Impact Assessment of a Supplementary Food on Nutritional Status.

By

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DECLARATION

The work described in this thesis was carried out by me at the Faculty of Applied Sciences under the supervision of Mrs. K.M. Somawathie and Dr.[Mrs.] J.A.N. Priyadarshanie. A report on this has not been submitted to any other university for another degree.

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TO MY

PARENTS AND TEACHERS

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ABSTRACT

In Sri Lanka as other developing countries, malnutrition is one of the major public heath problem affecting specially to the children. Many supplementary feeding programs carried out by the Department of Health and other non-government authorities to reduce the malnutrition among vulnerable groups.

But Impact assessment of supplementary feeding programs are not evaluated by any one or any organization yet. The survey was carried out to identify the effectiveness of the supplementary feeding programs among vulnerable groups.

The objectives of the survey were to determine the composition of the supplementary food, Determine the current nutritional status of the children in the particular area and determine the effect of supplementary food on improvement of nutritional status.

To determine the composition of the supplementary food, chemical analysis was carried out and find out the % of protein, fat, moisture, ash and crude fibre content.

In general, evaluation of the impact of supplementary food on the nutritional status of vulnerable groups will focus establishing whether or not the population malnourished individual has decreased within specific time period.

Malnutrition being defined by the any one of the following three indicators singly or in combination. They are, Weight for age (under weight), height for age(stunting), weight for height (wasting)

In identifying the nutritional status it has been the recent practice to use the method suggested by WHO, i.e. z-scores and NCHS reference standards. So the survey was carried out using the NCSH standards.

Before starting the feeding program, detecting the nutritional status of children (3 to 5 year) in the area was done. Then they were divided into two groups and one was fed with the supplementary food while other was not fed. Height and weight measurements were collected by fortnightly. After four months, populations were compared using statistical method.

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Chapter 01

Introduction

While economic growth measures material development of the population, nutritional measurements indicate the changes in human well being of the society. Hence, nutritional measurements are useful indicators in asserting the effect of development programs on human well being. Improvement of nutritional status of a population is also a pre requisite to improve productivity and production in both industrial and agricultural sectors

In general, evaluation of the impact of supplementary food on the nutritional status of vulnerable groups will focus on establishing whether or not the population malnourished individual has decreased within a specific time period. "Malnutrition" being defined by any one of the following three indicators, singly or in combination.

1) Weight for age.(Wasting)
2) Height for age.(Stunting)
3) Weight for height.(Underweight)

(WHO, 1983).

The values of height and weights are compared with the distribution of indicators in a reference population of well nourished healthy children established by United States National Center of Health & Statistics .(NCHS.)

- Height for age is a measure of liner growth. A child whose height for age is below minus two standard deviations (-2SD), from the median of the reference population, is considered stunted or chronically undernourished.

- The weight for height index measures acute undernourishment. A child whose weight for height falls below minus two standard deviations(-2SD),), from the median of the reference population, is classified as wasted or acutely undernourished.

- Children with a weight for age falls below minus two standard deviations (-2SD) from the median of the reference population, is considered as underweight.
  (Sri Lanka Demographic and Health Survey, 2000 Preliminary Report)

Lunugamwehera MOH area has been selected for the survey, which is in Hambantota district and belongs to Southern province. The estimated population of the area in 2002 is about 31,862 with a population density of 121 persons per km^2. Nearly, 90% of the population engage in the agricultural activities. (Department of Census and Statistics, 2002).

There are two agricultural seasons based on the two monsoons received in the country. The major proportion of the annual rainfall is received to the area, during the northeast (Nov-Jan) monsoon. Based on annual rainfall distribution pattern, the area is referred as dry zone, which receives less than 1500mm of annual rainfall.

During last 2-3 years, there were many changes in annual rainfall pattern and it greatly affected the economy of the area. Farmers of the area, suffered with lack of rainfall and they had to struggle with their lands to obtain a better harvest. These problems affected directly to the dietary habits as well as nutritional status of children, pregnant and lactating mothers.

Many supplementary feeding programs carried out by ministry of Health and other non- government organizations. The main aim of these feeding programs is to improve the nutritional status of a target group. Many problems were associated with these feeding programs, mainly the financial problems.

Impact assessment of these feeding programs were not evaluated yet. This may be the main reason to fail the most of the feeding programs.

The Department of Social Services conduct a special food aid program in the area, specially for the vulnerable groups to improve their nutritional status. The Medical Officer of Health carries out this program, with the assistance of Public Health Midwives. They distribute the supplementary food to children, pregnant mothers and lactating mothers to increase their nutritional status.

1.1 Objectives of the study.

The study was done to achieve the following main objectives.

(1). Determine the composition of the supplementary food. .

(2). Determine the effect of supplementary food on the improvement of nutritional status of the children

(3). Determine the current nutritional status of children aged 3 to 5 years in Lunugamwehera MOH area.

Chapter 02.

Literature Review.

2.1 Measuring Nutritional Status.

Anthropometry has been widely used as a "proxy" to nutritional status of children during growth. It is the most popular tool available to nutritionists for investigation of nutritional status of individuals, particularly young children. Although, different types of anthropometric measurements are available for measuring growth patterns of children, weight and height have been the most suitable.

It is difficult to differentiate the contribution of various factors, which determine the growth patterns of the young children. However, it is commonly accepted that social and economic deprivations influence the body size and growth patterns of populations through a very complex process. Growth velocity patterns of children and body weight changes are useful 'proxy' indicators in understanding the implications of household food insecurity and other ecological effects in determining the nutritional status of individuals.

Anthropometric measurements have been widely used in population studies as a proxy for overall growth and health status of a child. (Ratnayaka and Weerasinghe, 1988/89).

2.2 Nature and dimension of nutrition and diet related problems.

In Sri Lanka as in other developing countries, malnutrition and ill health are associated with a cluster of related and often coexistent factors such as limited resources for the basic needs of food and shelter, poor access to safe water and large family size. These factors act synergistically in the progression and perpetuation of undernutrition.

Undernutrition could have a lasting effect on family development. It can result in inefficiency and low labour productivity that lead to low income and economically and socially deprived household or community.

The effects of all these factors both socioeconomic and environmental are ultimately manifested through a final common pathway. The factor, which ultimately determines the nutritional status of an individual, is the availability, at the cellular level of energy and nutrients required for normal growth, development, maintenance, repair and function of the organisms. These nutrients must be available in adequate amounts, in proper proportions and at the appropriate times. Availability of nutrients depends on;

1). an adequate access to sources of food.

2). factors that influence the requirements such as absorption and utilization of nutrients, level of physical activities of individual, environmental factors and stress situations.

The correlation between the level of dietary inadequacy prevailing in a house-hold and the degree of undernutrition among members of the household, will depend on factors such as food availability and purchasing power, intra family distribution of food, infant feeding and child care practices and general living conditions.

The following sections examine the different factors, which contribute and lead to under nutrition.

1) Dietary energy deficiency.

Energy deficiency may be 'acute' or 'chronic'. Acute energy deficiency exists when there is a gross imbalance between energy supplied by the diet and the energy needs of the body. This negative balance is met by utilizing the body's energy stores, named body fat. As fat stores are consumed, proteins are catabolized for energy purposes. Loss of body fat and protein results in rapid loss of body weight reduced function impairment of health and if the deficiency is allowed to continue, will finally lead to death.

