

CHAPTER - IV

RESULTS AND DISCUSSION

The consequent outcome of this research named “**Effect of Nutrition Interventions on Vitamin A and Iron Nutriture of School Children (6 – 8 years) from Fishermen Community**”, are discussed and analyzed individually in detail under the successive sections.

Phase I: Prevalence of VAD and IDA among Fisherfolk Children in the Selected Villages

- A. Socio-Economic Background of the Fisherfolk Children
- B. Clinical Symptoms of VAD and IDA among the Fisherfolk Children
- C. Nutritional Anthropometry of the Fisherfolk Children
- D. Dietary Pattern of the Fisherfolk Children

Phase II: Background Information and Nutritional Status of Fisherfolk Children Selected for Supplementation

- A. Socio-Economic Background of the Selected Children for Supplementation
- B. Nutritional Status of the Children before Supplementation

Phase III: Acceptability and Nutritive Value of Orange Fleshed Sweet Potato

- A. Acceptability trails orange fleshed sweet potato
- B. Nutrient content of boiled orange fleshed sweet potato supplement

Phase IV: Impact of Intervention on Nutritional Status and Knowledge, Attitude and Practice (KAP)

- A. Impact of supplementation of orange fleshed sweet potato
- B. Impact of nutrition education on KAP

Phase I: Prevalence of VAD and IDA among Fisherfolk Children in the Selected Villages

A. Socio Economic Background of the Fisherfolk and their Children

The background information along with socio-economic status of the fisherfolk in the research area are presented in Tables and Figures.

The selected eight fisherfolk villages were particularly chosen for the study as almost all the fishermen families residing are below poverty line. The villages in spite of having Panchayat Union Primary School, Anganwadi, Post office, Ration shop and

Gramina Bank lack essential facilities like Cyclone shelter, Ice plants, Fish drying platform and railway station. Though the government claimed to provide the villages with electricity, pucca houses, supply of drinking water and proper medical centres, none of them were truly implemented. Most of the fishermen live in small and congested kaccha houses with no latrines and improper sanitation. Away from today’s globalized world, fisherfolk live a life in the midst of poverty and uncertainty.

1. Population of the selected fishing villages

The areas selected for the study are the coastal areas of East Godavari region of Andhra Pradesh state focusing 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 Konapaapeta, were chosen keeping in view the practicability in implementation of the research, accessibility of subjects and cooperation from the authorities.

