

## METHODOLOGY

The methodology involved in conducting the present study on the **Effect of Supplementation of Health Mix and Nutrition Education on the Health and Nutritional Status of Handloom Weavers** is presented under the following headings

### Phase I

#### **Eliciting the Socio Economic, Dietary and other Background details of the Handloom Weavers**

- A. Selection of Area and Handloom Weavers for the Study
- B. Formulation of Interview Schedule
- C. Collection of Information on Socio Economic, Dietary and other Background details of the Handloom Weavers

### Phase II

#### **Assessment of Nutritional and Health Status of the selected Handloom Weavers**

- A. Assessment of Nutritional Status
  1. Anthropometric Measurements
  2. Biochemical and Biophysical Assessment
  3. Clinical Examination
  4. Dietary Assessment
- B. Assessment of Energy Balance and Work Output

### Phase III

#### **Formulation and Testing of Health Mixes**

- A. Selection of Functional Foods
- B. Formulation and Preparation of Health Mixes based on Functional Foods
- C. Acceptability Testing, Nutrient Analysis and Antinutritional Factors of Health Mixes
- D. Shelf life of Health Mixes
- E. Computation of Cost of Health Mixes

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## Phase IV

### Supplementation of Health Mixes to the selected Handloom Weavers

- A. Selection of weavers for Supplementation Study
- B. Supplementation of Health Mixes
- C. Evaluation of the Effect of Supplementation

## Phase V

### Conduct of Nutrition Education Program

- A. Selection of weavers for Nutrition Education
- B. Development of Nutrition Education Materials
- C. Conduct of Nutrition Education Program
- D. Evaluation of the Effect of Nutrition Education Program

## Phase VI

### Data Analysis

## Phase I

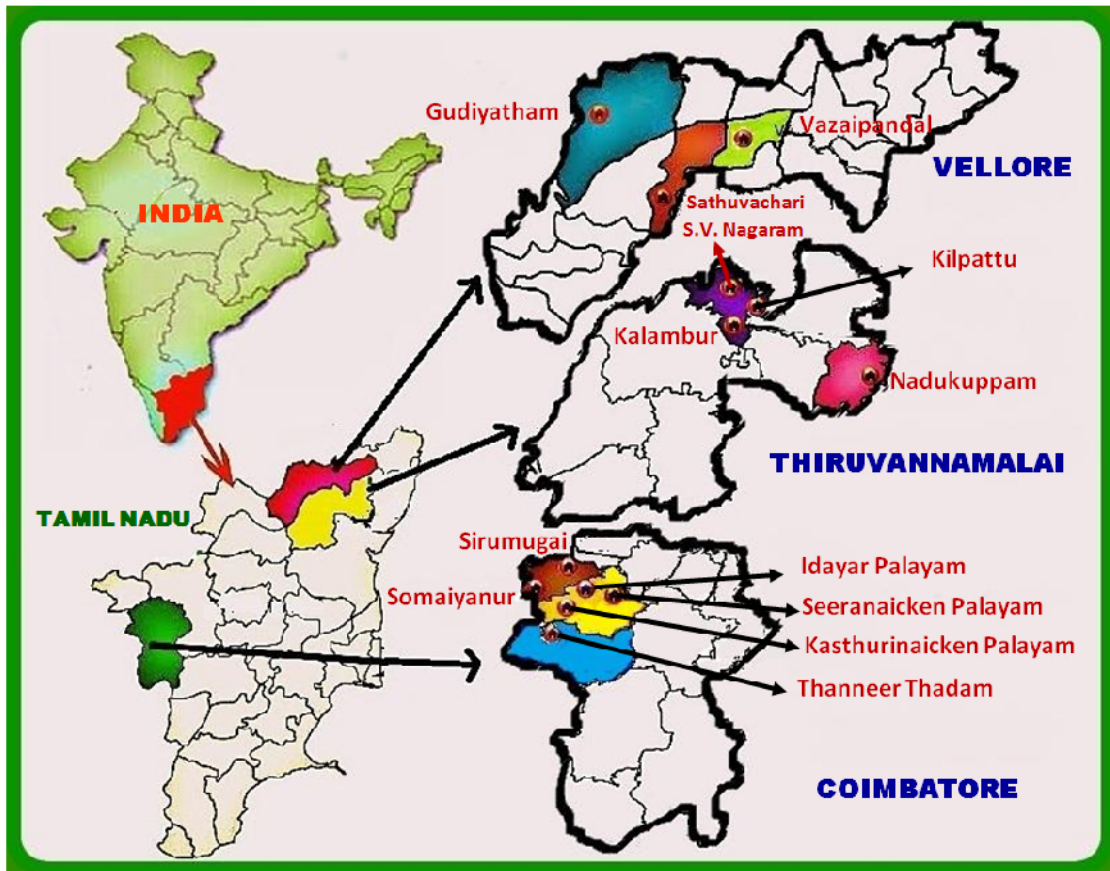
### Eliciting the Socio Economic, Dietary and other Background details of the Handloom Weavers

#### A. Selection of Area and Handloom Weavers for the study

In India, Tamil Nadu is well known for its rich culture and tradition of handloom weaving. In Tamil Nadu more than 2.17 lakh people are involved in weaving profession. In Coimbatore 23607 handloom weavers are involved in weaving activities. There are 12414 handloom weavers engaged in weaving profession in Vellore district and in Thiruvannamalai district there are 17100 handloom weavers engaged in weaving activities (Census of India, 2011). From Tamil Nadu Coimbatore, Vellore and Thiruvannamalai districts were selected for the general survey, since adult handloom weavers are adequately available for the study. Easy accessibility, cooperation expressed by weavers and familiarity of these areas to the investigator are the other reasons for selecting these three districts.

Figure 1 presents the map of the selected three districts of Tamil Nadu.

**FIGURE 1**  
**MAP OF THE SELECTED DISTRICTS OF TAMIL NADU**



In Coimbatore district 2 urban and 4 rural areas, in Vellore district 1 urban and 2 rural areas and in Thiruvannamalai district 2 urban and 2 rural areas were selected for the study. A total of 6 urban areas and 7 rural areas where handloom weavers are residing were selected for the study.

The following were the places selected for the general study from the three districts

1. Coimbatore - Idayar palayam (U), Seeranaicken palayam (U), Somaiyanur (R), Sirumugai (R), Thanneer Thadam (R), Kasthurinaicken palayam (R)
2. Vellore - Vazaipandal (R), Gudiyaatham (U), Sathuvachari(U)
3. Thiruvannamalai - S.V.Nagaram(R), Kalambur(U), Kilpattu(U), Nadukuppam (R)

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Both men and women weavers available during the study period numbering 1118 (1056 men and 62 women) aged 20-60 years were selected for the general study. Among the three districts Thiruvannamalai district was selected for supplementation study.

## **B. Formulation of Interview Schedule**

A schedule is a form containing some questions or blank tables which are to be filled by the research investigator after getting information from the informants. The schedule may contain direct questions and presented by the interviewer (Saravanel, 2007). An interview schedule is a method of collecting data and involves presentation of oral-verbal stimuli and reply in terms of verbal-oral responses. An interview method is said to be the easiest and the most reliable method of collecting data (Kothari, 2007).

For the present study, an interview schedule was developed to collect details from handloom weavers regarding the socio economic background (age, sex, education, income, activity, expenditure pattern etc) dietary pattern (type of diet, meal pattern, food frequency, consumption pattern of beverages, oil etc) health and hygiene, life style pattern (yoga, exercise, smoking and alcohol intake etc) and nutrition knowledge.

The schedule also included questions on work profile like infrastructure, ventilation, duration of work and occupational health problems. The schedule was pretested among ten handloom weavers and then modifications incorporated, finalised and used for the survey (Appendix I).

## **C. Collection of Information on Socio Economic, Dietary and other Background details of the Handloom Weavers**

The investigator explained the objectives and importance of the study to the handloom weavers before conducting the survey and their full co-operation was obtained. The interview schedule was administered to the available sample of 1118 adult handloom weavers from the areas selected for the study. Prior permission was obtained from co-operative societies where the handloom weavers have registered as members and from individuals during home visits for conducting the survey. The investigator interviewed the handloom weavers during the convenient timings mentioned by them either at home or at co-operative societies over a period of ten months (Plate1).



**Plate 1**  
**Collection of Background information**



**Plate 2**  
**Measurement of Height**



**Plate 3**  
**Measurement of Weight**

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## Phase II

### Assessment of Nutritional and Health Status of the selected Handloom Weavers

#### A. Assessment of Nutritional Status

Nutritional assessment involves gathering and evaluation of medical, social, nutritional and medication histories, physical examination and biochemical data. The identification of nutritional problems evolves from thorough assessment of these factors. Nutritional screening using simple assessment techniques helps to identify patients who would benefit from more intensive nutritional assessment (Mahan and Stump, 2011).

Nutritional status can be determined with the help of assessment of a combination of anthropometric, clinical, biochemical parameters and dietary intake to get a better picture. Measurements of nutritional status are usually valuable 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 population and thereby to reduce the risks and the burden of the disease that may have a nutritional component (Geiseler and Power, 2008). An optimal scheme of nutrition assessment enables the clinicians to quickly detect the presence of disease condition and to provide guidelines for nutritional therapy. Nutrition assessment leads to maintain the assessed status or attain a healthier status (Christie *et al.*, 2010).

The nutritional status of the adult handloom weavers was assessed by using **A B C D** technique.

1. **A**nthropometric measurements
2. **B**iochemical and **B**iophysical assessment
3. **C**linical examination
4. **D**ietary assessment

#### 1. Anthropometric Measurements

Anthropometry is the measurement of human body parts and sites to assess the nutritional status (Rao, 2000). Nutritional anthropometry is a measurement of human body at different ages and levels of nutritional status. It is based on the

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concept that appropriate measurements should reflect any morphological variation occurring due to significant functional physiological change (Bamji et al., 2009).

