
The methodology adopted for the present study on “Effect of Nutrition Intervention on Nutritional Status and Lifestyle Pattern of the Selected Tribal Girls (10-15) from Kannur and Wayanad Districts of Kerala” consisted the following phases:

Phase I: Selection of the tribal and non-tribal girls to conduct household survey

Phase II. Assessment of nutritional status of the selected tribal and nontribal girls

Phase III: Evaluation of nutritional and reproductive health awareness among the selected girls

Phase IV: Selection of tribal subjects for nutrition intervention

Phase V: Raising nutrition garden at home level and collection of data related to wild edible flora and analysis of nutrients and phytochemicals in the selected edible plants

Phase VI: Formulation and evaluation of nutrition education modules and conveyance of nutrition education

Phase VII: Effect of nutrition interventions on nutritional status of the selected tribal girls

Phase VIII: Assessment of nutritional Knowledge, Attitude and Practices (KAP) on dietary and life style pattern, personal and menstrual hygiene and health status of the selected tribal girls.

Phase IX: Statistical analysis and interpretation of data

Phase I: Selection of the tribal and non-tribal girls to conduct household survey

1. Selection of tribal area.

According to Census of 2011, there are 533 tribes with the population of 84,326,240 tribals, constituting 8.2 percent of the total population in different states of India. The tribal population in Kerala is 4,84,839, constituting 1.45 percent of the total population. Considering the district wise distribution of tribal population in Kerala State, Wayanad has the highest number of tribals (151443) Idukki (55815) and Kannur has 41371 tribal populations. Tribal population in Kerala State is depicted in Table 4.

Table 4. District-wise Distribution of Tribal Population in Kerala (in Rank Order)*

S/N	District	Total Population	Total Tribal Population	% against Total Population in the District	% against Total Tribal Population in the State
1	Wayanad	817420	151443	18.53	31.24
2	Idukki	1108974	55815	5.03	11.51
3	Palakkad	2809934	48972	1.74	10.10
4	Kasaragod	1307375	48857	3.74	10.08
5	Kannur	2523003	41371	1.64	8.53
6	Trivandrum	3301427	26759	0.81	5.52
7	Malappuram	4112920	22990	0.56	4.74
8	Kottayam	1974551	21972	1.11	4.53
9	Ernakulum	3282388	16559	0.50	3.42
10	Kozhikode	3086293	15228	0.49	3.14
11	Kollam	2635375	10761	0.41	2.22
12	Thrissur	3121200	9430	0.30	1.94
13	Pathanamthitta	1197412	8108	0.68	1.67
14	Alappuzha	2127789	6574	0.31	1.36
Total		33406061	484839	1.45	100

*census 2011

As seen from Table 4, the percentage of tribal population in Wayanad District is 18.53 percent which is 31.24 percent of the total tribal population of the State. Some tribes were regarded as primitive tribes with little or no contact with the common people. They have their own beliefs and traditions on a daily basis, in the term of their own diet, life style, dress, jewelry and religious traditions. Every primitive society has its own God and Tribal leader. Tribes constitute 1.64 per cent of the total population of Kannur and it is 8.53 percent of the total tribal population of the state. Many tribal communities in these area were immigrants and were interacted with the mainstream population and liked to follow the lifestyle and dress pattern of the common people because they want to be outwardly similar. But they have their own customs and traditions in their community. These communities have no leader like the primitive community. The area selected for the present study was Aralam Panchayat of Kannur and Pulpally Panchayat of Wayanad District of Kerala State. Maps of Wayanad and Kannur Districts are depicted below.

Table 6. Tribes in Kannur

S/N	Tribes in Kannur	(N)	%	S/N	Tribes in Kannur	(N)	%
1	Paniyan	12557	33.4	5	Malavettuvan	1364	3.6
2	Karimbalan	10031	26.6	6	Kanikkaran	24	0.1
3	Kurichian	9049	24.0	7	Mudugar	5	0.0
4	Mavilan	4612	12.3	8	Others*	130	0.3
Total						37642	100

*Others include 130 Non Tribal Members presently residing in the Scheduled Tribe families, Source: Tabulated from Tribal Survey Report (2011)

Therefore, due to the availability of large number of tribes and non-tribes, easy accessibility, cooperation of the community and familiarity of the investigator with the people and place, these areas were selected to study the nutritional and health status, life style, hygiene and dietary practices of the tribal and nontribal subjects and to find out the effect of nutrition intervention on dietary, personal, and menstrual hygiene, and nutritional and health status related knowledge of the selected tribal and nontribal girls.

2. Selection of tribal and nontribal girls

The primary objective of the household survey is to obtain accurate and reliable information about the universe with minimum cost, time and energy and to set out the limits of accuracy of such estimate (Avasthi et al., 2017). The percentage of the tribes to total population of Kannur is 1.64 percent and in Wayanad is 18.53 percent. In these areas, the availability of tribal and nontribal girls aged between 10 and 15 years were comparatively high and interested to acquire nutrition and health knowledge with the support of the investigator, tribal school teachers and tribal promoters.

A total of 600 girls aged between 10 and 15 years were randomly selected for the collection of data regarding socio economic status, dietary and life style pattern, personal and menstrual hygiene, health and nutritional knowledge. Among 600 girls, 300 girls were from Aralam Panchayat of Kannur District. Out of 300, 150 were selected from non-tribe group and 150 selected from migrant tribes. Another 300 girls were selected from Pulpally Panchayat of Wayanad District. Out of them, 150 from non-tribe group and 150 from primitive tribe. Non-tribal girls were selected for the study to find out the differences in their dietary and life style pattern between these two groups in the same study locale. Purposive sampling method was adopted for this study.

The girls for the study were selected on the basis of the following inclusion and exclusion criteria and are considered as the subjects for the study.

