CHAPTER – V
SUMMARY AND CONCLUSION

Anemia is a worldwide problem in persons of all ages, it is not a diagnosis but rather a sign or symptom of underlying disorder. Anemia is widely prevalent in all the states of India among all the age group including children, adolescent girls, pregnant and non pregnant women. In India, college girls contribute major portion of population. It has been reported to be a major micronutrient deficiency and its prevalence was reported to be above 80% in various states of India. Wide prevalence of anemia, among communities will results in a poor health of any country. It is most silently prevalent deficiency disease all over the world. In India, it was found to have an association with literacy status of mother, occupation of father, structure of family, types of diet, caste, birth order, types of activities etc. Iron deficiency anemia is the most common form of malnutrition in the world and is the eighth leading cause of disease in girls and women in developing countries.

Anemia is a condition where there is a reduction in haemoglobin concentration in the red blood cells. Haemoglobin is the iron containing pigment of red blood cells, that carries oxygen from lungs to the tissues, in other words, anemia is manifested by decrease in the oxygen carrying capacity of blood. Anemia is a major medical problem, affecting people of all ages all over the world. IDA is a serious public health problem and is the commonest one. The goal of anemia management is to investigate and understand the different stages of anemia. Identification of the etiology of a nutritional anemia as the result of inadequate intake, poor absorption, heme and non heme iron in the diet or increased requirement is essential to support the provision of targeted medical nutrition therapy. Therefore, present study was undertaken to assess the status, study of anemia prevalence, effect of dietary intervention and Iron supplementation among college girls of Mehsana city and Taluka with following objectives.
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General objective

1. To study nutritional status and estimation of haemoglobin level in college girls of Mehsana city and taluka.
2. To implement intervention program for enhancing awareness regarding diet and iron supplementation in need based college girls of Mehsana city and taluka.

Specific Objectives:

1. To assess the prevalence of anemia in college girls.
2. To assess the dietary and nutritional knowledge among college girls.
3. To study dietary pattern and nutrient intake of college girls (N= 70).
4. To determine the age at menarche of college girls.
5. To create awareness regarding iron rich foods (recipes).
6. To study the nutritional anthropometric indices among college girls.
7. To study the effect of iron supplementation on hemoglobin levels of college girls.
8. To study the effect of dietary intervention program (supplementation of GCS powder) on hemoglobin levels of college girls.
9. To study the effect of knowledge intervention program on nutritional knowledge level.
10. To study the effect of socio-economic factors on nutritional status of college girls.

Review and Literature

In this chapter, an attempt has been made to review the relevant and related literature pertaining to the present study from various research journals, books, websites and other related literature. For developing a conceptual frame work and an appropriate design for the study, a review of past study is necessary. Therefore, a brief
account of the work reported by the past researchers was reviewed and presented under the following heads.

2.1 Prevalence of Anemia
   2.1.1 Global prevalence of anemia
   2.1.2 National prevalence of anemia
   2.1.3 Prevalence of anemia in Gujarat

2.2 Etiology of Anemia

2.3 Pica- Eating disorders of non nutritional substances

2.4 Nutritional Status

2.5 Intervention strategies for eliminating anemia
   2.4.1 Supplementation
   2.4.2 Fortification
   2.4.3 Bio availability of dietary iron
   2.4.4 Improving bio availability of dietary iron
   2.4.5 Nutrition education
   2.4.6 Effect of garden cress seeds supplementation

**Methods and Materials**

The scientific study requires adoption of appropriate methods and procedures in order to reach reliable, unbiased and specific conclusions. This chapter mainly deals with the research design, tools and techniques of scientific investigation employed for the collection, tabulation, analysis and interpretation of the data in the light of the objectives of this study. In short, this chapter contains methodology which was adopted for the study and is discussed under the following sub-heads.

3.1 Literature search

The literature search was includes both carried out from printed and electronic sources. Printed materials included books, reports, dissertations, periodicals (journals, magazines and newspaper), statistical report, manuscripts, dictionaries, conference proceedings and hand books. Electronic sources that is online database were used to
search electronically available information such as periodicals (journal, articles, magazines and newspaper articles).

3.2 Specifications for the selection of samples

The samples were selected from ten colleges of Mehsana city and taluka. City college girls were selected as urban and village girls were selected as rural respondents. College girls who were in the age group of 18 to 23 years were selected.

3.3 Research design

Design: Descriptive, Ex-post facto and experimental i.e. pre and post test without control design was applied.

Variables of the study: It includes independent and dependent variables of college girls.

Independent variables: These are;(1) personal variables-age, age at menarche, types of diet, types of work, history of heavy menstrual bleeding, morbidities, pica, activities, marital status,(2) socioeconomic variables-caste, income, father’s education, father’s occupation, mother’s education, mother’s occupation, and types of family,(3) communicational variables- sources of information and extent of information used by college girls(4) nutritional variables- frequency of iron and vitamin C rich food intake.

Dependent variables: These are; (1) Nutritional status (BMI) (2) Clinical signs and symptoms (3) Nutritional knowledge level (4) Awareness regarding anemia (5) Blood Haemoglobin level.

Conceptual framework: The study was based on the variables, which were decided as per the objectives of the study. The dependent variables were nutritional status, clinical signs and symptoms, nutritional knowledge level, awareness regarding anemia and blood haemoglobin level of college girls. The college girls of Mehsana city and taluka were selected for the study. The study was divided into two parts such as pre
test and post test. Pre testing was applied on decided universe and post test was applied on only those college girls that depicted abnormal haemoglobin level or need based intervention was conducted. The feedback (post test) was carried out to find the results of enhancement of the intervention program among the selected college girls.

