CHAPTER - III

METHODOLOGY

The methodology convoluted for current research designated '**Effect of Nutrition Interventions on Vitamin A and Iron Nutriture of School Children (6 – 8 years) from Fishermen Community**' was focused at investigating the nutritional status of the fisherfolk children both boys and girls aged between 6- 8 years which included the assessment of intervention, planning and execution of an effective intervention module to enhance the nutritional status of the selected children related to the selected aspects of vitamin A and iron status. Research methodology deals with the steps taken to conduct the study, or the methods and procedures followed to investigate the research problem. It gives a detailed outlook about the choice of research approach, description of settings, sample, sample size, sampling modus, the built-up and usage of tools, methods of data assemblage, and modus operandi of data analysis. The present research has been conducted for appraising outcome of nutrition supplementation on the vitamin A and iron profile of the boys and girls aged 6-8 years, belonging to the artisanal fishermen community of rural Kakinada, Andhra Pradesh, India. The different methodological procedures adopted for the study have been distinctly presented under the following five phases each evolving from the previous one so that findings were validated, refined, modified and accumulated at every stage. The five phases of the study are:

The Five Phases of the Study

Phase I: Selection and Screening of Fisherfolk children for Vitamin A deficiencies and Iron deficiency Anaemia

A. Selection of the research area and subjects

B. Formulation of tools and conduct of the socio-economic survey

C. Screening of children and identifying children with vitamin A deficiencies and iron deficiency anaemia

Phase II: Assessment of Nutritional Status of Children with Vitamin A Deficiencies and Iron Deficiency Anaemia

A. Anthropometrical assessment

B. Biochemical assessment

C. Clinical assessment

D. Dietary survey

Phase III: Selection, Preparation and Nutritional Analysis of Boiled Sweet Potato for Intervention

A. Selection of sweet potato variety rich in beta-carotene

B. Preparation and acceptability of orange-fleshed sweet potato

C. Nutrient analysis of the sweet potato

Phase IV: Supplementation and Assessing the Impact of the Boiled Sweet Potato and Nutrition Education to the Selected Group of Children

A. Grouping of Fishermen children and conduct of supplementation and nutrition education

1. Group 1: Supplemented with boiled sweet potato along with school meal
2. Group 2: Supplemented with boiled sweet potato, school meal and nutritional education
3. Group 3: Nutrition education with school meal
4. Group 4: Control group provided only with the school meal.

B. Impact of interventions among fishermen children.

1. Anthropometrical assessment
2. Biochemical assessment
3. Clinical assessment
4. Nutritional education

Phase V: Statistical Analysis

The Institutional Human Ethics Committee has delineated the ethical approval for this study with approval no. AUW/IHEC-17-18/FSN/FHP-05 (Appendix I).

Phase I: Selection and Screening of Fisherfolk children for Vitamin A deficiencies and Iron Deficiency Anaemia

A. Selection of the Research Area and Subjects

The research was piloted in the East Godavari territory, Andhra Pradesh state with a focus on the children of artisanal fishing communities. Kakinada coastal region was selected with the view that for any social research involving rural people as the unit of the study, two-way communication between the researcher and the sample population is a must to achieve good rapport and to ensure free and unbiased feedback and support from the sample population. Keeping this in view, the researcher's home town, Kakinada was selected for the study.

The East Godavari territory of Andhra Pradesh is precisely a large district in the State and is positioned geographically at 81°30´ and 82°37´ East and 16°30´and 18´ North. The frontier limits of East Godavari territory are the Bay of Bengal in the East and South, Towards West is the Khammam region and towards North is the Vishakhapatnam zone. The constituency spreads over 12805 sq. km with a populace of 51,51,549 as per the 2011 census which accounts for 6.08 per cent of the total inhabitants of the State. The language spoken throughout the area is Telugu. With a coastline of 161km. there are 13 coastal mandals with 99 coastal fishermen villages. The fishermen population is 3,85,392 (marine 3,03,000 and inland 82,392) and of this total population, 76,777 of them are into active fishing.

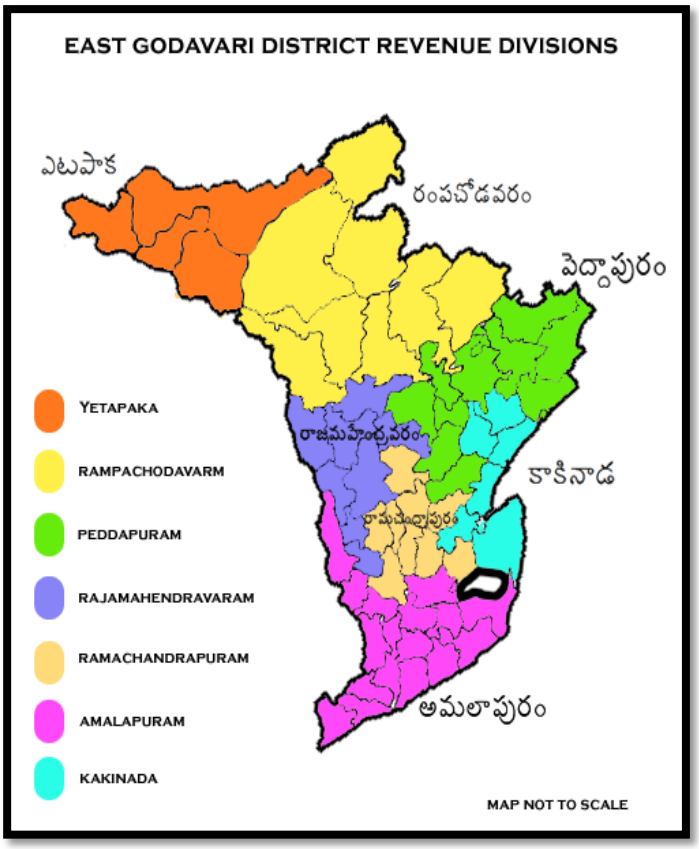


Figure 1: Map of East Godavari District

Kakinada mandala is amidst the other 60 mandals of East Godavari region of Andhra Pradesh. It's the headquarters of the East Godavari district. As per 2011 census of India, a populace of 443,028 has been recorded where 222,461 were male and 217,459 were female. One hundred and one slums were identified in Kakinada with a population of 132,185, i.e., 41 per cent citizenries. The economy of the city comes from agriculture, fishing and industrial sectors and agro products such as paddy and coconut. The industrial

sector mainly comprises the edible oil refineries, fertilizers and natural gas. Agriculture and fishing are the primary sources of economy. Kakinada has a natural harbour.

