%) followed by other backward class (OBC) (28.00%), schedule tribe (ST) (16.00 %) and general community (12 %). Splitwise, for selected blocks, data showed that 45, 33 and 54 per cent subjects belonged to the schedule caste, 29, 34 and 21 per cent to backward class, 18, 23 and 7 per cent to ST category and 8, 10 and 18 per cent to general community in Panchrukhi, Baijnath and Bhawarna, respectively. Sachan et al. (2012) obtained that majority of anemic adolescent girls in the study belonged to schedule caste followed by general category and backward class. The data reported to religion and community status of the studied area is well supported with reference of Anonymous (2013) which states that District Kangra has more population of Hindu religion followed by Sikh and other minor communities. Schedule caste population was also more in number as compared to ST population.

4.1.2 Socio-economic profile

The information pertaining to education level of father's of subjects reported in Table 4.2 revealed that 89.33 per cent were educated and smaller percentage of them i.e. 7.33 per cent were illiterate. Remaining 3.33 per cent were not alive. Further detailing of education depicted that 52.66 per cent were below matric level, 26.66 per cent passed matric only, 8.39 per cent studied up to senior secondary level and only 1.33 and 1.00 per cent completed graduation and post graduation respectively.

Table 4.2 Socio-economic profile of families of selected adolescent girls (N=300)

Particulars	Blocks			
	Panchrukhi (n=100)	**Baijnath (n=100)**	**Bhawarna (n=100)**	**Total (N=300)**
Father's education				
Illiterate	7	10	5	22(7.33)
Below matric	57	60	41	158(52.66)
Matric	27	22	31	80(26.66)
Senior secondary	5	5	15	25(8.33)
Graduate	1	-	3	4(1.33)
Postgraduate	1	-	2	3(1.00)
Diploma/ Skilled Training	-	-	-	-
Not alive	2	3	5	10(3.33)
Mother's education				
Illiterate	4	21	4	29(9.66)
Below matric	70	66	20	156(52.00)
Matric	19	12	59	90(30.00)
Senior secondary	2	1	14	15(5.00)
Graduate	1	-	2	3(1.00)
Postgraduate	-	-	1	1(0.33)
Diploma/Skilled trainii	-	-	-	-
Not alive	4	-	-	4(1.33)
Father's occupation				
Farmer	11	15	6	32(10.66)
Artisan	14	17	16	47(16.66)
Service	10	8	14	10(6.66)
Business	40	10	27	77(25.66)
Labourer	23	47	32	102(34.00)
Mother's occupation				
Housewife	80	76	77	233(77.66)
Working	8	9	16	33(11.00)
Labourer	8	15	7	30(10.00)
Monthly income (Rs/month)				
<5000	37	42	27	106(35.33)
5001-10000	51	53	58	162(54.00)
1001-15000	8	4	6	18(6.00)
>15000	4	1	9	14(4.66)
Mean monthly income±SD	7000±1.63	6000±1.34	9000±1.88	7333±1.43
House				
Owned	94	84	74	252(84.00)
Rented	6	16	26	48(16.00)
Type of house				
Kuccha	35	51	20	106(35.33)
Semi-Pucca	36	27	19	82(27.33)
Pucca	29	22	61	112(37.33)
Source of drinking water				
Tap water	62	65	58	185(61.66)
Hand pump	37	30	42	109(36.33)
Bouri/ well	1	5	-	6(2.00)

#Figure in parentheses represents percentage

None of them did diploma or any skilled training. Block wise, majority of fathers of the subjects in Baijnath block (69%) were educated followed by Panchrukhi block (57 %) and Bhawarna block (41 %) respectively. Sharma (1993) also stated the same results on socio economic profile of these three selected blocks.The finding corroborates with Census (2011) which reports male literacy rate in Kangra district as 91.49 per cent. Patttnaik et al. (2013) reported that fathers of adolescent girls in their study (53%) had primary education, 37.7 per cent studied up to secondary education, 60 per cent have gone up to higher secondary level and only 2.6 per cent completed graduation while 0.7 per cent of them were illiterate. On similar lines, Gupta et al. (2017) reported regarding the education level of father of their subjects and found that 40.09 per cent had primary education, 36.64 per cent studied up to secondary education, 18.97 per cent did higher secondary or higher and 4.31 per cent of them were illiterate.

Literacy percentage of mothers showed their education level was at par their male counterparts i.e. 90 per cent were educated of which 52 per cent were under matriculated followed by matriculated (30%), senior secondary (5.00%) graduate, (1.00%) and post graduate (1.33 %). 9.66 per cent mothers did not receive any type of education. The report on socio-economic indicators of Himachal Pradesh by Anonymous (2013) published literacy percentage of 87.5 per cent for males and 73 per cent for females residing in Kangra district. A close examination of the data indicated that the literacy rates of the studied population was higher as compared to national level figures and even higher from the neighboring states of Punjab, Haryana and Jammu and Kashmir. Pattanik et al. (2013) assessed education level of mothers of adolescent girls in their study and found that only 2 per cent of mothers were illiterate while 66.2 per cent have completed primary education and 29.8 per cent studied up to secondary education. Similarly Gupta et al. (2017) reported that 11.21 per cent mothers of the adolescent girls in their study group were illiterate, 59.48 per cent completed primary education and 24.57 per cent studied up to secondary level education. Only 4.74 per cent of mother further did higher secondary or graduation.

With respect to occupation, 34 per cent of fathers were labourer, 25.66 per cent businessman, 16.66 per cent were engaged in artisan work, 10.66 per cent were agriculturist and only 6.66 per cent were in Government/private services. Gupta et al. (2017) assessed occupation of parents of their respondents and found that 16.38 per cent of fathers were unemployed and unskilled worker, 39.22 per cent were skilled

worker, 20.26 per cent were service holder and 24.14 per cent were having their own business.

The distribution of the subjects according to the occupation of mothers revealed that maximum per cent of mothers (77.66 %) were housewives, 11 per cent were in service and remaining 10.33 per cent were doing labourer work. Singh (2014a) estimated that 68.3 per cent mothers of adolescent girls were housewives and 31.6 per cent mothers were working.

The data in Table 4.2 revealed that majority of adolescent girls (54 %) belonged to families having earning between 5,000 to 10,000 rupees per month followed by 35.33 per cent with family income less than 5,000.Only 6 per cent and 4.66 per cent had family income between 10,000-15,000 and more that 15,000 respectively. Block wise, mean family income was highest in Bhawarna block (Rs 9000±1.88) followed by Panchrukhi (Rs 7000±1.63) and Baijnath (6000±1.34). Kaur and Kaur (2011) reported that 60 per cent of rural families subjects belonged to families with income less than Rs 5,000 per month, 28 per cent with family income of Rs 5000-10000 per month and 12 per cent female subjects belonged to income group having more than Rs 10,000 per month. A study by Singh (2014b) reported that majority of respondents residing in Kangra district (136) belonged to BPL family and rest 114 respondents belonged to APL family.

The socio-economic profile of the selected families of adolescent girls further revealed that 84 per cent of families had their own house and 16 per cent lived in rented accommodation. Of the total families surveyed, 37.33 per cent had pucca house, 35.33 had kuccha house while 27.33 lived in semi-pucca type of house. More than 50 per cent of families (61.66 %) had access to tap water while 36.33 per cent families used hand pump as a source of water. Only fewer percentage of selected families (2%) had well and *bouri* as a source of water. It was further recorded that tap water and hand pump were used by 62, 65 and 58 per cent and hand pump 37, 30 and 42 per cent in Panchrukhi, Baijnath and Bhawarna respectively. B*ouri* and well source were rarely used by selected population. Study done by Singh (2014a) reported that 68.3 per cent adolescent girls had their own house, 89 per cent of subjects were living in pucca houses followed by mixed house (6.1 %) and only 4.8 per cent subjects lived in kuccha house. He also reported that 85 per cent subjects were having tap water supply and 15.6 per cent used hand pump as a source of water. Singh (2014b)

observed that out of 250 respondents living in Kangra district, 91 stayed in semi pucca house, 90 in kaccha house while 69 respondents lived in pucca house.

Various indicators discussed above were analysed to assess socio-economic status of the studied population. Analysis of the indicators presented gives evidence of a better socio-economic status in terms of education, type of house and accessibility to drinking water. Socio-economic status of parents affects childhood conditions which are reflected in their health and education.

4.1.3 Land holding, agriculture crops and horticulture plantation

The state of Himachal Pradesh has predominately rural settlement. Kangra district has considerable diversity in its physiographly, land use pattern and cropping system (CGRT 2008). More than 90 per cent of total population directly or indirectly depends upon agriculture for their livelihood. This scenario relevantly corroborates with the data presented in the Table 4.3 which highlights the landholding pattern by families of selected adolescent girls. Maximum number of (95.66 %) families owned land of which 56.66 per cent had marginal land holding followed by 24.66 per cent with small and 18.33 with medium land holding. Only 1 per cent of population was landless. A meager percentage of 2.66 per cent families rented their land. Only two families in Baijnath block rented out their land contributing to mean of 0.66 per cent. Shegal and Kawatra (2002) surveyed different villages from arid, semi arid-semi wet and wet zone of Haryana state and found that 37, 30.50 and 37.25 per cent families respectively were landless and those having land had marginal (27.33 %) to large size(11.33 %) holdings. Land holding pattern calculated by Singh (2014b) in Kangra district (HP) revealed that 80 respondents had 1 to 2 acres cultivated land and least number of respondents had more than 2 acres of cultivated land.

The blocks selected in the present study falls under Palam valley region of Kangra district that comprise mid-hill sub humid zone. The agro climatic conditions of the studied area are most suitable for growing of agriculture crops as well as horticulture crops. The data in Table 4.3 present details about the agriculture crops grown during the rabi and kharif seasons. The agro climatic environment of Kangra district is suitable for production of vegetables.

Table 4.3 Land holding, agriculture crops and horticulture plantation pattern by families of selected adolescent girls (N=300)

Particulars	Blocks			
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)	Total (N=300)
Land holding				
No land	-	3	-	3(1.00)
Owned	96	94	97	287(95.66)
Rented in	4	1	3	8(2.66)
Rented out	-	2	-	2(0.66)
Size of land holding				
Marginal	36	52	82	170(56.66)
Small	33	31	10	74(24.66)
Medium	30	17	8	55(18.33)
Large	1	-	-	1(0.33)
Agriculture (Rabi crops)				
Wheat	62	33	16	111(37.00)
Oil seeds	38	30	6	74(24.66))
Potato	49	36	12	97(32.33)
Fodder crops	47	38	7	92(30.66)
Vegetables	92	53	18	163(54.33)
Agriculture (Kharif crops)				
Paddy	64	39	15	118(39.33)
Maize	53	27	16	96(32.00)
Soybeans	48	28	11	87(29.00)
Fodder crops	45	29	6	80(26.66)
Vegetables	93	58	18	169(56.33)
Horticulture				
Mango	47	41	8	96(32.00)
Litchi	4	6	3	13(4.33)
Guava	84	47	12	143(47.66)
Peach	63	11	4	78(26.00)
Citrus	74	44	9	127(42.33)
Papaya	33	25	4	62(20.66)
Sand pear	38	28	5	71(23.66)
Sugar cane	19	7	0	26(8.66)
Loquat	22	17	3	42(14.00)
Use of produce from land				
Marketed	13	-	-	13(4.33)
Self-sufficient	59	17	2	78(26.00)
In-sufficient	12	53	23	88(29.33)
Sufficient +marketed	11	2	-	13(4.33)

#Figure in parentheses represents percentage

So, majority of families of selected respondents grew vegetables as well as fodder crops for milch animals in both seasons with a close percentage of 56.31 and 54.33 for vegetables and 26.66 and 30.66 for fodder crops in kharif and rabi season respectively. The selected families raised wheat (37 %), oilseeds (24.66 %) and potatoes (32.33 %) during rabi season which was replaced with paddy (39.33 %), maize (32 %) and soyabean (29 %) during kharif season. Horticulture crop plantation clarifies that majority of respondents had planted guava (47.66 %) followed by citrus (42.33 %), mango (32.00 %), peach (26.00 %), sand pear (23.66 %) papaya (20.66 %), loquat (14.00 %) sugarcane (8.66 %) and only 4.33 per cent had litchi plant.

Shegal and Kawatra (2002) surveyed different villages from arid, semi arid, wet and wet zones of Haryana state and found that 37, 30.50 and 37.25 per cent families of respondents were landless land those having land had marginal (27.33%) to large size (11.33%) holdings. The data regarding use of produce from land showed that for 29.33 per cent families, the produce was insufficient while 26.00 per cent stated that the production was self-sufficient. An equal number of respondents i.e. 4.33per cent said that the production from their land was not only sufficient for their family but also for marketing.

4.1.4 Milch and other domestic animals rearing pattern

Data compiled and calculated for milch farming rearing pattern depicted that only 28.33 of families reared milch animals which were only cow while 71.66 had no milch animals. The cows reared were mainly of indigenous breed 15.66 per cent and 12.66 per cent were cross breed mainly Jersey and Holstein. 25.33 per cent of families had only one cow and only 3 per cent had more than 2 cows which may be due to nuclear family pattern prevalent in the studied area.

None of the families in selected block of Bhawarna reared goat. Only 3 families in Panchruhki and 15 families in Baijnath block kept goat. Gaddi is a popular tribe of Himachal Pradesh from Bharmour region but many of them due to their migratory livelihood have settled down in Kangra district mainly in area of Baijnath and Dharamshala. Their main occupation is shepherding and makes their livehood by rearing and selling sheep or goats. That may be reason of more number of families documented for rearing goats and sheep.

Table 4.4 Milch and other animal rearing pattern by families of selected adolescent girls (N=300)

Particulars	Blocks			
	Panchrukhi (n=100)	**Baijnath (n=100)**	**Bhawarna (n=100)**	**Total (N=300)**
Milch animals	43	35	7	85(28.33)
No milch animals	57	65	93	215(71.66)
Breed				
Indigenous	21	19	7	47(15.66)
Cross breed	22	16	-	38(12.66)
Number of Cow				
1	38	34	4	76(25.33)
2	5	1	3	9(3.00)
Number of Goat				
1	3	-	-	3(1.00)
2	-	2	-	2(0.66)
>3	-	13	-	13(4.33)
Yield (Kg)				
1-2	13	13	2	28(9.33)
3-4	20	15	3	38(12.66)
>4	10	6	2	18(6.00)
Amount for consumption (Kg)				
1-2	5	12	-	17(5.66)
3-4	31	4	1	36(12.00)
>4	7	1	3	11(3.66)
Amount for sale (Kg)				
1-2	20	6	-	26(8.66)
3-4	2	13	1	16(5.33)
>4	5	14	-	19(6.33)
Domestic animals	14	13	-	27(13.50)
No domestic animals	76	77	-	153(76.50)
Breed				
Indigenous	14	13	-	27(9.00)
Cross breed	-	-	-	-
Number of Sheep				
<5	1	-	-	1(0.33)
5-10	3	-	-	3(1.00)
>10	5	10	-	15(5.00)
Number of Poultry				
<5	2	1	-	3(1.00)
5-10	3	2	-	5(1.66)
Purpose				
Domestication	6	2	-	8(2.66)
Selling	8	11	-	19(6.33)

#Figure in parentheses represents percentage

As stated, more number of cows were cross-bred but the yield of milk was very less i.e. 3-4 liter as reported by 12.66 per cent of families. 9.33 per cent had yield between 1-2 liter and 6 per cent had more than 4 liter of milks. As the data reveal, the amount of milk yield was less and was sufficient for their consumption only however, a few families sell out also. 8.66 per cent reported selling of 1-2 liter milk, 6.33 sell more than 4 liter and 5.33 per cent between 3-4 liter of milk.

This observation agrees with the study of Sehgal and Kawatra (2002) reported that 80.50 per cent of families of selected adolescent girl's households in Haryana owned milch animals. Milch animals generally owned were cow and buffalo with few having goats. Singh (2014b) documented livesock inventory of Kangra district and found that 40 per cent respondents have cow (local) in which 65 per cent had one or two cow and 30 per cent had more than two cows. 45 per cent reared one or two buffalos.

A perusal of data in Table 4.4 depicted that only 13.50 per cent families reared domestic animals viz. sheep and poultry that too of indigenous breed (9 %). This small percentage of rearing practice was mainly prevalent in Panchrukhi and Baijnath block only. Further categorization of data suggested that 6.33 per cent were reared for marketing and only 2.66 per cent for domestication purpose.

4.2 Dietary pattern

Diet plays a very important role in growth and development of adolescents, during which, development of healthy eating habits is of supreme importance. Most of the adolescents have the habit of skipping the meals, particularly breakfast, or have irregular meals thereby affecting their health and nutrition. Therefore, this parameter was studied with the objective to assess the food habits, food and meal pattern, meal skipping and fast keeping.

Table 4.5 present the information on dietary pattern of adolescent girls selected from three blocks of Kangra district. The data highlighted that majority of adolescent girls, 55.33 per cent were vegetarian, 41.00 per cent were non- vegetarian and only 3.66 per cent were ovatarian.

Table 4.5 Dietary pattern of selected adolescent girls (N=300)

Particulars	Blocks			
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)	Total (N=300)
Food habit				
Vegetarian	58	88	20	166(55.33)
Non-vegetarian	36	11	76	123(41.00)
Ovatarian	6	4	1	11(3.66)
Non vegetarian food consumption				
Chicken	58	67	73	198(66.00)
Mutton	49	37	53	139(46.33)
Fish	35	13	40	88(29.33)
Pork	44	3	10	57(19.00)
Frequency of non vegetarian food				
Once a week	7	-	24	42(14.00)
Once in fortnight	-	-	21	21(7.00)
Once a month	42	8	34	115(38.33)
Occasionally	9	12	9	39(13.00)
Food pattern				
Whenever they want	51	10	93	154(51.33)
At meal times	48	90	7	145(48.33)
When nothing to do	1	-	-	1(0.33)
Mode of meals				
Frequent small	51	38	86	175(58.33)
Few heavy	49	62	14	125(41.66)
Meal time				
Breakfast	97	38	88	233(74.33)
Lunch	27	100	67	194(64.66)
Evening tea	97	77	94	268(89.33)
Dinner	98	99	98	295(98.33)
After dinner	18	19	32	69(23.00)
Lunch time				
Bring lunch pack	21	76	47	144(48.66)
Mid day meal	6	24	20	50(16.66)
Canteen/vendor	-	-	-	-
Skip	73	-	33	106(35.33)
Skipped meal				
Breakfast	3	62	12	77(25.66)
Lunch	73	-	33	106(35.33)
Dinner	2	1	2	5(1.66)
Fast keeping	66	87	43	196(65.33)
Weekly	27	25	22	74(24.66)
Monthly	14	23	8	45(15.00)
Yearly	25	39	13	77(25.66)
No fast keeping	34	13	57	104(34.66)

#Figure in parentheses represents percentage

Non vegetarian study subjects was consuming mainly chicken (66 %) followed by mutton (46.33 %), fish (29.33 %) and pork (9 %). Though 41 per cent subjects was non vegetarian but majority of them had consumption once in a month. Almost equal percentage of subjects were taking animals foods once a week or occasionally. Sharma (1993) also reported same results on non vegetarian food consumption once a week in selected bocks of Kangra.

As per food pattern, 51.33 per cent of adolescent girls consumed meal whenever they want and 48.33 per cent preferred to eat at meal times. Most of the girls consumed frequently small meal (58.33 %) and 41.66 per cent had preference for heavy meal.

Data regarding meals taken revealed that 98.33 per cent of adolescent subjects take dinner. Only 64.66 per cent were having lunch, which they bring from their home (48.66 %) and enjoy while sitting in the company of their friends in the school lawns or had as mid day meal (16.66 %). At lunch time, girls were not allowed to cross the school gate hence the data on lunch from canteen or vendors was nil. A glance at the data, block wise, highlighted that 73 per cent of subjects in Panchrukhi block and 33 per cent in Bhawarna block skipped lunch whereas, in Baijnath block 100 per cent had their lunch meal because school principal had ruled out to beneficiary students to eat the mid day meal hence the relevant data had no values.

A percentage of 35.33 skipped lunch and preferred to eat after school at home, thereby leading to increase in percentage of 89.33. A good number of 233 girls (74.33 %) ate breakfast which is a positive sign as adolescent due to a change in behavior pattern and lifestyle skip breakfast. A further detailing of skipping meals highlighted the trend of skipping lunch (35.33 %) followed by breakfast (25.66%). A negligible percentage skipped dinner.

The trend of keeping fast by the selected adolescent girls showed that 65.33 per cent of girls kept fast while 34.66 per cent did not prefer to skip their meal during the day. An almost equal percentage of population i.e. 24.66 and 25.66 kept fast weekly and yearly respectively, while 15 per cent preferred to keep fast once a month.

Similar results were found by Puri et al. (2008) that a large number of Government (63.3%) and private (53.2%) school students were not bringing tiffins in the schools. Nearly one fifth of adolescent students liked to eat from the vendors outside the school and 11.6 per cent of adolescents did not take lunch at home. Half of

the adolescents usually visit restaurants/eating joints after school hours. Dinner was important meal for all majorities of subjects in rural (96.67%) and urban (91.67%) area. Singh (2014a) reported majority of the subjects (60.8%) having 3 meals a days, 298.2 per cent having 2 meals and very few of them (10.0%) were having 4 meals a day. More than half of the total subjects i.e. 65.83 per cent were recorded to take lunch at home as they reside nearby the school.

4.2.1 Fast food consumption pattern

Adolescence is a crucial life stage characterized by dramatic modifications in lifestyle patterns. These modifications include more unhealthy food choices, eating outside the home, sedentary behaviors, all of which put adolescents at nutritional risk. Some dietary patterns are quite common among adolescents, like snacking, usually on energy-dense foods, wide use of fast food and low consumption of fruits and vegetables. Taste, time considerations, convenience, and cost are major factors that contribute to an adolescent's food choices.

Table 4.6 revealed the consumption pattern of selected fast foods by adolescent girls. The data obtained for different fast food depicted that majority of the adolescent girls rarely consumed (67.25 %) them, followed by weekly consumption (11.81 %). A percentage of 11.22 never consumed these fast foods. A very negligible data was recorded for daily and alternate consumption of these foods in Panchrukhi and Baijnath blocks. The daily consumption of chips/ *kurkure* and of biscuits/cake/pastry was recorded for Bhawarna block. A mixed data pattern is visible for consumption of different foods reported in the Table 4.6 However, the most preferred one were chips/kurkure, pasta/ noodles and biscuits cake/ pastry in Baijnath and Bhawarna blocks. An equal preference was reported for respondents residing in Panchrukhi block.

Kumar et al. (2006) studied that *samosa,* a deep fried Indian snack was the most preferred (99.2%) fast food item and pizza (22.8%) came out to the least preferred item. *Chaat* also came out to be the most common fast food item preferred by 99.2 per cent respondents. The majority of the respondents (73.2%) were occasional consumers of fast food. Puri et at. (2008) found that junk food items, *samosa* (42.4%), *tikki/chat* (39.7%), noodles (25.4%), burger (24.5%) and pizza (23.3%) were preferred most by the adolescents.

Table 4.6 Fast food intake pattern of selected adolescent girls (N=300)

Food	Daily	Alternately	Weekly	Rarely	Never
Panchrukhi Block (n=100)					
Chips/ Kurkure	6	-	29	64	1
Samosa	-	3	37	55	5
Pakora/ Bread Pakora	-	-	37	62	1
Momos	-	-	34	65	1
Burger/ Tikki	-	-	36	56	8
Pasta/Noodles	-	-	27	51	22
Patties	-	-	29	56	15
Biscuits/ Cake/ Pastry	-	1	22	52	25
Sandwich	-	-	27	48	25
Baijnath Block (n=100)					
Chips/ Kurkure	3	6	39	50	2
Samosa	-	1	11	87	1
Pakora/ Bread Pakora	2	-	5	85	8
Momos	3	-	6	75	16
Burger/ Tikki	-	-	9	89	2
Pasta/Noodles	-	-	22	67	11
Patties	2	-	8	53	37
Biscuits/ Cake/ Pastry	3	1	21	62	13
Sandwich	-	-	18	64	18
Bhawarna Block (n=100)					
Chips/ Kurkure	25	4	29	41	1
Samosa	-	-	2	98	0
Pakora/ Bread Pakora	-	-	15	82	3
Momos	-	-	2	80	18
Burger/ Tikki	-	-	1	90	9
Pasta/Noodles	-	1	7	77	15
Patties	-	-	2	73	25
Biscuits/ Cake/ Pastry	37	-	5	58	0
Sandwich	2	-	1	76	21

4.2.3 Beverage consumption pattern

Table 4.7 provides the data regarding frequency of beverage consumption pattern of selected adolescent girls. Majority of respondents (41.46 %) consumed the reported beverages daily, followed by rare (31.06%), alternate (8.76 %), and weekly consumption (7.20 %). 12 per cent of the subjects never consumed any type of beverages. Among those consumed daily by majority of the respondents were cold

drink and milk in Panchrukhi and Baijnath block and coffee/ tea in Bhawarna respondents. In contrary to the two blocks, Bhawarna respondents rarely preferred cold drink and milk.

Table 4.7 Beverage consumption pattern of selected adolescent girls (N=300)

Panchrukhi Block (n=100)					
Food	**Daily**	**Alternately**	**Weekly**	**Rarely**	**Never**
Coffee/ Tea	12	7	-	79	2
Cold drink	72	27	-	-	1
Juice	72	26	-	-	2
Milk	67	6	-	24	3
Lassi	8	25	-	3	64
Baijnath Block (n=100)					
Coffee/ Tea	25	10	7	55	3
Cold drink	69	1	7	2	21
Juice	78	2	9	2	9
Milk	31	10	11	46	2
Lassi	30	8	9	26	27
Bhawarna Block (n=100)					
Coffee/ Tea	78	-	15	5	2
Cold drink	12	1	15	72	0
Juice	2	-	1	97	0
Milk	66	-	-	20	14
Lassi	-	1	34	35	30
Grand total (%age)	622(41.46)	124(8.26)	108(7.20)	466(31.06)	180(12.00)

A study by Hejazi and Mazloom (2009) reported that soft drink consumption was high among the subjects with an average of 360 ml/day. Mahajan (2011) found that beverage consumption was higher in urban school boys as compared to rural area boys.

4.3 Cooking techniques

4.3.1 Fuel used pattern

Fig. 4.1 elucidated the information regarding the fuel pattern used for cooking by the families of selected adolescent girls. It was found that majority of subjects used LPG to a large extent (90.66 %) followed by *chulla* (wood stove) (86.33 %) mixed fuel cooking (65.17 %), kerosene stove (49.33 %) and only 34.33 per cent used induction cooking.

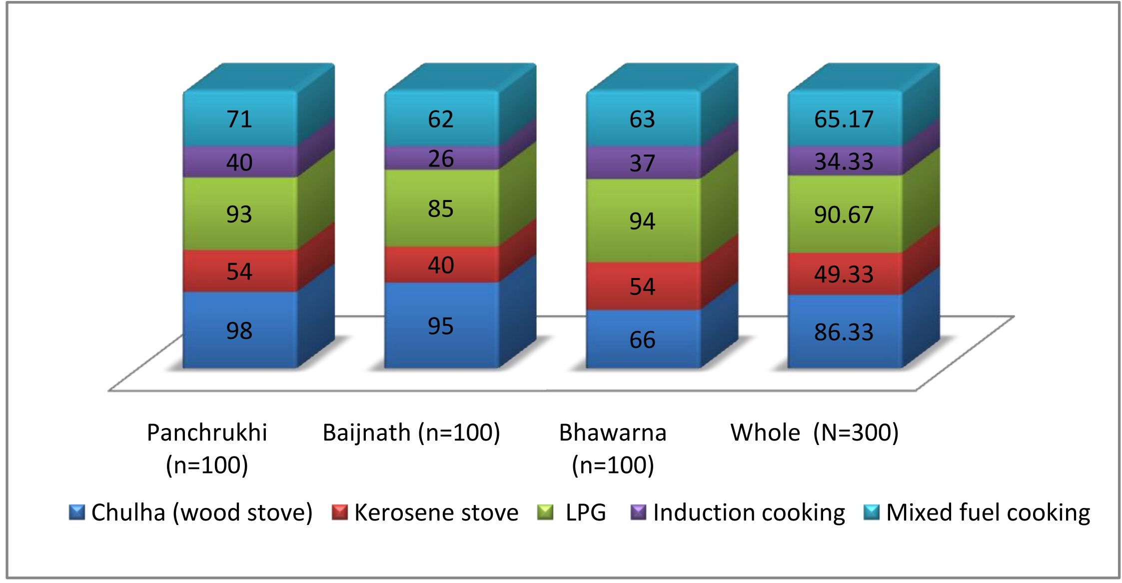


Fig. 4.1 Fuel used for cooking by families of selected adolescent girls (N=300)

In Panchrukhi block, 98 per cent subjects used chulla as major fuel for cooking followed by LPG (93%), mixed fuel cooking (71%), kerosene stove (54%) and only 40 per cent used induction. Similarly in Baijnath block, majority used chulla (95%) for cooking followed by LPG (85%), mixed fuel (62%), kerosene stove (40%) and induction cooking (26%) and in Bhawarna trend of fuel used for cooking was 94, 66, 63, 64 and 37 per cent respectively for cooking fuel.

Namisa et al. (2010) conducted a study in Jorhat district of Assam which stated that in the selected households, 97.5 per cent used fire wood as fuel for cooking. Vyas et al. (2011) found that electricity, kerosene and LPG were the conventional fuels utilized by farm household for cooking in Kangra district. They also reported that consumption of these fuel sources were high in both family types i.e. nuclear and joint. Contrary to the reports of the present study, (Singh 2014b) also observed that out of 250 families of Kangra district majority of families (107) used LPG gas for cooking and least used chulla.

4.3.2 Cooking method pattern

Methods of cooking used by families of selected adolescent girls are presented in Table 4.8. Various methods viz. pressure cooking, stewing/simmering, open pan cooking, boiling and frying were adopted by 100 per cent families irrespective of blocks. These methods were either used alone or in combination. Baking, roasting and

grilling method were not adopted by the selected adolescent girl families as no relevant cooking equipment was available with them. The study of Sajjan (2008) showed that majority of adolescent girl families of Punjab were using boiling (83.52%) simmering (81.76 %) and frying (93.93%) cooking methods.

Table 4.8 Cooking methods adopted by selected families (N=300)

Particulars	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)	Total (N=300)
Method of cooking				
Pressure cooking	100	100	100	300(100)
Stewing/Simmering	100	100	100	300(100)
Open pan cooking	100	100	100	300(100)
Boiling	100	100	100	300(100)
Baking/ Roasting/ Grilling	-	-	-	-
Frying	100	100	100	300(100)
Utensils used for cooking-				
i) Stainless steel				
Daily	100	100	100	300(100)
Alternately	-	-	-	-
Weekly	-	-	-	-
Rarely	-	-	-	-
ii) Aluminum				
Daily	98	99	95	292(97.33)
Alternately	1	-	-	1(0.33)
Weekly	1	1	2	4(1.33)
Rarely	0	-	3	3(1.00)
iii) Iron				
Daily	32	20	30	82(27.33)
Alternately	54	35	23	112(37.33)
Weekly	9	16	21	46(15.33)
Rarely	5	29	26	60(20.00)
iv) Copper/ Brass				
Daily	-	5	6	11(3.66)
Alternately	-	-	-	-
Weekly	3	1	1	5(1.66)
Rarely	58	33	32	123(41.00)
Never	39	61	61	161(53.66)

#Figure in parentheses represents percentage

The table further presents the information on different types of utensils used for cooking by the selected households. The data highlighted that all the subjects used stainless steel utensils daily irrespective of blocks. Majority of subjects used aluminum utensils daily (97.33%) followed by weekly (1.33%), rarely (1%) and (0.33 %) alternately. Iron utensils were used by subjects alternately (32.33%) followed by daily (23%), rarely (20%) and weekly (15.33%) in order of its applicability. The

utensils of copper/brass were in used in least order the families. Majority of them never used (53.66%) however some utilized them rarely (4%) daily (3.66%) and weekly (1.66%). A discussion with families revealed that though iron, copper and brass utensils were used daily for cooking/serving by their elders but the difficulty and cost in their maintenance and availability of easily maintained material like steel has increased its applicability in the kitchen. An important disclosure was made by some elders that some decades back, girls and women during their menstrual periods were served food in copper utensils. Data was also collected for non-stick utensils but none of the families were using them.

4.3.3 Frequency of food consumption

A food frequency questionnaire consists of a finite list of foods with response categories used to gather information on how often (frequency) a specific food, or category of food is eaten.

Table 4.9 represents the seasonal variations in mean food frequency scores of different food groups. The table depicts the mean scores for frequency of consumption of cereals and millets for the last one month. Eating plenty of cereals is a key component of the dietary guidelines, as they are an important source of carbohydrate, dietary fiber and protein. They are also mostly low in fat and are a good source of vitamins (particularly B vitamin and vitamin E) and minerals (including iron, magnesium and phosphorus).The frequency scores of wheat, rice and maize was calculated as 8.92, 8.20 and 1.3 in Panchrukhi block, 8.43, 7.94 and 4.17 in Baijnath block and 8.53, 8.08 and 4.13 in Bhawarna block in winter season and 8.78, 8.18 and 3.43, 8.70, 7.89 and 1.61 and 8.86, 7.95 and 1.22 per cent in respective blocks in summer season.

Wheat was consumed in the form of *chapatti*, *parantha, puri*, *bhatura*, *dalia* and bread. The staple foods i.e. wheat and rice were frequently consumed by the selected households because these are the two major crops grown by farmers of Himachal Pradesh so are available throughout year at affordable price. The mean consumption of cereals was marginally higher in Bhawarna block. The above result were in confirmation with the study done by Chacko and Begum (2007) which

Table 4.9 Mean food frequency scores of selected adolescent girls (N=300)

Food stuffs	Blocks		
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)
1. Cereals-Winter(Oct.-March)			
Wheat	8.92±0.33	8.43±0.87	8.53±0.74
Rice	8.20±0.40	7.94±0.58	8.08±0.36
Maize	1.3±0.98	4.17±3.85	4.13±1.81
Summer (April-Sept.)			
Wheat	8.78±0.46	8.70±0.88	8.86±0.42
Rice	8.18±0.38	7.89±0.72	7.95±0.55
Maize	3.43±1.71	1.61±2.53	1.22±2.10
2. Pulses (whole/split)			
Bengal gram	4.93±0.40	4.26±1.70	4.49±1.22
Black gram	4.69±1.10	2.91±2.65	4.27±1.54
Green gram	2.37±1.30	1.75±0.87	3.83±2.04
Red gram	2.65±1.35	2.01±0.35	3.18±2.40
Rajmah	4.74±0.90	4.13±1.04	3.69±1.72
Lentil	3.07±1.14	2.09±2.35	2.95±2.67
Soybean	3.00±1.11	2.23±2.37	0.78±1.44
Pulses(sprouted)			
Bengal gram	1.13±0.52	1.03±2.2	3.07±1.79
Green gram	1.96±0.53	1.69±2.35	0.79±1.53
Pulses (roasted)			
Bengal gram	1.28±.84	1.23±0.80	2.62±1.54
3. a) Green leafy vegetables - Winter(Oct.-March)			
Spinach	4.54±1.25	3.13±1.11	4.83±1.35
Fenugreek leaves	3.96±1.65	3.49±2.35	3.64±1.94
Mustard leaves	4.95±1.45	3.03±1.23	4.83±0.84
Bathua	3.59±2.10	0.57±1.88	0.1±0.70
Radish leaves	1.76±2.22	0.78±3.05	3.48±2.29
Coriander	6.16±2.20	3.27±1.28	9.14±2.24
Cauliflower leaves	4.49±1.43	3.63±2.08	1.49±2.87
Cabbage	3.25±1.14	4.00±2.13	3.11±2.98
Summer (April-Sept.)			
Spinach	1.86±0.71	0.40±0.11	2.42±2.27
Colocasia leaves	5.22±1.22	4.14±1.58	2.25±2.22
Coriander	7.52±3.77	1.84±2.28	1.09±2.27
Amaranth	3.92±1.72	3.08±2.51	1.96±2.30
3. b) Other Vegetables-Winter(Oct.-March)			
Potato	6.88±0.32	5.72±1.16	5.89±1.71
Cauliflower	4.58±1.31	3.74±0.70	5.51±0.53
Radish	2.34±.14	1.51±1.77	3.27±2.53
Carrot	2.17±0.75	1.45±2.37	5.90±3.09

Summer (April-Sept.)			
Bitter gourd	4.47±1.30	1.07±2.26	1.21±1.97
Bottle gourd	4.77±0.97	4.25±1.84	2.67±2.62
Pumpkin	4.68±1.88	3.82±1.70	2.33±2.21
Beans	4.56±1.28	4.01±2.64	3.74±2.03
4. Fruits-Winter(Oct.-March)			
Apple	2.59±1.28	2.50±3.11	3.11±2.51
Banana	2.41±1.11	1.72±0.58	2.58±1.51
Peach	2.00±0.77	0.76±0.58	2.58±1.51
Guava	5.01±0.67	1.51±2.60	1.06±1.83
Amla	6.73±1.19	5.71±1.49	3.83±2.04
Pear	1.68±1.65	2.09±2.90	2.75±4.14
Lemon	1.51±1.26	0.96±2.47	1.45±2.34
Orange	4.64±1.29	6.16±1.96	4.95±1.43
Papaya	4.29±1.47	1.54±2.63	1.55±2.19
Grapes	1.12±0.84	2.06±2.49	2.34±2.38
Mango	1.01±0.32	2.05±0.32	0.30±1.75
Sugarcane	0.99±0.10	0.85±2.04	2.02±2.29
Summer (April-Sept)			
Apple	4.73±0.90	3.83±2.51	3.47±2.22
Banana	1.54±1.32	1.88±1.65	4.69±1.79
Peach	1.69±1.62	1.78±1.76	4.22±1.60
Guava	2.46±1.31	3.11±1.27	3.99±1.88
Pear	4.02±1.78	3.10±2.64	4.22±1.78
Papaya	1.15±0.59	1.02±2.06	3.93±2.23
Grapes	0.32±0.63	0.25±2.50	4.65±2.70
Mango	5.38±0.63	4.81±2.06	3.33±2.33
Sugarcane	0.99±0.10	0.99±3.16	0.95±2.23
5. Milk and milk products			
Milk	2.13±2.56	2.09±3.16	4.66±2.88
Curd	6.46±1.44	6.40±1.53	4.68±1.89
Cheese	1.00±0.00	1.75±2.13	2.25±1.18
6. Animal Foods			
Egg	1.06±1.63	2.76±2.50	6.41±1.98
Chicken	1.93±1.18	0.44±2.00	7.04±1.46
Fish	1.61±1.09	0.96±1.9	7.22±0.6
Mutton	1.67±0.89	0.87±1.87	6.84±1.00
7. Nuts & oilseeds			
Groundnuts	1.02±0.20	1.09±3.31	5.65±2.16
Sesame	0.99±0.10	0.32±2.63	2.57±2.40
Almonds	1.0±0.00	0.39±2.87	4.64±2.5
Coconut	4.00±0.00	0.23±2.23	3.27±2.21
8. Jaggery and Sugar	8.03±0.02	7.82±0.77	8.86±1.07

Values- (Mean±SD)

Note: Score system; 9-thrice in a day, 8-twice in a day, 7-daily, 6-thrice in week, 5- twice in a week, 4- weekly, 3- thrice in month, 2- twice in monthly, 1- monthly, and 0- never

revealed that cereal and cereal based products were consumed frequently by a considerably large segment of selected adolescent subjects from middle income families. Singh (2014a) which revealed that cereals and millets products were consumed frequently by a considerable large segment of selected adolescent girl subjects from middle income families.

On perusal of the data, it was observed that on the whole, consumption of pulses and legumes like bengal gram, black gram, green gram, red gram, rajmah, lentil and soybean varied as 4.93, 4.69, 2.37, 2.65, 4.74, 3.07 and 3.00 in Panchrukhi block, in Baijnath block the mean frequency was calculated as 4.26, 2.91, 1.75, 2.01, 4.13, 2.09 and 2.23 and in Bhawarna block variation were 4.49, 4.27, 3.83, 3.18, 3.69, 2.95, and 0.78 respectively. The mean frequency of consumption of pulses in all blocks varied from twice a month to twice a week for selected pulses. Less frequency of pulses consumption might be due to poor production and rising cost. Pulses in sprouted and roasted form were also consumed in studied blocks and they were aware about the importance of sprouting pulses. Gifting/distributing sprouted bengal gram and *gur* to neighbors and relatives by family of newborn is a tradition still alive in Kangra district. Olivares et al. (2004) confirmed the above results by reporting that the frequency of consumption of dhal and legumes varied from once a week to twice a week in adolescent subjects.

India is endowed with an array of leafy vegetables suited for tropical, sub-tropical and temperate climates and grown all the year round. Consumption of green leafy vegetables is as old as human race itself. Green leafy vegetables represent an excellent component of the habitual diet. Green leafy vegetables are known to be most inexpensive source of several vital nutrients. Leafy vegetables are appreciated because they not only supply the productive nutrients and add variety to a monotonous diet, but also had an alternative taste, pleasing appearance and aroma. The frequency scores of consumption of spinach (4.54, 3.13, 4.83), fenugreek leaves (3.96, 3.49 3.64), mustard leaves (4.95, 3.03, 4.83), bathua (3.59, 0.57, 0.1), radish leaves (1.76, 0.78, 3.48), coriander (6.16, 3.27, 9.14), cauliflower (4.49, 3.63, 1.44) and cabbage (3.25, 4.00, 3.11) in winter were calculated. In summer, the frequency of consumption of green leafy vegetables was less due to less availability however, spinach (1.86, 0.40 and 2.43), colocasica leaves (5.27, 4.14 and 2.25) coriander (7.52, 1.84 and 1.09) and amaranth (3.92, 3.08 and 1.96) were consumed as per scores compiled for Panchrukhi, Baijnath and Bhawarna blocks respectively.

Deepa (2002) studied the seasonal variations in the consumption pattern of green leafy vegetables among rural and urban adolescent girls of Dharwad district. The study showed that the rural adolescent girls consumed only *gogu* (2.5 g) while urban adolescent girls consumed *methi* (2.3 g) and shepu (3.8 g) during summer. The increased consumption of amaranth (15.9 g and 9.3 g), *gogu* (5.0 and 8.0 g), and cabbage (0.8 and 5.2 g) was observed during the rainy season by the rural and urban subjects. Consumption of *methi* leaves (1.8 g) was exhibited by urban adolescent girls only. Kaur and Kaur (2011) observed that consumption of green leafy vegetables preparation like *saag* (mustard leaves and spinach) and *methi* (fenugreek leaves) was high among adolescent girls during the period of survey in winter month. The mean frequency scores suggested that consumption of green leafy vegetables was low among selected adolescent girls during summer season, however during winter season the mean score of consumption was more.

The scores were calculated for group of other vegetables in winter season for potato (6.88, 5.72 and 5.89), cauliflower (4.58, 3.74 and 5.51), radish (2.34, 1.51 and 3.27) and in summer, bitter gourd (4.47, 1.07 and 1.21) bottle gourd (4.77, 4.25 and 2.67), pumpkin (4.68, 3.82 and 2.33) and beans (4.56, 4.01and 3.74) scored as per values in parenthesis in Panchrukhi, Baijnath and Bhawarna block respectively. Insufficient frequency of other vegetables group was found between blocks, the mean frequency of consumption of other vegetables varied from twice a month to twice a week in both season.

Table 4.9 further showed the seasonal variation in frequency scores of fruits. During winter season, orange (4.64, 6.16, 4.95) followed by papaya (4.29,1.54, 1.55), grapes (1.12, 2.06, 2.34), Mango (1.01, 2.05, 0.30) and sugarcane (0.99, 0.85, 2.00) were eaten in descending order, whereas in summer season apple (4.73, 3.83, 3.47), banana (1.54, 1.88, 1.69), peach (1.69, 1.78, 4.22), guava (2.46, 3.11, 3.99), amla (1.23, 1.01, 1.13), pear (4.02, 3.10, 4.22), papaya (1.15, 1.02 and 3.93), grapes (0.32, 0.25 and 4.65) and sugarcane (0.99, 0.99 and 0.95) were consumed in Panchrukhi, Baijnath and Bhawarna block respectively. Singh (2014a) recorded highest tomato (8.04) consumption followed by lemon (6.68), banana (5.71), grapes (5.04) amla (5.03), guava (4.85), papaya (4.87) and orange (4.58) among adolescent girls of Ludhiana city.

Further calculations were done for mean frequency scores of milk (2.13, 2.04, 4.66), curd (6.46, 6.40, 4.68) and cheese (1.00, 1.75, 2.25) in all three blocks. It was observed that consumption was very low as they consumed weekly to once a month only. Singla (2011) also reported inadequate consumption of milk and milk products. The present results are in line with the results reporting that dairy products including milk and yoghurt were most frequently consumed among adolescents (Olivares et al. 2004). Further, Leal et al. (2010) also observed the satisfactory intake of milk and milk products among the adolescent boys as it was close to the expected frequency of 0.85.

Mean frequency scores for egg (1.06, 2.76 and 6.41), chicken (1.93, 0.49 and 7.04), fish (1.61, 1.96 and 7.22) and mutton (1.67, 0.87 and 6.84) were recorded. Poor consumption of non-vegetarian foods was documented in Panchrukhi and Baijnath block which may be attributed to its expensive cost and also majority of the adolescent being vegetarian belonged to low income group families. Among the non vegetarian food, only eggs were consumed more frequently by the non vegetarian subjects.

Except for coconut in Panchrukhi and groundnut in Bhawarna, poor frequency scores were obtained for sesame and almonds. The poor consumption of nut and oil seeds may be due to their high cost. For sugar and jaggery scores of 8.03, 7.82 and 8.86 were recorded for selected families in the three selected blocks that varied twice in a day to daily. The present results were in confirmation with the study by Leal et al. (2010) showing that the consumption of the group sugars and sweets was 3.11 times the expected frequency among adolescents. Consumption of cereals, pulses, other vegetables, fruits, milk and milk products, meat and poultry was low among the subjects which were reflected in their low nutritional profile.

4.4 Nutritional status

The nutritional status of an individual is often the result of many interrelated factors. It is influenced by the adequacy of food intake both in terms of quality and quantity and also by the physical health of the individual. The value of nutritional assessment is greatly enhanced when it is supplemented by a diet survey. A diet survey provides information about the amount and types of food consumed by

the people and bring out dietary inadequacies as judged by the available standards. It constitute an essential part of nutritional status of individual or group and provides essential information on daily food intake, nutrient intake levels and sources of nutrients. Diet surveys of communities yield data regarding the extent of dietary deficiencies, the quantity and type of foods required for overcoming them and also regarding the economic and social factors influencing food production and consumption.

4.4.2 Food intake

The mean daily food intake and per cent adequacy of food intake by selected adolescent girls are presented in Table 4.10 and illustrated in Figure 4.2.

i. Cereals and millets

Among the selected blocks, the consumption of cereals varied significantly ($p<0.05$) with values as 259.50 ± 4.27, 236.63 ± 4.79 and 267.20 ± 4.09 g in Panchrukhi, Baijnath, Bhawarna. Per cent adequacy of cereals was observed as 89.06, 86.50 and 78.88 in in Panchrukhi, Baijnath, Bhawarna block, respectively. The intake of cereals was less than suggested intake as evident from their per cent adequacy. Main cereals consumed were rice, wheat and maize. The food frequency score for cereals in two agricultural seasons showed an average score of 8 for rice and wheat but since their result were qualitative as only their consumption was asked in positive or negative answer but the actual intake measure may be low, which had now reflected in the present data.

Zanvar and Devi (2007) reported mean daily consumption of cereals among adolescent girls aged 13 to 18 years of Marathwada region that ranged between 245.13 to 277.92 g which was lesser as compared to ICMR recommendation. Singla (2011) reported 200 ± 1.00 g mean daily cereal intake of adolescent girls, which was also found to be less than recommendation. Singh (2014a) also reported 237.3 ± 37.6 and 277.3 ± 46.0 g mean daily cereal intake in summer and winter season of adolescent girls and intake was also found less than 90 per cent of recommendation.

Table 4.10 Mean daily food intake and per cent food adequacy of dietary selected adolescent girls (N=300)

Food groups (g/day)	SDI (g/day)	CD (p≤0.05)	Blocks		
			Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)
Cereals & millets	300.00	12.24	259.50±4.27 (86.50)	236.63±4.79 (78.88)	267.20±4.09 (89.06)
Pulses	65.00	3.04	42.14±1.14 (64.83)	36.54±1.10 (56.21)	48.06±1.03 (73.94)
Milk (ml) & milk products	500.00	14.08	338.50±8.79 (67.70)	307.72±8.46 (60.54)	375.21±8.70 (75.04)
Roots & tubers	133.00	2.38	123.06±5.49 (92.30)	118.03±1.13 (88.42)	127.08±1.62 (95.71)
Green leafy vegetables	100.00	8.85	39.53±4.80 (39.53)	29.57±1.92 (29.57)	49.81±1.90 (49.81)
Other vegetables	200.00	6.74	140.56±5.93 (70.28)	127.44±5.47 (63.72)	150.42±6.58 (75.21)
Fruits	100.00	4.74	35.30±2.42 (35.30)	29.57±2.44 (29.57)	40.15±2.40 (40.15)
Sugar	26.00	4.69	27.75±2.75 (106.73)	28.17±0.64 (105.52)	30.07±0.75 (112.74)
Oils	36.00	2.95	35.85±1.07 (99.58)	37.05±1.04 (102.70)	39.81±1.08 (108.56)

Values: Mean±SE(Per cent adequacy), SDI- suggested dietary intake

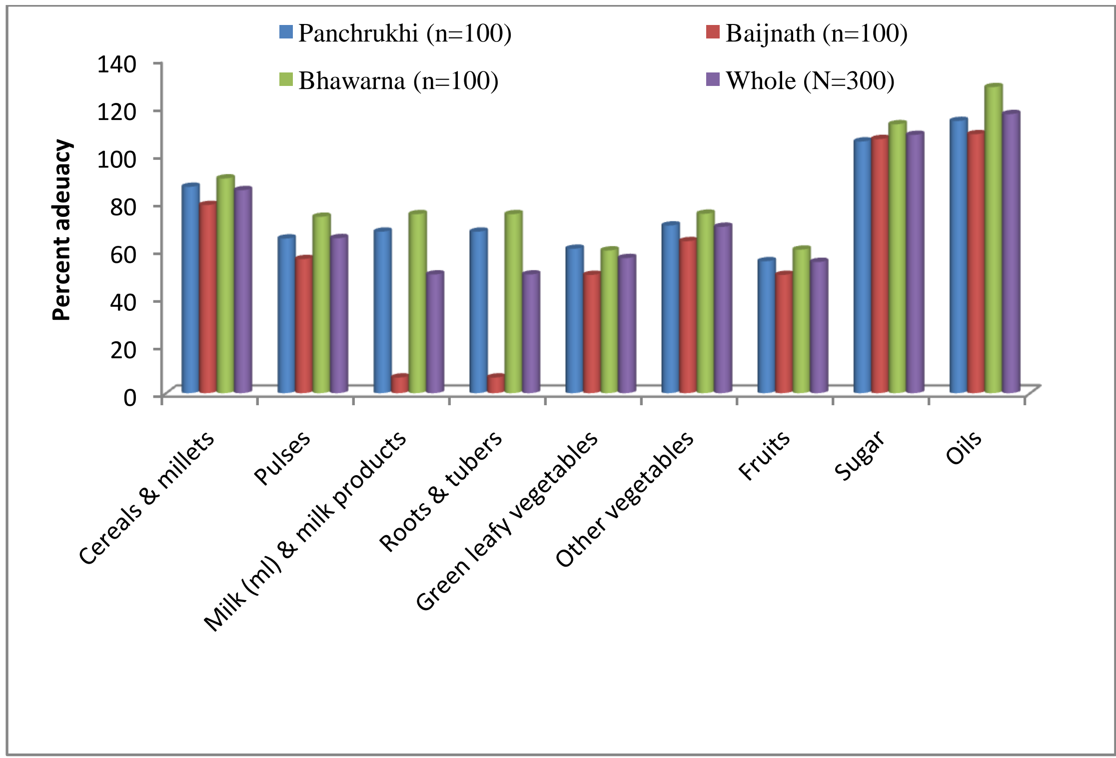


Fig. 4.2 Per cent adequacy of food intake by selected adolescent girls

ii. Pulses and legumes

The mean daily intake of pulses and legumes was recorded as 42.14±1.14 g, 36.54±1.10 g and 48.06±1.03 g with per cent adequacy of 64.83, 56.21 and 73.94 in Panchrukhi, Baijnath and Bhawarna respectively. A significant ($p<0.05$) difference in consumption of pulses was observed among the selected respondents. As evident from the values, Baijnath block respondents had lowest adequacy and highest being in Bhawarna households. The study of Rao et al. (2006) stated that the average intake of protein among adolescents was below the recommended dietary intakes. The deficit in intake of protein was reported to be 20-30 per cent. Goswami et al. (2009) reported 45.04 ±17.92 g mean daily pulse intake which was found to be less than the recommendation. The mean frequency scores for pulse in Table 4.10 was very less which in turn is reflected in this data. Inflation in price of pulses may be the reason for its low consumption. Many studies have reported that diet plate in India consist more amount of cereals as compared to pulses.

iii. Milk and milk products (ml)

The average intake of milk and milk and milk products was observed as 338.50 ± 8.79, 307.72 ± 8.46 and 375.21 ± 8.70 g in Panchrukhi, Baijnath and Bhawarna blocks respectively. Milk and milk products intake varied significantly ($P\leq0.05$) between and also among the blocks. The adequacy of this group was workout as 67.70 per cent in Panchrukhi, 60.54 per cent in Baijnath and 75.04 per cent in Bhawarna block.

iv. Vegetables

The results presented in Table 4.11 showed that average intake of roots and tubers was significantly higher ($P\leq0.05$) among selected block of Bhawarna (127.08 ± 1.62 g) followed by Panchrukhi (123.06 ± 5.49g) and Baijnath (118.03 ± 1.13 g). The per cent adequacy therefore was lowest in Baijnath block (88.42) followed by Panchrukhi (92.30) and Bhawarna (95.71).

Contrary to roots and tubers, the intake of green leafy vegetables was very low i.e. below 50 per cent of adequacy. Suggested intake for this group is 100g but the households were consuming only 29.57±1.92, 39.53±1.92 and 49.81±1.90 g in studied blocks of Baijnath, Panchrukhi and Bhawarna. The mean frequency

consumption scores of green leafy vegetables as assessed for winter and summer seasons was very low. Most of the household in present investigation were of rural background who grew agriculture crops. Many of them grew leafy vegetables in their backyard garden. But during the interview, they reported that their children did not like to consume leafy vegetables so they were not frequently consumed in the family diet. In addition, adolescence period is known for many changes in lifestyle including the dietary pattern. They usually have a tendency to shift from traditional diet to fast food and peer accepted food pattern.

v. Fruits

The average fruit intake (Table 4.10) was recorded as 35.50 ± 2.42, 29.57 ± 2.44 and 40.15 ± 2.40 g in Panchrukhi, Baijnath and Bhawarna blocks with similar values of per cent adequacy. Significant difference was obtained regarding its consumption. As for green leafy vegetables, the per cent adequacy was below 50 which is really an alarming sign. It means there is diet low in levels of vitamin and minerals which are required for utilization of energy in the body. Low amount of these essential nutrients are associated with reduced physical stamina and work.

Sugar and oils

The mean daily intake of sugar was observed as 27.75 ± 2.75, 28.17 ± 0.64 and 30.07 ± 0.73g in Panchrukhi, Baijnath and Bhawarna block respectively with per cent adequacy recorded as 100.73, 105.74 and 112.74. Similarly intake of fats and oils was close to suggested dietary intake values for Panchrukhi (35.85 ± 1.07 g) and more than suggested intake for Baijnath (37.05 ± 1.04 g) and Bhawarna (39.81 ± 1.08) blocks.

Meat and poultry data was negligible due to high vegetarian subjects found in all the three selected blocks. Consumption of this group was almost negligible and they consumed it once a month interval which reduce the values for this group.