**Operational definition:** It includes nutritional status, i.e. assessment of nutritional status by anthropometry, prevalence of anemia, iron supplementation, dietary intervention, knowledge intervention.

**Selection, description and development of the instrument:** It includes; the interview schedule which was constructed in such a way that it could be understood easily by college girls and would enable them to answers the questions frankly and quickly. The schedule was prepared in English and Gujarati. Observations was also done by verbal information. The interview schedule was designed and divided into different sections covering the following areas: background information of the respondents, information regarding clinical signs and symptoms, reproductive information, anthropometric measurement and biochemical parameters, dietary pattern or food frequency of iron and vitamin C rich foods, nutritional knowledge level, awareness regarding anemia and 24 hours diet recall.

**Validity and Reliability :** To established validity, a panel of judges from the faculty of Home Science, faculty of Education and faculty of Social Science were selected. They were asked to check the positive and negative direction, (where applicable) clarity and relevance of the content for each statement of the scale. The researcher enhanced the reliability of the study through pre-testing the tool on a sample of 20 respondents who were not the part of sample but had similar characteristics to the sample selected for the study. Pretesting gave an idea about the time needed for the interview. Each interview took 15- 20 minutes to get the frank and clear answers from the respondents. These responses were scored using split-half method.

**3.4 Sample, Sampling procedure and Sample size**
**Selection of sample:** The sample was selected on the bases of predefined variables on the study using purposive random sampling technique from the taluka of Mehsana from urban and rural area. The total sample size was 1140.

**Locale of the study:** This investigation was carried out in Mehsana district of Gujarat state. The district of Mehsana is located in the Northern side of Gujarat and is surrounded by Patan, Banaskantha, Sabarkantha and Gandhinagar districts. Moreover the researcher belongs to Mehsana and is familiar with people, officials, organizations and language, which helped in collecting reliable and valid data.

**Sampling procedure:** For this study, the multi-stage random sampling and purposive random sampling technique was used for the selection of the colleges and respondents. Total ten colleges were selected from Mehsana taluka.

**Selection of district, taluka and city:** The Mehsana district from the North Gujarat was selected for the study. The two different situation viz., urban and rural area were selected from the district. The Mehsana city which is the head quarter of the district was selected as urban area, whereas villages of Mehsana taluka was selected as rural area of this district.

**Selection of colleges:** For the selection of the colleges, a list of colleges were selected which were situated in Mehsana city and in Mehsana taluka. Total ten colleges were selected for the study. Using this list, all the ten colleges were selected randomly, and college girls belonged to rural area were selected as rural situation from the Mehsana taluka and college girls were belonged to urban area were selected as a urban situation from Mehsana city. Thus, total ten colleges were selected for the study.

**Selection of respondents:** At the final stage, the purposive random sampling method was applied for the selection of respondents (college girls). A list of students of graduation and post graduation was prepared for each selected college in consultation with respective principals and class teachers. From these lists, total 1140 students from ten colleges were randomly selected, 578 students from urban and 562 students from
rural area. Thus, finally 1140 respondents (college girls) were selected from the localities of Mehsana city and Mehesana taluka of Mehsana district. Purposive sampling procedure was applied.

**Sample Size:** It was carried out as per age group, place of residence, age at menarche, father’s monthly income, educational faculty and caste of college girls.

**Unit of Enquiry:** College girls of Mehsana city and taluka were selected as a unit of enquiry.

**Tools of study:** The well-structured interview schedule was prepared in light of the study and used as a tool for collection of data. The instrument used in the study was the interview schedule, which was considered to be the most appropriate to get the correct response and information from the college girls. Keeping in view the objectives of the study, the interview schedule in English and Gujarati was prepared.

**Pre-testing of the schedule:** Pre-testing of the interview schedule was carried out to know whether the questions were clearly understood to the respondents or not before finalizing. The interview schedule was pre-tested with 25 students of college girls which were not selected in present study. On the basis of the experience gained, suitable words in the questionnaire and statements were corrected, modified and restructured in the final format of the interview schedule. The revised interview schedule was used for final data collection.

**Development of intervention program:** One of the objective of the present study was to give need based intervention program to enhance the level of awareness regarding nutrition and anemia among the college girls. The researcher with the help of review literature developed as a content material to be taught to the college girls to enhance their level of awareness regarding nutrition and anemia

**Intervention program:** Intervention program was conducted as a dietary supplementation, iron supplementation and dietary knowledge intervention. Dietary intervention was carried out with supplementation of GCS powder with lemon juice for 28 days. Iron supplementation was carried out with supplementation of iron, folic
acid, vitamin B$_{12}$ and vitamin C tablets for three months. Knowledge intervention was carried out with expert’s lectures, power point presentation and iron rich recipes demonstration to college girls for creating awareness regarding low cost iron rich foods.

**Post test of samples:** Post test of college girls were carried out by biochemical estimation like CBC (N=70 and N=20).

### 3.5 Data collection, Analysis, Measurement and Interpretation:

Data collection: Pre test data collection was carried out by interview schedule, anthropometric measurements like weight, height and BMI, nutritional knowledge level, awareness regarding anemia and CBC was carried out for intervention program. Post test data was collected by CBC of girls included in dietary intervention i.e. GCS powder supplementation and iron tablet supplementation.