The traditional joint family arrangement present in an Indian community still persists among the fisherfolk of Andhra Pradesh. The size of the family varies from one another but mostly has an average of six members. The fishing activities are distributed among members of the entire family. Many fisherfolk women participate actively in fishing related activities such as sorting of fish, selling the catch, processing of fish and shrimp, etc. the children perform household chores, making and mending of nets and sometimes attend school. "Sangams" or associations of fisherfolk deal with socio-religious liaisons of their villages.

Community leadership is an inherited position among the fisherfolk communities. The majority of the population belong to the scheduled caste and a few belong to the scheduled tribe. Mostly dominated by the Agni Kula Kshatriya caste (traditional river fishers) and Vadabalijas (traditional marine fisher caste). The caste headman, generally an elder along with other senior members form an informal committee which helps to solve the fisherfolk's problems related to family disputes, caste and internal affairs of the village. This informal system commends the political administration called the "panchayat". Panchayat usually focuses on physical infrastructure of the village, its problems and relations with "Taluk Samithi" and Zilla Parishad.

The areas selected for the study are the coastal areas in particular, in the territory of East Godavari of Andhra Pradesh state with a focus on the children of artisanal fishing communities. Out of all the fishing villages in the district, eight fishermen villages namely, Chollangi, Nemam, Vakalapudi, Valasapaka, Uppada, Mulapeta, Ponnada and Konapaapapeta, were selected based on feasibility of conducting the study, availability of subjects and cooperation from the authorities. Intensive field studies for socio-economic status, basic amenities and facilities available, religion and community-wise distribution of fishermen population, residential status, educational status of the fisherfolk, employment status, income and expenditure and support from the government in selected eight fishermen villages was conducted.

Plate I: Fishermen Hamlets and their Living Environment

Plate II: Fisherfolk's Neighbourhood Condition

Plate III: Fisherfolk at Work

Children aged 6 -8 years belonging to the fishermen community who are under below poverty line in the eight selected fishing villages in and around rural Kakinada of East Godavari District were considered for selection of subjects. School children from the fishermen community (both boys and girls) aged between 6-8 years who were attending various schools in their neighborhood were selected purposively for the study.

Table III

Population Distribution in the Selected Eight Villages

Details	Name of the Villages						Total
	Chollangi	Nemam	Uppada	Mulapeta	Ponnada and Konapaapapeta	Vakalapudi and Valasapaka	
No. of households	870	1105	3190	2020	2165	6308	15658
Households of fishermen community	601	584	1458	1089	1612	3107	8451
Households of other communities	269	521	1732	931	553	3201	7207
No. of Fisherfolk children (6-8 years)	158	108	178	119	151	147	1000

A total of 15,658 households were identified in the eight coastal villages surveyed. Out of 15,658 households, 8,451 households were of the fisherfolk community. Chollangi had a total of 870 households of which 601 were of fisherfolk. Nemam has 584 fishermen households out of 1,105 houses. Uppada has 1458 fishermen households out of 3190. Mulapeta has 1089 fishermen houses out of 2020. Ponnada and Konapaapapeta have 1612 fisherfolk houses out of 2165. Vakalapudi and Valasapaka have 3107 fishermen households out of 6308. The children aged between 6-8 years identified from these 8451 fishermen households were 1000. 158 children from Chollangi, 147 from Vakalapudi and Valasapaka, 108 from Nemam, 178 from Uppada, 119 from Mulapeta and 151 from Ponnada and Konapaapapeta. These 1000 children aged 6-8 years were identified during the survey for the study. The data was collected through a field survey by using a questionnaire to elicit information regarding the socio-economic background, dietary intake, dietary pattern, anthropometric measurements and clinical assessment for all the 1000 children by purposive sampling method.

Purposive sampling, also called judgement sampling is a form of non-probability sampling. This type of sampling is an intended choice of the partaker due to the characteristics possessed by the entrant (Etikan and Ilker, 2016). Purposeful sampling is useful to identify and select specific candidates in regard to the area of research. Criterion

sampling is one of the commonly preferred method of purposive sampling which is applicable for implementation of the research. (Palinkas and Lawrence et al., 2015).

For selecting children for the study, the inclusion and exclusion of the subjects included:

Inclusion Criteria

School going children aged between 6-8 years, children with nutritional deficiencies, the willingness of the school management and parents to participate in the study, children from fishermen families categorized under below poverty line and children who are regular to school (at least having 75 per cent attendance) were included.

Exclusion Criteria

Children with previous serious health issues like HIV, Cancer, etc., children with physical deformities, children who are already taking supplements and children who are not enrolled on the school were excluded.

B. Formulation of Tools and Conduct of the Socio-Economic Survey

1. Formulation of an interview schedule

An interview schedule is a familiar method to gather information by conducting personal interviews in a structured manner. Therefore, they are also known as structured interviews. They require a predetermined questionnaire to acquire the useful information for research purpose from the participants (C.R.Kotari).

An interview schedule was formulated to elicit the information regarding the socio-economic background, dietary intake, dietary pattern, anthropometric measurements and clinical assessment for all the 1000 selected children (Appendix II).

2. Conduct of socio-economic survey

Health status of any nation is directly proportional to their socio-economic conditions. The social class is an evaluator of a person's or a community's bourgeoisie. It plays a huge role impact on their health, education, diet, lifestyle, etc., (Wani, 2019).

The investigator visited the fisherfolk areas which were located near to the sea coast, with high proximity to natural calamities and less access to basic amenities. The families were approached individually by the investigator in person to gather information

and to develop a rapport with them. The schools in which the chosen children were studying were visited by the investigator to observe and collect details regarding them.

With the aid of the interview schedule, the particulars regarding the selected fisherfolk children's socioeconomic status such as age, gender, family background, financial status, their habits, dietary practices, foods consumed and frequency of food consumption and anthropometries such as height, weight and BMI were recorded.

C. Screening of Children and Identifying Children with Vitamin A Deficiencies and Iron Deficiency Anaemia

Anthropometric measurements were taken for all the children according to the procedures illustrated by Bamji (2019). To study the food and nutrient consumption pattern, a three-day 24-hour recall method and food consumption frequency were carried out for all the children. Food and nutrient intakes were computed from the 3-day 24-hr dietary survey. Nutrient analysis was calculated following the guidelines from given by ICMR in Recommended Dietary Allowances for Indians (2020).