Mahajan (2011) study the energy intake was nearly adequate in urban and rural adolescent boys. The intake of fat was much higher than that of RDA among both the groups and deficient intake of protein, β-carotene, thiamine, riboflavin, iron, niacin, folacin, vitamin B12, ascorbic acid, and calcium was recorded among both urban and rural adolescent boys.

Savita et al. (2011) study on dietary status of post adolescent girls of Karnataka and found that the per cent adequacy ranged from 19.28 to 90.47 per cent for all the foods. Per cent adequacy for cereals, pulses, other vegetables, milk and milk products ranged from 60-70. Fats and oils 90-110 per cent. Least adequacy was (19.28 %) for leafy vegetables while, 52.85 per cent adequacy was observed for fruits.

A glance at the table clarifies that the consumption of two groups i.e. fats/oils and sugar was more than the dietary intake and of remaining group was low as compared to reported standards. Consumption of important food group viz. fruits and green leafy vegetables was even below 50 per cent. Adequacy of remaining groups ranged between 56.21 to 89.06 per cent. The impact of changing lifestyle, urbanization, the influence of mass media on dietary pattern, peer influence and adolescent behavior seems to have an impact on mean daily food intake of selected adolescent girls.

4.4.3 Nutrient intake

The mean daily intake of nutrients by selected adolescent girls and per cent adequacy of nutrients is presented in Table 4.11 and illustrated in Figure 4.3.

i. Energy

The mean daily intake of energy in Panchrukhi, Baijnath and Bhawarna block was 1990.62 ± 25.65, 1819.31 ± 28.68 and 2167.77 ± 31.13 kcal respectively. As compared to RDA (ICMR 2010) of 2170 kcal, energy consumption was less. Significant ($P \leq 0.05$) variation was observed when compared at block level. The per cent adequacy of energy intake by the subjects was found higher in Bhawarna (99.89) followed by Panchrukhi (91.73) and Baijnath (83.83). A study conducted by Deepa et al. (2004) reported significantly higher intake of energy and protein among rural and urban subjects during rainy season as compared to winter and summer. Singh (2014a) also reported higher intake of energy in winter season as compared to summer season.

ii. Protein

Mean daily protein intake was lower than RDA calculated as 38.57±0.73, 34.49±0.76 and 48.60±0.71g in selected blocks of Panchrukhi, Baijnath and Bhawarna. A significant ($P \leq 0.05$) difference was found in the intake in population residing in different studied blocks. Per cent protein adequacy was higher in

Table 4.11 Mean daily nutrient intake and per cent adequacy of nutrients in selected adolescent girls (N=300)

Nutrients	RDA (12-18 years)	CD($p \leq 0.05$)	Blocks		
			Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)
Energy (kcal/day)	2170	79.09	1990.62±25.05 (91.73)	1819.31±28.68 (83.83)	2167.77±31.13 (99.89)
Protein (g/ day)	51	2.06	38.57±0.73 (75.87)	34.49±0.76 (67.86)	48.60±0.71 (95.62)
Fat (g/ day)	32	1.51	40.00±0.49 (125.00)	36.80± 0.52 (115.00)	47.08± 0.59 (147.12)
Calcium (mg/ day)	750	13.84	385.25±5.37 (51.36)	354.19±4.66 (47.22)	423.87±4.85 (56.51)
Iron (mg/ day)	26	1.15	19.42±0.42 (76.89)	16.39±0.42 (64.92)	22.52±0.39 (89.18)
Zinc (mg/ day)	10	0.33	5.81±0.12 (55.31)	5.60±0.11 (53.36)	7.99±0.12 (76.11)
Carotene (µg/ day)	4800	106.60	887.22±39.40 (18.48)	512.18±35.01 (10.67)	1308.14±40.22 (27.25)
Vitamin B_1 (mg/ day)	1	0.05	0.27±0.01 (25.52)	0.26±0.01 (24.47)	0.44±0.01 (42.28)
Vitamin B_2 (mg/ day)	1	0.05	0.55±0.01 (44.81)	0.48±0.02 (39.93)	0.66±0.01 (53.43)
Niacin (mg/ day)	13	0.49	11.23±0.14 (84.76)	7.70±0.19 (58.14)	11.40±0.18 (86.05)
Vitamin B_6 (mg/ day)	1	0.06	0.48±0.02 (25.00)	0.28±0.02 (14.63)	0.54±0.02 (28.31)
Ascorbic (mg/ day)	40	1.12	24.48±0.41 (61.20)	22.94±0.41 (57.33)	25.86±0.37 (64.65)
Folate (µg/ day)	172	3.03	54.02±0.88 (31.31)	46.01±1.22 (38.26)	59.84±1.13 (34.69)
Vitamin B_{12} (µg/ day)	1	0.01	0.06±0.00 (5.9)	0.05±0.00 (4.7)	0.11±0.00 (11.00)

Values: Mean±SE(Per cent adequacy), RDA- recommended dietary intake

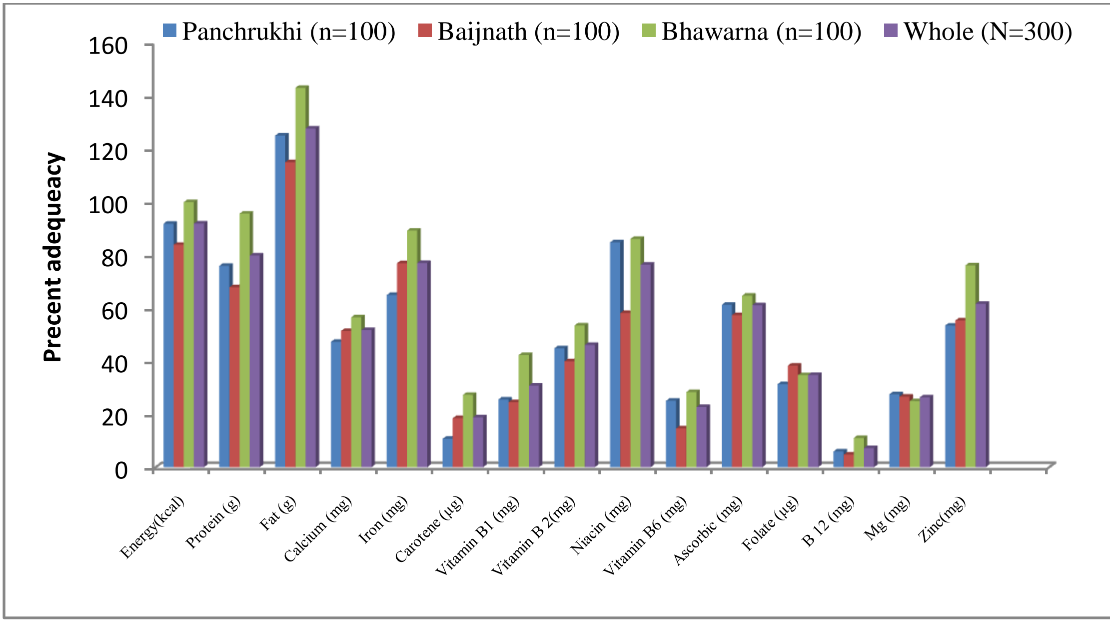


Fig. 4.3 Per cent adequacy of nutrient intake by selected adolescent girls

Bhawarna (95.62 %) followed by Panchrukhi (75.87%) and Baijnath (67.86%). The intake was lower than recommended allowances which can be attributed to inadequate intake of pulses and legumes as well as milk and milk products. Majority of adolescent girls belonged to families of lower to middle income group who may be unable to purchase sufficient amount of protein rich foods due to its high cost. Sharma et al. (2005) reported protein intake less than 30 per cent of recommended dietary allowances. The deficiency was more pronounced in case of Government school students (50%) than the private school students (5%). The low intake was attributed to poor economic status of the children studying in Government school. Singh (2014) also stated the inadequate protein intake among adolescent girls.

iii. Fat

Contrary to other nutrients, the perusal of data on fat intake revealed a higher consumption by the subjects living in Panchrukhi, Baijnath and Bhawarna block as 40.00±0.49, 36.80±0.52 and 47.08±0.59g with per cent adequacy 125, 115 and 147.12. A significant ($p \leq 0.05$) difference persisted block wise. Jain (2012) showed higher mean daily intake of fats in winter season (59.1 g) as compared to summer season (48.9) among Punjabi women and the study results of Singh (2014a) showed 78.6 and 111. 2 per cent adequacy of fat intake with recommended daily allowance which was lower in summer and higher in winter season.

iv. Calcium

The average daily intake of calcium by selected adolescents was observed as 285.25±5.37, 354.19±4.66 and 423.87±4.85 mg in Panchrukhi, Baijnath and Bhawarna block with per cent adequacy of 47.22, 51.36 and 56.51, respectively. A significant ($p \leq 0.05$) difference was observed in mean calcium intake. The intake was found to be inadequate with recommended daily allowance and may be attributed to the low intake of milk and milk products and green leafy vegetables by selected respondents. Singla (2011) reported inadequate intake of calcium in adolescent girls. Singh (2014a) showed intake of 85.4 per cent of recommended calcium in adolescent girls.

v. Iron

The results (Table 4.11) revealed average daily intake of iron as 16.39±0.42, 19.42±0.42 and 22.52±0.39 mg in Baijnath, Panchrukhi and Bhawarna blocks with per cent adequacy of 64.92, 76.89 and 89.18. A significant ($p \leq 0.05$) difference was observed in iron intake among adolescent girls. The average intake was found lower than the recommended intake in all three selected blocks. Even protective foods like green leafy vegetables were available at affordable cost but ignorance, dislike and unawareness might influence of intake of iron. Singh (2014a) also recorded low intake of iron with higher per cent adequacy (89.9) in winter and lower (63.7) in summer seasons.

vi. Zinc

The perusal of the data revealed zinc intake by subjects in Panchrukhi, Baijnath and Bhawarna as 5.60±0.11, 5.8±0.12 and 7.99±0.12 mg with per cent adequacy of 55.31, 53.36 and 76.11. When compared with RDA, intake was observed lower. A significant ($p \leq 0.05$) difference persisted in all the three selected blocks for zinc intake.

vii. Carotene

The values calculated for carotene were 887.22±39.40, 512.18±35.01 and 308.14±4.22 µg with observed adequacy of 18.48, 10.67 and 27.25 per cent among selected adolescent girls of Panchrukhi, Baijnath and Bhawarna blocks. The data displayed a significant ($p \leq 0.05$) difference between blocks. The intake was lower than recommended allowances in all the three blocks. The findings by Leal et al. (2010) reported intake of β-carotene below the recommended for 86 per cent of the boys and a positive association between male gender and low intake of β-carotene.

viii. Vitamin B_1 (Thiamine)

The mean intake of thiamine by selected adolescent girls (Table 4.11) in all the three selected blocks was calculated for Panchrukhi (0.27±0.01 mg), Baijnath (0.26±0.01mg) and Bhawarna (0.44±0.01 mg). The adequacy of thiamine intake ranged between 24.47-42.28 per cent and was found lower than 45 per cent in Bhawarna and less than 30 in rest of the blocks when compared to recommended

allowances. A significant difference ($p \leq 0.01$) persisted in the intake of thiamine. Batra (2009) reported mean daily intake of thiamine as 0.9 ± 0.03 and 0.8 ± 0.03 mg in vegetarian and non-vegetarian adolescent girls of Punjab.

ix. Vitamin B_2 (Riboflavin)

The result showed (Table 4.11) significantly ($p \leq 0.05$) higher intake of riboflavin by selected adolescent girls in Bhawarna (0.60±0.0 mg) as compared to Panchrukhi (0.55±0.0 mg) and Baijnath (0.48±0.02 mg) blocks but lower than RDA with 53.43, 44.81 and 39.93 per cent adequacy observed respectively. The result were line with finding of Jain (2012) who reported the mean daily intake of riboflavin during winter season (0.9±0.2 mg) higher than summer season (0.7±0.3 mg)in selected women of Punjab. The results were in confirmation with the study by Rao et al. (2006) stating that the average intake of riboflavin by adolescent boys was below the Recommended Dietary Allowances (RDA). The extent of deficit in the intake of micronutrient was 40-50 per cent.

x. Vitamin B_3 (Niacin)

The average daily intake of niacin by selected adolescent girls in all the three selected blocks was observed as 11.23 ± 0.14, 7.70 ± 0.19 and 11.40 ± 0.18 mg. The intake ranged between 58.14-86.05 per cent adequacy as per RDA and was observed to be inadequate. Olivares et al. (2004) also reported a lower intake of niacin as compared to recommended dietary intakes among adolescents. Mahajan (2011) reported intake of niacin as 61.47 and 72 per cent of RDA's in urban and rural adolescent of Punjab.

xi. Vitamin B_6 (Pyridoxine)

The mean daily intake of vitamin B_6 was observed significantly ($p \leq 0.05$) higher in Bhawarna (0.54 ± 0.02 mg) as compared to Panchrukhi (0.48±0.02 mg) and Baijnath (0.28±0.02 mg) blocks with lower per cent adequacy of 28.31, 25and 14.63 per cent respectively. The intake of pyridoxine was also reported lower than RDA by Singh (2014a) in adolescent girls of Punjab.

xii. Vitamin C (Ascorbic acid)

The data (Table 4.11) showed mean ascorbic acid intake in selected adolescent girls in Panchrukhi, Baijnath and Bhawarna blocks as 24.48±0.4, 22.94±0.41 and 25.86±0.37 mg with per cent adequacy 61.20, 57.33 and 64.65 respectively. A significant difference persisted in the intake of ascorbic acid intake. The intake was lower than RDA of 40g per day. These results were in line with the finding of Jain (2012) who reported significantly increased intake of vitamin C during winter season (39.9 ± 24.3mg) than summer season (38 ± 30.0 mg).

xiii. Folate

On perusal of the data mean daily intake of folate was observed as 54.02±0.88 mg in Panchrukhi, 46.01±1.22 mg in Baijnath and 66.01±1.22 mg in Bhawarna blocks respectively by selected adolescent girls. The intake was found to be inadequate as 31.31, 38.26 and 34.69 per cent of RDA was calculated for in Panchrukhi, Baijnath and Bhawarna blocks respectively. A significant ($p \leq 0.05$) difference was observed in mean daily intake of folic acid among blocks. Hurson and Corish (2008) also found that micronutrient intake for iron and folate achieved only 83 and 78 per cent of the recommended nutrient intake for boys of 15–18 years. Batra (2009) reported mean daily intake of folate as 74.66±3.20 and 62.83±3.34 mg in vegetarian and non-vegetarian adolescent girls.

xiv. Vitamin B_{12}

The mean daily intake of vitamin B_{12} was observed significantly ($p \leq 0.05$) higher in Bhawarna (0.11±0.0 µg) as compared to Panchrukhi (0.06±0.00 µg) and Baijnath (0.05 ± 0.0 µg). The adequacy of vitamin B_{12} intake ranged between 4.5-11 per cent. Dapi (2010) also observed that the proportion of the adolescents below the recommendations for vitamin B_{12} was significantly lower among the urban than rural areas. Singh (2014a) reported daily inadequate intake of vitamin B_{12} among adolescent girls of Punjab which was significantly less than the RDA in summer and winter seasons.

4.4.4 Anthropometric status

Anthropometric examination includes body measurements such as height, weight, skinfold thickness. These are important tools in the evaluation of nutritional

status of individuals or groups. Anthropometric measurements although genetically determined, are strongly influenced by nutrition and if correctly recorded and interpreted, reflect the pattern of growth and physical state of individuals. They also indicate how the individual deviate from the average at various ages in body size, build and nutritional status.

For the evaluation of growth performance, the observed level of growth has to be compared with a standard which is considered to represent normal growth (Gopaldas and Seshadri 1987). The World Health Organization (WHO) in 1996 made provisional recommendation for the interpretation of anthropometric data during adolescence and recommend the use of National Centre for Health Statistics (NCHS) reference value for comparison. Anthropometric measurements of different age group of selected adolescent girls and it's comparison with NCHS and ICMR standards has been reported in in Table 4.12 and Table 4.13.

Height

The mean height of the selected adolescent girls was observed as 151.80±1.11, 151.70±1.58 and 151.91±1.18 cm for 12-14 years, 155.55 ± 1.30, 148 ± 3.63 and 157.52 ± 1.03 cm for 15-16 years and 159.18 ± 2.10, 158.96 ± 0.93 and 162.44 ± 0.99 cm for 17-18 years old adolescent girls residing in Panchrukhi, Baijnath and Bhawarna blocks. Comparison of height values with ICMR and NCHS standard showed that majority of subjects irrespective of age group met standard height above 90 per cent. Bhawarna block girls were above 98 per cent standard for all age groups. Adolescent period is a period of growth and development, so, variation in measurement persisted among the blocks. Anand et al. (1999) recorded the prevalence of stunting (height for age) as 41 and 19.9 per cent as per NCHS and Indian standard among adolescent school children in rural north India. Zanvar et al. (2007) compared 500 adolescents (13-18 years) from urban, rural and tribal areas of Marathwada region and found that urban adolescent girls had better height (152.26 ± 8.6 cm) than rural and tribal counterparts (150.19 ± 7.11, 145.51 ± 9.38 cm respectively).A study conducted by Kowsalya et al. (2008) on the iron nutrition of 100 adolescents (13-18 years) in Manipur found that the mean height and weight of the selected adolescent girls were below the standard value.

Weight (kg)

Weight of adolescent girls indifferent age groups and its comparison with ICMR and NCHS has been presented in Table 4.12 and Table 4.13. The data indicated that mean weight of adolescent girls aged 12-14, 15-16 and 17-18 year was 34.72±1.67 , 40.66±1.33 and 43.81±1.27 kg in Panchrukhi block, 34.17±1.72, 40.58±1.21and 42.10±1.56 kg in Baijnath block and 37.25±1.00, 41.17±1.19 and 45.86±1.56 kg in Bhawarna block respectively. The data revealed that when Tukey HSD test was applied for analysis of the difference between the blocks, it was found that as for height girls of Bhawarna block in all age groups had significantly higher weight measurement. Statistical analysis inferred that height of 12-14 years group of Bhawarna block significantly differ when compared with rest of the two blocks while the difference between Panchrukhi and Baijnath was non-significant. Same scenario was visible for 17-18 years too. However, for 15-16 years significant difference was observed for all selected blocks.

Table 4.12 Anthropometric profile of selected adolescent girls (N=300)

Anthropometric parameters	Blocks		
	Panchrukhi (n=100)	**Baijnath (n=100)**	**Bhawarna (n=100)**
Height (cm)			
12-14	151.80±1.11[b]	151.70±1.58[b]	151.91±1.18[a]
15-16	155.55±1.30[c]	148.60±3.63[b]	157.52±1.03[a]
17-18	159.78±2.10[b]	158.96±0.93[b]	162.44±0.99[a]
Weight (kg)			
12-14	34.72±1.67[b]	34.17±1.72[b]	37.25±1.00[a]
15-16	40.66±1.35[b]	40.58±1.21[b]	41.17±1.19[a]
17-18	43.81±1.27[b]	42.70±1.56[b]	45.86±1.56[a]
BMI (kg/m^2)			
12-14	14.98±0.63[b]	14.73±0.26[b]	15.07±0.28[a]
15-16	16.68±0.30[c]	15.86±1.54[b]	17.72±0.29[a]
17-18	17.08 ±0.20[b]	16.97±0.45[b]	17.17±1.32[a]
Trieceps skinfold thickness (mm)			
12-14	7.98±0.41[b]	6.65±0.39[b]	7.32±0.27[a]
15-16	7.53±0.52[c]	6.89±0.29[b]	9.71±0.51[a]
17-18	9.65±0.50[b]	7.35±0.43[b]	8.12±0.64[a]

Note: Tukey HSD test significant at 5% level of significance
Superscripts with different notion (a,b,c) implies that they are significantly different ($p<0.05$)
Means with same subscripts in rows are not significantly different

Mean weight when compared ICMR and NCHS standards depicted that 75.31-85.86 per cent adolescent population in selected area met the national standards and were at par with each other. Shekhar (2005) conducted a study to assess nutritional status of subjects aged 17-18 years and reported that mean height and mean weight was 156.6 cm and 51.5 kg and mean BMI of the subjects ranged between 16.8 to 20.8. A study conducted by Deshmukh et al. (2006) on nutritional status of adolescents in rural Wardha showed that 53.8 per cent of the adolescents were thin, 44 per cent were normal and 2.2 per cent were over weight. Jain (2012) compared weight of the subjects in two seasons and reported mean weight of the subjects as 63.4 ± 12.2 kg in winter as 62.5 ± 11.5 kg in summer season. Singh (2014a) also worked effect of seasonal variation on weight of adolescent girls of Ludhiana city and recorded per cent meet of weight with national standard. It was 91.20 and 99.79 for 13-14 years and 81.60 and 89.81 for 14-15 year group in summer and winter seasons respectively.

Table 4.13 Comparison of anthropometric profile of selected adolescent girls with respective standards (N=300)

Anthropometric parameters	Standard		Blocks					
			Panchrukhi (n=100)		Baijnath (n=100)		Bhawarna (n=100)	
Height (cm)	ICMR	NCHS	ICMR	NCHS	ICMR	NCHS	ICMR	NCHS
12-14	152.00	154.30	99.86	98.38	99.80	98.31	99.09	98.51
15-16	158.50	161.53	98.14	96.30	93.75	92.00	98.02	98.14
17-18	160.00	163.40	99.46	97.79	98.95	97.29	99.74	100.3
Weight (kg)								
12-14	41.00	43.80	84.28	79.28	82.94	78.02	90.41	85.05
15-16	49.00	53.30	82.54	76.29	82.40	76.15	83.59	77.26
17-18	53.00	56.65	80.12	77.39	82.21	75.39	85.86	80.78
BMI (kg/m^2) ICMR Standard								
12-14	18.00		84.16		82.75		84.66	
15-16	19.00		85.10		80.91		89.61	
17-18	20.00		82.38		83.35		82.91	
Trieceps skinfold thickness (mm) NCHS Standard								
12-14	15.00		53.20		44.33		48.80	
15-16	16.00		47.06		43.06		60.69	
17-18	17.00		56.76		43.24		47.76	

Body mass index (BMI)

Mean body mass index (BMI) of all three age groups i.e. 12-14, 15-16 and 17-18 was significantly higher in Bhawarna block (15.67±0.28, 17.72±0.29 and 17.17±1.32 kg/m^2) when compared to Panchrukhi (14.98±0.63, 16.68±0.30 and

17.08±0.2 kg/m^2) and Baijnath (14.73±0.26, 15.86±1.54 and 16.97±0.45 kg/m^2). The difference was statistically insignificant when compared between Panchrukhi and Baijnath. Table 4.13 clarifies further that BMI values were lower than the ICMR standard i.e. <90 per cent in all the three selected blocks with variation of 80.91 to 89.61 per cent. Jain (2012) assessed BMI of Punjabi adolescent girls and reported the mean values of 25.0±5.4 kg/m^2 in winter and 24.4±4.9 kg/m^2 in summer season. Singh (2014a) concluded that there is a relationship between BMI and independently assessed measures of socio-economic standard in communities of India.

Triceps skin fold thickness (TSF)

Values of triceps skin fold thickness in Panchrukhi, Baijnath and Bhawarna for age group 12-14, 15-16 and 17-18 year was recorded as 7.98±0.41, 6.65±0.39 and 7.32±0.27 mm, 7.53 ± 0.52, 6.89±0.29 and 9.71±0.51 mm and 9.65±0.05, 7.35±0.43 and 8.12±0.64 mm respectively. Tukey HSD test indicated that as for height measurement, Bhawarna block girls had significantly higer triceps skinfold measurement i.e. calorie reserve. When compared for 15-16 age group, all blocks different significantly with each other. When compared with NCHS standards, only 43.06 to 60.69 per cent population of selected adolescent girls met the standard. A study of Sharma and Chawla (2005) reported triceps skin fold thickness in control and experimental group (nutritional counseling) i.e. 6.35 and 6.24 mm at baseline and 6.51 and 6.57 mm after experimentation and met standards of 62.83 and 66.17 per cent after intervention. Singla (2011) also reported the mean triceps skin fold thickness values of adolescent girls between 11 to 18.6 mm and also stated that majority were in borderline for energy reserve.

Extracting the values of triceps skinfold and fitting them into different divisions of calorie reserves (Table 4.14 and Figure 4.4) elucidated that on the whole an almost equal proportion of the population in all the three selected blocks were on either side of calorie balance i.e. 15.33 per cent had adequate reserves (16.5-10.0) and 15 per cent had severely depleted reserve. Maximum girls i.e. 69.66 per cent were in borderline stage (9.95-5.00).

Singh (2014a) studied tricep skin fold thickness of adolescent girls of Punjab and reported summer and winter seasons variation for age group 13-14 years as 11.53 and 13.09 mm and for age group 14-15 years as 11.76 and 13.21mm and also stated values of triceps skin fold was lower than the NCHS standards.

Table 4.14 Interpretation of skin fold thickness of selected adolescent girls (N=300)

Particulars	Blocks		
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)
Triceps skinfold thickness (mm)			
Adequate (16.5-10.0)	11	8	27
Borderline(9.99-5.00)	74	64	71
Severely depleted(<5.00)	15	28	2

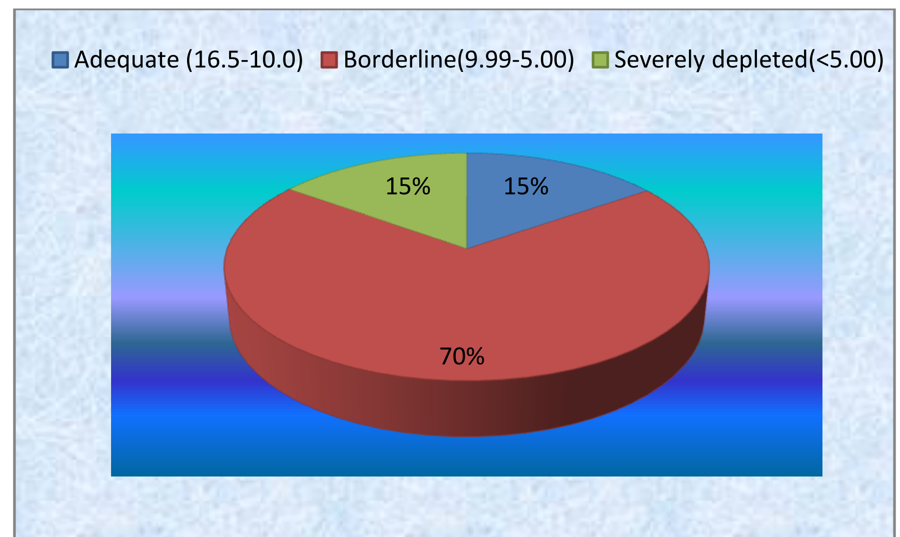


Fig. 4.4 Mean triceps skin fold thickness of selected adolescent girls (N=300)

Measurement of anthropometric indicators viz. height, weight and BMI of selected subjects gave the evidence of moderate nutritional status as almost more than 80 per cent of population met the nutritional standards. On the other side, an average of 50 per cent adolescent girls met NCHS standards for triceps skinfold indicating depleted calorie reserves.

Prevalence of under nutrition

Further categorization of body mass index was worked out for prevalence of malnutrition in three hundred selected subjects and data has been presented in Table 4.15 and pictorially illustrated in Figure 4.5. Majority of the respondents i.e. more than 80 per cent were found to be under weight in whole (BMI<18.5). Further split clarifies that most of the respondents i.e. 53, 50 and 42 per cent in Panchrukhi Baijnath and Bhawarna had moderate thinness (BMI 14.00-16.99).17,10 and 26 per cent had mild thinness (BMI 17.00-18.49) and 15, 27 and 12 per cent had severe thinness as assessed having BMI <14.00 in stated blocks respectively . Only 13, 10

and 14 per cent adolescents had by normal nutritional status in order of the blocks presented in the table respectively. A negligible percentage of the girls were overweight and obese.

Chaudhary et al. (2003) assessed nutritional status of adolescent girls in rural area of Varanasi and examined anthropometric measurements of weight, height and mid arm circumference (MAC) and hemoglobin. Two-third of studied subjects were undernourished (BMI < 18.5 kg/m^2) and nearly one-third experiencing chronic energy deficiency grade-III (BMI < 16 kg/m^2). Nearly one third girls were anemic (Hb < 12 g/dl); anemia was significantly more in non-menstruating girls and subjects not using footwear during defecation.

4.4.5 Clinical Assessment

Clinical examination is the simplest and most essential part of all nutritional surveys. There are a number of physical signs, both specific and non-specific known to be associated with the state of malnutrition. The subjects were examined from head to foot in good illumination for the presence or absence of signs/symptoms related to nutritional deficiencies.

Assessment of nutritional deficiencies evaluated clinically among selected adolescent girls in different blocks of Kangra district has been presented in Table 4.16. General appearance of the subjects revealed that majority (87 %) were mesomorphic in appearance and almost an equal percentage of 6 were either endomorphic or ectomorphic. Since more than the studied population had height and weight measurements more than 80 per cent of the standards, so protein energy malnutrition was not prevalent in selected blocks. Only 5 cases in Panchrukhi and 3 cases in Baijnath were reported while not a single case was analyzed for this indicator in Bhawarna block which may be due to the reason that 98 per cent and 80. 66 per cent adolescent girls met the national standards of height and weight measurement.

On the whole, thiamine deficiency was prevalent in studied population as evident from reporting of loss of ankle and knee jerks and calf muscle tenderness. Symptom of angular stomatitis, cheilosis and magenta tongue were prevent asserting riboflavin deficiency.

Table 4.15 Prevalence of malnutrition among selected adolescent girls (N=300)

Particulars	Blocks		
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)
BMI(Kg/m^2)			
Underweight (<18.5)	85	87	80
i. Severe thinness (<14.00)	15	27	12
ii. Moderate thinness(14.00-16.99)	53	50	42
iii. Mild thinness(17.00-18.49)	17	10	26
Normal (18.50-24.99)	13	10	14
i. 18.50-22.99	6	8	5
ii. 23.00-24.99	7	2	9
Over weight (25.00- 29.99)	1	2	4
i. Pre obese (25.00-27.49)	1	1	3
ii. 27.50-29.99	-	1	1
Obese(≥30.00)	1	1	2
i. Obese I(30.00-34.99)	-	1	3
ii. Obese II(35.00- 39.99)	-	-	1
iii. Obese III(≥40.00)	-	-	-

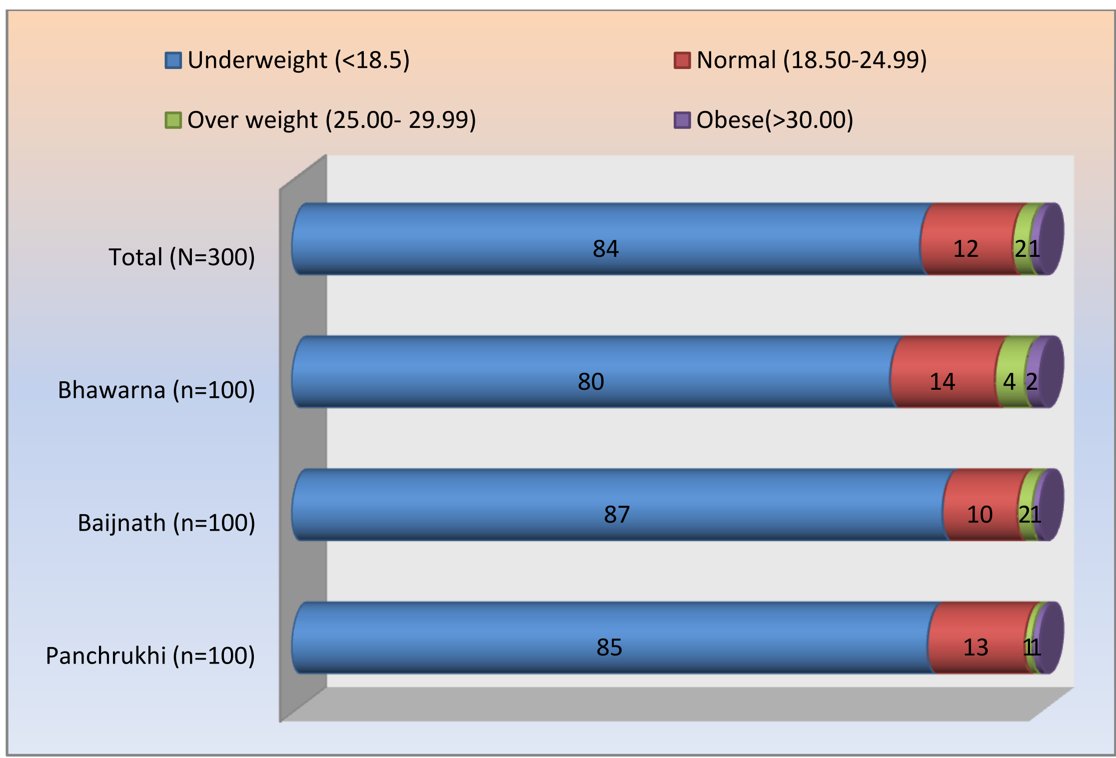


Fig. 4.5 Prevalence of under nutrition among selected adolescent girls (N=300)

Data reported in the table further elucidated that 27 per cent of the girls had atropic lingual papillae and tongue fissuring and had scarlet and raw hue that affirmed deficiency of B_3 i.e. niacin.

An average of 17.33 per cent adolescent girls shortlisted in three blocks of District Kangra, Himachal Pradesh had deficiency of vitamin C as evident from symptoms of easy fatigue and listlessness felt by the subjects as well as reporting of spongy and bleeding gums and tender bone.

The symptoms of iron deficiency were studied in detail in the selected subjects. Among the analysed symptoms, maximum subject felt lethargy/fatigue on doing work (40 %) thereby reducing their productivity and output. Most of the subjects were at par in relation to recorded symptoms of lack of concentration (36.33 %), tachycardia (36.66 %) and feeling cold hand and feet (33.33 %) 82 and 47 respondents out of 300 had pale conjunctiva and pale skin while 71 experienced breathlessness on slight exertion thereby, feeling dizzy and weak (25 %) and also experienced headache (22.33%).

While assessing and recording clinical symptoms of different deficiencies in selected adolescent girls, no symptoms or indicators of vitamin A, vitamin D and iodine deficiency could be assessed.

Table 4.16 Assessment of nutritional deficiencies among selected adolescent girls (N=300)

Particulars	Blocks			
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)	Total (N=300)
General Appearance				
Endomorphic	1	17	1	19(6.33)
Mesomorphic	88	74	99	261(87.00)
Ectomorphic	11	9	-	20(6.66)
Protein Energy Malnutrition				
Diminished subcutaneous fat	3	1	-	4(1.33)
Muscle wasting	2	-	-	2(0.66)
Oedema in ankles	-	2	-	2(0.66)
Hair (Problems)	-	-	-	-
Diffuse pigmentation skin	-	-	-	-
Moon face	-	-	-	-
Flaky-paint dermatosis	-	-	-	-
Vitamin A deficiency-Not present				
Vitamin D deficiency- Not present				
Thiamine deficiency-				

Oedema	-	5	-	5(1.66)
Loss of ankle & knee jerks	13	27	6	46(15.33)
Calf-muscle tenderness	3	62	5	70(23.33)
Riboflavin deficiency				
Angular stomatitis	4	34	9	47(15.66)
Angular scars	4	16	2	22(7.33)
Cheilosis	6	27	1	34(11.33)
Magenta tongue	21	47	28	96(32.00)
Niacin deficiency				
Scarlet & raw tongue	12	33	8	53(17.66)
Atropic lingual papillae	12	21	48	81(27.00)
Tongue fissuring	6	33	16	55(18.33)
Vitamin C deficiency				
Spongy & bleeding gums	9	41	6	56(18.66)
Tender bone	-	26	16	42(14.00)
Easy fatigue and listlessness	14	42	2	58(19.33)
Iron deficiency				
Breathlessness on slight exertion	11	51	9	71(23.66)
Pale conjunctiva	31	31	20	82(27.33)
Paleness of skin	6	24	17	47(15.66)
Paleness & smoothness of tongue	2	23	14	39(13.00)
Spoon shaped nails	-	3	-	3(1.00)
Feeling of lethargy/ Fatigue	17	57	46	120(40.00)
Weakness/ Dizziness	23	37	15	75(25)
Lack of concentration	39	40	27	106(35.33)
Disrupted sleep	6	7	3	16(5.33)
Tachycardia	36	52	22	110(36.66)
Decrease physical activity	10	17	3	30(10.00)
Poor physical development	5	9	3	17(5.66)
Cold hand and feet	23	60	17	100(33.33)
Oedema of feet	-	9	-	9(3)
Loss of appetite	4	11	2	17(5.66)
Irritable and restless	6	36	3	45(15.00)
Headache	15	44	8	67(22.33)
Decreased exercise tolerance	15	8	9	32(10.66)
Increased incidence of infections	9	9	4	22(7.33)
Angular cheilosis	1	44	6	51(17.00)
Sudden fainting	2	5	12	19(6.33)
Glossitis	41	2	5	48(16.00)
Hair loss	-	-	-	-
Iodine deficiency- Not present				

#Figure in parentheses represents percentage

Kumar et al. (2006) did clinical examination of 80 adolescent girls from Allahabad and observed various signs and symptoms of anemia among adolescents like breathlessness, tiredness and pale nails. Dhingra (2011) revealed that majority (90%) of tribal girls were having pale cold skin, 86.5 per cent had yellow conjunctiva, 68.0 per cent showed rapid heart rate while 64.5 per cent were having fast breathing. The other health related ailments reported by the respondents were low blood pressure (67.5 %), with complaint of fatigue (76 %), general weakness (5 %) and dizziness (16 %) followed by sticky and foul smelly stool (34.5%) spleenonegaly (32.00%) and weight loss (26.5%). He investigated the prominent clinical symptoms among adolescent girls may be due to low intake frequency of green leafy vegetables.

4.4.6 Hemoglobin assessment

The mean hemoglobin profile (Hb), prevalence of anemia and per cent adequacy has been presented in presented in Table 4.17 and Table 4.18 and pictorially outlined in Figure 4.6 and 4.7. The mean hemoglobin level of selected adolescent girls aged 12-14 years was 9.59±0.10, 9.56±0.13 and 9.96±0.01 g/dl and for girls aged 15-16 years 9.37±0.01, 9.29±0.10 and 10.30±0.15 g/dl and 9.60±0.09, 9.35±0.12 and 10.01±0.11 g/dl for age age group of 17-18 yeras in Panchrukhi, Baijnath and Bhawarna blocks respectively.

Per cent adequacy of hemoglobin level with respect to WHO standards stated that on an average, 79.33 per cent adequacy in Panchrukhi block and 78.43 per cent in Baijnath block were calculated. More than 90 adequacy was calculated for subjects residing in Bhawarna block for all age groups.

Based on the analysed values of hemoglobin by method of ‘Sahli’ prevalence of anemia was calculated as per WHO standard for the determined group. Quite obvious from the data, maximum adolescent subjects in the age group of 12-18 years residing in Kangra district were suffering from moderate anemia (77.33 %) followed by mild anemia (12.33 %). Only 6.33 per cent subjects had severe anemia and only 4 per cent were having normal hemoglobin. Blockwise split clarifies that maximum respondents from Baijnath block (82 %) had moderate anemia followed by Panchrukhi residents (77 %) and Bhawarna block residents (73 %). On the same lines, for severe anemia, 9 respondents were from Baijnath followed by 6 from Panchrukhi and 4 from Bhawarna.

Table 4.17 Hemoglobin profile (g/dL) of selected adolescent girls (N=300)

Age group	Blocks		
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)
12-14	9.59±0.10 [b]	9.56±0.13 [b]	9.96±0.05[a]
15-16	9.37±0.10 [c]	9.29±0.10 [b]	10.30±0.15[a]
17-18	9.60±0.09 [b]	9.35±0.12 [b]	10.01±0.11[a]

Note: Tukey HSD test significant at 5% level of significance
Superscripts with different notion (a,b,c) implies that they are significantly different ($p<0.05$)
Means with same subscripts in rows are not significantly different

Table 4.18 Prevalence of anemia among adolescent girls (N=300)

Category of Anemia	Blocks			
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)	Total (N=300)
Normal (≥12 g/dl)	4	1	7	12(4.00)
Mild (11-11.9g/dl)	13	8	16	37(12.33)
Moderate(8-10.9g/dl)	77	82	73	232(77.33)
Severe (<8 g/dl)	6	9	4	19(6.33)

DLHS-4 (2012-13) state fact sheet data of Himachal Pradesh revealed that in children (6-59 month) total prevalence of anemia was 58.6 per cent in which 60.4 per cent rural and 45.9 per cent urban children were involved. Koushik et al. (2014) assessed the prevalence and the severity of the anemia in 150 adolescent girls of Guntur, Andhra Pradesh, India. The prevalence of anemia was 77.33 per cent (with severe anemia being 12.06 %, moderate anemia being 50.86 % and mild anemia 37.06 %) and majority of the girls had the moderate anemia. Devi et al. (2015) determined the prevalence of anemia among school going 320 adolescent girls of Government Secondary Schools of District Rohtak (Haryana). The overall prevalence came out to be 73 per cent among study subjects. On the basis of severity, nearly half of subjects (54%) were found with mild anemia, 18 per cent of girls had moderate anemia while 1 per cent girls were severely anemic.

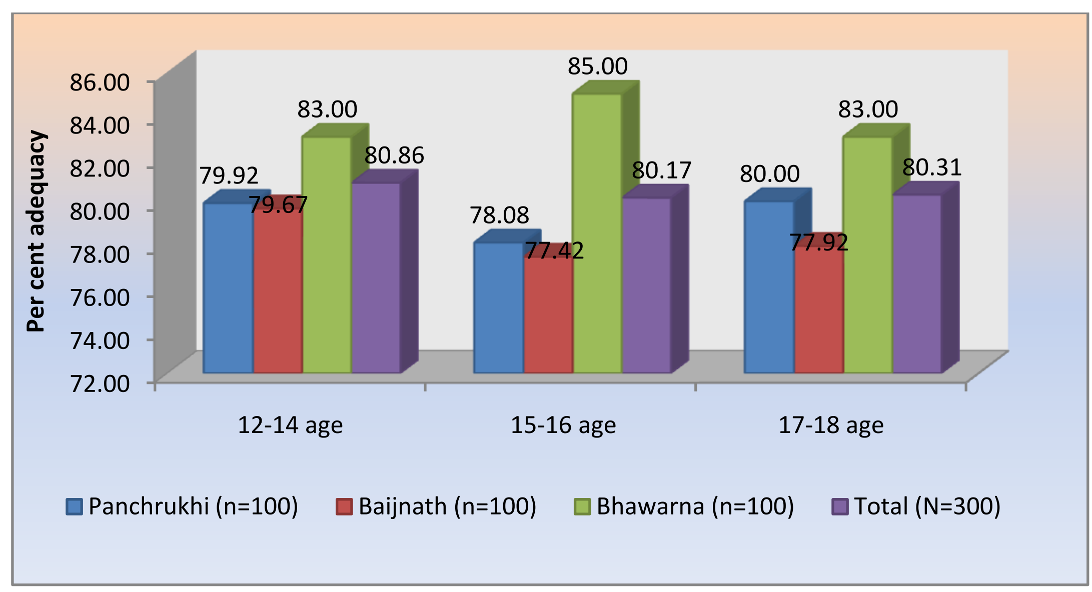


Fig. 4.6 Per cent adequacy of average hemoglobin level of subjects with WHO standard

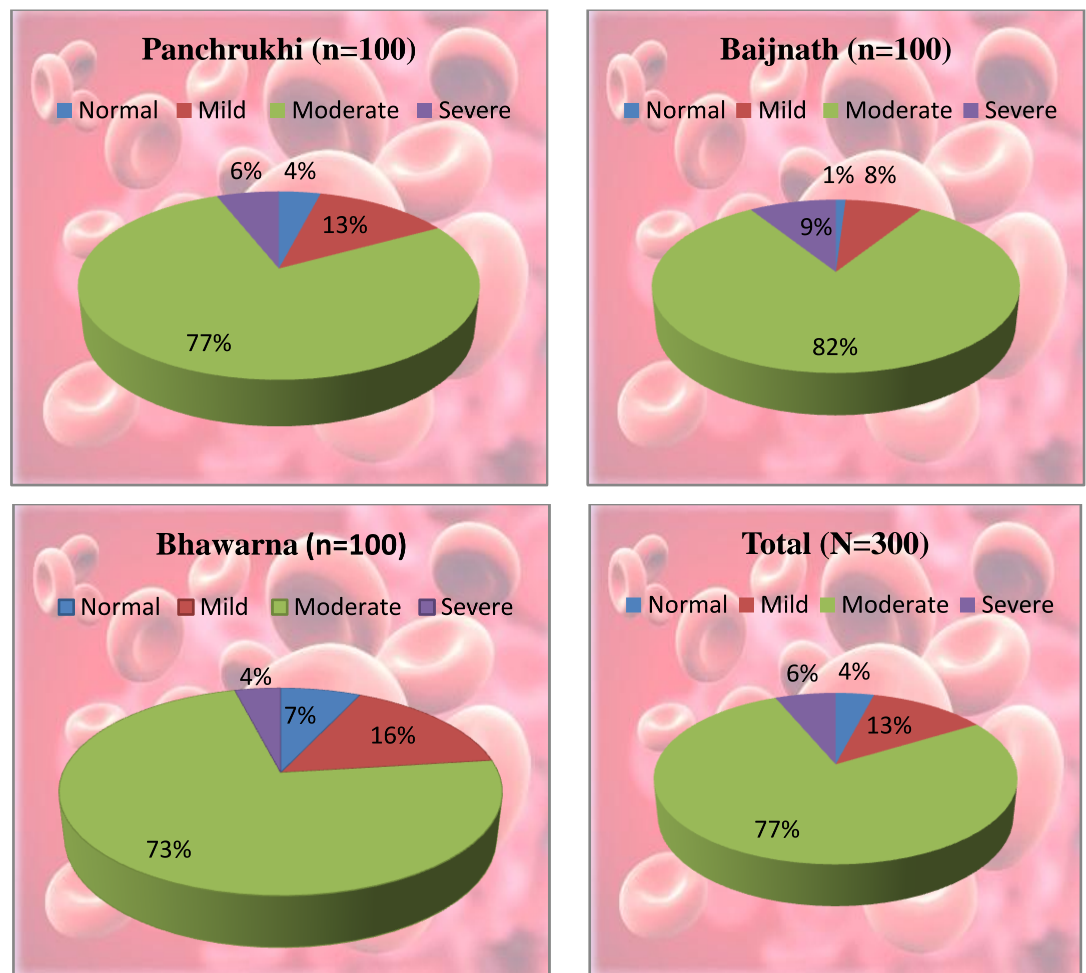


Fig. 4.7 Prevalence of anemia among adolescent girls (N=300)

4.5 Physical activity pattern

Physical activity is one of the major lifestyle related health determinants. However, such an important health protecting behavior seems to decline during adolescence. So, this parameter was examined under various domains and intensities of activity and have been described in Table 4.19 for selected adolescent girls. Walking was the sole daily activity performed by 100 per cent adolescent girls residing in the selected blocks and very few did cycling (12%) and skating/yoga/gym (10%) activities which were performed usually on weekly and fortnightly basis. Cycling and skating/yoga/gym were performed only by Panchrukhi respondents. None of the subjects in Baijnath and Bhawarna blocks were interested in these physical activities. This may be attributed due to un-affordability of these resources by low income group families of the selected groups. Almost all the selected subjects spend time in doing physical exercise but, these were compulsory school exercise performed in schools at set time.

There is an evidence of association between physical activity and dietary behaviors in adolescent. Poor diet and physical inactivity are established risk factors for chronic diseases. In young people, physical activity and healthy diets including regular breakfast consumption and adequate levels of fruits and vegetables have important short and long term health protective effects. In the present investigation, 25.66 per cent of overall respondents skipped breakfast and had less than 50 per cent adequacy for fruits as well as for green leafy vegetables group. This mean their diet was deficient in important nutrients particularly vitamins and minerals, the reduced levels of which are responsible for reduced work capacity thereby, affecting the activity pattern of selected respondents.

Majority of adolescent girls spend 15-30 minutes (95.33%) time for doing exercise and very few adolescent girls and that too in Baijnath block spend 10-15 minutes (4.66%). Majority of adolescent girls performed exercise either daily (66.66 %) or alternatively (33.33 %).

Most of the adolescent girls came to school daily by walking (91.66%) and only 8.33 per cent came by bus. As most of them were residing nearly the school so, they preferred to come school by walking. Devi (2013) observed that daily walking was the most performed activity by adolescent boys and girls of Haryana and rare practice of doing exercise was observed.

Table 4.19 Activity pattern of selected adolescent girls (N=300)

Activity	Blocks			
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)	Total (N=300)
Walking				
Daily	100	100	100	300(100)
Weekly	-	-	-	-
Fortnightly	-	-	-	-
Rarely	-	-	-	-
Cycling				
Daily	-	-	-	-
Weekly	1	1	-	2(0.66)
Fortnightly	6	-	-	6(2.00)
Rarely	4	-	-	4(1.33)
Skating/ Yoga/ Gym				
Daily	-	-	-	-
Weekly	-	-	-	-
Fortnightly	2	-	-	2(0.66)
Rarely	8	-	-	8(2.66)
Time spend on exercise (Minutes)				
i) 10-15				
Daily	-	14	-	4(4.66)
Alternatively	-	-	-	-
Rarely	-	-	-	-
ii) 15-30				
Daily	-	86	100	186(62)
Alternatively	100	-	-	100(33.33)
Rarely	-	-	-	-
Come to school				
i) Walking				
Daily	100	75	100	275(91.66)
Alternatively	-	-	-	-
Rarely	-	-	-	-
ii) Bus				
Daily	-	25	-	25(8.33)
Alternatively	-	-	-	-
Rarely	-	-	-	-

#Figure in parentheses represents percentage

4.6 Mass media exposure

Various research investigations have suggested that exposure to mass media as part of social environment influence food consumption of adolescents and can be used effectively as an educational tool to promote health. So the availability, preference and theme of mass media as information sources were examined. Table 4.20 describes

the data regarding exposure of mass media by selected adolescent girls. The availability of mass media resources showed that majority of the subjects had accessibility to books (96.00%) followed by newspaper (52%) and magazines (14%). Electronic media data revealed that majority of selected families had television (98.66 %) followed by computer (49.33%) and radio (32.00%). Books in printed media and television in electronic media were the mostly available resources of mass media in selected families of all three blocks.

Table 4. 20 Exposure of mass media of selected adolescent girls (N=300)

Media	Blocks			
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)	Total (N=300)
Availability of mass media resource –				
i) Print media				
Newspaper	47	72	37	156(52.00)
Magazines	27	11	4	42(14.00)
Books	98	92	98	288(96.00)
ii) Electronic media				
Radio	94	2	-	96(32.00)
TV	100	96	100	296(98.66)
Computer	1	57	90	148(49.33)
Preference of mode of media				
Printed media	-	48	-	48(16.00)
Electronics media	2	51	-	53(17.66)
Both	98	1	100	199(66.33)
Preference of language to view media				
Hindi	98	99	90	287(95.66)
English	2	1	10	13(4.33)
Liking for theme/ material of media				
Literary	47	26	15	88(29.33)
Scientifics	42	-	-	42(14.00)
Entertainer	100	99	90	289(96.33)
Health related	41	1	10	52(17.33)

#Figure in parentheses represents percentage

The data further confirmed that the majority of the subjects (66.33 %) preferred both electronic as well as printer media and splitwise 16 and 17 per cent preferred printed and electronic media separately. Most of the respondents gave credibility to Hindi medium language (95.66%) to read print media and remaining 4.33 per cent preferred English medium, to view or read media because Hindi language is the medium of instruction and communication in the schools. Further

observation provided the evidence that majority of the subjects liked entertaining theme program (96.33%) on media followed by literary (29.33%), health related (17.33 %) and least preferences to scientific (14.00%) theme programs. Singh (2014a) worked on mass media exposure of adolescent girls and found that television and books were the most available media resources in family and majority of them like entertainment theme in media.

4.7 General health record

Complaints of headache, stomachache, fatigue are common among adolescent girls. Chronic pain may have long term effects and negatively affects school attendance, academic and developmental experiences. Iron deficiency has consequences of depressed immune function. Hence, the prevalence and frequency of common ailments was investigated.

The data in Table 4.21 revealed the general health record of selected adolescent girls and their parents. The family history of metabolic diseases like diabetes (0.66%), chronic heart diseases (1.00%) and obesity (1.33%) was found to be very rare or negligible. This may be attributed that majority of the respondents belonged to low to medium income group and occupation of parents was either laborer or farmers so their physical exercise stamina was more and moreover they may be unaware about these types of metabolic diseases. So 93, 96 and 98 per cent population were not having family history of any metabolic diseases. Data further revealed that 100 per cent of the respondents in all the selected blocks did not have family history of any deficiency disorder like anemia, osteoporosis and iodine deficiency which may be attributed to fact that many people ignore symptoms of these deficiencies and didn’t go to doctor for health checkup /diagnosis.

Information on frequency of fever, illness or any disorder/ ailment elucidated that 38 per cent of total girls had fever sometime (38%) while 34.33 per cent rarely had fever. Less than 40 per cent (38 %) of the respondents rarely suffer from cold/ respiratory disorder whereas 34.33 per cent usually had respiratory problems. Regarding other ailments majority of the subjects suffered sometime from diarrhea/stomach infection/nausea/vomiting followed rarely attacks in 35.66 per cent subjects. 20 per cent usually had attacks of these illnesses. Same scenario of frequency of other aliments like headache/body ache and loss of appetite/lethargy was visible.

Table 4.21 General health record of selected adolescent girls (N=300)

Particulars	Blocks			
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)	Total (N=300)
Family history of metabolic disease				
Diabetes	1	1	0	2(0.66)
Chronic heart disease	1	1	1	3(1.00)
Obesity	1	2	1	4(1.33)
No disease	93	96	98	
Relationship				
Mother	2	3	1	6(2.00)
Father	1	1	1	3(1.00)
Family history of deficiency disease if any (anemia, osteoporosis, iodine deficiency)				
Yes	-	-	-	-
No	100	100	100	300(100.00)
Frequency of				
i) Fever illness				
Usually	33	32	15	80(26.66)
Some time	40	41	33	114(38.00)
Rarely	25	27	51	103(34.33)
ii) Cold/ respiratory disorders				
Usually	43	44	16	103(34.33)
Some time	21	29	32	82(27.33)
Rarely	37	27	50	114(38.00)
ii) Diarrhea/ stomach infection/ nausea/ vomiting				
Usually	18	24	18	60(20.00)
Some time	52	45	35	132(44.00)
Rarely	30	31	46	107(35.66)
iii) Headache/body ache				
Usually	24	51	15	90(30.00)
Some time	30	32	56	118(39.33)
Rarely	46	13	29	88(29.33)
iv) Loss of appetite/lethargy				
Usually	15	51	18	84(28.00)
Some time	29	43	46	118(39.33)
Rarely	50	6	31	87(29.00)

#Figure in parentheses represents percentage

4.8 Information on medicitional supplementation

Table 4.22 illustrated the information on intake of vitamins and minerals supplementation by adolescent girls and showed that only 66.66 per cent of total adolescent girls were taking iron and folic acid tablets having composition of 100mg elemental iron and 500µg folic on weekly basis in tablet form. A low adherence of iron and folic acid tablets intake was observed even though supplements were distributed in school regularly under Weekly Iron Folic Acid Supplementation (WIFAS) program. Reporting of symptoms such as headache, stomach pain, vomiting, nausea and loose and foul smelling stool were associated with their low intake. Intake was higher in Bhawarna block (78 %) followed by Panchrukhi (73 %) and Baijnath block (49 %).

The services delivered under WIFAS include bi-annual deworming but the presented data showed that only 69 per cent of adolescent girls were taking deworming medicine that too once a year. Block wise, 89 per cent of subjects from Panchrukhi, 73 per cent from Baijnath and only 45 per cent from Bhawarna block had taken deworming medicine distributed under Weekly Iron Folic Acid Supplementation program. No data on other supplements intake was documented.