The data were transferred in to the master table and frequencies were marked whenever necessary. The number and percentages were given to the various frequency items. The data were tabulated, statistically analyzed and presented in such way that it would give proper answer to the specific objectives of the study. The data was processed on manual and electronic computer. The following statistical tools were used for interpreting the data.

**Statistical analysis:** The data collected through interview schedule were analyzed and interpreted in order to draw meaningful light of objectives of the study. Frequency and percentage, arithmetic mean, Standard deviation (S.D.), Pearson’s coefficient of correlation and Multiple regression were applied.

**Hypothesis testing:** It was conducted by pre decided hypothesis by F test representing by ANOVA and ‘t’ test for the measurement of level of significance.

- **H$_0$$_1$: There will be no significant influence of age on haemoglobin level, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern (Frequency of iron and vitamin C rich food intake).
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Ho$_2$: There will be no significant difference between area of residence of college girls and haemoglobin level, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern (Frequency of iron and vitamin C rich food intake).

Ho$_3$: There will be no significant influence of age at menarche on haemoglobin level, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern (Frequency of iron and vitamin C rich food intake).

Ho$_4$: There will be no significant influence of educational faculty on haemoglobin level, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern (Frequency of iron and vitamin C rich food intake).

Ho$_5$: There will be no significant influence of income on haemoglobin level, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern (Frequency of iron and vitamin C rich food intake).

Ho$_6$: There will be no significant influence of caste on haemoglobin level, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern (Frequency of iron and vitamin C rich food intake).

Ho$_7$: There will be no significant difference of intervention on haemoglobin level and knowledge intervention program on knowledge level.

Results and discussion

Keeping in view the objectives of the study, the data were subjected to the appropriate statistical tests and are presented in the classified and categorized form, tables and diagrams and discussed in this chapter. The results of the various aspects are presented under the following sections.

4.1 Personal, socio-economic and communicational characteristics of the selected college girls.

4.2 Nutritional status of college girls.

4.3 Nutritional knowledge and awareness regarding anemia among college girls.
4.4 Dietary pattern of college girls.

4.5 Effect of dietary intervention and iron supplementation on blood haemoglobin level.

4.6 Relationship between personal, socio-economic, communicational characteristics of college girls and their nutritional status.

4.7 Testing of hypothesis.

**4.1 Personal, socio-economic and communicational characteristics**

The findings related to personal characteristics revealed that the age of college girls were ranged from 18 to 23 years, among them 50.70% were from urban and 49.30% were from rural areas. The age at menarche was ranged from 12 to 17 years and mean age at menarche was 14 years. Majority of girls had started menstrual cycle at 14 years. Majority (98.16%) girls consumed vegetarian diet. Majority of (80.79%) girls performed moderate work. Only less than one fourth girls had heavy menstrual bleeding. According to data collected majority (52.19%) had presence of any one morbidity. Most common observed morbidities were headache (42.02%), sneezing and cough (22.45%). Majority (40.01%) had pica - geophagia i.e. eating soil or clay and pagophagia (35.61%). Majority of girls did cooking (98.86%), dusting and mopping (100%), washing clothes (64.04%) and animal husbandry (30.18%) among rural girls. Only, girls (16.10%) were married. Majority (42.37%) of girls belong to OBC followed by SC/ST (31.40%) and general caste (26.23%). Majority of girl’s father’s monthly income was Rs.10,001 to 20,000. Majority (60.88%) of girl’s mother were educated up to secondary level and majority girl’s mother were housewives. Majority (52.54%) lived in joint family. All the girls used news paper as a source of information and majority (61.40%) of them had medium level of sources of information.

**4.2 Nutritional status of college girls.**

Mean measurements
Nutritional status is the state of our body as a result of the foods consumed and their use by the body. Nutritional status can be good, fair and poor. Nutritional status was measured by anthropometry i.e weight, height and BMI, clinical signs and symptoms, biochemical parameters i.e. blood haemoglobin level and prevalence of anemia and blood indices or CBC of intervened college girls. The mean weight of urban and rural girls was 47.09 kg and 46.44 kg, respectively, which was lower than the standard weight. The mean height of urban and rural girls was 157 cm and 154.8 cm respectively. The mean BMI of urban and rural girls were 19.7 and 19.34, mean BMI of urban girls were normal but rural girl’s BMI was lower which underweight condition was.

**Body Mass Index**

For, BMI classification, 19.74% and 20.88% of urban and rural girls were underweight and their BMI was < 18.5. 28.94% and 26.40% of urban and rural girls had normal BMI. Overall, 40.62% of girls were underweight, 55.35% had normal BMI and 3.68% and 0.36% were obese and overweight respectively. BMI as per income classification, lower income group girls had normal BMI. As per age classification, 19.29% and 21.23% of urban and rural girls were underweight. Overall, 40.62% were underweight and the maximum underweight prevalence was seen in 19 and 20 years of age.

**Blood heamoglobin**

Blood haemoglobin is also health indicator for the assessment of nutritional status. In present investigation 21.58% and 21.49% of urban and rural girls were mildly anemic, 9.65% and 10.79% of urban and rural girls were moderately anemic and 3.60% and 2.28% of urban and rural girls were severely anemic. Overall, 69.30% of selected college girls were anemic. As per commuting classification, frequency of anemic condition was higher in commuters as compared to localites and hostelites which may be due to inadequate intake of food and essential nutrients because of daily commuting. Majority of urban girls as per residential area classification were suffering from any one type of anemia and prevalence of anemia was higher in them.
As per educational faculty classification, Science girls had high blood haemoglobin level (mean Hb.-10.89g/dl) compared to other faculty girls, reason may be due to their knowledge level regarding nutrition science. For caste classification of haemoglobin levels, it was seen that prevalence rate of anemia was higher among OBC college girls due to their typical style of food intake for the prolonged period of time. As per income classification, higher prevalence of anemia was found in middle income group i.e. mild and moderate anemia, while, severe anemic girls were seen in higher percentage among affluent class. As per age classification of college girls, the percentage prevalence of mild and moderate anemia was higher among age group of 19 and 20 years.