Clinical examination is commonly perceived as a method to detect malnutrition. All subjects were examined clinically by a medical practitioner to detect symptoms of vitamin A deficiency disorders and to also detect symptoms of iron deficiency anaemia such as pale conjunctiva, emaciation and Koilonychia and other symptoms like dermatitis, gingivitis, dental caries, etc., The clinical examination Performa used for this purpose is enclosed in Appendix III.

The different disorders of vitamin A in humans as summoned by WHO IN 1996 are,

- Night Blindness (XN)
- Conjunctival Xerosis (X1A)
- Bitot’s Spots (X1B)
- Corneal Xerosis (X2)
- Corneal Ulcer (X3A)
- Keratomalacia (X3B)
- Corneal Scarring (XS)
- Xerophthalmic Fundus (XF)

The different signs for clinically screening Iron deficient anemia are,

- Extreme Fatigue
- Weakness
- Pale Skin
- Chest Pain
- Shortness of Breath and Rapid Heart Beat
- Headache, Dizziness or Light-Headedness
- Cold Hands and Feet
- Inflammation and Soreness of Tongue
- Brittle Nails
- Unusual cravings for Non-Nutritive substances such as Ice, Dirt, Chalk or Starch
- Poor Appetite.

Out of 1000 children surveyed and screened, 234 subjects had been identified having clement to medium vitamin A and Iron deficiencies. The screening of the subjects was done with the help of the survey. The anthropometrical measurement such as height and weight were measured, the clinical assessment was done by a clinician who examined children for signs and symptoms of vitamin A and iron-deficient anaemia. A dietary assessment was also taken and analyzed to detect the deficiencies.

Ethical consideration with regards to the right of respondents was applied when surveyed and screened and who were chosen and were willing to par take in the research. The informants were given full details regarding the research and the information required from them. Information was provided and explained to the respondents before taking their consent. Covertness and incognito of the subjects were taken care of by the researcher and the former were assured of the same.

Phase II: Assessment of Nutritional Status of Children with Vitamin A Deficiencies and Iron Deficiency Anaemia

Nutritional assessment an explication of anthropometric, biochemical, clinical and dietary data to find out if a person or a group are healthy or malnourished (over-nourished or under-nourished).

The methods selected for nutritional assessment depends on the age of the individual, the need for assessment and the expertise available. Nutritional assessment of

the subjects was carried out using the ABCD method, A- Anthropometry, B- Biochemical, C-Clinical and D- Dietary (Human Nutrition, University of Hawaii, 2020). These refer to the following represented in Figure 2.

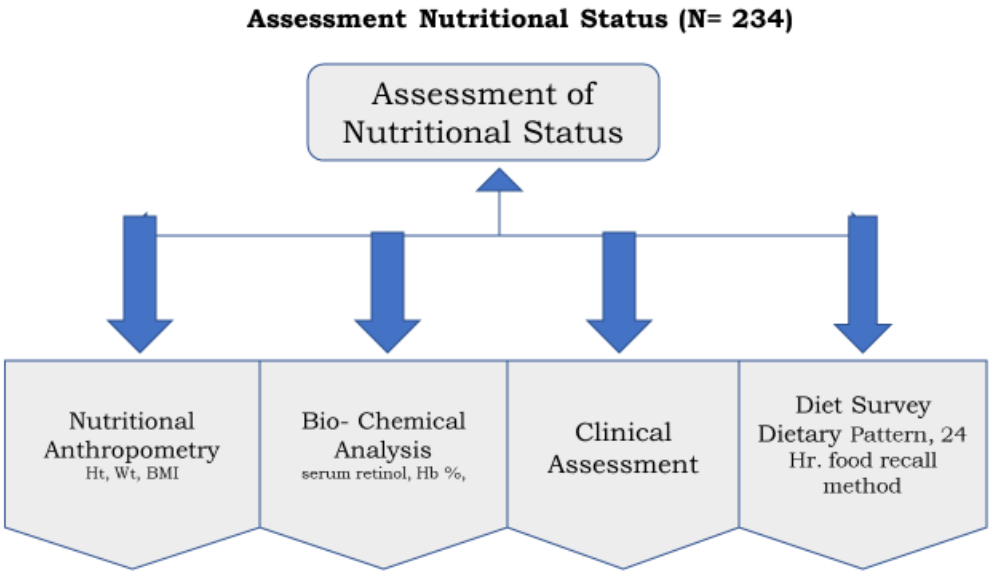


Figure 2: Assessment of Nutritional Status in Fisherfolk children

A. Anthropometric Measurements

Anthropometry is a reliable and useful mechanism to assess the nutritive stature of subjects. Anthropometry (measurements of body for assessing the nutritional status) is a pragmatic, low cost, effective and congenial technique to assess children's growth and development. It contemplates the aspects of health and nutritional stature and prognosticates conduct, health and survival of the children.

The selection of a single or combined anthropometric measurement depends upon the subjects and the specific data to be collected. The following anthropometric measurements were carried out for the 234 subjects who were screened having vitamin A and Iron deficiency anaemia. The anthropometric assessment was done by measuring the height, weight, BMI, height according to age and weight according to age. Measurement of height and weight are useful tools for assessing nutritional status and the changes in these measurements will reflect on the nutritional status (Appendix IV).

i) Height

Height for all 234 children was taken using a wall-mounted stature meter. The standard steel tape certified by the Department of Weights and Measures was used to assess the accuracy of the instrument. The children were made to stand erect facing straight on a flat levelled surface with heels together and toes apart, head straight, 0hands-free on either side, without bending knees, without footwear and with minimal clothing. The moving headpiece of the vertical measuring bar was lowered onto the top of the head with slight pressure just to reduce the thickness of the hair and the readings were taken to the nearest 0.1 cm (Plate IV). An average of three successive measurements was taken as a final measurement (Bamji, 2017).

Plate IV: Measuring Height of the Subjects using Wall Mounted Stature Meter

ii) Weight

Change in body weight reflects the short-term nutritional status. Each of the 234 children's weight was measured individually using a digital weighing balance. A digital weighing balance was placed on an even leveled floor and tested for its accuracy with known standard weights. The children were made to stand straight on the weighing scale with their weight evenly distributed on both feet and with minimal clothing and without footwear, their body weight was measured. The weight of the subjects was recorded to an accuracy of 0.1kg (Plate V). An average of three successive measurements was taken as a final measurement (Bamji, 2017).