Anthropometry deals with physical measurements that provide an indirect assessment of body composition, growth, and development. Measurements taken during regular intervals of time and compared with the standard measurements reveal the pattern and trends. It also indicates the changes in an individual's nutritional status. Anthropometry is considered to be the most sensitive parameter for assessing the nutritional status (NIN 2009). It is the single most universally applicable, inexpensive and invasive method available to assess the size, proportions and composition of the human body. Anthropometric indicators for body fat are widely used to predict increased chronic disease risk at the individual and at population levels. Anthropometric measurements like waist hip ratio and waist circumference provide additional information about central fat distribution (Klein *et al.*, 2007).

#### **a. Measurement of height**

Height is an anthropometric measurement used frequently for nutritional assessment (Vij, 2011). The height of an individual is influenced by genetic and environmental factors. Inadequate dietary intake and or infection reduce nutrient availability at cellular level resulting in growth retardation. Height is affected by long-term nutritional deprivation, and is considered as an index of chronic or long duration malnutrition (NIN, 2009).

In each urban or rural areas, the selected handloom weavers were asked to assemble at a common place like marriage hall, community hall, temple or a big house for conducting the survey, taking anthropometric measurements and clinical examination.

Standing height of all the selected handloom weavers was measured according to the procedures recommended by the International Society for the Advancement of Kin Anthropometry (Marfell-Jones *et al.*, 2001) using a non stretchable tape in centimeters fixed firmly to the wall. Each adult was made to stand without slippers with heels, buttocks and shoulders resting lightly against the backrest so that the Frankfort plane was horizontal. The head was held straight and arms hanging to the sides. A wooden scale was then placed close to the top of the head,

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crushing the hair and height was measured to the nearest 0.1 cm and recorded (Plate 2).

**b. Measurement of weight**

Body weight is the most widely used simplest method to assess the growth and development of an individual (NIN, 2009). Weight also provides a crude evaluation of overall fat and muscle stores (Brahman, 2005). Series of measurements of weight are more sensitive indicators of changes in nutritional status than single measurement at a point of time (Tussing, 2009). Weight is the simplest reproducible anthropometric measurement for the overall evaluation of nutritional status of individuals.

A portable human weighing balance was used to measure the body weight of the handloom weavers. Zero error of the scale was checked periodically before weighing and measurements were done under basal conditions. The adults were made to stand erect with light clothing, bare foot and without touching any other object. Weight was measured in kilograms to the nearest 0.1Kg and recorded (Plate 3).

**c. Body Mass Index (BMI)**

WHO Expert Committee (2004) recommended the use of BMI for the determination of the nutritional status of the population between the age group of 20-60 years. BMI or Quetelet's Index is a key index relating a person's body weight to his height and represents the most useful anthropometric index and frequently used to evaluate an individual's nutritional status with special focus on obesity (Gallagher and Javed, 2009). BMI is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults (WHO, 2011).

$$\text{BMI} = \text{Weight in kg} / \text{Height in m}^2$$

Classification	BMI range*
Underweight	<18.5
Normal	18.5-24.9
Pre-obese	25.0-29.9
Obese class I	30.0-34.9
Obese class II	35.0-39.9
Obese class III	≥40.0

\*WHO (2011)

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BMI is a validated measurement of nutritional status. BMI of the adult handloom weavers was calculated using the formula and categorized accordingly to know their nutritional status.

## **2. Biochemical and Biophysical Assessment**

### **2a. Biochemical Assessment**

Biochemical test helps to diagnose deficiency diseases at the subclinical stage and confirm it as a diseased state (Bent, 2003). Most biochemical tests reveal current status and useful to quantify any mild deficiencies (Park, 2000). Biochemical tests can be conducted on easily accessible body fluids like blood and urine. Biochemical measurements of nutritional status yield objective and quantitative data and are the most sensitive indicators of nutritional status ([www.nhibi.nin.gov](http://www.nhibi.nin.gov)).

Measurements of nutrients or their byproducts in body cells or fluids such as blood and urine can be used to detect nutrient deficiencies and excesses. Blood carries newly absorbed nutrients to the cells of the body, the amounts of nutrients in the blood may reflect the amount in the current diet rather than the total body status of the nutrient. To assess the status of the nutrients, it may therefore be necessary to analyze the cells in the blood or other tissues for indications of abnormal function such as altered rates of chemical reactions (Smolin and Mary, 2010).

Biochemical assessment is considered to be a more objective and precise methodology due to its consistency and accuracy. For assessing the biochemical profile, the selected handloom weavers were informed to come the next morning following 12 hours of fasting and blood was drawn from the adults with the help of trained technician (Plate 4). The biochemical tests performed included random blood sugar, fasting and post prandial blood glucose, serum calcium, serum phosphorus and blood haemoglobin using standardized procedures.

Biochemical tests like blood haemoglobin, random blood sugar and serum calcium which are related to the health problems like anaemia, Diabetes Mellitus, hypertension and musculoskeletal problems of weaver's were done for a sample of 403 based on age, gender, clinical examination and health conditions. In addition, for a subsample of 90 weavers fasting and postprandial blood glucose, serum phosphorus for 90 and vitamin D for 15 were done based on the findings for the prevalence of diseased conditions by using standardized procedures.

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### **i. Fasting Blood glucose**

Elevated fasting blood glucose levels are associated with an increased risk of Diabetes Mellitus (Perez *et al.*, 2010). Increased level of fasting blood glucose is associated with diabetes and insulin resistance, in which the body cannot properly regulate blood glucose level. Fasting blood glucose greater than 126mg/dl on more than one occasion will indicate diabetes ([www.clevelandclinic.org/heart/testing/...tests/blood-sugar-tests.aspx](http://www.clevelandclinic.org/heart/testing/...tests/blood-sugar-tests.aspx)). Random blood sugar test was done for a sample of 403 with the help of a trained laboratory technician. Among them 90 adults were selected who had a higher random sugar level for the fasting blood glucose test using in vitro quantitative determination of glucose in serum plasma. The selected subjects were informed previous day to come empty stomach by telephone. They were asked to assemble at a common place of the selected village which is nearer to the weavers. After the collection of blood sample they were recommended to take food for the post prandial blood test.

### **ii. Post prandial Blood glucose**

Christoper *et al.*, (2002) associated increased levels of postprandial blood glucose with increased risk of type 2 diabetes as insulin resistant, cardiovascular disease, hypertension, dyslipidemia and obesity. The American Diabetes Association recommends a post prandial glucose level under 180 mg/dl and a fasting glucose between 90-130 mg/dl as safe (ADA, 2006). The postprandial blood glucose levels were estimated for the selected 90 adult handloom weavers using in vitro quantitative determination of glucose in serum plasma (Trinder, 2012).

### **iii. Serum Calcium**

Abnormalities of calcium, phosphorus and magnesium homeostasis are common and collectively called disorders of mineral metabolism (Sharon, 2008). When serum calcium level falls below the normal range of 9.0-10.6mg/dl it will lead to several problems. Low levels of serum calcium increase the risk of hypertension or high blood pressure. Severe deficiency leads to abnormal heart beat, dementia and convulsions. Calcium deficiency ailment is osteoporosis in which the bones become porous and fragile ([www.localhealth.com/article/calcium-deficiency](http://www.localhealth.com/article/calcium-deficiency)). Calcium was estimated for the selected 403 adult handloom weavers using calcium reagent kit intended for in vitro quantitative determination of calcium in serum (Sarkar and Chauhan, 2012).

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#### **iv. Serum Phosphorus**

Phosphorus play a vital role in bone formation utilization of carbohydrate and fats during metabolism and synthesis of proteins for growth, maintenance and repair (Arisa Larios, 2013). When serum phosphorus levels fall below the normal range of 2.5 to 5.0 mg/dl it leads to several physical disturbances. This condition is called as hypophosphatemia which may occur due to alcoholism, chronic diarrhoea, malnutrition and uncontrolled diabetes. Low phosphorus levels along with low levels of other vitamins and minerals such as calcium and vitamin D may weaken the bones and increase the risk of bone fractures. Hence serum phosphorus levels were estimated for the selected 90 handloom weavers by using phosphorus kit - Molybdate UV method (Fiske and Subbarow, 2009).

#### **v. Vitamin D**

Vitamin D is a group of fat-soluble secosteroids responsible for enhancing intestinal absorption of calcium and phosphorus. The most important compounds in this group are vitamin D<sub>3</sub> (cholecalciferol) and vitamin D<sub>2</sub> (ergocalciferol). Ergocalciferol and Cholecalciferol can be ingested from the diet and from supplements (Holick, 2006). The body can synthesize vitamin D (specifically cholecalciferol) through the skin, from cholesterol, when sun exposure is adequate hence its nickname, the "sunshine vitamin". Although vitamin D is commonly called as a vitamin, it is not actually an essential dietary vitamin in the sense, as it can be synthesized in adequate amounts by mammals exposing to sunlight. A substance is only classified as an essential vitamin when it cannot be synthesized in sufficient quantities by an organism, and which must be obtained from the diet. In common with other compounds vitamin D is lacking in the disease, rickets, the childhood form of osteomalacia (Wolf, 2004).

Synthesis, intakes from the diet, as well as exposure to sunlight generally contribute to the maintenance of adequate serum concentrations. Beyond which prevent osteomalacia, rickets, and other health effects of vitamin D supplementation in the general population is inconsistent (Pittas *et al.*, 2010). The best evidence of benefit is for bone health (Ross *et al.*, 2011) and a decrease in mortality in elderly women (Bjelakovic *et al.*, 2011). Hence Vitamin D levels were estimated for a selected subsample of 15 adults using Elecsys and Cobas e-analyzers method

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(Hart *et al.*, 2006). Serum Vitamin D was done only for 15 adult handloom weavers since the cost of experiment was high.