**Clinical signs and symptoms**

Results found in relation to clinical signs and symptoms of anemia are 69.34% had inadequate muscle functioning with decreased work performance and physical activity intolerance (56.75%). 68.93% experienced fatigue, 33.53% had pagophagia and 42.43% geophagia and 48.56% had low immunity. 20.43% had severe anemia with prominent paleness of skin and brittle nails. Majority of college girls had four days of menstrual bleeding and majority (48.42%) of them had 28 days regularity of menstrual cycle. Abdominal pain and decreased food intake during menstrual period was main menstrual problem seen in majority of college girls. Hypochromic normocytic anemia was prominent in CBC girls i.e.65.93% Normochromic normocytic (47.14%) and hypochromic microcytic (46.71%) anemia was seen in iron supplemented girls, whereas, dietary intervened girls showed 50% prevalence of hypochromic microcytic anemia. Macrocytic magaloblastic anemia was detected in very few girls.

**Morphological classification**

The mean values of blood indices depicts that RBC values of selected college girls were in the same range of reference values i.e. 4.2 to 5.4 mill/c.mm. PCV values were lower than that of reference values i.e. 37 to 47%. MCV and MCHC were in
range of reference values i.e. 78 to 100 fl and 32 to 36 g/dl respectively. MCH values were too lower as compared to reference values i.e.27 to 31pg. RDW was seen in higher range as compared to reference values i.e. 11.5 to 14 %. The main parameter of study i.e. blood haemoglobin was seen in form of moderate anemia as compared to 12.5 to 16 g/dl.

**4.3 Nutritional knowledge and awareness regarding anemia among college girls.**

Nutritional knowledge and its awareness was recorded as mean 13.51 % of girls had knowledge regarding daily requirements of nutrients, 58.87 % of girls had knowledge of sources of nutrients, 51.96 % of girls had knowledge of nutrients present in foods, 56.44 % of girls had knowledge of deficiency diseases related to nutrients. 38.29 % of girls had awareness regarding anemia and 18.41 % had knowledge regarding signs and symptoms of anemic condition. 55.61 % had fair nutritional knowledge and 65.96 % had fair awareness regarding anemia.

**Nutritional knowledge level**

Majority of girls i.e.28.08 %, 27.54 %, 70.37 % and 70 % of urban, rural, CBC and iron supplemented college girls had fair nutritional knowledge.

**Awareness level regarding anemia**

Majority of girls i.e.30.87 %, 35.1 %, 82.96 % and 62.85 % of urban, rural, CBC and iron supplemented college girls had fair awareness level regarding anemia.

**4.4 Dietary pattern of college girls.**

To know the dietary pattern and actual intake of various foods and nutrients, a diet survey was carried out by using 24 hours dietary recall method. In the present study, the food consumption pattern for different foods was recorded and results are as followed.

**Daily food intake**

Daily food intake among college girls were studied for the actual consumption. Fats and oils, wheat, sugar was consumed daily by all urban (50.75) and rural (49.3%).
The major cereal consumed by the girls was wheat (50.7% & 49.3%) for urban and rural girls respectively. It was observed that bajra, rice flakes, puffed rice and bread was consumed frequently. Only 4.5% of rural girls consumed bajra daily. 21.75% and 20.61% of urban and rural girls consumed rice daily. Red gram dhal was consumed daily by urban (25.06%) and by rural (21.49%) whereas, green gram dhal was consumed daily urban (1.5%) and by rural (2.5%) respectively. Tomato, onion, lemon and coriander were consumed daily by all the girls. Only, 23.42% and 21.23% of urban and rural girls were consumed milk daily and majority (urban 42.54% and rural 43.61%) of girls consumed buttermilk daily. Only 1.5% of urban and 8.33% were consuming jaggery daily. Very few foods were included daily in the diet of college girls.

**Alternate day intake**

Alternate day food intake among college girls were that bread (urban-1.4%), rice flakes (urban-0.61%, rural-0.44%), puffed rice (urban-5.61%, rural-3.5%), bajra (urban-0.53%, rural-0.88%) potato (urban-24.39%, rural-26.32%), guava, fenugreek leaves (urban-0.61%) and cucumber (urban-17.37%, rural-16.32%), tomato (urban-19.83%, rural-17.98%) consumed by all college girls. Not a single pulse was consumed by all college girls. Red gram dhal (urban-4.3%, rural-7.46%) and green gram dhal (urban-7.54%, rural-061%) was consumed.

**Weekly intake**

Weekly food intake among college girls were consumed fenugreek leaves (urban-8.77%, rural-7.63%), black gram dhal (urban-6.15%, rural-5.05%) and green gram dhal (urban-3.51%, rural-6.05%). Some other foods like dates (urban-26.26%, rural-10.20), muskmelon (urban-20.8%, rural-18.42%), sapota (urban-20.18%, rural-2.14), grapes (urban-22.15%, rural-18.5%) and curd (urban-7.10%, rural-9.22%).