Inclusion	Exclusion
<ul style="list-style-type: none"> • Tribal and nontribal girls aged between 10-15 years. • Willing and well co-operative to participate in the study with written consent • Enrolled in the study 	<ul style="list-style-type: none"> • Non-tribe and tribe girls below 10 years and above 15 years. • Not willing and non-co-operative to participate in the study • Not liked to enrolled in the study

The application form which included the methodology adopted in the research study was submitted and presented in the Institutional Human Ethics Committee of Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore and Ethical Clearance was obtained. The approval number for the present study was AUW/IHEC-17-18/FSN/FHP-03 and the certificate is enclosed in Annexure.1. as well as the permission obtained from Kerala State Tribe Development Department (Annexure 2), Tribal Development Office (Annexure 3), and Collectorate (Annexure 4).

3. Formulation of tools to collect data

Questionnaire and interview schedule were formulated as the tools to collect the data. The collection of data through questionnaire contains many questions pertaining to the field of inquiry and provides space for answers. It may be defined as an instrument for collecting information from a number of persons, supposed to possess it by making them record their replies to a number of questions (Gupta, 2017).

Interview as stated by FAO (2015) is more accurate than other methods as the interviewers come in direct contact with the interviewees. In this present study, background information, in terms of family size, type of family, composition, occupation, literacy level, income and expenditure pattern of the families of the selected tribal and nontribal subjects were collected. Other data related to food and dietary habits, including food intake, foods included or excluded during menstruation, and availability of under exploited tribal foods also were also collected. Personal and menstrual hygienic practices and life style pattern were collected. Anthropometric measurements, clinical examination and dietary intake were included to assess the effect of nutrition intervention on nutritional status of the selected subjects in the study areas. Questionnaire and interview schedule used for collection of data are given in Annexure. 6.

4. Conducting household survey

Girls aged between 10-15 years from the above setup comprised the target group for the study. A total of 600 girls were included in the study. Out of these, 300 girls were from Kannur District and 300 from Wayanad District. Cross-sectional studies, direct observation cum guided interview schedule and direct interview method were employed to the selected tribals (N=600) in this study for the collection of data. These methods were reported to be the suitable way to proceed systematically and quickly to collect information (Kothari, 2013). In this method, there is face-to face interaction between interviewer and respondent before eliciting information. The researcher explained each item of the interview schedule and the responses were recorded accordingly. Selection of girls for the present investigation were on the basis of stratified random design. Detailed background information and life style pattern were collected from the selected 600 girls by using a pre tested interview schedule specially designed for this purpose. All the 600 families of the selected girls in the selected study areas of Kannur and Wayanad Districts were covered for the household survey.

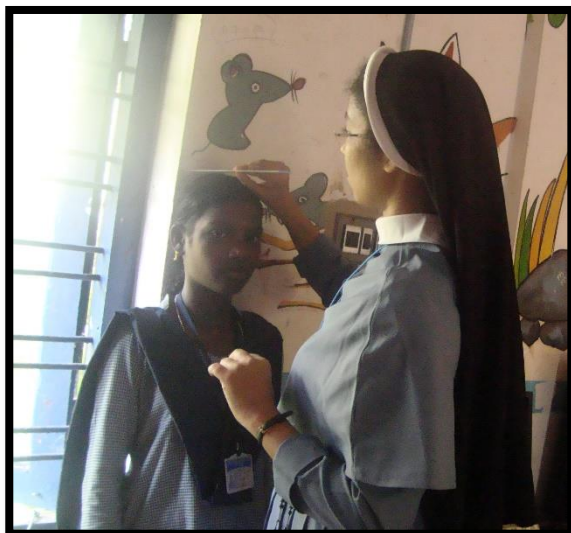
Phase II. Assessment of nutritional status of the selected tribal and nontribal girls

Evaluation of nutritional status of a community is one of the initial phases of the plan of any public health strategy to battle malnutrition. The essential point of such an evaluation is to determine the type, magnitude and distribution of malnutrition in distinctive geographical areas, to identify the ‘at-danger groups’, monitor changes in the extent of malnutrition, select beneficiaries for intervention programmes and evaluate the impact of intervention (Laxmaiah et al., 2012). An understanding of nutrient gaps is helpful in planning nutritious diets to overcome nutrition-related morbidities and thus promote health of the people (Bamji et al., 2017). In the present study, nutritional anthropometry, clinical examination and dietary intake were the methods employed to assess the nutritional status of the selected subjects.

1. Anthropometric Measurements

Nutritional anthropometry is defined as measurement of variations of the physical dimensions and the gross composition of the human body at different ages and degrees of nutrition (Jelliffe, 1966). The methods are standardized and are precise and accurate. The procedures were accurate and standard in identifying mild, moderate and severe forms of

Anthropometric Measurements



Clinical Examination



Plate 1

malnutrition. Anthropometry remains the most practical tool for the assessment of nutritional status among members of the community in developing countries like India (Chakraborty et al., 2011). The selection of an ideal single or a combined use of anthropometric indicators depend upon the sensitivity and specificity of the indicator chosen. Various anthropometric measurements such as height and weight were measured, and Body Mass Index (BMI) were computed using the standardized procedures for all the 600 selected subjects chosen for the present study (Plate 1).

a. Height:

A vertical tape which is non-stretchable, settled perpendicular to the ground on the wall was utilized as the scale to gauge the height of the respondents. It was fixed carefully without any folds or tilting to any side. The selected girls were made to stand erect, looking straight on the platform with heels together and toes apart, without shoes. Height was read to the nearest of 0.5 cm. An average of three measurements was taken as the final measurement (Jelliffe and Jelliffe, 1969). The height of an individual is influenced both by genetic and environmental factors. The maximum growth potential of an individual is decided by the hereditary factor while environmental factors, most important being nutrition and morbidity, determine the extent of exploitation of that genetic potential. Measures of height and weight are useful markers of nutritional status because these indicators over time may reflect a change in nutritional status (Randall (2013) and Harris, 2010). Growth is the best indicator of nutritional status and its analysis remains the simplest tool for assessing changes in nutritional status (Harman et al, 2001). The height of the selected subjects (N=600) i.e., tribal (N=300) and nontribal (N=300) girls (10-15 years) was measured using a stadiometer and the readings were recorded accurately up to 0.1 cm.

b. Weight

Electronic human weighing balance was used to record the weight of the selected girls. The balance was checked (with known weights) for accuracy prior to weighing the girls. It was kept on a flat surface and the girls were made to stand bare foot and erect with minimal clothing and were weighed on the platform of the electronic model weighing scale to the nearest 0.1kg. All the precautions to be followed as per the instructions by Jelliffe and Jelliffe, (1969) were taken into consideration while taking the measurements. The weight

was recorded in kilograms to the nearest gram. Weight of the selected 300 tribal and 300 nontribal girls was recorded using a digital weighing balance to the nearest 0.01kg.

c. Body Mass Index (BMI)

BMI has been recommended as the best anthropometric indicator of nutritional status (Woodruff and Duffield, 2002). Of the anthropometric indices, Body Mass Index is considered to be more nutritionally than genetically related factor. Body Mass Index of the selected 600 girls of 10-15 years were calculated using the formula of weight in kilogram divided by the square of height in meter.

2. Clinical Examination

Clinical examination of an individual indicates deviation from health due to malnutrition. Clinical symptoms were the ultimate visible effects on the body due to chronic nutrient deficiencies which can be assessed by physical examination. Adequate nutrient intake and deficiencies was manifested on any stage of life and all the body systems were highly dependent on it. Therefore a thorough systematic approach to physical assessment was essential (Feeney et al., 2010). A large number of clinical signs indicate nutritional deficiencies. The general expression of micronutrient deficiency was a wasted, thin individual with dry scaly skin and poor wound healing, thin hair and spooned and depigmented nails (Ahmed and Haboubi, 2010). It was an important practical method for assessing the nutritional status of a community. Each individual was examined carefully for the presence or absence of clinical signs.

All the selected girls (10-15 years) were clinically examined with the help of a General physician for exclusive clinical signs for identifying the signs of nutritional deficiency (Plate 1). Signs and symptoms in their physical appearance, skin, hair and eyes indicative of various deficiency disorders were noted using clinical assessment schedule. Clinical examinations of the selected subjects of tribal (N=300) and nontribal (N=300) girls were carried out by the rapid clinical examination method as recommended by Jelliffe (1966).

3. Dietary Intake

Nutrition was a basic human need and a prerequisite to a healthy life. Adequate nutrition is one of the pillars of personal and public health. Before developing and implementing

effective intervention, it is important to know the nutritional situation of the target group to improve their nutrition level (Elmadfa, and Meyer, 2010). Precise information on food consumption pattern of people, through application of appropriate methodology is needed not only for assessing the nutritional status of people, but also for elucidating the relationship of nutrient intakes with deficiency as well as degenerative diseases (Kader and Perera, 2014).). In order to assess the dietary pattern of the selected 600 tribal and nontribal girls, their meal pattern and meal skipping practices, individual and environmental factors influencing diet patterns and snacking pattern were recorded. Twenty-four-hour recall and food frequency questionnaire were administered among the selected girls (N=600) to study the frequency of consumption of nutritious foods and actual nutrient consumption.

a. 24 hour recall method

24 hour recall method of data collection requires individuals to remember the specific foods and amount of foods they consumed in the past 24 hours. Quantifying nutritional intake is best performed by dietitian. Out of the several methods used for nutritional assessment, twenty four hour recall method is the most commonly used method and is based on an interview during which the person recalls all the food items consumed in the previous 24 hours (Rao et al., 2009). The selected girls were asked to recall a day's food intake in terms of simple household measures using the standardized cups and spoons according to the procedure described by Gopalan et al (1990) for collecting information regarding the food and nutrient intake.

The selected girls were asked to recall all the food items consumed by them on previous day along with quantity of each food item consumed. The intake of foods consumed by an individual per day was recorded and the raw equivalents of each food item was computed. The daily food and nutrient intakes were computed using Tables of Food Composition (ICMR 2016) and Nutritive Value of the Indian Foods. The food and nutrient intakes were compared with Recommended Dietary Allowances for nutrients (RDA) of the corresponding age groups suggested by ICMR (2016). Based on this, the mean food intake and the mean nutrient intake of the selected girls were calculated using Food Consumption Tables (ICMR, 2017).

b. Dietary habits

The dietary habits, food skipping pattern, water consumption, food consumption pattern, and the participation of Mid-Day Meal Programme (MDMP) were recorded. Torheim et al.

(2003) stated that in food frequency questionnaire, the respondent is presented with a list of foods and is required to say how often each item is consumed, in broad terms as 'x' times per day per week per month. Foods listed are usually chosen for the specific purpose of a study and may not assess total diet. The food frequency questionnaire may be interviewer-administered or self-completed (Storey and Kate, 2015).

“Diet history method is used for obtaining qualitative details of diet to study patterns of food consumption at household or industrial level. The procedure includes assessment of the frequency of consumption of different foods daily, or number of times in a week or fortnight or occasionally. This method has been used to study (i) meal pattern (ii) dietary habits (iii) people's preferences and avoidance during physio-pathological conditions like pregnancy, lactation, sickness etc.” (Thimmayamma and Parvathirao, 2003). For this study, the food frequency questionnaire was administered to the selected girls (600) which included common nutritious foods, role and sources of nutrients in health and diseases.