Plate V: Measuring Weight of the Subjects using Digital Weighing Balance

iii) Body- Mass-Index

The body-mass-index (BMI) is used to assess the nutrition stature of any individual. It is used as an indicator to scale the degree of malnutrition in children and adults (Casadei and Kiel, 2020). It is generally considered a good index to assess the contemporary energy shortfall as it is calculated on the account of ongoing height and weight of the children. (Swaroop Kumar Sahu, Et, al, 2015). Thus, applying body mass index to assess the ongoing nutritional stature in an Indian context is applicable in all settings as it requires only the measurement of height and weight (Ramachandran P and Gopalan HS, 2011). Body Mass Index can be deliberated by dividing the weight (kg) by their height (m^2). In the current study, the BMI was computed by applying the statistical formulae given below (WHO, A training course on Child growth Assessment, Geneva, 2008).

$$BMI = \frac{\text{Weight (kg)}}{\text{Height } (m^2)}$$

iv) Height for age

Another parameter of anthropometry is the height-for-age. The collected anthropometric data has been elucidated by application of mean height and its standard deviation values. Then the per centage of the median value is calculated which is compared with child growth standards per centiles suggested by WHO 2007.

SD Classification height for age

> -2SD of the median: Normal

≤ -2 SD and ≥ -3SD of the median: Moderate Stunting

< -3 SD of the median: Severe Stunting

Weight for age

Another parameter of anthropometry is the weight for age. The collected anthropometric data has been elucidated with application of mean weight and its standard deviation values. Then the per centage of the median value has been calculated which is compared with the weight-for-age reference data provided by WHO, 2007 for children from 5-10 years. These Child Growth Standards are the indicators to categorize children into different grades.

SD Classification weight for age

> -2SD of the median: Normal

≤−2 SD and ≥−3 SD of the median: Moderate underweight

<−3 SD of the median: Severely underweight

B. Biochemical Assessment

The biochemical tests give us an accurate picture of an individual's nutritional stature and are utmost reliable from a technical point of view. Biochemical measurements generally figure out the status of the past nutrient intake and also depicts transition resulted due to persistent nutrient deficit intake and not the present intake. It may help to indicate the presence of poor nutrient intake before the onset of a biochemical gash or a later clinical abrasion that results from dysfunctionality of a tissue or organ. The biochemical assessment of different vitamins and minerals stored in the body is one of the reliable indicators for assessing the nutritional status. With the help of the biochemical lab technician, 2 ml of blood was drawn from the children and serum retinol and haemoglobin levels were assessed (Appendix V).

i) Blood haemoglobin

Haemoglobin estimation in the red blood cells is a direct indicator of anaemia and is the primary method for screening anaemia among children. Blood haemoglobin levels were estimated calorimetrically using the cyanmethemoglobin method (Bamji, 2017).

ii) Serum retinol

Measurement of serum retinol concentration in blood is a common subclinical test used to identify the population with a high risk of vitamin A deficiencies. Serum retinol of all the 234 children was estimated using the High-performance liquid chromatography method.

C. Clinical assessment

Clinical assessment is a method used to examine specific parts of the body to identify signs of deficiency thereby, to assess the nutritional stature of a patient. The patient is asked about their knowing of any symptoms that might suggest nutrient deficiency and also examined by a clinician. Some of the signs of malnutrition in children are growth failure or stunted growth, behavioral changes like irritability, sluggish or anxiety, etc. Other signs can include weak muscles, tiredness, low mood, scaly skin and dry thin hair, spooned and pigmented nails, poor wound healing and an increase in infections and illness (https://www.nhsinform.scot/illnesses-and-conditions/nutritional/malnutrition).

All the children selected were clinically examined by a doctor for signs and symptoms of vitamin A and iron deficiencies (Plate VI).

Plate VI: Examination for Clinical Symptoms

D. Dietary survey

Diet plays an eminent part in the onset of various nutritional and chronic deficiency diseases. Assessment of dietary intake is done by individualized review and un-biased observation. Dietary assessment at the regional level gives us the fundamental information about frequency of food consumption and distribution of food which showcases possible inadequate diet intake and nutritional stature. Individualized assessment can be carried out with the help of open-ended surveys, for example, dietary recalls and closed-ended surveys such as food frequency questionnaires. Each method has its pros and cons (Shim et al., 2014).

Subjective dietary assessment method helps to assess an individual's food intake. It includes the 24-hour dietary recall and Food Frequency Questionnaire. The details were collected by individualized dietary assessment that assessed a person's dietary intake such as the 24-hour dietary recall method and Food frequency method. A pre-designed questionary form was used to gather the data. The 24hr dietary recall is an open-ended survey that gathers all details regarding the food eaten over a specific time span.

24-hour dietary recall method

A 24-hour dietary recall (24HR) is an authentic tool in public health nutrition to assess dietary intake in nutrition surveys, transverse studies, clinical investigation and group studies. It evaluates the personalized dietary intake and overall nutritional assessment (Castell, et al., 2015). The 24-hour dietary survey was conducted in an in-depth interview manner with the child along with their parents and teacher. It is an easy method and usually requires about half an hour for a single day recall. It is structured to capture every detail about foods and beverages intake by the subject on the previous day or in the last 24 hours. This method can be used to evaluate the nutritional status of an individual with an elaborate face to face interview. In the current research, the different items consumed, the cooking methods and quantity of food eaten are noted for the 234 children. The amount of each food item consumed is measures using a standard measuring cups and spoons (Appendix VI). The average food consumption of each child was statistically evaluated. The mean was then juxtaposed with the recommended dietary requirements suggested by ICMR (2020).

The food frequency method

A food frequency questionnaire (FFQ) is a proforma of different foods and beverages with a regularity assessing section for the respondents. It helps to assess the frequency of intake of each food item over a specified period. This also required the presence and participation of the parent and teacher along with the subject to get accurate information. It is assessed by a pre-structured form with grids in which respondents are asked to mark the frequency of consumption of different foods and beverages (Correa-Burrows, 2017). The grids to fill have headings like ‘daily’ or ‘weekly’ or ‘once a month' to 'never' and the respondents have to mark one of these options. The type of foods generally consumed and its regularity over a time span was assessed using an interview schedule.