In chronic energy deficiency the energy imbalance is not so marked. The individual 'adapts' himself or herself by limiting physical activity, impairment of function and by 'stunting'. Restriction of physical activity in a child could impair both physical and mental development. In adults it leads to poor work performances, stress of infection or infestation could precipitate acute deficiency on chronic energy deficiency.

2).Energy requirements

Nutritional requirements serve two purposes. First, it indicates the recommended daily intake of energy and nutrients for different sections of the population in a given country. Secondly, such requirements provide guidelines for estimation of food supplies for the country.

The nutritional requirements which are recommended by human nutritionists via various international organizations have been subject to revision, based on the latest scientific findings. One major change in this area has been that of energy and protein requirements. These requirements depend on age, sex, weight and physical activities of individuals. Based on the guiding principles provided by the international expert panels, certain adjustments and modifications have been made by committee to arrive at national requirements.

The correct view on energy requirements as proposed by FAO/WHO/UNU (1995) is based on energy balance criteria, where the energy requirement is defined thus:

The energy requirement of an individual is the level of energy intake from food that will balance energy expenditure. When the individual has a body size and composition and level of physical activity consistent with long term good health and that will allow the maintenance of economically necessary and socially desirable physical activity. In children and pregnant or lactating women, the energy requirements include the energy needs associated with deposition of tissues or the secretion of milk at rates consistent with good health.

3). Energy protein malnutrition

Estimation of the prevalence ratio of malnutrition among children in usually beset with definitional and measurable problems. Nevertheless, in the absence of Sri Lankan reference population standards, the National Centre of Health & Statistics (NCHS) reference results were used to examine the height and weights of Sri Lankan children, to identify those who are nutritionally at risk. (International Conference on Nutrition).

2.3 Previous Nutritional Studies

To assess the nutritional status of the child population, a number of anthropometric surveys have been carried out in Sri Lanka by various organizations and individuals using different sampling frames and methodologies. Through several area specific anthropometric surveys have been carried out since the 1930's. Their usefulness in assessing the national nutritional status has been limited. The first national anthropometric survey was carried out during 1975/76 as a collaborative project between the Ministry of Health and the Centre for Disease Control (CDK) USA. This survey however did not include socio-economic determinants that were necessary for formulating policies pertaining to public health and community nutrition.

The second nutritional survey was carried out by the Food and Nutrition Policy Planning Division (FNPPD) of the Ministry of Plan Implementation in 1980/81.In addition to providing nutritional assessments both district and sectoral levels, this survey collected data on socio-economic indicators that have bearing on the nutritional status of children. Among the other objectives of the survey was the validation of the infant mortality indicator, assessment of the purchasing power indicator and some assessments of the effectiveness of the health care delivery systems through the "maternal and child care clinics"(MCH).

Through the Family Health Bureau undertakes nutrition surveillance of target groups such as the pre school children, pregnant and lactating mothers and other at risk groups, through their routinely collected data and information systems via the MCH infrastructure. It was through that a nutritional survey of the population should be repeated once in every 5 years similar to the island wide population census that is conducted by the Department of Census and Statistics. In addition to anthropometric measurements, such surveys would provide data on the exogenous factors that have a bearing on the nutritional condition of the household.

The third nutritional survey was carried out simultaneously in all the districts during the period of 1988/89. The survey unit was considered to be a household with at least one child below the age of 60 months. This is comparable to the sampling unit

used in 1980/81 FNPPD survey. This cluster sampling method employed in this survey resembled closely the method adopted in the 1980/81 survey.

The size of the sample selected enabled the assessment of the nutrition status within an error of 2%. Two main schedules used in the survey gathered information on anthropometry, birth weights, demography, land use, income, expenditure assets and liabilities, breast feeding and weaning practices, immunization and environmental sanitation. This survey also gathered information on infant and child mortality, accessibility to health clinics, data on the use of growth monitoring cards and minimum prices of selected food items.

Field investigations were conducted by the District Development Officers. These officers were trained by the Training Division of the Central Bank in the collection of data relating to determinants of malnutrition. The national division of the Medical Research Institute helped in training officers to take anthropometric measurements. The field activities were supervised by the District Assistant Directors of Planning. The analysis of the data was performed using standard computer software, namely the SPSS for statistical analysis and the Centre for Disease Control package to analyze anthropometric data. (Ratnayake and Weerasinghe, 1988/89).

2.4 Growth Monitoring.

2.4.1 Choosing a reference population.

Monitoring the growth of a child requires comparing changes in a same measure taken at regular intervals. A single measurement only indicate the child size at the moment; it offers the little information about whether the child size is increasing, entering a period of stability, or declining. Because most children will continue to grow even if only slightly. Unless they extremely ill, it is to mistake some growth to adequate growth unless the child's measurements is compared to a reference population.

Creating local standards may not be feasible for each country or ethnic group. Internationally accepted reference populations have been recommended for use with

adjustments to be made in the cut-off points for defining malnutrition within each area.

Over the last two decades two sets of reference population data for pre-school children have been used extensively and internationally the Boston and Tanner standards. Although well recognized these reference population values are now been replaced by the National Center of Heath and Statistics.(NCHS)

2.4.2. NCHS Reference population.

In 1974, the United States National Academy of Sciences recommended updating the reference population used for comparing the health status of groups within the United States. The results of several years of work is a set of tables and charts that combine two reference populations, both large and randomly selected from different economic and ethnic groups the United States.

The tables based on data collected by the Health Examination Survey of NCHS. Tables and charts are available for weight, height, skin fold thickness and head and arm circumference.

2.4.3. NCHS Standards.

While reference population values serve to relate the progress of an individual child to a known growth potential, this comparison become more useful to the health worker or mother.

Determination of cut-off points is an important issue for local consideration. Since it can determine how severe the problem appears and can determine the priority assigned to the child nutrition programs in particular region.

Cut-off points are expressed in three ways; Percentages of the median, Percentiles, and Standard deviation units.

- **Percentages of the median.**

Percentages of the median are calculated by first identifying the median value for the reference population; this median value, then is called 100% value. Second, absolute values at different percentage units from the median are calculated.

Several classification systems have been proposed using percentages of the median. Gomez et al in 1956 proposed one system for calculating weight for age. Cut-off points based on percentages of the median have been developed also for weight for height and height for age by Waterlow, Mclren and Read.

- **Percentiles.**

The number of the percentile represents a position out of 100. The fiftieth percentile represents the midpoint of the population; exactly half of the children will be above and half below this value.75% of the median value and the third percentile are almost identical.

- **Standard deviation units.(z scores.)**

Standard deviation (SD) units, also called z scores, are most often used to express survey results. However World Health Organization (W.H.O.) and Waterlow now advocate using standard deviation units to express growth monitoring results. Today only the W.H.O. chart designed for use by health professionals has cut-off lines that represent SD units calculated from the N.C.H.S. reference population data.

The following are SD units equivalents for different indicators as they are commonly expressed in growth monitoring;

1 SD unit – 11-12% units from the median weight for age.
1 SD unit – 10% units from the median weight for height.
1 SD unit –4-5% units from the median height for age.

The normal growth channel for any population is considered to be that range between plus and minus two SD units of the median, a range that includes almost 98%of the reference population.

It has been suggested that this be considered the "lower level of normality "and that national or project goals could include reducing the percent of children below this limit to 3%of the population. For guidance, the rough equivalents for –SD units, undernutrition are given as percentages of median;

Weight for age	77% of the median.
Weight for height	80% of the median.
Height for age	90% of the median.