4. Menstrual status

“Adolescence is a period of rapid growth and they went through important physiological changes including secondary characteristics of their sexuality such as, development of breast, growth of pubic hair, primary characteristics like maturation of reproductive organs and onset the menstruation among girl children” (Stang and Story, 2005). In order to assess the menstrual health among the selected subjects, the data related to age of puberty, special food included or avoided during menstruation and its reasons, source of reproductive and menstrual information, menstrual discomforts, absorbent used, method of cleaning and drying the reusable menstrual absorbent, and school skipping pattern during menstruation were collected and discussed systematically.

5. Psychological status

Preadolescence was also considered as a psychological transition period. There were several psychological changes occurring during this stage. The effect of these changes will continue into their later stages. Mental status have a positive influence on the food selection and consumption. The psychological discomforts among the selected girls (N=600) were gathered and systematically recorded.

Phase III: Evaluation of nutritional and reproductive health knowledge among the selected subjects

The magnitude of the nutritional and reproductive knowledge during adolescent age influence their reproductive and nutritional health of their selves and it affect the health of the next generation. Nutrition and menstrual hygiene were the both sides of the same coin in the life of a young girl. Reproductive and nutritional health take part an important benchmark in the development of young girls. Simple life style modification with proper diet and physical activity will pave way for better promotion in health of the women and thereby future generation health.

1. Evaluation of nutritional awareness among the selected girls

A specially constructed and pretested questionnaire was formulated to evaluate the nutritional awareness among the tribal and nontribal girls. The questionnaire consisted of four variable aspects, Knowledge on nutrients and health, knowledge on deficiency diseases, knowledge on healthy life style pattern and knowledge on nutrients. Each aspects contained six to seven questions and a

Variable contents on nutritional awareness	Total Score
Knowledge on nutrients and health	6
Knowledge on deficiency diseases	6
Knowledge on healthy lifestyle pattern	7
Knowledge on nutrients	6
Total	25

total of 25 questions were tested to assess the nutritional awareness and the responses were tabulated and verified statistically (Annexure 7).

2. Evaluation of reproductive health awareness among the selected girls

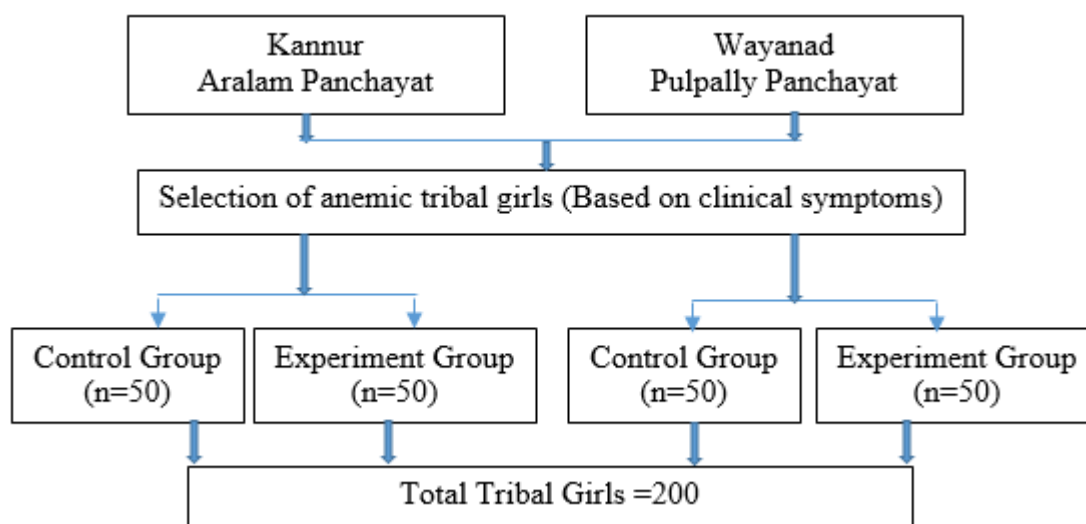
Particularly fashioned and pretested questionnaire was constructed to assess the reproductive health awareness among the selected subjects. The questionnaire consisted of 25 questions under four various aspects which were Knowledge on menstruation, knowledge on menstrual absorbent knowledge on hygiene

Variable Contents on reproductive health awareness	Total Score
Knowledge on menstruation	6
Knowledge on menstrual absorbent	8
Knowledge on hygiene practices	6
Knowledge on sexually transmitted diseases	5
Total	25

practices, and knowledge on sexually transmitted diseases. Each section entailed six, eight, six and five questions respectively.

Phase IV: Selection of tribal girls for intervention

Screening process among the tribal girls (10-15 years) was carried out with the help of health professionals. Subjects, those who had a substantial clinical symptoms of nutritional anemia were considered for the further intervention. It was noticed that 60 percent of the tribal girls (10-12 years) were not willing to continue intervention study whereas 13-15yrs girls were found to be agreeable for further study. Thus girls aged between 13 to 15 years were enrolled in to the intervention assessment (100 subjects from Aralam Panchayat and 100 subjects from Pulpally Panchayat). The selected 100 subjects were divided into two groups of 50 subjects from each panchayat and thus a total of four groups for the further intervention study for the period of six months. One control group and one experimental group were created in this way. The experimental group was directed with nutrition, menstruation and reproductive health education, dietary reform, life style modification, nutrition garden implementation and psychological guidelines. Whereas for the control group, general instruction was given in the early stage of the study. Experimental and control groups of tribal girls observed continuously for six month. Examined and compared the outcomes with initial data and continued the intervention for six more months among the selected subjects.