Phase III: Selection, Preparation and Nutritional Analysis of Boiled Sweet Potato for Intervention

Sweet potato (*Ipomoea batatas*) is a dicotyledon belonging to Convolvulaceae family. It is cultivated specifically for its high nutritive values and healthful qualities (Chhama Devi et al., 2017) and is exclusive in promoting food security. Sweet potato is graded at the utmost level among other important staple crops (Shekhar *et al.*, 2015). Orange fleshed sweet potato has caught an eye of researchers and scientists because of its elevated carotenoid content, attractive colour, sweet taste and soft texture (Neela, 2019).

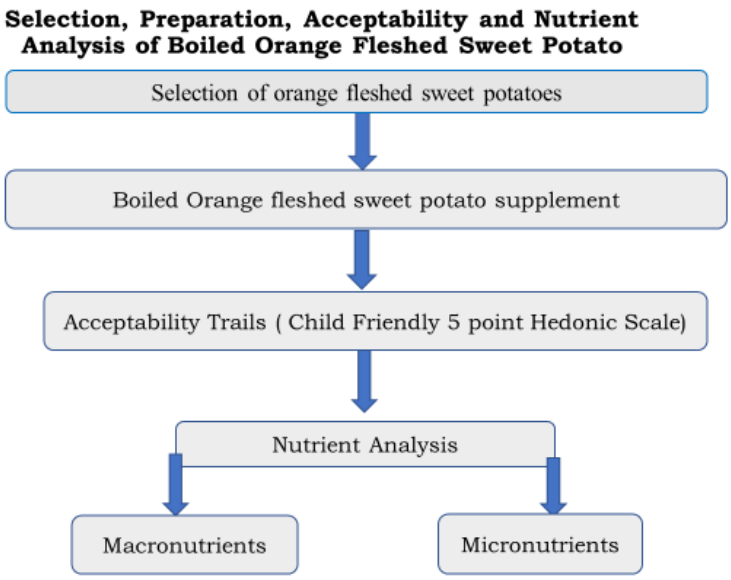


Figure 3: Steps in Selection, Preparation and Standardization of Boiled Sweet Potato for Intervention

Orange fleshed sweet potatoes have the potential to positively affect the vitamin A status (Jerkins et al., 2015). The orange flesh sweet potato is rich in antioxidants and has a reputation to enhance vitamin A stature (Laurie et al., 2015; Hotz et al., 2012; Li and Mu 2013; Burri, 2011). The newly found abundance of nutrients in OFSP are significant, thus suitable as a healthy food, especially for communities suffering from malnutrition (Kaspar et al., 2013).

A. Selection of Sweet Potato Variety Rich in Beta-Carotene

Sweet potatoes are of many varieties with skin colours from almost white to brown with shades of pink, copper, magenta and purple. Even the flesh colours vary from light yellow to pink, red and orange. Orange fleshed sweet potatoes contains very high concentrations of β - carotene, an excellent food rich in vitamin A making it a worthy staple food for consumption. (Neela et al. 2019)

They are a substantial source of carotene and great sources of micronutrients vitamins B1, B2, B6 and manganese. Sweet potato is a bundle of rich nutrients such as vitamin A and vitamin C. Fresh OFSP has a good amount of starch which ranges from 6.9 to 30 per cent. It also contributes energy and fibre. It has low fat content and high amounts of β-carotene (Aina et al., 2010).

One medium-sized orange fleshed sweet potato provides twice as much as β-carotene recommended daily for vitamin A requirement. The tuber is generally eaten after cooking (Vimala et al., 2011).

Orange fleshed sweet potatoes cultivation was first initiated at the Horticulture Research Station, Peddapuram, East Godavari district of Andhra Pradesh in 2013. This new variety has been introduced into the market and it contains high concentrations of beta-carotene also called pro-vitamin A (Ashok and George et al., 2017).

As it is a very rich source of beta-carotene and is available in the local market, a detailed study about the sweet potato was done at Central Tuber Crops Research Institute (ICAR), Thiruvananthapuram on different varieties of sweet potatoes which are especially rich in beta- carotene content (Plate VII). The list of different varieties of sweet potatoes at ICAR considered for the study and their beta-carotene and ascorbic acid content is presented in Table IV. Orange fleshed sweet potato variety known as 'Kamala Sundari' was selected for the supplementation due to its high beta-carotene levels and its availability in the study area.

Plate VII: Study on Different Sweet Potato Varieties at ICAR

Table IV

Nutritional Composition of Orange Fleshed Sweet Potato Genotypes

Genotypes	Ascorbic acid (mg/100g)	β-Carotene content (mg/100g)	Retinol Activity Equivalent (RAE)	Retention of β-carotene in cooked tubers (per cent)
S-61	14.37	4380	365.0	87.76
S-594	12.87	5840	486.6	82.28
S-1156	13.75	4730	394.1	76.69
S-1281	14.57	5420	451.6	81.46
SV-98	26.82	4860	405.0	78.65
362-7	15.78	6970	580.8	84.08
IGSP-15	13.92	2890	240.8	79.82
CIP SWA-2	15.76	6570	547.5	81.29
187017-1	17.31	3120	260.6	78.32
440038	13.97	5470	455.8	76.56
440127	15.29	2580	215.0	79.63
420027	14.12	2710	225.8	77.77
ST-14	18.66	9740	811.6	87.22
Kamala Sundari	21.54	6430	535.8	81.56
90/101	19.93	4060	338.3	80.44
C.D. at 5 per cent	0.72	-	-	2.18

(Mitra S, 2012)

B. Preparation and Acceptability of Orange Fleshed Sweet Potato

Sweet potatoes were prepared freshly and served for sensory evaluation. Each potato weighed approximately 100 gm. They were washed thoroughly with water. 4.6 g of table salt was added to 4 litres of drinking water to make a saline solution. This solution was brought to boiling point in a steam kettle to which 1kg of the sweet potatoes were added and cooked for 15 minutes, until fork-tender. After boiling, the potatoes were removed from the kettle and cooled. Then their skin was removed and were placed in disposable zip bags. The bags containing sweet potato were placed in insulated containers and were transported to the schools for serving. Potatoes were taken out of the bags and served on the plates just before commencing the breakfast. The cooked orange fleshed sweet potatoes were stored for a maximum of two hours after cooking and weren't held beyond that time (Appendix VII).