Most of the fruits and vegetables, dry fruits, milk and milk products were consumed half monthly, monthly and occasionally by college girls. Some foods were never consumed like lentils, moth beans, rajma, beet roots, ridge gourd, bitter gourd,
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kankoda, walnuts, pistachio, cheese and honey by college girls. Other foods like panipuri (urban-50.7%, rural-49.3%) was most frequently street food by college girls. Pakodas, vada pav, pavbhaji, dabeli, sandwich were also frequently consumed by girls. Punjabi (urban-40.90%, rural-31.32%), chinese (urban-43.60%, rural-25.18%), and south Indian foods (urban-50.7%, rural-21.75%) were also frequently consumed by college girls. Vasana and chavyanprash was also consumed by girls. 43.86% and 4202% of urban and rural college girls consumed iodized salt. Only 0.56% of urban girls were consumed eggs, meat and fish.

**Intake level of iron and vitamin C**

Majority of urban and rural girls had fair intake level of iron and vitamin C. 23.42% and 24.74% of urban and rural girls had fair intake of iron and vitamin C whereas, 57.04% and 62.86% of CBC and iron supplemented college girls had fair intake level of iron and vitamin C.

**4.5 Effect of dietary intervention and iron supplementation on blood haemoglobin level.**

There was a positive and significant improvement observed in intervention program i.e. GCS powder supplementation, iron tablet and knowledge intervention. GCS powder was supplemented with lemon juice for 28 days to anemic college girls. It showed that before supplementation the mean blood haemoglobin of girls was 8.98 g/dl and after supplementation, it was 10.29 g/dl and increment in haemoglobin was 10.92%. Before supplementation, mean PCV was 33.39% and after the supplementation, it was 34.29%. There was 2.14% increment in PCV. Before supplementation, mean MCV was 78.56 fl and after the supplementation, it was 78.56 fl. There was no increment in MCV. Before supplementation, mean MCH was 23.73 pg and after the supplementation, it was 23.69 pg. There was 0.15% increment in MCH. Before supplementation, mean MCHC was 29.73 g/dl and after the supplementation, it was 29.84 g/dl. There was 0.32% increment in MCHC. Before supplementation, mean RDW was 16.07% and after the supplementation, it was 15.79
%. There was 2.2% decrease in RDW, which is a good sign for correcting anemia. Before supplementation, mean RBC was 4.26mill/c.mm and after the supplementation, it was 4.43mill/c.mm. There was 3.15 % increment in RBC. The daily supplementation of GCS powder was beneficial with respect to rise in haemoglobin levels and maintaining adequate iron status of essentially the anemic college girls.

**Iron Supplementation**

Iron supplementation was carried out by daily supplements of iron, folic acid and vitamin C tablets having 60 mg of elemental iron for 90 days. Before supplementation data was collected for the presence of worm infestation and no one had worm infestation. CBC was conducted before and after iron supplementation. It showed that before supplementation, the mean blood haemoglobin of girls was 10.25 g/dl and after supplementation, it was 10.77 g/dl with an increment of haemoglobin that was 12.66 %. Before supplementation, mean PCV was 35.17 % and after the supplementation, it was 37.46 %. There was 5.46 % increment in PCV. Before supplementation, mean MCV was 82.64 fl and after the supplementation, it was 83.28 fl. There was 0.72 % increment in MCV. Before supplementation, mean MCH was 24.16 pg and after the supplementation, it was 25.92 pg. There was 6.07 % increment in MCH. Before supplementation, mean MCHC was 28.96 g/dl and after the supplementation, it was 31.21 g/dl. There was 6.01 % increment in MCHC. Before supplementation, mean RDW was 15.77 % and after the supplementation, it was 14.79 %. There was 0.98 % decrease in RDW, which is a good sign for correcting anemia. Before supplementation, mean RBC was 4.22 mill/c.mm and after the supplementation, it was 4.30 mill/c.mm. There was 1.66 % increment in RBC. The daily supplementation of IFA was beneficial with respect to rise in haemoglobin levels and maintaining adequate iron status of essentially the anemic college girls.

Side effects and beneficial effects of GCS powder supplementation. 80 % of selected girls disliked the taste, therefore, it leads to a poor acceptability. 70 % had slightly loose stool. Only 20% observed heavy menstrual bleeding. 75 % of them
disliked the flavor, that leads to a poor intake of GCS powder. As far as beneficial
effects of GCS powder supplementation was concerned, it was observed that 85 % had
overall good feeling.70% experienced reduced body ache, especially back ache.50 %
experienced reduced fatigue and 100 % had no constipation. 80 % observed increased
blood haemoglobin level after the supplementation. 40 % had regularity in menstrual
cycle.

Majority of iron supplemented college girls did not experienced any major side
effects and the beneficial effects experienced are good feeling 79 %, 12 %
experienced reduced body ache, 62 % experienced reduced fatigue and 72 % of
showed increased haemoglobin levels. Thus, it can be concluded that both GCS
powder and iron supplementation had beneficial effect on overall health and general
well being of college girls.

After supplementation of iron tablets and GCS powder. The changes observed
in the anemic conditions were, 5 % observed no change in severe anemic condition
among girls of GCS supplementation.2.85 % and 5 % of iron supplementation and
GCS powder supplementation girls were shifted from severe to moderate anemia. Only
1.43 % of iron supplementation girls were shifted from severe to mild anemia.7.14 %
and 45 % of iron supplementation and GCS powder supplementation girls had no
change.18.57 % of iron supplementation girls were shifted from moderate to mild
anemia 4.29 % of iron supplementation girls were shifted from moderate to normal
anemia.21.43% and 45 % of iron supplementation and GCS powder supplementation
girls had no change in anemic condition and 44.29 % of iron supplementation girls
were shifted from mild to normal condition. Thus, it can be concluded that majority of
girls had improved haemoglobin level.