#### **vi. Haemoglobin**

Haemoglobin is the protein in red blood cells that carries oxygen. A low haemoglobin count is generally defined as less than 13.5g/dl of blood for men and less than 12g/dl for women and referred to as anemia which is associated with many diseases ([www.mayoclinic.com/health/low-hemoglobin/mayo/83](http://www.mayoclinic.com/health/low-hemoglobin/mayo/83)). Haemoglobin levels were estimated for the selected 403 handloom weavers by using cyanmethaemoglobin method (NIN, 1990). For all the blood estimations 3ml of blood was required which was collected by the trained laboratory technician using standard procedures.

### **2b. Biophysical Assessment**

#### **i. Blood Pressure**

Arterial blood pressure is the force exerted by the blood on the wall of a blood vessel as the heart pumps (contracts) and relaxes. The diastolic blood pressure is the degree of force when the heart is relaxed. Systolic blood pressure is the degree of force when the heart is pumping (contracting). (Westat, 1993).

To assess the prevalence of hypertension among the handloom weavers blood pressure was measured for the selected 403 adults by using a digital blood pressure apparatus. The adults were seated quietly in a chair with feet on the floor and arm supported at heart level. The cuff was placed around the upper arm. Pressure was raised to nearly 200 mmHg and then gradually released. Systolic and diastolic pressures were measured for all the selected 403 adult weavers (Plate 5).

#### **b. X-Ray**

X-ray of knee joint was taken for a subsample of 20 handloom weavers selected with musculoskeletal disorder having low calcium level and severe knee pain for the supplementation study. They were made to lie in supine position. Placed the knee joint in the center of first half of film (2<sup>nd</sup> half covered with lead divider). Made sure the knee joint was not moving and the central ray was directed vertically to the center. Selected adults were asked to lie in lateral recumbent position. The affected knee was placed on the film and flexed to 90°. Rotated the hip if necessary to bring the knee into a true lateral position. Then the central ray was

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directed vertically to the knee joint (Garkal, 2000). The whole procedure was done by technicians in the X-ray clinic.

### **3. Clinical Examination**

Clinical examination is important to assess the signs and symptoms that may indicate potential specific nutrient deficiency. A clinical assessment, sometimes also referred to as a health assessment, which is documented process that is used to evaluate and diagnose an individuals' overall well-being, whether mental, physical, or both (Mahan and Stump, 2004). By becoming familiar with the signs and symptoms of a condition, by recognizing its prevalence and importance, a clinician is more likely to diagnose a patient with that condition (Roy *et al.*, 2009). Physical signs and symptoms are valuable aids in detecting nutritional deficiencies (Frieden, 2010).

Various clinical parameters that are indicative of signs and symptoms of Diabetes Mellitus, hypertension and musculoskeletal disorders and general clinical signs and symptoms such as brittle and thin hair, wrinkled skin, poor nail growth, transverse line, bleeding gums, dental caries, sleep and behavioral disturbance, mental tension, breathing problems, joint pain, shoulder pain, leg pain, asthma, ulcer, vision disorders and fatigue were diagnosed among all the 1118 adults with the help of a physician assisted by the investigator and recorded in the developed interview schedule (Plate 6).

### **4. Dietary assessment**

Dietary assessment, the first step in identifying nutritional status may confirm the intake of excess or lack of one or more dietary constituents. Before developing and implementing effective intervention programmes to improve nutrition at the population level, which is important to know the nutritional status of the target group (Elmadfa and Meyer, 2011).

The purpose of any diet survey is to find out the habitual nutrient intake of individuals and provides information about dietary intakes, pattern of specific foods consumed and nutrient intakes. It indicates relative dietary inadequacies, which are helpful in planning for nutrition education activities (Srilakshmi, 2006). Diet records and food frequency questionnaires (FFQs) are common instruments used to assess dietary intakes. It is most accurate and feasible method to measure food intake in adults (Mckeown *et al.*, 2001).



**Plate 4**  
**Drawing of Blood Sample**



**Plate 5**  
**Measurement of Blood Pressure**



**Plate 6**  
**Clinical Examination**

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Diet history plays a vital role in determining the nutritional status of the individuals. The food intake pattern of selected 60 handloom weavers was assessed using a 24 hour recall method which was followed for three consecutive days. Standard cups and measures were shown and the adults were asked to recall their exact food intake during the previous three days. Quantities of foods consumed were found out in standard measurements and entered on the data sheet to determine the average daily intake of various foods. The mean food intake was compared with ICMR (2010) Recommended Dietary Allowances. From the food intake data nutrient intake of the adults was computed using the Food Composition Tables (Gopalan *et al.*, 2007) and compared with the Recommended Allowances (ICMR, 2010).

## **B. Assessment of Energy Balance and Work Output**

Raquel *et al.*, (2009) stated that BMI and weight gain are strongly associated with type 2 diabetes incidence. Energy intake in excess leads to moderately increased risk, while physical activity is associated with decreased risk of type 2 diabetes. It was observed that energy balance plays an important role in the development of type 2 diabetes and this effect can be modified by BMI. Hence an attempt was made to study the energy balance among selected weavers.

### **1. Energy Intake**

Energy intake was calculated from the 24 hour recall food intake data for three days among the selected 27 handloom weavers, who constitute 10 per cent of the total weavers for supplementation study.

### **2. Energy Expenditure**

FAO (2003) defines Total Energy Expenditure as the energy spent, on an average in a 24 hours period by an individual or a group of individuals. The energy expenditure of the selected 27 handloom weavers was determined using the time activity record. This involved self recording of various types of activities by the adults for 1440 minutes (24 hours) of the day. Schedules were distributed to the adults and they were instructed to carefully record their activities for the whole day. The filled schedules were collected from the subjects. The specific activities were coded

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following the procedure recommended by ICMR (2002). The total energy expenditure for the whole day was calculated by employing the factorial approach and the computed BMR from body weight and the recommended BMR factors for Indians for different levels of physical activity.

### **3. Assessment of Energy Balance**

Energy balance was calculated among the adult handloom weavers selected for the study using the total daily mean energy intake of the adults obtained from 24 hour dietary recall method for three days and total daily energy expenditure of each adult using the 24 hours activity schedule and BMR factors. Energy balance was categorized as positive, normal and negative and interpreted accordingly.

### **4. Work Output**

With regard to work output by the selected handloom weavers (n=270) the length of the fabric in centimeters woven by weavers during a period of one hour was taken as a measurement before and after supplementation of health mixes. The measured values were categorized based on the saree designs such as simple, medium and heavy.

## **Phase III**

### **Formulation and Testing of Health mixes**

#### **A. Selection of Functional Foods**

Over the last few years consumer's interest in health and functional foods has increased considerably in industrialized countries thus offering an opportunity for agro-food sector to add value to agricultural commodities. Functional food is fresh or processed food claimed to have a health-promoting and disease-preventing property beyond the basic function of supply of nutrients. Functional foods offer potential health benefits that could enhance the well-being of consumers and reduce the economic status and social costs of treating non-communicable diseases (Das *et al.*, 2010).

Today the world appears to be increasingly interested in the health benefits of foods and have begun to look beyond their basic nutritional benefits to prevention of disease and health enhancement. Traditional systems of medicine owe their

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significance to the bioactive components that have their origin in plant sources and most of them were associated with routine food habits (Ullah and Khan, 2013).

Functional foods include amla, carrot, oats, fatty fish, soy, tomatoes, nuts, grape juice, greens, milk, almond, walnuts and blue berries etc. Functional foods arose as nutritional science evolved from indentifying and correcting nutritional deficiencies. It promotes optimal health and reduces the risk of chronic diseases (www.ific.org).

Functional foods have potential benefits on health and scientific evidence is supporting the role of functional foods in prevention and treatment of many diseases. Diabetes, heart disease, cancer, and hypertension are the most important diseases that can be treated or prevented by functional foods and other diseases include arthritis and osteoporosis (Sahelian, 2011).

Foods of natural source provide considerable protection against many of the leading chronic diseases that take the lives of millions of people worldwide each year. Processed foods refined carbohydrates, packed with sugar and hydrogenated fats lead to a continual state of inflammation throughout the body. Metabolic syndrome, diabetes, hypertension, heart disease and Alzheimer's disease are all fueled by the release of dangerous chemical messengers that are the result of inflammation. Changes in diet over a short period of time have been shown to significantly reduce the risk of disease and improve the quality of life. Healthy natural food combinations reduce the risk of chronic diseases (Philip, 2010).

Food supplementation is one of the effective ways of improving the health status of handloom weavers by means of increasing the serum calcium level, regulating the blood glucose and blood pressure. Keeping all these points in mind the investigator selected low cost, locally available ingredients and foods familiar to the community to formulate food supplements to manage diseases like diabetes, hypertension and musculoskeletal disorders.

Foods like bengal gram dhal, black gram, carrot, tomato, cauliflower leaves, amla, flax seeds and soya were selected for the formulation of health mixes for supplementation. Pepper, cumin seeds, red chillies and salt were added to improve the taste and acceptability of food mixes

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Bengal gram (channa) dhal is a very important pulse crop that grows as a seed of a plant named *Cicer Crietinu* in the Leguminosae family. Channa dhal is good for diabetics because it has low glycemic index which regulate the blood glucose level. Dilawari *et al.*, (2001) reported that Bengal gram dhal was found to be more effective in reducing post prandial plasma glucose levels. Moreover the mean peak rise in plasma glucose was decreased by 82.1 per cent with bengal gram dhal, while wheat and rice showed a reduction only by 25 and 16 per cent respectively. Mani *et al.*, (1992) found that bengal gram dhal lowered the risk of diabetes mellitus.