2.5 current situation of the malnutrition.

According to the national surveys, on measuring nutritional status, current situation of malnutrition in Sri Lanka can be summarized as follows;

Table 2.1 current situation of malnutrition in Sri Lanka

Background variables	Height for age		Weight for height		Weight for age	
	1993	2000	1993	2000	1993	2000
Sex						
Male	22.7	11.9	15.6	15.1	34.8	29.0
Female	25.1	15.3	15.4	12.6	40.9	29.8
Age in months						
03-05	4.9	3.9	3.1	1.3	5.8	0.7
06-11	11.8	5.7	6.8	10.3	1.9	20.2
12-23	25.7	16.2	18.2	18.2	36.3	28.8
24-35	23.8	12.4	15.1	13.3	42.4	34.0
36-47	27.5	13.4	18.2	13.9	46.7	30.7
48-59	28.7	19.1	17.6	15.9	43.0	37.9
sector						
Colombo	19.7	7.4	12.2	10.1	31.2	18.2
Other Urban	16.8	8.6	16.8	6.3	29.9	21.3
Rural	22.9	12.8	16.4	15.9	38.3	30.8
Estate	53.7	33.8	9.5	11.8	52.1	44.1

(Sri Lanka Demographic &Health survey-2000)

Chapter 03

Methodology

3.1 Analysis the composition of supplementary food.

A sample of supplementary food containing 75% Soya and 25% Wheat flour and fortified with vitamins was chemically analyzed to determine its composition.

3.1.1 Chemical analysis for Protein.

Material used;

Sodium sulphate pellets.

Sodium thiosulphate pellets.

4% Boric acid.

0.02M standard Hydrochloric solution.

Kjedhal catalyst tablets.

Kjeldhal indicator.

Ether.

Apparatus used;

Kjeldhal digestion kit.

(Kjeldhal digestion flask, Kjeldhal heater, fume trap, Distillation unit)

Titration flask.

Weighing balance.

Procedure;

- Sample of supplementary food was defatted using ether.
- Defatted sample was mixed with conc. H_2SO_4 and digested for 4 hours. Selenium based Kjeldhal tablets were used as catalysts.
- Blank titration was also carried out.
- After digestion, apparatus were kept an hour for cooling.
- Kjeldhal digestion apparatus was conditioned by passing steam through it, for several minutes.
- Then, the sample in the digestion flask, was dissolved in ammonia free distilled water and it was transferred to the semi-microkjeldhal apparatus.

- $NaOH/Na_2S_2O_3$ solution was added to it.
- 4% Boric acid solution was taken in to a titration flask and three drops of Kjeldhal indicator was added to it. It was kept at the end of the digestion apparatus to trap ammonia liberated.
- The steam was passed through the flask.
- Then the Boric acid solution was titrated with 0.02M HCl acid. The end point was in pink color.
- The blank distillation and titration was also carried out.
- Amount of protein in the sample was calculated using the following equation ;

$$\text{Protein content} = \left[\frac{(\text{sample titre.} - \text{Blank titre.}) * \text{Molarity of HCl} * 14 * 100}{\text{weight of the sample taken} * 1000} \right] * 6.25$$

3.1.2 Chemical analysis for fat

3.1.2.1. Determination of free fat.

Apparatus used;

- Soxhelet extraction apparatus
- Motor & pestle
- Electronic balance
- Oven
- Thimble
- Majoinner flask
- Beakers

Materials used;

- Hydrochloric solution
- Ethanol
- Anhydrous Na_2SO_4

Procedure;

- Sample of supplementary food and anhydrous Na_2SO_4 was mixed together into 1;2 ratio and it was ground into fine powder using motor & pestle.
- Powdered material was transferred into extraction Thimble and it was placed in Soxhlet apparatus.
- Petroleum ether was put into a clean dried round bottom flask, which was previously weighed.
- It was immediately fixed with Soxhelt siphon and condenser.
- Then it was refluxed until get clear colorless petroleum ether solution and it was allowed to complete three cycles of siphon offings to removed the apparatus.
- Solvent was distilled off and the flask was placed in the oven for about two hours at 105^0 C.
- Then the flask taken out and it was cooled and weighed.
- The above process was repeated until it was given a constant weight.
- Amount of free fat in the sample was calculated by;

$$\text{Free fat content} = \left[\frac{\text{Final weight of the flask} - \text{Initial weight of the flask}}{\text{Initial weight of the sample}}\right] * 100\%$$

3.1.2.2. Determination for total fat.

- Sample of supplementary food was dehydrated using a suitable amount of anhydrous Na_2SO_4 and it was ground until free flowing powder was obtained.
- Powdered material was put into a beaker and HCl acid, 95% of ethanol was added to the sample.
- It was mixed thoroughly and then the beaker was placed in a 70-80^0 C water bath and stirred for 30-50 minutes frequently until it is given light color.
- Then the beaker was taken out and cooled in atmosphere
- Ethanol was added to beaker and solution was transferred to the Majoiner flask.
- Required amount of ether was taken and washed the beaker using ether by three portions and also added to the above equipment.
- The flask was shaken vigorously for few minutes.

- Pet ether was added and shaken vigorously again.
- Then the flask was kept until clear layer of pet ether was appeared.
- Dried flask was taken which was previously weighed and upper ether layer was put into a flask. This process was carried out for three times.
- Finally, pet ether solution was put into a water bath at 90^0 C to evaporate ether.
- After all the ether was evaporated, the flask was dried in an oven until it was given a constant weight.
- Amount of total fat in the sample was calculated by;

$$\text{Total fat} = \left[\frac{\text{Constant weight of the flask} - \text{Initial weight of the flask}}{\text{Initial weight of the sample}}\right] * 100\%$$

3.1.3. Chemical analysis for crude fiber.

Material used;

Petroleum ether

Dilute H_2SO_4 acid

Anti bumping agents

Apparatus used;

Round bottom flask

Reflux condenser

Sintered crucible

Dessiccator

Heating mantel

Electronic balance

Suction pump

Procedure;

- Sample was defatted using petroleum ether.
- Dilute H_2SO_4 was taken into a round bottom flask and defatted sample was added to it.

- Fumic stones were used as an anti- bumping agents.The mixture was heated using heating mantel.
- When the mixture was started to boil, the reflux condenser was connected to the flask.
- The boiling was cotinued exactly for 30 minutes.
- Then the flask was removed and filtered through fine linen held in a funnel and washed with boiling water, until the washings no longer acidic to litmus.
- The residue was transferred to a crucible and it was dried at 105^0 C in a hot air oven until obtain a constant mass.
- Then the residue was ashed at 600 ± 20^0c until all the carbon matter was burned.
- The crude fiber content of the sample was calculated by;

$$\text{Crude fiber} = \frac{\left[\text{Constant weight of the sample after oven drying}\right] - \left[\text{constant weight of the sample after ashing}\right]}{\text{Initial weight of the sample before defatting.}} * 100\%$$

3.1.4. Chemical analysis of ash .

Apparatus used;

Muffle furnace

Silica dish

Electronic balance

Desiccator.

Procedure;

- Clean and dry silica dish was taken and weighed accurately using electronic balance.
- Then the sample was weighed into a above dish.
- The sample and dish were kept on the burner and ignited until no more fumes are evolved.