4.5.3 Knowledge intervention

Knowledge intervention is an effective tool for changing dietary behavior
among community. It brings desirable changes in knowledge level which leads to a
beneficial effect on health and over all nutritional status. Knowledge intervention was carried out by lectures, power point presentation and recipe demonstration of various iron rich foods.

Lecture delivered by home science expert that included all the facts about anemia. The literature was prepared in a local language i.e. Gujarati. After lecture, oral feedback was taken and overall it resulted in gaining good knowledge related to anemia facts.

Power point presentation included all the basic facts which are responsible for anemic condition among college girls. It included prevalence of anemia, causes of anemia, effects of anemia, symptoms of anemia, dietary guidelines for the prevention of anemia and points which are essential to overcome anemic condition.

**Recipe Demonstration**

Recipe demonstration was carried out at Smt, A. S. Chaudhary Mahila Arts and Home Science College, Mehsana. The aim of recipe demonstration was to improve the knowledge regarding iron rich foods and its method of preparation. Niger seeds chikki, mix sukhadi and Cow peas dhokali were demonstrated to selected college girls.

The nutritive value of niger seeds chikki in 100 g i.e. 9.72 g of protein, 539.20 Kcal, 27.74 mg iron and 152 mg calcium respectively. The nutritive value of mix sukhadi in 100 g i.e. 8.5 g of protein, 533.57 Kcal, 16.97 mg iron and 67.57 mg calcium respectively. The nutritive value of cow peas dhokali in 100 g i.e. 10.12 g of protein, 289.28 Kcal, 3.97 mg iron and 148.91 mg calcium respectively. Niger seeds chikki had highest iron content as compared to other selected recipes.

The main aim of recipe demonstration was creating awareness regarding low cost iron rich foods which are locally available and addition of these recipes resulted in prevention of anemia as long term approach. These iron rich recipes aids in reducing
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4.6 Relational Analysis

4.6.1 Co relational analysis

The calculated coefficient of correlation showed that among all eighteen variables, 13 variables viz., age, morbidities present, heavy menstrual bleeding, caste, father’s occupation and education, income, pica, activities, iron and vitamin C intake frequency, sources of information and mother’s education had played significant role in nutritional status of all college girls.

Among all 18 variables, 12 variables viz., age, morbidities present, heavy menstrual bleeding, caste, father’s occupation and education, income, pica, activities, iron and vitamin C intake frequency, sources of information and mother’s education had played significant role in nutritional status of urban college girls.

Among all 18 variables, 15 variables viz., age, age at menarche, morbidities present, types of work, heavy menstrual bleeding, caste, father’s occupation, income, pica, activities, iron and vitamin C intake frequency, sources of information, mother’s education and mother’s occupation had played significant role in nutritional status of rural college girls.

Co relational analysis of dietary intake and haemoglobin level or anemic condition among college girls. In case of haemoglobin, 0.148, 0.178, 0.141 and 0.132 for pulses, GLVs, fruits, milk and milk products intake were found significant and positive at 0.01 level of significance of all college girls. Thus, it can be concluded that dietary intake of pulses, GLVs, fruits and milk and milk products had played significant role in maintaining nutritional status and improving anemic condition of all college girls.
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For the **iron tablet** supplemented college girls, diet type, types of work, morbidities, pica, nutritional knowledge and awareness regarding anemia played an important role in association with BMI, clinical signs and symptoms and haemoglobin and nutritional status of college girls.

For **GCS powder** supplemented college girls, diet type, types of work, morbidities, pica, nutritional knowledge and awareness regarding anemia played an important role in association with BMI, clinical signs and symptoms, haemoglobin and nutritional status of college girls.

4.6.2 Regression analysis

Regression analysis indicating significant contribution of these four variables viz., age at menarche, types of work, types of diet and activities were significant at 0.05 level of significance for all and rural college girls and “P” value of variable age at menarche was highly significant at 0.01 level of significance (P<0.01), indicating significant contribution of these four variables in explaining the variation in level of nutritional status (BMI) of college girls.

Regression analysis indicating significant contribution of these nine variables viz., types of work, heavy menstrual bleeding, types of family, pica, activities, morbidities were highly significant at 0.01 level of significance(P<0.01), indicating significant contribution of these six variables in explaining the variation in clinical signs and symptoms of college girls and other variables viz., father’s occupation, income and age at menarche were significant at 0.05 level of significance for all, urban and rural college girls. “P” value of these variables were highly significant at 0.01 level of significance (P<0.01) and significant at 0.05 level of significance(P<0.05), indicating significant contribution of these nine variables in explaining the variation in level of nutritional status (clinical signs and symptoms) of college girls.
Regression analysis indicating significant contribution of these nine variables viz., age, age at menarche, father’s occupation, income, sources of information and types of diet were highly significant at 0.01 level of significance (P<0.01), indicating significant contribution of these six variables in explaining the variation in nutritional knowledge of all college girls and other variables viz., income(rural), activities were significant at 0.05 level of significance for urban- rural, urban and rural college girls. “P” value of these variables were highly significant at 0.01 level of significance (P<0.01) and significant at 0.05 level of significance (P<0.05), indicating significant contribution of these nine variables in explaining the variation in nutritional knowledge of all college girls. Remaining variables had non-significant relationship with level of nutritional knowledge of all college girls.