Plate VIII: Preparation of Sweet Potato

Organoleptic testing entails the judging of taste or flavour, smell or odour, look or appearance and texture or mouthfeel of a food product. The five human senses that are intricated in an organoleptic assessment of food are sight, hearing, touch and smell. The boiled sweet potato cubes were evaluated for their acceptability by children, parents and caretakers at randomly selected schools.

According to Jones (2011), the human sense is nexus of several techniques including five special senses such as vision, hearing, smell, taste and touch. Sensory testing with children is challenging; it poses some of the most difficult problems in sensory analysis and product testing because children's cognitive, communicative, and social skills are still developing.

According to Piaget's theory and stages of cognitive development, children's capability of understanding, perceiving and representing is at a developing phase during their childhood years (McLeod, 2018). When children are taken up as subjects, the research tool must be simple and easy for the children/ caregivers to understand (Natabirwa and Tumwesigye et. al., 2020). The hedonic scale are designed with smiley faces, so that it is clear to understand and also fun for children.

The children, parents and caretakers were first asked if they were interested to take part in the sensory test. The current research used sensory evaluation with the help of a 5-point child-friendly hedonic scale (Figure 4), fringing the satisfaction of subjects regarding the appearance, taste, flavour, colour, texture, and wholesome contentedness of the cooked orange fleshed sweet potato samples. The children were explained about the representation of each face on the scale and then asked to mark the face according to the likability or overall satisfaction of the supplement.

Figure 4: 5-point Child Friendly Hedonic Scale

The test samples acquiring an average score above 5 were counted to be "acceptable", the mean score of 3 and 4 were assumed as "passive", and the mean score less than 2 were considered to be "rejected".

C. Nutrient Analysis of the Sweet Potato

The boiled orange-fleshed sweet potatoes were subjected to nutrient analysis namely energy, moisture, carbohydrate, protein, fat, fibre, calcium, iron, thiamine, riboflavin, vitamin B6, vitamin A and vitamin C were estimated at the food testing laboratory at the School of Food Technology, JNTUK. High-Performance Liquid Chromatography (HPLC) has been used to analyse carbohydrates, protein, water-soluble and fat-soluble vitamins. The Gas Chromatography (GC) technique was used for moisture, fat and fibre analysis and atomic spectroscopy was used to analyse iron and calcium.

As per the ICMR (2020) guidelines for Indians, the daily recommended allowance for a child aged between 4 – 6 years is 510 µg/day of Retinol Activity Equivalents (RAE) and the RDA for both boys and girls aged 7 – 9 years is 630 µg/day of Retinol Activity Equivalents (RAE). In the present study, 100 gm of boiled Orange fleshed Sweet Potato selected for intervention provides 788µg of retinol activity equivalents (RAE). Although the boiled orange-fleshed sweet potato contains elevated amount of beta-carotene, not all the pro-vitamin is accessible due to its bio-availability.

Phase IV: Supplementation and Assessing the Impact of the Boiled Sweet Potato and Nutrition Education to the Selected Group of Children

A. Grouping of Fishermen Children and Conduct of Supplementation and Nutrition Education

The children selected for intervention were grouped into four groups as represented in Table V and Figure 5.

Table V

Age-wise Grouping of the Selected Fisherfolk Children

(N=234)

Gender	Age	Group1 (N=56)	Group2 (N=59)	Group3 (N=61)	Group4 (N=58)
Boys	6	11	8	11	10
	7	9	11	9	12
	8	11	10	10	9
Girls	6	10	9	12	9
	7	8	11	9	7
	8	7	10	10	11

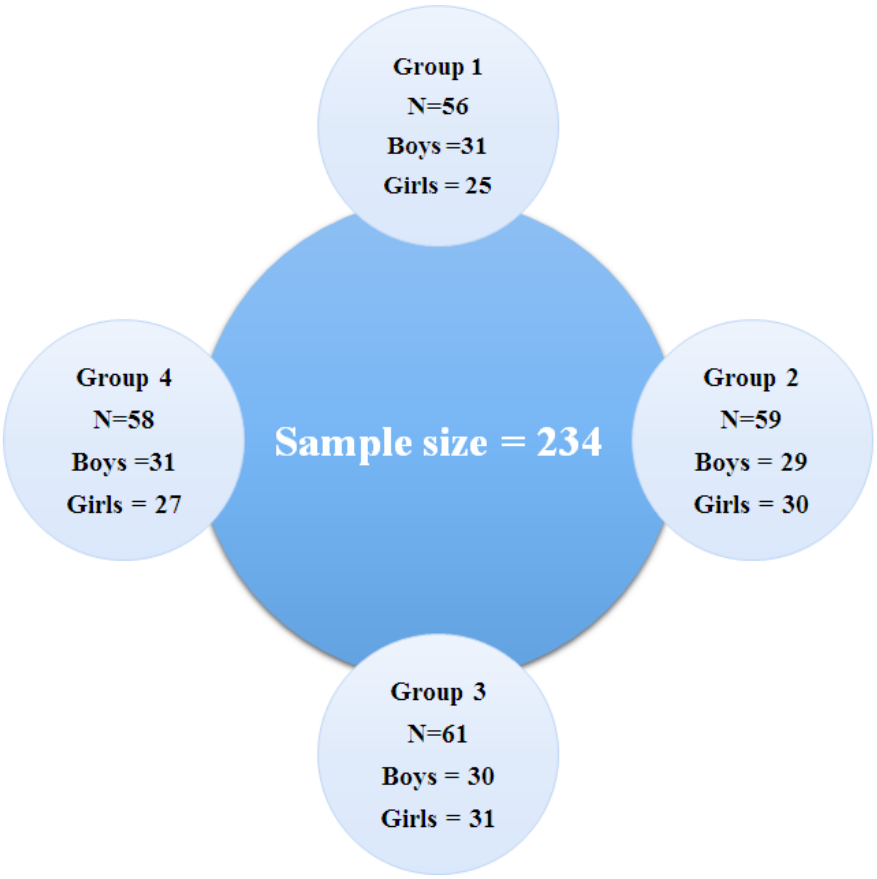


Figure 5: Grouping of the Selected Fisherfolk Children

Table V and Figure 5 depicts the grouping of the selected fisherfolk children. Two hundred and thirty-four children aged between 6-8 years who were detected having Vitamin and Iron deficiencies were selected for supplementation and were placed in four different groups (3 experimental groups and 1 control group). The selected 234 subjects

comprising of 121 boys and 113 girls, out of which 40 boys and 40 girls were 6 years old, 41 boys and 35 girls were 7 years old and 40 boys and 38 girls were 8 years old.

