3. METHODOLOGY

The methodology adopted for the present study on the “Impact of Nutritional Interventions on Pregnant Adolescents from Malappuram District, Kerala” consisted the following steps:

A. Selection of area
B. Selection of subjects
C. Selection of tool
   1. Interview schedule
   2. Health assessment card
   3. Proforma for nutritional knowledge
D. Assessing the nutritional status of pregnant adolescents
E. Conduct of nutritional interventions
   1. Nutrition education
   2. Supplementary feeding
      2a) Selection of foods for supplementation
      2b) Preparation of supplementary food
F. Studying the impact of nutritional interventions
   1. Nutritional knowledge of the pregnant adolescents
   2. Anthropometric measurements of the pregnant adolescents
   3. Biochemical profile of the pregnant adolescents
      3a) Blood haemoglobin
      3b) Serum total protein, albumin, globulin
      3c) Serum retinol
   4. Anthropometric measurements of the exoterogestate infants
      4a) Weight
      4b) Crown-heel length
      4c) Head circumference
      4d) Chest circumference
      4e) Mid upper arm circumference
G. Analysis of data
A. SELECTION OF AREA

Based on the criteria like the prevalence of higher number of adolescent pregnancies, reachability and willingness of the medical staff, three Blocks, namely, Kondotty, Pookkotur and Edavanna of Malappuram district, Kerala, were selected for the study (Figure IV).

B. SELECTION OF SUBJECTS

All the adolescent girls who were pregnant in the age group of 16-19 years and had their antenatal care from the Primary Health Centres/subcentres of the blocks Kondotty, Pookkotur and Edavanna over a period of 24 months were selected for the study. All these pregnant adolescents were studied from their second trimester of pregnancy to parturition. Thus, a total of 1350 pregnant adolescents were studied.

Out of this, a subsample of 60 pregnant adolescents from Kondotty, Morayur and Tripanachy, who were in the 2nd trimester of pregnancy, at set period of time were selected to study the impact of nutritional interventions.

Since the higher authorities were reluctant to authorize the recommended supplements to a larger number of pregnant adolescents, the group had to be reduced to a batch of willing 20 on personal risk.

C. SELECTION OF TOOL

The tools selected for the study included interview schedule, health assessment card and proforma for assessing the nutritional knowledge.

1. Interview schedule

According to Kothari (2007) the interview schedules (proforma containing a set of questions) are being filled in by the enumerators who are specially appointed for the purpose.
BLOCK MAP OF MALAPPURAM DISTRICT, KERALA

FIGURE IV
These enumerators along with the schedules go to the respondents, put to them the questions from the proforma in the order the questions are listed and record the replies in the space meant for the same in the proforma.

An interview schedule (Annexure I) was prepared to collect the basic information relating to the socio-economic profile, dietary pattern and risk scoring among the selected pregnant adolescents. A pilot study, was conducted which of course is a test to judge the strength of the schedules used for the collection of data. It has helped the researcher to tone up the schedule to administer them for the collection of data from the subjects. A simple risk scoring schedule was developed in order to identify the various risk factors in the pregnant adolescents and to categorize them into normal, low or high risk category based on the obstetric problems (Paul and Vijayalakshmi, 1994).

2. **Health assessment card**

Apart from the interview schedule, a health assessment card (Annexure II) was evolved to collect information like stage of pregnancy, body weight, arm circumference, major and minor ailments, nutrient supplements consumed, foods avoided and included, the details of the present parturition and the anthropometric measurements of the exterogestate infants.

3. **Proforma for nutritional knowledge**

A proforma (Annexure III) was designed to assess the nutritional knowledge of the selected pregnant adolescents who were included for the nutrition interventions. The aspects covered in the proforma were the importance of nutrition during adolescence and pregnancy, effects of adequate / malnutrition on the mother and foetus, care during pregnancy and complication and its management. The proforma was administered to the subjects before and after the nutrition education to assess the nutritional knowledge.
RESEARCH DESIGN

FIGURE V
D. ASSESSING THE NUTRITIONAL STATUS OF PREGNANT ADOLESCENTS

According to Catherine and Hilary (2005), measures of nutritional status are usually valuable in as much as they may be predictive of health outcomes. The practical requirements for assessment of nutritional adequacy arise from the need to intervene, either by advice or by more aggressive strategies to improve the nutrition of individuals or populations and thereby to reduce the risks and burdens of those diseases that have or may have a nutritional component.