Regression analysis indicating significant contribution of these six variables viz., age, father’s occupation, pica, sources of information and father’s education were highly significant at 0.01 level of significance (P<0.01), indicating significant contribution of these six variables in explaining the variation in awareness regarding anemia in all college girls. “P” value of these variables were highly significant at 0.01 level of significance (P<0.01) indicating significant contribution of these six variables in explaining the variation in level of awareness regarding anemia in all college girls. Remaining variables had non-significant relationship with level of awareness regarding anemia in all college girls.

Regression analysis indicating significant contribution of these four variables viz., age at menarche, heavy menstrual bleeding, income and activities were highly significant at 0.01 level of significance (P<0.01), indicating significant contribution of these four variables in explaining the variation in haemoglobin of all college girls and age at menarche (rural) was significant at 0.05 level of significance (P<0.05). “P” value of these variables were highly significant at 0.01 level of significance (P<0.01) and (P< 0.05) indicating significant contribution of these four variables in explaining the variation in level of haemoglobin of college girls.
Regression analysis indicating significant contribution of these five variables viz., age at menarche (awareness regarding anemia), types of diet (BMI), iron and vitamin C intake (clinical signs and symptoms), father’s occupation (awareness regarding anemia and hemoglobin) and morbidities (hemoglobin) were highly significant at 0.01 level of significance (P<0.01), indicating significant contribution of these five variables in explaining the variation in hemoglobin of selected college girls and sources of information (nutritional knowledge), pica (clinical signs and symptoms and nutritional knowledge) and activities (hemoglobin) was significant at 0.05 level of significance (P<0.05). “P” value of these variables were highly significant at 0.01 level of significance (P<0.01) and (P< 0.05) indicating significant contribution of these eight variables in explaining the variation in selected independent variables of iron supplemented college girls.

The multiple correlation (R) GCS powder supplementation was 0.878 indicating that correlation between nutritional status and the level of hemoglobin calculated on the basis of independent variable was significant after the Garden cress seed powder supplementation among selected college girls. Garden cress seed powder supplementation was given for only 28 days, therefore, not a single variable was found of significant value and regression analysis.

4.7 Testing of hypothesis

The age influences blood hemoglobin level, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern i.e. frequency of iron and vitamin C rich food intake. For testing the hypothesis, ANOVA was computed with different six age group of college girls data and statistical significant result were found in blood hemoglobin and nutritional status at p< 0.05 level. There was highly significant difference found in awareness regarding anemia, nutritional knowledge and dietary pattern of college girls at p< 0.01 level. So formulated hypothesis was not accepted, it shows that there is a significant influence of age of college girls on
Summary and Conclusion

haemoglobin level, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern of all college girls.

Hypothesis testing **between urban and rural** girls, ‘t’ analysis was computed and it revealed that there was not any significant difference found between area of residence of college girls and blood haemoglobin level. It expressed that all the selected college girls had a similar haemoglobin level as per urban and rural classification. So the hypothesis was accepted. Similarly, dietary pattern i.e. frequency of iron and vitamin C rich food intake were also in college girls of both areas. So the formulated hypothesis was accepted. As per nutritional knowledge, awareness regarding anemia and nutritional status concern, the hypothesis was not accepted because there was a highly statistical significant difference found at p< 0.01 level. It expressed that there was definitely difference found in nutritional knowledge, awareness regarding anemia and nutritional status of urban and rural college girls.

**Age at menarche** influences the blood haemoglobin, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern. For testing hypothesis ANOVA was computed with different groups of age at menarche data of college girls and highly significant influence was found in blood haemoglobin, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern at p< 0.01 level. So the hypothesis was not accepted and it expressed that there was an influence of age at menarche on blood haemoglobin, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern. Thus, it can be concluded that age at menarche affects overall health and nutritional status of all college girls.

**Educational faculty** i.e. arts, science, commerce, home science, professional science, social science also affects nutritional status due to the blood haemoglobin, nutritional knowledge, awareness regarding anemia and difference in knowledge level regarding health and nutrition. For testing hypothesis ANOVA was computed with
different educational faculties data of college girls and there was a highly significant difference found in haemoglobin level, nutritional knowledge, awareness regarding anemia and dietary pattern at p< 0.01 level. Nutritional status was significant at p<0.05 level. So the hypothesis was not accepted and it expressed that educational faculty also plays an important role in the perception of knowledge regarding health and nutrition. Thus, it can be concluded that educational faculties also important variable for good health.

Income influences the haemoglobin level, nutritional knowledge, awareness regarding anemia and dietary pattern. For testing hypothesis ANOVA was computed with different income groups of parents of college girls and result found that there was a highly significant difference between income group and haemoglobin level, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern at p< 0.01 level. So the hypothesis not accepted and it expressed that income greatly affect haemoglobin level, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern. Thus it can be concluded that income has a power of purchasing food, services and education which resulted in improving overall health status of all college girls.