The present study suggested that all the adolescent girls dislike the iron supplementation and deworming tablets because they were unaware about the instructions for supplement intake, its importance and symptoms of side effects. Another service under this national scheme is nutrition counseling to minimize the potential side effects of iron-folic acid supplements and deworming but its adherence seem to be lacking in selected schools. The low intake of iron supplements and deworming tablets could be one of the reasons for prevalence of anemia. Sen and Kahani (2012) reported significantly higher increment in hemoglobin level in iron supplemented groups than non-supplemented group. Singh (2014a) observed that only 19.2 per cent total adolescent girls were taking iron tablets weekly in Punjab in studied group of 120 girls.

Table 4.22 Information on supplementation taken by selected adolescent girls (N=300)

Particulars	Blocks			
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)	Total (N=300)
Intake of iron-folic acid				
Yes	73	49	78	200 (66.66)
No	27	41	22	100(33.33)
Form				
Tablet	73	49	78	200(66.66)
Syrup	-	-	-	-
Composition of supplement				
100mg Fe &500µg folic acid	73	49	78	200(66.66)
Frequency				
Daily	-	-	-	-
Weekly	73	49	78	200(66.66)
Monthly	-	-	-	-
Take supplement from				
KSY	-	-	-	-
W I FS	73	49	78	200(66.66)
PHC	-	-	-	-
Intake of deworming medicine				
Yes	89	73	45	207(69.00)
No	11	27	55	93(31.00)
Once in year	89	73	45	207(69.00)
Twice in year	-	-	-	-
No data on other supplements intake was found				

#Figure in parentheses represents percentage

4.9 Information regarding menstruation

Menstruation is an inevitable part of a girl's life and more so an important indicator of normal physical, physiological and functional well being. Menstruation has a variable pattern with a few years of menarche. It vary with different age group, socioeconomic status and lifestyle. The information regarding menstruation cycle of selected adolescent girls has been presented in the Table 4.23. In the present study, majority of selected adolescent girls (77.32 %) were found to attain menarche in the age of 14 to 15 year (43.60%) and 12-13 years (33.66 %).

Table 4.23 Information regarding menstrual cycle of selected adolescent girls (N=300)

Particulars	Blocks			
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)	Total (N=300)
Menstrual cycle setup				
Yes	69	84	79	232(77.33)
No	31	16	21	68(22.66)
Age				
12-13	32	39	30	101(33.66)
14-15	37	45	49	131(43.66)
Cycle				
Regular	20	-	-	20(6.66)
Irregular	49	84	71	204(60.00)
Menstrual cycle period				
<28	46	52	32	130(43.33)
>28	23	32	47	102(34.00)
Days of irregular				
<2	20	-	-	20(6.66)
2-4	-	32	47	79(26.33)
>4	49	52	32	133(44.33)
Premenstrual syndrome				
Vomiting	35	12	48	95(31.66)
Nausea	-	32	-	32(10.66)
Abdominal Pain	11	6	-	17(5.66)
Backache	21	19	31	71(23.66)
Duration of flow(days)				
<2	-	2	-	2(0.66)
2-3	20	75	1	96(32.00)
4-5	49	7	70	126(42.00)
>5	-	-	8	8(2.66)
Menstrual flow				
Normal	68	82	79	229(76.33)
Above normal	1	-	-	1(0.33)
Below normal	-	2	-	2(0.66)

#Figure in parentheses represents percentage

A total of 60.00 per cent subjects had irregular menstrual cycle. Period having irregularity of more than 4 days (44.33 %), 2-4 days (26.33 %) and less than 2 days (0.66 %) were reported 43.33 per cent of girls had periods that initiated before 28 days while 34 per cent of girls had a cycle of more than 28 days followed by premenstrual symptoms of vomiting (31.66%) backache (23.66 %) nausea (10.66 %) and abdominal pain (31.66%). 42 per cent of the girls had 4-5 days flow during the

cycle followed by 32 per cent having duration of 2-3 days of flow that was normal (76.33%) in volume during the day.

In conclusion, the age at menarche and other menstrual characteristics observed in this study are similar to adolescent menstrual characteristics discussed by variation studies in other population of the world. Kulkarni and Durga (2011) observed 71.39 and 78.67 per cent girls living in slum area attaining menstruation at mean age of 12 years. Further data revealed that the duration of menstrual cycle period was recorded less than 28 days (43.3 %) and more than 28 day (34.00 %). 44.33, 26.33 and 6.66 per cent of adolescent girls found to be more than 4, 2-4 and less two days of menstrual irregularity.

4.10 Academic profile and social behavior

Iron deficiency is a systemic condition which leads to consequences of decreased scholastic performance, reduced physical work capacity and impaired cognitive function. The information regarding school achievements and social behavior of selected adolescent girls has been presented in the Table 4.24. The information was collected from the school records and it was observed that 38.66 per cent secured C grade in their previous three academic sessions. These who failed reported for its is high standard with reasons of weak in study (8%) and illness during examinations (10.00%). Majority of subjects (68 %) studied at home for 1-3 hrs per day, 23.00 per cent studied for 3-6 hrs per day and a very few (8.66 %) had sitting capacity of more than 6 hrs per day at home. Block wise, data showed that majority of adolescent girls studied for 1- 3 hrs at their home in Panchrukhi (51%), Baijnath (72 %) and Bhawarna (81 %).

Majority of the subjects showed interest in extra-curricular activities and participate actively in sports (45 %) cultural (44.33 %) and less in physical activity (14.33 %). Regarding achievement/award 55.66 per cent received no award. The award/winners were from cultural field (21.66 %) followed by physical/ sports (20 %) only 2.66 per cent had academic achievement.

Table 4.24 Academic profile and social behavior of selected adolescent girls (N=300)

Particulars	Blocks			
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)	Total (N=300)
Aggregate grade obtained in previous three academic sessions				
A	30	13	31	74(24.66)
B	36	31	30	97(32.33)
C	30	53	34	116(38.66)
D	4	3	5	12(4.00)
Failure in class, if any				
Primary	-	-	-	-
Middle	-	-	2	2(0.66)
High	2	37	13	52(17.33)
Secondary	-	-	-	-
No failure	98	63	85	246(82.00)
Reasons of failure				
Weak in study	2	7	15	24(8)
Illness	-	30	-	30(10.00)
Hours of study at home				
1-3	51	72	81	204(68.00)
3-6	47	9	13	69(23.00)
>6	2	18	6	26(8.66)
Participation in extra-curricular activities				
Cultural	19	52	62	133(44.33)
Sports	21	55	59	135(45.00)
Physical	13	3	27	43(14.33)
Achievement/award if any				
Academic	2	5	1	8(2.66)
Culture	17	48	-	65(21.66)
Physical/Sports	11	-	49	60(20.00)
No award	70	47	50	147(55.66)
Like to make friends	64	96	42	202(67.33)
Play with friends	65	95	100	260(86.66)
Not play with friends	35	5	-	40(20.00)
Daily	1	57	86	144(48.00)
Weekly	21	37	8	66(22.00)
Monthly	-	-	3	3(1.00)
Occasionally	43	1	3	47(15.66)

#Figure in parentheses represents percentage

Finding their way in the peer group is an important developmental task for adolescents. A strong desire emerges to be included in peer activity and to be accepted by peers. Regarding peer behavior, 67.33 per cent like to make friends and play with them (86.66 %) of which 48 per cent played daily, 22 per cent weekly and 15.66 per cent occasionally. Singh (2014a) also reported that anemic subjects had poor academic records. Majority of adolescent studied at home for 1-3 hrs and interest in participation in co-curricular activities more among non anemic subjects.

4.11 Perceptions and knowledge regarding anemia

The information regarding the perceptions and knowledge regarding anemia among selected adolescent girls is presented in Table 4.25. It was observed that 52.33 per cent of selected adolescent girls knew the information regarding anemia disorder which was sourced from school (17 %) followed by medical workers (11.66 %), family members (7.66%), television (5.33%) and only 4.33 per cent knew it from friends. Though Weekly Iron Folic Acid Supplementation programme was running in the school for long time but no such sensitization program was organized for creating awareness and eradication, of the disorder. Infact, programs on emergency management (27%), sanitation and hygiene (8 %) and drug addiction (2.60 %) were organized by the reported school authorities.

While deliberating with the subjects, it was disheartening to know that very meager information on anemia was available in their study book. Though 8 respondents on a whole in Panchrukhi and 4 in Bhawarna reported about some topics but the data was almost blank for Baijnath black.

Though a good number of respondents had availability of print media resource but they did not came across any topic on importance of green leafy vegetables. Since they had lack of interest in this field so they might not be aware or came across with this important topic. The data in the table explain that a very few number of adolescents had knowledge of iron rich food sources. Only 10 respondents in Panchrukhi had knowledge of green leafy vegetables as a source of iron, 13 in Bhawarna reported sprouted pulses and jaggery/dates as iron rich sources. None of the respondents of Baijnath block had knowledge regarding food sources of iron.

Out of 300 subjects interviewed, only 5 per cent were aware of presence of vitamin c in citrus foods as only 3 per cent had knowledge regarding iron absorption enhancer. Hence, 25.33 per cent consumed tea/coffee after meal as they had lack of awareness of the fact that these beverages should not be consumed with meals. So, a high percentage of 95, 91and 86 were reported to have lack of knowledge regarding iron absorption inhibitors.

The information on anemia further indicated that 80 per cent had no knowledge about female gender being prone to anemia. Only 20 per cent knew this fact who stated onset of menstruation (40.66%) being the main reason. Regarding academics, 72.66 per cent faced problem in understanding class lecture which they managed by peer help (66 %).

As for physical activity, 93 per cent felt tired quickly after playing or doing some work after a duration of more than 30 minutes (47.33%) and 15 to 13 minutes period (40.33%).Further scrutiny of data revealed that 84.66 per cent had no knowledge of prominent symptoms of anemia. Only 15.33 per cent knew about symptoms of anemia as pale skin (10%), spoon shaped nails (3%), pale conjunctiva (1.66%) and paleness and smoothness of tongue (0.66%).

Knowledge assessment of respondents showed that 96.66 per cent girls were of the view that anemia can't be prevented. Inspite of the Weekly Iron Folic Acid Supplement program in the school, 30 to 66 per cent had no knowledge of supplements given in the school. They also had very meager knowledge for Governmental schemes of supplementation like Weekly Iron Folic Acid Supplementation (11 %), Iron Deficiency Anemia Control Programme (10.66 %) and Kishori Shakti Yojna (7 %). Assessment of this parameter conclude that majority of the respondents were unaware of the health problems related to anemia although they could not give precise details about how it occurs and its effect on health and nutrition. So nutrition and health education is fundamental to address this issue.

Table 4.25 Perceptions regarding anemia of selected adolescent girls (N=300)

Particulars	Blocks			
	Panchrukhi (n=100)	Baijnath (n=100)	Bhawarna (n=100)	Total (N=300)
Any information about anemia	46	51	60	157(52.33)
Source of information about anemia				
Friends	4	3	6	13(4.33)
Family members	1	2	20	23(7.66)
School	32	18	1	51(17.00)
TV	2	2	12	16(5.33)
Medical worker	7	7	21	35(11.66)
Programme organized in school				
Emergency management	45	32	4	81(27.00)
Drug addiction	-	8	-	8(2.66)
Sanitation and hygiene	-	11	13	24(8.00)
Any topic related to anemia in study book				
Decrease blood level	3	-	4	7(2.33)
Iron is related to blood	3	-	-	3(1.00)
Anemia common in females	2	1	-	3(1.00)
Any topics on importance of GLV read in books, newspapers, magazines etc.				
Rich in minerals and vitamins	2	10	4	16(5.33)
Good in anemia	2	8	-	10(3.33)
Provide fibre in diet	1	-	-	1(0.33)
Knowledge iron rich food sources				
Meat, Egg and fish	-	-	2	2(0.66)
Green leafy vegetables	10	-	1	11(3.66)
Jaggery and dates	-	-	4	4(1.33)
Sprouted pulses	-	1	6	7(2.33)
Cereals	-	-	-	-
Awareness of presence of vit. C in citrus fruit	4	3	8	15(5.00)
Knowledge regarding iron absorption enhancer	3	2	4	9(3.00)
Consume tea/coffee after meal	27	43	6	76(25.33)
Level of knowledge regarding non- consumption of tea/ coffee with meal				
Yes	5	9	14	28(9.33)
No	95	91	86	272(90.66)
Reasons-Inhibit iron absorption	-	-	6	6(2.00)
Enhance iron absorption	-	-	-	-
Suffer from worm problem	5	9	8	22(7.33)

Knowledge regarding females being prone to anemia				
Yes	23	19	18	60(20.00)
No	77	81	82	240(80.00)
Reasons				
Onset of menstruation	13	15	16	44(14.66)
Increased physiological blood demand	4	2	1	7(2.33)
Expansion of body mass & blood volume	2	1	-	3(1.00)
Rapid growth spurt of fetus	4	1	1	6(2.00)
Any problem faced in understanding class lecture				
Yes	62	92	64	218(72.66)
No	38	8	36	82(26.33)
Management of misunderstand lecture				
Do at home thyself	1	1	4	6(2.00)
By parents help	2	5	-	7(2.33)
By peers help	58	80	60	198(66.00)
Ignore	1	6	-	7(2.33)
Feel tired quickly after playing or doing some work				
Yes	96	98	85	279(93.00)
No	4	2	15	21(7.00)
Duration (minutes)				
<15	7	3	7	17(5.66)
15-30	40	44	37	121(40.33)
>30	53	56	33	142(47.33)
Prominent symptoms of anemia				
Yes	23	3	20	46(15.33)
No	77	97	80	254(84.66)
Paleness skin	12	3	15	30(10.00)
Paleness conjunctiva	2	-	3	5(1.66)
Paleness and smoothness of tongue	-	-	2	2(0.66)
Spoon shaped nails	9	-	-	9(3.00)
Anemia can be prevented				
Yes	-	-	10	10(3.33)
No	100	100	90	290(96.66)
Diet modification	-	-	4	4(1.33)
Iron fortification of foods	-	-	1	1(0.33)
Iron supplementation	-	-	5	5(1.66)
Knowledge of supplements given in school	32	12	48	92(30.66)
Govt. schemes/agencies to control anemia in India				
KSY	3	3	15	21(7.00)
IDA	12	4	16	32(10.66)
WIFAS	12	2	19	33(11.00)

#Figure in parentheses represents percentage

Section-II: (Development and standardization of products)

Quality evaluation of garden cress seeds and its value added products

Section-II deals with development and standardization of value added iron rich products incorporated with processed and unprocessed garden cress seeds and their quality evaluation in terms of sensory attributes and nutritional parameters. The recipe which was nutritionally balanced, contained more amount of iron and was highly acceptable was therefore selected for dietary intervention carried out and discussed further in section-III.

4.12 Nutritional evaluation of whole and treated seeds garden cress

Garden cress (*Lepidium sativum*) is an annual herb, belong to Brassicaceae family that grow in winter seasons. It is an important source of iron, folic acid, calcium, vitamin C, E and A. It is richest source of iron containing 100mg of iron containing 100mg of iron for 100 g of seeds and is therefore known as *raktabija* in Sanskrit. This underutilized crop is cultivated to a lesser extent in Himachal Pradesh and because of unawareness of its health benefits, its consumption as food is very very less but as feed is promoted in areas of cultivation.

4.12.1 Proximate composition

Proximate composition provides crude estimation of macronutrients and form the basis for food analysis. The mandatory nutritional labelling in processed food and food products explore its importance. Table 4.26 shows the proximate composition of the whole and treated garden cress seeds on dry weight basis. Garden cress seeds contain alkaloids, tannins and glucosinolates which imparts a peppery taste and flavor and therefore a bitter and hot mouth feel. Therefore, these seeds were treated to reduce these components and enhances its acceptability for their incorporation in developed products.

The per cent moisture content of whole seeds was analyzed as 4.82 which increased in treated seeds to 5.13 which may be attributed to production of mucilage during soaking treatment and its retention later on after drying. Soaking, drying and roasting of seeds had significant effect on the selected parameters. Processing of seeds i.e. soaking the seeds, draining of superficial water, drying and further roasting decreased the ash, fat, fibre and protein content and increased the moisture content as well as total carbohydrates. The presence of high dietary fiber and its bran possessing

high water holding capacity may have resulted in increased moisture content in treated seeds. Values of ash, fibre, fat and protein content analyzed as 4.95, 24.96, 9.72 and 26.31 per cent respectively in whole seeds reduced to 4.72, 23.34, 7.59, and 24.17 per cent after the treatment. The per cent reduction was calculated in limits of 4.64, 6.49, 21.91 and 8.13 respectively. In contrary, treated seeds had higher moisture and total carbohydrate content as 5.13 and 35.03 per cent as compared to whole seeds i.e. 4.82 and 29.25 per cent. Per cent increase was calculated 6.43 and 19.76.

Table 4.26 Proximate composition (%, DW basis) of whole and treated garden cress seeds

Parameters	Garden cress seeds			
	Whole	Treated	Per cent increase	CD ($p \leq 0.05$)
Moisture	4.82±0.09	5.13±0.01	+6.43	0.72
Ash	4.95±0.00	4.72±0.01	-4.64	0.08
Crude fat	24.96±0.02	23.34±0.03	-6.49	0.26
Crude fiber	9.72±0.32	7.59±0.20	-21.91	1.69
Crude protein	26.31±0.03	24.17±0.02	-8.13	0.13
Total Carbohydrates	29.25±0.27	35.03±0.22	+19.76	1.89

Data are expressed as the mean ± standard deviation

All the analysed parameters were statistically significant in whole and treated seeds when compared at 5 per cent probability level. The difference was more significant for crude fiber and total carbohydrates. Mathews et al. (1993) evaluated 24.3 ± 0.67per cent protein, 14.9 ±0.79 per cent fat, 55.4 ± 1.8 per cent carbohydrate, 27.3 ± 0.43 per cent acid detergent fiber and 35.7 ± 0.82 per cent neutral detergent fiber in *L. sativum* seeds. Andersson et al. (1999) analyzed 19 per cent protein, 20 per cent crude fat and 40 per cent dietary fiber in *L. campestre*. Gokavi et al. (2004) found that protein and fat were concentrated in endosperm whereas dietary fibre, minerals and carbohydrate were in bran fraction of garden cress. The high protein, fat, dietary fibers, calcium, phosphorous and iron contents in this seeds bring out its high nutritive value which making it useful in post pregnancy diets. Agarwal and Sharma (2013) studied garden cress seeds and quantitatively analyzed whole, husk removed, husk, roasted and microwave processed forms for proximate principles. Their results reported that moisture content was highest in husked garden cress seeds powder i.e. 6.01 per cent, protein and fat content was highest in husk removed garden cress seeds powder i.e. 27.61 per cent and 25 per cent respectively. Ash in value of 6.50 per cent

and total carbohydrates of 38.11 per cent were found highest in micro waved processed garden cress seeds powder while fibre in value of 15.11 per cent found highest in roasted garden cress seeds powder.

4.12.2 Mineral composition

The mineral profile of whole and treated garden cress seeds is presented in Table 4.27.Scrutiny of data revealed that both whole and treated garden cress seeds are good sources of minerals especially potassium, phosphorous and calcium. The copper, zinc and sodium content of whole and treated seeds were 7.83 mg, 9.77 mg, 24.63 mg and 8.37 mg, 10.85 mg, 36.80 mg per 100g sample respectively and these minerals were highest in treated garden cress seeds which may be attributed to retention of minerals by the mucilage present inside the seeds and as well as by roasting treatment which concentrated minerals content. Calcium, phosphorus and potassium content were high in whole garden cress seeds i.e. 391.27 mg, 613.17 mg and 1449.29mg per 100g and low in treated garden cress seeds, 239.37 mg, 514.30 mg and 1328.00 mg per100g respectively. Treatment of seeds led to per cent increase of 6.86, 11.05 and 49.41 for copper, zinc and sodium. On the other hand soaking, drying and roasting steps involved in treatment caused per cent reduction of 38.82, 16.12 and 8.36 for calcium, phosphorus and potassium.

Table 4.27 Mineral composition (mg/100g, DW basis) of whole and treated garden cress seeds

Parameters	Garden cress seeds			
	Whole	**Treated**	**Per cent increase**	**CD ($p \leq 0.05$)**
Copper	7.83±0.02	8.37±0.01	+6.86	0.06
Zinc	9.77±0.00	10.85±0.01	+11.05	0.05
Calcium	391.27±0.00	239.37±0.15	-38.82	0.51
Sodium	24.63±0.26	36.80±0.00	+49.41	1.23
Phosphorus	613.17±0.00	514.30±0.00	-16.12	1.56
Potassium	1449.20±0.01	1328.00±0.02	-8.36	1.87

Data are expressed as the mean ± standard deviation

There was significant difference found in whole seeds and treated seeds with regard to all reported minerals. The results are in lines with the findings of Gokavi et al. (2004) who analyzed more phosphorus (652mg/100g) content in endosperm of garden cress than whole meal. However, calcium content was found more in bran (556.32mg/100g) as compared to endosperm and whole meal. Gopalan et al. (2000)

reported 377 mg calcium and 723 mg phosphorous in *L. sativum.* The difference between the reported values and the values obtained in the present study may be attributed to the varietal variations and also to the agronomical conditions. All the fractions have low sodium and high potassium content which makes it beneficial as an ingredient in health foods. High potassium diet is recommended for athletes who are involved in hard exercise and also for disorders related to high blood pressure (Luft 1987).

4.12.3 Total iron, ionisable iron, soluble iron content and per cent bioavailability of iron content

Table 4.28 depicts the total iron, ionisable, soluble iron content and per cent bioavailability of iron in whole seeds and treated garden cress seeds. Soaking, drying and roasting treatment of garden cress had significant effect on analyzed parameters. The total, ionisable and soluble iron content of 109.10, 21.37 and 81.22 mg per 100g enhanced to values of 138.37, 32.43 and 120.00 mg per 100g respectively. Per cent increase of 26.82, 51.75 and 47.74 was calculated thereafter. Per cent bioavailability of iron analyzed as 9.92 per cent increased to 11.59 per cent with per cent increase of 47.16 by the simple step of processing. Statistically, significant difference was found between whole and treated seeds for total iron and *in-vitro* iron profile. Processing of seeds led to considerable deviations.

Table 4.28 Total iron, ionisable iron, soluble iron and bio-available iron in whole and treated garden cress seeds

Parameters	Garden cress seeds			
	Whole	Treated	Per cent increase	CD ($p\leq0.05$)
Total iron (mg/100g)	109.10±0.06	138.37±0.02	+26.82	0.24
Ionisable iron (mg/100g)	21.37±0.09	32.43±0.09	+51.75	0.15
Soluble iron(mg/100g)	81.22±0.00	120.00±0.00	+47.74	0.04
Bio-available iron (%)	9.92±0.01	11.59±0.01	+47.16	0.03

Data are expressed as the mean ± standard deviation

The results were confirmed by the findings of Parmar (1996) and Reddy et al. (1997) on soluble iron content of different wheat varieties that ranged between 1.32 to 2.30 mg/100g. Gopalan et al. (2010) reported 100 mg iron per 100 g of iron in *L. sativum*. Das et al. (2005) determined the *in vitro* availability of iron and found that rice had total iron content of 0.61 mg/100g, and ionisable iron as 29.50 per cent. The total iron content of L. sativum leaves was determined as 63.47±5.27 mg/100g on dry weight basis by Hassan et al. (2011). The study done by Agarwal and Sharma (2013)

analyzed the total iron content of 127.10 mg/100g in roasted garden cress followed by husk removed (121.46 mg/100g), microwaved (117.65 mg/100g), whole (112.66 mg/100g) and husked seeds (73.03 mg/100g).The processing techniques viz. soaking and germination could increase the bioavailability of iron by 5.24 per cent and 37.17 per cent respectively, in niger seeds samples and also leach out anti nutritional factors (Baranwal and Bhatnagar 2013).

4.13 Sensory and nutritional evaluation of iron rich value added products

Garden cress seeds has potential both as foodstuff and nutracutical. It was widely used in many parts of the world in ancient time and has also been well known in India since vedic age. Because of biodiversification, its utilization reduced to great extent. It is high time to reinvent and utilize this magic nutritional seed by developing food products and enjoy its virtues.

Trials of recipes enrichment using garden cress in variable proportions and their prototypes were taken up to develop products of high acceptability. Initially raw garden cress powder was used for development of products and standardization. The slight bitterness and astringency of garden cress greatly reduced the acceptability of the products. Therefore two variants, variants-1 containing unprocessed garden cress and variant-2 containing processed garden cress were developed along with control recipe for comparison purpose. Sensory evaluation was carried out on the basis of color, taste, flavour and texture.

4.13.1 Sensory acceptability of value added products

Sensory evaluation is a scientific discipline that provides information on how products and perceived through the senses. It is a vital tool used in food industry for quality control assurance, new product development, recipe/process change investigation etc. In the present study, the most widely used scale for measuring food acceptability i.e. 9-point hedonic scale was used that consists of evaluation reporting from “like extremely” to “dislike extremely”.

i) *Ladoo*

Table 4.29 shows the mean sensory scores of *ladoo.* In relation to colour which indicates that variant-2 had the highest score (8.12) followed by control (7.84) and variant-1 (7.22) respectively. Descriptive term for colour shows that variant-2 was ‘liked very much’ while control and variant-1 were ‘liked moderately’ by the

Table 4.29 Sensory evaluation of iron rich developed recipes

Recipes	Sensory Attributes	Treatments			
		Control	Variant-1	Variant-2	Mean
Ladoo	Colour	7.84	7.22	8.12	7.73
	Taste	7.77	7.65	7.80	7.74
	Flavour	7.78	6.71	7.83	7.44
	Texture	7.25	7.16	7.44	7.28
	Mean	7.66	7.19	7.80	7.55
	Factors	Attributes (A)	Variant (B)		A×B
	CD(p≤0.05)	0.02	0.02		0.04
Mathri	Colour	7.94	6.94	8.02	7.64
	Taste	7.46	6.71	7.91	7.36
	Flavour	7.56	6.48	7.68	7.24
	Texture	7.97	6.48	8.10	7.52
	Mean	7.73	6.65	7.93	7.44
	Factors	Attributes (A)	Variant (B)		A×B
	CD(p≤0.05)	0.01	0.01		0.03
Shakkarpare	Colour	7.51	6.32	7.03	6.95
	Taste	7.23	6.10	6.75	6.69
	Flavour	7.14	5.97	6.83	6.65
	Texture	7.64	6.12	6.72	6.83
	Mean	7.38	6.13	6.83	6.78
	Factors	Attributes (A)	Variant (B)		A×B
	CD(p≤0.05)	0.03	0.03		0.06
Biscuits	Colour	7.64	6.03	6.11	6.59
	Taste	7.66	5.89	6.10	6.55
	Flavour	7.61	5.87	6.04	6.51
	Texture	7.57	5.96	6.61	6.71
	Mean	7.62	5.94	6.21	6.59
	Factors	Attributes (A)	Variant (B)		A×B
	CD(p≤0.05)	0.02	0.02		0.04
Maximum possible score : 9					

panel of judges. The mean scores in relation to taste, flavour and texture was again calculated higher for variant-2 followed by control and variant-1 respectively indicating that variant-2 gave the best taste, flavor and texture to *ladoo*. It was seen that addition of 10g processed garden cress flour in the variant-2 improved acceptability of *ladoo*. Significant difference was observed between the treatments

indicating that the addition of processed and un-processed garden cress flour affected the appearance and colour of the *ladoo*, the colour became lightly darker and more acceptable with treatment.

In relation to taste, significant difference between the three treatments revealed that incorporation of garden cress flour affected taste. Processed garden cress flour in variant 2 reduced the pungency and thereby increased the taste while un-processed garden cress flour in variant-1 decreased the taste due to pungent taste and little bitterness present due to tannins and glucosinolates.

Significant difference was again observed between the variants and control for flavour and texture indicating that the addition of processed and un-processed garden cress flour too affected the flavour and texture of *ladoo*. Flavour became more acceptable as processed garden cress flour was added because the peppery aromatic flavor of garden cress seed, being volatile in nature reduced during processing. The texture became fragile, crispy and more acceptable in variant-2 *ladoo* because the mucilage produced during soaking of seeds imparted the desirable textural characteristics.

The findings of the present study are in line with the previous studies. Kaur and Sharma (2015) worked on enrichment of five traditional Indian food preparations namely, *atta besan ladoo, shakarpara, chikki, mathri and matrey* with treated garden cress seeds. The results showed that up to 10 per cent incorporation of garden cress flour was in food preparations were highly acceptable in roasted treatment as compared to soaked overnight treatment. The *ladoo* gained highest scores for all sensory attributes when 10 g garden cress flour was incorporated against the 15 g incorporation (Uma and Sucharitha, 2016). Rana and Kaur (2016) prepared supplemented products viz. biscuits, *ladoo* and *namakpare* with garden cress seeds using proportions of 5 per cent, 10 per cent and 15 per cent. All supplemented products were accepted as “desirable to moderately” desirable in terms for all sensory parameters and at 10 per cent supplementation proportion was most desirable as compared to 5 per cent and 15 per cent proportions.

Sensory evaluation of *Mathri*

Table 4.29 shows the mean scores of *mathri* in relation to colour which indicates that variant-2 had the highest score (8.02) followed by control (7.94) and variant-1(6.94) respectively. Descriptive term for colour shows that variant-2 and control were ‘liked very much’ while variant-1 was ‘moderately liked’ by the panel of

judges. The mean scores in relation to taste, flavour and texture was again calculated higher for variant-2 followed by control and variant-1 respectively indicating that variant-2 gave the best taste, flavour and texture to *mathri*. It was seen that addition of 10g processed garden cress flour in the variant-2 improved acceptability of *mathri*. Significant difference was observed between the treatments indicating that the addition of processed and un-processed garden cress flour affected the appearance and colour of the *mathri*, the colour became golden brown and more acceptable.

Significant difference between the three treatments revealed that incorporation of garden cress flour affected taste. Processed garden cress flour in variant 2 reduced the pungency and there by increased the taste while un-processed garden cress flour in variant-1 affected the acceptability of this sensory attribute.

Significant difference was again observed between the variants and control for flavour and texture suggesting that the addition of processed and un-processed garden cress flour too affected the flavour and texture of *mathri*. Flavour became more acceptable as processed garden cress flour was added because of reduction in its peppery aromatic flavor during processing. In lines with *ladoo*, the texture becomes fragile, crispy and more acceptable in variant 2 *mathri.*

Agarwal and Sharma (2013) performed an experiment on garden cress seed with different processing methods (roasted, microwaved and whole) and used them for incorporation in *mathri.* Addition of 5 per cent level of all treated garden cress seed powder was rated "desirable" by the panel of 15 judges. The results of Kaur and Sharma (2015) showed that up to 10 per cent incorporation of garden cress flour in five traditional Indian food preparations were highly acceptable for roasted treatment as compared to soaked overnight treatment.

Sensory evaluation *of shakkarpare*

Mean scores of *shakkarpare* in relation to colour indicated that control had the highest score (7.51) followed by variant-2 (7.03) and variant-1(6.32) respectively. Descriptive term for colour shows that control and variant-2 were 'liked moderately' while variant-1 was 'liked slightly' by the panel of judges. The mean scores in relation to taste, flavour and texture was again calculated higher for control, variant-2 and variant-1 which indicating that addition of garden cress flour reduced the acceptability of *shakkarpare* when compared to control.

In relation to colour, taste, flavour and texture, significant difference between the three treatments revealed that incorporation of garden cress seed flour in processed and un-processed form affected sensory attributes. Due to darker colour, pungent taste, peppery aromatic flavor and slightly hard texture brought down the sensory scores and incorporation of garden cress was not liked by judges for *shakkarpare.* Descriptive anaysis of results for all variants was 'liked moderately' to 'liked slightly'.

The results of present study corroborated with findings of Singh and Srivastava (2012) who formulated iron rich *namakpare* mixes and reported that finger millet up-to 60 per cent can be successfully incorporated. Kaur and Sharma (2015) worked on enrichment of five traditional Indian food preparations namely, *atta besan ladoo, shakarpara, chikki, mathri and matrey* with treated garden cress seeds. The results showed that up to 10 per cent incorporation of garden cress flour in food preparations were highly acceptable for roasted treatment as compared to soaked overnight treatment.

Sensory evaluation of biscuits

Table 3 shows the mean scores of biscuits in relation to colour which indicates that control had the highest score (7.64) followed by variant-2 (6.11) and variant-1 (6.03) respectively. Descriptive nomenculture for colour shows that the control was 'liked moderately' while variant-1 and variant-2 were 'liked slightly' by the panel of judges. The mean score of biscuits in relation to taste, flavour and texture was again calculated higher for control and slightly less in variant-2 and variant-1 which indicated that addition of garden cress reduced the sensory scores of variants as compared with control.

In relation to colour, taste, flavour and texture, significant difference between the three treatments revealed that incorporation of garden cress seed flour in processed and un-processed form affected sensory attributes. Like *shakkkarpare* darker colour, pungent taste and flavor brought down the sensory scores indicating that incorporation of garden cress was not liked by the judges for biscuits and therefore the variants were rated as 'liked moderately' to 'liked slightly'.

Results with slight variations have been reported by Patil et al. (2015) who prepared biscuits by the using garden cress seed at 05, 10, 15 and 20 per cent level. On the basis of overall sensory attributes, 100: 10 proportion got higher score than samples of proportion 100:05 and 100:15. Rana and Kaur (2016) prepared supplemented products viz. biscuits, *ladoo* and *namakpare* with garden cress seeds using proportions of 5 per cent, 10 per cent and 15 per cent. All supplemented products were accepted as "desirable to moderately desirable" for all sensory parameters and 10 per cent supplementation proportion was most desirable as compared to 5 per cent and 15 per cent proportions.

Overall acceptability of developed products

The overall acceptability scores of iron rich recipes is illustrated in Figure 4.8. In *ladoo* variant-2 secured highest sensory scores (7.77) as compared to control and variant-1, having average scores of 7.64 and 7.01 respectively. The variant -2 in *mathri* also secured higher followed by control and variant-1 with mean scores 7.91, 7.72 and 6.65 respectively which may be ascribed to incorporation of processed garden cress flour in *ladoo* and *mathri* thereby increasing their overall acceptability. The overall acceptability score of control recipe of *shakkarpare* and biscuits was highest followed by variant-2 and variant-1 respectively. The sensory score slightly declined when garden cress was incorporated in *shakkarpare* and biscuits.

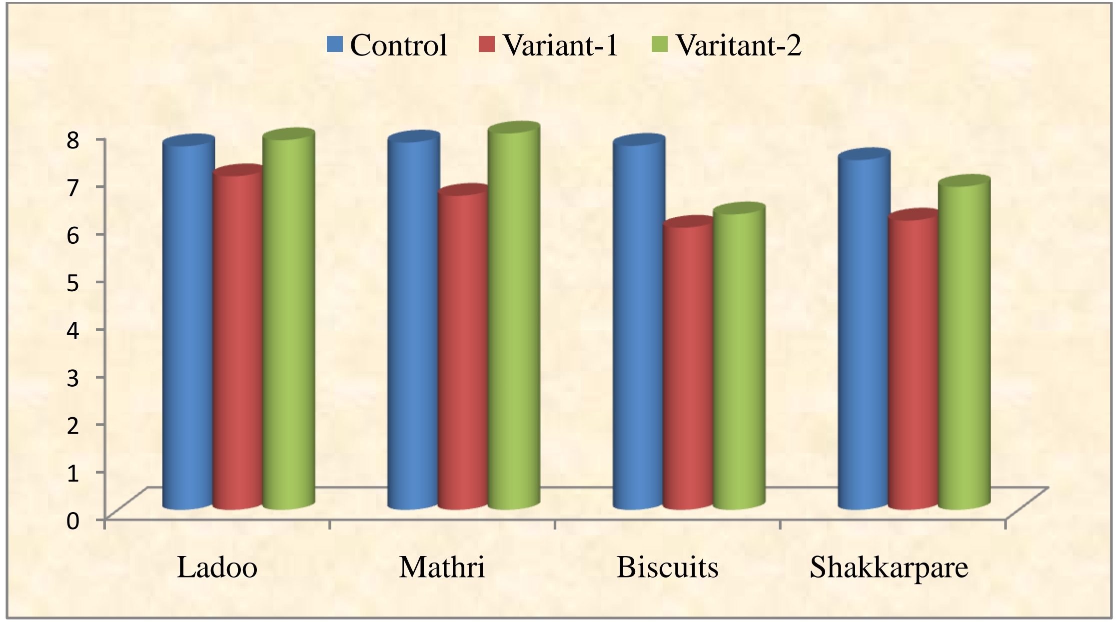


Fig. 4.8 Overall acceptability of control recipes and iron rich recipes

All the developed iron rich recipes viz. *ladoo, mathri*, *shakkarpare* and biscuit had mean sensory scores of 7.55 (like moderately), 7.44 (like moderately), 6.59 (like slightly) and 6.78 (like slightly), respectively. Among various developed recipes,variant-2 of, *ladoo* and *mathri* was highly acceptable whereas for *shakkarpare* and biscuit, control recipes had more acceptability.

Reviews relevant to present study reports of Angel and Devi (2014) who formulated and developed cheapest nutritious iron rich health mix with garden cress seeds. In the mix they stated that 5g incorporation of garden cress seeds was acceptable. Elizabeth and Poojara (2014) developed ten recipes with the incorporation of garden cress seeds. Incorporation of 10g of garden cress seeds was acceptable in sixty per cent of the developed snacks. Sharma (2015) studied the acceptability of germinated garden cress seeds by incorporating into the food consumed daily like sandwich, raitha, soups and salads. The incorporate level of germinated seeds varied from 7-30 per cent of seeds into the above recipes, and stated that samples prepared with 10-15per cent of garden cress seeds was most acceptable.

4.13.2 Proximate composition

Standardized control and iron enriched recipes were estimated for proximate parameteres (on dry weight basis) and results reported in Table 4.30 per 100g. In *ladoo* all the proximate parameters like ash (2.10 %), crude fat (23.97 %), crude fibre (1.43 %), crude protein (9.55 %) were significantly higher in variant-2 i.e. treated garden cress seeds incorporated *ladoo* except moisture (7.93 %) and carbohydrates (55.02 %).

Similarly in *mathri*, variant-2 was analysed with high content of ash (2.27 %), crude fat (36.24 %), crude fiber (6.95 %) and crude protein (10.44 %). On the same lines, 0.95, 32.15, 0.80, 5.16 and 2.23, 27.02, 1.84 and 6.80per cent of ash, fat, fiber and protein were evaluated for variant -2 having more amount as compared to control and variant-1. Significant difference was observed for parameters but not between the developed products thereby non-significant difference was calculated between the recipes.

Singh and Srivastava (2012) formulated iron rich *namakpare* mixes. The mixes were studied for proximate composition. These *namakpare* mixes were nutritious (crude protein 9.34-23.68 per cent, crude fat 0.85-4.57 per cent, crude fibre 0.30-3.51 per cent, total ash 0.60-4.51 per cent, carbohydrates 54.90-59.79 per cent, physiological energy 355-370 Kcal/100 g) and were of low cost.

Table 4.30 Proximate composition (% DW basis) of developed recipes

Recipes	Proximate Parameters	Treatments			
		Control	**Variant-1**	**Variant-2**	**Mean**
Ladoo	Moisture	8.08	8.68	7.93	8.23
	Ash	1.33	1.93	2.1	1.79
	Crude fat	23.71	23.87	23.97	23.85
	Crude fiber	0.36	1.1	1.43	0.96
	Crude protein	7.9	8.83	9.55	8.76
	Total carbohydrate	58.73	55.59	55.02	56.55
	Mean	16.69	16.57	16.82	16.69
	Factors	Parameters (A)	Variant (B)	A×B	
	CD(p≤0.05)	0.04	0.02	0.07	
Mathri	Moisture	6.2	6.52	6.03	6.25
	Ash	1.47	1.9	2.27	1.88
	Crude fat	36.21	36.21	36.24	36.22
	Crude fiber	0.25	0.87	0.95	0.69
	Crude protein	8.45	9.97	10.44	9.62
	Total carbohydrate	47.42	44.55	44.07	45.35
	Mean	16.67	16.67	16.67	16.67
	Factors	Parameters (A)	Variant (B)	A×B	
	CD(p≤0.05)	0.06	NS	0.11	
Sakkarpare	Moisture	5.7	6	5.58	5.76
	Ash	0.52	0.73	0.95	0.73
	Crude fat	31.8	31.95	32.15	31.97
	Crude fiber	0.08	0.72	0.8	0.53
	Crude protein	3.99	4.83	5.16	4.66
	Total carbohydrate	57.91	55.76	55.36	56.34
	Mean	16.67	16.67	16.67	16.67
	Factors	Parameters (A)	Variant (B)	A×B	
	CD(p≤0.05)	0.09	NS	0.16	
Biscuits	Moisture	7.47	7.83	7	7.43
	Ash	1.02	1.8	2.23	1.68
	Crude fat	26.81	26.95	27.02	26.93
	Crude fiber	1.33	1.43	1.84	1.54
	Crude protein	6.09	6.47	6.82	6.46
	Total carbohydrate	57.51	55.51	55.09	56.03
	Mean	16.7	16.67	16.67	16.68
	Factors	Parameters (A)	Variant (B)	A×B	
	CD(p≤0.05)	0.08	NS	0.14	

Nathiya and Nora (2014) formulated and assessed the nutrient content of cookies (nutricookies) prepared by incorporating oats, wheat germ, wheat flour, soybean flour and garden cress seeds. They averaged range of carbohydrate calculated as 65 to 75 g per 100g, protein 17 to 22g per 100 g, fat 13 to 14.8g per 100g and moisture 2.75 to 3.76 per cent per 100g. Kaur and Sharma (2015) worked on enrichment of five traditional Indian food preparations namely, *atta besanladoo, shakarpara, chikki, mathri and matrey* with treated garden cress seeds. The nutritional analysis results showed that the preparations prepared by incorporating roasted garden cress seeds had increased nutrients contents.

Rana and Kaur (2016) prepared supplemented products viz. biscuits, *ladoo* and *namakpare* with garden cress seeds using proportions of 5, 10, and 15 per cent. They reported that as garden cress seeds proportion increased in the recipes, proximate composition increased significantly.

4.13.2 Mineral content

The mineral profile of developed recipes is presented in Table 4.31. A glance at the table revealed that as for proximate parameters, variant-2 of all the developed iron rich products was again assessed for its highest values of analysed minerals viz. copper, zinc, calcium, sodium and phosphorus when compared with variant-1 and control formulation.

Scrutiny of data explained that in *ladoo* and *mathri* 7.08, 6.77, 51.32, 17.00, 146.21, 692.12 and 7.92, 6.06, 51.92, 79.10,145.71, 682.71 mg/100g of copper, zinc, calcium, sodium, phosphorous and potassium were analysed on dry weight basis. On the other hand, following the same trend of texting minerals, 4.88, 4.12, 50.52, 8.60, 113.51, 482.19 and 5.77, 4.16, 50.21, 59.81, 11.71, 573.71 mg/100g were evaluated for *shakkarpare* and biscuits respectively.

Statistical analysis for mineral composition of developed formulation indicated significant difference among the selected parameters among the variant as well as between the parameters and variants. Nathiya and Vigasini (2014) formulated and assessed the nutrient content of cookies (nutricookies). The control provided 87.33 mg of calcium whereas the experimental samples provided more than 120 mg.

Table 4.31 Mineral composition (mg/100g DW basis) of developed recipes

Recipes	Minerals	Treatments			
		Control	**Variant-1**	**Variant-2**	**Mean**
Ladoo	Copper	5.54	6.19	7.08	6.27
	Zinc	3.45	4.06	6.77	4.76
	Calcium	38.01	42.02	51.32	43.78
	Sodium	8.00	11.21	17.00	12.07
	Phosphorus	125.30	139.70	146.21	137.07
	Potassium	441.61	633.11	692.12	588.95
	Mean	103.65	139.38	153.42	132.15
	Factors	Parameters (A)	Variant (B)	A×B	
	CD(p≤0.05)	0.06	0.04	0.11	
Mathri	Copper	4.15	5.29	7.92	5.79
	Zinc	3.17	4.56	6.06	4.60
	Calcium	39.22	42.01	51.92	44.38
	Sodium	73.20	74.80	79.10	75.70
	Phosphorus	125.10	139.53	145.71	136.78
	Potassium	371.81	643.58	682.71	566.03
	Mean	102.78	151.63	162.24	138.88
	Factors	Parameters (A)	Variant (B)	A×B	
	CD(p≤0.05)	0.35	0.25	0.62	
Shakkarpare	Copper	3.88	4.09	4.88	4.28
	Zinc	2.54	3.08	4.12	3.24
	Calcium	36.78	40.30	50.52	42.53
	Sodium	7.01	7.50	8.60	7.70
	Phosphorus	98.12	102.21	113.51	104.61
	Potassium	357.40	453.00	482.19	430.86
	Mean	84.29	101.70	110.64	98.87
	Factors	Parameters (A)	Variant (B)	A×B	
	CD(p≤0.05)	0.33	0.23	0.58	
Biscuits	Copper	4.09	4.68	5.77	4.85
	Zinc	2.46	3.07	4.16	3.23
	Calcium	37.20	40.68	50.21	42.70
	Sodium	50.30	56.31	59.81	55.47
	Phosphorus	95.61	102.81	111.71	103.38
	Potassium	442.80	553.20	573.71	523.24
	Mean	105.41	126.79	134.23	122.14
	Factors	Parameters (A)	Variant (B)	A×B	
	CD(p≤0.05)	0.09	0.06	0.15	

Kaur and Sharma (2015) worked on enrichment of five traditional Indian food preparations namely, *atta besan ladoo, shakarpara, chikki, mathri and matrey* with treated garden cress seeds. The nutritional analysis results showed thatcalcium content of *shakarpara* and *chikki* was the highest respectively whereas *atta besan ladoo* had minimum calcium content amongst all developed food preparations.

4.12.3 *In-vitro* iron content

Data in Table 4.32 pertains to total iron, ionisable iron, soluble iron content and per cent bioavailability of iron content in iron rich recipes. Total iron content ranged between 32.92-69.71, 35.69-65.64, 34.95-49.32 and 37.73 -59.27mg/100g for *ladoo, mathri, Shakkarpare* and biscuits for different treatments.. *In-vitro* iron content was significantly higher in variant-2 in all the recipes in which treated garden cress seed powder was used. It indicated that treated garden cress seed increased iron content in recipes.

Out of four recipes total iron content were reported highest in mathri 50.76 mg followed by *ladoo* 50.18 mg, biscuits 46.40 mg and *shakkarpare* 40.16 mg. *In-vitro* iron content (ionisable iron, soluble iron and per cent bio availability iron) was also recorded highest in *ladoo* (3.55 mg, 55.93 mg and 3.07 %)and *mathri* (3.63 mg, 58.45 mg and 3.06 %). It showed from the data *ladoo* and mathri had highest total iron as well as *in-vitro* iron content as compared to *shakkarpare* and biscuits.

The treatment of soaking and drying of garden cress seeds had an appreciable influence on total iron, ionisable iron and soluble iron content as well as bioavailability of iron of variant-2 for all developed recipes when compared with variant-1 having incorporation of unprocessed garden cress seeds and control which contained no garden cress.

The similar study reported by Singh and Srivastava (2012) formulated iron rich *namakpare* mixes. These namakpare mixes were nutritious with ionizable iron content of 878.00-1342.00 µg per cent, *in-vitro* iron bioavailability of 28.67-42.00 per cent, calcium level 22.00-517.37 mg per cent and phosphorous level 119.00-434.90 mg per cent.

Nathiya and Vigasini (2014) formulated and assessed the nutrient content of cookies (nutricookies) and observed that samples with 10g, 20g and 30g garden cress seeds provided 24.58, 34.58 and 44.58 mg of iron per 100g. Rana and Kaur (2016)

Table 4.32 Total, ionisable, soluble iron content and % bioavailability of iron content in whole and treated garden cress seeds

Recipes	Parameters	Treatments			
		Control	Variant-1	Variant-2	Mean
Ladoo	Total iron (mg/100g)	32.92	47.92	69.71	50.18
	Ionisable iron (mg/100g)	1.83	2.44	3.55	2.61
	Soluble iron(mg/100g)	25.53	39.76	55.93	40.41
	Bioavailable iron (%)	2.88	2.92	3.07	2.96
	Mean	15.79	23.26	33.07	24.04
	Factors	Parameters (A)	Variant (B)		A×B
	CD(p≤0.05)	0.02	0.02		0.04
Mathri	Total iron (mg/100g)	35.69	50.94	65.64	50.76
	Ionisable iron (mg/100g)	1.85	2.81	3.63	2.76
	Soluble iron(mg/100g)	25.72	40.07	58.45	41.41
	Bioavailable iron (%)	2.17	2.93	3.06	2.72
	Mean	16.36	24.19	32.70	24.41
	Factors	Parameters (A)	Variant (B)		A×B
	CD(p≤0.05)	0.02	0.02		0.04
Shakkarpare	Total iron (mg/100g)	34.95	36.22	49.32	40.16
	Ionisable iron (mg/100g)	0.85	1.15	1.53	1.18
	Soluble iron(mg/100g)	26.12	30.05	38.80	31.66
	Bioavailable iron (%)	1.98	2.04	2.45	2.16
	Mean	12.78	13.90	18.43	15.04
	Factors	Parameters (A)	Variant (B)		A×B
	CD(p≤0.05)	0.02	0.02		0.03
Biscuits	Total iron (mg/100g)	37.73	42.21	59.27	46.40
	Ionisable iron (mg/100g)	1.22	1.73	1.94	1.63
	Soluble iron(mg/100g)	27.75	36.95	43.63	36.11
	Bioavailable iron (%)	1.64	1.90	1.99	1.84
	Mean	17.09	20.70	26.71	21.50
	Factors	Parameters (A)	Variant (B)		A×B
	CD(p≤0.05)	0.02	0.02		0.04

prepared supplemented products viz. biscuits, *ladoo* and *namakpare* with garden cress seeds using proportions of 5, 10 and 15 per cent. The iron content of supplemented biscuit was 13.60 mg and hat of control was 5.20 mg. Iron content of control *ladoo* was 6.49 mg which significant increased in supplemented *ladoo*to13.37 mg. The iron content of control *namakpara* was 2.70 mg which increased to 7.61 mg in supplemented *namakpara.*

Section-III (Impact evaluation –pre and post intervention)

Impact of diet and nutrition education intervention on moderately anemic adolescent girls

As discussed in section-I, 300 adolescent girls in the age group of 12-18 years were assessed for their demographic and socio-economic profiles, diets and nutrient intake and also screened for their hemoglobin. Based on hemoglobin level, these subjects were divided into different categories of anemia. From these anemic individuals, 90 moderately anemic adolescent girls were screened out and divided into three groups for conducting the major objective i.e. dietary and nutrition intervention. Each group constituted 30 girls. Group-I was imparted diet as well as nutrition counseling and group-II received only nutrition counseling. Group-III formed the control group i.e. no intervention of any type was provided to them.

4.14 Impact assessment of nutrition intervention

4.14.1 Knowledge, Attitude and Practice (KAP) test for nutrition and health

Lack of knowledge concerning nutrition is one of the most significant reason for nutritional problem and consequently inappropriate nutritional practices can lead to numerous complications. A Knowledge, Attitude and Practices (KAP) questionnaire is a tool to identify, what a population already knows (knowledge), how they feel (attitude) and what they are doing (practices) regarding a particular issue. Moderately anemic adolescents screened from their hemoglobin level and divided into three groups (30 per group) were interviewed by KAP questionnaire to identifty the level of knowledge, correct attitude and practices towards nutrition and health.

Based on the pre-test scores and level of knowledge regarding nutrition and health, nutrition counselling regarding balanced diet, function of different nutrients and their requirements, nutritional disorders-their control and prevention, cooking practices, anemia, iron rich foods, junk foods and sanitation and hygiene was imparted to the subjects in interactive sessions in experimental groups (group-I and group-II) in the form of poster, power point presentation, leaflet, phamphlet and flip charts for a period spread over four months. The subjects in control group were not given any kind of nutrition intervention. The evaluation of scores was done before and after nutrition counselling to assess impact of nutrition intervention on knowledge, attitude and practice regarding nutrition and health in all the groups.

Table 4.33 Impact of nutrition intervention on per cent scores of knowledge test of selected adolescents girls (n=90)

Parameters	Pre test	Post test	t-value	Gain in knowledge	Quantum of improvement
Group-I (n=30)					
Knowledge	33.33±2.43	84.17±1.76	17.11 S	50.84	2.53
Attitude	61.11±2.91	80.33±2.82	4.85 S	19.22	1.31
Practice	73.33±2.05	83.67±3.05	2.86 S	10.34	1.14
Overall	56.63±1.60	82.89±1.80	10.88 S	26.26	1.46
Group-II (n=30)					
Knowledge	29.94±1.43	88.50±1.95	24.42 S	58.56	2.96
Attitude	58.89±2.76	82.22±2.35	6.44 S	23.33	1.40
Practice	73.94±2.77	86.50±3.20	2.91 S	12.56	1.17
Overall	54.17±1.45	85.57±1.73	13.89 S	31.40	1.58
Control (n=30)					
Knowledge	42.22±2.96	59.83±2.28	1.81 NS	17.61	1.42
Attitude	46.11±3.76	47.17±2.47	0.62 NS	1.06	1.02
Practice	69.67±2.60	69.69±2.96	0.31 NS	0.02	1.00
Overall	52.67±2.17	57.90±1.81	1.12 NS	5.23	1.10

Significant at 5% (t value at 28 degree of freedom 2.04)

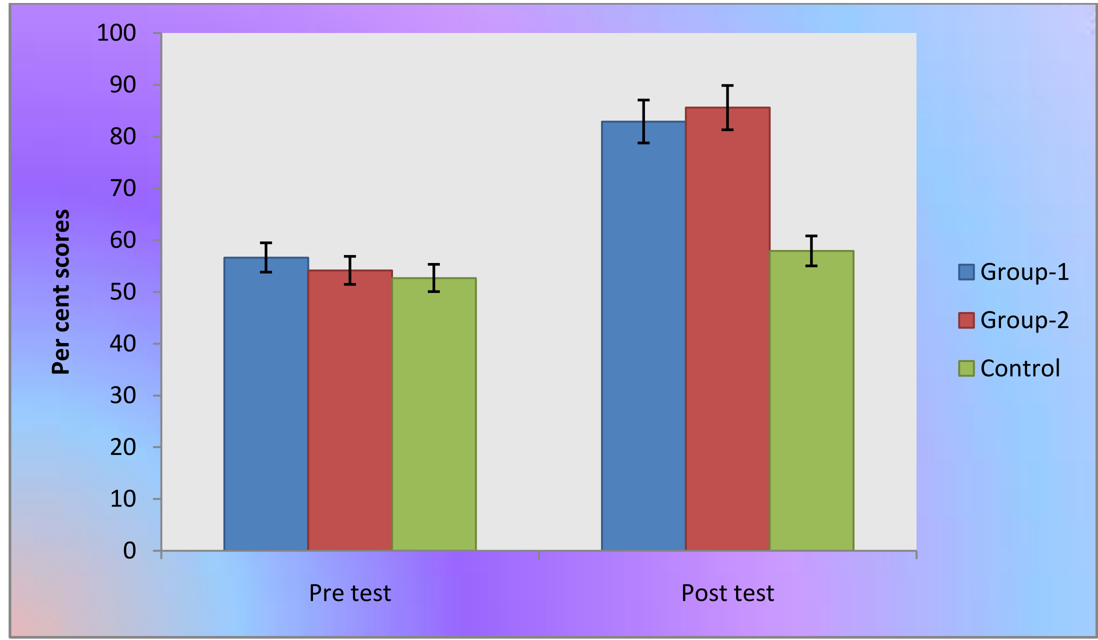


Fig. 4.9 Impact of nutrition intervention on overall knowledge test scores of selected adolescents girls (n=90)

Table 4.33 and Figure 4.9 and 4.10 clearly explains the impact of pre and post nutrition intervention on knowledge, practice, attitude as well as overall impact on scores obtained by selected adolescent girls. The mean scores obtained in pre- test for knowledge, practice, attitude and overall impact on adolescent girls group were 42.22±2.96, 46.11±3.76, 69.67±2.60 and 52.67±2.17 per cent for control 33.33±2.43, 61.11±2.91, 73.33±2.05 and 56.63± 1.60 for experimental group-I and 29.94±1.43, 58.89±2.76 73.94±2.77 and 54.17±1.45 per cent for group-II and corresponding mean scores in post-test were 59.83±2.28, 47.17±2.47, 69.69±2.96 and 57.90.90±1.81 per cent for control, 84.17±1.76, 80.33±2.82, 83.67±3.05 and 82.89±1.80 per cent for group-I and 88.50±1.95, 82.22±2.35, 86.50±3.20, and 85.57±1.73 per cent for group-II respectively. A significant improvement was recorded in group-I and group-II thereby asserting that these respondents moved in a desirable direction. Group-II that received only nutritional education had maximum gain in percentage of knowledge varying from 12.56-58.56, followed by group-I that received not only nutrition education but also dietary intervention and were recorded a change of 10.34-50.84 per cent of knowledge, attitude and practices related to nutrition and health intervention. Control group did not receive any type of nutrition intervention i.e. neither dietary intervention nor educational intervention therefore, the gain in knowledge was minimum ranging from0.02- 17.61.