The children were enthusiastic and eager to participate in the supplementation study.

Conduct of supplementation

Four groups of children, constituting three experimental groups and one placebo were part of the study. Group 1 was provided 100 gm of boiled orange-fleshed sweet potato along with their breakfast (100 gm of upma, provided by the school). Group 2 was provided 100 gm of boiled orange-fleshed sweet potato which was served along with their breakfast (100 gm of upma, provided by the school) and were also provided with nutrition education. Group 3 was administered with only nutrition education. Group 4 are the control group and were provided only with a school meal that is 150 gm of upma by the school and no supplementation.

Nutritional anthropometry, clinical and biochemical investigations were conducted for all 234 children initially and prior to supplementation. The result of supplementation was determined using the same parameters.

Nutrition Education

Nutrition is an undeniable important factor that plays a huge role in child's development. Proper nutrition is a must for children to accomplish in school. Nourishing a child with a proper diet helps them to function duly at school ang also helps to foster their developing minds and bodies. Enhancing nutritional knowledge is the key to bring about health and sustain nutritional stature. Nutrition education is important to improve the dietary habits and food choices in children and to reverse malnutrition. It also helps to improve the nutritional diagnosis. The factors responsible for malnourishment in children and women could be unhealthy dietary habits and less exercise.

The nutrition education module was designed to keep in view the information about basic nutrition and micronutrients in particular. Topics covered were about basic nutrients present in foods and their role, micronutrient-rich sources with particular emphasis on vitamin A and iron-rich foods, deficiency signs and symptoms, what is a balanced diet and best cooking methods.

Nutrition education was imparted to 249 members in which 120 were children selected for supplementation, 120 were their mothers or caretakers and 9 were their school teachers. Nutrition education was conducted with the use of audio-visual aids such as a collection of colourful posters and charts, nutrition exhibitions, positive deviance hearth for all the participants and paper education notebook activity (only for children). The education was given in the local dialect which was Telugu. The type of nutrition education methods and frequency is presented in Table VI and Plates IX to XII.

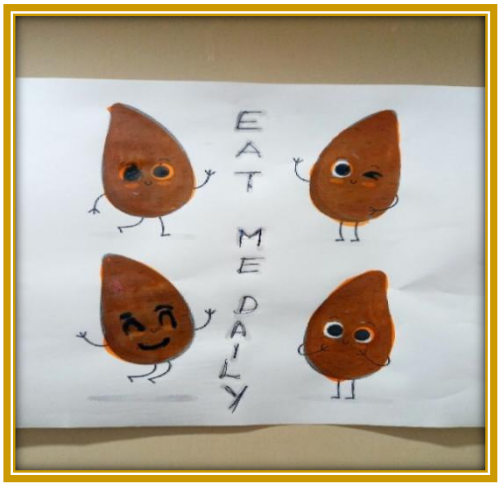
Table VI

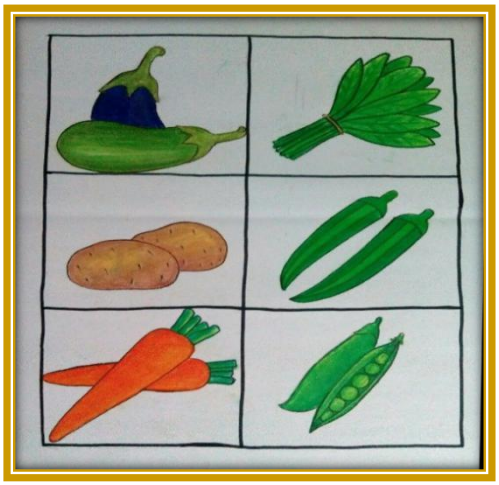
Nutrition Education Methods and Frequency of Education

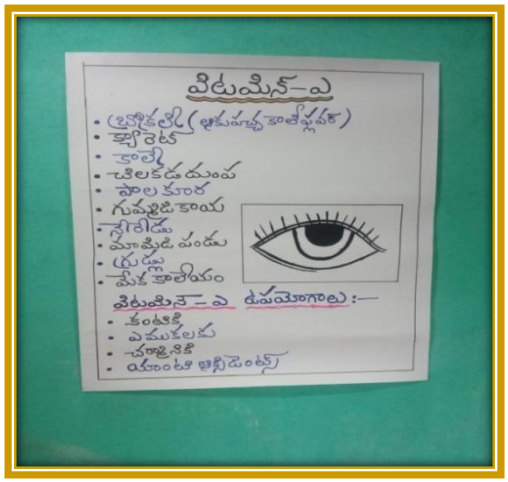
Aids	Frequency	Group 1	Group 2	Group 3	Group 4
Audio-Visual Aids	Weekly	Nil	Once	Once	Nil
Nutrition Exhibition	Fortnightly	Nil	Once	Once	Nil
Positive Deviance Hearth	Fortnightly	Nil	Once	Once	Nil
Paper book Education	Weekly	Nil	Twice	Twice	Nil

Audio-Visual Aids

Charts and posters with eye-catchy pictorial illustrations were used to add-in the attractiveness and promote easy comprehension to the viewers. They were prepared to impart education on topics such as healthy eating habits, low-cost nutritious foods, benefits of orange fleshed sweet potato, food-plate, personal and environmental hygiene, malnutrition and its causes, communicable and non-communicable diseases, their prevention and control. Powerpoint presentations were also given about 'Nutrition and Health' specifically designed for child development and growth and family health. The local dialect, Telugu, was used for presentation.







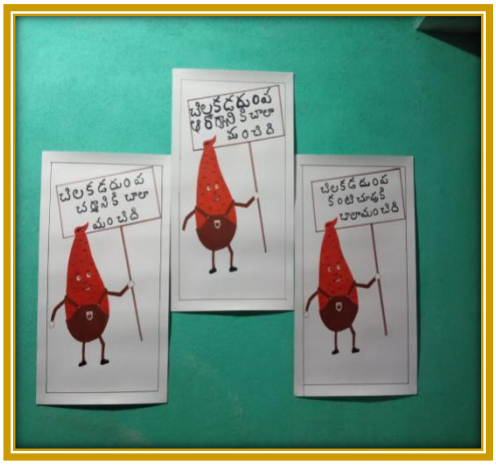


Plate IX: Charts for Nutrition Education

Nutrition Exhibition

Nutrition exhibitions are an effective and inexpensive way to pull over the crowd and to showcase different locally available foods that are nutritious and educate the locals about the goodness of health and nutrition and proper hygiene. Exhibitions grab the interest of one and all. It's a platform where different healthy foods were displayed and the importance of different foods in the diet was explained. Information about malnutrition, its causes and prevention were also included. Vitamin deficiencies such as bitot's spots, coronial xerosis, night blindness, anaemia, bleeding gums, etc., were highlighted and how to prevent them was clearly explained.