- After all were converted into black in color and after all the fumes were evolved, the dish was taken out from the burner and transferred it in to the muffle furnace which swas in about 550^0 C temperature.
- It was kept for four hours, to incinerate the sample.
- After about four hours, sample was taken out and kept in the desiccator for cooling.
- Then it was weighed using electronic balance.
- Igniting, cooling and weighing processes were repeated, at half-hour intervals until the difference between the two successive weighing was less than 1 mg.

- The, percentage of ash in the sample calculated by;

$$\text{Ash content} = \frac{\left[\begin{array}{l}\text{constant final weight}\\ \text{after igniting}\end{array}\right] - \left[\begin{array}{l}\text{weight of the}\\ \text{empty dish}\end{array}\right]}{\text{Initial weight of the sample}} * 100\%$$

3.1.5.Chemical analysis of moisture.

Apparatus used;

Moisture dish

Hot air oven

Electronic balance

Procedure;

- Sample of supplementary food was weighed using electronic balance into a moisture dish which was previously weighed .
- The moisture dish with the sample was kept in an oven for four hours at 105^0 c.
- After four hours the dish was taken out and cooled in a desiccator.
- Then, it was weighing using an electronic balance.
- The process was repeated until get constant mass with 30 minutes intervals.
- The lowest mass was recorded

- Moisture content in the sample was calculated by ;

$$\text{Moisture Content} = \frac{\left[\begin{matrix}\text{Wt of the dish}\\ \text{Before drying}\end{matrix}\right] - \left[\begin{matrix}\text{constant wt of the}\\ \text{dish after drying}\end{matrix}\right]}{\text{Initial weight of the sample}} * 100\%$$

3.2 Determine the nutritional status of children before the study.

3.2.1 Sampling design

In order to obtain the requisite information on nutritional status it is unnecessary and even inefficient to examine the entire population benefiting from the supplementary feeding. Adequate data may be obtained by examining a sample of the population.

Parent education program was carried out in selected area about the importance of the study and about the methodology of the study.

3.2.1.1 Dietary survey

Dietary survey was carried out three consequently days among 3-5 yrs aged children in Lunugamwehera MOH area. Recording method was used to obtain data

. Mothers were asked to record the dietary intake and habits of their children for three days before starting the feeding program. According to the results of the dietary survey 50 children who were having average dietary intake within the range of 1000-1200 kj/day were selected, randomly proportionately to the PHM area as follows.

Table 3.1: Sampling method of children.

PHM Area	No of children Aged 3 to 5 years	Selected proportion of children
Padawgama	232	8
Hamlet 3/4	162	6
Hamlet 5/6	152	6
Hamlet 1/3	136	5
Hamlet 7	114	5
Hamlet 10/20	108	4
Beralihela	107	4
Weerawila	95	4
Hamlet 18/19	93	3
Hamlet 2/4	69	3
Mattala	42	1
Mahaaluthgam ara	40	1
Total	1350	50

3.2.2 Collection of data.

Height and weight of the each and every child was measured and recorded with age and sex.

Age: The recording of age was straightforward procedure, which measured to the nearest completed month or year.

Weight: Children were weighed using a "Salter" spring balance with the scale measuring up to maximum of 25 Kg with increments of 100g. With this type of balance, the child was hung in a specially designed "bag". The children were undressed as much as possible before weighing.

Height: A vertical measuring rod was used for taking height of the children. After removing shoes, the child was allowed to stand on a flat scale by the scale with feet parallel and heals, buttocks, shoulder and back of head touching the upright. The head is allowed to hold comfortably erect, with the lower border of the orbit of the eye in the same horizontal plane, as the external canal of the ear. The arms were kept to the hanging loosely at the sides. The headpiece of the measuring device was gently lowered crushing the hair and making contact with the top of the head. Accuracy of the measuring rod was 0.1 cm.

3.2.3 Data analysis

The values of height and weight were compared with corresponding indicators of National Center for Health and Statistics. The nutritional status of children was evaluated by calculating the extent, which the anthropometric measurements deviate from the reference population.

NCHS standards were established to compare the following three characteristics of individuals.

1. Weight for age.
2. Height for age.
3. Weight for height.

- Weight for age is a measuring of acute undernourishment or wasting.
- Height for age measures chronic undernourishment or stunting.
- Weight for height index measures the underweight.

The children those who are having above indicators below (-2) Standard Deviations from the median of the reference population is referred as "malnourished". And the children who falls inbetween the (-2) SD & (+2) SD of any of the above indicators considered as "normal".

3.3 Determine the effect of supplementary food on improvement of nutritional status.

3.3.1 Supplementary food.

The Department of Social Services conducts a special food aid program in the Lunugamwehera MOH area, specially for vulnerable groups to improve their nutritional status. The Medical Officer of Health of the area carries it out with the assistant of PHM's .

Distribution of supplementary food is done through the maternal & child care health clinics.

3.3.2 Selecting a control group.

As a result of parent education program before the study some of them agreed not to fed their children with supplementary food during the survey period. So, the above group which includes 28 children were selected as control group. The rest (22) children selected for the treatment.

3.3.3 Feeding with supplementary food.

The treated group of children (22) were fed twice a week with supplementary food. Mohters were instructed to prepare supplementary food according to the following recipeand to fed their children on every Mondays & Thursdays. Also, instructed them to feed all the amount of food only to the child.

Supplementary food	50g (3tbsp)
Scraped coconut	50g(3tbsp)
Sugar	25g (2tbsp)
Salt	

3.3.4 Data collection

The measurements of height and weight were measured and recorded forghtenightely along with dietary intake of the day prior to the data collection.

3.3.5 Data analysis

Collected data was analyzed using paired t- test at 5% significant level.

Chapter 04.

4.0 Results and Discussion.

4.1 Composition of the supplementary food.

Composition of the supplementary food was obtained as follows;

Protein content	23.734%
Free fat content	4.035%
Total fat content	6.235%
Ash content	1.864%
Fibre content	4.84%
Moisture content	7.042%

4.2 Nutritional status of children before starting the feeding program.

.Table 4.1 Nutritional status of children weight for age.

Child no	Sex	Age in months	Weight in Kg	2 S.D. below median wt/age	Nutritional status.
01	F	42	15.0	11.9	Normal(N)
02	F	39	10.0	11.5	Low (L)
03	F	40	12.5	11.6	N
04	F	45	11.0	12.2	L
05	F	50	11.2	12.3	L
06	F	56	14.0	13.4	N
07	F	60	16.5	13.8	N
08	F	60	14.5	13.8	N
09	F	60	13.0	13.8	L
10	F	36	11.5	11.2	N
11	F	42	11.5	11.9	L
12	F	44	9.0	12.1	L
13	F	42	11.2	11.9	L
14	F	46	11.0	12.3	L

15	F	60	16.0	13.8	N
16	M	38	11.5	11.7	L
17	M	41	13.0	12.0	N
18	M	36	9.9	11.4	L
19	M	39	11.0	11.8	L
20	M	40	14.0	11.9	N
21	M	50	13.0	13.1	L
22	M	54	15.0	13.7	N
23	M	52	13.6	13.4	N
24	M	51	13.2	13.3	L
25	M	56	13.6	13.9	L
26	M	50	15.5	13.1	N
27	M	52	13.5	13.4	N
28	M	48	10.4	12.9	L
29	M	36	12.0	11.4	N
30	M	57	11.3	14.0	L
31	F	41	16.0	11.8	N
32	F	50	14.0	12.8	N
33	F	60	16.0	13.8	N
34	F	42	15.2	11.9	N
35	F	56	13.8	13.4	N
36	F	60	13.0	13.8	L
37	F	37	13.0	11.3	N
38	F	51	12.5	12.9	L
39	F	40	14.5	11.6	N
40	M	51	15.5	13.3	N
41	M	42	13.0	12.1	N
42	M	44	12.0	12.4	L
43	M	59	14.8	14.3	N
44	M	41	14.0	12.0	N
45	M	48	14.2	12.9	N
46	M	56	15.5	13.9	N

47	M	44	13.5	12.4	N
48	F	60	13.0	13.8	L
49	M	54	14.5	13.7	N
50	F	57	16	14.8	

The estimate for deficit in weight for age (Underweight) was 40% in the Lunugamwehera M.O.H.area among 3-5 yrs aged children.