The scores received were converted into percentages and distributed among different divisions for assessing the level of knowledge of the respondents in the initial and final session of the intervention. The data is presented in Table 4.34. The distribution of KAP level of the three different group showed that 66 and 63.66 per cent subjects of group-I and group-II had less than 34 per cent knowledge that has been rated poor. 26.66 and 36.33 per cent had average knowledge related to nutrients and health. After receiving nutrition education through different adiuo-visiual aids for a period spread over four months, 96.66 per cent girls in group-I and 100 per cent in group-II increase their knowledge scores to more than 80 per cent (rated as excellent).

No such improvement in the level of control group was recorded after intervention. 66.66 and 36.33 per cent control subjects who had poor and average knowledge remained almost at same knowledge level. 56.66 and 43.33 per cent and

Table 4.34 Impact of nutrition intervention on distribution rating of knowledge test per cent scores of selected adolescent girls (n=90)

Scores	Group-I(n=30)		Group-II(n=30)		Control(n=30)	
	Pre	Post	Pre	Post	Pre	Post
Knowledge						
<34 per cent (Poor)	20(66.66)	-	19(63.66)	-	20(66.66)	19(63.66)
34-50 per cent (Average)	8(26.66)	-	11(36.33)	-	11(36.33)	12(40.00)
51-80 per cent (Good)	3(10.00)	1(3.33)	-	-	-	-
>80 per cent (Excellent)	-	29(96.66)	-	30(100.00)	-	-
Attitude						
<30 per cent (Less)	17(56.66)	-	16(53.33)	-	27(90.00)	21(70.00)
31-60 per cent (Moderately)	13(43.33)	5(16.66)	14(46.66)	3(10.00)	3(10.00)	9(30.00)
>60 per cent(Highly)	-	25(83.33)	-	27(90)	-	-
Practice						
<40 per cent (Low)	22(73.33)	-	28(93.33)	-	21(70.00)	20(66.66)
41-80 per cent (Medium)	8(26.66)	-	2(6.66)	-	9(30.00)	10(33.33)
>80 per cent (High)	-	30(100.00)	-	30(100.00)	-	-
Overall						
<40 per cent (Poor)	21(70.00)	-	24(80.00)	-	23(76.66)	22(73.33)
41-75 per cent (Good)	9(30.00)	2(6.66)	6(20.00)	2(6.66)	7(23.33)	8(26.66)
>75 per cent(Very good)	-	28(93.33)	-	28(93.33)	-	-

#Figure in parentheses represents percentage

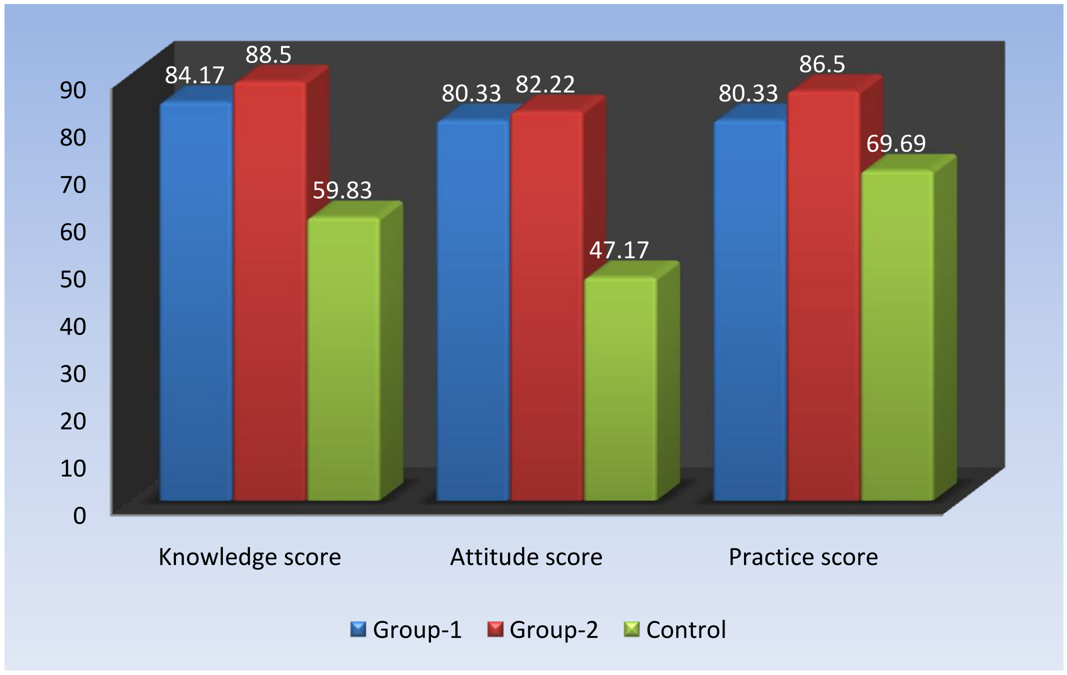


Fig. 4.10 Comparison of per cent KAP test scores of control and experimental groups after intervention of selected adolescents girls (n=90)

53.33 and 46.66 per cent of moderately anemic adolescent girls in group-I and group-II respectively had less and moderate attitude. After post intervention, only16.66 and 10.00 per cent remained at moderate level while 83.33 and 90 per cent rose to high attitude (>60 %) for nutrition and health in the stated groups respectively. Control group again lagged behind and no such change was visible as compared to other groups. Overall scenario of KAP test explained that most of the the adolescent girls in group I and –II who had poor to good knowledge substantiated their information and shifted into the category of "very good". So, the extent of improvement in mean scores of experimental group was higher than the control group indicating positive impact of intervention and supporting the fact that, nutrition education can significantly improve nutritional awareness of the beneficiaries.

Impact of nutrition intervention on response of participants to different questions asked under knowledge, attitude and practice test is presented in Table 4.35. Most adolescent girls had poor knowledge regarding anemia, its causes, prevention and management. Knowledge test data showed that there was significant difference in pre and post intervention knowledge of experimental group (I and II) while non-significant difference remained in control group.When the participants in current study sample were asked about their knowledge, only 23.33, 26.67 and 16.67 per cent respondents knew about nutrients required for growth and development, nutrients present in fruits and vegetables and deficiency of vitamin A in the pre-test. But after nutrition counseling, 100 per cent of the respondents had enhanced knowledge. Other enhanced scores ranged between 86-96 per cent. No change in knowledge was recorded in control group.

In practice test, it was observed that only 20 and 30 per cent of the subjects in group-I and group-II took citrus fruits with meal, 63 per cent in group-I preferred washing vegetables before cutting and 56.67 and 70.69 per cent check their hemoglobin in a year and used lemon in salad too. Positive impact of nutrition counseling was observed as 100 per cent girls were practicing these. Regarding sanitation and hygiene during menstrual periods, not much change in percentage was noted in group-I and group-II for changing their undergarments and sanitary pads but positive influence was noted for taking bath daily during periods which was 66.67 per cent in pre-test and 100 per cent in post-test. Group-II respondents were more aware of sanitary practices compared to the two groups.

Further, scores of attitude test showed that there was significant improvement observed after intervention in group-I and group-II. Attitude scores regarding various questions like effect of anemia on work capacity, iron as necessary nutrient for blood formation, balanced diet for adolescents, loss of nutrients during uncovered cooking, non-vegetarian foods as best source of iron and eradication of anemia through balanced diet were achieved 100 per cent after intervention in group-I. Almost same scenario was observed for group II. The scores of control group remained same as pre intervention period.

Similar scenario for group-I and group-II was also visible for practices performed by the subjects. Before nutrition intervention, 73.33 and 93.33per cent adolescent girls scored less than 40 per cent (low) and only 26.66 and 6.66 per cent scored between 41-80 per cent (medium) for correct practices. Excellent improvement was seen post intervention as 100 per cent of selected adolescent girls improve their nutrition practices scores to more than 80 per cnet (high).

Rao et al. (2007) conducted a study on adolescent girls (11-18 years) in schools of old city of Hyderabad. A significant improvement was found in the knowledge levels of both the experimental and control groups after the intervention. The improvement in the mean scores of the experimental group (3.09 ± 0.19) was significantly higher than the control group (1.65 ± 0.21). Positive impact of nutrition education was also reported by Sharma et al. (2009) on rural adolescent girls of 13 to 19 years The intervention was given for nine months to girls through lecturers, discussions and demonstrations. The post test was done on the girls after the period of intervention and found that the knowledge of girls on health was improved. Savita et al. (2013) conducted a study on impact of education intervention on nutritional knowledge of iron deficiency among post-adolescent girls. The percentage of correct response ranged from 39-69 per cent previously followed by 71 per cent to 96 per cent at immediately after education intervention and 70 per cent to 91 per cent at one month after education intervention. The response improved after education intervention that could help to combat micronutrient malnutrition.

Table 4.35 Impact of nutrition intervention on per cent scores for different questions related to knowledge, attitude and practice (n=90)

Particulars	Group-I		Group-II		Control	
	Pre	Post	Pre	Post	Pre	Post
Knowledge Test n=30						
Nutrients in balanced diet	26.67	76.67	60.00	100.00	36.67	36.67
Nutrients for growth and development	23.33	100.00	86.00	96.00	43.33	33.33
Nutrients in fruits and vegetables	26.67	100.00	26.67	100.00	36.67	36.67
Mineral need for Hb formation	30.00	100.00	30.00	100.00	10.00	10.00
Food rich in Vitamin C	73.33	93.33	86.67	91.00	33.33	33.33
Deficiency of Vitamin A	16.67	100.00	13.33	100.00	10.00	10.00
Deficiency of iron	50.00	100.00	63.33	99.00	33.33	34.00
Signs of anemia in body	76.67	86.67	86.67	100.00	50.00	32.00
Iron absorption inhibitors	56.67	100.00	60.00	100.00	50.00	36.67
Rich source of iron	70.00	100.00	70.00	97.00	50.00	53.33
Causes of anemia in females	43.33	80.00	63.33	100.00	26.67	36.67
Facility by govt. to prevent anemia	40.00	90.00	76.67	98.00	43.33	10.00
Best method of cooking	26.67	90.00	46.67	90.00	33.33	30.00
Vitamin increase in fermentation	46.67	83.33	23.33	93.33	23.33	16.67
Vitamin loss during over cooking	26.67	100.00	16.67	100.00	20.00	30.00
Mean±SD	**42.22± 5.04**	**93.33± 5.90**	**53.96± 6.73**	**97.62± 6.98**	**33.33± 3.42**	**29.29± 8.26**
t value	**4.82^{S}**		**2.77^{S}**		**1.61^{NS}**	
Attitude test n=30						
Good health need balanced diet	93.33	100.00	96.67	100.00	96.67	95.00
GLV should be eat in daily	86.67	96.67	80.00	100.00	96.67	96.00
Non-veg are good source of protein	30.00	93.33	26.67	100.00	56.67	60.00
Anemia affects our work capacity	23.33	100.00	20.00	83.33	40.00	40.33
GLV provides important nutrients	60.00	93.33	93.33	96.00	73.33	73.33
Tea should not be consume with meal	80.00	96.67	83.33	95.00	60.00	60.67
Iron utensils increase iron content	33.33	100.00	50.00	100.00	36.67	32.00
Iron is necessary for blood formation	26.67	80.00	60.00	83.33	20.00	22.33
Adolescents need balanced diet	70.00	100.00	60.00	100.00	70.00	70.33

Depletion of iron and folic acid in body cause anemia	30.00	66.67	33.33	100.00	33.33	40.67
Uncovered cooking leads to loss of nutrients	76.67	100.00	50.00	100.00	66.67	62.33
Non-veg food's iron is absorbed best	13.33	100.00	60.67	100.00	43.33	42.00
Balanced diet eradicating anemia	36.67	100.00	56.67	100.00	63.33	62.00
Deworming should be done time to time	76.67	80.00	83.33	90.00	86.67	85.00
Iron supplement course prevent anemia	63.33	93.33	80.00	96.67	86.67	87.00
Mean±SD	**52.00± 7.30**	**93.33± 3.84**	**58.67± 7.16**	**96.28± 5.24**	**62.00± 6.14**	**61.93± 5.36**
t value	**5.22^{S}**		**2.51^{S}**		**1.79 ^{NS}**	
Practice test n=30						
Wash vegetables before cutting	63.00	100.00	93.33	100.00	90.00	90.87
Take citrus with meal	20.00	100.00	30.00	100.00	26.67	26.67
Use iron utensils	56.67	93.33	76.67	96.67	70.00	70.00
Eat green leafy vegetables	86.67	96.67	96.67	98.00	96.67	96.87
Take tea after meal	93.33	73.33	56.67	90.00	60.00	60.00
Don’t eat sand/chalk	93.33	53.33	100.00	76.76	83.33	83.53
Take deworming tablet	73.33	100.00	50.00	100.00	66.67	66.67
Like to work with slipper	70.00	90.00	66.67	83.33	73.33	73.33
Eat food after hand wash	86.67	93.33	86.67	96.67	86.67	86.67
Check Hb in a year	56.67	100.00	70.00	100.00	70.00	70.00
Use lemon in salad	56.67	100.00	50.00	83.33	53.33	53.3
Do not like to eat vegetables without wash	100.00	100.00	96.67	100.00	86.67	86.47
Take bath daily in periods	66.67	100.00	73.33	90.00	73.33	73.33
Change sanitary pads 2-3 times in a day	90.00	93.33	70.00	100.00	90.00	90.00
Change undergarments daily	90.00	96.67	96.67	100.00	86.67	86.87
Mean±SD	**72.20± 5.26**	**96.66± 3.56**	**74.00± 5.37**	**95.88± 3.95**	**74.22± 4.65**	**74.30± 4.06**
t value	**3.67^{S}**		**2.45^{S}**		**1.34^{NS}**	

Significant at 5% (t value at 28 degree of freedom 2.04)

4.13.2 Physical fitness index

Physical fitness is linked to individual's capacity to do physical activity with a reasonable degree of efficiency without under fatigue and with rapid recovery from the effect of exercise. Several studies have established that anemia reduces physical work capacity. Because the decrease in hemoglobin reduces the availability of oxygen to the tissues, which in turn effect the productivity, cardiac output and concentration level, mild and moderate anemia impose handicaps on physical endurance and fitness. A good physical work capacity is a desirable attribute that depends on adequate intake of calories and iron. Physical fitness index (PFI) and aerobic work capacity are considered as an essential and important parameter to evaluate the cardiac respiratory fitness. The physical fitness activity was performed by the adolescent girls before and after nutrition to calculate the physical fitness index and aerobic capacity in group-I, group-II as well as control group.

Physical fitness data of selected adolescent girls presented in Table 4.36 elucidated that mean physical fitness index score obtained during pre-test by control group, group-I and group –II was 41.27±1.34, 42.57±1.96 and 43.88±1.71 and corresponding mean values in post-test as 41.93±1.44, 99.21±1.35 and 95.51±1.07. Gain in capacity score after 4 months intervention was calculated as 0.66 in control group whereas in group-I and II, it was 56.64 and 51.63. Quantum of improvement was 2.33 and 2.17 times in group-I and group-II and 1.01 times in control group indicating that dietary and nutrition intervention enhances the nutrition status and improves the physical work and capacity as well. Aerobic capacity calculated by equation using PFI data showed that mean values of group-I, group-II and control before initiation of intervention programme were 10.82±0.74, 11.32±0.64 and 8.10±0.50 VO_2ml/kg/15 minutes of exercise time. After intervention, an increase in hemoglobin level of moderate anemic adolescent girls was analysed, thereby crossing this level and shifting to little safe zone of mild anemia enhanced their aerobic capacity recording scores of 24.64±0.05, 23.74±0.35 and 8.15±0.50 for VO_2ml/kg/15 min. for group-I, group-II and control. A decrease in maximal consumption of oxygen (VO_2max) an indicator of aerobic work capacity occurs in anemic individuals that leads in reduction in oxygen transport capacity of the blood by the body. Control group did not record any appreciable increase in their aerobic capacity.

Table 4.36 Impact of nutrition intervention on physical fitness index (PFI) of selected adolescent girls (n=90)

Parameters	Pre test	Post test	t-value	Gain in capacity	Quantum of improvement
Group-I(n=30)					
PFI score	42.57±1.96	99.21±1.35	15.5 [S]	56.64	2.33
Aerobic capacity (VO_2ml/kg 15 min.)	10.82±0.74	24.64±0.51	15.6 [S]	13.82	2.28
Group-II (n=30)					
PFI score	43.88±1.71	95.51±1.07	16.04 [S]	51.63	2.17
Aerobic capacity (VO_2ml/kg 15 min.)	11.32±0.64	23.74±0.35	17.49 [S]	12.42	2.10
Control (n=30)					
PFI score	41.27±1.34	41.93±1.44	0.49 [NS]	0.66	1.01
Aerobic capacity (VO_2ml/kg 15 min.)	8.10±0.50	8.15±0.50	1.14 [NS]	0.05	1.00

Significant at 5% (t value at 28 degree of freedom 2.04)

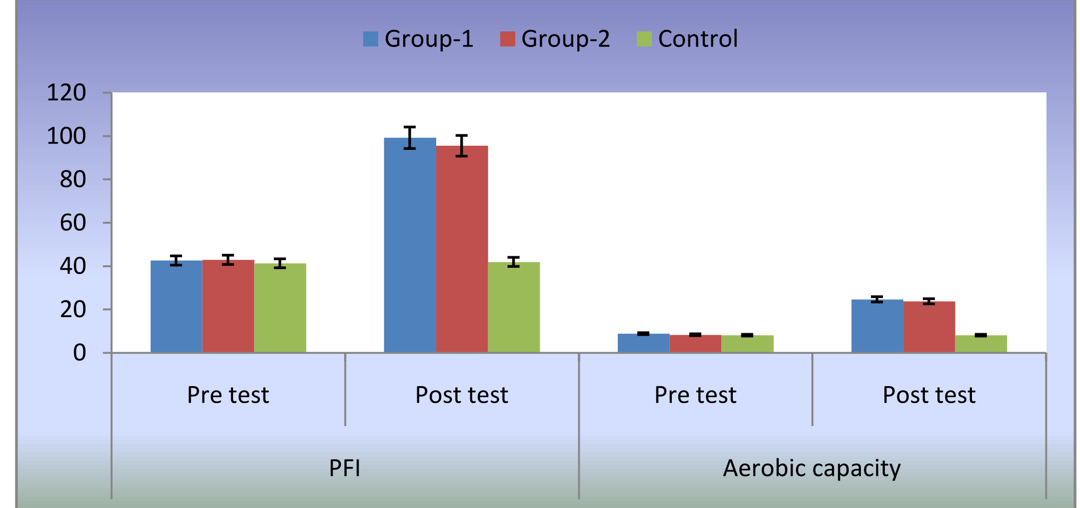


Fig. 4.11 Impact of nutritional intervention on physical fitness index of selected adolescents girls (n=90)

Physical fitness rating (Table 4.37) calculated in hierarchy of poor to excellent physical fitness index explained the positive impact of diet and nutrition intervention. 96.66 and 30 per cent of subjects in group-I and II were rated for poor fitness and 3.33 and 20 per cent rated for fair fitness during pre intervention improved their fitness level to good and excellent fitness. Control group were in the same boat of poor and fair category before and after intervention periods. There was a drastic positive shifting recorded for aerobic capacity that improved from poor to low average grade in pre-test to good and excellent category later after intervention. Only 6.66 per cent had excellent capacity after intervention in group-I. No such change occurred in adolescent girls of control group.

Table 4.37 Impact of nutrition intervention on physical fitness rating of selected adolescent girls (n=90)

Physical fitness rating	Group-I(n=30)		Group-II(n=30)		Control(n=30)	
	Pre	Post	Pre	Post	Pre	Post
Excellent (>91)	-	27(90.00)	-	20(66.66)	-	-
Good (84-91)	-	3(10.00)	-	7(23.33)	-	-
Fair (77-83)	1(3.33)	-	6(20.00)	3(10.00)	21(70.00)	20(66.66)
Poor (<77)	29(96.66)	-	24(30.00)	-	9(30.00)	10(33.33)
Aerobic capacity (VO_2ml/kg /15 min.)						
Poor (≥5)	1(3.33)	-	26(86.66)	-	27(90.00)	26(86.66)
Low average (16-25)	29(96.66)	-	4(13.33)	-	3(10)	4(13.33)
High average (26-30)	-	-	-	2(6.66)	-	-
Good (31-40)	-	9(30.00)	-	22(73.33)	-	-
Very good (41-45)	-	19(63.33)	-	6(20.00)	-	-
Excellent(≥45)	-	2(6.66)	-	-	-	-

#Figure in parentheses represents percentage

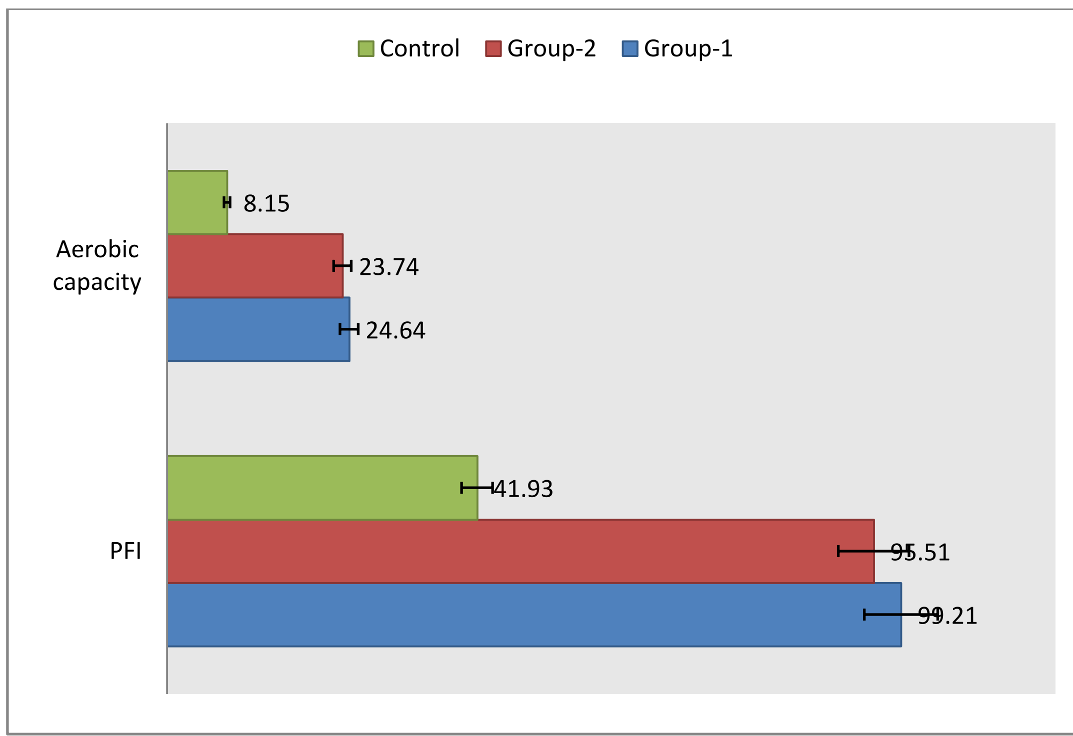


Fig. 4.12 Comparison of means physical activity values of control and experimental groups after intervention of selected adolescents girls (n=90)

A study by Vijaylakashmi and Selvasundari (1983) found that non-anemic women performed much better than anemic women in various physical activities like walking, running, skipping, number of steps climbed and mopping/cleaning. After supplementation with iron, the anemic young women showed improvement in work capacity. The study of Sen and Kanani (2006) concluded that a higher number of steps were climbed and a shorter time was taken to revert to the basal pulse rate (recovery time) by non-anemic girls compared to anemic girls.

4.14.3 Hemoglobin level

Impact of diet and nutrition intervention on mean hemoglobin level of selected adolescent girls was analysed and presented in Table 4.38 and 4.39 and pictorially illustrated in Figure 4.13 and 4.14. Hemoglobin level is the most commonly used indicator to detect anemia at field level. Thus, for the screening of anemia, the classification of different grades of anemia as given by WHO (2001) was used. The hemoglobin level of 90 moderately anemic adolescent girls was recorded before and after nutrition intervention. The mean initial level of hemoglobin in experimental group-I was 9.31±0.12 g/dl which increase significantly ($P \leq 0.05$) to 11.44±0.12 g/dl. In group-II the initial value of 9.51±0.11 g/dl also increment significantly ($P \leq 0.05$) 10.97±0.16 g/dl at final level, whereas the mean initial level of hemoglobin increased non significantly from 9.35±0.11 to 9.84±0.20 g/dl in control group after 4 months of nutrition intervention.

Table 4.38 Impact of nutrition intervention on mean hemoglobin level of selected adolescent girls (n=90)

Parameters	Reference value	Pre test	Post test	t-value
Group-I	≥12	9.31±0.12	11.44±0.12	11.94^{S}
Group-II		9.51±0.11	10.97±0.16	7.48^{S}
Control		9.35±0.11	9.84±0.20	1.38^{NS}

Significant at 5% (t value at 28 degree of freedom 2.04)

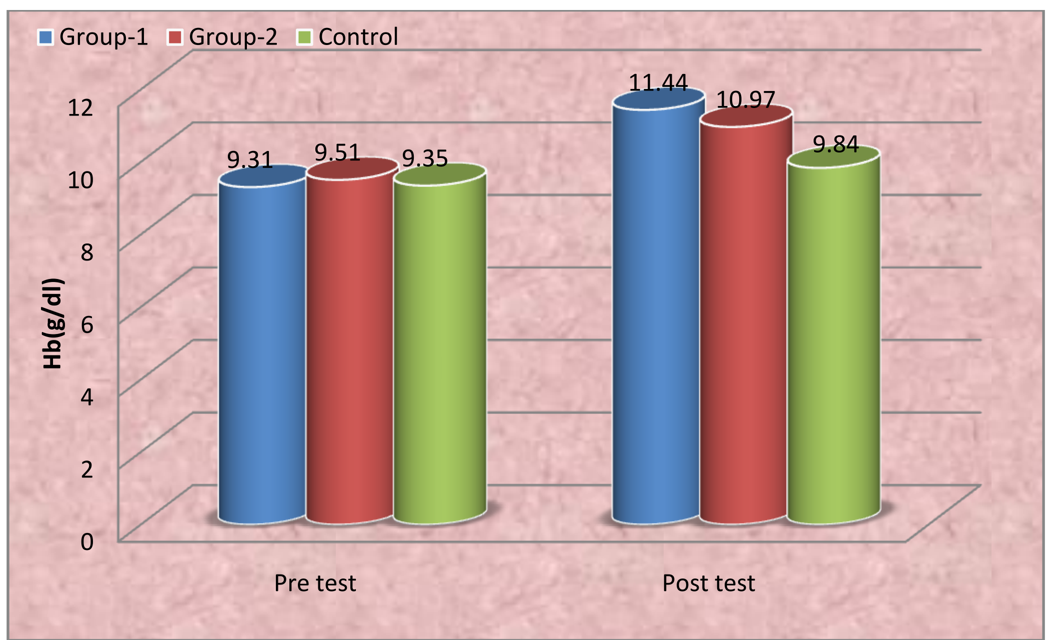


Fig.4.13 Impact of nutrition interventions on hemoglobin level of selected adolescents girls (n=90)

Impact of nutrition intervention on prevalence of anemia was also calculated and has been explained in Table 4.39 100 per cent of the adolescent girls analyzed during phase-1 and discussed in section-1 were moderately anemic (8-10.9g/dl Hb) during pre intervention time and after receiving intervention for a period of 120 days in group-I, 13.33 per cent were not anemic at all while 76.66 fall into mild anemic category, only 10 per cent did not show any improvement. Group-II respondents were imparted nutrition counseling only and 86.66 per cent remained in the same category of moderately anemic and 13.33 shifted to mild anemic category. There was no specific change in control group. They remain in same category as they did not receive any type of intervention. Various studies done in India have suggested that anemia prevalent in our country appears to be caused mainly by lower dietary intake and poor absorption of iron from cereal based vegetarian diets which leads to nutritional anemia. Further revealing of data showed that dietary intervention had remarkable significant result on hemoglobin as compared to nutrition education intervention. During the dietary intervention, subjects of group-I were provided with iron rich food preparations i.e. *ladoo* and *mathri* for period of four months. 20g of each preparation per day provided 100 per cent RDA.

Table 4.39 Impact of nutrition intervention on prevalence of anemia among selected adolescent girls N=90

Particulars	Group-I(n=30)		Group-II(n=30)		Control(n=30)	
	Pre	Post	Pre	Post	Pre	Post
Non anemic (≥12 g/dl)	-	4(13.33)	-	-	-	-
Anemic (<12g/dl)						
Mild (11-11.9 mg/dl)	-	23(76.66)	-	4(13.33)	-	-
Moderate(8-10.9 mg/dl)	30(100.00)	3 (10.00)	30 (100.00)	26(86.66)	30(100.00)	30(100.00)
Severe (<8 mg/dl)	-	-	-	-	-	-

#Figure in parentheses represents percentage

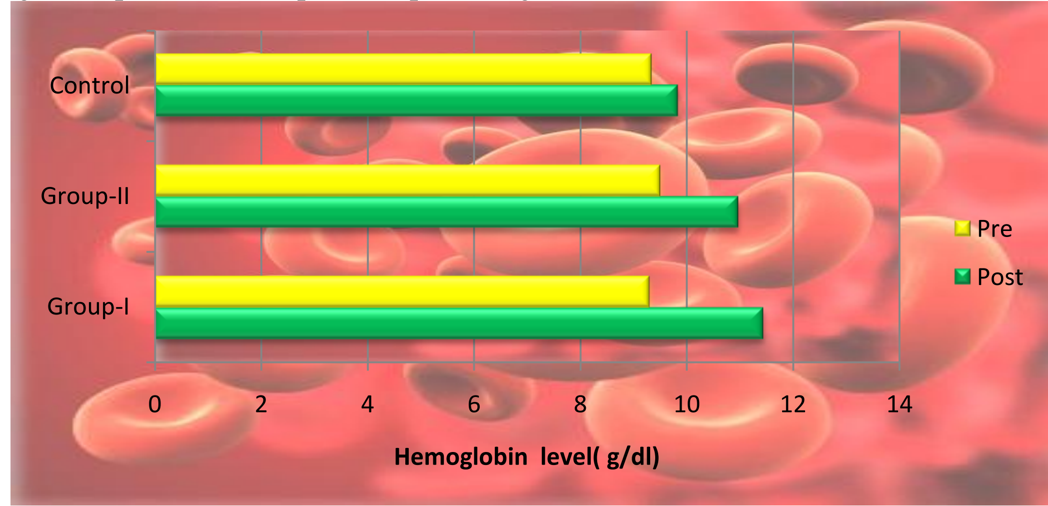


Fig. 4.14 Comparison of hemoglobin level of control and experimental groups after intervention of selected adolescent girls (n=90)

During nutrition education intervention subjects were educated and motivated to increase the intake of green leafy vegetables and fruit rich in vitamin C as they were lacking in their diet as assessed in pre intervention. In addition, various other topics in form of audio-visual aids were imparted to the experimental group. This may had a positive impact on this group therby significant improved the level of 90 per cent subjects.

Sajjan et al. (2008) reported mean initial level of hemoglobin in the experimental group as 9.76 g/dl. Mean initial level of hemoglobin of control group increased from 9.52 to 9.55 g/dl, after three month of nutrition education. A significant ($p \leq 0.05$) increment of 0.78 g/dl in experimental and 0.03 g/dl in control group was reported after the three month of nutritional education.

Similarly Singh et al. (2014a) reported the impact of nutrition counseling on mean Hb level and found the positive effect on hemoglobin level which significantly improved from 9.14 ± 1.5.6 to 9.78 ±1.32g/dl before and after nutrition counseling of adolescent girls.

Angel and Devi (2015) assessed the therapeutic impact of garden cress seed *ladoo* among the selected anemic adolescent girls in the age group of 12-15 years. Two hundred moderately anemic adolescent girls (each 100 in the experimental group and the control group) were chosen for further study. The *ladoo* that contained 10 mg of iron was given for a period of 6 months along with 5g amla powder. After 6 months of supplementation, improvement was observed in the clinical signs of the experimental group. The haemoglobin level (g/dl) gradually increased from 8.67±0.59 to 12.43±0.70. There was no specific change in the control group.

4.14.4 Dietary intake

Interventions trials were carried out on 30 moderately anemic adolescent girls in each group with iron rich foods and nutrition education (group-I) and nutrition education (group-II). Simultaneously a group of 30 girls with moderate anemia was kept as control (control group). The status of food intake was studied before and after intervention period. The subjects were enquired about their daily food intake using 24 hrs recall method before starting the intervention (initial) and after completion of the intervention (final).The data of food intake is presented in Table 4.40 and illustrated in Figure 4.15 and 4.16

i. Cereals

The daily consumption of cereals by different groups i.e. control (248.00±8.25 g), group-I (251.00±6.01g) and group-II (230.66±6.52 g) during pre-test was recorded. At the end of intervention period, per day cereal consumption by them increased to 255.00±8.25, 273.06±6.14 and 266.66±6.22 g, respectively which was however again low as per suggested dietary intake. Statistically, intake of cereals by group- I was higher than control but was at par with group-II. Within the group, post intake of cereals by both group was significantly ($p<0.05$) higher than their pre intake. Statistically ($p<0.05$) no difference was found in cereal intake of control group at pre and post intervention. The per cent adequacy of cereals intake was reported above 90 in group-I and below 90 in group-II (88.89) and control (85.00) after intervention.

Table 4.40 Impact of nutrition intervention on mean food intake of selected adolescent girls (n=90)

Particulars	SDI (g/day)	Group-I			Group-II			Control		
		Pre	Post	t-value	Pre	Post	t-value	Pre	Post	t-value
Cereals & millets	300	251.00±6.01	273.06±6.14	2.56 S	230.66±6.52	266.66±6.22	2.73 S	248.00±8.60	255.00±8.25	0.58 NS
Pulses	65	42.00±1.91	57.53±1.21	7.01 S	33.27±2.00	43.27±2.00	3.51 S	41.80±2.46	42.56±2.33	0.20 NS
Milk (ml) & milk products	500	348.83±15.98	398.16±19.08	2.60 S	302.23±11.27	337.33±11.13	2.21 S	338.66±13.34	337.66±12.98	-0.07 NS
Roots & tubers	133	87.16±10.22	98.43±9.80	2.03 NS	99.43±11.00	102.33±9.62	1.57 NS	90.80±11.45	91.35±11.16	1.53 NS
Green leafy vegetables	100	41.60±2.92	43.66±3.53	1.11 NS	39.23±1.80	40.43±14.99	1.77 NS	41.96±2.95	42.76±10.39	1.46 NS
Other vegetables	200	140.00±9.45	149.50±5.01	1.09 NS	113.13±10.74	117.13±10.47	2.01 NS	106.33±12.12	107.03±12.79	0.03 NS
Fruits	100	19.50±5.01	21.50±5.0	1.09 NS	18.13±4.96	19.12±4.62	0.42 NS	19.90±5.36	16.70±5.37	-0.10 NS
Sugar	26	28.50±0.86	24.50±0.86	-1.81 NS	26.91±5.42	24.91±5.73	-0.24 NS	28.66±4.16	29.40±4.39	-0.92 NS
Oils	36	47.50±1.35	44.50±1.35	-3.66 NS	42.50±1.43	41.50±1.56	-0.44 NS	41.16±1.87	43.60±1.88	-0.91 NS

Significant at 5% (t value at 28 degree of freedom 2.04) S- Significant; NS- Non significant

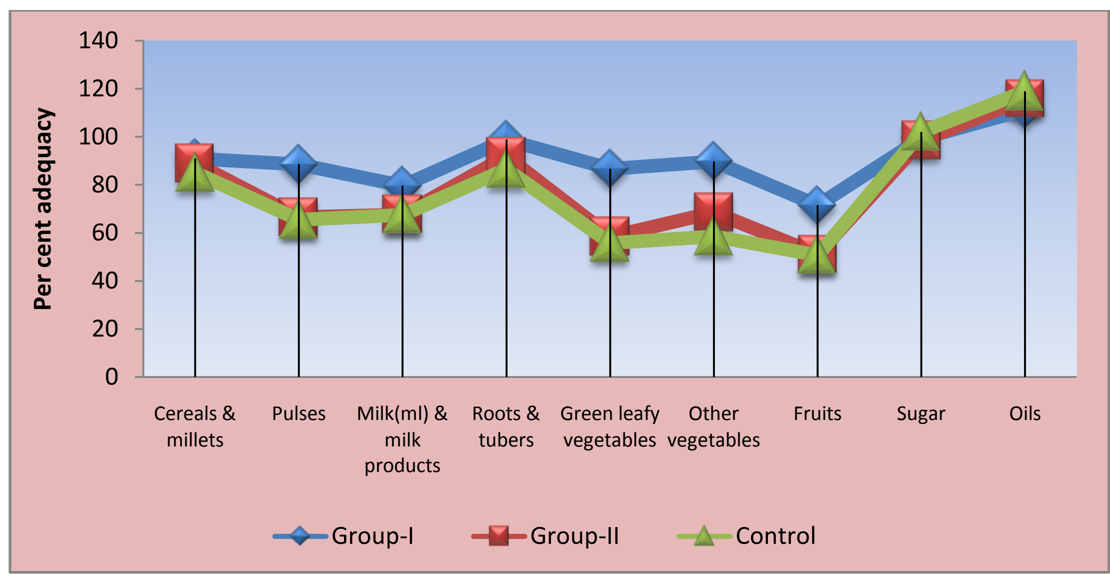


Fig. 4.15 **Impact of nutrition intervention on per cent adequacy of food intake of control and experimental group of selected adolescent girls (n=90)**

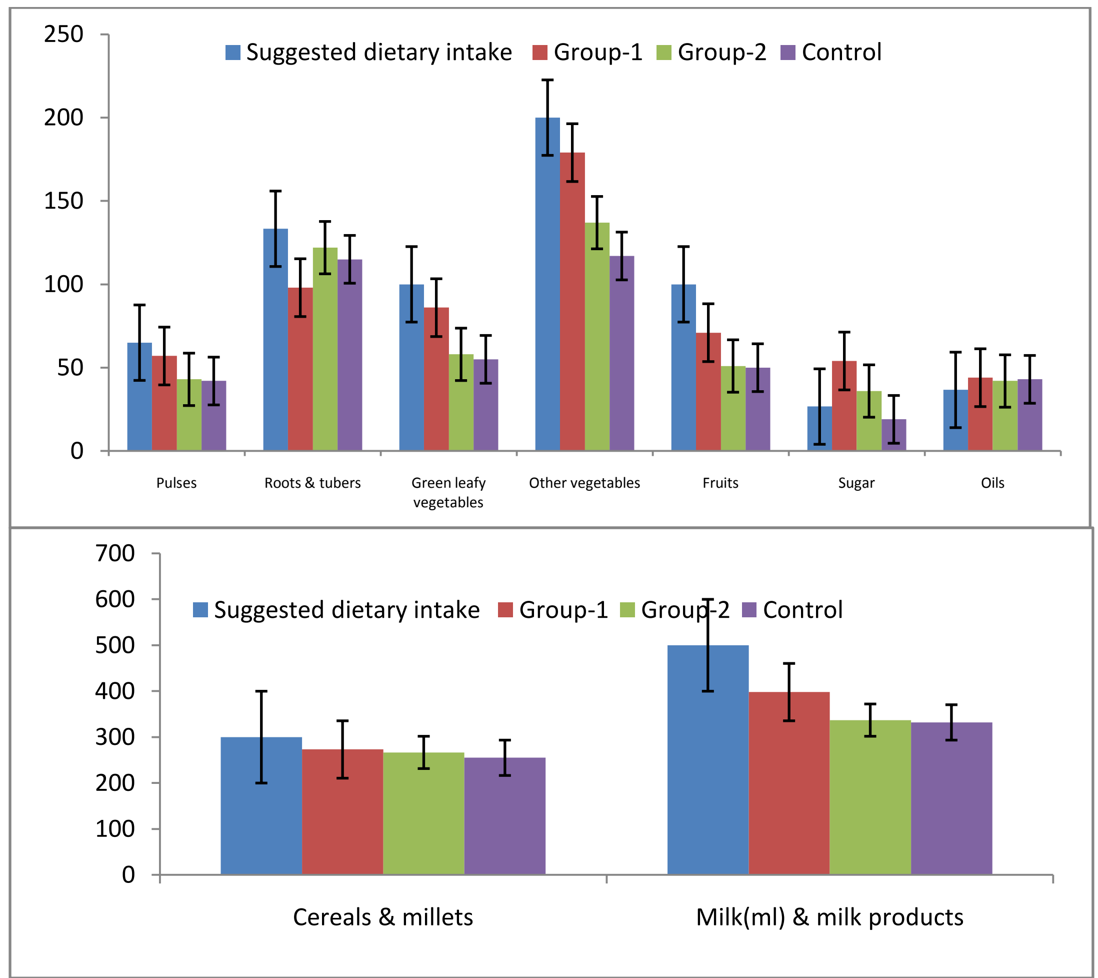


Fig. 4.16 **Comparison of dietary intake of control and experimental groups of selected adolescent girls (n=90)**

ii. Pulses

The initial daily consumption of pulses by control, group- I and group-II was 41.80±2.46, 42.00±1.91and 33.27±2.00 g. A significant difference was found with regard to pulses intake within and between the group-I and group-II (for pre and post intervention),while in control group statically no difference was observed.88.51, 66.57 and 65.48 per cent adequacy for intake was observed in group-I, group-II and control after intervention respectively.

iii. Milk and milk products

The daily intake of milk and milk products by different selected groups ranged from 302.23±11.27 to 348.83±15.98 g/day before intervention and 337.33±11.13 to 398.16±19.08 g/day after intervention with per cent adequacy in range of 67.53 to 79.63 after intervention. Variation in intake within experimental group at both stages was observed. In group-I and group-II, intake of milk and milk products by respondents during pre and post intervention were at par with each other.

iv. Roots and tubers

During pre-intervention, daily intake of roots and tubers by control (90.80±11.45 g), group-I (87.16±10.22 g) and group-II (99.43±11.00 g) were statistically similar. The per cent adequacy of roots and tubers after intervention was observed highest in group-I (73.82) followed by group-II (70.72) and control (69.51). Non-significant differences were again observed in the consumption of root and tubers between different groups and among the groups in two stages of counseling.

v. Green leafy vegetables

The daily consumption of green leafy vegetables was very low in subjects belonging to all selected groups. The initial mean daily consumption of green leafy vegetables by control, group-I and group-II was 41.96±2.95, 41.60±2.92 and 39.23±1.80 g respectively and the values at the end of nutrition counseling was 42.76±10.39, 43.66±3.53 and 40.43±14.99 g respectively. The per cent adequacy was also reported less than 50 per cent after intervention i.e.42, 43 and 40 in group-1, group-II and control. This low intake may be due to the less availability of green leafy vegetables during summer season i.e. when food intake was recorded and partially

due to the fact that most of the adolescent girls did not like to take green leafy vegetables in their daily menu. Statistically insignificant effect of intervention was calculated for intake of green leafy vegetables.

vi. Other vegetables

The initial daily intake of other vegetables by control (106.33±12.12g), group-I (140.00±9.45 g) and group-II (113.13±10.74 g) had insignificant statistically difference with post intervention values of 107.33±12.79g, 149.5±0.50g and 117.13±10.47g. A non-significant difference was also observed in the consumption of other vegetables between all groups. Per cent adequacy 69.75, 68.57 and 87.52 was recorded in experimental group I and II and control group.

vii. Fruits

The daily intake of fruits at pre and post stages of intervention in control, group-I and group-II were 19.90±5.36g, 16.70±5.37g, 19.50±5.01g, 21.50±5.00g, 18.13±4.96g and 19.12±4.62g respectively that indicated an insignificant change in consumption of this important group. When compared with suggested dietary intake, lower adequacy was recorded in experimental group-I, II and control group.

viii. Sugar

The daily consumption of sugar by different groups ranged from 24.50±0.86 to 29.40±4.39 g. The mean daily consumption of sugar inpre stage was control, I and II group was 28.66±4.16g, 28.50±0.86g and 26.91±5.42g, respectively, whereas at the end of supplementation, these were found to be 29.40±4.39, 24.50±0.86 and 24.91±5.73g with per cent adequacy of 32.13, 34.93 and 33.30 respectively. Intake of sugar had insignificant difference at initial and final stage of intervention program.

Oils: The mean daily intake of fats and oils in control, I and II groups was 41.16±1.87, 44.50±1.35 and 42.50±5.42 g respectively before initiation of intervention and 43.60±1.88, 41.50±5.73 and 37.50±1.35g respectively after the intervention. The per cent adequacy was i.e.98.00, 99.04 and 101.87 in group-1, group-II and control after intervention. Adequacy of oils and fat in diet was near to suggested dietary intake and even above recommendation. Respondents of experimental group I and II consumed less oils as compared to control group after intervention.

Chaturvedi et al. (1995) assessed food intake of adolescent girls belonging to low socio-economic group and found that the diets of adolescents were deficient in cereals, pulses and green leafy vegetable. Similarly Sehgal and Kawatra (2002) found that all the food group intake of supplement group increased significantly than pre intervention periods. Rani and Palraj (2013) supplement anemic coffee plantation laborers with *spirulina* in soup and recorded their food intake before and after 120 days of intervention periods. They found that dietary habits had positive impact on intervention group. Patil et al. (2014) showed dietary modification in adolescent girls of nutrition intervention group which involved increased iron intake, increasing total food intake, consumption of locally available iron rich foods and dietary practices favoring iron absorption.

4.15.5 Nutrient intake

Table 4.41 shows the daily mean intake of nutrients by control and experimental group during pre and post intervention and is discussed below:

i. Energy

The daily mean energy intake of group-I and group-II increased from 1638.52±58.45 and 1659.87±58.45kcal respectively at initial level of intervention to 1973.41±58.65 and 1729.43±65.74 kcal at the end of intervention period, whereas that of control group was similar before and after the study. As compared to control, the intake of energy by intervention groups was significantly higher. The per cent adequacy was higher in group-I (90.94) followed by group-II (78.89) and control (67.22) at the end of intervention. Significant differences were observed in energy intake among respondents of experimental groups (group-I and group-II).

ii. Protein

The mean daily intake of protein by control, group-I and group-II was 36.21±0.99, 35.50±1.03 and 35.02±1.04 g, before intervention trial and 36.34±1.06, 48.88±1.23 and 37.06±1.11g post intervention respectively. Increased per cent protein intake was76.50 to 76.92 by group-I and II which was higher than control group.

iii. Fat

The mean daily fat intake of different groups was similar initially that ranged from 45.45±1.19 to 46.97±1.19 g before conducting the intervention study. However,

after intervention, intake of fat by group-I (44.13±1.24 g), group-II (44.63±1.28 g) and control group (45.21±1.35 g) reduced and variation therefore was insignificantly observed. When the final intake of fat was compared for different groups with RDA (ICMR 2010), values were calculated for group-I (103.87 %), group-II (105%) and control (106.43%).

iv. Calcium

The initial mean calcium intake was calculated as 298.52±1.24, 295.34±11.50 and 295.05±11.50 mg in control, group-I and group-II whereas the final intake was 296.89±20.78, 418.32±12.31 and 360.64±20.52mg respectively with increase in per cent adequacy after intervention as 39.59, 64.11 and 53.87, when equated to recommended allowances. Significant differences were observed in calcium intake at both initial and final stages in groups except control group.

v. Iron

The initial values of iron intake by control and experimental groups (I and II) were 13.86±0.77, 13.68±0.67and 13.41±0.62 mg per day and the final values were 13.55±1.03, 26.14±0.47 and16.32±1.06mg per day, respectively. When the intake was compared to RDA, it was recorded that group-I iron intake met 100 per cent RDA after intervention. The reasons of higher adequacy in post intervention may be due to fact that dietary intervention of 100 per cent RDA was provided for iron by giving them sweet and savory preparation of *ladoo* and *mathri* for period of four months. Intake by group-II was lower than group-I. Non- significant difference was again calculated for control group.

vi. Zinc

The initial values of zinc intake by control, group-I and II were 5.03± 6.34, 5.15±0.29 and 5.35±4.07mg/day and during post intervention were found to be 5.22±4.65, 7.70±0.34 and 5.91±0.29 mg/day, respectively. A significant per cent increase was found between the group-I at pre and post stages of zinc intake and non-significant change was observed between group-II and control group.

vii. **Carotene**

The initial values of carotene intake in group-I, group-II and control were 510.38±28.36, 502.47±28.86 and 505.36±26.76 µg whereas at the end of intervention period, values were calculated as 639.6± 28.32, 522.33±46.17 and 505.64±44.36 µg,

respectively. Carotene intake after intervention in group-I was higher among groups. Non-significant difference was observed in control and group-II carotene intake. Intake of carotene was less than RDA. Lower intake of green leafy vegetables and fruits by these groups might be the reason for very low intake of carotene.

viii. Vitamin B_1

The vitamin B_1intake in different groups ranged between 0.26±0.02 to 0.38±0.03 mg and was at par with each other. Non-significant difference was observed between the initial and final intake of vitaminB_1 in all groups although intake slightly increased in experimental groups after intervention but was lower than 40 per cent of recommendations values.

ix. **Vitamin B_2**

The daily intake of vitamin B_2 by experimental groups and control group ranged from 0.39±0.03 and 0.52±0.30mgat pre and post stages of intervention. A significant change was observed in group-I for vitamin B_2 intake and non significant difference observed in group-II and control. The observed per cent adequacy of vitamin B_2 intake after intervention in group-I was 42.45 and 31.43 and 32.65in group-II and control.

x. **Vitamin B_2**

The initial values of niacin intake in group-I, group-II and control were 6.04±0.23, 6.05±0.25 and 6.03 ±0.23 mg and at the end of intervention period, values were 10.05±0.22, 7.18±0.35 and 6.61±0.32 mg, respectively. Significant difference of niacin intake was observed only in group-I at both stages of intervention. Non-significant difference observed in group-II and control. Adequacy of niacin intake was below 76 per cent at the end of intervention.

xi. Vitamin B_6

The initial values of vitamin B_6 intake by control, group-I and II were 0.46±0.03, 0.48±0.03 and 0.49±0.03 mg respectively whereas the final values were found to be 0.68±0.05, 0.55±0.03 and 0.43±0.03 mg/day, respectively. A significant difference was observed in group-I during pre and post intervention stages. The per cent adequacy of all groups was observed in the range of 22.63-35.79 which was lower than daily recommendation.