Caste influences the haemoglobin level, nutritional knowledge, awareness regarding anemia and dietary pattern. For testing hypothesis ANOVA was computed with different caste of parents of college girls and result found that there was a highly significant difference between caste and haemoglobin level, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern at p< 0.01 level. So the hypothesis was not accepted and it expressed that caste greatly affects haemoglobin level, nutritional knowledge, awareness regarding anemia, nutritional status and dietary pattern. Thus it can be concluded that caste had significant influence on type of diet on daily basis.
There was a significant impact found for iron tablet supplementation (H.S. at p<0.01) and GCS powder supplementation (S. at p<0.05) in blood hemoglobin among selected college girls. It also depicts that nutritional knowledge intervention had significant impact in nutritional knowledge and awareness regarding anemia. For testing hypothesis, ‘t’ analysis was carried out with before and after supplementation data and result showed that there was a highly significant difference found in blood haemoglobin, nutritional knowledge intervention at p< 0.01 level. So the hypothesis was not accepted and it expressed that supplementation or intervention greatly affects haemoglobin level, nutritional knowledge, awareness regarding anemia, nutritional status of selected college girls. Thus it can be concluded that intervention program had significant influence on overall health and nutritional status of selected college girls.

Conclusion:

Adolescence and college age is a transitional period from childhood to adulthood, during which certain problems may influence their future health and is considered as the best time to intervene, to assist physical development and to prevent anemia. IDA in adolescent girls causes reduced physical and mental capacity, diminished concentration in work and educational performance. Work on adolescent girls is scanty and needs attention. Looking at the results obtained from the present study and available literature, anemia, defined as concentration below the established cut–off level, is a major public health problem with major consequences for human health as well as social and economic development. The present study has shown the effectiveness of the daily supplementation of iron folic acid tablets and GCS powder and nutritional knowledge intervention. To conclude, considering the effectiveness of supplementation in college girls anemia prophylaxis measures should be initiated in India.
Implication

It is evident from the study that majority rural and urban college girls parents were educated up to primary and secondary level hence they require special training on diet and nutrition, and care of common diseases.

- The training program on college girls related aspect should be organized by government, primary health centre at village level and referral hospital at town level and civil hospital at city levels.
- Health and nutritional status of college girls in both area is similar but overall health and nutritional status was not found satisfactory in relation to anthropometric indices i.e. BMI and haemoglobin. These facts pertains that the parents of the college girls are either care less or they did not coup up with the anemic condition due to poor awareness and poor health and nutritional knowledge. Hence, government should extend medical facilities at the door step of the people of rural and urban poor areas.
- The colleges have to organize programs related to creating awareness regarding health and nutrition and try to improve overall health awareness.
- The parents of the college girls of the study area should be inform about the importance to follow healthy dietary habits which could improve the nutritional status in parallel with overcoming the devastating economic conditions.
- Morbidity pattern showed greater prevalence of cold and cough, fever, headache and seasonal infection etc, were found among the college girls of urban and rural areas. These results indicate the urgent need to deliver basic health and nutrition services enormous number of vulnerable and largely inaccessible girls. Such responsibility could be given to several non government organizations (NGOs) those who are working in remote areas.
- The prevalence of anemia was significantly higher in girls. This facts demands urgent attention of the parents and medical services provided as it will affect
badly when she become pregnant. Therefore, the mothers of the girls and the girls herself should be trained in respect of balanced diet to combat iron deficiency.

- People should be acknowledged about low cost and highly nutritious food items to ensure balance diets through nutrition education. Mass media can play vital role to educate the people in these respect.

- The nutrients consumption was lower than RDA in these college girls indicates that the required daily intake of protein and iron are low. The government schemes should be implemented properly to needy people i.e. college girls.

- Certain corporate groups can collaborate with public private partnership mode to provide nutritive and quality food in the rural and urban areas for needy.

- Providing equality of opportunities in education encompasses taking care of the nutritional needs of all girls (from childhood) for ensuring optimum growth and good nutritional status. A proactive role from the Government and community leaders is needed for the current era.

- In addition, series of workshops, seminars and lectures of eminent workers and scientists on nutrition awareness may be organized for parents, teachers, students and health workers.

**Recommendations**

- On the basis of come out of the research work the following points are recommended. The present study was confined to Mehsana city and Mehsana taluka of Mehsana district of North Gujarat. A similar study could be replicated in other parts of the state for the better health improvement (i.e. anemia) of college girls.

- The study concentrated on nutritional status, anemia prevalence, dietary pattern, nutrient intake of college girls. Future studies can be implemented to
investigate the socio-economic impact on health and nutritional status and also change in dietary pattern.

- The variables other than those included in the present investigation might be influencing on nutritional status of college girls. Such variables could be included in future research study.

- During the course of the study, it was felt that college health check up programs need more efforts to disseminate the knowledge of nutrition, care of common diseases, low cost food items. A training module can be developed to fulfill the educational needs of girls.

- Knowledge intervention program will be conducted more precisely and cover in depth knowledge about health and nutrition not only among the college girls but to the parents.

- Extensive and persuasive efforts are required to bring behavioural changes in the community for people to adopt dietary diversification. Ultimately, the only sustainable solution to IDA is to help the communities to consume regularly foods that are rich in iron, to encourage intake of promoters of iron absorption such as vitamin C and to discourage high consumption of inhibitory factors.

- Genetically modified (GM) foods use biotechnological techniques to increase the micro nutrient content of foods by genetic manipulation. Foods such as carotene – rich canola oil and vitamin A-rich golden rice are being produced in some countries. A similar strategy would help to increase production of iron – rich foods in the countries where per capita availability of iron rich foods is very low. However, there is a need to protect against any deleterious effects due to the use of such GM foods. Proper labeling is needed in the case of use of processed foods based on GM ingredients. Multi-sectoral and integrated approach will be required to eliminate anemia in the poorer communities. The cooperation of the sectors of health, education, agriculture and industry is essential.