Using the interview schedule, the data was collected from all the 1350 pregnant adolescents who visited the Primary Health Centres and sub centres of the three blocks over a period of 24 months time (Plate I). With the help of the medical staff the health assessment cards were distributed to all the pregnant adolescents and data was registered during their visits to the health centres every month. Thus, the nutritional status of the pregnant adolescents was evaluated.

E. CONDUCT OF NUTRITIONAL INTERVENTIONS

Caballero (2001) opines that interventions in nutrition introduced in early life has the potential to improve nutritional status and bring about major reductions in the incidence of several diseases.

From among 26 pregnant adolescents who were in the fourth month of pregnancy and had visited the Primary Health Centres in Kondotty block 20 adolescents who were willing to participate in the study were selected and considered as the control group. The nutritional knowledge of these 20 subjects was also assessed using the proforma at the fourth and nineth month of pregnancy apart from administering the interview schedule and health assessment card.
CONDUCTING SURVEY

PLATE I
1. Nutrition education

Poor economic condition does stand in the way of improved nutrition, but ignorance regarding nutrients needed by the body and cheap foods, which can provide them, are also partly responsible. Nutrition education has been described as the process, which assists the public in applying knowledge from the nutrition science and the relationship between diet and health to their practices (Barasi, 2007). Thus, nutrition education helps people gain knowledge of nutrition and persuades to bring about required changes in their food habits.

At a specific period of time, there were 25 pregnant adolescents in Morayur in the fourth month of pregnancy. From these, 20 pregnant adolescents who were willing to participate in the nutrition education classes were selected and they were considered as experimental group I (EI).

Nutrition education (Plate II) was imparted to all the selected 20 pregnant adolescents during their visits to the health centres on antenatal days. The aspects covered were importance and functions of food, food and nutritional requirements during adolescence and pregnancy, stages of pregnancy, physiological changes during pregnancy, minor ailments and their management, care during pregnancy, desirable weight gain and effects of adequate / malnutrition during pregnancy on the mother and foetus, importance of breast feeding and immunization. Education was imparted through various audio visual aids like posters, charts, folders and food guide pyramid.

2. Supplementary feeding

When there are significant levels of malnutrition, and / or when the general ration is not adequate, one possible course of action is to establish a supplementary feeding programme to protect the vulnerable groups.
IMPARTING NUTRITION EDUCATION

PLATE II
During a particular period, there were 27 pregnant adolescents in Tripanachy and Pulpatta health centres under Edavanna Block and from them 20 who were willing to participate in the nutrition supplementation were selected and considered as experimental group II (Ex II).

According to Bamji et al. (2003) diet is a vital determinant of health and nutritional status of an individual. Precise information on food consumption pattern of people through application of appropriate methodology is often needed not only for assessing the nutritional status of the population but also for calculating the relationship of nutrient intakes with deficiency as well as degenerative diseases. Food weighment survey is relatively more accurate and it involves direct weighment of food, though it is time consuming and needs cooperation of other family members throughout the study period. Hence, for all these selected sixty subjects (Control, EI and EII), a three day food weighment survey was conducted initially and at the end of nutrition intervention (that is at the fourth and ninth month of pregnancy) using a proforma (Annexure IV).

In the food weighment survey, weight of all the raw foods used for cooking, weight of the total cooked food and the food consumed by the pregnant adolescents were recorded. From this, the consumption of different raw foods by each subject and their nutrient intake was calculated using the food composition table and it was compared with RDA of ICMR. Based on the nutritional deficiencies prevalent in the diets of pregnant adolescents in Experimental group II the supplementation was planned.

As protein, calcium, folic acid, iron, vitamin A and energy were deficient in their diets, two supplementary food were formulated in the form of laddu and biscuits (Plate III).
A - Ladoo; B - Biscuits

SUPPLEMENTARY FOODS

PLATE III
2a. **Selection of foods for supplementation**

The ingredients (Plate IV) selected for the preparation of the supplements included the commonly used locally available but nutritionally dense foods like wheat flour (*Triticum aestivum*), rice flakes (*Oryza sativa*), soya chunks (*Glycine max Merr*), curry leaves (*Murraya koenigii*), jaggery / sugar (*Saccharum officinarum, Saccharum officinarum*) and hydrogenated oil.

Wheat flour (*Triticum aestivum*) was selected as it is a good source of energy and minerals. It contains a significant amount of iron, phosphorus, magnesium, manganese, copper and zinc (Shakuntala and Shadakshara Swamy, 2005).

Rice flakes (*Oryza sativa*) is made from parboiled rice. It is thin and papery. It was included due to its high content of calcium and iron. It also contains a high amount of riboflavin and niacin (Norman and Joseph, 2007).