Table 4.2 Nutritional status of children height for age.

Child no	Sex	Age in months	Height in cm	2 S.D. below median ht/age	Nutritional status
01	F	42	95.0	90.2	Normal(N)
02	F	39	86.5	88.4	Low (L)
03	F	40	99.5	89.0	N
04	F	45	95.5	91.9	N
05	F	50	90.0	94.6	L
06	F	56	100.0	97.6	N
07	F	60	107.0	99.5	N
08	F	60	105.0	99.5	N
09	F	60	101.5	99.5	N
10	F	36	85.0	86.5	L
11	F	42	88.5	90.2	L
12	F	44	91.0	91.3	L
13	F	42	95.5	90.2	N
14	F	46	89.0	92.4	L
15	F	60	101.0	99.5	N
16	M	38	91.5	87.9	N
17	M	41	95.5	90.4	N
18	M	36	87.0	87.3	L

19	M	39	91.0	89.2	N
20	M	40	93.0	89.8	N
21	M	50	98.5	95.5	N
22	M	54	102.0	97.7	N
23	M	52	103.0	96.6	N
24	M	51	99.5	96.1	N
25	M	56	101.0	98.7	N
26	M	50	104.5	95.5	N
27	M	52	102.0	96.6	N
28	M	48	96.0	94.4	N
29	M	36	85.0	87.3	L
30	M	57	93.0	99.2	L
31	F	41	98.0	89.6	N
32	F	50	98.5	94.6	N
33	F	60	104.8	99.5	N
34	F	42	94.8	90.2	N
35	F	56	100.0	97.6	N
36	F	60	105.0	99.5	N
37	F	37	89.0	87.1	N
38	F	51	90.0	95.1	L
39	F	40	98.0	89.0	N
40	M	51	100.0	96.1	N
41	M	42	90.0	91.0	L
42	M	44	92.0	92.1	L
43	M	59	104.8	100.1	N
44	M	41	96.0	90.4	N
45	M	48	93.0	94.4	L
46	M	56	106.0	98.7	N
47	M	44	96.5	92.1	N
48	F	60	102.5	99.5	N
49	M	54	109.5	97.7	N
50	F	57	99.0	98.1	N

The estimate for deficit in height for age (stunting) was 26% in the Lunugamwehera M.O.H.area among 3-5 yr. aged children.

Table 4.3 Nutritional status of children weight for height.

Child no	Sex	Age in months	Weight in cm	2 S.D. below median wt/age	Nutritioal status
01	F	42	95	11.6	N
02	F	39	86	9.9	N
03	F	40	99.5	12.5	N
04	F	45	95.5	11.7	L
05	F	50	90	10.7	N
06	F	56	100	12.7	N
07	F	60	107	14.3	N
08	F	60	105	13.8	N
09	F	60	101.5	13	N
10	F	36	85	9.7	N
11	F	42	88.5	10.4	N
12	F	44	91	10.8	L
13	F	42	95.5	11.7	L
14	F	46	89	10.5	N
15	F	60	101	12.9	N
16	M	38	9105	11.2	N
17	M	41	9505	12	N
18	M	36	87	10.3	L
19	M	39	91	11.1	L
20	M	40	93	11.5	N
21	M	50	98.5	12.7	N
22	M	54	102	13.4	N
23	M	52	103	13.7	L
24	M	51	9905	12.9	N
25	M	56	101	13.2	N
26	M	50	104.5	14	N

27	M	52	102	13.4	N
28	M	48	96	12.1	L
29	M	36	85	9.9	N
30	M	57	93	11.5	L
31	F	41	98	12.2	N
32	F	50	98.5	12.3	N
33	F	60	104.8	13.7	N
34	F	42	94.8	11.5	N
35	F	56	100	12.7	N
36	F	60	105	13.8	L
37	F	37	89	10.5	N
38	F	51	90	10.7	N
39	F	40	98	12.2	N
40	M	51	100	13.	N
41	M	42	90	10.9	N
42	M	44	92	11.3	N
43	M	59	104.8	14	N
44	M	41	96	12.1	N
45	M	48	93	11.5	N
46	M	56	106	14.4	N
47	M	44	96.5	12.2	N
48	F	60	102.5	13.2	L
49	M	54	109.5	15.3	L
50	F	57	99	12.4	N

The estimate for deficit in weight for height (wasting) was 22% in the Lunugamwehera M.O.H.area among 3-5 yrs aged children.

4.2.1 Nutrition status by sex.

Table 4.4 - Nutrition status by sex.

Sex	Sample size	Stunting %	Wasting %
Male	24	12	18
Female	26	14	22

4.3 Nutritional status status of children after the study period.

When statistical analyzing of data obtain from the two groups, which are fed with the supplementary food and the control group it can be identify the difference between the groups. The group which is fed with the supplementary food has significant difference from the control group in weight gain.

But, comparing height statistically prove that there is no difference between the two samples.

In interpreting the results obtain by these three indicators which are weight for age, height for age and weight for height, it should be noticeable that an acute lack of food will invariable produce thin children irrespective of their height or age.

On the other hand, a prolong lack of food not only will produce thin children but also will affect their growth and result in a reduce stature. This reduction of stature is usually noticeable even after food supplies have been brought up to normal and individuals are no longer thin.

Likewise, successful supplementation of the diet can be expected to be noticeable first in a change in weight for height, but it may take one year or more to affect the height for age.

Chapter 05

Conclusion & Recommendations.

5.1 Conclusion

According to the statistical analysis of the data, there is a positive effect of supplementary food on improvement of nutritional status of the children, aged 3-5 yrs in the particular area.

There is a significant improvement in the weight of the children at 5% significance level and it is a good indicator of the improvement of the nutritional status. But there is no any significant improvement in height of the children during the survey period at 5% significance level. As the weight is increased, the overall nutritional status was increased due to the feeding of the supplementary food.

So, supplementary feeding programs can improve the nutritional status of individuals. But, impact assessment also important to improve the effectiveness of the program.

5.2 Recommendations for Further Studies.

- Time period was not enough to evaluate the supplementary food on improvement of height of the children. Because, height increases slowly in children. To get measurable height difference takes at least one year. So, study must be conduct for longer period to evaluate the height.
- Sample size is affected to the accuracy of the results. If it is possible to carryout the study with large sample, the accuracy may increased.
- Study must carry out different age groups separately, to study the effect of supplementary food on different age groups.

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Appendix I

Chemical analysis of supplementary food.

01. Determination of free fat content.

Initial weight of the flask = 149.0053 g.

Final constant weight of the flask = 149.4089 g.

Weight of the free fat in the Supplementary food sample = (149.4089-149.0053) g.