Weksler and Babette (2017) suggested that the clinical symptoms of anemia is clearly visible when the patient is suffered from moderate to severe anemia. Cent percent of the control and experimental group of subjects agonized from paleness (Nail, conjunctiva, lip and tongue), fatigue and malaise.

Phase V: Raising nutrition garden at home level and collection of data related to wild edible flora and analysis of nutrient and phytochemical content

1. Preparation of land for developing nutrition garden

As a first step in developing n Garden, the investigator approached Tribal Development Officers to get permissions to raise nutrition garden in the selected tribal communities. Area selected for nutrition garden was free from shades and with sufficient sunlight to stimulate the growth of the plants. The tribal settlement was in a dense forest and there was a possibility to attack from wild animals. So the area had a good electric fencing in the residential and agricultural areas. The area was blessed with good fertilized soil and was made to good tilth, free from pebbles and weeds and then soil is leveled properly. Cow dung and fresh leaves were added with soil at the time of preparation of land. In each of the selected house, plot was measured 1.5 -2 m long in which four to six plants were planted with a spacing of 60 cm, with the support of investigator.

Majority of the selected families wanted to plant vegetables in sacks and bamboo baskets by filling soil in it. People planted green chillies, tomatoes, brinjal, and spinach in these basket/sacks. But Drumstick, papaya and curry leaves were directly planted in the soil whereas cucumbers, yard long beans, pumpkins, small gourds and bitter gourd were planted near fences around the house and allowed to grow on the fence. Every house was separated using tree branches and bamboo trunk fences. The creepers spread over the fence and grew well.

2. Selection and distribution of seeds and seedlings

Seeds and seedlings of trees, shrubs and creepers were sowed and planted. Planting was carried out under the guidance of horticultural Experts of Tamilnadu Agricultural University, Coimbatore. The selected plants are listed in Table.7.

Table 7: Plants selected for the nutrition garden

Type of the plants	Common/local name	Botanical name	Distribution of seeds/seedlings/cuttings
Trees			
Papaya	Kappakka	<i>Carica papaya</i>	Seeds
Drumstick	Muringa	<i>Moringa oleifera</i>	Cuttings and seedling
Curry leaves	Curryveppu	<i>Murraya koenigii</i>	Seedlings
Shrubs			
Chekurmanis	Veelicheera	<i>Sauropus androgynus</i>	Cuttings
Brinjal	Vazhuthana	<i>Solanum melongena</i>	Seeds
Ladies finger	Venda	<i>Abelmoschus esculentus</i>	Seeds
Tomato	Thakkali	<i>Solanum lycopersicum</i>	Seeds
Red amaranth	Chemcheera	<i>Amaranthus cruentus</i>	Seeds
Green amaranth	Pachacheera	<i>Amaranthus viridis</i>	Seeds
Pea (Bush Type)	KuttiPAYar	<i>Vigna unguiculata</i>	Seeds
Creepers			
Bitter gourd	Paval	<i>Momordica charantia</i>	Seeds
Snake gourd	Padavalam	<i>Trichosanthes cucumerina</i>	Seeds
Small gourd/Ivy	Kovaikka	<i>Coccinia grandis</i>	Seeds
Cucumber	Vellari	<i>Cucumis sativus</i>	Seeds
Pumpkin	Mathan	<i>Cucurbita</i>	Seeds
Pea (creepy variety)	Vallipayar	<i>V. unguiculata</i>	Seeds
Ash gourd	Kumbalanga	<i>Benincasa hispida</i>	Seeds

In the Table 7, seeds, seedlings and cuttings were distributed at free of cost to the families of the selected tribal subjects in the study areas (Plate 2).

3. Maintenance and monitoring of nutrition garden activities

Before sowing vegetables seeds, fertilized soil collected from dense forest, and then removed the large stones and wood roots from it. The method of sowing varied according to the nature of the crops. Seeds of crops of ladies finger, peas, bitter guard, pumpkin, and papaya were soaked overnight and then drained the water out and keep the seeds in a damp cloth to germinate. Then it planted in to the pit with the prepared soil. Seeds of red and green amaranth, brinjal, cucumber, ash guard, snake guard, and tomato were soaked in the water

Selection and distribution of seeds and seedlings



Vegetable crops grown in the nutrition garden



Plate 2



Plate 3

over night and drained the water and mix it with sand and spread in to the prepared land. After three weeks, the small seedlings replanted in to the soil beds or bamboo baskets or sacks. Matured branches of drum stick, small gourd/ ivy, and cherkumani were planted separately beside the land.

a. Maintenance of nutrition garden

After the establishment of seeding during the third week after planting earthing up of ridges was carried out with the application of top dressing of manure (dungs, ashes, coconut husk, and dried leaves from the forest). The plot was kept free from weeds by occasional weeding, the garden was maintained by the selected girls of the study and the farm fresh produce were utilized by the families of the selected tribal girls. Plate 3 showed the vegetable crops grown in the nutrition garden.

b. Monitoring of nutrition garden

Nutrition garden activities were carried out in the selected tribal areas. To maintain and monitor the nutrition garden, proper education was inculcated to have optimum production and effective utilization of farm fresh vegetables, greens and so on and also highlighted the valuable contribution of micro nutrients and phytochemical content. Systematically nutrition education related to nutrition garden activities was given and frequently group discussions was carried out for proper practical knowledge.