Debashri (2004) opines that Indian dietaries are deficient in proteins and fats of high biological value. It is also deficient in vitamins and minerals like calcium, phosphorus and iron. The excessive amount of starch and carbohydrates contained in Indian diet lower down the coefficient of digestibility due to the bulk. In such a context, addition of soya bean to Indian diet will be a great implementary factor. Soy chunks (*Glycine max Merr*) contain proteins which are better than the protein from other sources of vegetables and are easily digestible. The protein in soya bean is a “complete protein” as it supplies in sufficient amount the kind of amino acid required by the body for building and repairing of tissues. It also contains essential amino acids. It is a rich source of phosphorus and calcium and contains vitamins A, B, C, D, E and K.

Curry leaves (*Murraya koenigii*) was selected due to its high content of beta carotene.
A – Soy Chunks Powder; B – Rice Flakes Powder; C – Curry Leaves Powder; D – Jaggery Syrup

A – Soy Chunks Powder; B – Wheat Flour; C – Curry Leaves Powder; D – Sugar Powder; E – Rice Flakes Powder

INGREDIENTS FOR SUPPLEMENTARY FOOD

PLATE IV
Egg was also selected as eggs have an excellent nutritive value. As per Christine (2009), egg has been called the “perfect protein” because of its amino acid profile and is also rated high in digestibility. Eggs are an excellent source of vitamin A. The yolk is also a good source of vitamin D and also a good source of B vitamins. According to Bermudez et al. (2009) eggs contain many important nutrients necessary for foetal development and human survival. The results of his study showed that egg and egg containing traditional dishes consumed by pregnant Latinas before and during pregnancy helped in the higher intakes of protein, fat, vitamin K, selenium, beta carotene, lutein, cholesterol, total polyunsaturated fatty acids and docosahexaenoic acid.

2b. Preparation of supplementary food

Supplementary Food I – Laddu (100g)

i) Rice flakes and soy chunks were powdered and roasted.
ii) Curry leaves were shade dried, powdered and roasted.
iii) Jaggery was melted, filtered and made into syrup.
iv) The powdered rice flakes, soy and curry leaves were added into the syrup and made into balls (laddu). The laddu was prepared in different proportions of the ingredients and was evaluated for the acceptability. The laddu which obtained the maximum score (rice flakes 40g, soya chunks 30g, curry leaves 10g and jaggery 20g) was selected for supplementation and analyzed for its nutrient content.

Supplementary Food II – Biscuit (100 g)

i) Rice flakes, soy chunks and dried curry leaves were powdered and roasted.
ii) Wheat flour was roasted
iii) Powdered the sugar
iv) The wheat flour and the powdered rice flakes, soy chunks, curry leaves and sugar were mixed with fat and baked into biscuits.
The biscuits were prepared in different proportions of the ingredients and were evaluated for acceptability and the biscuit which obtained the maximum score (wheat flour 20g, rice flakes 30g, soy chunks 15g, curry leaves 10g, sugar 10g and fat 15g) was selected for the supplementation and the nutrient content was analyzed.

Thus, the two most accepted supplementary foods were distributed alternatively (to avoid monotony) to all the selected 20 pregnant adolescents. Along with the laddu or biscuits, an egg was also distributed to all the pregnant adolescents to bridge the gap of nutrient deficiency.

The nutrient content of the food supplement / person / day is given in Table 1.

**TABLE 1**

**NUTRIENT CONTENT OF THE SUPPLEMENTARY FOOD**

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity (g)</th>
<th>Energy (Kcal)</th>
<th>Protein (g)</th>
<th>Fat (g)</th>
<th>Calcium (mg)</th>
<th>Iron (mg)</th>
<th>β-carotene (µg)</th>
<th>Thiamine (mg)</th>
<th>Riboflavin (mg)</th>
<th>Folic acid(µg)</th>
<th>Ascorbic acid (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laddi</td>
<td>100</td>
<td>338</td>
<td>11.3</td>
<td>3.2</td>
<td>275</td>
<td>3.6</td>
<td>893</td>
<td>0.30</td>
<td>0.15</td>
<td>39.3</td>
<td>0.4</td>
</tr>
<tr>
<td>Biscuit</td>
<td>100</td>
<td>538</td>
<td>10.3</td>
<td>30.4</td>
<td>285</td>
<td>3.6</td>
<td>1285</td>
<td>0.26</td>
<td>0.11</td>
<td>31.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Mean</td>
<td>100</td>
<td>438</td>
<td>10.8</td>
<td>16.8</td>
<td>280</td>
<td>3.6</td>
<td>1089</td>
<td>0.28</td>
<td>0.13</td>
<td>35.3</td>
<td>0.4</td>
</tr>
<tr>
<td>Egg</td>
<td>40</td>
<td>69</td>
<td>5.3</td>
<td>5.3</td>
<td>24</td>
<td>0.8</td>
<td>672</td>
<td>0.04</td>
<td>0.16</td>
<td>31.3</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>507</td>
<td>16.1</td>
<td>22.1</td>
<td>304</td>
<td>4.4</td>
<td>1761</td>
<td>0.32</td>
<td>0.29</td>
<td>66.6</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>% of RDA</td>
<td>21</td>
<td>21</td>
<td>73</td>
<td>30</td>
<td>12</td>
<td>73</td>
<td>27</td>
<td>21</td>
<td>17</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