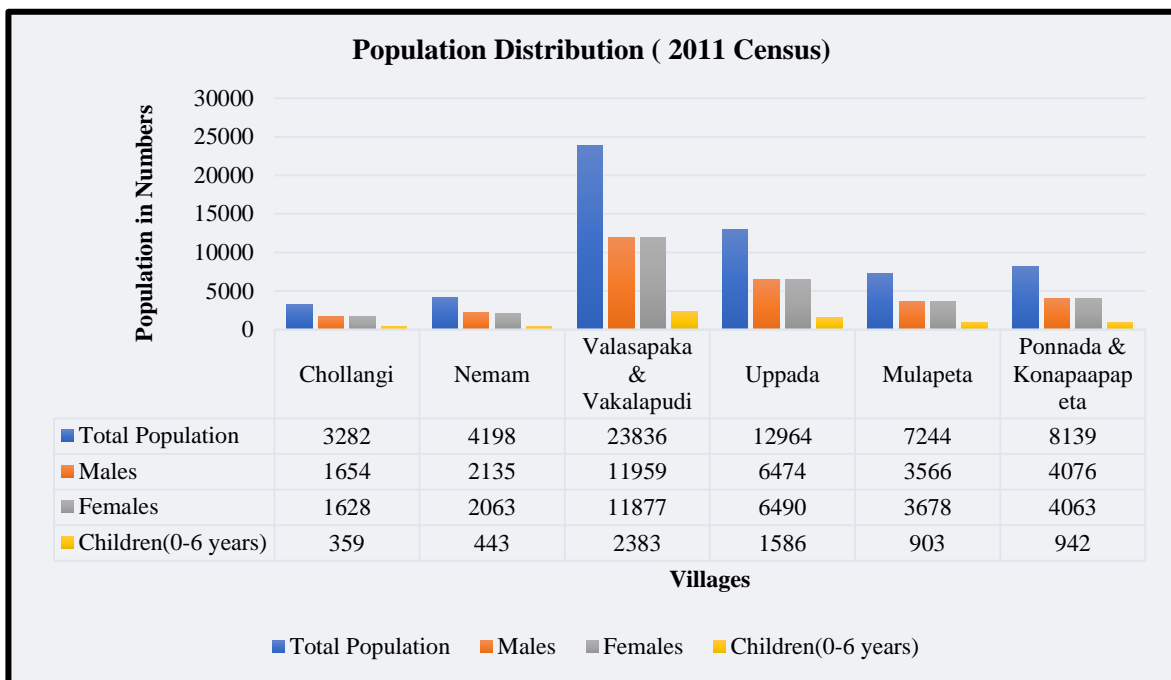


Figure 7: Population Distribution of Fisherfolk in the Selected Villages

Chollangi

Chollangi, a hamlet situated in Thallarevu Mandal of East Godavari territory, Andhra Pradesh, is positioned 9 km south from district headquarters, Kakinada. It is close to Bay of Bengal with a total population of 3282 and the number of houses is 870. The female population is 1628. The child population (0-6years) was 359 (2011 census).

Nemam

Nemam, a small hamlet in Kakinada Rural Tehsil of East Godavari district is situated 11 km away from district headquarter Kakinada. The total geographic area is 666 hectares. It is close to Bay of Bengal. Nemam is populated with 4,198 inhabitants with a male population of 2,135 and female population of 2,063 and has 1,105 houses. The child population (0-6years) was 463.

Vakalapudi and Valasapaka

Vakalapudi and Valasapaka are coastal villages of Kakinada rural Mandal, East Godavari district, India. They are situated 7 km from district headquarter Kakinada. It is near to Bay of Bengal. According to Census 2011, the population is 23,836 comprising of 6308 households. Out of this 11,959 are males while the females count 11,877. The child population (0-6years) is 2383.

Uppada

Uppada hamlet in Kothapalle mandala of East Godavari district is situated on coastline having a total of 3190 families and a population of 12,964. Out of which 6474 are males and 6490 are females as recorded in population census 2011. The child population (0-6years) is 1586.

Mulapeta

Mulapeta is a coastal hamlet in Kothapalle mandala of East Godavari district is 26 km from district headquarters Kakinada. The total geographic area is 540 hectares. It has a total of 2020 houses and a population of 7244. There are 3566 males and 3678 females as recorded in population census 2011. The child population (0-6years) is 903. It is positioned on coastline of Bay of Bengal and the main occupation of the people here was fishing and agriculture.

Ponnada and Konapaapeta

Ponnada and Konapaapeta are coastal hamlets in Kothapalle mandala of East Godavari district is 27 km from district headquarters Kakinada. The geographic area is 1586 hectares. It has a total of 2165 houses and a population of 8,139. Out of which 4076 are males and 4063 are females as per population census 2011. The child population (0-6years) is 942.

2. Religion and community- wise distribution of the fishermen population

The religion and community system are an important indicator of socio-economic conditions of the fishermen community. The data collected during the study period have indicated that, many fishermen families were Christians (56 per cent) mostly converted to Christianity from other religions, Hindus (38 per cent) and Muslims (6 per cent). They were also categorized into scheduled caste also called as 'Palle', the lowest sector in fishing community and scheduled tribe who involved in net making and boat construction works.

Agni Kula Kshatriya caste is also found in the fishermen community who are generally traditional river fishers and Vadabalijas who are traditional marine fisher caste.

3. Residential status of the fisherfolk population

A total of 15,658 houses were surveyed in the eight villages during the study. Ownership of the house is an indicator to reveal the socio-economic conditions of fishermen. It was observed that, out of all the houses surveyed, 8451 houses belonged to the fishermen families in which only 47 per cent of their families have got own houses. Out of own houses, 16 per cent were constructed by the Government (in various schemes and tsunami relief houses). Out of the total number of houses surveyed, 13 per cent live in concrete houses, 28 per cent reside in tiled houses 21 per cent in thatched houses, an 38 per cent of the fishermen live in litter roofed houses. Moreover, the houses of the fishermen hardly have basic amenities like the toilet and wash area. Only four per cent of the total surveyed households have a separate toilet and the remaining households use the common toilet provided by the Government of Andhra Pradesh but mostly open defecation was noticed in all villages. Most of the houses have only two rooms, a living room cum bedroom and a kitchen. The concrete houses built under the Government Schemes, had three rooms but were very small in size. The majority of the houses surveyed were very small in size with very less ventilation and accommodating more than six members indicating the poor socio- economic status of the fishermen families.