**Bengal Gram Dhal**



**Black Gram Dhal**

Black gram belongs to the leguminosae family. Whole Black gram is a rich source of protein, fiber, several vitamins and essential minerals such as calcium and iron. Black gram consist of polyphenols and carotenoids which are effective in the prevention of cardiovascular disease, cancer and diabetes (Scalbert, 2005).

Carrots contain predominant phytochemicals such as anthocyanins, phenolic acids and carotenoids. These phytochemicals could be useful in the treatment of metabolic syndrome since anthocyanins improve glucose tolerance, hypertension and insulin resistance (Poudyal *et al.*, 2010).



**Carrot**

Among the vegetables carrots are high in fiber, carotenoids, and phenolics such as p-coumaric, chlorogenic and caffeic acids (Alasavar *et al.*, 2001). Consuming foods containing phenolic compounds has decreased the risk of cardiovascular diseases (Lagiou *et al.*, 2006). Carrots are a rich source of nitrates, which when

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converted into nitric oxide may increase vasodilation possibly by decreasing blood pressure. Phenolic compounds are dietary antioxidants found in plants that are shown to inhibit LDL oxidation, decrease total and LDL cholesterol and induce endothelium dependent vaso-relaxation (Lapointe *et al*, 2006).

According to Andrew *et al.*, (2011) drinking fresh carrot juice daily significantly increased antioxidant status and suppressed lipid peroxidation without affecting the plasma cholesterol and triglyceride status.

Tomatoes commonly used in the diet, are a major source of antioxidants and contribute to the daily intake of a significant amount of these molecules. Tomato products are excellent sources of potassium, folate, Vitamin A, C, E and fiber. It contains a variety of phytochemicals including lycopene,  $\alpha$ -carotene and  $\beta$ -carotene (USDA, 2004).



**Tomato**

Tomatoes are incredibly versatile foods which provide several vitamins and minerals like magnesium, phosphorus and copper. Tomatoes confer protection against hypertension, high cholesterol, strokes and heart disease. Tomatoes are rich source of antioxidants such as vitamin C and vitamin A, which help in building bones, and it regulates the blood sugar level ([www.zeenews.india.com/ayurveda/top-7Health-benefits-of-tomato-1361.html](http://www.zeenews.india.com/ayurveda/top-7Health-benefits-of-tomato-1361.html)). Cuevas *et al.*, (2013) observed that tomatoes have a high effect on cardiovascular diseases by increasing High Density Lipoprotein Cholesterol (HDL-C).

Tomatoes are the richest source of lycopene which prevents the production of inflammatory cytokines and reduce the risk of inflammatory diseases. Increased level of body fat leads to an increase in circulating inflammatory mediators. It was observed that consumption of tomatoes provide a useful approach for reducing the risk of cardiovascular disease and diabetes (Ghavipour *et al.*, 2013).

Green leafy vegetables occupy an important place among the food crops as they provide adequate amounts of many vitamins and minerals. They are rich

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sources of ascorbic acid, riboflavin, beta carotene, folic acid and minerals like calcium, iron and phosphorus (Joshi and Mathur, 2010).



### **Cauliflower leaves**

Cauliflower, a cruciferous vegetable in the species *brassica oleracea*, belongs to the family *brassicaceae*. *Brassica Oleracea* (Cauliflower) leaves are propagated through seeds. It consists of white curd, thick stalks and green leaves which surround the flower ([www.wikipedia.org/wiki/cauliflower](http://www.wikipedia.org/wiki/cauliflower)).

Cauliflower leaves are rich in folate, vitamin C, Vitamin E and beta carotene and contain some important nutrients like indole-3-carbinol and phytonutrient sulforaphane. It contains folate which helps in making and stimulating the blood and prevents symptoms of anaemia. Cauliflower leaves can be incorporated in common recipes for increasing bioavailability of the minerals. Cauliflower leaves are a good source of minerals such as calcium, copper, iron, manganese and potassium. Manganese is used as co-factor for the antioxidant enzyme superoxide dismutase in the body. Potassium is an important intracellular electrolyte which helps to counter the hypertensive effects of sodium (Bhuvanewari and Ramya, 2014).

The ascorbic acid found in cauliflower leaves is especially good for bone density and strong skeletal system and boosts immunity and prevents arthritis. It lowers high blood pressure, cures cataract and aids in treating cancer. Vitamin C is essential for good skin health. It promotes the production of collagen which is responsible for the elasticity of the skin and slows down the wrinkles. It repairs cuts, wounds, and injuries faster. It cures diabetes, controls insulin production and prevents heart attack and heart related diseases. It is also beneficial in maintaining good dental, muscle and eye health ([www.en.wikipedia.org/wiki/Cauliflower](http://www.en.wikipedia.org/wiki/Cauliflower))

*Phyllanthus emblica* commonly known as amla is widely distributed in tropical and subtropical areas and has therapeutic potential against chronic diseases. Amla contains vitamin-C, polyphenols such as tannin, gallic acid, ellagic acid, flavonoids like quercetin and rutin ([www.wikipedia.org/wiki/Phyllanthus\\_emblica](http://www.wikipedia.org/wiki/Phyllanthus_emblica)).

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Amla is considered as a versatile and powerful antioxidant that protects the body against all types of cancer and helps to reduce blood pressure (Srikumar, *et al*, 2005). Amla plays an important role in brain and supports the heart, mental function, regulates elimination, strengthens the lungs, enhances fertility, helps urinary system, promotes healthier hair, increases vitality, flushes out toxins, strengthens the eyes, improves muscle tone, acts as antioxidant and enhances immunity. ([www.healthing.about.com/od/herbaltherapy/a/amlaberry\\_x.htm](http://www.healthing.about.com/od/herbaltherapy/a/amlaberry_x.htm)).



**Amla**

There is evidence in vitro that its extracts induce apoptosis and modify gene expression in osteoclasts involved in rheumatoid arthritis and osteoporosis (Penolazzi, *et al.*, 2008). The leaves, bark and fruit have been shown to possess efficacy against laboratory models of diseases, such as inflammation, cancer, age-related renal disease and diabetes (Ganju *et al.*, 2003; Yokozawa *et al.*, 2007). Amla contains high amounts of vitamin C which is effective in controlling diabetes (Kumar *et al.*, 2012). A recent scientific study found that three grams of powdered amla taken per day was more effective than the prescription drug in controlling fasting blood sugar levels ([www.superfoodprofiles.com/health-benefits-of-amla](http://www.superfoodprofiles.com/health-benefits-of-amla)). The antioxidant activity of amla extract is associated with the presence of hydrolysable tannin, having ascorbic acid-like action (Pozharitskaya *et al.*, 2007). Studies by Kim *et al.*, (2010) suggest that fructose induced metabolic syndrome including hyperglycemia and hypertension is attenuated by the poly phenol rich fraction of amla and intake of amla in the form of extract.

Flax seed also known as linseed (*linum usitatissimum*) is a member of the genus *linum*, the family *linaceae*. It is a food and fibre crop that is grown in cooler regions of the world ([www.en.wikipedia.org/wiki/flax](http://www.en.wikipedia.org/wiki/flax)).

Flax seed is used for many conditions related to the gastrointestinal tract, including constipation, colon damage due to over use of laxatives, diarrhoea, inflammation of the lining of the large intestine (diverticulitis), irritable colon or irritable bowel syndrome (IBS), sores in the lining of the large intestine (ulcerative



**Flax Seeds**

colitis), inflammation in the lining of the stomach (gastritis) and inflammation of the small intestine (enteritis). Flaxseed is also used for disorders including high cholesterol, coronary artery disease, heart and blood vessels, hardening of the arteries (atherosclerosis), and high blood pressure (hypertension). ([www.webmd.com.../ingredientmono-991-flaxseed.astr](http://www.webmd.com.../ingredientmono-991-flaxseed.astr)). Consumption of flax seed has also been shown to reduce total and LDL cholesterol (Bierenbacum *et al.*, 1993).

Stephen Daniells (2012) observed that consumption of milled flax seed incorporated buns (30g/day) for one year by peripheral arterial disease subjects with hypertension led to a greater reduction in systolic blood pressure of about 15 mmHg.

Soya bean a species of legume to East Asia from US widely grown for its numerous uses. The plant is classified as an oil seed rather than a pulse by the UN Food and Agricultural Organisation (FAO) ([www.en.wikipedia.org/wiki/soyabean](http://www.en.wikipedia.org/wiki/soyabean)). Soya beans are considered by many agencies to be a source of complete protein (Henkel and John, 2000).



**Soya bean**

Sirtori (2001) reported that soy isoflavones reduced the plasma cholesterol levels and osteoporosis. The role of soya bean is in the prevention of disease especially in relation to heart disease, osteoporosis and cancer. Isoflavones promote bone growth and retard bone loss. It was observed that isoflavones of soy protein when substituted for animal protein, enhanced the bone strength (Messina, 2000). Nanri *et al.*, (2010) suggested that higher intake of soy products is associated with a lower risk of Type II diabetes. It was observed that consumption of soy protein resulted in significant reductions in total cholesterol, LDL and triglycerides but insignificant in HDL cholesterol (Anderson *et al.*, 1995).

Cumin is a seed belonging to the family umbelliferae. Cuminaldehyde is an important phytochemical and possess many health benefits with nutraceutical properties like anti-allergic, antioxidant and hypoglycemic (Sowbhagya, 2013). Intake



**Cumin Seeds**

profile-cumin).

Black pepper (*piper nigrum* L) extracts have been used as a folk medicine (Keith Singletary, 2010). Black pepper is the king of spices. It has anti microbial properties, anti-cancer, anti bacterial and anti-inflammatory. It is also rich in vitamin C which prevents hypertension. Pepper controls blood cholesterol and suppresses bad cholesterol thereby decreasing the risk of cardiovascular disease ([www.king-of-spices-10-black-pepper-health-benefits](http://www.king-of-spices-10-black-pepper-health-benefits)). Black pepper is a natural antibiotic and contains fiber, potassium, iron, vitamin C and vitamin K which regulate stomach ailments, anaemia and heart disease (Mcgee and Harold, 2004).