The laddu, biscuit and the egg were distributed at their door step once in a week by the investigator and the supplementation was carried out from the beginning of the fourth month to the end of eighth month of pregnancy, that is, for a period of five months. Instructions were given not to share the supplementary food with the other members of the family.

Nutrition education was also imparted in the already stated aspects during the supplementation and at their visits to the Primary Health Centres.
F. STUDYING THE IMPACT OF NUTRITIONAL INTERVENTIONS

Impact of nutrition education and supplementation was assessed through nutritional knowledge of the pregnant adolescents and nutritional status of the pregnant adolescents and their exerogestate infants.

1. Nutritional knowledge of the pregnant adolescents

The proforma on nutritional knowledge was administered to all the selected pregnant adolescents of the control and the two Experimental groups I and II before and after nutrition education and supplementation (fourth and nineth month of pregnancy).

2. Anthropometric measurements of the pregnant adolescents

As per NIN (2009) nutritional anthropometry is a measurement of human body at different age levels and degrees of nutrition. Growth retardation may be the first response of the body towards nutritional deficiencies while appearance of clinical signs may be the final stage. From the public health point of view identification helps to prevent milder cases going into severe forms with consequent risk of high mortality.

Oliveira et al. (2004) states that anthropometric measurements, among the most frequently applied methods for assessing nutritional status in pregnant women, are recognized as effective tools in the prevention of perinatal morbi-mortality, the prognosis of child health and the promotion of women’s health. Several studies have shown an association between anthropometric indicators and pregnancy outcome.

The anthropometric measurements, namely, height, weight and mid upper arm circumference of all the selected 60 pregnant adolescents were recorded from fourth to nineth month.
The height of an individual is influenced both by genetic and environmental factors. The maximum growth potential of an individual is decided by hereditary factors. The environmental factors such as nutrition and morbidity determine the extent of exploitation of that genetic potential (NIN, 2009). Height of all the selected pregnant adolescents was determined using a scale drawn on a vertical flat wall with the help of a fibre glass tape. The individual was made to stand erect near the wall with their heels together and toes apart and head upright touching the wall. The head was held comfortably high. A smooth thin ruler was held on top of the head in the centre and the height was read in centimeters to the nearest 0.1cm. The height of all the selected pregnant adolescents were registered during the 4th month of pregnancy.

Body weight is the most widely used and simplest reproducible anthropometric measurement. A major determinant of foetal outcome during pregnancy is maternal weight gain. A routine measurement of weight is recommended during pregnancy when resources permit, in order to identify excess or inadequate weight gain. Studies carried out by the Nutrition Foundation of India show that maternal weight gain during pregnancy is an important determinant of birth weight of the infant (Gopalan, 2004). As shown in the WHO collaborative study inadequate pre pregnancy weight and inadequate weight gain have cumulative effects on risk of intra uterine growth retardation. Hence the body weight of all the subjects was determined each month (4th to 9th month) of study using a portable weighing machine to the nearest 0.1 kg accuracy.

At any time during pregnancy, mid-upper arm circumference may be used as a substitute indicator, if weight is not available, although it is less sensitive and specific. According to Ogbonna et al. (2007), maternal mid arm circumference was strongly related to infant birth size indices with each unit resulting in maternal mid arm circumference resulting in a 36.1g increase in birth weight. Mid arm circumference was taken for all the samples from fourth
to nineth month of pregnancy using a flexible, non-stretchable tape to the nearest 0.1cm.

3. **Biochemical profile of the pregnant adolescents**

   According to Gordon (2000), biochemical tests are the most objective and sensitive measures of nutritional status. Biochemical tests help to detect deficiencies before symptoms are clinically evident. Biochemical estimation helps to confirm clinical and dietary data, so that diagnosis can be made and the nutritional and medical care can be planned and implemented effectively.