= 0.4035 g.

Initial weight of the sample = 10.00 g.

% of free fat in the supplementary food sample

$$= \frac{0.4035 * 100\%}{10.00}$$

= 4.035%

02. Determination of total fat content.

Initial weight of the flask = 64.5563g.

Final constant weight of the flask = 64.6812g.

Weight of the free fat in the Supplementary food sample = (64.6812-64.5563) g.

= 0.1247g.

Initial weight of the sample = 2.00 g.

% of free fat in the supplementary food sample

$$= \frac{0.1247 * 100\%}{2.00}$$

= 6.235%

03. Determination of total ash content.

Weight of the dish with
supplementary food sample = 22.438 g.

weight of the sample = 5.00 g.

Final constant weight of
The dish with ash = 17.5312 g.

% of ash in supplementary food = $\frac{(17.5312-17.4380) * 100\%}{5.00}$

= 1.864%

04.Determination of moisture content.

Weight of the dish with
supplementary food sample = 24.6969 g.

weight of the sample = 5.00 g.

Final constant weight of
The dish with ash = 24.3448 g.

% of moisture in = $\frac{(24.6969-24.3448) * 100\%}{5.000}$
supplementary food

= 7.042 %

05.Determination of fiber content.

Weight of the sample = 10.00 g.

Initial weight of the dish With sample = 41.5995 g.

Final constant weight of the dish = 32.6524 g.
With the sample after drying

Final constant weight of the dish = 32.1679 g.
With the sample after ashing

Weight loss on inceration = $\frac{(32.6524-32.1679)}{10.00}$ *100%

= 4.84%

06.Determination of protein content.

Sample titre. = 10.4 ml

Blank titre. = 4.3 ml

$$\% \text{ of nitrogen} = \left[\frac{(10.4\text{ ml} - 4.3\text{ml}) * 0.5603 * 100}{90\text{ mg}}\right] * 6.25$$

$$= 23.743\%$$

Appendix II.

Results of dietary survey.

No. of child	Day 01 kcal	Day 02 kcal	Day 03 kcal	Average kcal/day
01	999.036	1012.952	1126.366	1046.118
02	938.596	1275.49	1085.94	1100.008
03	1086.27	940.49	1154.34	1060.363
04	865.43	1036.58	1257.193	1053.067
05	1041.84	938.53	1130.793	1037.054
06	1239.414	1048.533	994.5768	1094.174
07	1121.8336	978.5236	1002.17	1034.175
08	960.075	1201.18	1059.89	1073.715
09	1164.843	975.583	959.666	1033.364
10	1097.396	1159.383	939.413	1065.397
11	829.243	1062.85	1146.473	1012.855
12	948.313	1054.216	1022.769	1008.432
13	1038.006	836.322	1276.29	1050.204
14	1136.673	1082.44	911.56	1043.557
15	1156.596	1081.236	1037.295	1091.709
16	1158.566	992.483	975.49	1042.179
17	1053.856	1225.403	960.075	1079.681
18	1048.953	944.793	1028.543	1007.429
19	1012.660	964.8736	1074.523	1017.352
20	820.783	1122.603	1057.720	1000.368
21	1075.1536	1122.8236	1074.046	1090.674
22	1015.8266	1052.5936	1049.0636	1039.161
23	1001.8336	1017.5936	1018.2036	1012.543
24	1123.483	1055.513	1186.175	1121.723
25	1036.400	1034.623	1061.8225	1044.281
26	999.045	1036.54	1157.34	1064.308
27	1230.411	829.309	950.514	1003.411
28	1115.005	1001.025	982.531	1032.853
29	1012.859	990.252	1122.59	1041.900
30	1220.212	854.951	1023.058	1032.740
31	723.514	1204.251	1154.002	1027.255
32	1097.390	954.914	1169.851	1074.051
33	1152.711	973.314	1005.69	1043.905
34	916.1604	1126.673	1082.414	1041.749
35	820.786	1122.60	1057.729	1000.371
36	1092.148	1122.831	1075.153	1096.710
37	1204.214	1002.681	954.01	1053.635
38	984.061	999.654	1024.077	1002.597
39	836.632	1254.251	924.631	1005.171
40	1163.231	1033.36	828.832	1008.474
41	1095.541	1075.1536	973.341	1048.011

42	1123.481	1054.55	1003.25	1060.427
43	973.251	1049.951	1202.666	1075.289
44	1243.324	1051.29	752.431	1015.681
45	1063.24	1222.54	724.223	1003.334
46	999.231	1036.54	1164.23	1066.667
47	1204.256	849.881	972.496	1008.877
48	836.541	1302.05	902.211	1013.600
49	815.450	1003.54	1264.25	1027.746
50	1042.36	994.251	990.204	1008.938

Appendix III.

NCHS Reference values.

Table 01- Stature (cm) by age of boys aged 3-5 years.

Age		-3SD	-2SD	-1SD	Median	+1SD	+2SD	+3SD
Yrs.	Mon.							
3	0	85.3	87.3	91.1	94.9	98.7	102.5	106.3
3	1	84.1	87.9	91.8	95.6	99.5	103.3	107.2
3	2	84.7	88.6	92.4	96.3	100.2	104.1	108.0
3	3	85.2	89.2	93.1	97.0	101.0	104.9	108.8
3	4	85.8	89.8	93.8	97.7	101.7	105.7	109.7
3	5	86.4	90.4	94.4	98.4	102.4	106.4	110.5
3	6	86.9	91.0	95.0	99.1	103.1	107.2	111.2
3	7	87.5	91.6	95.7	99.7	103.8	107.9	112.0
3	8	88.0	92.1	96.3	100.4	104.5	108.7	112.8
3	9	88.6	92.7	96.9	101.0	105.2	109.4	113.5
3	10	89.1	93.3	97.5	101.7	105.9	110.1	114.3
3	11	89.6	93.9	98.1	102.3	106.6	110.8	115.0
4	0	90.2	94.4	98.7	102.9	107.2	110.5	115.7
4	1	90.7	95.0	99.3	103.6	107.9	112.2	116.5
4	2	91.2	95.5	99.9	104.2	108.5	112.8	117.2
4	3	91.7	96.1	100.4	104.8	109.1	113.5	117.8
4	4	92.2	96.6	101.0	105.4	109.8	114.2	118.5
4	5	92.7	97.1	101.6	106.0	110.4	114.8	119.2
4	6	93.2	97.7	102.1	106.6	111.0	115.4	119.9
4	7	93.7	98.2	102.7	107.1	111.6	116.1	120.5
4	8	94.2	98.7	103.2	107.7	112.2	116.7	121.2
4	9	94.7	99.2	103.7	108.3	112.8	117.3	121.8
4	10	95.2	99.7	104.3	108.8	113.4	117.9	122.5
4	11	95.7	100.2	104.8	109.4	114.0	118.5	123.1
5	0	96.1	100.7	105.3	109.9	114.5	119.1	123.7

Table 02 - Stature (cm) by age of girls aged 3-5 years.