4. Estimation of nutrient content of the selected wild edible flora

Tribal communities are forest dwellers and they gather many forest resources including edible floras which is not recognized among nontribal the nontribal population. Most of these plants' nutritional properties were not yet established. To identify the edibility of the selected plant, the quantitative and qualitative assessment for the nutrients were piloted. According to the preference of the selected girls and its wide distribution eight wild edible plants were selected for the assessment (Plate 4). This aspects was carried out, as the request of tribal welfare officers of Aralam and Pulpally.

a. Quantitative estimation of nutrient contents using Field Emission Scanning Electron Microscopy (FESEM) Analysis

Field Emission Scanning Electron Microscope (FESEM) is a devise used to assess the internal and surface morphology of a sample with high resolution (1000A) in this microscope

Selected wild edible plants



Plate 4

works with electrons instead of light. This technique can reveal the spatial interrelationships and three-dimensional structure of plant cell organelles, pictured cytoskeletal elements, probably microtubules, in leaf mesophyll cells and thus provided an overall idea about the tested sample. With a minimal sample charging and damage, a Scanning Electron Microscope provides slenderer penetrating rays at low and high electron power with its Field Emission Cathode in the electron gun. Electrons engendered under vacuum by a field emission source are enhanced in a field gradient. The ray passing from electromagnetic lenses centering onto the sample. Because of this barrage many kinds of electrons are emitted from the sample. There is a detector placed beside this catches the secondary electron and provide an image of the sample surface by relating the strength of those secondary electron and displayed on the monitor. EDX (Energy Dispersive X-Ray Analysis) is a kind of X-ray method normally accustomed to recognize the definite Material's elemental composition. It is also Known as EDS or EDAX. This is generally attached to SEM. The records generated from EDAX showing different peaks corresponding to the elements composition of the selected sample. The qualitative as well as the quantitative analysis along with its spatial distribution was measured.

Procedure

There were some procedure prior to analyzing wild edible plants in FESEM, Which were,

- Collect the plant from the field and wash it scrupulously with distilled water.
- Coarse ground the sample using a finer abrasive.
- Wet it to prevent heating and to get the better surface finish.
- Polished it to produce flat and stretch free surface and dry well.
- Sputtered with gold and fixed on a metal stub by using double-sided carbon tape.
- Observe through Field Emission Scanning Electron Microscope (FESEM)

b. Procedure for phytochemical Analysis

The plants collected from the forest of the selected areas and gently washed it in double distilled water and set aside some time to drain the remained water from it. Then spread out the leaf of each plant separately in a clean cloth under shade. Spread the leaves in every second hours to keep the plants dry evenly. Left these leaves under shade for eight continuous days and reserved it a plastic cover and sealed it safely for experiment.

Extract preparation

Powdered plant leaves were soaked with (1gm in 10ml) aqueous and ethanol for overnight in orbital shaker at 400C, and at 70-80rpm. After incubation the samples were filtered through Whatmann Filter Paper No.1 and used for further study. Qualitative assessment of phytochemicals was carried using the standard procedures and discussed in the following paragraphs.

1. **Test for Alkaloids:** 1 ml of plant extract was mixed with 1 ml of Mayer's Reagent and few drop of Iodine Solution. Formation of yellow coloured precipitate is indicated the presence of Alkaloids.
2. **Test for Terpenoids:** To 1 ml of extract added 1 ml of concentrated H₂SO₄ and heated for 2 minutes. Presence of Gray colouration indicates the presence of terpenoids.
3. **Test for Phenol:** To 1 ml of crude extract added 1 ml of FeCl₃ and mixed thoroughly, a blue green or black colouration developed and indicated the presence of phenol.
4. **Test for Reducing Sugar:** To 1 ml of extract 1 ml of Fehling's solution A and 1 ml of Fehling's solution B were added. Formation of red colour indicated the presence of reducing sugar.
5. **Test for Saponin:** To 1 ml of extract added 2-3 ml of distilled water, mixed well and observed the formation of 1 cm layer of foam, which indicated the presence of Saponin.
6. **Test for Flavonoids:** 1 ml of extract was mixed with magnesium ribbon and few drops of concentrated HCl was added the drop wise. Appearance of pink scarlet colour confirmed the presence of flavonoids.
7. **Test for Quinines:** To one ml of extract, 1 ml of 1% NaOH was added and mixed well. Appearance of blue green or red indicated the presence of Quinines.
8. **Test for Protein:** 1 ml of extract was mixed with a few drop of Mercuric Chloride solution and formation of yellow colour indicated the presence of protein.
9. **Test for Steroids:** To 1 ml of extract, 1 ml of chloroform and concentrated H₂SO₄ was added drop by drop. A red color solution was formed at the lower part of chloroform layer and indicated the presence of steroids.

Phase VI: Formulation and evaluation of nutrition education modules and conveyance of nutrition education**1. Preparation of lesson plan and collection of reference materials and resources for the formulation of nutrition education modules**

According to Gil et al. (2013), nutrition education is a set of planned educational activities targeted at certain groups of population and aimed at acquiring healthy nutrition behaviors. This could be possible through diverse channels, in general, this occurs within schools targeting young children. Since food habits in early stages of life are said to determine practices and inclination in adulthood. The success of nutrition education (n. Education) module preparation mainly depends on the time, quantity and quality of the content and effort of the experts. Greater the effort spent on the module preparation, the greater the success will be.

In the first step of Phase VI, a detailed lesson plan was framed for preparation of the module. This was done with the consultation of nutrition experts and school teachers. A lesson for effective nutrition education was planned and prepared with proper care by including all the healthy dietary guidelines for the health and wellbeing of the selected tribal girls. The selected tribal girls were very primitive group. So the tools developed for the intervention of nutrition and personal hygiene education was simple easy to understand and described the role of foods and nutrients, importance of disease free healthy life, importance of nutrition in various age and stage of life cycle and highlighting the balanced diet, nutrient rich sources, common deficiency diseases, its causes, consequences and prevention, need of personal and menstrual hygiene and its association with reproductive health and health tips for young girls.