   Biochemical parameters namely blood haemoglobin, serum total protein, albumin, globulin and retinol were determined for the selected pregnant adolescents (Plate V).

   a. **Blood haemoglobin**

   Haemoglobin levels are of great practical value in the nutritional assessment of expectant mothers. Haemoglobin analysis is an important tool in diagnosing anaemia. Anaemia is one of the most frequent complications in pregnancy. According to Thirumanidevi and Uma (2005), anaemia is directly or indirectly responsible for 10-20 per cent of maternal death, high incidence of premature births and intra uterine malnutrition. Hence, estimation of haemoglobin was done for all the pregnant adolescents using cyanmethaemoglobin procedure, at the fourth month of pregnancy and at the end of 8th month of pregnancy (Annexure 5).
BIOCHEMICAL ANALYSIS

PLATE V
b. **Serum total protein, albumin, globulin**

Serum total proteins can be used as an indicator of protein nutrition status. Efficiency of protein utilization increases during pregnancy and the need for protein especially during the second and third trimester also increases. Hence, the estimation of serum total protein, albumin and globulin was done for the 50 per cent of the adolescents at the 4\(^{th}\) and at the end of 8\(^{th}\) month of pregnancy using the biurete method (Annexure 6).

c. **Serum retinol**

WHO (2004) showed that pregnant women have an increased risk of vitamin A deficiency. Hence, the estimation of serum retinol was done for 50 per cent of the selected samples (30 nos) of the control, experimental groups I and II at the beginning of the fourth and at the end of 8\(^{th}\) month of pregnancy by HPLC method (Annexure 7).

4. **Anthropometric measurements of the exterogestate infants**

Anthropometry involves obtaining physical measurements of an individual and relating them to standards that reflect the growth and development of the individual.

Anthropometric measurements like weight, crown heel length, head, chest and mid upper arm circumferences of all the exterogestate infants of the selected mothers were measured within three days of birth.

a. **Weight**

Body weight is the most widely used and the simplest reproducible anthropometric measurement for the evaluation of nutritional status of young children (NIN, 2009). It is a time honoured basic indicator in clinical practice, especially in paediatrics.

The body weight of the infant was determined using baby weighing scale. This scale consists of a fixed pan. By placing the scale on the flat surface
and adjusting the knob to zero (so that the pointer reads ‘0’) the measurement was taken. The weight was recorded to the nearest measurement 0.1kg accuracy for all the exterogestate infants.

b. **Crown-heel length**

Jelliffe and Jelliffe (1989) point out that height of an individual is principally a measure of skeletal bony tissue. It is made up of the sum of four components – legs, pelvis, spine and skull.

The crown heel length of the exterogestate infant was measured using infantometer. For measuring the length, the infant was laid on the board and the head was positioned against the fixed head board with the eyes looking vertically, the legs were straightened, the knees were kept together and extended by applying gentle pressure and the feet kept on upright angles. The sliding foot piece was moved to obtain firm contact with the heels and the length was read to the nearest 0.1cm.

c. **Head circumference**

Head circumference measurements are useful in children younger than three years of age, primarily as an indicator of non-nutritional abnormalities. Head circumference is related to the brain size mainly and to a small extent to the thickness of the scalp tissues and the skull. Measurements were made with a narrow flexible, non-stretchable tape.

The child’s head was steadied and the greatest circumference was measured, by placing the tape firmly around the frontal bones, just superior to the spura orbital ridges, passing it through the head at the same level on each side, laying it over the maximum occipital prominence at the back. Measurements were taken to the nearest 0.1cm.
d. **Chest circumference**

In well nourished children, the circumference of the chest, usually becomes larger than that of the head after the first six month of life.

The chest circumference was measured for all the infants by using a non-stretchable flexible tape. The tape was placed at the nipple line at the mid inspiration state and measured to the nearest 0.1cm.

e. **Mid upper arm circumference**

Arm circumference is an inferential measurement of labile stores of energy (fat) and protein (muscle) and the arm circumference would be diminished in undernourished infants and would be greater than normal if subcutaneous fat is more.

As a measurement, it is relatively easy to record accurately, provided the tape is snugly fitted, and is not squeezed too tight. The mid upper arm circumference is measured while hand is allowed to rest freely and relaxed at the sides of the body. The arm circumference was measured to the nearest 0.1cm using a fibre-glass tape for all the infants.

G. **ANALYSIS OF DATA**

The data thus collected were consolidated, analyzed and the statistical appraisal was done to see the impact of different factors on the nutritional / health status on the pregnant adolescents and their neonates.

The results thus obtained are presented in Chapter IV under results and discussion.