Plate X: Nutrition Exhibition on Kitchen Gardening and Hygiene

Positive deviance hearth

The concept of Positive deviance hearth was adapted to this research where fisherfolk women who had healthy children were encouraged to share their knowledge in preparing low-cost nutritious food recipes, thereby developing an interest in others to try and prepare healthy food for their families. As the fisherfolk of the research area were familiar with this concept of the program, it was easier to implement and impart nutrition education and has been very enthusiastic, beneficial and successful in enriching food practices in mothers or caretakers.

Plate XI: Pamphlets Distribution to Enhance Healthy Food Choices

Use of nutrition education paper activities

Schools have the utmost potential to make remarkable benefaction in promoting healthy eating habits in children. This approach to foster improved nutrition education was an initiative to introduce the knowledge of foods and their importance in the school curriculum. An art session of different locally available nutritious foods and how they help our body was organised and each subject was made to participate in it. Twice a week the subjects were asked to draw the picture given in the given charts with the help of their teachers as an extra-curricular activity in their school schedule (Plate XII). The subjects being children were very much interested in this activity.

Plate XII: Art Session as a Part of Nutrition Education

Group 1 was supplemented with boiled sweet potato along with a school meal

Group 1 had a total of 56 children, 31 boys and 25 girls. They were supplemented with boiled sweet potato along with school meal which was usually upma. 100 gm of boiled orange-fleshed sweet potato is served along with their breakfast (100 gm of upma, provided by the school). The subjects were asked to consume the sweet potato first and the same was supervised. This intervention was carried for a period of 6 months on weekdays. Sundays and public holidays were excluded from the intervention.

Group 2 was supplemented with boiled sweet potato and nutritional education along with school meal

Group 2 had a total of 59 children, 29 boys and 30 girls. They were supplemented with boiled sweet potato along with school meals. 100 gm of boiled orange-fleshed sweet potato was served along with their breakfast (100 gm of upma, provided by the school). Nutrition education was provided to the children, their parents and teachers. Classes were conducted every Wednesday and Saturday for 1 hour. Topics were about the importance of nutrition-rich foods, orange-fleshed sweet potatoes and locally available low-cost-nutritious foods, cooking process, cleanliness and kitchen gardening. The subjects were served sweet potatoes to eat and the same was supervised. This intervention was carried for six months on all weekdays. Sundays and public holidays were for the intervention.

Group 3 children were given nutrition education along with school meal

Group 3 had a total of 61 children, 30 boys and 31 girls. They were provided with only nutrition education, breakfast of 150 gm of upma, provided by the school. Nutrition education was provided to the children, their parents and teachers every Wednesday and Saturday for 1 hour. the importance of nutritional foods, orange-fleshed sweet potatoes and locally available cheap yet nutritious foods, cooking process, cleanliness and kitchen gardening.

Group 4 was the control group provided only with school meal

Group 4 was the control group had a total of 58 children, 31 boys and 27 girls. They were provided with only a school meal, 150 gm of upma. They weren't given the orange-fleshed sweet potato or either nutritional education. The parents, caregivers and the teachers were given all details regarding supplementation of boiled orange-fleshed sweet potato to maintain appropriate attendance records. Moreover, a regular day-to-day

monitoring was done to ensure that the supplements were completely consumed by the subjects.

B. Impact of Interventions among Fishermen Children

ASSESSING THE EFFECT OF INTERVENTION				
NUTRITIONAL STATUS	**BIO-CHEMICAL ANALYSIS**	**CLINICAL ASSESSMENT**	**DIETARY SURVEY**	**NUTRITION EDUCATION**
• Height • Weight	• Serum retinol • Haemoglobin	• Vitamin A and Iron deficiency anaemia	• Mean food intake • Mean nutrient intake	• Knowledge • Attitude • Practice
• Before readings • After readings	• Before readings • After readings	• Before readings • After readings	• Before readings • After readings	• Before readings • After readings

Figure 6: Assessing the Effect of Intervention

1. Nutritional anthropometry

The effect of supplementation on the selected Vitamin A deficient subjects was evaluated using anthropometric measurements like height and weight before the onset of supplementation and after completion of the supplementation.

2. Biochemical analysis

The biochemical tests for the assessment of serum retinol and blood haemoglobin were carried out before and after supplementation for all the 234 subjects to find out the result of consuming boiled orange-fleshed sweet potato.

3. Clinical examination

The manifestations arising from nutritional disorders were examined before and at the end of supplementation of orange fleshed sweet potato for six months and reversal if any was noted.

4. Dietary survey

Frequency of food's eaten and food eaten in a day (24-hour food recall method) were collected to calculate mean food intake and mean nutrient intake, from the parents or caretakers before the supplementation and was compared with the data collected after supplementation.

5. Nutrition education

Knowledge, Attitude and Practice scores were analysed with the help of a detailed questionnaire of 60 questions with 20 questions from the following – knowledge about good nutrition, attitude to learn and food preparing practices. The details were acquired from the parents especially mothers, caretakers and teachers prior to and at the completion of nutrition education. Questions over food, nutrients and their functions were given to assess their knowledge. Questions related to healthy nutrition and the necessity for nutrition education were put forward to estimate their attitude. Questions on practices were generally on daily dietary intake, cleanliness and personal hygiene. One mark was assigned for every question providing an equal weightage. To the questions on practice, multiple choices answers were provided. The answer marks were evaluated to assess the KAP level of all the selected children, mothers and caretakers. The questionnaire of KAP is in Appendix VIII.

Phase V: Statistical Analysis of the Study

In Statistical data analysis, quantifying the data was done. It includes measures of central tendency (averages - mean) and measures of variability about the average (standard deviation). After the data collection, the researcher ran the analysis and presented it in tables, figures and diagrams. The researcher used appropriate simple statistical methods like mean, standard deviation, graph, per centages, correlation coefficient, and t-test.