Collection of resources, reference materials, pictures, books, journals and pamphlets were used to develop nutrition education modules. The developed modules were posters, charts, pamphlets, ppt, and booklets. The education modules consisted of various aspects of health and wellness of the young children and young girls. The level nutritional knowledge was assessed before and after nutritional education using specially designed questionnaires. Before using the nutritional modules, three subject experts of tribal nutrition and three tribal school teachers were requested to evaluate the modules and corrections were systematically

incorporated for effective implementation of nutrition education modules for the period of one year.

2. Evaluation of nutrition education modules

Evaluation is the systematic determination of the relevance efficiency, effectiveness and impact of the programme. Each educational modules evaluated periodically to measure the number of educational objectives obtained or fulfilled and to implement effectively. The utility and acceptability of the newly developed modules were tested using the following steps.

- a) Educating the selected subjects and
- b) Evaluating the effect of nutrition education modules.

Their initial knowledge was evaluated by administration of a specially designed questionnaire. The questionnaire developed for this purpose is given in Annexure 2.

3. Conducting nutrition and personal hygiene education

American Dietetic Association (ADA, 2011) defines nutrition education as instruction or training intended to acquire nutrition-related knowledge and/or nutrition-related skills and be provided in individual. A specially designed performa was administrated to evaluate the effect of nutrition and hygiene education on knowledge, attitude and practices of the selected tribal girls before and after the nutrition and reproductive health education for the period of one year and scores were carefully recorded and consolidated (Plate 5). Effectiveness of nutrition education is the degree with which it helps individuals to build food habits and practices that are consistent with the nutritional needs of the body and adapted to the cultural pattern and food resources of the region in which they live (Schubert, 2008). Teaching modules designed for nutrition education were distributed to tribal educational institutions and tribal health care centers for awareness promotion programmes. It was implemented in three stages.

3.1. Nutrition and reproductive health education to the selected tribal girls

The problem which the selected tribal girls face with in order to attain nutritional health could exposed through the direct interact with subjects. The investigator created an awareness among the selected subjects in the selected tribal areas. Majority of the tribal girls were suffering from one or another of deficiency diseases in developing countries (Richard, 2013). It was very distressing to note that the tribal children studying in the class of VI, VII, VIII,

Nutrition and personal hygiene education



Plate 5

IX, and X did not have knowledge about nutritional importance and health benefits of balanced diet, etiology, signs and symptoms, complications and preventive measures of common nutritional problems. This might be due to the limited sources of health information and not giving importance to their diet, nutrition and health. Rural and tribal girls are less exposed to different health improvement programme existing in the community for the welfare of the vulnerable group of population especially young children and adolescence. Well-designed educational behavior change communication focused on key messages can go a long way in improving the nutritional status of the community (Ruel, 2011). Nutrition Education was imparted for period of one year.

3.2. Nutrition and reproductive health education to the selected tribal girls and their family members

There was an urgent need for improving overall nutritional status of adolescents through nutrition education, community awareness and supplementation programmes (Kapur and Suri, 2020). The adolescent population depended on home food for their survival. It is not effective whatsoever the selected subjects learned about the nutrition, and their parents are responsible for the cooking practices. So this study was also aimed to educate the family members of the selected subjects about the nutritional needs for the various age groups especially young children and adolescent groups. Evaluated the cooking practices and promoted the healthy dietary practices and introduced new methods were also considered as the part of the nutrition education. Adequate awareness was created about malnutrition and preventive measures were imparted through nutrition education and promotion of nutrition garden to conquer sustainable optimum health.

3.3. Nutrition and personal hygiene education to the promoters of the tribal settlement.

This study was concentrated on a little strata of primitive community. The tribal promoters who were in charge of different sub divisions of tribal welfare activities effectively conveyed these valuable information to the other tribal girls, those who were not involved in this study. In this manner, the present study attained a wide coverage of sustainable utility and continuity for effective promotion of health.

Phase VII: Effect of nutrition interventions on nutritional status of the selected tribal girls

Various nutritional and reproductive health intervention programs piloted among the selected tribal subjects experimental group of the selected study areas. Effect of intervention

programs assessed once in six months and observed noticeable changes among the selected subjects. Intervention programs extended to one year and assessment was carried out for the nutritional and reproductive health status and recorded the life style modification of the selected subjects in the experimental groups. Assessment of nutritional status is a comprehensive evaluation of an individual health status using the socio-economic and dietary profile, environmental factors, anthropometric measurement and, clinical examination (Hercberg et.al., 2010). For the present study, nutritional anthropometry, clinical examination, and individual dietary intake by 24 hours recall method were used to assess the nutritional status of the selected tribal girls, before and after the study period of one year. Effect of interventions were assessed by comparing the initial and final scores secured for each aspects of the nutritional status by the application of statistical analysis.

Anthropometric measurements: Anthropometrical measurements (height, weight and BMI) of the selected tribal girls in the experimental and control group were recorded and documented the deviation for analysis.

Clinical profile: Visible remarks of the nutritional deficiency was recorded in each stages of study by the help of health professionals and documented the variation before and after the intervention programs.

Dietary intake: Nutritional consumption (Macro and Micro nutrients) among the control and experimental subjects were recorded before and after the study and analyzed for obtained the influence of intervention programs.

1. Effect of nutrition and reproductive health education modules on life style pattern of the selected tribal girls

Nutritional education modules were developed to impart nutrition knowledge to the selected tribal girls and evaluated the effect of nutrition education on nutritional knowledge and life cycle pattern of the selected tribal girls. Nutrition awareness was created among the selected subjects using specially designed charts, poster, pamphlets, ppt, and booklets. The content of the nutrition education modules were in terms of basic five food groups, functions, sources and requirements of macro and micro nutrients, signs and symptoms and consequence of deficiency of macro and micro nutrients, personal hygiene including menstrual hygiene and sanitation, importance of promoting nutrition garden and nutritional significance and healthy benefits of the garden fresh produces, and their life style

modification for the period of one year. A healthy life style pattern is consisted of nutritious diet, regular exercise, good work culture, sound sleep, avoiding alcohol consumption and pan and betel leaves and chewing and free from stress and strain. The details of the life style pattern of tribal communities were collected from the selected subjects, family members and elders in these communities as well as from the tribal promoters. Proper education for healthy life style pattern was highlighted to lead a healthy life.