4. Basic amenities (Electricity, Sanitation, and Drinking water)

Electricity is one of the basic necessities required in our present day-to-day living. It is also one of the indicators that measures the socio-economic stature of the fisherfolks. During the survey it was observed that about 86 per cent of the fishermen houses were provided with electricity. Sanitation in the fishermen villages was at a very poor state. The

data reveals that 78.6 per cent of the households in the coastal villages of fishermen do not have any household toilets. Only 21.4 per cent of the total surveyed households have a separate toilet facility and the remaining households either use the common toilet provided by the Government of Andhra Pradesh or mostly defecate in open places. The open defecation by the fishermen population in the areas nearby their residence was identified as one of the main causes for the spread of infectious diseases among the fisherfolk population, which thereby weakens their socio-economic condition by affecting their health. Drinking water is the most important must-to-have basic amenity to one and all. The data obtained during the study brought to light that the fisherfolk, even though, were provided with drinking water supply, the salinity of ground water was very high. The data indicates that 81 per cent of the fisherfolks households in the selected villages were using public water taps available on the streets which were provided by the government of Andhra Pradesh. The remaining 19 per cent of the fisherfolk rely on well water or borewell water for drinking purpose.

5. Educational status of the fisherfolk population

Literacy is another factor to assess the standard of a nation's human capital. It is the key for socio-economic progress and education is the foundation of development in any society. The literacy rate of the fisherfolk of the selected villages is presented in Table VII and Figure 8.

Table VII
Literacy Rate of Fisherfolk of the Selected Villages

Villages	Total Literacy Rate (%)	Male Literacy Rate (%)	Female Literacy Rate (%)
Chollangi	72.02	72.9	71.2
Nemam	44	60	28.1
Vakalapudi and Valasapaka	50.7	70.1	31.2
Uppada	50.2	52.5	48
Mulapeta	56.5	59.5	53.5
Ponnada and Konapaapeta	56.9	58.6	55.2

It was observed during the study that the fisherfolk have a positive attitude towards education. But their poverty and poor economic conditions could not provide desirable education in their community. Though the Government of Andhra Pradesh has been

providing different schemes towards attaining education, many of the fisherfolks children don't attend school in order to participate in fishing with their elders or doing the household chores. The data collected clearly reveals that the average literacy rate in the eight fishermen villages surveyed was 61.08 per cent in which the men's literacy rate was 62.3 per cent and the women's literacy rate was 47.85 per cent.