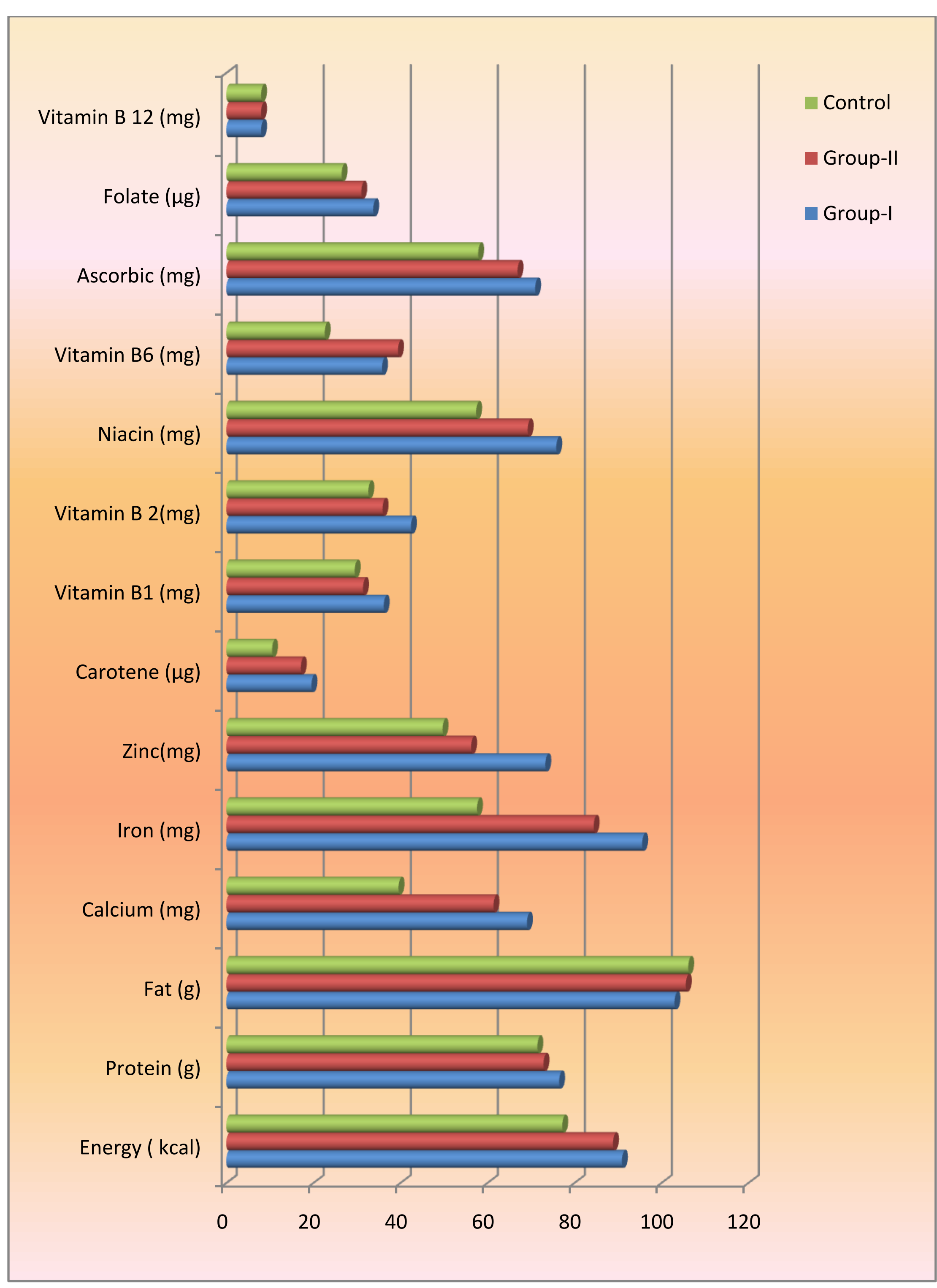


Fig. 4.17 **Impact of nutrition intervention on per cent adequacy of nutrient intake of different groups**

Table 4.41 Impact of nutrition intervention on mean nutrients intake per day of selected adolescent girls (n=90)

Nutrients	RDA	Group-I			Group-II			Control		
		Pre	Post	t-value	Pre	Post	t-value	Pre	Post	t-value
Energy (kcal)	2170	1638.52±58.45	1973.41±58.65	2.84 S	1659.87±58.45	1729.43±65.74	3.06 S	1637.16±60.82	1635.60±65.81	1.66 NS
Protein (g)	51	35.50±1.03	48.88±1.23	4.33 S	35.02±1.04	37.06±1.11	3.33 S	36.21±0.99	36.34±1.06	1.39 NS
Fat (g)	32	46.97±1.19	44.13±1.24	-7.62 NS	45.45±1.19	44.63±1.28	-5.60 NS	45.95±1.14	45.21± 1.35	-5.39 NS
Calcium (mg)	750	295.34±11.50	418.32±12.31	11.24 S	295.05±11.50	360.64±20.52	7.31 S	298.52±1.24	296.89± 20.78	-1.78 NS
Iron (mg)	26	13.68±0.67	26.14±0.47	11.62 S	13.41±0.67	16.32±1.06	6.44 S	13.86±0.77	13.55 ±1.03	-1.45 NS
Zinc (mg)	10	5.15±0.29	7.70±0.34	4.07 S	5.35±4.07	5.91±0.29	1.26 NS	5.03±6.34	5.22 ±4.65	1.07 NS
Carotene (µg)	4800	510.38±28.36	639.6±28.32	9.70 S	502.47±28.36	522.33±46.17	0.28 NS	505.36±26.76	505.64 ±44.36	1.97 NS
Vitamin B_1 (mg)	1	0.26±0.02	0.38±0.03	2.98 S	0.28±0.20	0.33±0.03	1.28 NS	0.28±0.02	0.31 ±0.0	0.60 NS
Vitamin B_2(mg)	1	0.39±0.04	0.52±0.30	2.76 S	0.39±0.03	0.44±0.03	1.12 NS	0.38±0.03	0.40 ±0.23	0.86 NS
Vitamin B_3(mg)	13	6.04±0.23	10.05±0.22	6.04 S	6.05±2.23	7.18±0.35	1.61 NS	6.03±0.23	6.61 ±0.32	1.30 NS
Vitamin B_6 (mg)	1	0.46±0.03	0.68±0.05	2.85 S	0.48±0.03	0.55±0.03	1.19 NS	0.49±0.03	0.43 ±0.03	-1.33 NS
Ascorbic (mg)	40	21.86±0.50	28.40±0.43	6.40 S	21.74±0.50	26.78±0.62	6.32 S	22.96±0.46	23.16 ±0.63	1.11 NS
Folate (µg)	172	49.02±1.94	58.25±1.32	3.34 S	45.78±1.94	46.55±2.12	1.69 NS	45.27±1.70	45.75 ±1.82	1.20 NS
Vitamin B_{12} (mg)	1	0.34±0.00	0408±0.00	7.12 S	0.33±0.00	0.38±0.00	1.13 NS	0.33±0.00	0.30 ±0.00	-1.03 NS

Significant at 5% (t value at 28 degree of freedom 2.04)

Table 4.42 Impact of different nutrition intervention on mean nutrient intake (g/day) of selected adolescent girls (n=90)

Group	Nutrients													
	Energy (kcal)	**Protein (g)**	**Fat (g)**	**Ca (mg)**	**Iron (mg)**	**Carotene (µg)**	**B1 (mg)**	**B2 (mg)**	**B3 (mg)**	**B6 (mg)**	**Vit. C (mg)**	**Folate (µg)**	**B 12 (g)**	**Zinc (mg)**
RDA	2170	50.82	32.5	750	25.25	4800	1.05	1.22	13.25	1.9	40	172.5	1	228.75
Group-1	1973.41± 58.65	38.88± 1.23	34.13± 1.24	518.32± 12.31	24.14± 0.47	939.6± 28.32	0.38± 0.03	0.52± 0.3	10.05± 0.22	0.68± 0.05	28.40± 0.43	58.25± 1.32	0.08± 0.00	39.44± 1.12
% Adequacy	90.94	76.50	105.02	69.11	95.60	19.58	36.19	42.45	75.85	35.79	71.00	33.77	8.00	17.24
Group-2	1929.43± 65.74	37.06± 1.11	35.63± 1.28	460.64± 20.52	21.32± 1.06	822.33± 46.17	0.33± 0.03	0.44± 0.03	9.18± 0.35	0.75± 0.03	26.78± 0.62	53.55± 2.12	0.08± 0.00	40.60± 1.25
% Adequacy	88.89	72.92	109.63	61.42	84.44	17.13	31.43	35.92	69.28	39.47	66.95	31.04	8.00	17.75
Control	1675.60± 65.81	36.34± 1.06	46.21± 1.35	296.89± 20.78	14.55 ±1.03	505.04 ±44.36	0.31 ±0.0	0.40 ± 0.23	7.61 ±0.32	0.43 ±0.03	23.16 ±0.63	45.75 ±1.82	0.08 ±0.00	34.26 ± 1.07
% Adequacy	77.22	71.50	142.18	39.59	57.62	10.52	29.52	32.65	57.43	22.63	57.90	26.52	8.00	14.98
CD ($p \leq 0.05$)	161.38	2.89	3.04	32.16	1.84	78.25	0.07	0.10	NS	0.11	1.29	6.00	0.01	3.47

xii. Vitamin C

The daily intake of ascorbic acid by control (22.96±0.46mg), group-I (21.86±0.50 mg) and group-II (221.74±0.50 mg) before intervention was observed. Final intake was recorded higher in experimental group i.e. 28.40±0.43 and 26.78±0.62mgand almost similar intake i.e. 23.16±0.63 mg observed in control respectively. It was found that at both the periods i.e. before and after intervention, the vitamin C intake was significantly different among experimental group except control groups. This may be due to the fact that the respondents included lemon juice and guava (both good sources of vitamin C) in their diets after intervention stage.

xiii. Folate

The initial values of folic acid intake in group I, group II and control group were 49.02±1.94, 45.78±1.94 and 45.27±1.70 μg per day respectively whereas the final values were found to be 58.25±1.32, 46.55±2.12 and 45.75±1.82 μg per day, respectively with per cent adequacy lower than 40 per cent of RDA. The group-I intake differed significantly in pre and post stages of intervention and non significant difference was observed in control and group-II initial and final intervention.

xiv. Vitamin B_{12}

The initial daily intake of vitamin B_{12} was 0.33, 0.34 and 0.33 μg, respectively in control, I and II group whereas, the final values were calculated as 0.30, 0.48 and 0.33μg per day, respectively. The final intake was significantly higher than initial intake in group-I and non significant difference was observed in control and group-II during pre and post intervention.

The results of present study are supported by the investigation of Chaturvedi et al. (1995) who assessed nutrient intake of adolescent girls belonging to low socio-economic group and found that the diets of adolescent were deficient in calories by 26 to 36 per cent and protein by 23 to 32 per cent and also stated that energy, protein, vitamin and minerals can be met to adolescent girls by dietary intervention strategies. Sehgal and Kawatra (2002) found all the nutrient intake of supplement group increased significantly than pre intervention periods. Rani and Palraj (2013)

supplement anemic coffee plantation laborers with *spirulina* in soup and recorded their nutrient intake before and after 120 days of intervention periods. They found that after intervention intake of iron, protein and carbohydrate increased significantly.

4.15 Correlation coefficient (r) between different variables

Correlation is a measure of association between two variables. Spearman's correlation coefficient was used to determine the correlation between anthropometric measurements, diet and nutrient intake and other general parameters associated with hemoglobin profile. The values of correlation coefficient can vary from minus one to plus one. Minus one indicates a perfect negative correlation, while plus one indicates perfect positive correlation. A correlation of zero means there is no relationship between the two variables.

Table: 4.43 Correlation coefficient (r) between anthropometric, hemoglobin, nutrient intake and other general parameters in selected adolescent girls

Particulars	Height	Weight	BMI	Triceps skin fold	Hemoglobin
Energy	0.390**	0.552**	0.444**	0.285*	0.264*
Protein	0.388**	0.651**	0.447**	0.311**	0.357**
Calcium	0.013 NS	0.146*	0.139*	0.103*	0.124*
Iron	0.070NS	0.022 NS	0.103 NS	0.023 NS	0.620**
Ascorbic acid	0.030 NS	0.018 NS	0.019 NS	0.081 NS	0.501**
Folic acid	0.073 NS	0.226*	0.082 NS	0.037 NS	0.429**
VitaminB_6	0.046 NS	0.021 NS	0.032 NS	0.029 NS	0.121 NS
VitaminB_{12}	0.041NS	0.097NS	0.058 NS	0.014 NS	0.051 NS
Family type	0.105 NS	0.104 NS	0.007 NS	0.084 NS	0.018 NS
Family Education	0.063 NS	0.232 NS	0.038 NS	0.050 NS	0.120*
Family income	0.022 NS	0.338*	0.157*	0.257*	0.127*
Food habits	0.055 NS	0.115*	0.052 NS	0.019 NS	0.358**
Meal time	0.068NS	0.161*	0.087 NS	0.003 NS	0.164*
Use of iron utensils	0.049 NS	0.108 NS	0.013 NS	0.070 NS	0.223*
Iron supplements	0.031NS	0.041 NS	0.082 NS	0.012 NS	0.483**

*Significant at 10% ** Significant at 5% NS Non significant

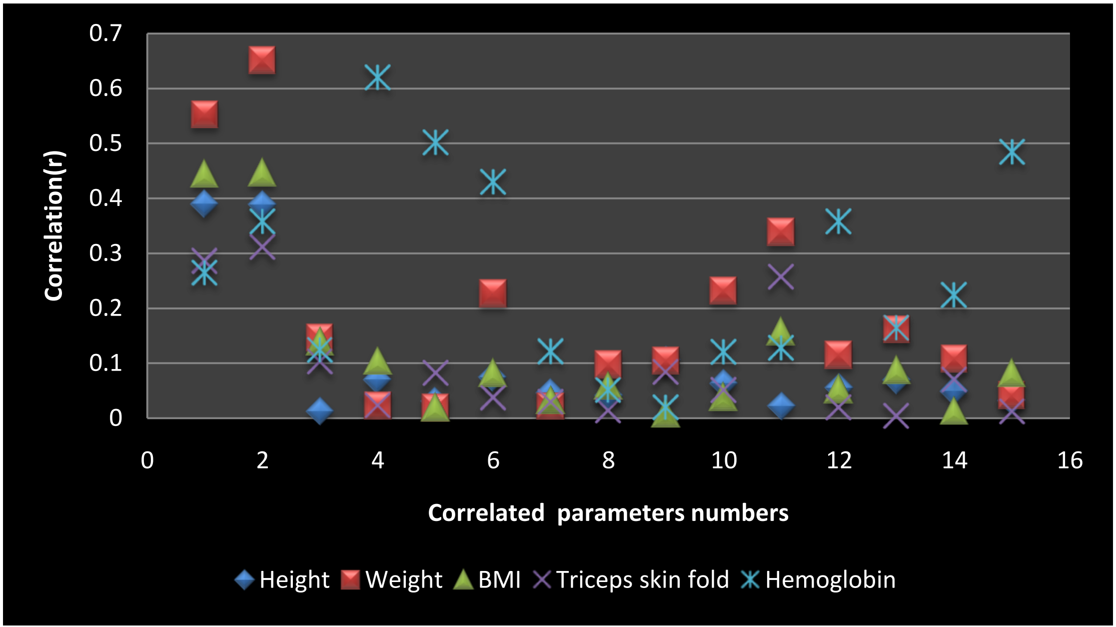


Fig. 4.18 Correlation coefficient (r) between anthropometric and other general parameters in selected adolescent girls

The data explained for correlation of different defined parameters in Table 4.43 and Figure 4.18 showed that height was positively and significantly correlated with energy (r = 0.390) and protein (r = 0.388) and non significantly to other observed variables. Weight was positively correlated with maximum of the measured variables and was most relevant with protein (r = 0.651) followed by energy (r = 0.552) and family income (r = 0.338). Basal metabolic index was also significantly correlated with energy (r = 0.285), protein and calcium (r = 0.103) intake as well as family income (r = 0.257). Hemoglobin significantly correlated to all analyzed variables expect vitamin B_6, vitamin $B_{12}$and family type. The most relevant correlation of hemoglobin was with iron supplements (r =0.620) followed by ascorbic acid intake (r = 0.483), folic acid (r = 0.429) and with other variables correlation vaired between 0.124 – 0.358.

Goswami (2008) reported that hemoglobin was significantly (P≤0.005) and positively correlated to protein and iron (r=0.296 and 0.35). Similarly Singh (2014a) reported that weight vs energy and weight vs protein had positive relation in both seasons (winter and summer) also reported hemoglobin and iron intake in both season also strong positive correlated

5. SUMMARY AND CONCLUSIONS

Anemia is a global as well as national nutritional deficiency disorder that is prevalent among female adolescents aged 15-19 years. Of the various management strategies, dietary intervention is considered as a safer and more feasible solution to combat anemia. The intervention requires nutrition education to improve knowledge and practices that support positive health outcomes as well as the dietary supplementation that can overcome the burden of this deficiency. Hence, present study on "Impact of dietary intervention on nutritional status of anemic adolescent girls of Kangra district (H.P.)" was planned with hypothesis that supplementation of adolescent's diet with iron rich foods and nutrition counseling will help in alleviating anemia in adolescent girls. The research investigation was carried out during 2014-2016 in three blocks of Kangra district, Himachal Pradesh viz. Baijnath, Panchrukhi and Bhawarna. One hundred subjects from the Government schools in each block were selected randomly for the purpose. The research was done in three phases. Baseline profile and nutritional profile of three hundred adolescent girls was assessed during phase-I. Phase-II constituted standardization and development of iron rich recipes using garden cress as the main iron source and nutritional and sensory evaluation of developed products. Phase-III involved evaluation of the major objective i.e. dietary intervention of moderately anemic adolescent girls and its impact assessment. The results of the present study concluded under this investigation are summarized as under:

Section-I Assessment of nutritional status of adolescent girls and prevalence of anemia

- The general profile of three hundred subjects for different age groups revealed that 37.66 per cent subjects were in age group of 12-14 years, 36.66 per cent in 15-16 years and remaining 25.66 per cent subjects were in age group of 17-18 years. Maximum adolescent girls (47.33 %) were studying in IX-X class and remaining 32.00 and 20.66 per cent were in XI-XII and VI-VIII class respectively. 61.00% of the subjects came from nuclear families and 39per cent were still living in joint family system. Most of the families (66.66 %)

comprised of four to six members, whereas 29.33 per cent comprised of more than 6 members and only 4 per cent of families had less than four members.

- Majority of the subjects (44.66 %) were at the second ordinal position while 35.66, 19.66 per cent were at first and third and above positions of birth order and majority of respondents had one to two siblings (69.66%).
- As for religion, 98.33% belonged to Hindu religion and only negligible percentage i.e. 1.66 was Sikh. The distribution of the adolescent girls on the basis of community revealed that majority of them belonged to schedule caste (SC) (44.0%) followed by other backward class (OBC) (28.00%), schedule tribe (ST) (16.00 %) and general community (12 %).
- Regarding parents education, 89.33 per cent father and 90 per cent mother of respondents were educated. As for occupation, 34 per cent of fathers were labourer, 25.66 per cent businessman, 16.66 per cent were engaged in artisan work, 10.66 per cent were agriculturist and only 6.66 per cent were in Government/private services. Maximum per cent of mothers (77.66 %) were housewives, 11 per cent were in service and remaining 10.33 per cent were doing labourer work.
- Majority of adolescent girls belonged to families having earning between 5,000 to 10,000 rupees per month followed by 35.33 per cent with family income less than 5,000.Only 6 per cent and 4.66 per cent had family income between 10,000-15,000 and more that 15,000 respectively.
- The socio-economic profile of the selected families of adolescent girls further revealed that 84 per cent of families had their own house and 16 per cent lived in rented accommodation. Of the total families surveyed, 37.33 per cent had pucca house, 35.33 had kuccha house while 27.33 lived in semi-pucca type of house. More than 50 per cent of families (61.66 %) had access to tap water while 36.33 per cent families used hand pump as a source of water. Maximum number of families owned land of which 56.66 per cent had marginal land holding followed by 24.66 per cent with small and 18.33 with medium land holding.

- Majority of selected families grew vegetables as well as fodder crops for milch animals in kharif and rabi seasons. For 29.33 per cent families, the produce was insufficient while 26.00 per cent stated that the production was self-sufficient. An equal number of respondents i.e. 4.33 per cent said that the production from their land was not only sufficient for their family but also for marketing. The cows reared were mainly of indigenous breed 15.66 per cent and 12.66 per cent were cross breed mainly Jersey and Holstein. Only 13.50 per cent families reared domestic animals viz. sheep and poultry that too of indigenous breed (9 %).
- Majority of adolescent girls were vegetarian, 41.00 per cent were non-vegetarian and only 3.66 per cent were ovatarian. Non vegetarian population was consuming mainly chicken once in a month.
- As per food pattern, 51.33 per cent of adolescent girls consumed meal whenever they want and 48.33 per cent preferred to eat at meal times. Most of the girls consumed frequently small meal (58.33 %) and 41.66 per cent had preference for heavy meal. Data regarding meals taken revealed that 98.33 per cent of adolescent subjects take dinner. A percentage of 35.33 skipped lunch and preferred to eat after school at home.
- Most preferred fast foods were chips/kurkure, pasta/ noodles and biscuits cake/ pastry in Baijnath and Bhawarna blocks. An equal preference was reported for respondents residing in Panchrukhi block.
- The information regarding fuel pattern used for cooking by the families of selected adolescent girls showed that majority of subjects used LPG to a large extent (90.66 %). Various methods viz. pressure cooking, stewing/simmering, open pan cooking, boiling and frying were adopted by 100 per cent families irrespective of blocks. Information on different types of utensils used for cooking by the selected households highlighted that all the subjects used stainless steel utensils daily, iron utensils were used occasionally by subjects and utensils of copper/brass were used in least order the families.

- The frequency scores of wheat, rice and maize was calculated as 8.92, 8.20 and 1.3 in Panchrukhi block, 8.43, 7.94 and 4.17 in Baijnath block and 8.53, 8.08 and 4.13 in Bhawarna block in winter season and 8.78, 8.18 and 3.43, 8.70, 7.89 and 1.61 and 8.86, 7.95 and 1.22 per cent in respective blocks in summer season. The mean frequency of consumption of pulses in all blocks varied from twice a month to twice a week for selected pulses. Consumption of green leafy vegetables was more in winter as compared to summer season. Mean frequency of consumption of other vegetables varied from twice a month to twice a week in both season. Consumption of fruits and milk and milk products was very low as they were consumed weekly to once a month only. Among the non vegetarian food, only eggs were consumed more frequently by the non vegetarian subjects. Poor frequency scores were obtained for nuts and oilseeds.

- The intake of cereals was less than suggested intake as evident from their per cent adequacy. Main cereals consumed were rice, wheat and maize. A significant ($p<0.05$) difference in consumption of pulses was observed among the selected respondents. As evident from the values, Baijnath block respondents had lowest adequacy and highest being in Bhawarna households.

- The per cent adequacy of other vegetables intake was lowest in Baijnath block (88.42) followed by Panchrukhi (92.30) and Bhawarna (95.71). The intake of green leafy vegetables was very low i.e. below 50 per cent of adequacy. The average fruit intake was recorded as 35.50 ± 2.42, 29.57 ± 2.44 and 40.15 ± 2.40 g in Panchrukhi, Baijnath and Bhawarna blocks. Sugar and oils was close to suggested dietary intake values for Panchrukhi and more than suggested intake for Baijnath and Bhawarna blocks.

- The mean daily intake of energy in Panchrukhi, Baijnath and Bhawarna block was 1990.62 ± 25.65, 1819.31 ± 28.68 and 2167.77 ± 31.13 kcal respectively. Mean daily protein intake was lower than RDA calculated as 38.57±0.73, 34.49±0.76 and 48.60±0.71g in selected blocks of Panchrukhi, Baijnath and Bhawarna.

- Fat intake revealed a higher consumption by the subjects living in Panchrukhi, Baijnath and Bhawarna block as 40.00±0.49, 36.80±0.52 and 47.08±0.59g with per cent adequacy 125, 115 and 147.12.The data of micro nutrients i.e. vitamin and minerals intake was lower than the recommended daily intake.
- Comparison of height with ICMR and NCHS standard showed that majority of subjects irrespective of age group met standard height above 90 per cent. Bhawarna block girls were above 98 per cent standard for all age groups. Mean weight when compared ICMR and NCHS standards depicted that 75.31-85.86 per cent adolescent population in selected area met the national standards and were at par with each other.
- BMI values were lower than the ICMR standard i.e. <90 per cent in all the three selected blocks with variation of 80.91 to 89.61 per cent. Most of the respondents had moderate thinness (BMI 14.00-16.99).followed by mild thinness (BMI 17.00-18.49) and severe thinness (BMI <14.00). Only 13, 10 and 14 per cent adolescents had by normal nutritional status in order.
- Values of triceps skin fold thickness in Panchrukhi, Baijnath and Bhawarna for age group 12-14, 15-16 and 17-18 year was recorded as 7.98±0.41, 6.65±0.39 and 7.32±0.27 mm, 7.53 ± 0.52, 6.89±0.29 and 9.71±0.51 mm and 9.65±0.05, 7.35±0.43 and 8.12±0.64 mm respectively. Equal proportion of the population in all the three selected blocks were on either side of calorie balance i.e. 15.33 per cent had adequate reserves (16.5-10.0) and 15 per cent had severely depleted reserve. Maximum girls i.e. 69.66 per cent were in borderline stage (9.95-5.00).
- General appearance of the subjects revealed that majority (87 %) were mesomorphic. Thiamine and niacin deficiency was prevalent in studied population. Symptom of angular stomatitis, cheilosis and magenta tongue were prevent asserting riboflavin deficiency. Vitamin C deficiency was evident from symptoms of easy fatigue and listlessness felt by the subjects as well as reporting of spongy and bleeding gums and tender bone.

- For symptoms of iron deficiency, maximum subjects felt lethargy/fatigue on doing work (40 %) thereby reducing their productivity and output. Most of the subjects were at par in relation to recorded symptoms of lack of concentration (36.33 %), tachycardia (36.66 %) and feeling cold hand and feet (33.33 %). 82 and 47 respondents out of 300 had pale conjunctiva and pale skin while 71 experienced breathlessness on slight exertion thereby, feeling dizzy and weak (25 %) and also experienced headache (22.33%).
- Walking was the sole daily activity performed by 100 per cent adolescent girls residing in the selected blocks. The availability of mass media resources showed that majority of the subjects had accessibility to books (96.00%) followed by newspaper (52%) and magazines (14%). Electronic media data revealed that maximum selected families had television (98.66 %) followed by computer (49.33%) and radio (32.00%). The subjects liked entertaining theme program (96.33%) on media.
- Information on frequency of fever, illness or any disorder/ ailment elucidated that 38 per cent of total girls had fever sometime (38%) while 34.33 per cent rarely had fever.
- Intake of vitamins and minerals supplementation by adolescent girls showed that only 66.66 per cent of total adolescent girls were taking iron and folic acid tablets having composition of 100mg elemental iron and 500µg folic on weekly basis in tablet form. Only 69 per cent of adolescent girls were taking deworming medicine that too once a year.
- Majority of adolescent girls were found to attain menarche in the age of 12 to 15 years. A total of 60.00 per cent subjects had irregular menstrual cycle. Premenstrual symptoms of vomiting (31.66%) backache (23.66 %) nausea (10.66 %) and abdominal pain (31.66%) were reported. 42 per cent of the girls had 4-5 days flow during the cycle followed by 32 per cent having duration of 2-3 days of flow that was normal(76.33%) in volume during the day.
- The information regarding previous three academic sessions observed that 38.66 per cent secured C grade. Majority of subjects (68 %) studied at home

for 1-3 hrs per day. They showed interest in extra-curricular activities and participate actively in sports (45 %) cultural (44.33 %) and less in other physical activity (14.33 %). Regarding peer behavior, 67.33 per cent like to make friends and play with them (86.66 %) of which 48 per cent played daily, 22 per cent weekly and 15.66 per cent occasionally. Knowledge and perceptions regarding anemia data revealed that very less respondent aware about anemia problem.

Section-II: (Development and standardization of products)

- Ash, fibre, fat and protein content were 4.95, 24.96, 9.72 and 26.31 per cent respectively in whole seeds that reduced to 4.72, 23.34, 7.59 and 24.17 per cent respectively in treated seeds. Treated seeds had higher moisture and total carbohydrates content as compared to whole seeds. Calcium, potassium, sodium and phosphorus content was assessed in whole (391.27, 1449.20, 24.63 and 613.17mg per 100g) and treated seeds (239.37, 1328.00, 36.86 and 514.30mg per 100g) respectively. Soaking, drying followed by roasting treatments led to 6.86, 11.05 and 49.41 per cent increase for copper, zinc and sodium levels.

- Roasting of garden cress increased the total iron content as well as *in-vitro* iron profile in treated seeds. The total iron, *ionisable* iron, soluble iron and per cent *bio-availability* of iron was analyzed higher in treated seeds and lesser in whole garden cress seeds i.e.138.37mg/100g, 32.43mg/100g, 120.00mg/100g, 15.85 per cent and 109.10mg/100g, 21.37mg/100g, 81.22mg/100g, 10.77 per cent respectively. Garden cress seeds are rich source of protein, dietary fiber and minerals along with better bioavailability of iron.

- In *ladoo,* all the proximate parameters like ash (2.10 %), crude fat (23.97 %), crude fibre (1.43 %), crude protein (9.55 %) were significantly higher in variant-2 i.e. treated garden cress seeds incorporated *ladoo* except moisture (7.93 %) and carbohydrates (55.02 %). Similarly in *mathri*, variant-2 was analysed with high content of ash (2.27 %), crude fat (36.24 %), crude fiber (6.95 %) and crude protein (10.44 %). On the same lines, 0.95, 32.15, 0.80, 5.16 and 2.23, 27.02, 1.84 and 6.80per cent of ash, fat, fiber and protein were evaluated for variant -2 having more amount as compared to control and variant-1.

- In *ladoo* and *mathri* 7.08, 6.77, 51.32, 17.00, 146.21, 692.12 and 7.92, 6.06, 51.92, 79.10, 145.71, 682.71 mg/100g of copper, zinc, calcium, sodium, phosphorous and potassium were analysed on dry weight basis. On the other hand, following the same trend of texting minerals, 4.88, 4.12, 50.52, 8.60, 113.51, 482.19 and 5.77, 4.16, 50.21, 59.81, 11.71, 573.71 mg/100g were evaluated for *shakkarpare* and biscuits respectively.
- Total iron content ranged between 32.92-69.71, 35.69-65.64, 34.95-49.32 and 37.73 -59.27mg/100g for *ladoo, mathri, Shakkarpare* and biscuits for different treatments.. *In-vitro* iron content was significantly higher in variant-2 in all the recipes in which treated garden cress seed powder was used. It indicated that treated garden cress seed increased iron content in recipes.
- All the food preparations developed by incorporating garden cress seeds were found to be organoleptically acceptable by the panel of judges. No bitter after taste was sensed in variant -2 in all recipes in which processed garden cress was used whereas for variant-1 recipes had bitter after taste in which un-processed garden cress seeds were used.
- All the developed iron rich recipes viz. *ladoo, mathri*, *shakkarpare* and biscuit had mean sensory scores of 7.55 (like moderately), 7.44 (like moderately), 6.59 (like slightly) and 6.78 (like slightly), respectively. Among various developed recipes, variant-2 of *ladoo* and *mathri* was highly acceptable.

Section-III (Impact evaluation –pre and post intervention)

- The mean scores obtained in pre- test for knowledge, practice, attitude and overall impact on adolescent girls group were 42.22±2.96, 46.11±3.76, 69.67±2.60 and 52.67±2.17 per cent for control 33.33±2.43, 61.11±2.91, 73.33±2.05 and 56.63± 1.60 for experimental group-I and 29.94±1.43, 58.89±2.76 73.94±2.77 and 54.17±1.45 per cent for group-II and corresponding mean scores in post-test were 59.83±2.28, 47.17±2.47, 69.69±2.96 and 57.90.90±1.81 per cent for control, 84.17±1.76, 80.33±2.82, 83.67±3.05 and 82.89±1.80 per cent for group-I and 88.50±1.95, 82.22±2.35, 86.50±3.20, and 85.57±1.73 per cent for group-II respectively.

- Overall scenario of KAP test explained that most of the adolescent girls in group I and –II who had poor to good knowledge substantiated their information and shifted into the category of "very good". So, the extent of improvement in mean scores of experimental group was higher than the control group indicating positive impact of intervention.
- Physical fitness index score obtained during pre-test by control group, group-I and group –II was 41.27±1.34, 42.57±1.96 and 43.88±1.71 and corresponding mean values in post-test as 41.93±1.44, 99.21±1.35 and 95.51±1.07. Gain in capacity score after 4 months intervention was calculated as 0.66 in control group whereas in group-I and II, it was 56.64 and 51.63. Physical fitness rating explained that 96.66 and 30 per cent of subjects in group-I and II were rated for poor fitness and 3.33 and 20 per cent rated for fair fitness during pre intervention improved their fitness level to good and excellent fitness. There was a drastic positive shifting recorded for aerobic capacity that improved from poor to low average grade in pre-test to good and excellent category later after intervention. Only 6.66 per cent had excellent capacity after intervention in group-I. No such change occurred in adolescent girls of control group.
- The mean initial level of hemoglobin in experimental group-I was 9.31±0.12 g/dl which increase significantly ($p \leq 0.05$) to 11.44±0.12 g/dl. In group-II the initial value of 9.51±0.11 g/dl also increment significantly ($P \leq 0.05$) 10.97±0.16 g/dl at final level, whereas the mean initial level of hemoglobin increased non significantly from 9.35±0.11 to 9.84±0.20 g/dl in control group after 4 months of nutrition intervention.
- After receiving intervention for a period of 120 days, in group-I, 13.33 per cent were not anemic at all while 76.66 fall into mild anemic category, only 10 per cent did not show any improvement. Group-II respondents were imparted nutrition counseling only and 86.66 per cent remained in the same category of moderately anemic and 13.33 shifted to mild anemic category.
- Nutrition intervention had positive impact on dietary habits. Significantly increase was observed after intervention in intake of cereals and millets, pulses

and milk and milk products in group-I and group-II. Other food groups like fruits and vegetables increased but non-significantly. Intake of sugars and oils decreased slightly from initial intake. No change in dietary pattern was observed in control group.

- Nutrition intervention had also an impact on nutrient intake that increased significantly after intervention in group-I except fat and vitamin B_1. In group-II, energy, protein, calcium, iron and ascorbic acid intake increased significantly after intervention. No variation in intake of nutrients during pre and post intervention was observed in control.
- Correlation coefficient of selected parameters showed a strong positive correlation between anthropometric measurements viz. height, weight, BMI, TSF with energy and protein. Hemoglobin was also positively correlated with folic acid, ascorbic acid, food habits and iron supplements taken.

Recommendations

- Garden cress seeds contain certain anti nutrients which imparts a peppery taste and flavor and therefore a bitter and hot mouth feel. Hence, these seeds needs to be treated (soaking for 3 hrs, drying at 60°Cand roasting) to reduce these components and enhances its acceptability for their incorporation in developed products.
- Variant-2 recipe of *ladoo* and *mathri* that contained processed garden cress as major iron rich source was highly acceptable. Both these recipes i.e. 20 g preparation of *ladoo* and *mathri* provided 100 per cent RDA for iron and therefore can be included in the diet of anemic individuals to cure nutritional anemia.
- Garden cress is rich source of iron. Processing of seeds had significant effect on analyzed parameters viz. total iron, ionisable and soluble iron as well as per cent bioavailability of iron enhanced after the treatment.
- Positive impact of diet and nutrition intervention was observed on KAP scores, physical fitness index, diet and nutrient intake as well as haemoglobin levels of the adolescent girls. Majority of moderately anemic girls that

received dietary intervention as well as nutrition counselling shifted to mild anemic zone and also had normal haemoglobin at post intervention. Hence, this strongly support the impact of diet and nutrition intervention on eradicating anemia in adolescent girls.

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APPENDICES

Appendix-I

Questionnaire cum Interview Schedule for Adolescent Girls (12-18 years)

Questionnaire No.______________ Block__________________

Date________________________ Village_________________

I. General and Socio Economic Information

1. Name of the respondent____
2. Age (yrs.) __________________
   - 12-14__________________
   - 15-16__________________
   - 17-18__________________
3. Date of Birth_________________
4. Name of School____________________________________ Class______________
5. Address ____
   ____
   Contact No. : _______________________
6. Family Type: Joint/ Nuclear/Extended
   - Size of Family_________________
   - Ordinal position of the subject in the family____________________
   - No. of siblings_____________________________
7. Religion- Hindu/ Sikh/ Christian/ Muslim/ Other
8. Community- General/ OBC/ ST/ SC
9. Name, occupation and education of Parents-
   - Father____
     Occupation- Farmer/ Artisan/ Service/ Business/ Labourer/ Any other
     Education- Illiterate/ Below matric/ Matric/ Senior Secondary/ Graduate/ Post Graduate/ Technical diploma
   - Mother____
     Occupation- Housewife/ Service/ Business/ Labourer/ Any other
     Education- Illiterate/ Below matric/ Matric/ Senior Secondary/ Graduate/ Post Graduate/ Technical diploma
10. Pattern of land holding- No land/ Owned/ Rented in/ Rented out
    If land is owned/ rented in, answer these-

a) Size of land holding- ___________________________

b) Types of agriculture crops grown-

S. No	Rabi crops	Yes/No	S. No	Kharif crops	Yes/No
1.	Wheat		1.	Paddy	
2.	Oil seeds		2.	Maize	
3.	Potato		3.	Soybean	
4.	Fodder crops		4.	Fodder crops	
5.	Vegetables (winter)		5.	Vegetables (summer)	
6.	Any other		6.	Any other	
7.			7.		

c) Types of horticulture crops grown-

S. No	Crops	Yes/No	S. No	Crops	Yes/No
1.	Mango		9.	Loquat	
2.	Litchi		10.	Any other	
3.	Guava		11.		
4.	Peach		12.		
5.	Citrus		13.		
6.	Papaya		14.		
7.	Sand pear		15.		
8.	Plum		16.		

d) Produce from land- Marketed/ Self-sufficient/ In-sufficient

11. Rearing of animals-

a) Milch animals- Yes/ No

Particulars	Numbers		Yield per day	Amount used for on consumption	Amount for Sale	Monthly Income (if any)
	Desi	Hybrid				
Cow						
Buffalo						
Goat						
Any other						

b) Other domestic animals- Yes/ No

Particulars	Numbers		Purpose		Amount used for consumption (with frequency)	Monthly Income (if any)
	Desi	Hybrid	Domestication	Selling		
Sheep						
Pig						
Poultry						
Any other						

12. Monthly income of family______________________ Rs/month

13. House- Rented/ Owned

a) Type of house- Kuccha/ Semi-Pucca/ Pucca

14. Source of drinking water- Tap water/ Hand pump/ Bouri/ Well/ Any other

II. Dietary Information

1. Are you
    - Vegetarian
    - Non-vegetarian
    - Ovatarian

    If non vegetarian, which type of non vegetarian foods are usually consumed by you
    - Chicken
    - Mutton
    - Fish
    - Pork
    - Any other
2. How often do you take non vegetarian foods or egg?
    - Daily
    - On alternate day
    - Once a week
    - Once in fortnight
    - Once a month
    - Occasionally(specify)

3. Do you eat?
    - Breakfast
    - Mid morning
    - Lunch
    - Tea time
    - Dinner
    - After dinner
4. You eat
    - Whenever you want
    - At meal times
    - When you have nothing to do
5. What is your general mode of taking meals?
    - Frequent small meals
    - Few heavy meals
6. Which meal is skipped generally?
    - Breakfast
    - Lunch
    - Dinner
7. Do you bring your lunch from home? Yes /No
   If no, from where you get lunch
    - Mid-day meal
    - School canteen
    - From vendors
    - You skip lunch
8. Do you keep fast? Yes/ No
   If yes, then how many times
    - Once a week
    - Twice a week
    - Once in a fortnight
    - Once in a month
    - Once in a year
9. How many times do you take food outside home?
    - Daily
    - On alternate day
    - Once a week
    - Once in fortnight
    - Once a month
    - Occasionally
    - Never
10. Your desire to eat fast food in day
    - Never
    - Once
    - Twice
    - All time
11. Which type of food do you prefer with the influence of your peer?
    - Fried
    - Boiled
    - Baked
    - All above
    - Any Other
12. What fast food do you eat?

Food	**Daily**	**Alternately**	**Weekly**	**Never**
Chips/ Kurkure				
Samosa				

Pakora/ Bread Pakora				
Momos				
Burger/ Tikki				
Pasta/Noodles				
Patties				
Biscuits/ Cake/ Pastry				
Sandwich				
Any other				

13. Do you consume beverage?
    Yes/No
    If yes, what kind of beverages you take?

Beverage	Daily	Alternately	Weekly	Never
Coffee/ Tea				
Cold drink				
Juice				
Milk				
Lassi				
Any other				

14. Which fuel generally used for cooking in your home?
    - Chulha (wood stove)
    - Kerosene stove
    - LPG
    - Induction cooking
    - Mixed mode- Chulha (wood stove)/ Kerosene stove/ LPG/ Induction cooking
    - Any other mode
15. What is the general/ common mode of cooking food at home?
    - Pressure cooking
    - Stewing/Simmering
    - Open pan cooking
    - Boiling
    - Baking/ Roasting/ Grilling
    - Frying
    - Solar cooking
16. Which metal utensils are generally used for cooking?
    - Stainless Steel
    - Aluminum
    - Iron
    - Brass
    - Copper/ Bronze
    - Any other

III. Food Frequency Table

Food stuffs	Daily			Weekly			Monthly		
	Once a day	Twice a day	Thrice a day	Once a week	Twice a week	Thrice a week	Once a month	Twice a month	Thrice a month
1. Cereals									
Winter(Oct.-March)									
Wheat									
Rice									
Maize									
Any other									
Summer (April-Sept.)									
Wheat									
Rice									
Maize									
Any other									
2. Pulses (whole/split)									
Bengal gram									
Black gram									
Green gram									
Red gram									
Rajmah									
Lentil									
Soybean									
Any other									
Pulses(sprouted)									
Bengal gram									
Green gram									
Any other									
Pulses (roasted)									
Bengal gram									
Any other									
3. a) Green leafy vegetables									
Winter(Oct.-March)									
Spinach									
Fenugreek leaves									
Mustard leaves									
Bathua									
Radish leaves									
Coriander									
Cauliflower leaves									
Cabbage									
Any other									
Summer (April-Sept.)									
Spinach									
Colocasia leaves									
Coriander									
Amaranth									
Any other									
3. b) Other Vegetables									
Winter(Oct.-March)									
Potato									
Cauliflower									
Radish									
Carrot									
Any Other									

Summer (April-Sept.)									
Bitter gourd									
Bottle gourd									
Pumpkin									
Beans									
Any Other									
4. Fruits									
Winter(Oct.-March)									
Apple									
Banana									
Peach									
Guava									
Amla									
Pear									
Lemon									
Orange									
Papaya									
Grapes									
Mango									
Sugarcane									
Any other									
Summer (April-Sept)									
Apple									
Banana									
Peach									
Guava									
Amla									
Pear									
Lemon									
Orange									
Papaya									
Grapes									
Mango									
Sugarcane									
Any other									
5. Milk and milk products									
Milk									
Curd									
Cheese									
Any other									
6. Animal Foods									
Egg									
Chicken									
Fish									
Mutton									
Any other									
7. Nuts & oilseeds									
Groundnuts									
Sesame									
Almonds									
Coconut									
Any other									
8. Jaggery and Sugar									

IV. Food and Nutrient intake for three consecutive days (24 hours dietary recall method)

Meal	Menu	Quantity cup/spoon	Ingredients	Amount ml/g
Day I				
Early Morning				
Breakfast				
Midmorning				
Lunch				
Evening tea				
Dinner				
After dinner				
Day II				
Early Morning				
Breakfast				
Mid morning				
Lunch				
Evening tea				
Dinner				
After dinner				
Day III				
Early Morning				
Breakfast				
Mid morning				
Lunch				
Evening tea				
Dinner				
After dinner				

V. Analysis of 24-Hour Dietary Recall Data

Day	Nutrient Intake Per Day				
	Energy (Kcal)	Protein (g)	Fat (g)	Carbohydrate (g)	Iron (mg)
I					
II					
III					
Mean daily nutrient intake					

Day	Nutrient Intake Per Day				
	Vitamin C (mg)	Folic acid (µg)	Vitamin B12 (µg)	Vitamin A (µg)	Pyridoxine (mg)
I					
II					
III					
Mean daily nutrient intake					

VI. Anthropometric Assessment

Height (cm)____________________________________

Weight (kg)____________________________________

Triceps Skinfold Thickness (mm)__________________

VII. Biochemical Assessment

Hemoglobin level ___________________________________g/dl

VIII. Assessment of Nutritional Deficiencies (Clinical Assessment)

1. General Appearance
    - Endomorphic
    - Mesomorphic
    - Ectomorphic
2. Protein Calorie Malnutrition
    - Diminished subcutaneous fat
    - Muscle wasting
    - Oedema in ankles
    - Hair (Dyspigmentation, Easy pluckability, Thin sparse)
    - Diffuse pigmentation of the skin
    - Moon face
    - Flaky-paint dermatosis
3. Vitamin A deficiency
    - Night blindness
    - Conjunctival xerosis
    - Keratomalacia
    - Xerosis of skin
    - Follicular hyperkeratosis type-I
4. Vitamin D deficiency
    - Frontal or parietal bossing
    - Knock knees or bow legs
5. Thiamine deficiency
    - Oedema
    - Loss of ankle & knee jerks
    - Calf-muscle tenderness
6. Riboflavin deficiency
    - Angular stomatitis
    - Angular scars
    - Cheilosis
    - Magenta tongue
7. Niacin deficiency
    - Scarlet & raw tongue
    - Atropic lingual papillae
    - Tongue fissuring
8. Vitamin C deficiency
    - Spongy & bleeding gums
    - Tender bone
    - Easy fatigue and listlessness
9. Iron deficiency
    - Breathlessness on slight exertion
    - Pale conjunctiva
    - Paleness of skin
    - Paleness and smoothness of tongue/ Burning tongue
    - Spoon shaped nails
    - Feeling of lethargy/ Fatigue
    - Weakness/ Dizziness
    - Lack of concentration/ memory problems
    - Disrupted sleep
    - Tachycardia

- •Decrease physical activity
- •Poor physical development
- •Cold hand and feet
- •Oedema of feet
- •Loss of appetite
- •Irritable and restless
- •Headache
- •Decreased exercise tolerance
- •Increased incidence of infections
- •Angular cheilosis
- •Sudden fainting
- •Glossitis
- •Hair loss

10. Iodine deficiency
    - •Thyroid enlargement
    - •Feeling of lethargy
    - •Poor cognitive and mental development

IX. Activity Pattern

1. In the morning do you go for-					
Activity	**Daily**	**Alternatively**	**Weekly**	**Fortnightly**	**Rarely**
Walking					
Cycling					
Skating					
Yoga/ Gym					
Nothing					
Any other (Specify)					
2. How much time do you spend for doing exercise?					
Nil					
<10min.					
10-15 min.					
15-30 min.					
30-45 min.					
45-60 min.					
>1hr.					
3. How do you go to school?					
Walking					
Bus					
Cycle					
Scooter					
Dropped by parents					
4. How much time do you spend on media?					
TV					
Radio					
Newspaper					
Magazine					
Computer/ internet					
Mobile					
Any other (Specify)					
Total					

X. General Health Record

1. Do you have family history of any metabolic disease? Yes /No

A) If yes, specify,
- Diabetes
- Chronic heart disease
- Obesity
- Any other

B) If yes, specify relationship with
- Mother
- Father
- Sister
- Brother
- Any other

2. Do you have family history of any deficiency disease? Yes/ No

A) If yes, specify,
- Anemia
- Iodine deficiency
- PEM
- Osteoporosis
- Any other

B) If yes, specify relationship with
- Mother
- Father
- Sister
- Brother
- Any other

3. How often did you fall ill during last one year?

Sr. No	Illness	Frequency of illness (Last one year)
1.	Fever	
2.	Cold/ Respiratory disorders	
3.	Diarrhea/ Stomach infection/ Nausea/ Vomiting	
4.	Headache/ Body ache	
5.	Tiredness	
6.	Loss of Appetite and lethargy	
7.	Any other ailment	

4. Do you take any medicine? Yes/ No
If yes, for what ailment___________________________

XI. Supplementation

1. Have you ever received or receiving medicinal iron-folic acid supplementation? Yes/No
If yes, in what form- Tablet/syrup
Composition____
How many days____

How often do take them? Daily/ Weekly/ Monthly

2. Where did you take iron supplement?
- Anganwadi (Kishori Shakti Yojna)
- School(Weekly Iron and Folic acid Supplementation)
- Primary health centre
- Any other

3. Have you ever received deworming medicine? Yes/No
If yes, How many times in a year and what interval?
Time___________________________ Interval______________________

4. Have you ever received medicines other than iron supplementation? Yes/No

If yes, in what form Tablets/syrups
Name of Ailment____
Supplement names____
Composition____
How many days____

XII. Menstrual History

1. Do you have menstrual cycle setup? Yes/ No
If yes, answer these,
2. Age of Menarche ________________

3. Your menstrual cycle - Regular / Irregular
If irregular, how many days +______days/ -_______days

4. Duration of your menstrual cycle: _______________days (>28days/ <28days)

5. Premenstrual Syndrome- Vomiting / Nausea / Abdominal Pain / Backache

6. Do you feel stress/ anxiety during your periods? Yes/No

7. Duration of Blood Flow: ___________days

8. Menstrual flow is normal / above normal / below normal

9. Did you check your Hb in last 6 months? Yes/No
If yes, value of Hb__________________________

XIII. Academic, Cultural, Social and Sport Participation

1. Percentage obtained in the previous three classes / aggregate marks by the end of academic session

Academic Session	Class	Percentage of Marks

If failure in any class, specify reasons
- Illness
- Family issues
- Personal reasons
- Any other

2. How many hours do you study at home? ________________
3. Do you participate in extracurricular activity in your school? Yes/ No
If yes, specify
- Cultural activity
- Sports
- Physical activity
- Any other

4. Do you have any achievement/ award? Yes/No
If yes, specify
- Academic
- Culture
- Physical/Sports
- Any other

5. If yes, specify position ________________
6. Do you like to make friends? Yes/ No
7. Do you play with friends? Yes/ No

If yes when
- •Daily
- •Weekly
- •Monthly
- •Occasionally

XIV. Mass Media Exposure

1. Source of mass media available to you-
   - •Print Media- Newspaper/ magazines/ books/ any other
   - •Electronic Media- Radio/ TV/ computer/ any other
2. Which mode of media do you prefer?
   - •Print media
   - •Electronic media
   - •Both
3. In which language you like to read the printed media?
   - •Hindi
   - •English
   - •Any other
4. What type of material do you like in above mentioned media?
   - •Literary
   - •Scientific
   - •Entertainer
   - •Health related
   - •Any other

XV. Knowledge Regarding Anemia

1. Have you ever heard of the problem of anemia before? Yes/ No
2. Do you get/ come across any information on iron deficiency anemia? Yes/ No
   If yes, what is the source of information?
   - •Friends
   - •Family members
   - •School
   - •Medical worker
   - •TV
   - •Newspaper/ magazine
   - •Radio
   - •Leaflet/ posters
   - •Other
3. Are health programmes organized in your school? Yes/ No
   If yes, specify the theme of programmes organized recently
   ____
4. Is there any topic related to anemia in your study books? Yes /No
   If yes, what do you understand from that topic?
5. Have you read any topic on "Importance of green leafy vegetables in our diet" in study books/ newspaper/ magazine? Yes/No
   If yes, what do you understand from that topic?
6. Do you know foods which contain good amount of iron? Yes/No
   If yes, Specify foods
7. Do you know about citrus fruits? Yes/No
   If yes, which vitamin is present in citrus fruit?
8. Do you know absorption of iron in diet is enhanced by vitamin C? Yes /No
9. Do you consume tea/ coffee after meals? Yes /No
10. Do you know tea and coffee should not be taken with meal? Yes/No
    If yes, what could be the reasons?
11. Do you frequently suffer from worm problem? Yes/ No
12. Do you think females are more vulnerable to anemia as compared to males? Yes/No
    If yes, what could be the reasons?
13. Do you take interest in studies? Yes/No

14. Do you face problem in understanding the lecture when delivered by teacher in class room? Yes/No

    If yes, how do you mange to understand that lecture?
    - Do at home thyself
    - By parents help
    - By peers help
    - Ask the teacher again
    - Ignore
15. Do you know that lack of concentration/ interest in study is sign of anemia? Yes/ No
16. Do you feel tired quickly after playing or doing some work? Yes/ No

    If yes, duration____

    ____

    ____
17. Are you aware that frequent fatigue and breathlessness are symptoms of anemia? Yes/No
18. Do you know other prominent symptoms of anemia? Yes/No

    If yes, specify –
19. Do you know anemia can be prevented? Yes/No

    If yes, what are the anemia prevention measures?
20. Do you know weekly iron and folic acid supplements are given to you for the prevention of anemia? Yes/No

    If yes, what is the dosage given-

    And when-
21. Do you know some schemes/ agencies launched by Government of India for control of anemia? Yes/No

    If yes, what are these?

Appendix-II

CONSENT FORM FOR PARENT TO PARTICIPATE IN RESEARCH STUDY

Mr/Ms____

I request you to enroll your daughter in research study entitled, **"Impact of dietary intervention on nutritional status of anemic adolescent girls of Kangra district (H.P.)"** conducted by Ms. Preeti Choudhary, research scholar under the guidance of Dr. (Ms) Radhna Gupta, Associate Professor, Dept of Food Science, Nutrition and Technology College of Home Science, CSKHPKV, Palampur.

I request you to allow your daughter to participate in the study. This study will help to understand the causes and problems due to anemia in young girls. During the study, she will be asked some questions about the anemia and her hemoglobin level will be also be measured with the help of trained medical staff. If she is found to be moderately anemic,she may be allowed for dietary intervention programme scheduled for a period of three months.

Particulars	Name	Signature\Thumb print
Participants		
Parent's/ Guardians		
Investigator's		

Appendix-III

Permission letter to school Principal for conduct study

To

____

____

Subject: Request for permission to conduct part of research study in your school

Respected sir,

I would like to inform you that I am Ms. Preeti Choudhary, student of 2nd Year Ph.D programme, Department of Food Science, Nutrition and Technology, College of Home Science, CSKHPKV, Palampur. Sir, my research study is on, **"Impact of dietary intervention on nutritional status of anemic adolescent girls of Kangra district (H.P.)"** The main objective in the research study is to examine the prevalence of iron deficiency anemia in selected adolescent girls and to study the impact of nutritional intervention on health and nutritional status of anemic respondents. This research project will be conducted under the guidance of Dr. (Ms) Radhna Gupta, Associate professor, Deptt. of Food Science, Nutrition and Technology, College of Home Science, CSKHPKV, Palampur.

Prior to undertake the study, I need your consent to approach the adolescent girls (12-18 years) of your school to take part in the study.

I assure you Sir, that I will make every effort to ensure that the research study does not disrupt the working environment or student's lectures in any way and any data collected will remain confidential. I have gained approval for the study from the Dean, Post Graduate Studies, CSKHPKV, Palampur. I hope this program will be of great benefit to everyone involved.

Thank you for your time and consideration in this matter.

Yours Sincerely,

Preeti Choudhary
Ph.D. (Food Science and Nutrition)
Deptt. of Food Science, Nutrition & Technology
COHS, CSKHPKV, Palampur

Appendix-IV

Evaluation Card for Hedonic Rating Test for Food Products
Name: __________________
Product: ________________ Dated: ______________

Please evaluate the food samples presented to you and check how much you like or dislike each one for a particular attribute. Use the point that best describe your feeling about the sample. Please give reason for your attitude. An honest expression of your personal feeling will help us in assessing the organoleptic acceptability of samples presented to you for evaluation:

Sample code	Colour	Flavour	Texture/consistency	Overall acceptability	Remarks, if any

Signature: _______________

Expression	Points to be assigned
Liked extremely	9
Liked very much	8
Liked moderately	7
Liked slightly	6
Neither liked or disliked	5
Disliked slightly	4
Disliked moderately	3
Disliked very much	2
Disliked extremely	1

Appendix-V

Block	**Name**________________________________ **Name of school**___________________________	**Class**________________ **Section**______________
Group No.	**Name of village**___________________________ **Father's Name**___________________________	**Date**________________ **Age**_________________

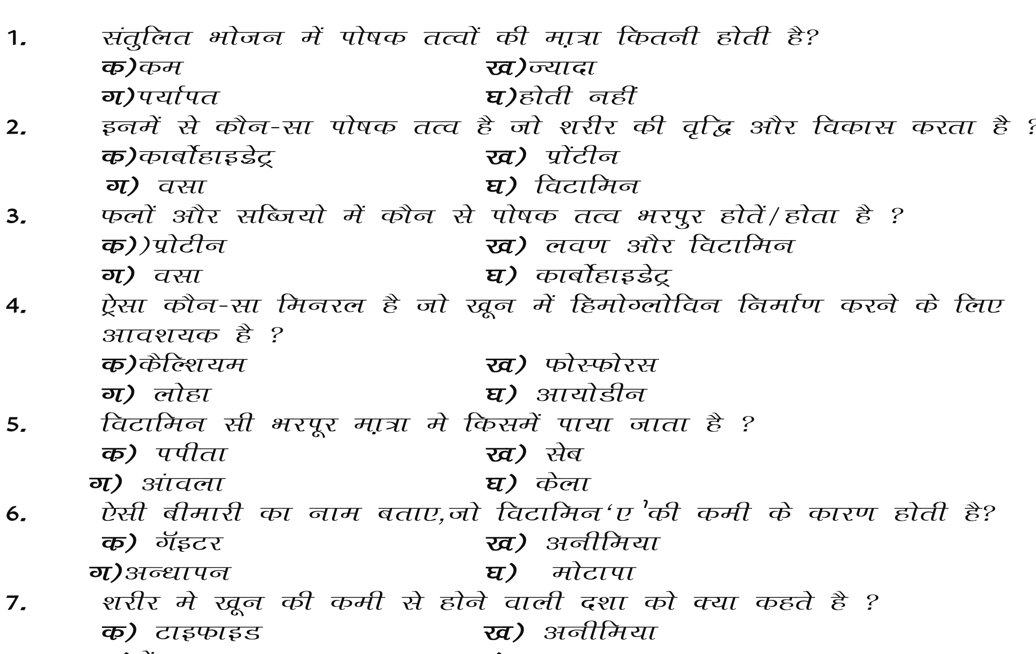
Inventory Schedule for Assessment of Nutritional Knowledge

Note: Tick only one answer of once. Do not over cut.

Sr.No	(I) **Practice Test**	हाँ	नहीं
1.	क्या आप सब्जियों को काटने से पहले धोते हैं?		
2.	क्या आप आंवला, अमरुद, नीबू और संतरा खाने के साथ लेते हो?		
3.	क्या आप खाना लोहे के बर्तनों मे पकाते हैं ?		
4.	क्या आप हरी पत्तेदार सब्जियां जैसे चौलाई, पालक, सरसो इत्यादि खाते हैं?		
5.	क्या आप खाना खाने के साथ या बाद मे चाय/कॉफी पीते हैं?		
6.	क्या आप मिट्टी या चॉक खाते हैं?		
7.	क्या आप पेट के कीडेमारने की दवाई लेते हो?		
8.	बिना चप्पले या जुते के खेतो में या घर में काम करना पंसद करते हैं?		
9.	बिना हाथ धोए अक्सर खाना खा लेते हैं?		
10.	क्या आप साल मे कम से कम एक बार खून की जांच करवाते हो?		
11.	क्या आप सलाद के साथ नीबू का रस प्रयोग मे लेते हैं?		
12.	क्या आप फल सब्जियो को बिना धोए खाना पसन्द करते हैं?		
13.	क्या आप मासिक धर्म में रोज नाहते हो?/ क्या आप रोज नाहते हो?		
14.	क्या आप हमेशा साफ रुमाल अपने पास रखते हो?/क्या आप मासिक दरम के दौरान 2-3 बार स्वछ नैपकिन बदलते हैं?		
15.	क्या आप अपने अदंरुनी वस्त्र रोज बदलते हैं?		