2. Effect of nutrition garden and inclusion of the selected wild edible flora on dietary pattern of the selected tribal girls.

Vegetable crops cultivated in the nutrition garden were harvested after attaining the maturity of the plant and its yield. Majority of the vegetables were harvested once or twice, some vegetables like amaranths, peas, ladies finger, and tomatoes were harvested more than seven times during the study period of one year. Produce of trees were harvested only when it attained maturity. Nutrition garden served as a continuous source to produce farm fresh foods and its consumption both in the home and at school were developed and advised the families of the selected subjects to continue to follow the same nutrition garden in their area for garden fresh products. These foods were included in their daily dietaries and reduced the quantum of foods procurement from the outside market. Through this way, nutritionally and economically viable garden fresh produces were attained and benefited to promote the nutritional status of an individual, and thereby their family.

Phase VIII: Assessment of Nutritional Knowledge, Attitude and Practices (KAP) on dietary and life style pattern, personal and menstrual hygiene and health status of the selected tribal girls.

A Knowledge, Attitude, and Practice (KAP) study is a quantitative method (pre-prepared questions in a standardized questionnaire) that provides an access for qualitative and quantitative information. KAP study revealed that misrepresentations or misconceptions intended to perform and barriers to behavior change. Note that KAP survey is basically an "opinion" and is based on "declarative" (statements). Propose an intervention strategy that reflects the specific local conditions and the cultural factors that influence them; Plan activities that were relevant to the respective population (Du Monde, 2011). With these backdrops, KAP study was assessed in the present study using the specially designed interview schedules.

1. Created the performa for evaluation

A performa was created to evaluate the KAP among the selected tribal subjects. It contained a set of questions regarding basics of nutrition, reproductive health and menstrual hygiene and were used to assess the knowledge, attitude and practice of the selected tribal subjects, prior to the nutrition education programme. The tool for data collection was formulated and standardized by the investigator. Screening and reliability were tested by subject experts. The results of the study showed that there was lacunae in knowledge, attitude and practice of the selected tribal subjects in both study areas. Therefore, more emphasis was given to the selected subjects who scored very low. Many open discussion sessions and dialogues were also carried out after the education programme among the selected subjects. Some open sessions were conducted with the help of the Gynecologist and Psychologist to encourage physically and psychologically for their optimum health status.

KAP on Nutritional care and support, Personal and Menstrual Hygiene was assessed among the selected 200 subjects (50 subjects as control and 50 subjects as experimental from both tribal areas) of the study groups..

2. KAP on nutritional knowledge

Three sets of questions which had fifteen questions in each set was prepared to assess the knowledge, attitude and practices among the selected subjects. Data was collected on dietary habits, meal consumption, nutrition garden, health benefits of consuming fresh vegetables and fruits, collection of wild foods and its usage, preservation of gathered foods, and inclusion of green leafy vegetables available at their door step, daily in their diet, their nutrient sources and method of cooking, storage conditions, intake of water, variation in preparation of foods, skipping of meals, consumption of all the food groups food beliefs and taboos in their community. Questions on awareness of nutrition, deficiency symptoms, risks, and availability of nutrient rich foods were also included and implemented for evaluation.

3. KAP on personal and menstrual hygiene

In this aspects, three sets of questions were prepared. Each facets contained 15 questions to conduct the assessment on Knowledge, attitude and practice among the selected subjects. Importance of personal and menstrual hygiene, details regarding menstrual practices, sanitation, washing hands before eating, disposal of waste water, walking in bare foot, cutting of nails regularly and so on were considered for further action of the present study. Questions on usage of sanitary napkins, usage of other absorbent used during menstrual cycle, frequency of using sanitary napkins, importance of bathing, daily changing of inner garments, methods

used for drying garments and menstrual absorbent, traditional practices associated with puberty, food consumption pattern during menstruation, skipping meals as well as skipping academic and personal activities during menstrual periods were gathered. Based on their responses, feedback were collected from the selected subjects. Initial knowledge, attitude and practices of the selected subjects were recorded properly. After the nutrition and personal hygiene education for the period of six months, same questionnaire was implemented to check their KAP. Based on their improvement in KAP, education program was extended for another six more months and conducted the assessments after one year and observed changes in their knowledge attitude and practice on nutrition and personal hygiene practices among the selected tribal girls.

Phase IX: Statistical analysis and interpretation of data

The software used to analyze the data in this study is Minitab 17. Which is a tool used for statistical evaluation. It is an interactive tool that is mainly used to analyze research data. Minitab has a wide range of applications for data validation using Six Sigma techniques. It provides advanced statistical tools and simple graphs and it offers a short and effective solution, which requires high validation. Minitab is a flexible software with practical applications for a wide range of data. It provides a simple and effective way to input statistical data, identify trends and patterns, and explain answers to current problems.

Descriptive statistics (mean and standard deviation) was used to represent the basic distribution of various parameters. Karl Pearson's Correlation was used to determine the degree of linear relationship between two or three variables. One way ANOVA was done to find out the significance on the impact of interventions on various clinical and anthropometric parameters. Boxplot analysis was done to find out the statistical significance between the types of nutritional deficiencies and distribution of subjects in different categories. Correlation analysis and boxplot analysis was executed between the dietary intake of iron and biochemical parameters and to analyze the KAP scores. The statically analyzed the data were systematically discussed and interpreted in the Chapter IV- Results and Discussion.