**Pepper**



**Coriander Seeds**

*Coriandrum sativum* (coriander) has been reported to have a number of possible medicinal attributes including antispasmodic, carminative and stomachic properties (Dhanapakiam, *et al.*, 2008). Additionally, coriander has been advocated as an anti-diabetic remedy.

Considering all the health benefits of functional food ingredients for the development of health mixes bengal gram, black gram, tomato, cauliflower leaves, carrot, amla, flax seeds, soya, cumin seeds, pepper and coriander seeds were selected for the study.

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## **B. Formulation and Preparation of Health Mixes based on Functional Foods**

For the formulation of Basic Health mix bengal gram dhal, black gram dhal, cumin seeds, pepper, coriander seeds and chilli powder were procured from departmental stores. Carrot, tomato, cauliflower leaves and amla were purchased from the local vegetable market. Flax seed and soya flour for the preparation of variations were ordered in advance and obtained from departmental stores located at Coimbatore.

Bengal gram dhal and black gram dhal were roasted and powdered separately. Carrots and tomatoes were chopped and amla was deseeded and chopped into fine pieces. Cauliflower leaves were cleaned free from foreign matters and thick stems. All the vegetables were sun dried on a clean plastic sheet till the moisture content significantly reduced. Then the ingredients were milled using a pulveriser to obtain the respective powders. All the spices were roasted and powdered using a pulveriser. Various proportions of ingredients were tried out and acceptability tests were done to find out the best proportion. For the Basic Health mix 30g bengal gram dhal flour, 15g black gram dhal flour and 5g each of all the spices and 5g each of all the vegetable powders were blended homogenously to obtain 80g of mix which had a good acceptability.

Based on the health problems of the handloom weavers, functional foods like amla powder for diabetes mellitus, flax seeds powder for hypertension and soya flour for musculoskeletal disorders respectively were added to Basic Health Mix. Fifteen g each of amla powder or Flax seeds powder or soya flour were added to 80g of Basic Health Mix to get variation 1 with amla, variation 2 with flax seeds and variation 3 with soya flour.

Figure 2 presents the steps involved in the preparation of Basic Health Mix and variations. The composition of ingredients for the health mixes are given in Table I.

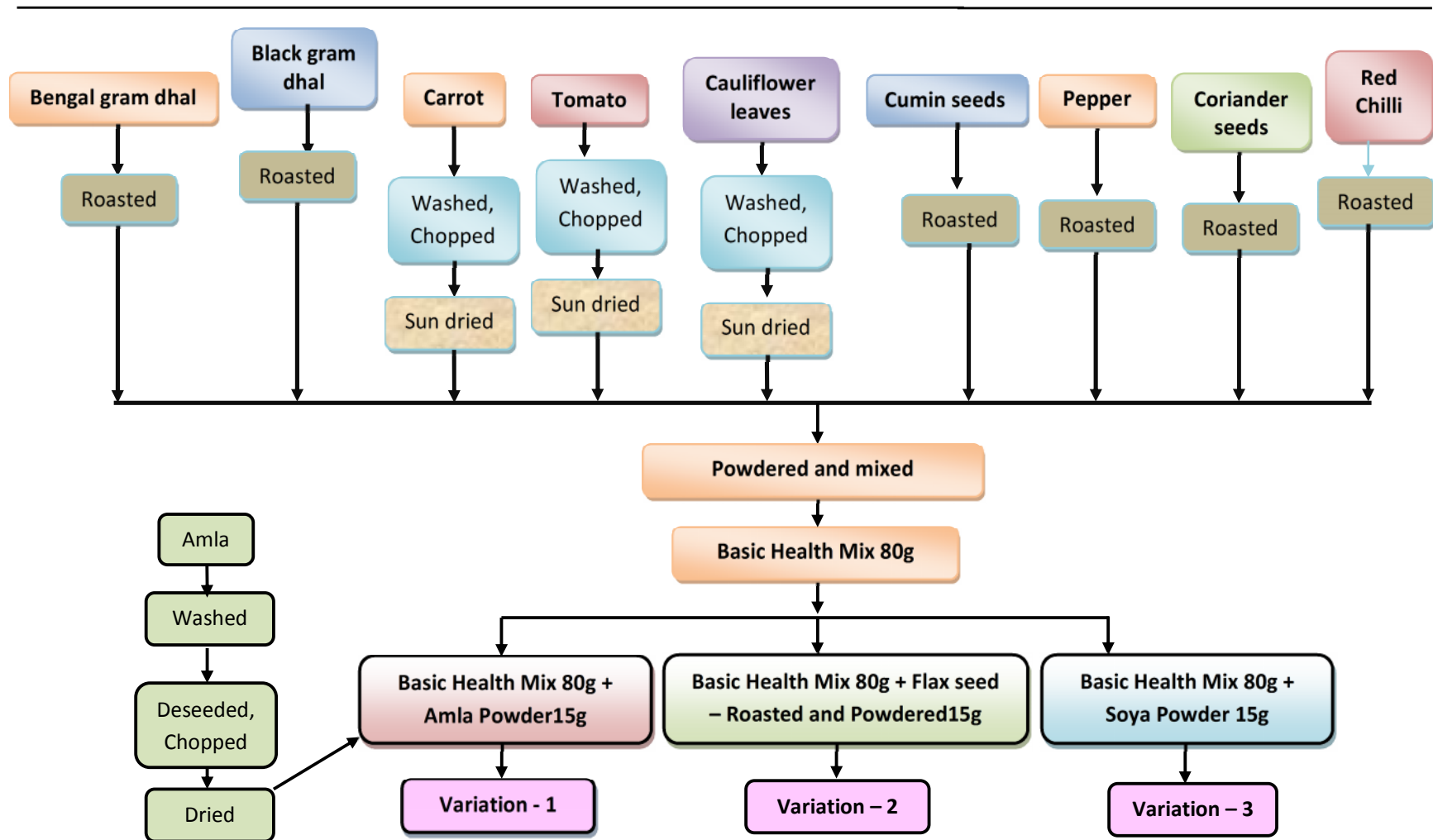


FIGURE 2. STEPS IN THE PREPARATION OF FUNCTIONAL FOOD MIXES

**TABLE - I**  
**COMPOSITION OF HEALTH MIXES**

Ingredients (g)	Basic Health Mix	Variation 1 (Amla)	Variation 2 (Flax seed)	Variation 3 (Soya)
<b><u>Powders of</u></b>				
Bengal gram dhal	30	30	30	30
Black gram dhal	15	15	15	15
Carrot	5	5	5	5
Tomato	5	5	5	5
Cauliflower leaves	5	5	5	5
Cumin seeds	5	5	5	5
Pepper	5	5	5	5
Coriander seeds	5	5	5	5
Chilli powder	5	5	5	5
Amla	-	15	-	-
Flax seed	-	-	15	-
Soya	-	-	-	15

Adequate amount of salt was added to each of the mixes to make them more palatable. For hypertension group variation 2 was given without salt.

### **C. Acceptability Testing, Nutrient Analysis and Antinutritional Factors of Health Mixes**

Acceptability test was done for the Basic Health mix and 3 variations. A panel of 25 semi-trained members were requested to evaluate the Basic Health mix and the variations organoleptically using a five point scale (Appendix II). The most acceptable proportions were selected for the supplementation. The evaluation of the selected health mixes revealed that all the mixes scored more than 19 out of 25 highlighting the good acceptability of health mixes (Plate 7).



**Plate 7**  
**Acceptability Testing**



**Plate 8**  
**Nutrient Analysis of Health Mixes**



**Plate 9**  
**Shelf life of Health Mixes**

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## **Nutrient Analysis**

The Basic Health mix and the three variations were analysed for their nutrient content. The proximate principles like energy and carbohydrate were analysed using NIN (2004) procedures and protein, fat, moisture, crude fibre and minerals were analysed using the AOAC (2000) procedures (Plate 8). All minerals like calcium, phosphorus, sodium, potassium, iron, magnesium and vitamins such as vitamin A, C and E were analysed using the ISI (2004) procedures.

## **Antinutritional factors of Health Mixes**

Antinutritional factors in foods may inhibit the utilization of nutrients in our body. Hence the important antinutritional factors like oxalate, phytate, tannin and alkaloid were estimated for all the health mixes. The modified methods of the Ukpabi and Ejidoh (1989) were used for the determination of oxalate content of the samples. The phytate of each of the samples was determined through phytic acid determination using the procedure described by Lucas and Markaka (1975). Estimation of tannin was done by adopting the method of Sujata *et al.*, (2012). The alkaloid content was determined gravimetrically (Harborne, 1973).

Based on the food and nutrient intake by 24 hour food recall method for 3 days it was found that 30 g of health mix could meet one third of the requirements of antioxidant vitamins such as A and C and minerals such as calcium and phosphorus and deficits of other nutrients among the weavers. Further this quantity was also found to be convenient for consumption by the adults in one day and hence 30g per adult per day was selected as suitable for the study.

The functional food powders were prepared in bulk once in a fortnight during the summer season and stored in air tight containers in a cool and dry place and then used for preparation of health mixes.

## **D. Shelf life of Health Mixes**

All the food mixes were examined initially and after a storage period of three months for their microbial content (bacteria, yeast and mould) to evaluate the shelf life of the health mixes. Microbial content was found out by standard plate count,

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yeast and mould count and the results were compared with the permissible limits. Shelf life tests were done for the fresh and three months stored samples (Plate 9).

### **E. Computation of Cost of Health Mixes**

The total cost incurred in the preparation of the health mixes based on the market prices prevalent during the specific time, was computed. The cost of unit weight of food mixes including processing and packaging cost was calculated and the economic feasibility was assessed.