Sr. No	II **Attitude Test**	सहमत	असहमत	पता नहीं
1.	संतुलित भोजन अच्छी सेहत के लिए जरुरी है।			
2.	ठरी पत्तेदार संब्जिया हमें रोज खानी चाहीए।			
3.	मांसाहारी भोजन प्रोटीन का अच्छा स्त्रोत है			
4.	अनीमीया सीधा हमारे कार्य करने की क्षमता पर प्रभाव डालता है।			
5.	मेथी, पालक, चौलाई आदि सब्जियां शरीर को आवयक तत्व देती है।			
6.	भोजन करते समय चाय/कॉफी साथ मे पीनी चाहिए।			
7.	लोहे के बर्तन मे खाना बनाने से लौह लवण की मात्रा बढ जाती है।			
8.	लौह तत्व खून बनाने के लिए सहायक है।			
9.	किशोरी लडकियों को संतुलित आहार की आवशयकता नहीं होती है।			
10.	आयॅरन एवम फोलिक एसिड की कमी से अनीमिया हो जाता है।			
11.	अगर भोजन को ढक कर नहीं पकाया जाए तो उसके पोषक तत्वों को कोई हानि नहीं होती है।			
12.	मांसाहार भोजन में लौह लवण का सवसे अधिक अवशोषण होता है।			
13.	पर्याप्त मात्रा मे भोजन खाने से अनीमिया से बच सकते है।			
14.	पेट के कीड़े मारने की दवाई समय- समय पर लेना आवशयक है।			
15.	अनीमिया दूर करने के लिए आयरन की गोलियों का पूरा कोर्स करना आवशयक है।			

III) Knowledge Test:



1. संतुलित भोजन में पोषक तत्वों की मा़त्रा कितनी होती है?
   क)कम **ख)**ज्यादा
   ग)पर्यापत **घ)**होती नहीं
2. इनमें से कौन-सा पोषक तत्व है जो शरीर की वृद्वि और विकास करता है ?
   क)कार्बोहाइडेट्र **ख)** प्रोटीन
   ग) वसा **घ)** विटामिन
3. फलों और सब्जियो में कौन से पोषक तत्व भरपुर होतें/होता है ?
   क))प्रोटीन **ख)** लवण और विटामिन
   ग) वसा **घ)** कार्बोहाइडेट्र
4. ऐसा कौन-सा मिनरल है जो खून में हिमोग्लोविन निर्माण करने के लिए आवशयक है ?
   क)कैल्शियम **ख)** फोस्फोरस
   ग) लोहा **घ)** आयोडीन
5. विटामिन सी भरपूर मा़त्रा मे किसमें पाया जाता है ?
   क) पपीता **ख)** सेब
   ग) आंवला **घ)** केला
6. ऐसी बीमारी का नाम बताए,जो विटामिन'ए'की कमी के कारण होती है?
   क) गॅइटर **ख)** अनीमिया
   ग)अन्धापन **घ)** मोटापा
7. शरीर मे खून की कमी से होने वाली दशा को क्या कहते है ?
   क) टाइफाइड **ख)** अनीमिया
   ग)घेंघा **घ)** रक्तचाप

8. अनीमिया के शरीर में क्या चिन्ह और लक्षण हैं ?
   क) थकान/साँस फूलना **ख)**लकवा
   ग)कुष्ठ रोग **घ)** गूंगापन व बहरापन
9. लौह लवण के उतम अवशोषण के लिए भोजन के साथ निम्न पदार्थ का सवेन नहीं करना चाहिए ?
   क) गन्ने का रस **ख)** शिकंजी
   ग)फलो का रस **घ)** चाय व कॉफी
10. निम्न भोज्य पदार्थो मे से कौन आयरन का अच्छा स्त्रोत है ?
   क)हरी पतेदार सब्जियां **ख)**घी/तेल
   ग)चीनी/मीठी वस्तुए **घ)** दूध/दही से बने पदार्थ
11. अनीमिया से स्त्रियों में क्या परिणाम निकलते है ?
   क) गर्भपात या जच्चा की मृत्यु **ख)** स्वस्थ जच्चा व बच्चा
   ग)घेंघा रोग **घ)** अन्धापन
12. अनीमिया की रोकथाम करने के लिए सरकार द्वारा दी जाने वाली इनमें से कौन सी सहायता है ?
   क) सब्जिया देना **ख)** चावल देना
   ग) लिहे तत्व की गोलिया देना **घ)** गेहूं देना
13. खाना पकाने की सबसे अधिक अच्छी विधि कौन-सी है ?
   क)उबालना **ख)** प्रेशर कुकर में पकाना
   ग) तलना **घ)** भूनना?
14. खमीरीकरण व अंकुरीकरण करने से कौन से विटामीन भोजन में बढते है?
   क)विटामीन ए **ख)**विटामीन सी व बी
   ग)विटामीन डी **घ)**विटामीन के
15. कौन सा पोसक तत्व अधिक पकाने तथा पके हुय भोजन क पानी निकाल देने से नस्ट होता है?
   क) वसा **ख)** विटामिन बी
   ग)प्रोटीन **घ)**कार्बोहाइड्रेट्र

Appendix-VI

(i) POWER POINT PRESENTATIONS

अनीमिया

- अनीमिया, वह स्थिति है, जिसमें रक्त में हीमोग्लोबिन का स्तर सामान्य से कम हो जाता है। इसे 'आयरन की कमी' या 'खून की कमी' भी कहा जाता है।
- आयरन हमारे शरीर में लाल रक्त कोशिकाओं का निर्माण करता है। ये कोशिकाएं ही शरीर में हीमोग्लोबिन बनाने का काम करती हैं। इसलिए आयरन की कमी से शरीर में हीमोग्लोबिन की कमी हो जाती है
- हीमोग्लोबिन कम होने से शरीर में ऑक्सीजन की कमी होने लगती है क्योंकि हीमोग्लोबिन ही फेफड़ों से ऑक्सीजन लेकर रक्त में ऑक्सीजन पहुंचाता है।
- यदि रक्त में पर्याप्त हीमोग्लोबिन की कमी हो, तो शरीर के अंगों और ऊतकों को सही मात्रा मे ऑक्सीजन नहीं मिल पाएगी।

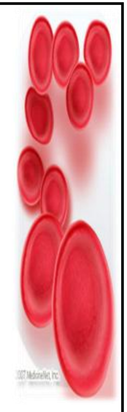
अनीमिया कैसे होता है

- भोजन में पौष्टिक तत्वों या आयरन, विटामिन, लवणों तथा प्रोटीन की कमी से
- पेट के कीड़े, मलेरिया आदि रोग से
- महिलाओं में अधिक माहवारी आने, दुर्घटना आदि में चोट लगने पर खून बहने से
- एसिडिटी की दवाई व दर्द निवारक दवाइओ का अधिक सेवन से
- पौष्टिक व संतुलित भोजन का सेवन न करने से

किशोरावस्था में एनीमिया के दुष्प्रभाव

- **किशोरावस्था** में एनीमिया होने के दुष्प्रभाव एक व्यक्ति के पूरे जीवन में दिखाई पड़ता है। इससे कार्यक्षमता पर दुष्प्रभाव पड़ता है। भूख कम होने लगती है और सही पोषण नहीं मिलने से आयु के अनुसार शारीरिक वृद्धि नहीं हो पाती है। युवतियों में एनीमिया आगे जाकर उनकी गर्भावस्था को भी प्रभावित करता है और वह असुरक्षित मातृत्व के दौर से गुजरती है। यही कारण है कि यहां पर उच्च मातृत्व मृत्यु दर है। उनके बच्चे भी कम वनज के पैदा होते है, और कुपोषण का शिकार हो जाते हैं।

हीमोग्लोबिन स्तर



- हीमोग्लोबिन स्तर 11 ग्राम/डेसीलीटर रक्त से कम होने पर एनीमिया माना जाता है। हीमोग्लोबिन के विभिन्न स्तर हैं:
- 10 से 10.9 ग्राम/डेसीलीटर रक्त तक हल्का एनीमिया
- 7 से 9.9 ग्राम/डेसीलीटर रक्त तक मध्यम स्तर का एनीमिया
- 7 ग्राम/डेसीलीटर रक्त से कम होने पर गंभीर एनीमिया

अनीमिया से प्रभावित

4 मास से 6 वर्ष के बच्चे

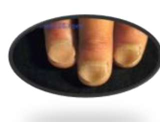
गर्भवती महिलायें

11 -18 वर्ष की किशोरियां

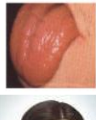
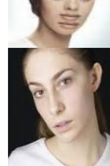
बच्चे को दूध पिलाने वाली माताएं

खून की कमी के लक्षण

- आंखें पीली हो जाना
- कमजोरी और थकावट महसूस होना
- त्वचा व नाखूनों का पीला होना
- हाथों और पैरों का ठंडा होना
- हृदय की धड़कन तेज या असामान्य होना
- थकान, चिड़चिड़ापन और ऊर्जा में कमी



- सांस लेने में कठिनाई, कमजोरी और चक्कर आना
- पलकों और नाखूनों का फीका पड़ना, कई बार नाखूनों का चम्मच जैसा आकार हो जाना
- जीभ में पीड़ा और मुँह में अजीब स्वाद आना
- बालों का झड़ना और ठंड सहन न कर पाना

अनीमिया के परिणाम

- किसी काम में मन न लगना और एकाग्रता की कमी
- शरीर में थकावट महसूस होना
- बार-बार बीमार पड़ना
- प्रसव की समयः माता की मृत्यु
  - बच्चे का समयः से पूर्व जन्म
  - काम वजन वाले बच्चे का जन्म
  - बार- बार संक्रमण रोगों की होने का खतरा

बच्चों में खून की कमी की परिणाम

- बच्चे का जल्दी थक जाना , जिससे खेल - कूद में भाग नहीं लेना
- बार-बार बीमार होना
- पढ़ाई में ध्यान नहीं लगना

अनीमिया क दूर करने की लिए क्या करें?

1) खान- पान-

- अण्डा, मांस, मछली और मुर्गा का सेवन करें
- आयरन युक्त आहार जैसे बाजारा, खजूर, गुड़, अंकुरित दालें, हरी पत्तेदार सब्जियां (जैसे पालक, मैथी, बथुआ) अण्डा, माँस, मछली इत्यादि का सेवन ज्यादा से ज्यादा करना होगा। विटामिन "सी" युक्त खाद्य पदार्थ जैस- नींबू, आंवला, संतरा, अमरूद आदि लेने से आयरन के अवशोषण की क्षमता बढ़ जाती है।

रहन- सहन

- कुछ भी खाने से पहले व बाद में तथा शौच की बाद हाँथ अच्छी तरह से धोएं
- जमीन पर हमेशा जूता- चप्पल पहन कर चलें
- खेल - कूद कर या खेत में काम करने की बाद साबुन से हाथ धोए
- उंगलिओ के नाख़ून काट कर रखें
- तांबे के गिलास या जग में पानी रखा पीएं
- लोहे की कढ़ाई / पतीले में दाल सब्जी पकाएं, तांबे या कांसे के बर्तनों में खाएं तथा सब्जी,फल आदि काटने के लिए लोहे का चाकू प्रयोग करें

एनीमिया को दूर करने के लिए क्या न करें

खान- पान

- खाने के साथ चाये या कॉफी न लें
- दूध के साथ खून बढ़ाने की गोलिया न लें
- कैल्शियम और आयरन की गोलियां एक ही समय पर नहीं लेनी चाहिए।
- आयरन से भरपूर भोजन के साथ विटामिन सी का सेवन आयरन का अवशोषण करने में शरीर की मदद करता है।

रहन- सहन

- नंगे पांव न चलें
- चाक - मिटटी आदि खाने से बचें
- सप्ताह में दो बार नखून काटें दांतो से नाख़ून न काटें

आयरन की खुराक कैसे लेनी चाहिए

- आयरन की गोलियों को खाली पेट लेना सबसे अच्छा होता है। परन्तु दुष्प्रभाव कम करने के लिए आप उन्हें भोजन के बाद भी ले सकती हैं।

  यह बात ज़रूर ध्यान में रखें कि दूध का कैल्शियम और चाय व कॉफी में मौजूद टैनिन आयरन के अवशोषण को कम करते है। इसलिए कैल्शियम और आयरन के सप्लीमेंट एक साथ न लें।
- विटामिन सी आयरन को अवशोषित करने में मदद करता है। इसलिए आप संतरे, निम्बू पानी या आंवला का रस इन गोलियों के साथ ले सकती हैं। आयरन का अवशोषण बढ़ाने के बारे में और अधिक पढ़ें।

सहकारी संस्थाए जहां से लोहे की गोलिया मिलती हैं

वीकली आयरन एंड फोलिक एसिड सप्लिमेंटशन	किशोरी शक्ति योजना	नेशनल न्यूट्रीशनल अनीमिया प्रोफलेक्सिस प्रोग्राम
• साप्ताहिक लड़को व लड़कियों को एक आयरन की गोली वर्ष भर दी जाती है तथा वर्ष मे दो बार पेट के कीड़े मरने की दवाई दी जाती है	• किशोरी लड़कियों को वर्ष मे 100 आयरन की गोलियाँ तथा वर्ष मे दो बार पेट के कीड़े मरने की दवाई दी जाती है	• किशोरी लड़कियों को वर्ष मे 100 आयरन की गोलियाँ तथा वर्ष मे दो बार पेट के कीड़े मरने की दवाई दी जाती है

जंक फ़ूड

❑जंक फ़ूड का चलन पूरे विश्व में दिन पर दिन बढ़ता जा रहा है। चिप्स,चॉक्लेट्स ,पिज़्ज़ा, बर्गर इत्यादि तले -भुने खाने को जंक फ़ूड की संख्या में गिना जाता है।

❑ बच्चें हो या बड़े हो इस जंक फ़ूड का प्रभाव सबपे बढ़ता जा रहा है। परन्तु इस जंक फ़ूड को खाने के सिर्फ नुकसान ही है।

❑बच्चो पे इसका असर जल्दी पड़ता है। मोटापा इसका सबसे बड़ा नुकसान हैं।

जंक का मतलब कबाड़ जैसा होने से है। जिस तरह कबाड़ की बहुत कम कीमत होती है, उसी तरह जंक फूड में भी न के बराबर न्यूट्रिएन्ट्स होते हैं। साथ ही, नुकसान अधिक होता है।

जंक फ़ूड के तथ्य

जंक फूड में पाई जाने वाली वसा में कोलेस्ट्रॉल का उच्च स्तर, अत्यधिक चीनी और नमक रहता है। अत्यधिक कैलोरी के साथ चीनी के कारण मोटापा बढ़ता है। कोलेस्ट्रॉल और नमक के करण उच्च रक्तचाप, आघात और दिल की बीमारी का खतरा बढ़ता है। अत्यधिक नमक के कारण गुर्दे की कार्यक्षमता भी प्रभावित होती है।

जंक फ़ूड के दुष्परिणाम

- थकान
- पाचन क्रिया को भी प्रभावित करता है.
- मोटापा
- खून में सुगर लेवल को बढा-घटा सकता है
- दिमाग की शक्ति को कम
- दांतो की समस्याए
- जिगर की बीमारियां
- दिल की बीमारियां

संतुलित खाना….. एक अच्छी आदत

- **जिस आहार में सभी पोषक पोषक तत्व (**कॉर्बोहाइड्रेट, प्रोटीन, विटामिन, कैलशियम, आयरन आदि **)** प्रचुर मात्रा में **शामिल** हों।
- **जो शरीर के कार्यो के लिए सभी महत्वपूर्ण और आवश्यक पोषक तत्व प्रदान करे।**

संतुलित आहार के फायदे

- भर नियंत्रित करता है
- ऊर्जा का स्तर बढ़ता है
- अच्छा पोषकीय स्वस्थ्य
- बीमारियो से लड़ने की क्षमता बढ़ना
- स्वस्थ दिल और जिगर

पोषक तत्व

- **साबुत अनाज------------**कॉर्बोहाइड्रेट
- **दालें व फली --------------**प्रोटीन
- **डेयरी उत्पाद--------------** कैलशियम
- **फल व सब्जियां-----------** विटामिन और खनिज पदार्थ

फ़ूड पिरामिड

आयरन युक्त भोजन

परिचय

- आयरन की आवश्यकता हीमोग्लोबिन बनाने के लिए होती है। हीमोग्लोबिन लाल रक्त कोशिकाओं में पाया जाने वाला प्रोटीन है, जो शरीर के विभिन्न अंगों तथा ऊतकों में ऑक्सीजन पहुंचाने का काम करता है। यदि हमारे आहार से आयरन की उतनी मात्रा नहीं मिल पा रही, जितनी शरीर को जरूरत है, तो आयरन की कमी या आयरन की कमी वाला एनीमिया हो सकता है। जिसे खून की कमी भी कहते हैं।
- भारत में बहुत सी महिलाएं शाकाहारी हैं और शाकाहारी आहार में आमतौर पर आयरन की मात्रा कम होती है। शायद इसीलिए भारतीय महिलाओं में आयरन की कमी या एनीमिया दुनियाभर में सबसे अधिक है।

आयरन की आवश्यकता

Category	Age (Years)	RDA- Iron mg/day
Infant	0.5	0.46 g/kg/d
	0.5-1	05
Children	1-3	09
	4-6	13
	7-10	16
Males	10-12	21
	13-15	32
	16-17	28
	>17	17
Females	10-12	27
	13-15	27
	16-17	26
	>17	21
Pregnant		35
Lactating	1st -6 months	25
	2nd -6 months	25

भोजन में आयरन के प्रकार

- आयरन के दो तरह के स्रोत हैं:
- मांसाहारी और शाकाहारी दोनों प्रकार के भोजन से हमें आयरन मिल सकता है।
- मांसाहारी स्रोत (हीम आयरन)। ये अधिक आसानी से शरीर द्वारा अवशोषित होते हैं।
- शाकाहारी स्रोत (नॉन हीम आयरन)। ये कम आसानी से शरीर द्वारा अवशोषित होते हैं।

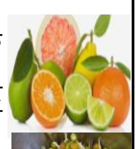
आयरन के मांसाहारी स्रोतों में शामिल हैं:

- मटन (मेमना)
- चिकन (मुर्गी), ख़ास तौर पर चिकन की जाँघों और टांगों में पाया जाने वाला गहरे रंग का मांस अच्छा होता है
- सीपदार मछली जैसे झींगा (प्रॉन), शम्बूक (मसल्स), तिसरियो (क्लैम्स)
- पारम्परिक तौर पर आयरन के भरपूर स्रोत के लिए कलेजी खाने की सलाह दी जाती है।

आयरन के शाकाहारी स्रोत:

- हरी पत्तेदार सब्जियां जैसे चौली, पालक, फूलगोभी का हरा हिस्सा, शलगम का साग, पुदीना, मूली के पत्ते, प्याज की कलियां, सरसों का साग और मेथी का साग आयरन के अच्छे स्रोत हैं। इसलिए इन्हें किसी न किसी रूप में प्रतिदिन अपने आहार में शामिल करने का प्रयास करें।
- आयरन से भरपूर सब्जियां जैसे चुकंदर, कद्दू, शकरकंदी और हरी गोभी
- मेवे और बीज जैसे काजू, नारियल, कद्दू के बीज, सरसों के बीज, तिल, पिस्ता, किशमिश, साबुत धनिया और अखरोट
- फलियां और दालें जैसे सोयाबीन, लोबिया, राजमा, सूखी मटर, छोले, साबुत काले चने और अन्य दालें
- कुछ पेय जैसे खजूर का शरबत या नारियल पानी में भी कुछ आयरन होता है

आयरन अवशोषण कैसे बढ़ायें ?



- विटामिन सी का सेवन शरीर में आयरन के **अवशोषण** को बढ़ाता है।
- खमीरीकरण (फर्मेंट) और अंकुरित फलियां और खट्टे फलों और सब्जियों से विटामिन सी पाया जाता है

- आयरन का **अवशोषण** बढ़ाने के लिए परम्परागत रूप से लोहे के बर्तनों में खाना पकाने से **अवशोषण** को बढ़ाता है।
- खाना पकाते समय आप अगर उसमें टमाटर या नींबू का रस (जिसमें काफी मात्रा में विटामिन "सी" होता है) डाल दें तो लोहे के बर्तन से और अधिक लौह तत्व खाने में मिल जाएगा ।

आयरन के अवशोषण में क्या बाधा बनता है?

- आपका शरीर कितना आयरन **अवशोषण** करता है, यह कई बातों पर निर्भर करता है,
- भोजन में आयरन की मात्रा कितनी है
- भोजन में किस तरह का आयरन मौजूद हैः मांस (हीम) या शाकाहारी (नॉन हीम) आयरन
- आहार में कौन से अन्य खाद्य पदार्थ शामिल हैं
- मांसाहारी भोजन में पाया जाने वाला हीम आयरन शरीर आसानी से समाहित कर लेता है। अन्य खाद्य पदार्थों के सेवन से भी इस पर असर नहीं पड़ता।
- आयरन के शाकाहारी स्रोत आसानी से शरीर में समाहित नहीं होते, इसलिए आयरन से भरपूर भोजन के साथ क्या खा रहे हैं, इस पर ध्यान देने की जरुरत है। ऐसी भी कुछ सामग्रियां है, जो शरीर में आयरन के **अवशोषण** में अवरोध उत्पन्न कर सकती हैं

- **टैनिन** चाय और कॉफी में पाया जाने वाला एक तत्व है, जो आयरन के **अवशोषण** में रुकावट डाल सकता है। इसलिए भोजन के सेवन और आयरन सप्लीमेंट लेने के एक घंटे पहले और एक घंटे बाद में कॉफी या चाय न पीएं।
- **फाइटेट (फाइटिक एसिड)** , पूर्ण अनाज से बनी चीजों जैसे चक्की आटा, पूर्ण अनाज ब्रेड या पास्ता में पाया जाता है। यह भी आयरन के **अवशोषण** में बाधा डाल सकता है।
- **कैल्शियम** की अत्याधिक मात्रा भी आयरन के समाहन में बाधा डालती है। इसलिए आयरन सप्लीमेंट के साथ या भोजन के साथ कैल्शियम सप्लीमेंट नहीं लिया जाना चाहिए। इसी वजह से भोजन के साथ या इसके बाद दूध नहीं पीना चाहिए।

भूमिका

- *भोजन बनाते समय उसकी पौष्टिकता टिकाये रखना भी एक कला है। आहार से पौष्टिक तत्वों की प्राप्ति हमे तभी होगी जब उसमे पौष्टिकता बरकरार होगी। अज्ञानता व लापरवाही के कारण हम भोजन के पौष्टिक तत्वों को नष्ट कर देते है।*

पोषण बरकरार रखने के तरीके

- हमेशा सब्जियों को धोकर काटे, न की काटकर धोए।
- सब्जियों को छोटे टुकड़ो में ना काटिये क्योंकि कटा हिस्सा पानी और हवा के सम्पर्क में आने से उसके पोषक तत्व या तो पानी में बहकर निकल जाते है या हवा के सम्पर्क में नष्ट हो जाते है।
- सब्जियों को हमेशा ढँककर पकाये।
- हरी सब्जियों को कम से कम पकाये।
- धीमी आँच पर खाना पकाये। इससे ईंधन की भी बचत होगी और पोषक तत्व भी बने रहेंगे।
- सब्जियों को पकाने के लिए कम से कम पानी का उपयोग करे।
- सभी प्रकार के पोषक तत्वों की प्राप्ति हो इसलिए भोजन में विविधता होनी चाहिए।
- अधिक तेल व मिर्च मसाले स्वास्थ को हानि पहँचाते है इसलिए इनका प्रयोग कम से कम करे।

- तला हुआ खाना अधिक बार खाने से बचे। ये पचने में भी भारी होता है और पौष्टिकता भी कम होती। ।
- मुंग, मोट, चना, राजमा आदि को अंकुरित करके सप्ताह में 2 से 3 बार नाश्ते में या खाने में प्रयोग में लाते रहे। इन अनाजों में Vitamin C व E प्रचुर मात्रा में होता है।
- अक्सर हम सब्जियों के पत्ते फेक देते है। उनमे भी पौष्टिक तत्व पाये जाते है।
- चोकरयुक्त आटे का प्रयोग करे। ये विटामिन, मिनरल से युक्त होता है।
- खाना बनाते वक्त खाने का सोडे का प्रयोग नहीं करना चाहिए। इससे भोजन के पौष्टिक तत्वों में कमी आती है
- विनेगर (सिरका), इमली व नींबू ये पोषक तत्वों की रक्षा करते है इसलिए इनका प्रयोग कम मात्रा में कर सकते है।
- सब्जिया, दाल, चावल आदि को पकाते वक्त लगनेवाला पानी अगर बच जाता है तो इसे फेंके नही क्योंकि इसमें घुलनशील पोषक तत्व होते है। आटा गूंथने के लिए ये पानी काम में ला सकते है।
- तैयार पदार्थ हमेशा ढँककर रखे। भोजन को बारबार गर्म करने से पोषक तत्वों की हानि होती है।

भोजन के पोषण सरंक्षण के पांच नियम

1. पकाना :-

- खाना ढक कर पकाएॅ ताकि पोषक तत्वों की क्षति न हो। इससे स्वाद भी बना रहता है।
- हलाने और छानने की प्रक्रिया ज्यादा लम्बे समय तक जारी न रखें क्योकि खाने मे हवा भी सम्मिलित हो जाती है जिसकी वजह से विटामिन सी नष्ट हो जाती है।
- खाने को तब तक पकाना चाहिए जब तक वह अच्छी तरह से पक न जाए क्योकि तभी उसमें स्वाद आएगा और वह आसानी से पच जाएगा । पोषक तत्वों को बचाने के लिए खाने को ज्यादा देर तक पकाना नहीं चाहिए।सब्जियां पकाने के बाद चमकदार रंग की एंव करारी होनी चाहिए।
- खाने को प्रेशर कुकर में पकाना चाहिए ताकि समय, उर्जा एंव पोषक तत्व बचे रहें।

2. सब्जियां एंव फल :-

- सब्जियों को पकाने से कुछ ही समय पूर्व काटें ताकि उसमें मौजूद विटामिन्स की क्षति न हो।
- सब्जियां काटने से पूर्व जरूर धोएं। काटने के बाद सब्जियों को अधिक समय तक न धोएं क्योंकि इससे पानी मे घुलनशील पोशक तत्व नश्ट हो जाते हैं।
- सब्जियों को जहा तक सम्भव हो बिना छिले इस्तमाल करना चाहिए या फिर छिलके कि पतली परत ही निकालनी चाहिए क्योंकि छिलके मे कई पोश्क तत्व मौजूद होते हैं।
- खाने से ठीक पहले सब्जियों को पकाना चाहिए।

सब्जियां एवं फल :-

- मौसम के अनुसार मिलने वाले फल एवं सब्जियां इस्तेमाल करनी चाहिए।
- फल एवं सब्जियों को बड़े भागो में काटें ताकि उनके उपर के तल का क्षेत्र कम हो जाए और वे हवा एवं पानी के सम्पर्क में कम आएॅ।
- सब्जियो को उबलते पानी में कम पकाएं ताकि उनका रंग स्वाद एवं पोषक तत्व बचा रहे।
- सलाद को खाने से थोडी देर पूर्व ही काटें ।
- पहले से कटी सब्जियों का इस्तेमाल न करें।

3. तेलः -

- स्वस्थ्यवर्धक तेल का प्रयोग करें जैसे सोयाबीन एवं सरसों।
- ऊष्मा रोधक तेल का प्रयोग करें जैसे सरसो का तेल।
- ठोस वसा की जगह तेल का प्रयोग करें ताकि शरीर का कोलेस्ट्रॉल कम रहे।
- कई प्रकार के तेल या फिर अलग समय पर अलग तेल का इस्तेमाल करें ताकि सारे जरूरी फैटी एसिड प्राप्त हो सकें ।
- अच्छे तेलों की जगह सस्ते तेलों का प्रयोग न करें जैसे कि मक्खन की जगह मार्जरीन व घी की जगह वनस्पति।

4. भोजन का बचा भाग :-

- गेहूँ के भूसे को न फेंकें क्योकि उसमे विटामिन बी एवं रेशा होता है।
- वह पानी जिसमें दालें भिगाएं उसे फैंक दें क्योकि उससे कई ऐंटी न्यूट्रियन्ट्स जैसे फाईटेट्स नष्ट हो जाते हैं।
- वह पानी जिसमें खाने को पकाया है उसे न फेंकें।

5. अम्लीय भोजन का प्रयोग: -

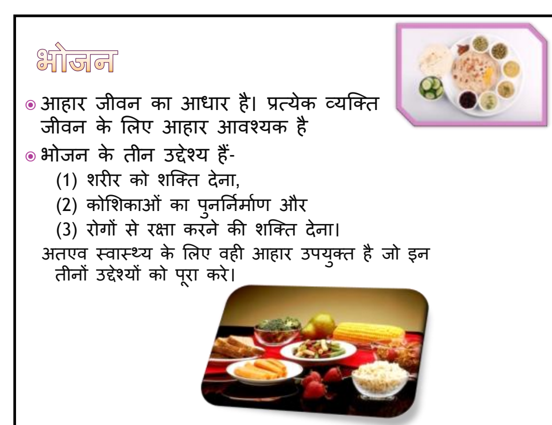
- नींबू, टमाटर, सिरका एवं दही सलाद में उपयोग करने से विटामिन सी का बचाव होता है।

भोजन के पोषक तत्व

भोजन

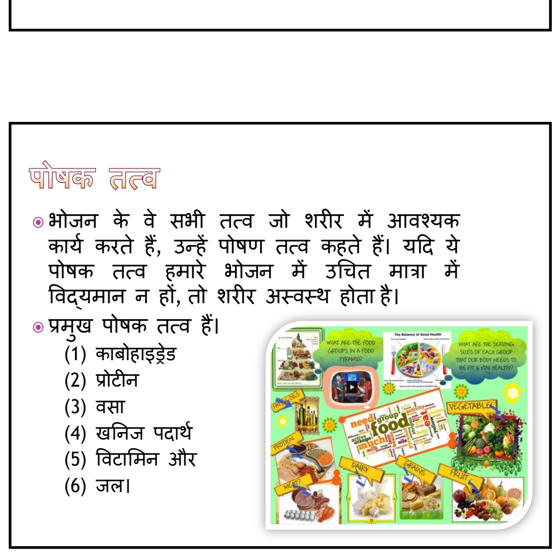
- आहार जीवन का आधार है। प्रत्येक व्यक्ति जीवन के लिए आहार आवश्यक है
- भोजन के तीन उद्देश्य हैं-
  (1) शरीर को शक्ति देना,
  (2) कोशिकाओं का पुनर्निर्माण और
  (3) रोगों से रक्षा करने की शक्ति देना।

अतएव स्वास्थ्य के लिए वही आहार उपयुक्त है जो इन तीनों उद्देश्यों को पूरा करे।



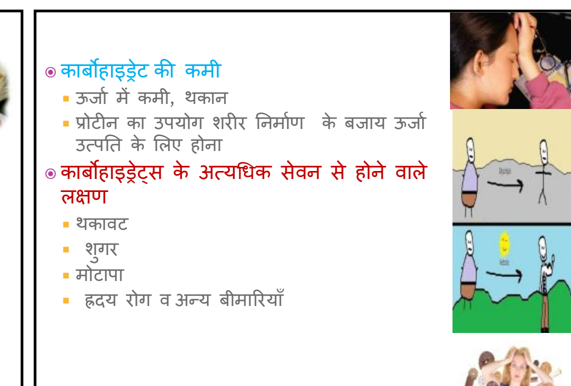
पोषक तत्व

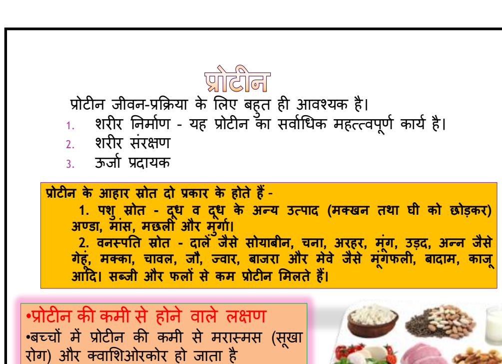
- भोजन के वे सभी तत्व जो शरीर में आवश्यक कार्य करते हैं, उन्हें पोषण तत्व कहते हैं। यदि ये पोषक तत्व हमारे भोजन में उचित मात्रा में विद्यमान न हों, तो शरीर अस्वस्थ होता है।
- प्रमुख पोषक तत्व हैं।
  (1) काबोहाइड्रेड
  (2) प्रोटीन
  (3) वसा
  (4) खनिज पदार्थ
  (5) विटामिन और
  (6) जल।

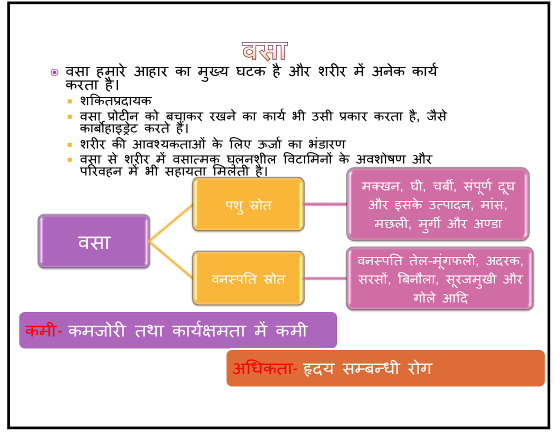


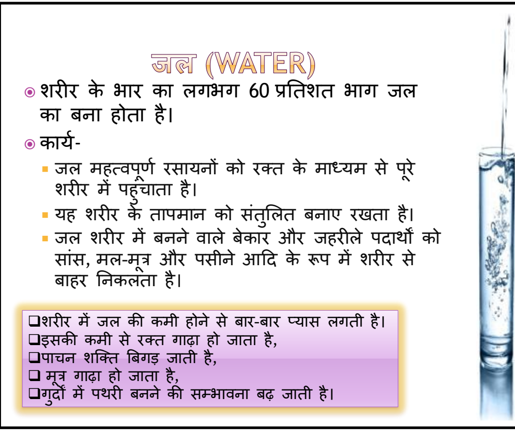
अधिक मात्रा में आवश्यक पोषक तत्व

कार्बोहाइड्रेट
कार्बोहाइड्रेट के कुछ स्त्रोत हैं:-
शकरकंदी
आलू
गन्ना
पपीता
गेहूँ
तरबूज
आम
चावल
बाजरा
मक्का
शरीर को शक्ति प्रदान करना।

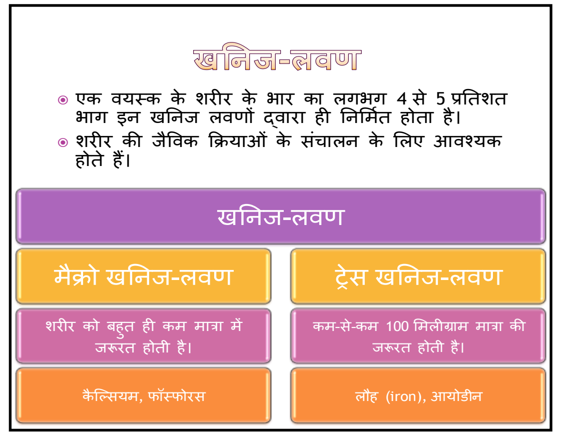

कार्बोहाइड्रेट की कमी
ऊर्जा में कमी, थकान
प्रोटीन का उपयोग शरीर निर्माण के बजाय ऊर्जा उत्पत्ति के लिए होना
कार्बोहाइड्रेट्स के अत्यधिक सेवन से होने वाले लक्षण
थकावट
शुगर
मोटापा
हृदय रोग व अन्य बीमारियाँ


प्रोटीन
प्रोटीन जीवन-प्रक्रिया के लिए बहुत ही आवश्यक है।
1. शरीर निर्माण - यह प्रोटीन का सर्वाधिक महत्त्वपूर्ण कार्य है।
2. शरीर संरक्षण
3. ऊर्जा प्रदायक
प्रोटीन के आहार स्रोत दो प्रकार के होते हैं -
1. पशु स्रोत - दूध व दूध के अन्य उत्पाद (मक्खन तथा घी को छोड़कर) अण्डा, मांस, मछली और मुर्गा।
2. वनस्पति स्रोत - दालें जैसे सोयाबीन, चना, अरहर, मूंग, उड़द, अन्न जैसे गेहूं, मक्का, चावल, जौ, ज्वार, बाजरा और मेवे जैसे मूंगफली, बादाम, काजू आदि। सब्जी और फलों से कम प्रोटीन मिलते हैं।
•प्रोटीन की कमी से होने वाले लक्षण
•बच्चों में प्रोटीन की कमी से मरास्मस (सूखा रोग) और क्वाशिओरकोर हो जाता है
•वयस्कों में प्रोटीन की कमी से शरीर भार में कमी, कमजोरी और रोग-प्रतिरोधक शकित में कमी आ जाती है।


वसा
वसा हमारे आहार का मुख्य घटक है और शरीर में अनेक कार्य करता है।
शकितप्रदायक
वसा प्रोटीन को बचाकर रखने का कार्य भी उसी प्रकार करता है, जैसे कार्बोहाइड्रेट करते हैं।
शरीर की आवश्यकताओं के लिए ऊर्जा का भंडारण
वसा से शरीर में वसात्मक घुलनशील विटामिनों के अवशोषण और परिवहन में भी सहायता मिलती है।
वसा
पशु स्रोत
मक्खन, घी, चर्बी, संपूर्ण दूध और इसके उत्पादन, मांस, मछली, मुर्गी और अण्डा
वनस्पति स्रोत
वनस्पति तेल-मूंगफली, अदरक, सरसों, बिनौला, सूरजमुखी और गोले आदि
कमी- कमजोरी तथा कार्यक्षमता में कमी
अधिकता- हृदय सम्बन्धी रोग


जल (WATER)
शरीर के भार का लगभग 60 प्रतिशत भाग जल का बना होता है।
कार्य-
जल महत्वपूर्ण रसायनों को रक्त के माध्यम से पूरे शरीर में पहुँचाता है।
यह शरीर के तापमान को संतुलित बनाए रखता है।
जल शरीर में बनने वाले बेकार और जहरीले पदार्थों को सांस, मल-मूत्र और पसीने आदि के रूप में शरीर से बाहर निकलता है।
❑शरीर में जल की कमी होने से बार-बार प्यास लगती है।
❑इसकी कमी से रक्त गाढ़ा हो जाता है,
❑पाचन शक्ति बिगड़ जाती है,
❑ मूत्र गाढ़ा हो जाता है,
❑गुर्दों में पथरी बनने की सम्भावना बढ़ जाती है।

कम मात्रा में आवश्यक पोषक तत्व

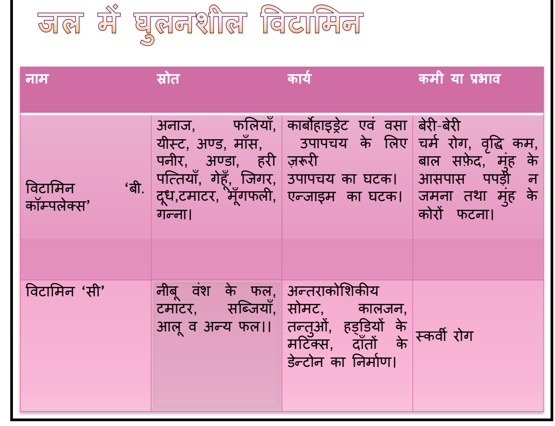


खनिज लवण	मुख्य स्रोत	कार्य	कमी से होने वाले प्रभाव	अधिकता के प्रभाव
कैल्सियम	दूध से बने पदार्थ, अण्डे, मछली, सोयाबीन, बादाम, मूली, गोभी के पत्ते, गाजर।	यह हड्डियों तथा दांतों की रचना करता है और उन्हें मजबूत बनाता है	❖रिकेट्स ❖पैरों में चीटियां-सी रेंगने की अनुभू ❖हड्डियां कमजोरति	रक्तचाप बढ़ना
फॉस्फोरस (Phosphorus)	दुग्ध उत्पाद, मांस, मछली, अण्डे, सोयाबीन, सेब, पत्तागोभी, पालक, मूली, गाजर, आलू।	कैल्सियम तथा विटामिन-डी के साथ मिलकर हड्डियों के निर्माण में सहायता करता है तथा मस्तिष्क को मजबूत बनाता है।	❖हड्डियां कमजोर हो जाती है। ❖व्यक्ति मंदबुद्धि हो जाता है। ❖पैरों में चीटियां-सी रेंगने की अनुभूति, सुई-सी चुभनों आदि अप-संवेदनाएं पैदा हो जाती है।	

खनिज लवण	मुख्य स्रोत	कार्य	कमी से होने वाले प्रभाव	अधिकता के प्रभाव
लौह (iron)	पालक, बथुआ, गाजर, टमाटर, अनार, खजूर, किशमिश,जिगर , अण्डे की जर्दी, मांस, मछली आदि।	यह उतको को ऑक्सीजन पहुंचाने का कार्य करती है	❖खून की कमी, ❖थकान महूसस होना।	खूनी पेचिश
आयोडीन (Iodine)	आयोडीन युक्त नमक, मछली, प्याज, अण्डे की जर्दी, समुद्र से पैदा होने वाले खाद्य पदार्थ।	यह थाइरॉक्सीन संश्लेषण (सामान्य कोशिकीय श्वसन) को बनाए रखने का कार्य करता है	❖घेंघा रोग ❖ बच्चे मंदबुद्धि	थाइरॉइड की क्रियाशीलता में रुकावट पैदा हो जाती है।

वसा में घुलनशील विटामिन्स

नाम	स्रोत	कार्य	कमी या प्रभाव
विटामिन 'ए'	दूध, मक्खन, अण्डा, जिगर, मछली का तेल।	नेत्र की रोड्स में राडाप्सिन का संश्लेषण एपिथिलियम स्तर में वृद्दि।	रतौंधी
विटामिन 'डी'	मक्खन, जिगर, मछली का तेल, गेंहू, अण्डा में।	कैल्शियम व फॉस्फोरस का उपापचय, हड्डियाँ और दाँतों की वृद्दि	सूखा रोग, तथा आस्टियामलसिया
विटामिन 'ई'	हरी पत्तियाँ, गेहूँ, अण्डे की जर्दी।	जननिक एपिथीलियम की वृद्दि, पेशियों की क्रियाशीलता।	जनन क्षमता की कमी, पेशियाँ कमज़ोर।
विटामिन 'के	हरी पत्तियाँ, पनीर, अण्डा, जिगर,टमाटर।	जिगर में पाथांम्बिन का निर्माण।	रक्त का थक्का नहीं जमता।



जल में घुलनशील विटामिन

नाम	स्रोत	कार्य	कमी या प्रभाव
विटामिन 'बी. कॉम्पलेक्स'	अनाज, फलियाँ, यीस्ट, अण्ड, माँस, पनीर, अण्डा, हरी पत्तियाँ, गेहूँ, जिगर, दूध,टमाटर, मूँगफली, गन्ना।	कार्बोहाइड्रेट एवं वसा उपापचय के लिए ज़रूरी उपापचय का घटक। एन्जाइम का घटक।	बेरी-बेरी चर्म रोग, वृद्दि कम, बाल सफ़ेद, मुंह के आसपास पपड़ी न जमना तथा मुंह के कोरों फटना।
विटामिन 'सी'	नीबू वंश के फल, टमाटर, सब्जियाँ, आलू व अन्य फल।।	अन्तराकोशिकीय सोमट, कालजन, तन्तुओं, हड्डियों के मटिक्स, दाँतों के डेन्टोन का निर्माण।	स्कर्वी रोग

भोजन पकाने की सही विधियाँ

भूमिका

- आहार विशेषज्ञों के अनुसार खाना पकाते वक्त हम लोग जितना ध्यान स्वाद के लिए देते हैं उतना उसकी पौष्टिकता पर नहीं। इन कारणों से ही हम उपयोगी नियमों का पालन न करके खाद्य पदार्थों के 40 प्रतिशत पौष्टिक तत्वों को नष्ट कर देते हैं।

खाना पकाते वक्त ध्यान रखने वाली प्रमुख बातें

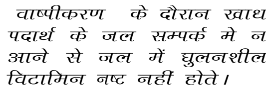
- किचन को पहले अच्छी तरह साफ कर भोजन पकाने की शुरूआत करें
- हरी और पत्तेजदार सब्जियों को काटने से पहले अच्छी तरह धुल लें। क्योंकि हरी और पत्तेदार सब्जियों में मौजूद विटामिन और मिनरल पानी में घुलनशील होते हैं।
- वजन नियंत्रण के लिए खाना पकाते वक्त कम घी या तेल का प्रयोग करना चाहिए, ज्यादातर भाप में पकाना चाहिए।
- उचित तापमान का ध्यान रखें, ज्यादा देर तक खाना पकाने से उनके पोषक तत्व समाप्त हो जाते हैं। सब्जियों को बार-बार गर्म नहीं करना चाहिए।
- मसालों का पूरा स्वाद लेने के लिए खाना पकाते वक्त नमक कम डालें।

खाना पकाना क्यों आवश्यक है ?

- भोजन के पाचन में साहयक होता है।
- खाने को नरम व चबाने लायक बनाने के लिये।
- पोषक तत्वों की उपलब्धता बढाने के लिये।
- भोजन को स्वादिष्ट बनाने के लिये।

भोजन पकाने की विधियां

- **वाष्पीकरण भाप में पकाना:**



वाष्पीकरण के दौरान खाद्य पदार्थ के जल सम्पर्क मे न आने से जल में घुलनशील विटामिन नष्ट नहीं होते।

- **प्रेशर कूकर मे पकाना :**

इस क्रिया में अधिक उर्जा के कारण पोषक तत्वों को होने वाली हानि कम होती है क्योंकि पकाने का समय कम हो जाता है।

- **बेकिंग/तंदूर मे पकाना**

अवन के अंदर खाना पकाने से कम वसा की जरूरत होती

- **मिला जुला भोजन**

अनाज दूध दाल व मेवों को एक साथ मिलाने से प्रोटिन की गुणवत्ता बढती है और शरीर मे उसका उपयोग भलीभांति हो पाता है।

- **भिगोना**

दालों को भिगोकर उसका पानी निकालने या अलग करने से हानिकारक तत्वों जैसे कि फाइटेट पानी के साथ मिलकर निकल जाते है।

- **खमीरीकरण :**
  खमीरीकरण आयरन व जिंक के अवशोषण को बढता है तथा प्रोटीन की गुणवत्ता एवं पाचन बढता है विटामिन बी की मात्रा तथा सूक्ष्म जीवी सुरक्षा व गुणवत्ता को बढाता है।

- **अंकुरण :**
  अंकुरण की प्रक्रिया से दालों की पाचन क्षमता बढती है हानिकारक पोषक तत्व जो मिनरल के अवशोषण को बाधित करते है अंकुरण की प्रक्रिया मे कुछ हद तक नष्ट हो जाते हैं अंकुरण की प्रकिया से भोज्य पदार्थ मे विटामिन सी और रेशे की मात्रा बढती है

गलत पाक कियाएं

- रोशनी के सम्पर्क मे रखना :
  रोशनी के सर्म्पक में आने पर विटामिन सी, बी विटामिन नष्ट हो जाते हैं।
- तलना :
  तलने की प्रक्रिया मे खाद्य पदार्थ अधिक तेल सोखते हैं जिससे सिर्फ कैलोरी बढती है अन्य कोई पोषक तत्व नही मिलते। तलने कि प्रक्रिया के दौरान कैंसर उत्पन्न करने वाले रसायनों का निर्माण होता है।

संतुलित आहार

संतुलित आहार

- संतुलित भोजन (Balanced diet) या बैलेंस डाइट वह है-
  - **जिस आहार में सभी पोषक तत्व** (कॉर्बोहाइड्रेट, प्रोटीन, विटामिन, कैलशियम, आयरन आदि) प्रचुर मात्रा में **शामिल** हों।
  - **जो शरीर के कार्यों के लिए सभी महत्वपूर्ण और आवश्यक पोषक तत्व प्रदान करे।**
  - **हम जो भी खाते हैं उसका असर हमारे शरीर पर पड़ता है। जन्म के बाद खाद्य-पदार्थ हमारे विकास को निर्धारित करते हैं।**
  - **यदि बचपन से ही खाने में संतुलित आहार मिले तो शरीर का विकास अच्छे से होता है।**

किशोरावस्था

- किशोरावस्था बचपन से जवानी के बीच के आयु को कहते हैं।

तीन अवस्था मे बांटा जा सकता है -

- पूर्व किशोरावस्था (9-13वर्ष)- इस दौरान शारीरिक संरचनाओं में तेजी से विकास होने के साथ लिंग संबंधी विकास भी होता है
- मध्य किशोरावस्था (14-15वर्ष)- इस अवस्था के दौरान युवा माता-पिता से अलग पहचान बनाते हैं एवं हम उम्र दोस्तों से संबंध बनाते हैं और विपरीत लिंग की ओर आकर्षित होते हैं। साथ ही उनमें नये चीजों की खोज की इच्छा तीव्र होती है।
- उत्तर किशोरावस्था काल (16-19 वर्ष)- इस अवस्था के दौरान युवाओं का पूर्ण शारीरिक (व्यस्कों के समान) विकास होता है। उनकी एक अलग पहचान बनती है और उनमें एक नयी सोच और विचार का जन्म होता है।

किशोरावस्था में संतुलित आहार जरूरी क्यों?

- 9 से 19 वर्ष के बीच, यह उम्र का वह दौर है जिसमें शारीरिक, मानसिक, मनोसामाजिक एवं भावनात्मक बदलाव होते हैं। इन सब चीजों के साथ सही सामंजस्य बनाए रखने के लिए उन्हें सही मात्रा में पोषक तत्वों की जरूरत होती है।
- **तन-मन को स्वस्थ बनाए रखने के लिए सही मात्रा में पोषण की जरूरत होती है,** और पोषण के लिए संतुलित आहार बेहद जरूरी होता है।

भोजन के समूह

- अनाज
- दालें व फली (प्रोटीन)
- डेयरी उत्पाद
- फल व सब्जियां
- वसा और कम मीठा

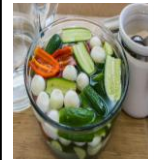
1) अनाज

सफेद चावल और सफेद ब्रेड यानि की मैदा से बने खाद्य पदार्थों की जगह ब्राउन राइस और ब्राउन ब्रेड आदि को अपने खाने में शामिल करें। साबुत अनाज, जैसे दलिया आदि भी शरीर को बेहद फायदा पहुंचाता है। साबुत दालें भी रोजाना खानी चाहिए।

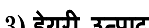
2) दालें व फली (प्रोटीन)

मीट और बीन्स, प्रोटीन के प्राथमिक स्रोत हैं, जो शरीर की मांसपेशियों को मजबूत बनाते हैं साथ ही दिमाग को भी तेज बनाते हैं। लो फैट मीट जैसे चिकन, मछली आदि स्वास्थ्य के लिहाज से बेहतर होते हैं। अंडे, दालें, सूखे मेवे, टोफू, पनीर आदि भी प्रोटीन के अच्छे स्रोत हैं।

भोजन बनाने की गलत विधियां



- **अधिक गर्म करना :**
  विटामिन सी, बी विटामिन नष्ट हो जाती हैं।अधिक गर्म करने से प्रोटीन सख्त व अपचनीय हो जाते हैं। अत्यधिक गर्म करने से कैंसर पैदा करने वाले हानिकारक तत्व उत्पन्न होते हैं।
- **सब्जियों को भिगो के रखना :**
  पानी से घुलने वाले विटामिन बह जाते है।
- **हवा में खुला रखना :**
  कटे हुए फल व सब्जियों को हवा में खुला छोढने से कटी हुई सतह विटामिन सी का ऑक्सीकरण हो जाता है और वस्‍ा बिगड कर बासी हो जाती है।



3) डेयरी उत्पाद

- डेयरी उत्पादों में कैल्शियम, विटामिन डी और दूसरे पोषक तत्व होते हैं हालांकि वसा भी डेयरी उत्पादों में अधिक होती है। ऐसे में लो फैट दूध और अन्य उत्पाद जिनमें वसा की मात्रा कम हो, का इस्तेमाल किया जा सकता है।

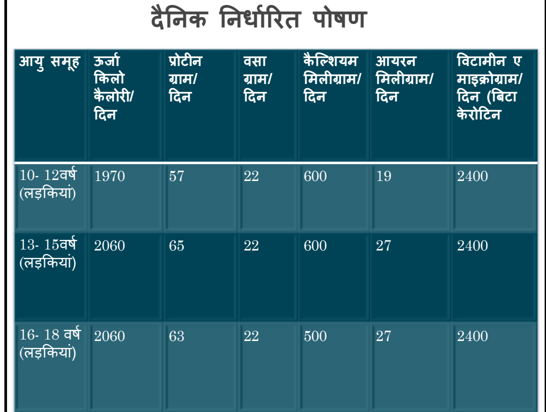
4) फल व सब्जियां

- **फल-** फलों में पोषक तत्वों की उच्च मात्रा होती है भूख लगने पर बिना झंझट तुरंत इन्हें खाया जा सकता है। फलों को मौसम के अनुरूप ही खाएं।
- **सब्जियां** - सब्जियां खनिज और विटामिन पाने का सबसे आसान तरीका है। ऐसे में रोज के भोजन में ज्यादा से ज्यादा सब्जियों को शामिल करें। हरी पत्तेदार सब्जियों के साथ विभिन्न रंगों की सब्जियों से आपको अलग-अलग पोषक तत्व मिल जाते हैं। पालक, बीन्स, ब्रोकली आदि ज्यादा से ज्यादा खाएं।

फ़ूड पिरामिड

संतुलित भोजन किशोरियों के लिए

दैनिक निर्धारित पोषण



आयु समूह	ऊर्जा किलो कैलोरी/ दिन	प्रोटीन ग्राम/ दिन	वसा ग्राम/ दिन	कैल्शियम मिलीग्राम/ दिन	आयरन मिलीग्राम/ दिन	विटामीन ए माइक्रोग्राम/ दिन (बिटा केरोटिन
10- 12वर्ष (लड़कियां)	1970	57	22	600	19	2400
13- 15वर्ष (लड़कियां)	2060	65	22	600	27	2400
16- 18 वर्ष (लड़कियां)	2060	63	22	500	27	2400

स्वछता व सफाई

परिचय

- स्वच्छता एक ऐसा कार्य नहीं है जो हमें दबाव में करना चाहिये। ये एक अच्छी आदत और स्वस्थ तरीका है हमारे अच्छे स्वस्थ जीवन के लिये। अच्छे स्वास्थ्य के लिये सभी प्रकार की स्वच्छता बहुत जरुरी है चाहे वो व्यक्तिगत हो, अपने आसपास की, पर्यावरण की, पालतु जानवरों की या काम करने की जगह (स्कूल, कॉलेज आदि) हो।

व्यक्तिगत स्वच्छता

हाथ कैसे और कब-कब धोने चाहिये

प्रर्याप्त साबुन या ताजी राख से पानी से हाथों को रगड़ कर धोना चाहिये।

खाने की चीजों के रख–रखाव के पूर्व हाथ धोना :–

- खाना बनाने/पकाने से पहले
- खाना परोसने से पहले
- खाना खाने से पहले
- बच्चों को खाना खिलाने से पहले

मल छूने के बाद :–

- मलत्यागके पाखाना साफ करने के बाद
- बच्चे के मल को फेकने के बाद

मल के रख–रखाव के बाद :–

- पशुओं के के बाद
- बच्चे मल को साफ करने के बाद
- द्रव्य एवं ठोस गंदगी को साफ करने के बाद

किसी भी प्रकार की सफाई करने के बाद

शरीर की साफ-सफाई

•हमें अपने नाखूनों को सामान्य अवकाश पर काटना चाहियें।
•दाँतो को दिन में कम से कम दो बार साफ करना चाहिये-सुबह सोकर उठने के बाद और रात को सोने से पहले।
•भोजन करने के बाद साफ पानी से कुल्ला करें।
•इसके साथ हम लोगों को रोज नहाना भी चाहिये।
•आँख, कान और नाक की सफाई अपनी आंखों को हर रोज साफ पानी से धोएं।

खाना बनाते समय किन बातों का ध्यान रखना चाहिये ?