Age		-3SD	-2SD	-1SD	Median	+1SD	+2SD
3	0	82.8	86.5	90.2	93.9	97.6	101.4
3	1	83.4	87.1	90.9	94.6	98.4	102.1
3	2	84.0	87.7	91.5	95.3	99.1	102.9
3	3	84.5	88.4	91.2.	96.0	99.8	103.6
3	4	85.1	89.0	92.8	96.6	100.5	104.3
3	5	85.7	89.6	93.4	97.3	101.2	105.0
3	6	86.3	90.2	94.0	97.9	101.8	105.7
3	7	86.8	90.7	94.7	98.6	102.5	106.4
3	8	87.4	91.3	95.3	99.2	103.1	107.1
3	9	87.9	91.9	95.8	99.8	103.8	107.8
3	10	88.4	92.4	96.4	100.4	104.4	108.4
4	11	89.0	93.0	97.0	101.0	105.1	109.1
5	0	89.5	93.5	97.6	101.6	105.7	109.7
4	1	90.0	94.1	98.1	102.2	106.3	110.4
4	2	90.5	94.6	98.7	102.8	106.9	111.0
4	3	91.0	95.1	99.3	103.4	107.5	111.6
4	4	91.5	95.6	99.8	104.0	108.1	112.3
4	5	92.0	96.1	100.3	104.5	108.7	112.9
4	6	92.4	96.7	100.9	105.1	109.3	113.5
4	7	92.9	97.1	101.4	105.6	109.9	114.1
4	8	93.4	97.6	101.9	106.2	110.5	114.8
4	9	93.8	98.1	102.4	106.7	111.1	115.4
4	10	94.3	98.6	102.9	107.3	111.6	116.0
4	11	94.7	99.1	103.5	107.8	112.2	116.6
5	0	95.1	99.5	104.0	108.4	112.8	117.2

Table 03 - Weight (kg) by age of boys aged 3-5 years.

Age		-3SD	-2SD	-1SD	Median	+1SD	+2SD	+3SD
Yrs.	Mon.							
3	0	9.8	11.4	13.0	14.6	16.4	18.3	20.1
3	1	9.9	11.5	13.2	14.8	16.6	18.5	20.3
3	2	10.0	11.7	13.3	15.0	16.8	18.7	20.5
3	3	10.1	11.8	13.5	15.2	17.0	18.9	20.7
3	4	10.2	11.9	13.6	15.3	17.2	19.1	21.0
3	5	10.3	12.0	13.8	15.5	17.4	19.3	21.2
3	6	10.4	12.1	13.9	15.7	17.6	19.5	21.4
3	7	10.5	12.3	14.1	15.8	17.8	19.7	21.7
3	8	10.6	12.4	14.2	16.0	18.0	19.9	21.9
3	9	10.7	12.5	14.4	16.2	18.2	20.1	22.1
3	10	10.8	12.6	14.5	16.4	18.4	20.4	22.4
3	11	10.9	12.8	14.6	16.5	18.6	20.6	22.6
4	0	11.0	12.9	14.8	16.7	18.7	20.8	22.8
4	1	11.1	13.0	14.9	16.9	18.9	21.0	23.1
4	2	11.2	13.1	15.1	17.0	19.1	21.2	23.3
4	3	11.3	13.3	15.2	17.2	19.3	21.4	23.6
4	4	11.4	13.4	15.4	17.4	19.5	21.7	23.8
4	5	11.5	13.5	15.5	17.5	19.7	21.9	24.1
4	6	11.6	13.7	15.7	17.7	19.9	22.1	24.3
4	7	11.8	13.8	15.8	17.9	20.1	22.3	24.6
4	8	11.9	13.9	16.0	18.0	20.3	22.6	24.8
4	9	12.0	14.0	16.1	18.2	20.5	22.8	25.1
4	10	12.1	14.2	16.3	18.3	20.7	23.0	25.4
4	11	12.2	14.3	16.4	18.5	20.9	23.3	25.6
5	0	12.3	14.4	16.6	18.7	21.1	23.5	25.9

Table 04- weight (kg) by age of girls aged 3-5 years.

Age		-3SD	-2SD	-1SD	Median	+1SD	+2SD	+3SD
Yrs.	Mon.							
3	0	9.7	11.2	12.6	14.1	16.1	18.0	20.0
3	1	9.8	11.3	12.8	14.3	16.3	18.3	20.2
3	2	9.9	11.4	12.9	14.4	16.5	18.5	20.5
3	3	10.0	11.5	13.1	14.6	16.7	18.7	20.8
3	4	10.1	11.6	13.2	14.8	16.9	19.0	21.1
3	5	10.2	11.8	13.3	14.9	17.0	19.2	21.3
3	6	10.3	11.9	13.5	15.1	17.2	19.4	21.6
3	7	10.4	12.0	13.6	15.2	17.4	19.6	21.8
3	8	10.5	12.1	13.7	15.4	17.6	19.8	22.1
3	9	10.6	12.2	13.9	15.5	17.8	20.1	22.3
3	10	10.7	12.3	14.0	15.7	18.0	20.3	22.6
3	11	10.8	12.4	14.1	15.8	18.1	20.5	22.8
4	0	10.9	12.6	14.3	16.0	18.3	20.7	23.1
4	1	10.9	12.7	14.4	16.1	18.5	20.9	23.3
4	2	11.0	12.8	14.5	16.2	18.7	21.1	23.5
4	3	11.1	12.9	14.6	16.4	18.9	21.3	23.8
4	4	11.2	13.0	14.8	16.5	19.0	21.5	24.0
4	5	11.3	13.1	14.9	16.7	19.2	21.7	24.3
4	6	11.4	13.2	15.0	16.8	19.4	21.9	24.5
4	7	11.5	13.3	15.1	17.0	19.6	22.2	24.8
4	8	11.5	13.4	15.2	17.1	19.7	22.4	25.0
4	9	11.6	13.5	15.4	17.2	19.9	22.6	25.3
4	10	11.7	13.6	15.5	17.4	20.1	22.8	25.5
4	11	11.8	13.7	15.6	17.5	20.3	23.0	25.8
5	0	11.9	13.8	15.7	17.7	20.4	23.2	26.0

Table 05- Weight (kg) by height (cm) of boys aged 3-5 years.

Height	-3SD	-2SD	-1SD	Median	+1SD	+2SD
85.0	8.9	9.9	11.0	12.1	15.0	16.5
85.5	8.9	10.0	11.1	12.2	15.1	16.6
86.0	9.0	10.1	11.2	12.3	15.3	16.7
86.5	9.1	10.2	11.3	12.5	15.4	16.8
87.0	9.2	10.3	11.4	12.6	15.5	16.9
87.5	9.3	10.4	11.5	12.7	15.6	17.1
88.0	9.4	10.5	11.6	12.8	15.7	17.2
88.5	9.5	10.6	11.7	12.9	15.8	17.3
89.0	9.6	10.7	11.8	13.0	16.0	17.4
89.5	9.7	10.8	11.9	13.1	16.1	17.5
90.0	9.8	10.9	12.0	13.3	16.2	17.6
90.5	9.9	11.0	12.1	13.4	16.3	17.8
91.0	9.9	11.1	12.2	13.5	16.4	17.9
91.5	10.0	11.2	12.3	13.6	16.5	18.0
92.0	10.1	11.3	12.4	13.7	16.7	18.1
92.5	10.2	11.4	12.5	13.9	16.8	18.3
93.0	10.3	11.5	12.6	14.0	16.9	18.4
93.5	10.4	11.6	12.8	14.1	17.0	18.5
94.0	10.5	11.7	12.9	14.2	17.2	18.6
94.5	10.6	11.8	13.0	14.3	17.3	18.8
95.0	10.7	11.9	13.1	14.5	17.4	18.9
95.5	10.8	12.0	13.2	14.6	17.5	19.0
96.0	10.9	12.1	13.3	14.7	17.7	19.2
96.5	11.0	12.2	13.4	14.8	17.8	19.3
97.0	11.1	12.4	13.5	15.0	17.9	19.4
97.5	11.2	12.5	13.7	15.1	18.1	19.6
98.0	11.3	12.6	13.8	15.2	18.2	19.7
98.5	11.4	12.7	13.9	15.4	18.4	19.9
99.0	11.5	12.8	14.0	15.5	18.5	20.0
99.5	11.6	12.9	14.1	15.6	18.6	20.2
100.0	11.7	13.0	14.3	15.7	18.8	20.3
100.5	11.8	13.1	14.4	15.9	18.9	20.5
101.0	11.9	13.2	14.5	16.0	19.1	20.6
101.5	12.0	13.3	14.6	16.2	19.2	20.8
102.0	12.1	13.4	14.7	16.3	19.4	20.9
102.5	12.2	13.6	14.9	16.4	19.5	21.1
103.0	12.3	13.7	15.0	16.6	19.7	21.3
103.5	12.4	13.8	15.1	16.7	19.9	21.4
104.0	12.5	13.9	15.3	16.9	20.0	21.6
104.5	12.6	14.0	15.4	17.0	20.2	21.8
105.0	12.7	14.2	15.5	17.1	20.4	22.0
105.5	12.8	14.3	15.6	17.3	20.5	22.2
106.0	12.9	14.4	15.8	17.4	20.7	22.4