## **Phase IV**

### **Supplementation of Health Mixes to the selected Handloom Weavers**

#### **A. Selection of Weavers for Supplementation Study**

Among the 1118 adults enrolled initially for the survey, 403 adults were selected based on their co operation for blood analysis and depending upon their age, gender clinical examination and who are not taking alcohol and cigarettes. The selected 403 adult handloom weavers were screened biochemically for hemoglobin, random blood sugar, and serum calcium. Blood pressure was also measured. Among them a total of 275 individuals with any one of the condition like diabetes mellitus, hypertension, and musculoskeletal disorders were selected for supplementation study. They were residing at different places such as Kilpattu, Kalambur, Nadukuppam and S.V. Nagaram within a radius of 18 km so that distribution of health mixes was done effectively. The inclusion criteria are male members within the age group of 35 to 60 years and doing weaving profession for more than 10 years and free from other chronic diseases and not taking alcohol. All of them were well informed regarding the objective of the study and their willingness and co-operation throughout the four months supplementation study was confirmed.

There were 5 handloom weavers who dropped out from the study after initial screening due to various reasons. From a total of 270 weavers three groups were formed for the supplementation study and group 1 had 90 adults with diabetes mellitus, group 2 comprised of another 90 adults having elevated Blood pressure and group 3 with 90 adults suffering from musculoskeletal disorders. Grouping of the adults was done with the help of physician.



**Plate 10**  
**Distribution of Health Mixes to the Handloom weavers**

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## **B. Supplementation of Health Mixes**

All the 180 handloom weavers were oriented before starting the supplementation. Remaining 90 adults were treated as control, 30 in each group. Basic health mix formed the foundations for experimental groups.

### **Group I: Adults with Diabetes Mellitus**

ED = Experimental 1 (Basic Health mix)

ED (A) = Experimental 1a Variation 1 (Basic Health mix + Amla Powder)

CD = Control with no supplementation

### **Group II: Adults with Hypertension**

EH = Experimental 2 (Basic Health mix)

EH (F) = Experimental 2a Variation 2 (Basic Health mix + Flax Seed Powder)

CH = Control with no supplementation

### **Group III: Adults with Musculoskeletal disorder**

EM = Experimental 3 (Basic Health mix)

EM (S) = Experimental 3a Variation 3 (Basic Health mix + Soya flour)

CM = Control with no supplementation

For experimental groups health mixes weighing 30 g each were filled into small packets and 20 such small packets were put into a larger zip lock cover. Salt was not included for adults in group II with hypertension. The investigator distributed one such large packet once in 20 days for a period of four months to the selected adults residing in selected four villages (Plate 10). The subjects were asked to consume one small packet (30g) everyday along with their food such as idli, dosa, rice or sambar.

The components of the functional food mixes and the functional properties of the ingredients were explained to the adult handloom weavers. It was assured that they are going to consume only food based supplements which are free from any side effects. The weavers were also informed to follow their regular diet.

During the supplementation period they were checked and interviewed by the investigator about any inconvenience or discomfort they faced in consuming the

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health mixes through home visits to the respective villages or by telephonic enquiries. It was also made sure that they consumed the health mixes regularly. Consent letters for participation were got from handloom weavers.

### **C. Evaluation of the Effect of Supplementation**

After a period of four months supplementation, the effect was evaluated by comparing the following parameters before and after supplementation.

#### **1. Anthropometric Assessment**

Anthropometric measurements including height, weight and BMI were assessed using standardized procedures both before and after supplementation and the results were compared.

#### **2. Biochemical Assessment**

Biochemical tests like fasting and postprandial blood glucose (n=90), serum calcium, serum phosphorus (n=90) haemoglobin (n=270) and Vitamin D (n=15) were assessed before and after supplementation and compared with initial values to evaluate the effect of supplementation.

#### **3. Biophysical Examination**

Blood pressure (n=270) for all and x-ray of knee joint (n=20) of adults from group III were examined among the selected weavers before and after supplementation study and the changes were recorded.

#### **4. Work output and Clinical assessment**

The work output in terms of length of fabric woven and clinical signs and symptoms of the selected weavers were assessed before and after supplementation study and the changes were recorded.

## **Phase V**

### **Conduct of Nutrition Education Program**

#### **A. Selection of weavers for Nutrition Education**

Nutrition education is the process, which assists the public in applying knowledge from nutrition science and the relationship between diet and health to their regular day-to-day practices (Barasi, 2001). Two intervention strategies like food

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supplementation along with nutrition education were found to be most effective in bringing about changes among populations (Vimalarani, 2008).

Nutrition Education on healthy diets and emphasis on increased physical activity would help to reduce the risks for cardiovascular disease. Nutrition Education intervention was found to decrease body weight, BMI, triacylglycerol level and an increase in HDL cholesterol level (Jian Quian *et al.*, 2007).

A nutrition education program conducted among obese and overweight low-income mothers, showed more effective weight control and improved their nutrition knowledge (Lehman *et al.*, 2006). Nutrition education offers a great opportunity to individuals to learn about the essentials of nutrition for health and to take steps to improve the quality of their diets and thus their well-being (Robinson *et al.*, 2004).

A total of 180 adult handloom weavers who were involved in the supplementation study were selected for nutrition education program from the four villages. The nutrition education program was conducted after the completion of the supplementation program for four months.

## **B. Development of Nutrition Education Materials**

Nutrition education program was arranged to create awareness among the adults on various aspects of health, non communicable diseases like diabetes, hypertension and musculoskeletal disorders and their prevalence rate, causes, signs and symptoms preventive measures and dietary modifications.

Nutrition education modules help to impart and emphasize information, improve interest and increase the learning process. Extra care was taken to make all the audio visual aids self explanatory and easily understandable by all the target groups. Charts, posters and booklets were developed and displays were made to educate the handloom weavers on various aspects of healthy living.

### **a. Charts:**

A chart is a graphical representation of data, in which the data is represented as bars in a bar chart, symbols, and lines in a line chart or slices in a pie chart. Chart can represent tabular numerical data, functions or some kinds of qualitative structure and provides different information (Jensen and Anderson, 2012). Fifteen charts

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depicting food guide pyramid, musculoskeletal disorder, preparation of health mixes, healthy life style practices, health and hygiene practices were developed and the charts were posted on the wall and used for nutrition education program (Plate 11a).

**b. Posters:**

Posters include both graphic elements and textual, although a poster may be either graphical or text (Gosling and Peter, 2003). Posters are designed to be eye catching and informative. Five posters covering symptoms and causes of diabetes mellitus, hypertension and musculoskeletal disorders, dietary management of non –communicable diseases were developed and used (Plate 12).

**c. Booklets:**

Booklets are thin book with papers, small, typically giving information on a particular subject ([www.thefreedictionary.com/booklet](http://www.thefreedictionary.com/booklet)). Five booklets in two languages each in Tamil and English on causes and dietary management of, diabetes mellitus, musculoskeletal disorders, hypertension, personal health and hygiene and healthy calcium rich recipes were developed and distributed among the handloom weavers (Plate 13).

**d. Displays:**

The definition of a display is an exhibition or a show of something ([www.yourdictionary.com](http://www.yourdictionary.com)›Dictionary Definitions). Display of five basic food groups (cereals, pulses, roots and tubers, green leafy vegetables, fruits, fats and oils and sugars), suitable diets for diabetes mellitus, hypertension and musculoskeletal disorders was done accompanied by oral communication which can be more easily remembered and reproduced (Plate 14).

**உணவில் அளிகம் சேர்க்கலாமே**



**பால் மற்றும் பால் பொருட்கள்**



**காய்கறிகள் மற்றும் பழங்கள்**



**மாமிச உணவுகள்**



**கொழுப்பு சத்து மிகுந்த உணவு வகைகள்**



**உணவுப் பிரமீக**



**Plate 11**

**Charts developed**

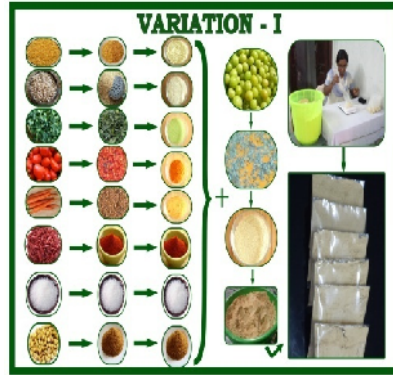


Plate 11a

Charts developed



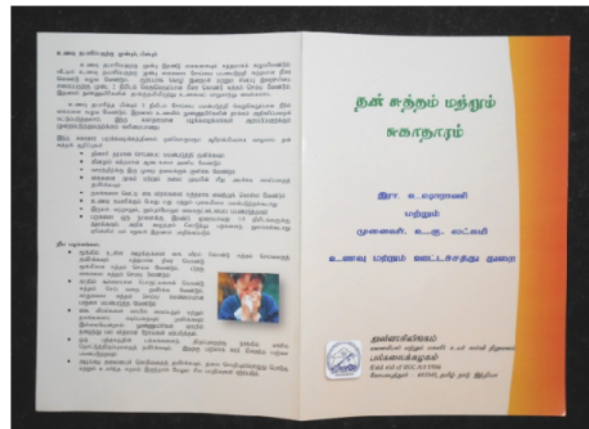
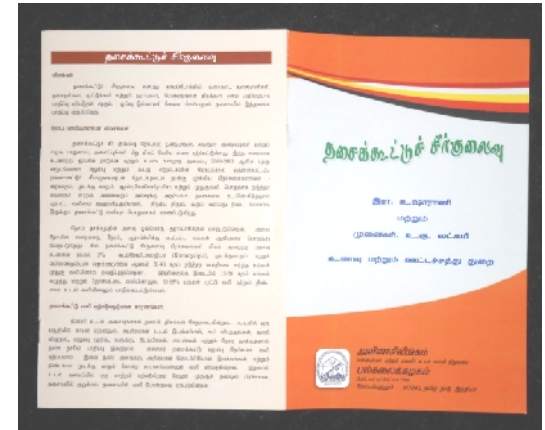
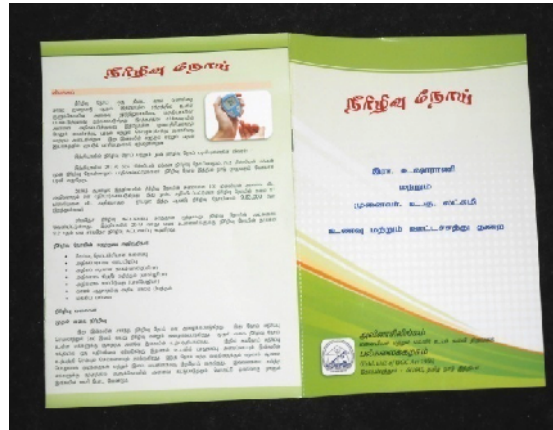