- सब्जियों और फलों को अच्छी तरह से धोकर इस्तेमाल करना चाहिये।
- बर्तनों को साफ पानी और साबुन/चूल्हे की ताजी राख से धोना चाहिये।
- मास को अच्छे से धोकर और पका कर ही खाना चाहिये।
- दूध को अच्छे से (5 मिनट) उबाल कर पियें।
- खाना बनाने के आस–पास की जगह हमेशा साफ रखें।
- खाना हमेशा ढक कर जमीन के स्तर से ऊपर रखना चाहिये।
- पके हुये खाने को ज्यादा दिनों तक इस्तेमाल नहीं करना चाहिये।
- खाना हमेशा ताजा और गरम करके खाना चाहिये।

स्वच्छ वातावरण

पानी का सुरक्षित रख—रखाव

- हमें पानी को हमेशा साफ जगह से भरना चाहिये।
- पानी के बर्तन को धोकर पानी भरना चाहिए तथा घर लाते समय ढक कर लाना चाहिए।
- इसके साथ घर पर भी बर्तन को हमेशा ढक कर जमीन से ऊपर रखना चाहिए।
- नल वाले घड़े का प्रयोग करे।
- यदि नल वाला घड़ा नहो तो पानी के बर्तन को टेढ़ी कर के पानी निकाले या पानी को कल्छी से ही निकालें।
- पानी को हमेशा साफ कपड़े से छानकर, उबाल कर पियें।

लोगों को शौचालयों का प्रयोग कैसे करना चाहिये?

- शौचालय का प्रयोग करने से पहले शौचालय में पानी डालें।
- शौचालय में ही मल त्याग करें।
- मलत्याग करने के बाद शौचालय में पानी जरूर डालें।
- मलत्याग के बाद हाथों को साबुन या चूल्हे की ताजी राख एवं पानी से अच्छी तरह धोयें।

माहवारी स्वच्छता व सफाई

- लड़की के योनि से हर माह 2-7 दिन रक्तस्राव होने को माहवारी कहते है।
- पहला मासिक धर्म 9 और 16 वर्ष की उम्र की बीच कभी भी आ सकता है,
- माहवारी का चक्र अक्सर 21 और 40 दिनों के बीच होता है।

माहवारी के समय किशोरियों को शरीर में क्या-क्या परेशानियाँ महसूस होती है?

- थकान होना
- शरीर का ढ़ीला होना
- चिड़चिड़ापन होना
- सिरदर्द होना
- स्तनों में कसाव होना
- काम में मन न लगना

माहवारी के दौरान सफाई

- माहवारी के समय रोजाना स्नान करना चाहिये।
- अपने भीतरी कपड़ों को अच्छी तरह साबुन एवं साफ पानी से धोकर खुली धूप में
- सुखाना चाहिये।
- पैड अथवा कपड़ा, जो भी प्रयोग किया जा रहा है उसको आवश्यकतानुसार एवं दिन में कम से कम 3-4 वार वदलना चाहिये।
- कपड़ा या पैड वदलने से पहले एवं वाद में हाथों को साबुन व पानी से धोना चाहिये।

(ii) PAMPHLETS/LEAFLETS

- सलाद को खाने से थोडी देर पूर्व ही काटें ।
- पहले से कटी सब्जियों का इस्तेमाल न करें।

3. तेलः–

- स्वस्थ्यवर्धक तेल का प्रयोग करें जैसे सोयाबीन एवं सरसों।
- ऊष्मा रोधक तेल का प्रयोग करें जैसे सरसों का तेल।
- ठोस वसा की जगह तेल का प्रयोग करें ताकि शरीर का कोलेस्ट्रॉल कम रहे।
- कई प्रकार के तेल या फिर अलग समय पर अलग तेल का इस्तेमाल करें ताकि सारे जरूरी फैटी एसिड प्राप्त हो सकें ।
- अच्छे तेलों की जगह सस्ते तेलों का प्रयोग न करें जैसे कि मक्खन की जगह मार्जरीन व घी की जगह वनस्पति।

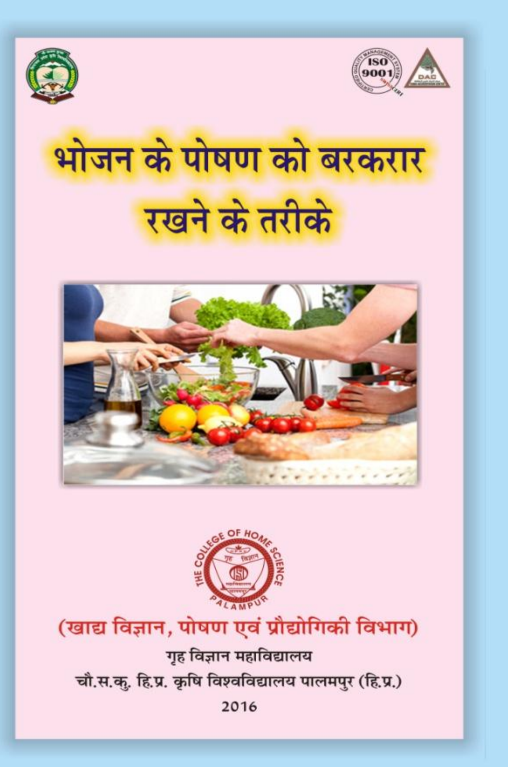
4. भोजन का बचा भाग :–

- गेहूँ के भूसे को न फेंकें क्योंकि उसमें विटामिन बी एवं रेशा होता है।
- वह पानी जिसमें दालें भिगाएं उसे फैंक दें क्योंकि उससे कई ऐंटी न्यूट्रियन्ट्स जैसे फाईटेट्स नष्ट हो जाते हैं।
- वह पानी जिसमें खाने को पकाया है उसे न फेंकें।

5. अम्लीय भोजन का प्रयोगः–

- नींबू, टमाटर, सिरका एवं दही सलाद में उपयोग करने से विटामिन सी का बचाव होता है।

डॉ राधना गुप्ता
प्रीति चौधरी



भोजन के पोषण को बरकरार रखने के तरीके

भोजन बनाते समय उसकी पौष्टिकता टिकाये रखना भी एक कला है। आहार से पौष्टिक तत्वों की प्राप्ति हमें तभी होगी जब उसमे पौष्टिकता बरकरार होगी। अज्ञानता व लापरवाही के कारण हम भोजन के पौष्टिक तत्वों को नष्ट कर देते हैं।

कुछ ऐसे सुझाव, जिनका पालन करके आप कम खर्च में अधिक विटामिन, खनिज तथा प्रोटीन प्राप्त कर सकती हैं:

1. प्रोटीन वाले खाद्य पदार्थ– सोयाबीन, फलियां व दालें प्रोटीन के अच्छे व सस्ते स्रोत हैं। अगर इन्हें पकाने और खाने से पहले अंकुरित भी कर लिया जाए तो इनमें विटामिनों की मात्रा और भी बढ़ जाती है। अंडे भी प्रोटीन का एक अच्छा स्रोत है। अन्य मांसों की अपेक्षा गुर्दे, कलेजी तथा जीगर सस्ते लेकिन उतने ही पौष्टिक होते हैं।
2. अन्न जैसे गेहूँ, चावल व अन्य अन्न तब अधिक पौष्टिक होते हैं जब कुटाई करके उनका चोकर (बाहरी सतह) अलग न कर दी जाए।
3. फल सब्जियां– इनको तोड़ने के बाद अगर इनका शीघ्रता शिघ्र प्रयोग किया जाए तो इनमें अधिक पौष्टिकता होती है। अगर आप इनका भंडारण करते हैं तो इनके विटामिन बचाये रखने के लिए इन्हें ठंडे व छायादार वाले स्थान में रखें। सब्जियां पकाते समय कम से कम पानी का प्रयोग करें क्योंकि पकाते समय सब्जियों के विटामिन पानी में मिल जाते हैं। ऐसे पानी को फैंके नहीं बल्कि उसे शोरबा (सूप) बनाने के लिए प्रयोग करें या फिर इसे वैसे ही पी लें। गाजर व गोभी की बाहरी सख्त सतह में अनेक विटामिन होते हैं और उसका प्रयोग स्वास्थ्यवर्धक सूप बनाने के लिए किया जा सकता है।
4. दूध और दूध के बने पदार्थ– इन्हें हमेशा ठंडी व छायादार जगह पर रखें। ये शरीर की रचना व वृद्धि करने वाले प्रोटीन तथा कैल्शियम में अत्यन्त समृद्ध होते हैं।
5. पैक करके बेचे जाने वाले खाद्य पदार्थों तथा विटामिन की दवाईयों पर पैसा बर्वाद न करें। माता–पिता पैसे को मिठाईयों, शीतल पेयों व सोडा आदि पर व्यर्थ न करके पौष्टिक खाद्य पदार्थों पर खर्च करें तो उतने ही पैसों में उनके बच्चे अधिक स्वस्थ रहेंगे। चूंकि आवश्यक विटामिनों को लोगों के भोजन से ही आसानी से प्राप्त कर सकते हैं, इसलिए विटामिनों की गोलियां, कैप्सूलों व सूईयों से बेहद सस्ती लेकिन उतनी ही असरदार होती हैं।

भोजन के पोषण सरंक्षण के पांच नियम

1. पकाना :–

- खाना ढक कर पकाएँ ताकि पोषक तत्वों की क्षति न हो। इससे स्वाद भी बना रहता है।
- हलाने और छानने की प्रक्रिया ज्यादा लम्बे समय तक जारी न रखें क्योंकि खाने में हवा भी सम्मिलित हो जाती है जिसकी वजह से विटामिन सी नष्ट हो जाती है।
- खाने को तब तक पकाना चाहिए जब तक वह अच्छी तरह से पक न जाए क्योंकि तभी उसमें स्वाद आएगा और वह आसानी से पच जाएगा। पोषक तत्वों को बचाने के लिए खाने को ज्यादा देर तक पकाना नहीं चाहिए। सब्जियां पकाने के बाद चमकदार रंग की एवं करारी होनी चाहिए।
- खाने को प्रेशर कुकर में पकाना चाहिए ताकि समय, उर्जा एंव पोषक तत्व बचे रहें।

2. सब्जियां एंव फल :–

- सब्जियों को पकाने से कुछ ही समय पूर्व काटें ताकि उसमें मौजूद विटामिन्स की क्षति न हो।
- सब्जियां काटने से पूर्व जरूर धोएं। काटने के बाद सब्जियों को अधिक समय तक न धोएं क्योंकि इससे पानी मे घुलनशील पोषक तत्व नष्ट हो जाते हैं।
- सब्जियों को जहां तक सम्भव हो बिना छिले इस्तेमाल करना चाहिए या फिर छिलके की पतली परत ही निकालनी चाहिए क्योंकि छिलके मे कई पोषक तत्व मौजूद होते हैं।
- खाने से ठीक पहले सब्जियों को पकाना चाहिए।
- मौसम के अनुसार मिलने वाले फल एव सब्जियां इस्तेमाल करनी चाहिए।
- फल एवं सब्जियों को बडे भागो में काटें ताकि उनके उपर के तल का क्षेत्र कम हो जाए और वे हवा एवं पानी के सम्पर्क में कम आएं।
- सब्जियों को उवालते पानी में कम पकाएं ताकि उनका रंग स्वाद एवं पोषक तत्व बचा रहे।

आहार

आहार जीवन का आधार है। प्रत्येक प्राणी के जीवन के लिए आहार आवश्यक है। मानव जीवन की तीन महत्वपूर्ण एवं आधारभूत आवश्यकता भोजन, कपड़ा तथा घर है। इन तीनों में सर्वाधिक महत्वपूर्ण भोजन है जिसके बिना जीवन संभव नहीं है।

भोजन के पोषक तत्व:

इन तत्वों की कमी के कारण शरीर अस्वस्थ हो सकता है अथवा शारीरिक, बौद्धिक अथवा मानसिक विकास रूक सकता है।

1. **शरीर को ऊर्जा प्रदान करने वाले पौष्टिक तत्व :** शरीर को ऊर्जा प्रदान करने वाले पौष्टिक तत्व हैं कार्बोज़ (कार्बोहाइड्रेट) एवं वसा।
2. **शरीर का निर्माण करने वाला पौष्टिक तत्व :** शरीर का निर्माण करने वाला पौष्टिक तत्व प्रोटीन है।
3. **शरीर को सुरक्षा प्रदान करने वाले पौष्टिक तत्व :** शरीर को सुरक्षा प्रदान करने वाले दो पौष्टिक तत्व हैं विटामिन एवं खनिज लवण।

आहार में उपस्थित मुख्य पोषक तत्व

आहार में उपस्थित मुख्य पोषक तत्व वे होते हैं जिनकी शरीर को अधिक मात्रा में आवश्यकता होती है:

वसा　　कार्बोहायड्रेट　　प्रोटीन

1. वसा:

शरीर को ऊर्जा प्रदान करने वाले दो तत्वों में से एक यह अत्यधिक महत्वपूर्ण पोषक तत्व है कार्बोज़ एवं प्रोटीन की तुलना में यह दुगना ऊर्जा देती है।

वसा के लाभ निम्नलिखित है:

1. प्रोटीन तथा कार्बोज की तुलना में, वसा से लगभग दुगनी ऊर्जा प्राप्त होती है जो कि वसा का मुख्य कार्य है।
2. वसा में घुलनशील विटामिन ए.डी.ई. एवं विटामिन के शरीर को मिलते हैं।
3. वसा, शरीर में संचित ऊर्जा के रूप में एकत्रित रहता है। भोजन न मिल पाने की स्थिति में, शरीर को ऊर्जा प्रदान करता है।

वसा के स्रोत: वनस्पति स्रोत से प्राप्त तेल एवं डालड़ा, दुधारू पशु के स्रोत से प्राप्त घी, मक्खन, दूध एवं मलाई, तिलहन जैसे तिल, सोयाबीन इत्यादि।

2. कार्बोहायड्रेड: वसा के अतिरिक्त, ऊर्जा प्रदान करने वाला महत्वपूर्ण तत्व कार्बोज़ है।

कार्बोज़ के प्रमुख कार्य:

1. शरीर का त्वरित ऊर्जा प्रदान करना।
2. भोजन को स्वादिष्ट बनाना।

कार्बोहायड्रेट के स्रोत: अनाज, बाजरा, कन्दमूल जैसे कि आलू, चुकन्दर, अरबी आदि और चीनी तथा गुड़।

3. प्रोटीन: शरीर का निर्माण व मुरम्मत का कार्य करता है।

प्रोटीन के प्रमुख कार्य निम्नलिखित हैं:

1. शरीर के कोशिका, ऊतक तथा अंगों एवं मांसपेशियों का निर्माण प्रोटीन करते हैं।
2. बीमारियों से शरीर की सुरक्षा करने वाले एंटीबॉडीज़ का निर्माण प्रोटीन द्वारा ही होता है।
3. शरीर में होने वाली जैव रासायनिक क्रियाओं में सहायक जैव उत्प्रेरक (इंज़ाईम) एवं हार्मोन्स प्रोटीन द्वारा ही निर्मित होते हैं।

प्रोटीन के प्रमुख स्रोत :

मेवे (काजू, बादाम एवं मूंगफली इत्यादि) सभी दालें, दूध अंडा एवं मांसाहार (मछली छोड़कर) प्रोटीन के बहुत अच्छे स्रोत हैं। सोयाबीन, प्रोटीन का सबसे सस्ता स्रोत है।

माईक्रोन्यूट्रीन्ट (कम मात्रा में आवश्यक पोषक तत्व):

शरीर के आवश्यक आंतरिक कार्यों को सम्पादित करने हेतु तथा सुरक्षा प्रदान करने वाले दो महत्वपूर्ण पोषक तत्व विटामिन एवं खनिज लवण हैं।

4. विटामिन

- वसा में घुलनशील विटामिन ये है विटामिन ए, डी, ई एवं के.
- जल में घुलनशील विटामिन यह है विटामिन बी समूह (काम्पलैक्स) एवं सी।

  चार प्रकार के विटामिन वसा में घुलनशील होते हैं
  - विटामिन ए
  - विटामिन डी
  - विटामिन ई
  - विटामिन के
- **विटामिन ए** वसा में घुलनशील विटामिन ए को रेटीनॉल के नाम से जाना जाता है।

विटामिन ए के प्रमुख कार्य: विटामिन ए स्वस्थ आंखों के लिये आत्यावश्यक है।

विटामिन ए की कमी:

1. विटामिन ए की कमी से रतौन्धी हो सकती है।
2. विटामिन ए की कमी से अंधत्व हो सकता है।

विटामिन ए के मांसाहार स्त्रोत: शार्क (मछली) लिवर (यकृत) आईल (तेल), कॉड (मछली) लिवर आईल एवं सॉ (मछली) लिवर आईल विटामिन ए के अच्छे स्त्रोत हैं। इन स्त्रोतों से सीधे विटामिन ए प्राप्त होता है।

- **विटामिन डी:** वसा में घुलनशील यह एक और विटामिन है जिसे कोलेकैल्सीफिरॉल भी कहते हैं।

विटामिन डी के प्रमुख लाभ:

1. विटामिन डी शरीर में कैल्शियम के अवशोषण के लिये आवश्यक है।
2. कैल्शियम अवशोषित होकर हड्डियां मजबूत होती हैं।

विटामिन डी के प्रमुख स्त्रोत:

सूर्य की रौशनी से मिलने वाली अल्ट्रावॉयलेट किरण शरीर की त्वचा पर पड़ने से शरीर में ही विटामिन डी का निर्माण होता है।

विटामिन डी की कमी के लक्षण:

1. शिशुओं और बच्चों में विटामिन डी की कमी से रिकैट्स नाम का रोग हो सकता है।
2. महिलाओं की हड्डियों में जोड़ों में दर्द होना।

- **विटामिन ई:** विटामिन ई, वसा में घुलनशील विटामिन होता है। वसा युक्त भोजन ग्रहण करने से यह शरीर को प्राप्त होता है।

विटामिन ई के प्रमुख लाभ:

1. विटामिन ई में ऐन्टी ऑक्सीडेंट (ऑक्सीकरण रोकने) के गुण होते हैं।

विटामिन ई के प्रमुख स्त्रोत: विटामिन ई सोयाबीन, मूंगफली, कपास के बीज एवं करड़ी के तेल में प्रचुर मात्रा में उपस्थित होता है। साबुत, अनाज, गहरे हरे रंग के पत्तेदार सब्जियों, दालों, मेवों तथा दलहन में भी प्रचुर मात्रा में उपस्थित होता है। मांसाहार में, यह अंडों के पीले भाग में मक्खन एवं यकृत में पाया जाता है।

- **विटामिन के:** विटामिन के को रक्त जमाने वाला विटामिन कहते हैं।

विटामिन के प्रमुख लाभ: चोट लगने पर बहते हुए रक्त को रोकने के लिये रक्त का थक्का, विटामिन के की सहायता से जमता है।

विटामिन 'के' के प्रमुख स्त्रोत : हरे पत्तेदार सब्जियां जैसे पालक, पत्ता गोभी तथा सलाद पत्ता इत्यादि में विटामिन के प्रचुर मात्रा में उपस्थित रहता है। मांसाहार में यह अंडे के पीले भाग में, दूध तथा लीवर (यकृत) में भी पाया जाता है।

जल में घुलनशील विटामिन: विटामिन बी समूह एवं विटामिन सी.

- **विटामिन बी कॉम्प्लैक्स (समूह):** भोजन के पाचन में ऊर्जा, कार्बोज, प्रोटीन तथा वसा का शरीर में उचित उपयोग हेतु विटामिन बी कॉम्प्लैक्स सहायक होता है।
  - **विटामिन बी-1:** इस विटामिन को थायामिन के नाम से भी जाना जाता है।

विटामिन बी-1 के प्रमुख स्त्रोत: विटामिन बी-1 के प्रमुख स्त्रोत निम्नलिखित हैं: बाजरा, ज्वार, साबुत अनाज (गेहूँ, चावल, रागी, सांवा, कोदो एवं कुटकी) के बाहरी आवरण (छिल्के) में प्रचुर मात्रा में पाया जाता है।

- **विटामिन बी-2:** विटामिन बी-2 रायबोफ्लेविन के नाम से भी जाना जाता है।

विटामिन बी-2 के लाभ :

विटामिन बी-2 कार्बोज एवं प्रोटीन के पाचन में सहायक होते हैं।

विटामिन बी-2 के प्रमुख स्त्रोत : दूध एवं दूध से निर्मित उत्पाद स्किम मिल्क (वसा सहित दूध), छाछ, दही, हरी पत्तेदार सब्जियां, अंकुरित दालें एवं मांसाहार में अंडे, लिवर (यकृत) में प्रचुर मात्रा में विटामिन बी-2 उपस्थित रहता है।

विटामिन बी-2 के कमी के लक्षण:

1. विटामिन बी-2 की कमी से जीभ पर छाले हो जाते हैं (गलॉसाईटिस)।
2. होंठों के किनारों का फटना (एंग्युलर स्टोमैटाईटिस)।

- **फोलिक अम्ल :** रक्ताल्पता दूर करने वाला विटामिन है।

फोलिक अम्ल के प्रमुख लाभ:

1. फोलिक अम्ल, लाल रक्त काणिकाओं के निर्माण एवं संख्यात्मक वृद्धि में सहायक होता है।
2. यह बच्चों और गर्भवती माताओं में रक्ताल्पता को दूर करने में सहायक होता है।

फोलिक अम्ल के प्रमुख स्त्रोत:

1. शाकाहार में फोलिक अम्ल के प्रमुख स्त्रोत हरी सब्जियां एवं दालें हैं।
2. मांसाहार में इसके प्रमुख स्त्रोत लिवर (यकृत) है।

फोलिक अम्ल की कमी के लक्षण: फोलिक अम्ल की कमी के कारण बच्चों और गर्भवती माताओं में विशेष प्रकार की रक्ताल्पता (मैगैलोब्लास्टिक रक्ताल्पता) होती है।

- **विटामिन बी-12 :** जल में घुलनशील विटामिन बी काम्प्लैक्स (समूह) में से एक विटामिन बी-12 विटामिन होते हैं।

विटामिन बी-12 के प्रमुख स्त्रोत:

1. विटामिन-12 का निर्माण मांसाहार में उपस्थित बैक्टीरिया करते हैं। मांसाहार जैसे दूध, अंडे, मीट इत्यादि विटामिन बी-12 के अच्छे स्त्रोत हैं।
2. शाकाहार विटामिन बी-12 का अच्छा स्त्रोत नहीं है किंतु भारत में दूध के सेवन के प्रचलन के कारण विटामिन बी-12 की मात्रा की पूर्ति हो जाती है।

- **विटामिन सी:** विटामिन सी को ऐस्कार्बिक अम्ल कहा जाता है।

विटामिन सी के प्रमुख स्त्रोत: शाकाहार में विटामिन सी के प्रमुख स्त्रोत नींबे वर्गीय (खट्टे फल) जैसे नींबू, संतरा एवं मौसमी इत्यादि। हरी मिर्च तथा हरी पत्तेदार सब्जियां हैं।

विटामिन सी की कमी के प्रमुख कारण: विटामिन सी की कमी से स्कर्वी नामक रोग होता है। जिसमें शारीरिक कमजोरी लगती है, मसूड़ों से खुन आता है एवं हड्डियों का विकास उचित प्रकार से नहीं हो पाता है।

5. खनिज लवण : खनिज लवण भी ऐसे ही पोषक तत्व हैं जिनकी शरीर को आवश्यकता कम मात्रा में होती है।

- **कैल्शियम :** कैल्शियम एक महत्वपूर्ण तत्व है। यह शिशुओं, बच्चों, किशोर, किशोरियों, गर्भवती तथा धाती माताओं के लिये बहुत आवश्यक है।

कैल्शियम के प्रमुख लाभ: कैल्शियम हड्डियों तथा दांतों की मजबूती के लिये आवश्यक है।

कैल्शियम के प्रमुख स्त्रोत: कैल्शियम का सबसे अच्छा स्त्रोत दूध एवं दूध उत्पाद (दही, छाछ, पनीर इत्यादि) है।

कैल्शियम की कमी के लक्षण:

1. दांतों तथा हड्डियों के विकास में बाधा होना।
2. दांतों तथा हड्डियों में दर्द होना टूटना।
3. बच्चों में रिकैट्स होना।

- **फॉस्फोरस :** फॉस्फोरस महत्वपूर्ण तत्व है जो कि शरीर द्वारा कैल्शियम के उपयोग में सहायता करता है।

फॉस्फोरस का प्रमुख लाभ: फॉस्फोरस, कैल्शियम से रासायनिक क्रिया कर कैल्शियम फॉस्फोरस का निर्माण करते हैं जो कि दांतों तथा हड्डियों में एकत्रित हो इन्हें मजबूत बनाते हैं।

फॉस्फोरस के प्रमुख स्त्रोत: शाकाहार में फॉस्फोरस, अनाज, दालों, तिलहन, मावों एवं दूध में उपलब्ध होता है। मांसाहार में फॉस्फोरस अंडे, मुर्गी तथा मछली में उपलब्ध होता है। कैल्शियम तथा प्रोटीन के अच्छे स्त्रोतों में आवश्यक मात्रा में फॉस्फोरस भी उपलब्ध होता है।

- **लौह तत्व :** कमतर मात्रा में शरीर के लिये आवश्यक लौह तत्व एक अत्यंत महत्वपूर्ण पोषक तत्व है।

लौह तत्व के प्रमुख लाभ :

रक्त में उपस्थित लाल रक्त कणिकाओं में हीमोग्लोबिन नामक तत्व उपस्थित होता है। इस तत्व का एक भाग हीम होता है जो कि लौह तत्व होता है। हीमोग्लोबिन, फेफड़ों से शरीर के विभिन्न अंगों के ऊतकों तक ऑक्सीजन पहुंचाते हैं और इन ऊतकों से फेफड़ों तक कार्बन-डायऑक्साईड पहुंचाता है।

लौह तत्व के प्रमुख स्त्रोत :

1. शाकाहार में लौह तत्व के प्रमुख स्त्रोत, हरी पत्तेदार सब्जियों में जैसे पालक, चैलाई तथा सरसों की भाजी, अरबी के पत्ते एवं पुदीना इत्यादि, अनाजों में जैसे गेहूँ का आटा, चावल के पोहे, बाजरा सभी एवं ज्वार इत्यादि साबुत दालों में एवं गुड़ में उपस्थित होता है, विशेष कर सोयाबीन में लौह तत्व प्रचुर मात्रा में उपस्थित होता है।
2. मांसाहार में, यकृत (लिवर) प्लीहा (स्प्लीन) तथा वृक (किडनी) लौह तत्व के बहुत अच्छे स्त्रोत हैं।

लौह तत्व की कमी के लक्षण :

लौह तत्व की कमी के कारण शरीर में हीमोग्लोबिन की कमी हो जाती है। इस स्थिति को रक्ताल्पता कहा जाता है।

- **आयोडीन :** कमतर मात्रा में आवश्यक महत्वपूर्ण पोषक तत्व जो अधिकतर गले में उपस्थित थायराईड ग्रंथि में पाया जाता है।

आयोडीन के प्रमुख स्त्रोत:

1. समुद्री मछलियों में आयोडीन अच्छी मात्रा में उपस्थित होता है।
2. आयोडीन युक्त नमक, आयोडीन का बहुत अच्छा स्त्रोत है।

आयोडीन की कमी के लक्षण: शरीर में आयोडीन की कमी से गले में सूजन आ जाती है जो कि घेंघा रोग की परिचायक होती है जिसके कारण शारीरिक तथा मानसिक विकास रूक जाता है।

6. जल - जल शरीर की सारी जीवित कोशिकाओं के प्रोटोप्लाज्म का जरूरी तथा मुख्य घटक होता है।

जल के मुख्य कार्य :

- जल महत्वपूर्ण रसायनों को रक्त के माध्यम से पूरे शरीर में पहुंचाता है।
- यह शरीर के तापमान को संतुलित बनाए रखता है।
- जल शरीर में बनने वाले बेकार और जहरीले पदार्थों को सांस, मल-मूत्र और पसीने आदि के रूप में शरीर से बाहर निकलता है।
- जल पाचक द्रव तथा स्नेहक द्रव बनाता है।

डॉ राधना गुप्ता
प्रीति चौधरी

(खाद्य विज्ञान, पोषण एवं प्रौद्योगिकी विभाग)
गृह विज्ञान महाविद्यालय
चौ.स.कु. हि.प्र. कृषि विश्वविद्यालय पालमपुर (हि.प्र.)

2016

आयरन युक्त भोजन

आयरन की आवश्यकता हीमोग्लोबिन बनाने के लिए होती है। हीमोग्लोबिन लाल रक्त कोशिकाओं में पाया जाने वाला प्रोटीन है, जो शरीर के विभिन्न अंगों तथा ऊतकों में ऑक्सीजन पहुंचाने का काम करता है। यदि हमारे आहार से आयरन की उतनी मात्रा नहीं मिल पा रही, जितनी शरीर को जरूरत है, तो आयरन की कमी या आयरन की कमी वाला एनीमिया हो सकता है। जिसे खून की कमी भी कहते हैं।

भारत में बहुत सी महिलाएं शाकाहारी हैं और शाकाहारी आहार में आमतौर पर आयरन की मात्रा कम होती है। शायद इसीलिए भारतीय महिलाओं में आयरन की कमी या एनीमिया दुनिया भर से सबसे अधिक है।

भोजन में आयरन के प्रकार

आयरन के दो तरह के स्रोत हैः

- मांसाहारी और शाकाहारी दोनों प्रकार के भोजन से हमें आयरन मिल सकता है।
- मांसाहारी स्रोत (हीम आयरन)। ये अधिक आसानी से शरीर द्वारा अवशोषित होते हैं।
- शाकाहारी स्रोत (नॉन हीम आयरन)। ये कम आसानी से शरीर द्वारा अवशोषित होते हैं।

आयरन के मांसाहारी स्रोतों में शामिल हैंः

- मटन (मेमना)
- चिकन (मुर्गी), खास तौर पर चिकन की जाँघों और टांगों में पाया जाने वाला गहरे रंग का मांस अच्छा होता है।
- सीपदार मछली जैसे झींगा (प्रॉन) श्मबूक (मसल्स), तसिरियो (क्लैम्स)

पारम्परिक तौर पर आयरन के भरपूर स्रोत के लिए कलेजी खाने की सलाह दी जाती है।

आयरन के शाकाहारी स्रोतः

- हरी पत्तेदार सब्जियां जैसे चौलाई, पालक, फूलगोभी का हरा हिस्सा, शलगम का साग, पुदीना, मूली के पत्ते, प्याज की कलियां, शलगम का साग और मेथी का साग आयरन के अच्छे स्रोत हैं। इसलिए इन्हें किसी न किसी रूप में प्रतिदिन अपने आहार में शामिल करने का प्रयास करें।
- आयरन से भरपूर सब्जियां जैसे चुकंदर, कद्दू, शकरकंदी और हरी गोभी।
- मेवे और बीज जैसे काजू, नारियल, कद्दू के बीज, सरसों के बीज, तेल, पीस्ता कीशमीश, साबुत धनिया और अखरोट।
- फलियां और दालें जैसे सोयाबीन, लोबिया, राजमा, सूखी मटर, छोले, साबुत काले चने और अन्य दालें।
- कुछ पेय जैसे खजूर का शरबत या नारियल पानी में भी कुछ आयरन होता है।

आयरन अवशोषण कैसे बढ़ाएं?

- विटामिन सी का सेवन शरीर में आयरन के अवशोषण को बढ़ाता है।
- खमीरीकरण (फरमेंट), अंकुरित फलियां और खट्टे फलों और सब्जियों से विटामिन सी पाया जाता है।
- आयरन का अवशोषण बढ़ाने के लिए परम्परागत रूप से लोहे के बर्तनों में खाना पकाने से अवशोषण बढ़ता है।
- खाना पकाते समय आप अगर उसमें टमाटर या नींबू का रस (जिसमें काफी मात्रा में विटामिन "सी" होता है) डाल दें तो लोहे के बर्तन से और अधिक लौह तत्व खाने में मिल जाते हैं।

आयरन के अवशोषण में क्या बाधा बनता है?

आपका शरीर कितना आयरन अवशोषण करता है, यह कई बातों पर निर्भर करता है।

- भोजन में आयरन की मात्रा कितनी है।
- भोजन में किस तरह का आयरन मौजूद हैः मांस (हीम) या शाकाहारी (नॉन हीम) आयरन।
- आहार में कौन से अन्य खाद्य पदार्थ शामिल हैं।
- मांसाहारी भोजन में पाया जाने वाला हीम आयरन शरीर आसानी से अवशोषित कर लेता है। अन्य खाद्य पदार्थों के सेवन से भी इस पर असर नहीं पड़ता।

आयरन के शाकाहारी स्रोत आसानी से शरीर में अवशोषित नहीं होते। इसलिए आयरन से भरपूर भोजन के साथ क्या खा रहे हैं। इस पर ध्यान देने की जरूरत है। ऐसी भी कुछ सामग्रियां हैं जो शरीर में आयरन के अवशोषण में अवरोध उत्पन्न कर सकती हैं।

- टैनीन चाय और कॉफी में पाया जाने वाला एक तत्व है, जो आयरन के अवशोषण में रूकावट डाल सकता है। इसलिए भोजन के सेवन और आयरन सप्लीमेंट लेने के एक घंटे पहले और एक घंटे बाद में कॉफी या चाय न पीएं।
- फाइटेट (फाइटिक एसीड), पूर्ण अनाज से बनी चीजों जैसे चक्की आटा, पूर्ण अनाज ब्रेड या पीसता में पाया जाता है। यह भी आयरन के अवशोषण में बाधा डाल सकता है।
- कैल्शियम की अत्याधिक मात्रा भी आयरन के अवशोषण में बाधा डालती है। इसलिए आयरन सप्लीमेंट के साथ या भोजन के साथ कैल्शियम सप्लीमैंट नहीं लेनी चाहिए। इसी बजह से भोजन के साथ या इसके बाद दूध नहीं पीना चाहिए।

डॉ राधना गुप्ता
प्रीति चौधरी

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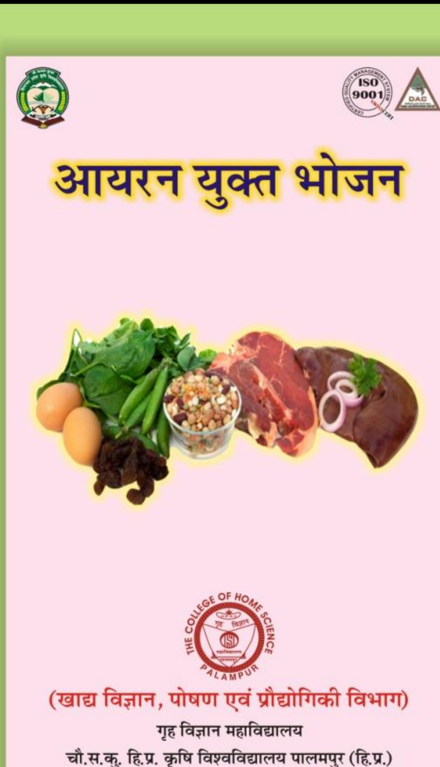
आयरन युक्त भोजन



THE COLLEGE OF HOME SCIENCE PALAMPUR

(खाद्य विज्ञान, पोषण एवं प्रौद्योगिकी विभाग)
गृह विज्ञान महाविद्यालय
चौ.स.कु. हि.प्र. कृषि विश्वविद्यालय पालमपुर (हि.प्र.)
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जंक फूड

जिंदगी की भागदौड़ में हमारा फूड कल्चर पूरी तरह से बदल चुका है। लोगों को हर वक्त जल्दबाजी होती है अपने काम को पूरा करने की। समय के साथ रहन–सहन, बातचीत और पहनावे के साथ हमारे खान–पान में भी काफी बदलाव आया है। समय न रहने की वजह से जो कुछ भी जल्दी से बनने वाला खाद्य पदार्थ घर में मौजूद है वही बन जाता है। लेकिन क्या कभी आपने सोचा कि इसका हमारे शरीर पर क्या प्रभाव पड़ सकता है। जिस चीज (भोजन) के लिए लोग दिनभर भागदौड़ में लगे हैं, आज उसी के लिए उनके पास वक्त नहीं है।

जंक फूड का चलन पूरे विश्व में दिन पर दिन बढ़ता जा रहा है। चिप्स, चॉक्लेटस, पीजा, बरगर इत्यादि तले–भुने खाने को जंक फूड की संख्या में गिना जाता है। बच्चे हों या बड़े हों इस जंक फूड का प्रभाव सबपे बढ़ता जा रहा है। परन्तु इस जंक फूड को खाने के सिर्फ नुक्सान ही हैं। बच्चों पे इसका असर जल्दी पड़ता है। मोटापा इसका सबसे बड़ा नुक्सान है।

इन जंक फूड में कार्बोहायड्रेट की मात्रा अधिक होती है जो सभी बीमारियों की जड़ होती है। इसी से कॉलस्ट्रॉल, हृदयघात, ब्लड प्रेशर जैसी बीमारियां होती हैं। हमें अपने जीवन को सही रखने के लिए इसका सेवन कम करना होगा। कभी कभार ऐसे जंक फूड खाने में कोई बुराई नहीं परन्तु हमें इसका आदि नहीं होना चाहिए। और इसके प्रभाव से बचने के लिए हमें योगा और कसरत करते रहना चाहिए।

जंक का मतलब कबाड़ जैसा होने से है। जिस तरह कबाड़ की बहुत कम कीमत होती है, उसी तरह जंक फूड में भी न के बराबर न्यूट्रियन्ट्स होते हैं। साथ ही, नुक्सान अधिक होता है।

जंक फूड के तथ्य

जंक फूड में पाई जाने वाली वसा में कॉलस्ट्रॉल का उच्चस्तर, अत्याधिक चीनी और नमक रहता है। अत्याधिक कैलोरी के साथ चीनी के कारण मोटापा बढ़ता है। कॉलस्ट्रॉल और नमक के कारण उच्च रक्तचाप, आघात और दिल की बीमारी का खतरा बढ़ता है। अत्याधिक नमक के कारण गुर्दे की कार्यक्षमता भी प्रभावित होती है।

जंक फूड के दुषपरिणाम

- थकान
- पाचन क्रिया को भी प्रभावित करता है।
- मोटापा
- खून में सुगर लेवल को बढ़ा–घटा सकता है।
- दिमाग की शक्ति को कम करता है।
- दांतों की समस्याएं
- जिगर की बीमारियां
- दिल की बीमारियां

किस तरह से हानिकारक है जंक फूड आपके स्वास्थ्य के लिए:

- आपकी भूख तो तुरंत शांत कर देता है, लेकिन यह आपको लेजी भी बना सकता है। असल में इन खाद्य पदार्थों में आवश्यक पोषक तत्व जैसे प्रोटिन, कार्बोहाइड्रेट की कमी होती है और मैदे और तेल से बने यह पदार्थ आपमें एनर्जी लेवल की कमी पर आपमें ऊर्जा कमी कर सकते हैं।
- लगातार जंक फूड का सेवन टिनेजर्स में डिप्रेशन का कारण बन सकता है। बढ़ती उम्र में बच्चों की कई तरह के बायोलॉजिकल बदलाव आने लगते हैं।
- फास्ट फूड या जंक फूड पाचन क्रिया को भी प्रभावित करता है। ज्यादातर खाना तेल में डीप फराई होने की वजह से इसमें मौजूद तेल पेट में जमा होने लगता है जिससे एसीडीटी की समस्या उत्पन्न हो सकती है। इन खानों में फाइवर्स की कमी होने की वजह से भी ये खाद्य पदार्थ पचने में दिक्कत करते हैं।
- फास्ट फूड का सेवन खून में सुगर लेवल को बढ़ा–घटा सकता है। इन चीजों में रिफाईंड सुगर की बहुत अधिक मात्रा पायी जाती है। जिसकी वजह से खून में सुगर की मात्रा को संतुलित करने के लिए अमाशय को अत्यधिक मात्रा में इंसुलिन इकट्ठा करना पड़ता है।
- जंक फूड का ज्यादा इस्तेमाल आपकी दिमाग की शक्ति को कम कर सकता है।

डॉ राधना गुप्ता
प्रीति चौधरी

ISO 9001

जंक फूड

THE COLLEGE OF HOME SCIENCE PALAMPUR

(खाद्य विज्ञान, पोषण एवं प्रौद्योगिकी विभाग)
गृह विज्ञान महाविद्यालय
चौ.स.कु. हि.प्र. कृषि विश्वविद्यालय पालमपुर (हि.प्र.)

2016

- **सब्जियों को भिगो के रखना**

पानी से घुलने वाले विटामिन बह जाते हैं।

- **हवा में खुला रखना**

कटे हुए फल व सब्जियों को हवा में खुला छोड़ने से कटी हुई सतह विटामिन सी का ऑक्सीकरण हो जाता है और वसा बिगड कर बासी हो जाती है।

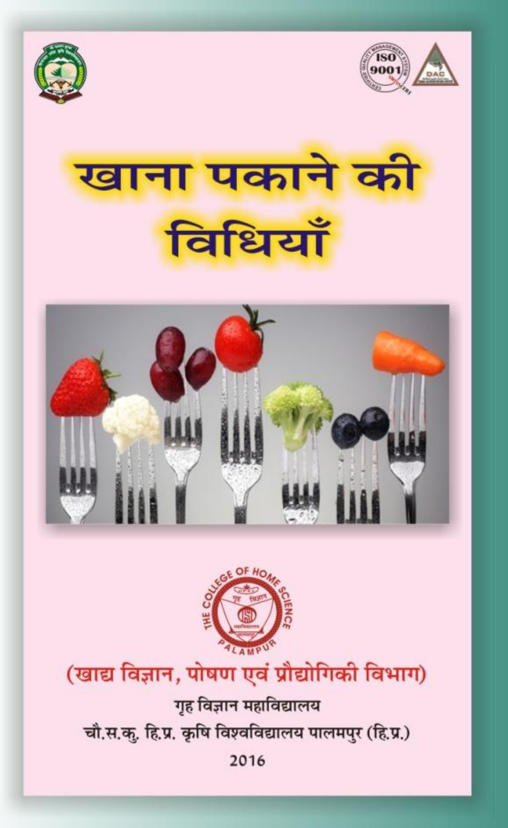
- **रोशनी के सम्पर्क मे रखना**

रोशनी के सम्पर्क में आने पर विटामिन सी, विटामिन बी नष्ट हो जाते हैं।

- **तलना**

तलने की प्रक्रिया मे खाध पदार्थ अधिक तेल सोखते हैं जिससे सिर्फ कैलोरी बढ़ती है अन्य कोई पोषक तत्व नहीं मिलते। तलने की प्रक्रिया के दौरान कैंसर उत्पन्न करने वाले रसायनों का निर्माण होता है।

डॉ राधना गुप्ता
प्रीति चौधरी



खाना पकाने की विधियाँ

आहार विशेषज्ञों के अनुसार खाना पकाते वक्त हम लोग जितना ध्यान स्वाद के लिए देते हैं उतना उसकी पौष्टिकता पर नहीं। इन कारणों से ही हम उपयोगी नियमों का पालन न करके खाद्य पदार्थों के 40 प्रतिशत पौष्टिक तत्वों को नष्ट कर देते हैं।

खाना पकाना क्यों आवश्यक है ?

- भोजन के पाचन में साहयक होता है।
- खाने को नरम व चबाने लायक बनाने के लिये।
- पोषक तत्वों की उपलब्धता बढाने के लिये।
- भोजन को स्वादिष्ट बनाने के लिये।

खाना पकाते समय ध्यान में रखने योग्य कुछ बातें:

- सब्जियों को काटने से पहले भली भांति धो लें (बाद में नहीं)।
- इन्हें पकाते समय बरतन को ढक कर रखें।
- भोजन को आवश्यकता से अधिक न पकायें।
- चावल पकाते समय उसमें केवल उतना ही पानी डालें कि पकाने के बाद आपको उसका पानी फैंकना न पड़े।
- गेहूँ का चोकर एक पोष्टिक पदार्थ है। चोकर हटाये बिना ही गेहूँ के आटे से रोटियां बनाई जा सकती हैं।

भोजन पकाने की विधियाँ

- **वाष्पीकरण भाप में पकानाः**

वाष्पीकरण के दौरान खाध पदार्थ के जल सम्पर्क मे न आने से जल में घुलनशील विटामिन नष्ट नहीं होते।

- **प्रेशर कुकर मे पकाना**

इस क्रिया में अधिक उर्जा के कारण पोषक तत्वों को होने वाली हानि कम होती है क्योंकि पकाने का समय कम हो जाता है।

- **बेकिंग/तंदूर मे पकाना**

अवन के अंदर खाना पकाने से कम वसा की जरूरत होती है।

- **मिला जुला भोजन**

अनाज, दूध, दाल व मेवों को एक साथ मिलाने से प्रोटिन की गुणवत्ता बढ़ती है और शरीर में उसका उपयोग भली–भांति हो पाता है।

- **भिगोना**

दालों को भिगोकर उसका पानी निकालने या अलग करने से हानिकारक तत्वों जैसे कि फाइटेट पानी के साथ मिलकर निकल जाते हैं।

- **खमीरीकरण**

खमीरीकरण आयरन व जिंक के अवशोषण को बढ़ाता है तथा प्रोटीन की गुणवत्ता एवं पाचन बढ़ाता है विटामिन बी की मात्रा तथा सूक्ष्म जीवी सुरक्षा व गुणवत्ता को बढ़ाता है।

- **अंकुरण**

अंकुरण की प्रक्रिया से दालों की पाचन क्षमता बढ़ती है हानिकारक पोषक तत्व जो मिनरल के अवशोषण को बाधित करते हैं अंकुरण की प्रक्रिया में कुछ हद तक नष्ट हो जाते हैं अंकुरण की प्रक्रिया से भोज्य पदार्थ में विटामिन सी और रेशे की मात्रा बढ़ती है।

भोजन बनाने की गलत विधियां

- **अधिक गर्म करना**

विटामिन सी, विटामिन बी नष्ट हो जाती हैं। अधिक गर्म करने से प्रोटीन सख्त व अपचनीय हो जाते हैं। अत्यधिक गर्म करने से कैंसर पैदा करने वाले हानिकारक तत्व उत्पन्न होते हैं।

खून की कमी अनीमिया

अनीमिया अथवा रक्तअल्पता ''शरीर में खून की कमी'' को कहते हैं। खून की कमी का प्रमुख कारण रक्त में लौह तत्व तथा फोलिक एसिड की कमी है। हमारा खून लाल रंग का होता है। यह लाल रंग, लौह तत्व या आयरन के कारण होता है। शरीर को आयरन की आवश्यकता हीमोग्लोबीन के निर्माण के लिए होती है जो लाल रक्त कणिकाओं में प्रोटीन का निर्माण कर शरीर के दूसरे भाग में आक्सीजन पहुंचाती है। पर्याप्त आक्सीजन के बिना किसी भी व्यक्ति की शारीरिक शक्ति और मानसिक क्षमता कम हो जाती है।

खून की कमी के कारण

बच्चों में	किशोरियों एवं महिलाओं में
भोजन में कम आयरन की मात्रा लेना	किशोरावस्था में शारीरिक विकास बहुत तेजी से होता है, जिससे शरीर में खून की जरूरत बढ़ जाती है।
आयरन के पाचन में रुकावट होना	माहवारी के दौरान शरीर से खून बहने की वजह
आयरन की अधिक आवश्यकता (बीमारी के समय)	भोजन में लौह तत्व या विटामिन-सी की कमी होना।
भोजन के तुरन्त बाद चाय पीने से लौह तत्व का अवशोषण कम हो जाता है	भोजन के तुरन्त बाद चाय पीने से शरीर में लौह तत्व की अवशोषण कम हो जाता है।
मलेरिया या पेट के कीड़ों के कारण खून की गम्भीर हानि	नंगे पैर रहने और बिना धुली साग-सब्जी से पेट में कीड़े हो सकते हैं।

खून की कमी के लक्षण

- कमजोरी, थकान और सुस्ती
- जल्दी सांस फूल जाना
- भूख न लगना
- हाथ-पांव दुखना
- काम में मन न लगना और ध्यान न दे पाना
- चक्कर आना, आंखों के आगे अंधेरा छाना
- अनियमित माहवारी

अनीमिया का स्तर विश्वसनीय रूप से हीमोग्लोबिन की जांच से ही जाना जा सकता है।। हीमोग्लोबिन का स्तर 7 ग्राम प्रतिशत से कम होने पर गंभीर रक्ताल्पता मानी जाती है। निम्न तालिका में दिये गये स्तर से यदि हीमोग्लोबिन कम है, तो वह अनीमिया का सूचक है।

आयु/लिंग	हीमोग्लोबिन (ग्राम/100 मि.ली. रक्त)
बच्चा (6 माह से पांच साल)	<11
बच्चा (6-14 साल)	<12
पुरुष	<13
महिला	<12
गर्भवती महिला	<11

खून की कमी के परिणाम

बच्चों में	किशोरावस्था में	महिलाओं में
• वृद्धि को प्रभावित करता है • कम ऊँचाई, अपर्याप्त वृद्धि • बीमारियों के प्रति कम प्रतिरक्षण क्षमता • भूख न लगना	• थकावट • माहवारी रुक सकती है • पढ़ाई में ध्यान न लगना • संक्रमण से लड़ने की क्षमता कम हो जाती है • अनीमिया की शिकार किशोरी बालिकायें अधिकतर छोटे कद की मां बनती है, जिससे कुपोषण का चक्र पीढ़ी दर पीढ़ी चलता रहता है	• प्रसव के समय मृत्यु का अधिक जोखिम • समय पूर्व प्रसव और कम वजन के बच्चों का जन्म होना • गर्भपात हो सकता है या मरा हुआ बच्चा पैदा हो सकता है

लौहतत्व के मुख्य स्त्रोत
(खाद्य भाग के 100 ग्राम में मात्रा)

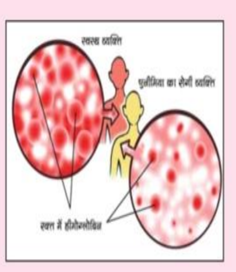
भोजन	लोहा (मि.ग्रा.)
हरी पत्तेदार सब्जियां	10-40
बाजरा, रागी	13-20
चावल, गेहूँ	3-6
दालें	5-9
मासाहारी भोजन	2-6
अन्य सब्जियां	2-5
फल	1-3

एनीमिया की रोकथाम

- आयरन से भरपूर भोजन दें जैसे - मांस, कलेजी, अंडे, दालें, पालक, मेथी, बथुआ आदि। मांस और अण्डों में पाया जाने वाला आयरन सब्जियों और दालों की अपेक्षा बेहतर ढंग से शरीर को उपलब्ध होता है।
- विटामिन-सी युक्त भोज्य पदार्थ जैसे नींबू, आंबला, अमरूद, घी, मिर्च, खट्टे रसेदार फल आदि का सेवन करें, ताकि शरीर आयरन को अच्छी तरह से पचा सकें।
- आयरन फोलेट एसिड की गोलियां लें।
- पेट के कीड़े मारने वाली दवाईयां लें।
- जितना संभव हो विभिन्न खाद्य पदार्थों को भोजन में शामिल कीजिए। ऊर्जा व पोषक तत्वों की पर्याप्त मात्रा के लिए भोजन के पांच समूहों के आधार पर प्रत्येक समूह में से खाद्य पदार्थों को दैनिक आहार में सम्मिलित करें।
- खाने में साबुत अनाज व सूखे फलों को शामिल करें।
- हरी पत्तेदार सब्जियां तथा साग जैसे चौलाई, पालक, सरसों इत्यादि को दैनिक भोजन में सम्मिलित करें। शिशु को दूध छुड़ाने के बाद दिए जाने वाले भोजन में भी हरी पत्तेदार सब्जियों को शामिल करें।
- अंकुरित दालों आदि का प्रयोग करें। अंकुरीकरण से विटामिन सी की मात्रा बढ़ती है और आयरन दुगुना हो जाता है।
- लोहे के बर्तनों में खाना पकाने से उसमें लोहे की मात्रा बढ़ जाती है।
- गुड़ भी लौहतत्व युक्त होता है, इसलिए इसका सेवन भी अनीमिया होने पर लाभप्रद होता है।
- चाय और काफी में उपस्थित टैनिन अमाशय में आयरन के अवशोषणों को कम करते हैं। अत: अनीमिया के रोगी चाय का सेवन कम करें। खाना खाने के एक घंटे के भीतर चाय या काफी कभी न लें।
- गृह वाटिका में ज्यादा से ज्यादा लौह प्रचुर सब्जियां लगाएं।

खून की कमी की रोकथाम के लिए लौहतत्व की गोली की पूरी खुराक लेना अत्यंत आवश्यक है। रिप्रोडक्टिव एवं चाइल्ड हैल्थ प्रोग्राम के तहत बच्चों तथा लड़कियों को आयरन तथा फोलिन अम्ल की दवाईयां प्रदान की जाती हैं।

नैशनल न्यूट्रीशन एनीमिया प्रोफालैक्सिस प्रोग्राम के अंतर्गत गर्भवती एवं स्तनपान करवाने वाली महिलाओं तथा बच्चों को लौहतत्व की गोलियां स्वास्थ्य केन्द्रों में मुफ्त दी जाती हैं। हमारे नमक को भी आयरन युक्त बनाने के अभियान के अंतर्गत इसमें सल्फेट तत्व मिलाया जाता है, जिसके 1 ग्राम से 1 मि.ग्राम लौहतत्व प्राप्त होता है। दस्त रोग और पेट के कीड़ों जैसी बीमारियों में लौह का शोषण कम होता है। अत: इनकी उचित रोकथाम भी जरूरी है। इस सब के साथ-साथ लोगों को अनीमिया के बारे में जागरूक करके तथा पोषक आहार के महत्व के बारे में बताने से इस समस्या से निजात मिल सकती है।



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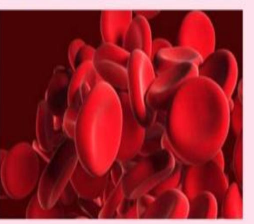

(खाद्य विज्ञान, पोषण एवं प्रौद्योगिकी विभाग)
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2016

संतुलित आहार

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भोजन का कार्य केवल शरीर को ऊर्जा प्रदान करना तथा निर्माण करना ही नहीं है, अपितु शरीर के विभिन्न अंगों के कार्यों को सुचारू रूप से नियन्त्रित करना तथा उनको विभिन्न बीमारियों से बचाना भी है। यदि हम किसी व्यक्ति के द्वारा ली जाने वाली आहार तालिका की विवेचना करें, तो हमें ज्ञात होता है कि उनके आहार में मुख्य रूप से दाल, रोटी, सब्जी, चावल आदि व्यंजन होते हैं। इस प्रकार के आहार में निर्माण-कारक एवं ऊष्मा उत्पादक पदार्थों का समावेश रहता है परन्तु शरीर में होने वाली समस्त क्रियाओं को संचालित करने वाले एवं शरीर को निरोग करने वाले पौष्टिक तत्व जैसे खनिज, लवण एवं जीवन तत्वों का अभाव होता है। इस कारण यह आहार पर्याप्त होने पर भी संतुलित नहीं कहा जा सकता।

संतुलित आहार वह भोजन है, जिसमें शारीरिक अवस्था एवं दैनिक परिश्रम की आवश्यकतानुसार सभी पौष्टिक तत्व उचित अनुपात में उपस्थित हों, जितनी कि एक व्यक्ति को प्रतिदिन आवश्यकता होती है। अत: संतुलित आहार वह आहार है जो हमारे शरीर को आवश्यक व उचित मात्रा में ऊष्मा उत्पादक, बाढ़ वर्द्धक, टूट-फूट की मरम्मत करने वाले, शरीर की क्रियाओं को संचालित और निरोग करने वाले पौष्टिक तत्वों को प्रदान करता हो।

संतुलित आहार के उद्देश्य

संतुलित आहार मुख्यत: शरीर को शक्ति, गर्मी, शारीरिक वृद्धि, मानसिक वृद्धि, रोगों से शरीर की रक्षा, रोग रोधक क्षमता प्रदान करता है तथा शारीरिक संरचना पर नियंत्रण रखता है। अत: जन-स्वास्थ्य की दृष्टि से संतुलित आहार के अन्तर्गत उचित मात्रा में सभी पौष्टिक तत्व का उपस्थित रहना अनिवार्य है। संतुलित आहार हर व्यक्ति के लिए अलग-अलग होता है। प्रत्येक व्यक्ति का संतुलित आहार उसकी आयु, लिंग, शरीर का आकार, जलवायु, कार्य एवं परिश्रम पर निर्भर करता है।