106.5	13.0	14.5	15.9	17.6	20.9	22.5
107.0	13.1	14.7	16.1	17.7	21.1	22.6
107.5	13.2	14.8	16.2	17.9	21.3	22.7
108.0	13.4	14.9	16.3	18.0	21.4	22.9
108.5	13.5	15.0	16.5	18.2	21.6	23.1
109.0	13.6	15.2	16.6	18.3	21.8	23.4
109.5	13.7	15.3	16.8	18.5	22.0	23.6
110.0	13.8	15.4	16.9	18.7	22.2	23.8

Table 06 - weight (kg) by height (cm) of girls 3-5years.

Height	-3SD	-2SD	-1SD	Median	+1SD	+2SD
85.0	8.6	9.7	13.2	14.6	13.2	15.9
85.5	8.7	9.8	13.3	14.7	13.3	16.1
86.0	8.8	9.9	13.4	14.8	13.4	16.2
86.5	8.9	10.0	13.5	14.9	13.5	16.3
87.0	9.0	10.1	13.7	15.1	13.7	16.4
87.5	9.1	10.2	13.8	15.2	13.8	16.6
88.0	9.2	10.3	13.9	15.3	13.9	16.7
88.5	9.3	10.4	14.0	15.4	14.0	16.8
89.0	9.3	10.5	14.1	15.6	14.1	17.0
89.5	9.4	10.6	14.2	15.7	14.2	17.1
90.0	9.5	10.7	14.4	15.8	14.3	17.3
90.5	9.6	10.7	14.5	15.9	14.4	17.4
91.0	9.7	10.8	14.6	16.1	14.5	17.5
91.5	9.8	10.9	14.7	16.2	14.6	17.7
92.0	9.9	11.0	14.9	16.3	14.7	17.8
92.5	9.9	11.1	15.0	16.5	14.9	18.0
93.0	10.0	11.2	15.1	16.6	15.0	18.1
93.5	10.1	11.3	15.2	16.7	15.1	18.3
94.0	10.2	11.4	15.4	16.9	15.2	18.4
94.5	10.3	11.5	15.5	17.0	15.4	18.6
95.0	10.4	11.6	15.6	17.2	15.5	18.7
95.5	10.5	11.7	15.8	17.3	15.6	18.9
96.0	10.6	11.8	15.9	17.5	15.8	19.0
96.5	10.7	11.9	16.0	17.6	15.9	19.2
97.0	10.7	12.0	16.2	17.8	16.0	19.3
97.5	10.8	12.1	16.3	17.9	16.2	19.5
98.0	10.9	12.2	16.5	18.1	16.3	19.7
98.5	11.0	12.3	16.6	18.2	16.5	19.8
99.0	11.1	12.4	16.7	18.4	16.6	20.0
99.5	11.2	12.5	16.9	18.5	16.7	20.1
100.0	11.3	12.7	17.0	18.7	16.9	20.3
100.5	11.4	12.8	17.2	18.8	17.0	20.5
101.0	11.5	12.9	17.3	19.0	17.2	20.7
101.5	11.6	13.0	17.5	19.1	17.3	20.8
102.0	11.7	13.1	17.6	19.3	17.5	21.0
102.5	11.8	13.2	17.8	19.5	17.6	21.2
103.0	11.9	13.3	17.9	19.6	17.8	21.4
103.5	12.0	13.4	18.1	19.8	17.9	21.6
104.0	12.1	13.5	18.2	20.0	18.1	21.7
104.5	12.2	13.7	18.4	20.1	18.2	21.9
105.0	12.3	13.8	18.5	20.3	18.5	22.1
105.5	12.4	13.9	18.7	20.5	18.7	22.3
106.0	12.5	14.0	18.9	20.7	18.9	22.5

106.5	12.6	14.1	19.0	20.9	19.0	22.7
107.0	12.7	14.3	19.2	21.0	19.2	22.9
107.5	12.8	14.4	19.3	21.2	19.3	23.1
108.0	13.0	14.5	19.5	21.4	19.5	23.3
108.5	13.1	14.6	19.7	21.6	19.7	23.5
109.0	13.2	14.8	19.8	21.8	19.8	23.7
109.5	13.3	14.9	20.0	22.0	20.0	23.9
110.0	13.4	15.0	20.2	22.2	20.2	24.1

Appendix IV

Statistical analysis of the data

Bonferroni confidence intervals for standard deviations

Lower	Sigma	Upper	N	Factor Levels
4.65913	5.21902	5.92517	176	1
5.91919	6.61475	7.48750	184	2

F-Test (normal distribution)

Test Statistic: 1.606
P-Value : 0.002

Levene's Test (any continuous distribution)

Test Statistic: 21.022
P-Value : 0.000

Homogeneity of Variance

Response weight combi
Factors subscript
ConfLvl 95.0000

Bonferroni confidence intervals for standard deviations

Lower	Sigma	Upper	N	Factor Levels
1.67051	1.87125	2.12444	176	1
1.62891	1.82032	2.06049	184	2

F-Test (normal distribution)

Test Statistic: 1.057
P-Value : 0.712

Levene's Test (any continuous distribution)

Test Statistic: 0.606
P-Value : 0.437

Two Sample T-Test and Confidence Interval

Two sample T for Wt vs Wtc

	N	Mean	StDev	SE Mean
Wt	176	14.03	1.87	0.14
Wtc	184	13.58	1.82	0.13

95% CI for mu Wt - mu Wtc: (0.06, 0.83)
T-Test mu Wt = mu Wtc (vs >): T = 2.30 P = 0.011 DF = 358
Both use Pooled StDev = 1.85

Two Sample T-Test and Confidence Interval

Two sample T for Ht vs Htc

	N	Mean	StDev	SE Mean
Ht	176	97.75	5.22	0.39
Htc	184	97.07	6.61	0.49

95% CI for mu Ht - mu Htc: (-0.55, 1.91)
T-Test mu Ht = mu Htc (vs >): T = 1.09 P = 0.14 DF = 345

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