PLATE 13a – BOOKLETS DEVELOPED IN TAMIL

## DIABETES MELLITUS

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**Definition**

Diabetes Mellitus is a chronic metabolic disorder that prevents the body to utilize glucose normally as primary. It is characterized by raised blood sugar level in the blood and abnormal or total absence of insulin and fat metabolism. This can be due to failure in the formation of insulin or insulin resistance.

**Prevalence of Diabetes and Pre-diabetes in India**

- 11.4% of 18 to 79 years adults have self-reported diabetes and 77.2 million adults with pre-diabetes in 2011. Diabetes prevalence in India increases over the epidemic proportionately to other countries.
- By 2020, India's diabetes burden is expected to cross the 100 million mark as against 60 million under estimate. The reason is that the sugar consumption is increasing rapidly with 15.5-200 source related due to diabetes during 2011.
- The International Diabetes Federation's (IDF) 199 Diabetes Atlas has reported that India's population of diabetes among 20-79 year olds is 6.5 per cent.

**Complications of both Type 1 and Type 2 Diabetes Mellitus**

- Foot ulcers and sore
- Impaired night vision
- Diabetic ketoacidosis
- Cardiac arrhythmia syndrome
- Diabetic cataract
- Diabetic neuropathy
- Blurred vision

**Types of Diabetes Mellitus**

1. Type 1 Diabetes Mellitus

It is called Insulin-dependent diabetes mellitus or juvenile-onset diabetes. It is caused by an autoimmune reaction where the body's immune system attacks the insulin-producing cells. People with Type 1 diabetes must use insulin for life. The disease can affect people of any age, but usually develops in children or young adults. People with this form of diabetes need injections of insulin every day to survive and to avoid the complications of their blood.

## HYPERTENSION

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**Management of Hypertension**

- Get healthy habits:** Try the Dietary Approaches to Stop Hypertension (DASH) diet, which emphasizes fruits, vegetables, whole grains and low-fat dairy foods. Eat less amount of saturated fat or avoid it and something low sodium.
- Exercise 30 to 60 min:** A top priority of 150 min a day is good for people of 18 years of age. To reduce the amount of salt intake, exercise should not be done in processed foods, such as canned soups or frozen dinner, eggs or pizza.
- Maintain a healthy weight:** Loss of 5 pounds (2.3 kg) by overweight people can lower the blood pressure.
- Reduce alcohol intake:** People should strictly control how much they drink. For men, it should be no more than 2 drinks a day. For women, it should be no more than 1 drink a day.
- Quit smoking:** Smoking can raise the blood pressure. It is good to quit smoking.
- Manage stress:** Stress does as much as possible. Practice healthy coping techniques, such as muscle relaxation, meditation and deep breathing. Getting plenty of sleep can help to reduce stress.
- Practice relaxation or slow and deep breathing:** Practice taking deep and slow breaths in 4-6 seconds. Then sit with your eyes closed, breathe in and out slowly. This can help to reduce stress and lower blood pressure.

## Musculo Skeletal Disorder

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**Definition**

Musculo skeletal disorder (MSD) is a term that refers to both those injuries that occur acutely over time and also those that occur over a long period. These injuries are usually related to the musculo skeletal system. These injuries are called as 'big picture' and 'small picture' injuries.

**Prevalence**

Musculoskeletal disorders are a major occupational health problem, and a significant public health problem. The prevalence of musculoskeletal disorders is increasing worldwide. The prevalence of musculoskeletal disorders is increasing worldwide. The prevalence of musculoskeletal disorders is increasing worldwide. The prevalence of musculoskeletal disorders is increasing worldwide.

**Causes of Musculo skeletal disorder**

MSD can be caused by a variety of factors, including repetitive motions, forceful exertions, awkward postures, and prolonged static postures. Other causes of MSD include poor ergonomics, poor workstation design, and poor work organization. MSD can also be caused by acute trauma, such as falls, lifting, and carrying heavy loads.

**Signs and symptoms of Musculo skeletal disorder**

People with musculoskeletal disorders may experience pain, stiffness, and weakness in their muscles, joints, or bones. They may also experience numbness, tingling, and swelling. MSD can affect any part of the body, but it is most common in the neck, shoulder, elbow, wrist, hand, and forearm.

## Personal Health and Hygiene

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**Agree, wearing the masks for at least 2 minutes with some water after gripping hand just before leaving will ensure that no bacterial contamination will occur to yourself or food.**

**Good Hygienic habits are easy to begin and maintain. Starting with a few of these that will help you to start on steps to develop good personal hygiene for improvement of health.**

**Tips for Personal Hygiene**

- Wash your hands regularly
- Wash your clothes when you can
- Take bath regularly
- Keep teeth clean and brush
- Keep fingernails short, clean and free of polish
- Avoid eating, drinking or using tobacco while preparing food
- Use the restroom for all personal grooming
- Use handkerchief when coughing or sneezing
- Brush the teeth before a day for at least 3-5 minutes. Make sure you do not put tooth powder on the face or hair.

**COSMETOLOGY (Beauty)**

- People have the habit of putting their finger inside their nose which is a bad habit. They can use a pin or a stick to clean their nose.
- Putting sharp objects like pins or needles should be avoided. Sharp bacteria on the hands and nails will enter the nose and eventually into the body and cause illness.
- Using the fingers when handling the pages of book should be avoided.
- Keeping the head often tilted to the right. In case of dental or eye pain, it will only worsen the condition.

## Calcium Rich Recipes

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PLATE 13b – BOOKLETS DEVELOPED IN ENGLISH





**Plate 15 - Conduct of Nutrition Education at different places**

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### **C. Conduct of Nutrition Education Program**

Before conducting the nutrition education program the initial nutrition Knowledge, Attitude and Practice (KAP) was elicited from the handloom weavers by using a specially designed questionnaire which comprised of 50 multiple choice questions developed for this purpose. Each correct response was assigned a score of one and each incorrect answer was assigned zero (Appendix III).

Based on their initial nutrition knowledge scores on nutritional status, food and nutrient intake, a health related nutrition education program was planned with greater focus on the following themes.

- i. Basic 5 food group (ICMR)
- ii. Nutritious foods for healthy living
- iii. Deficiency diseases
- iv. Dietary management of non-communicable diseases
- v. Health and Hygiene practices

All the selected handloom weavers were asked to assemble at Vallalar Thirumana mahal and Temple which are nearer to the selected villages on specific day of their leisure period (mid afternoon or midmorning) once in a fortnight. The investigator selected lecture method using charts, posters and exhibition. The handloom weavers were given education for a period of one hour. Discussions were held at the beginning and at the end of the session (Plate 15).

All their doubts were cleared. The adults were encouraged to follow the guidelines properly. The adults were educated about the preparation of functional food mixes with all the variations and advised to prepare and take the mixes even after the supplementation period.

### **D. Evaluation of the Effect of Nutrition Education Program**

The effectiveness of the nutrition education imparted was evaluated by giving the same questionnaire to the subjects. The KAP scores obtained before and after the nutrition education was compared and the impact of nutrition education program was evaluated.

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## Ethical Clearance of the research work

The research design of the study was presented before the Avinashilingam University Ethical Committee and got clearance with the number HEC.2011.33 (Appendix IV).