आयु : शिशुओं, बालकों एवं किशोरों को प्रौढ़ एवं वृद्ध (बुजुर्ग) व्यक्तियों के अनुपात में अधिक मात्रा में पौष्टिक तत्वों की आवश्यकता होती है। इसका मुख्य कारण है- यह समय उनका शारीरिक वृद्धि एवं विकास का समय है। बालकों में 1 वर्ष से 5 वर्ष की आयु में वृद्धि की गति अत्यन्त तीव्र होती है तत्पश्चात मन्द हो जाती है, किशोरावस्था में फिर यह गति तीव्र हो जाती है। इसलिए बालकों एवं किशोरों को वृद्धि और विकास के लिए उचित मात्रा में प्रोटीन की आवश्यकता होती है। प्रौढ़ावस्था एवं वृद्धावस्था में फिर यह गति रुक जाती है। वृद्धावस्था में शारीरिक वृद्धि रुकने के साथ-साथ पाचन-तन्त्र भी शिथिल पड़ जाते हैं। इसलिए वृद्धों को हल्का, सुपाच्य एवं कम भोजन देना चाहिए। प्रौढ़ावस्था में शारीरिक टूट फूट की मरम्मत के लिए आवश्यक भोज्य पदार्थ आहार में लेने चाहिए।

लिंग : स्त्रियों की शारीरिक बनावट पुरुषों की बनावट से भिन्न होती है। स्त्रियां सामान्यत: पुरुषों की अपेक्षा लम्बाई एवं भार में कम होती हैं। इसके साथ-साथ वह शारीरिक श्रम भी कम करती हैं। अत: उन्हें पुरुषों की अपेक्षा कम आहार की आवश्यकता होती है, परन्तु कुछ विशेष परिस्थितियों में उन्हें विशेष एवं अधिक भोजन की आवश्यकता होती है जैसे कि गर्भावस्था आदि।

व्यवसाय : व्यवसाय के अनुसार कार्य करने वाले व्यक्तियों को तीन भागों में बांटा जा सकता है। कठोर परिश्रम करने वाले, मध्यम परिश्रम करने वाले तथा कम परिश्रम करने वाले। अधिक परिश्रम करने वाले को अधिक ऊर्जा की आवश्यकता होती है। मानसिक कार्य करने वालों को कम ऊर्जा और अधिक प्रोटीन युक्त भोजन की आवश्यकता होती है।

जलवायु और मौसम: प्रत्येक व्यक्ति की खान-पान की आदतें उसके क्षेत्र के अनुसार होती हैं। शीत देशों के निवासियों को गर्म देशों के निवासियों की अपेक्षा अधिक ऊर्जा प्रदान करने वाले भोज्य पदार्थों की आवश्यकता होती है। संतुलित आहार के लिए इस बात का भी ध्यान रखना चाहिए कि किसी व्यक्ति को कितनी मात्रा में पौष्टिक तत्वों की आवश्यकता होती है, जो उसे भोजन से मिल सके। अनेक राष्ट्रीय एवं अन्तर्राष्ट्रीय कमेटियों ने विभिन्न पौष्टिक तत्वों की मात्रा प्रस्तावित की है।

ऊर्जा की मांग निम्न बातों पर निर्भर करती है -

(1) शारीरिक कार्य, (2) शारीरिक बनावट तथा आकार, (3) आयु एवं लिंग, (4) जलवायु तथा मौसम।

पोषक तत्व छ: प्रकार के होते हैं। कार्बोहाइड्रेट, प्रोटीन, वसा, विटामिन, खनिज लवण और पानी। संतुलित आहार के लिए इन सभी का हमारे भोजन में सही अनुपात में समावेश होना आवश्यक है।

(1) कार्बोहाइड्रेट : ये ऊर्जा का सबसे सस्ता साधन है क्योंकि यह आसानी से उपलब्ध हो सकता है।

(2) वसा : वसा भी ऊर्जा का मुख्य स्रोत है। वसा के रूप में शरीर में ऊर्जा एकत्रित रहती है। वसा शरीर के कोमल अंगों की बाहरी प्रहारों से रक्षा करता है। इसके साथ-साथ वसा शरीर के तापक्रम को नियंत्रित करता है।

(3) प्रोटीन : प्रोटीन भोजन में वृद्धि-वर्धक, शरीर के निर्माण एवं शरीर में होने वाली तोड़-फोड़ की मरम्मत का कार्य करता है। कोशिकाओं के अतिरिक्त प्रोटीन मांसपेशियों, बाल, रक्त, नाखून, पाचक रस में भी उपस्थित रहती है।

(4) खनिज लवण : प्रोटीन के साथ-साथ खनिज-लवण भी शरीर की वृद्धि और निर्माण का कार्य करते हैं। खनिज लवण अस्थियों, दांतों, मांसपेशियों का निर्माण तथा कोशिकाओं में होने वाली तोड़-फोड़ की मरम्मत करते हैं। शरीर में होने वाली विभिन्न क्रियाओं को नियंत्रित करते हैं और शरीर के रोगों से रक्षा करते हैं। भोजन में दस खनिज लवण शरीर के विभिन्न कार्यों के लिए आवश्यक होते हैं, जो हैं- कैल्शियम, फास्फोरस, लौह, आयोडीन, सोडियम, पोटैशियम, मैगनीशियम, तांबा, सल्फर, क्लोरीन आदि। इनकी एक निश्चित मात्रा प्रतिदिन के आहार में उपस्थित रहनी चाहिए।

(5) विटामिन: ये शरीर की रोगों से रक्षा करते हैं। विटामिन मुख्यत: छ: प्रकार के होते हैं 'ए', 'बी', 'सी', 'डी', 'ई', 'के'। प्रत्येक विटामिन शरीर में भिन्न-भिन्न कार्य करता है।

(6) जल : जल का भोजन में अत्यन्त ही महत्वपूर्ण स्थान है। यद्यपि जल हमें ऊर्जा प्रदान नहीं करता है, परन्तु शारीरिक क्रियाओं के सुचारु रूप से चलने और कोशिकाओं का जल अनुपात निर्धारित करने में इसका अत्यन्त महत्व है। प्रतिदिन एक व्यक्ति को कम से कम 2 लीटर जल की आवश्यकता होती है।

पांच खाद्य समूह : पोषक विशेषज्ञों ने आहार योजना करने के लिए भोज्य पदार्थों को पांच समूहों में विभाजित किया है। ये समूह शरीर को उसकी आवश्यकतानुसार सभी पौष्टिक तत्व प्रदान करते हैं। प्रत्येक भोज्य वर्ग में एक या उससे अधिक पौष्टिक तत्व की प्राप्ति होती है। एक संतुलित आहार के लिए इन पांच समूहों में से भोज्य पदार्थों का उपयोग करना अनिवार्य है क्योंकि ऐसा करने से ही सभी पौष्टिक तत्व उचित मात्रा में शरीर को प्राप्त हो सकेंगे।

पांच खाद्य समूह एवं उनके पौष्टिक तत्व

खाद्य समूह	पौष्टिक तत्व
अनाज : गेहूँ, रागी, बाजरा, ज्वार, चावल, आदि	ऊर्जा, प्रोटीन, विटामिन बी 1, बी 2, फोलिक एसिड, आयरन, रेशा
दालें एवं फलियां : अरहर, मूंग, मसूर, मलका, राजमा, मटर, सोयाबीन, लोबिया आदि	ऊर्जा, प्रोटीन, विटामिन बी 1, बी 2, फोलिक एसिड, आयरन, रेशा
दूध एवं मांसाहारी चीजें : दूध, दही, पनीर, मांस, मछली	प्रोटीन, वसा, विटामिन, बी 1, कैल्शियम
फल एवं सब्जियां	कैरोटिनोइडस, विटामिन सी, रेशा, आयरन
तेल और चीनी : घी, मक्खन, चीनी, गुड़ आदि	ऊर्जा एवं वसा

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शौचालय का प्रयोग

- शौचालय का प्रयोग करने से पहले शौचालय में पानी डालें।
- शौचालय में ही मल त्याग करें।
- मलत्याग करने के बाद शौचालय में पानी जरूर डालें।
- मलत्याग के बाद हाथों को साबुन या चूल्हे की ताजी राख एवं पानी से अच्छी तरह धोयें।

माहवारी स्वच्छता व सफाई

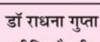
- लड़की के योनि से हर माह 2–7 दिन रक्तस्राव होने को माहवारी कहते है।
- पहला मासिक धर्म 9 और 16 वर्ष की उम्र की बीच कभी भी आ सकता है।
- माहवारी का चक्र अक्सर 21 और 40 दिनों के बीच होता है।

माहवारी के समय किशोरियों की परेशानियाँ

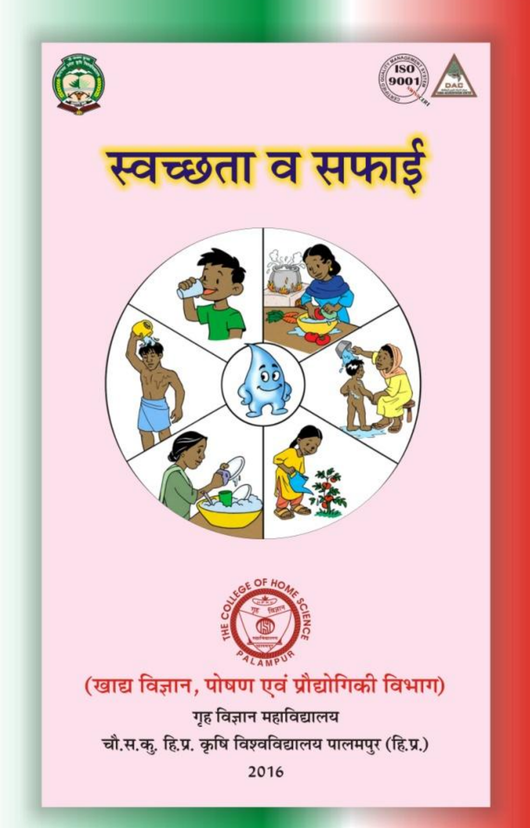
- थकान होना
- शरीर का ढ़ीला होना
- चिड़चिड़ापन होना
- सिरदर्द होना
- स्तनों में कसाव होना
- काम में मन न लगना

माहवारी के दौरान सफाई

- माहवारी के समय रोजाना स्नान करना चाहिये।
- अपने भीतरी कपड़ों को अच्छी तरह साबुन एवं साफ पानी से धोकर खुली धूप में सुखाना चाहिये।
- पैड अथवा कपड़ा, जो भी प्रयोग किया जा रहा है उसको आवश्यकतानुसार एवं दिन में कम से कम 3–4 बार बदलना चाहिये।
- कपड़ा या पैड बदलने से पहले एवं बाद में हाथों को साबुन व पानी से धोना चाहिये।



डॉ राधना गुप्ता
प्रीति चौधरी



स्वच्छता व सफाई

प्रत्येक मनुष्य अपने जीवन का पूरी तरह से आनन्द लेना चाहता है। जीवन का पूरा आनन्द सही अर्थों में तभी लाया जा सकता है यदि व्यक्ति का स्वास्थ्य अच्छा हो। अच्छा स्वास्थ्य, अच्छे स्वास्थ्य सम्बन्धी आचरण पर निर्भर करता है। हमारा दैनिक आचरण, हमारा रहन–सहन, खान–पान, व्यवहार–विचार आदि हमारे स्वास्थ्य को प्रभावित करते हैं। स्वच्छता एक ऐसा कार्य नहीं है जो हमें दबाव में करना चाहिए। ये एक अच्छी आदत और स्वस्थ तरीका है, हमारे अच्छे स्वस्थ जीवन के लिए। अच्छे स्वास्थ्य के लिए सभी प्रकार की स्वच्छता बहुत जरूरी है चाहे वो व्यक्तिगत हो, अपने आसपास की, पर्यावरण की, पालतु जानवरों की या काम करने की जगह स्कूल, कॉलेज, आदि हों।

साफ सफाई का सीधा संबंध मानव स्वास्थ्य से और संकरात्मक बीमारियों से है। सफाई व्यवस्था न होने के कारण फैलने वाली बीमारियों की सूची बहुत लंबी है। ऐसी ही कुछ बीमारियां जैसे डायरिया, हैजा, मलेरिया और वारम पेट के कीड़े, गंदगी के कारण फैलते हैं। सफाई व्यवस्था का कुछ इस प्रकार से ध्यान देकर आप स्वस्थ रह सकते हैं।

व्यक्तिगत स्वच्छता

हाथ कैसे और कब–कब धोएं

प्रर्याप्त पानी से हाथों को रगड़ कर साबुन या ताजी राख से धोना चाहिये।

1 **खाने की चीजों के रख–रखाव के पूर्व हाथ धोना :–**
   - खाना बनाने/पकाने से पहले
   - खाना परोसने से पहले
   - खाना खाने से पहले
   - बच्चों को खाना खिलाने से पहले

2 **मल छूने के बाद :–**
   - मलत्याग के पाखाना साफ करने के बाद
   - बच्चे के मल को फैंकने के बाद

3 **मल के रख–रखाव के बाद :–**
   - पशुओं का मल उठाने के बाद
   - बच्चे के मल को साफ करने के बाद
   - द्रव्य एवं ठोस गंदगी को साफ करने के बाद

4 किसी भी प्रकार की सफाई करने के बाद

शरीर की साफ–सफाई

- हमें अपने नाखूनों को सामान्य अवकाश पर काटना चाहिये।
- दाँतो को दिन में कम से कम दो बार साफ करना चाहिये– सुबह सोकर उठने के बाद और रात को सोने से पहले।
- भोजन करने के बाद साफ पानी से कुल्ला करें।
- हमें रोज नहाना चाहिये।
- आँख, कान और नाक की सफाई हर रोज साफ पानी से करनी चाहिए।

आहार में साफ सफाई

फलों और सब्जियों को अच्छी तरह से धोकर ही खायें। रसोईघर में खाने के बर्तनों को खुला न रखें, अन्यथा मक्खी–मच्छर खाने की चीजों पर बैठ सकते हैं। खाने–पीने की चीजों को डिब्बे में बंद करके रखें। खाना खाने और खाना बनाने से पहले हाथ जरूर धोयें।

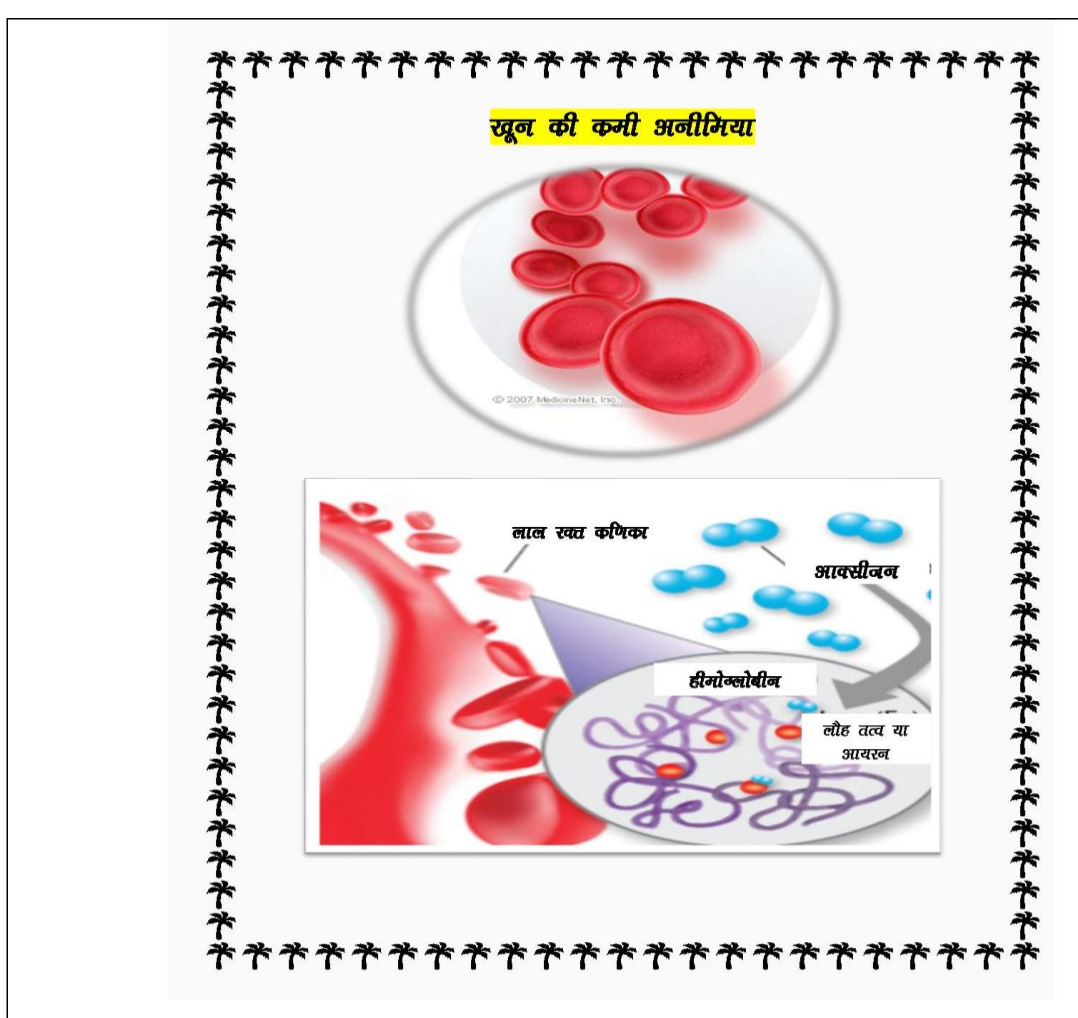
स्वच्छ वातावरण

व्यक्ति व समूह के स्वास्थ्य के लिए वातावरण की साफ सफाई बेहद आवश्यक है। ऐसी जगह जहां गंदगी फैली होती है वहां बीमारियों के फैलने की संभावना भी अधिक होती है। वो बच्चे जो सफाई से नहीं रहते, वो अधिक बीमार पड़ते हैं।

पीने के पानी की सफाई

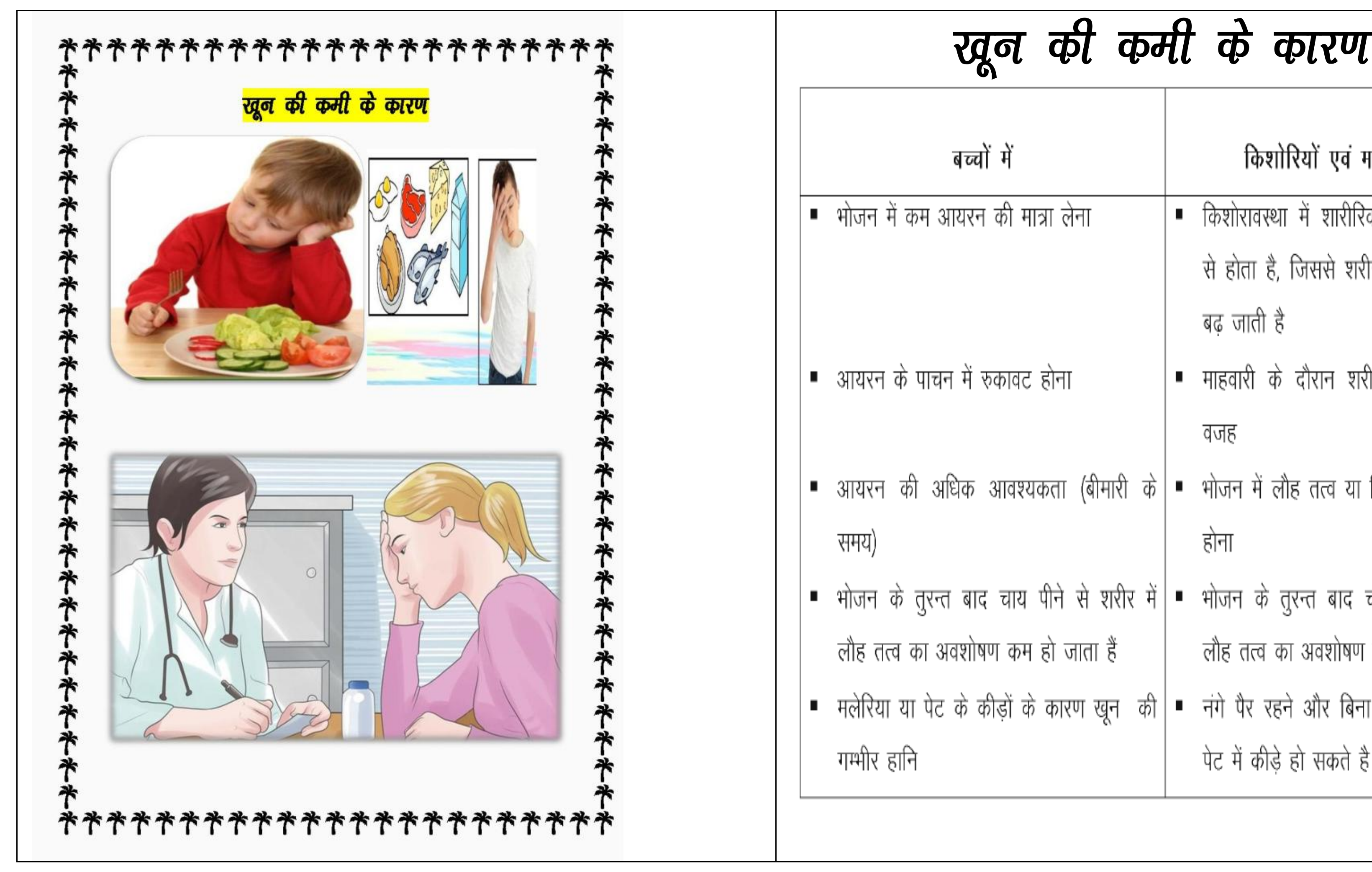
- हमें पानी को हमेशा साफ जगह से भरना चाहिये।
- पानी के बर्तन को धोकर पानी भरना चाहिए तथा घर लाते समय ढक कर लाना चाहिए।
- इसके साथ घर पर भी बर्तन को हमेशा ढक कर जमीन से ऊपर रखना चाहिए।
- नल वाले घड़े का प्रयोग करे।
- यदि नल वाला घड़ा नहो तो पानी के बर्तन को टेढ़ी कर के पानी निकाले या पानी को कल्छी से ही निकालें।
- पानी को हमेशा साफ कपड़े से छानकर, उबाल कर पियें।

(iii) FLIP CHARTS



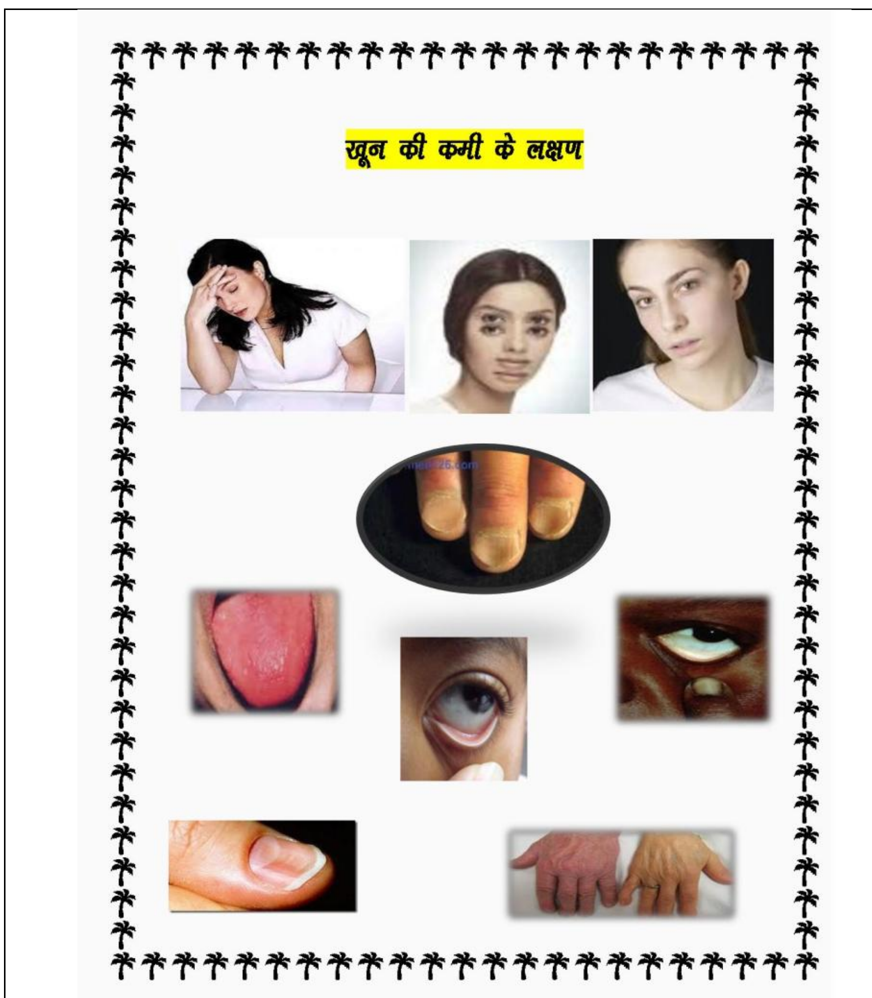
खून की कमी अनीमिया

अनीमिया अथवा रक्तअल्पता ''शरीर में खून की कमी'' को कहते हैं। खून की कमी का प्रमुख कारण रक्त में लौह तत्व तथा फोलिक एसिड की कमी है। हमारा खून लाल रंग का होता है। यह लाल रंग, लौह तत्व या आयरन के कारण होता है। शरीर को आयरन की आवश्यकता हीमोग्लोबीन के निर्माण के लिए होती है जो लाल रक्त कणिकाओं में प्रोटीन का निर्माण कर शरीर के दूसरे भाग में आक्सीजन पहुंचाती है। पर्याप्त आक्सीजन के बिना किसी भी व्यक्ति की शारीरिक शक्ति और मानसिक क्षमता कम हो जाती है।



खून की कमी के कारण

बच्चों में	किशोरियों एवं महिलाओं में
▪ भोजन में कम आयरन की मात्रा लेना	▪ किशोरावस्था में शारीरिक विकास बहुत तेजी से होता है, जिससे शरीर में खून की जरूरत बढ़ जाती है
▪ आयरन के पाचन में रुकावट होना	▪ माहवारी के दौरान शरीर से खून बहने की वजह
▪ आयरन की अधिक आवश्यकता (बीमारी के समय)	▪ भोजन में लौह तत्व या विटामिन–सी की कमी होना
▪ भोजन के तुरन्त बाद चाय पीने से शरीर में लौह तत्व का अवशोषण कम हो जाता हैं	▪ भोजन के तुरन्त बाद चाय पीने से शरीर में लौह तत्व का अवशोषण कम हो जाता हैं
▪ मलेरिया या पेट के कीड़ों के कारण खून की गम्भीर हानि	▪ नंगे पैर रहने और बिना धुली साग–सब्जी से पेट में कीड़े हो सकते है

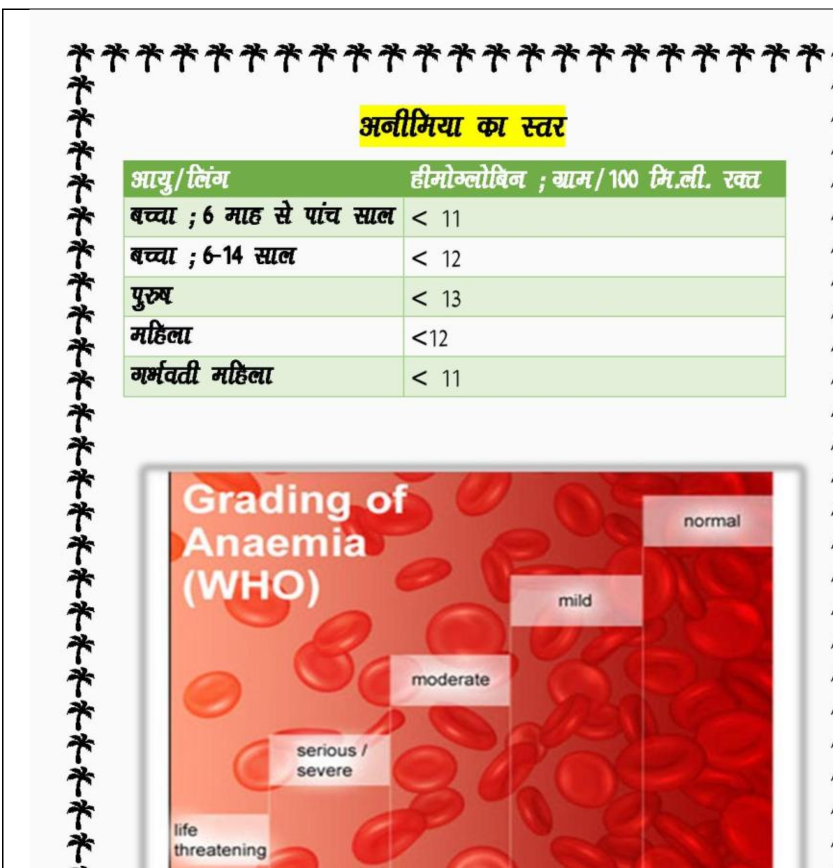


खून की कमी के लक्षण

- कमजोरी, थकान और सुस्ती
- जल्दी सांस फूल जाना
- भूख न लगना
- हाथ-पांव दुखना
- काम में मन न लगना और ध्यान न दे पाना
- चक्कर आना, आंखों के आगे अंधेरा छाना
- अनियमित माहवारी
- आंखें पीली हो जाना
- त्वचा व नाखूनों का पीला होना

  हल्के एनीमिया में लक्षण कम नजर आते हैं, लंबे समय से हुए एनीमिया के कई लक्षण आसानी से देखे जा सकते हैं

  - लेट के उठने पर आँखों के सामने अन्धेरा छा जाना
  - सांस फूलना
  - सिर दर्द रहना
  - हाथों और पैरों का ठंडा होना
  - हृदय की धड़कन तेज या असामान्य होना



अनीमिया का स्तर

आयु/लिंग	हीमोग्लोबिन ; ग्राम/100 मि.ली. रक्त
बच्चा ; 6 माह से पांच साल	< 11
बच्चा ; 6-14 साल	< 12
पुरुष	< 13
महिला	<12
गर्भवती महिला	< 11

अनीमिया का स्तर

अनीमिया का स्तर विश्वसनीय रूप से हीमोग्लोबिन की जांच से ही जाना जा सकता है।। हीमोग्लोबिन का स्तर 7 ग्राम प्रतिशत से कम होने पर गंभीर रक्ताल्पता मानी जाती है। निम्न तालिका में दिये गये स्तर से यदि हीमोग्लोबिन कम है, तो वह अनीमिया का सूचक है।

आयु/लिंग	हीमोग्लोबिन ; ग्राम/100 मि.ली. रक्त
बच्चा ; 6 माह से पांच साल	< 11
बच्चा ; 6-14 साल	< 12
पुरुष	< 13
महिला	<12
गर्भवती महिला	< 11

Grade	Description	Range (Hb in g/dl)
1	Mild	10-Lower limit of normal
2	Moderate	8-<10
3	Severe	6.5-<8
4	Life-threatening	<6.5
5	Death	Death

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खून की कमी के परिणाम

- वृद्धि को प्रभावित
- कम ऊँचाई, अपर्याप्त वृद्धि
- बीमारियों के प्रति कम प्रतिरक्षण क्षमता
- थकावट
- पढ़ाई में ध्यान न लगना
- संक्रमण से लड़ने की क्षमता कम हो जाती है
- भूख न लगना

- प्रसव के समय मृत्यु का अधिक जोखिम,समय पूर्व प्रसव और कम वजन के बच्चों का जन्म होना
- गर्भपात हो सकता है या मरा हुआ बच्चा पैदा हो सकता है

खून की कमी के परिणाम

बच्चों में	किशोरावस्था में	महिलाओं में
▪ वृद्धि को प्रभावित करता है ▪ कम ऊंचाई, अपर्याप्त वृद्धि ▪ बीमारियों के प्रति कम प्रतिरक्षण क्षमता ▪ भूख न लगना	▪ थकावट ▪ माहवारी रुक सकती है ▪ पढ़ाई में ध्यान न लगना ▪ संक्रमण से लड़ने की क्षमता कम हो जाती ▪ एनीमिया की शिकार किशोरी बालिकायें अधिकतर छोटे कद की मां बनती हैं, जिससे कुपोषण का चक्र पीढ़ी दर पीढ़ी चलता रहता है	▪ प्रसव के समय मृत्यु का अधिक जोखिम ▪ समय पूर्व प्रसव और कम वजन के बच्चों का जन्म होना ▪ गर्भपात हो सकता है या मरा हुआ बच्चा पैदा हो सकता है

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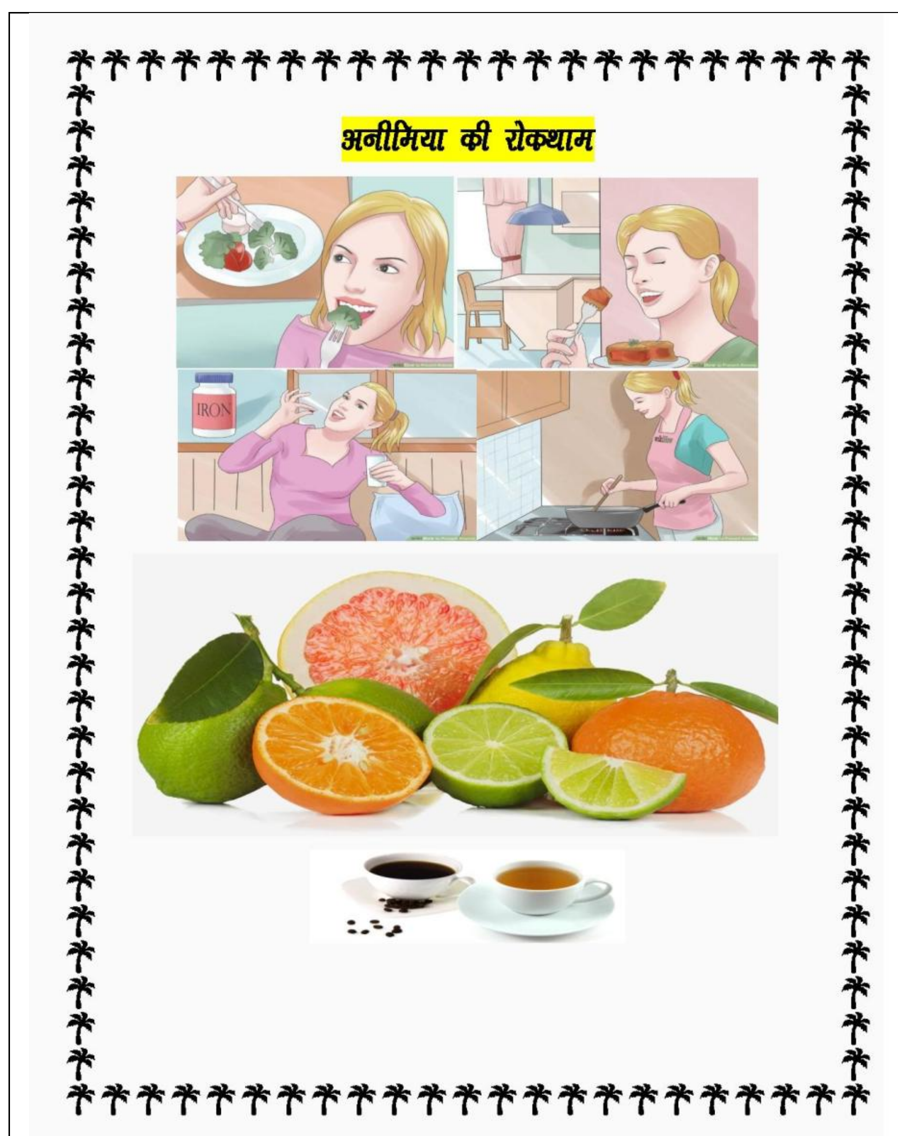

अनीमिया की रोकथाम

- आयरन से भरपूर भोजन जैसे - मांस, कलेजी, अंडे, दालें, पालक, मेथी, बथुआ आदि। मांस और अण्डों में पाया जाने वाला आयरन सब्जियों और दालों की अपेक्षा बेहतर ढंग से शरीर को उपलब्ध होता है।
- विटामिन-सी युक्त भोज्य पदार्थ जैसे नींबू, आंबला, अमरूद, घी, मिर्च, खट्टे रसेदार फल आदि का सेवन करें, ताकि शरीर आयरन को अच्छी तरह से पचा सकें।
- आयरन फोलेट एसिड की गोलियां लें।
- पेट के कीड़े मारने वाली दवाईयां लें।
- खाने में साबुत अनाज व सूखे फलों को शामिल करें।
- हरी पत्तेदार सब्जियां तथा साग जैसे चौलाई, पालक, सरसों इत्यादि को दैनिक भोजन में सम्मिलित करें।
- अंकुरित दालों आदि का प्रयोग करें। अंकुरीकरण से विटामिन सी की मात्रा बढ़ती है और आयरन दुगुना हो जाता है।
- लोहे के बर्तनों में खाना पकाने से उसमें लोहे की मात्रा बढ़ जाती है।
- गुड़ भी लौहतत्व युक्त होता है, चाय और काफी में उपस्थित टैनिन अमाशय में आयरन के अवशोषणों को कम करते हैं। अतः अनीमिया के रोगी चाय का सेवन कम करें। खाना खाने के एक घंटे के भीतर चाय या काफी कभी न लें।

खून की कमी की रोकथाम के लिए लौहतत्व की गोली की पूरी खुराक लेना अत्यंत आवश्यक है। इस सब के साथ-साथ लोगों को अनीमिया के बारे में जागरूक करके तथा पोषक आहार के महत्व के बारे में बताने से इस समस्या से निजात मिल सकती है।

स्वछता व सफाई

साफ सफाई का सीधा संबंध मानव स्वास्थ्य से और संक्रामक बीमारियों से है। सफाई व्यवस्था ना होने के कारण फैलने वाली बीमारियों की सूचि बहुत लंबी है। ऐसी ही कुछ बीमारियां जैसे डायरिया, कालरा, मलेरिया और वार्म पेट के कीड़े गंदगी के कारण फैलते हैं। सफाई व्यवस्था का कुछ इस प्रकार से ध्यान देकर आप स्वस्थ रह सकते है। अच्छे स्वास्थ्य के लिये सभी प्रकार की स्वच्छता बहुत जरुरी है चाहे वो व्यक्तिगत हो, अपने आसपास की, पर्यावरण की, पालतु जानवरों की या काम करने की जगह हो।

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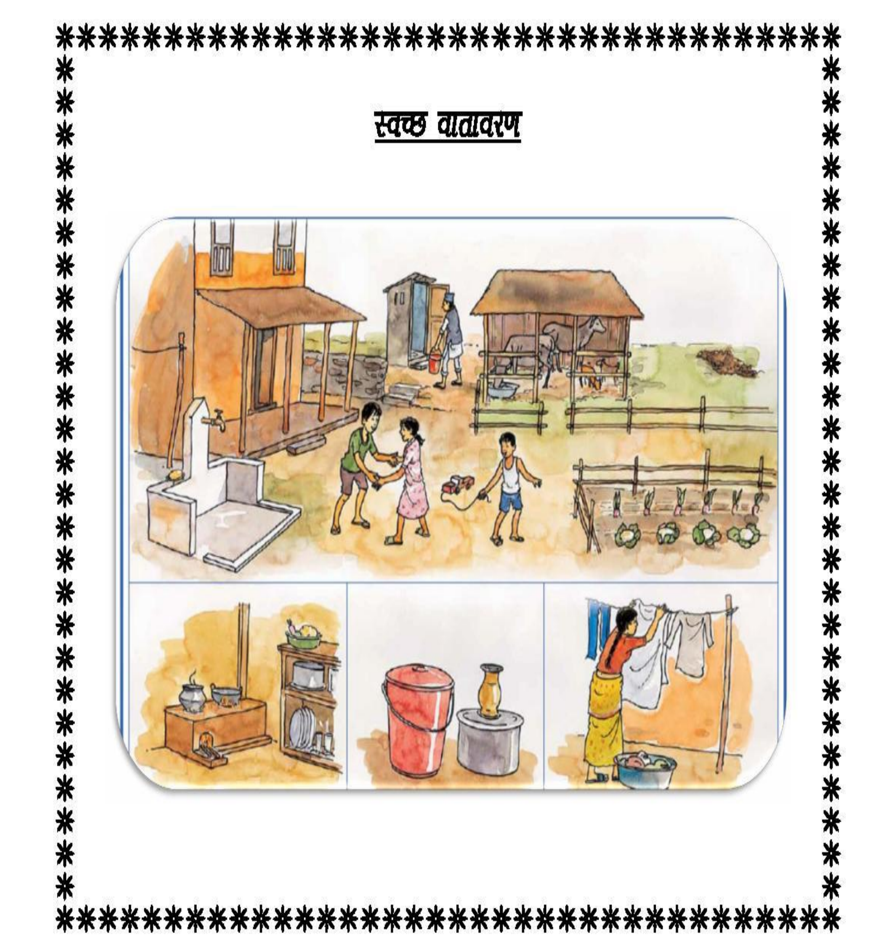
व्यक्तिगत स्वच्छता

- हमें अपने नाखूनों को सामान्य अवकाश पर काटना चाहियें।
- दाँतो को दिन में कम से कम दो बार साफ करना चाहिये-सुबह सोकर उठने के बाद और रात को सोने से पहले।
- भोजन करने के बाद साफ पानी से कुल्ला करें।
- रोज नहाना चाहिये।
- आँख, कान और नाक की सफाई हर रोज साफ पानी से करनी चाहिये।

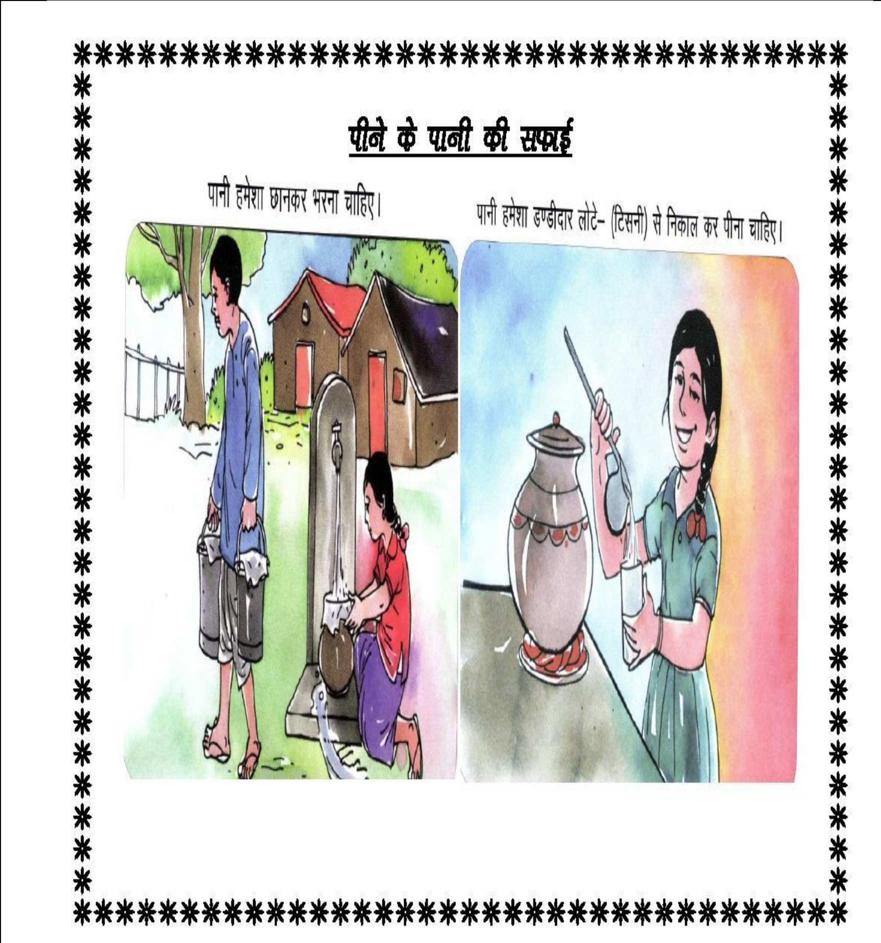
आहार में साफ सफाई

- सब्जियों और फलों को अच्छी तरह से धोकर इस्तेमाल करना चाहिये।
- बर्तनों को साफ पानी और साबुन/चूल्हे की ताजी राख से धोना चाहिये।
- मांस को अच्छे से धोकर और पका कर ही खाना चाहिये।
- दूध को अच्छे से 5 मिनट उबाल कर पियें।
- खाना बनाने के आस-पास की जगह हमेशा साफ रखें।
- खाना हमेशा ढक कर जमीन के स्तर से ऊपर रखना चाहिये।
- पके हुये खाने को ज्यादा दिनों तक इस्तेमाल नहीं करना चाहिये।
- खाना हमेशा ताजा और गरम करके खाना चाहिये।



स्वच्छ वातावरण

व्यक्ति व समूह के स्वास्थ्य के लिए वातावरण की साफ सफाई बेहद आवश्यक है। ऐसी जगह जहां गंदगी फैली होती है वहां बीमारियों के फैलने की सम्भावना भी अधिक होती है। वो बच्चे जो सफाई से नहीं रहते, वो अधिक बीमार पड़ते है।



पीने के पानी की सफाई

- हमें पानी को हमेशा साफ जगह से भरनाचाहिये।
- पानी के बर्तन को धोकर पानी भरनाचाहिए तथा घर लाते समय ढक कर लानाचाहिए।
- घर पर बर्तन को हमेशाढक कर जमीन से ऊपर रखना चाहिए।
- नलवाले घड़े का प्रयोग करे।
- यदि नल वाला घड़ा नहो तो पानी के बर्तन को टेढ़ी कर के पानी निकाले या पानी को कल्छी से ही निकालें।
- पानी को हमेशा साफ कपड़े से छानकर, उबाल कर पियें।

माहवारी स्वच्छता व सफाई

- माहवारी के समय रोजाना स्नान करना चाहिये।
- अपने भीतरी कपड़ों को अच्छी तरह साबुन एवं साफ पानी से धोकर खुली धूप में सुखाना चाहिये।
- पैड अथवा कपड़ा, जो भी प्रयोग किया जा रहा है उसको आवश्यकतानुसार एवं दिन में कम से कम 3-4 बार बदलना चाहिये।
- कपड़ा या पैड बदलने से पहले एवं बाद में हाथों को साबुन व पानी से धोना चाहिये।

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(iv) POSTERS

संतुलित आहार
पौष्टिक भोजन
स्वस्थ जीवन
का आधार
घी, मक्खन, तेल, मलाई चिकनाई युक्त
मिठाई कम खाएं।
दूध, लस्सी, दहीं, छाज, दांतों व हड्डियों को
मजबूत बनाती है।
(दूध 2-3 बार लें)
दालें, मछली, मूंगफली, मांस, चिकन आदि
शरीर को प्रोटीन देते हैं। (2-3 बार)
मेथी, पालक, बथुआ आदि
सब्जियां शरीर को आवश्यक तत्व देती हैं
व पाचन को दुरूस्त रखती हैं।
(सब्जियां 3-5 बार खाएं)
पपीता, आम, अंगूर, केला, खरबूजा,
अमरूद, सेब आदि शरीर को
आवश्यक तत्व प्रदान करते हैं।
(फल 2-4 बार खाएं)
रोटी, बाजरा, मक्का, जौं,
दलिया व चावल
(अनाज 6 बार से अधिक खाएं)
यह भोजन में ऊर्जा को प्रमुख
स्रोत है।

फायदेमंद खाना पकाने की विधियां

वाष्पीकरण (भाप से पकाना)

इस विधि में जल के संपर्क में न आने से जल में घुलनशील विटामिन नष्ट नहीं होते।

प्रेशर कुक्कर में पकाना

इस विधि में अधिक ऊर्जा के कारण पोषक तत्त्वों को होने वाली हानि कम होती है।

भिगोना

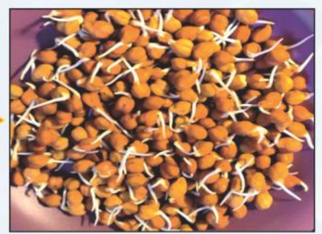
दालों को भिगोकर उसका पानी निकालने से हानिकारक तत्त्व पानी के साथ मिलकर निकल जाते हैं।

खमीरीकरण

इस विधि से प्रोटीन की गुणवत्ता एवं पाचन, विटामिन–बी की मात्रा तथा सूक्ष्म जीवी सुरक्षा व गुणवत्ता बढ़ती है।

अंकुरीकरण

इस विधि से दालों की पाचक क्षमता बढ़ती है तथा विटामिन–सी और रेशे की मात्रा बढ़ती है।



बेंकिग/तंदूर में पकाना

अवन के अन्दर खाना पकाने से कम तेल की जरूरत होती है।

भोजन में लौह तत्व के स्त्रोत
पशु स्त्रोत
मांस
जिगर
मछली
अण्डा
मुर्गा
वनस्पति स्त्रोत
पालक
मेथी
अरबी के पत्ते
हरा धनिया
स्युल
टमाटर
चुकन्दर
आंवला
अमरूद
अंकुरित दालें
वनस्पति स्त्रोत लोहे का अच्छा स्त्रोत तो है, मगर इसमें उपस्थित अना आवश्यक तत्व (एन्टीन्यूट्रियन्ट) इसके अवशोषण को रोकते हैं।
अवशोषण बढ़ाने के तरीके :
✓ विटामिन-सी वाले भोजन खाने से लोह तत्व का अवशोषण बढ़ता है।
✗ खाने के साथ चाय कॉफी न लें
✗ दूध के साथ खून बढ़ाने वाली गोलियां न खांए।
✓ लोहे की कढ़ाई में खाना पकाना।
✓ सब्जियां काटने के लिए लोहे के चाकू का प्रयोग करना।

भोजन के पौष्टिक तत्वों का संरक्षण

खाना बनाने की विधियों में ऐतियात बरतें।

- ✓ खाना ढक के पकाएं
- ✓ खाने को तब तक पकाएं जब तक अच्छी तरह से पक जाए।
- ✓ हिलाने और छानने की प्रक्रिया ज्यादा लम्बे समय तक जारी न रखें।
- ✓ खाने को प्रेशर कुक्कर में पकाएं।

क्यों?

- ✓ पौषक तत्व की क्षति न हो
- ✓ खाना आसानी से पच जाए।
- ✓ हवा के साथ संपर्क आने से विटामिन-सी नष्ट होता है।
- ✓ समय, ऊर्जा एवं पोषक तत्व बचे रहें।

सब्जियों एवं फलों को बनाने की सही विधि उपयोग में लाएं।

- ✓ सब्जियों को पकाने से कुछ ही समय पूर्व काटे।
- ✓ सब्जियों काटने से पहले जरूर धोएं।
- ✓ सब्जियों को जहां तक संभव हो बिना छिले तथा पतली परत निकालकर बनाए।
- ✓ फल एवं सब्जियां मौसम के अनुसार खाएं।
- ✓ सब्जियों को बड़े भागों में काटे।

क्यों?

- ✓ मौजूद विटामिन की हानि न हो।
- ✓ पानी में घुलनशील पौषक तत्व नष्ट हो जाते हैं।
- ✓ छिलके में कई पोषक तत्व मौजूद होते हैं।
- ✓ पचाने में आसानी होती है।
- ✓ हवा एवं पानी के संपर्क में कम आएं।

तेल

- ✓ स्वास्थ्य वर्धक तेल का प्रयोग करें। जैसे : सोयाबीन एवं सरसों।
- ✓ ठोस वसा की जगह तेल का प्रयोग करें।
- ✓ अलग-अलग तेल अलग समय पर इस्तेमाल करें।

क्यों?

- ✓ शरीर का कॉलेस्ट्रोल कम रहे।
- ✓ सारे जरूरी फैटी एसिड मिलें।

भोजन का बचा भाग

- ✓ गेहूँ के भूसे को न फेकें।
- ✓ वह पानी जिसमें खाना को पकाएं उसको न फेकें।

क्यों?

- ✓ विटामिन-बी एवं रेशा होता है।
- ✓ कई पोषक तत्व होते हैं।

अम्लीय भोजन का प्रयोग

- ✓ नींबू, टमाटर, सिरका एवं दहीं सलाद में उपयोग करें।

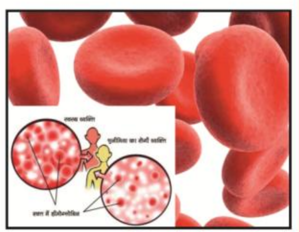
क्यों?

- ✓ विटामिन-सी बचाव होता है।

अनिमिया

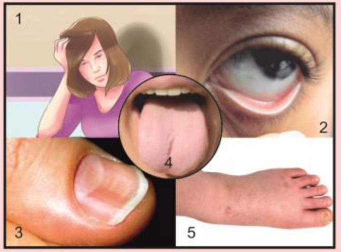
खून में आयरन की कमी से हीमोग्लोबिन कम हो जाता है। उस दशा को अनिमिया कहा जाता है।

- आयरन हमारे शरीर में लाल रक्त कोशिकाओं का निर्माण करता है।
- हीमोग्लोबिन सांस में लिए गए ऑक्सीजन शरीर की विभिन्न क्रियाओं के लिए ईंधन का काम करता है।



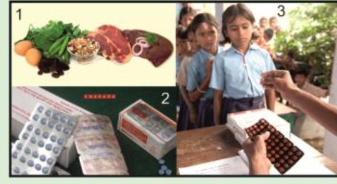
अनिमिया की पहचान

1. भूख न लगना/जल्दी थक जाना/सांस फूलना।
2. आँखों की नीचली पलक के अन्दर के हिस्से का सफेद/फीका पड़ना।
3. नाखूनों का सफेद/फीका पड़ना।
4. जीभ का सफेद या फीका पड़ना।
5. पैरों में सूजन आना।



अनिमिया से बचाव

1. रोज अपने खाने में आयरन युक्त खाद्य पदार्थ शामिल करें।
2. हर सप्ताह आयरन की एक गोली खाएं।
3. हर छः माह के अन्तराल पर पेट के कीड़े की दवाई खाएं।



जंक खाने को कहो नहीं
जंक खाने वालों का जीवन
जंक नहीं खाने वालों का जीवन
शक्ति की कमी
अच्छा पौषकीय स्वास्थ्य
ध्यान न लगना
नियन्त्रित भार
हृदय की बिमारियां
स्वस्थ हृदय
जिगर का फेल होना
रोग क्षमता में तेजी
तनाव मुक्त व
लंबे जीवन जीने के लिए
जंग खाना कम खाना चाहिए।

Brief Biodata of student

Name : Preeti Chaudhary

Father's Name : Mr. Onkar Chand

Mother's Name : Mrs. Saresta Devi

Date of Birth : 01th Oct 1989

Permanent Address : Village Nouri Post Office Badiarkhar Tehsil Baijnath District Kangra Himachal Pradesh 176081

Contact No. : 8894337469

Email. ID. : preetichoudhary0070@gmail.com

Academic Qualifications:

Examination passed	**Year**	**School/Board/ University**	**Marks (%)**	**Division**	**Major Subjects**
10th	2005	HPBOSE	68.14	First	General
10+2	2007	HPBOSE	58.20	Second	English, Physics, Chemistry, Mathematics & Physical Education
B. Sc. Home Science	2011	CSKHPKV-Palampur	7.26	First	All Home Science and allied subjects
M. Sc (Food Science and Nutrition)	2013	CSKHPKV-Palampur	7.24	First	Major: Food Science and Nutrition Minor: Horticulture
PhD. (Food Science and Nutrition)	2017	CSKHPKV-Palampur	7.60	First	Major: Food Science and Nutrition. Minor: i) Biochemistry ii) Home Science Extension and Communication Management

Thesis Title in M.Sc: Quality evaluation and value addition of organically vis-à-vis conventionally grown exotic vegetables

Scholarships: Merit Scholarship in Ph.D.

Notable Achievement: Qualified UGC NET Dec. 2014 (Home Science)

Publication:

- Total Publication-19
- Research Papers - 4
- Popular Articles - 5
- Conferences/Seminars – 3
- Abstracts Publications – 7