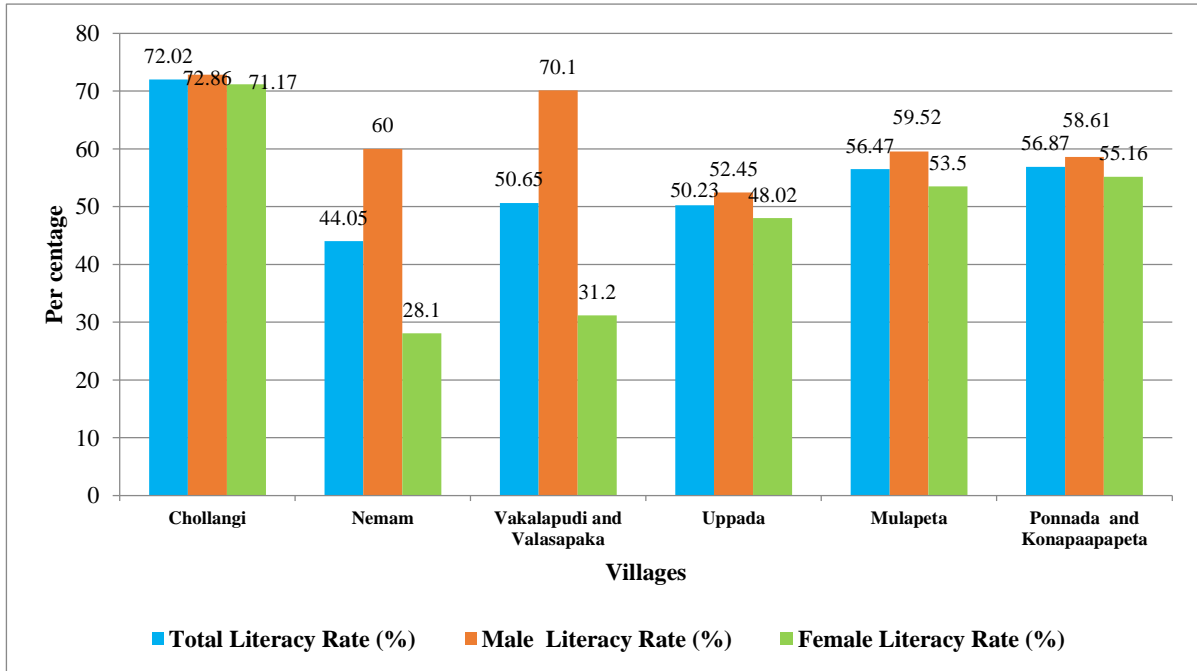


Figure 8: Literacy Rate of Fisherfolk of the Selected Villages

From the table it is evident that the fisherfolk of the coastal village Chollangi have a total level of literacy of 72.0 per cent in which the men's level of literacy was 72.9 per cent and the women's level of literacy was 71.2 per cent. The fisherfolk of the Nemam village have a total level of literacy of 44.1 per cent in which the men's level of literacy was 60 per cent and the women's level of literacy was very low, 28.1 per cent. The fisherfolk of the Vakalapudi and Valasapaka villages together have a total level of literacy of 50.7 per cent in which the men's educational level was 70.1 per cent and the women's educational level was recorded as very low, 31.2 per cent. In Uppada village the total level of literacy was 50.2 per cent, the lowest of all the villages surveyed. The men's level of literacy was 52.5 per cent and the women's level of literacy was 48.0 per cent. In Mulapeta village the total level of literacy was 56.5 per cent, the lowest of all the villages surveyed. The men's level of literacy was 59.5 per cent and the women's level of literacy was 53.5 per cent. The fisherfolk of the Ponnada and Konapaapeta villages together have a total level of literacy of 56.9 per cent in which the men's level of literacy was

58.6 per cent and the women’s level of literacy was 55.2 per cent. A greater per cent of the fisherfolk were educated only up to primary or secondary school level. The majority of them were school-dropouts. And it could be seen evidently from that the women’s level of literacy was far below average when compared with the men’s level of literacy. These numbers and rates are the reminder that fisherfolk community was far off from the development when compared to the rest of the world.

6. Employment status of the fishermen population

As a matter of fact, it is well known that fishing as an occupation is full of uncertainties. It’s not possible to fish all 365 days a year due to environmental issues, marine conservation issues, lean fishery season etc. Fishermen’s main employment is fishing and its associated activities and majority of them do not opt for any subsidiary occupation in times of non-fishing days. The data obtained in this regard during the study revealed that the main fishing workers were those who work for 6 months or more and marginal fishing workers were those who work for less than 6 months in the occupation.