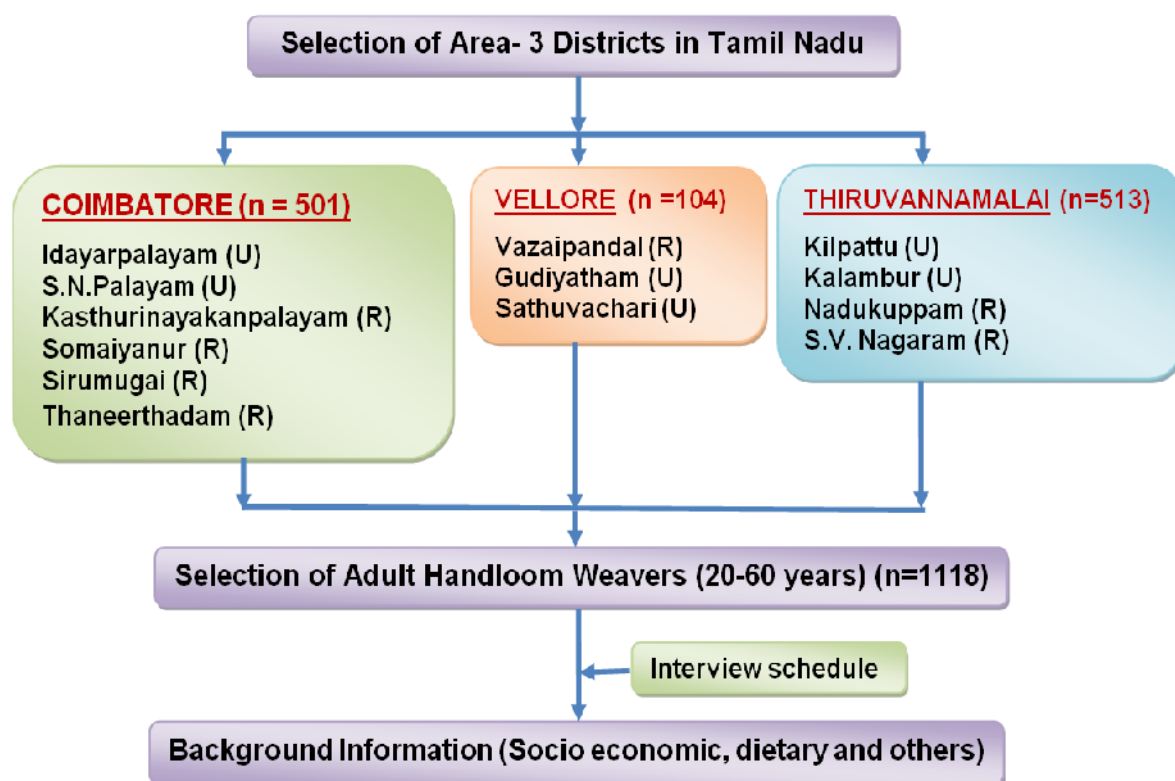
## Phase VI

### Data Analysis

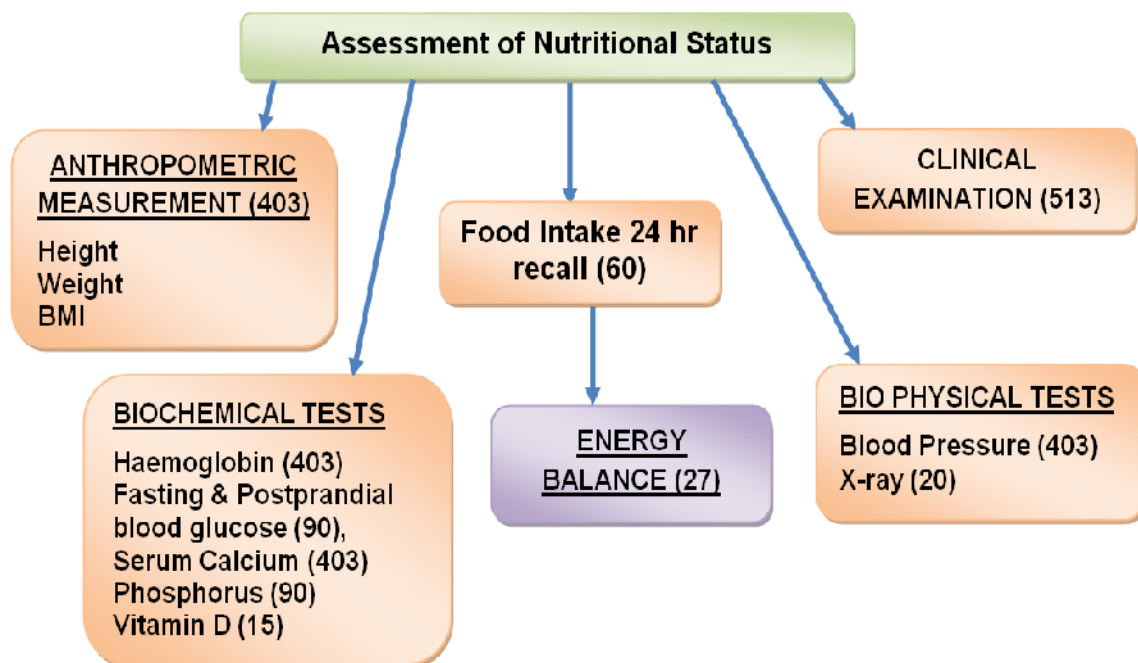
The data was collected, consolidated, tabulated and subjected to appropriate statistical analysis. Number and percentage were done wherever necessary. Mean and standard deviation were calculated for all the attributes. The effect of supplementation and nutrition education was evaluated using students 't' test. Statistical package for Social Sciences (SPSS) version 20.0 was used for the analysis.

The overall research design of the study is presented in Figure 3

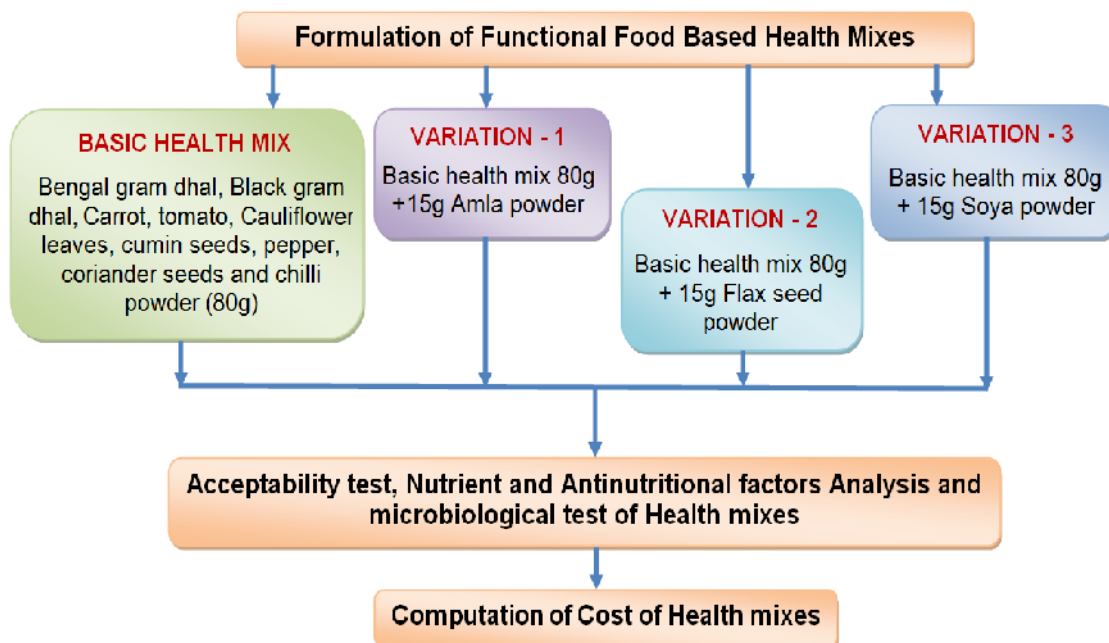
## PHASE I



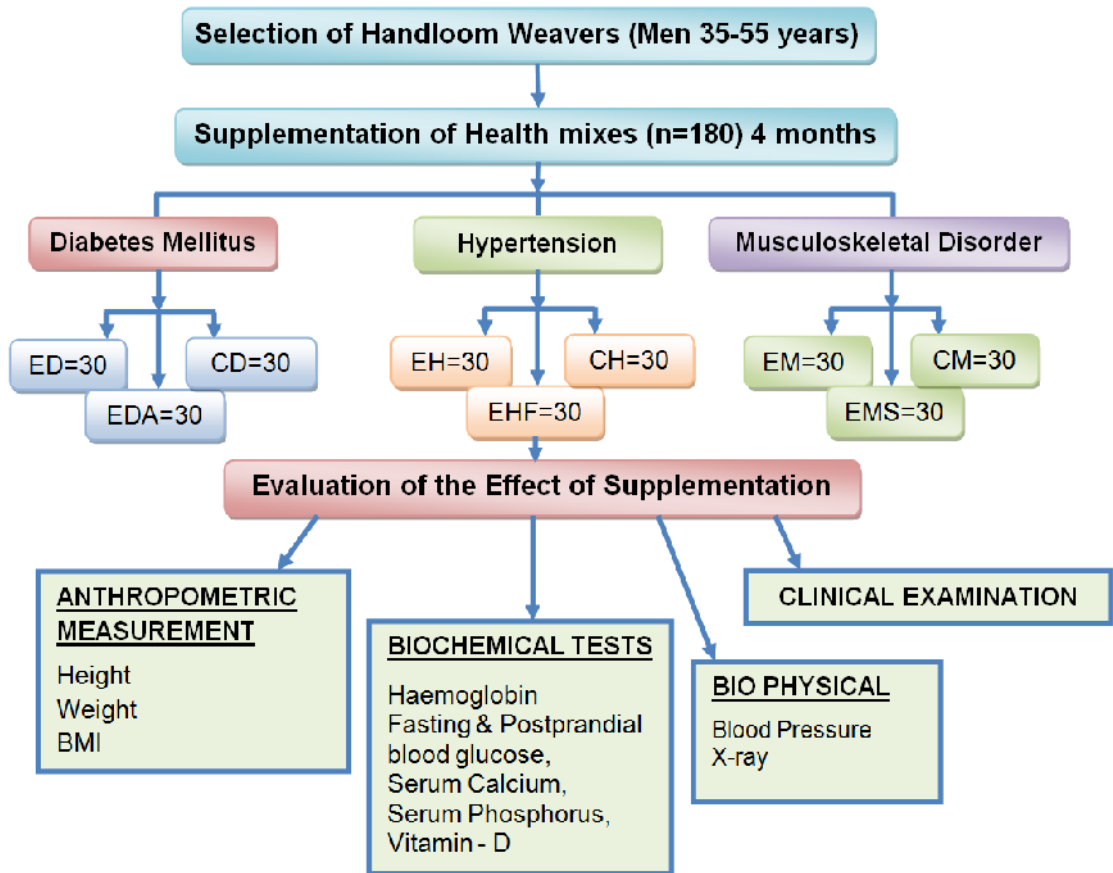
## PHASE II



## PHASE III



## PHASE IV



## PHASE V