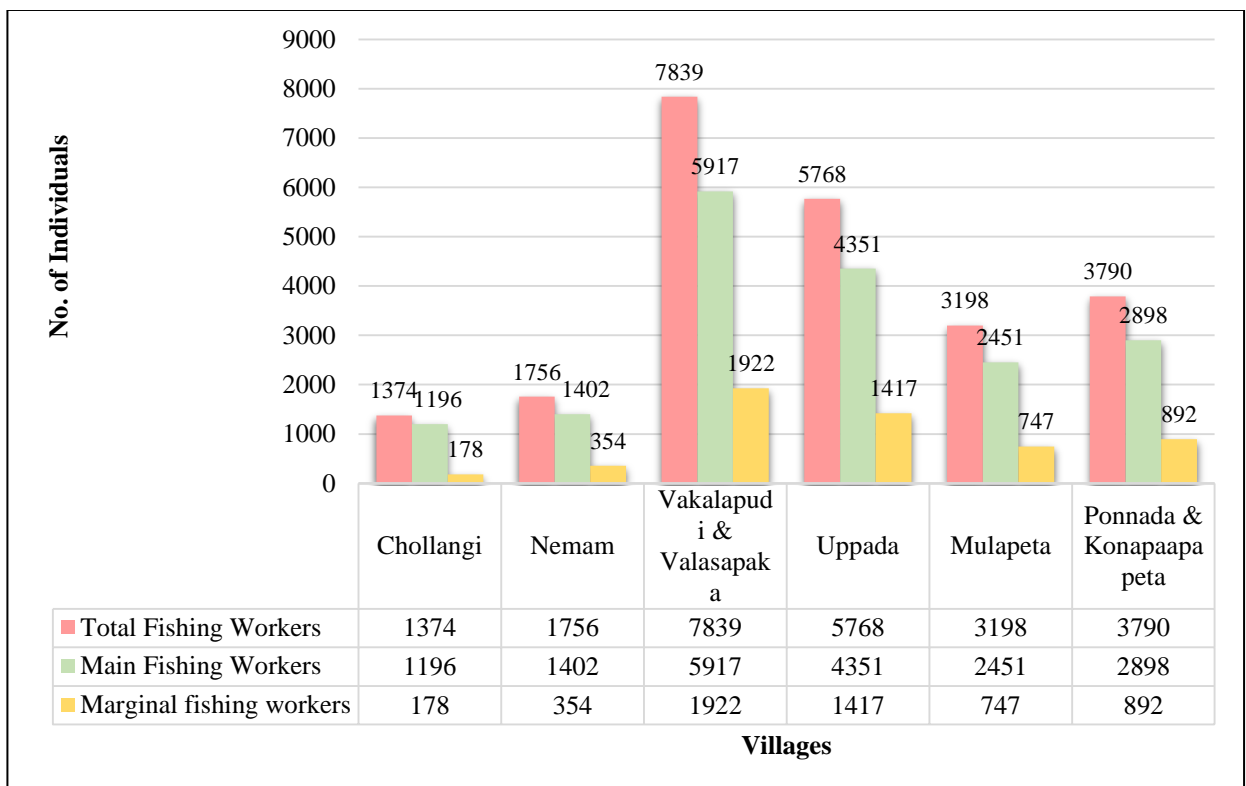


Figure 9: Employment Status of the Fisherfolk of the Selected Villages

We boast about our Country’s fishing resources and production. But the hardship, pain and sacrifices that goes into it and on the people, who rely on it is hard to imagine. If the data collected was analysed, it was evident that out of the 59,663 total fishermen

population in the eight villages surveyed, 23,725 (44.6 per cent) of them which includes both men and women, work on fishing as their source of income. In the total workers, 76 per cent of them were the main fishing workers who earn income to their households only by fishing activities and 24 per cent were marginal workers who apart from fishing engage themselves in other works too. Most women of the fisherfolk communities were involved in household works, drying fish, fresh fish and dry fish vendors but not in major fishing activities, hence there was no much remarkable improvement in the economic status as their household income was dependent solely on the men's income only.

7. Background information on type of family and children of fisherfolk

The family is an important measure of the socio-economic stature of any community. The type of family and the number of family members in it can indicate the structural background of the family and its economic status. The details of the type of family are presented in Table VIII.

Table VIII

Type of Family of the Selected Fisherfolk

Types of family (N=1000)		
Family Type	No. of Children	per cent of Children
Joint	622	62.2
Nuclear	378	37.8
Total	1000	100

From the Table VIII, it is evident that out 62 per cent of fisherfolk children residing in joint families and 38 per cent in nuclear families.

Among all subjects, 62 per cent children belong to joint families and 38 per cent belong to individual households. It is obvious that relatively high per centage of the fisherfolk believe and live-in joint family system as they believe that it would help them cut down on labour and increase income. Similar findings were reported by Mozahid et al. (2018) wherein revealed, 53.8 per cent of Bangladesh fishermen live in joint families. Aneena (2003) also came up with similar finding in the study that 67 per cent of the fishermen of coastal regions of Thrissur, abided in joint families while 33 per cent lived in nuclear families.

Table IX

No. of Children per Selected Fishermen's Household
(N=1000)

No. of Children	No. of Households	Per cent of Households
1-2 children	351	35.1
3-4 children	332	33.2
5-6 children	421	42.1
7 and above	176	17.6

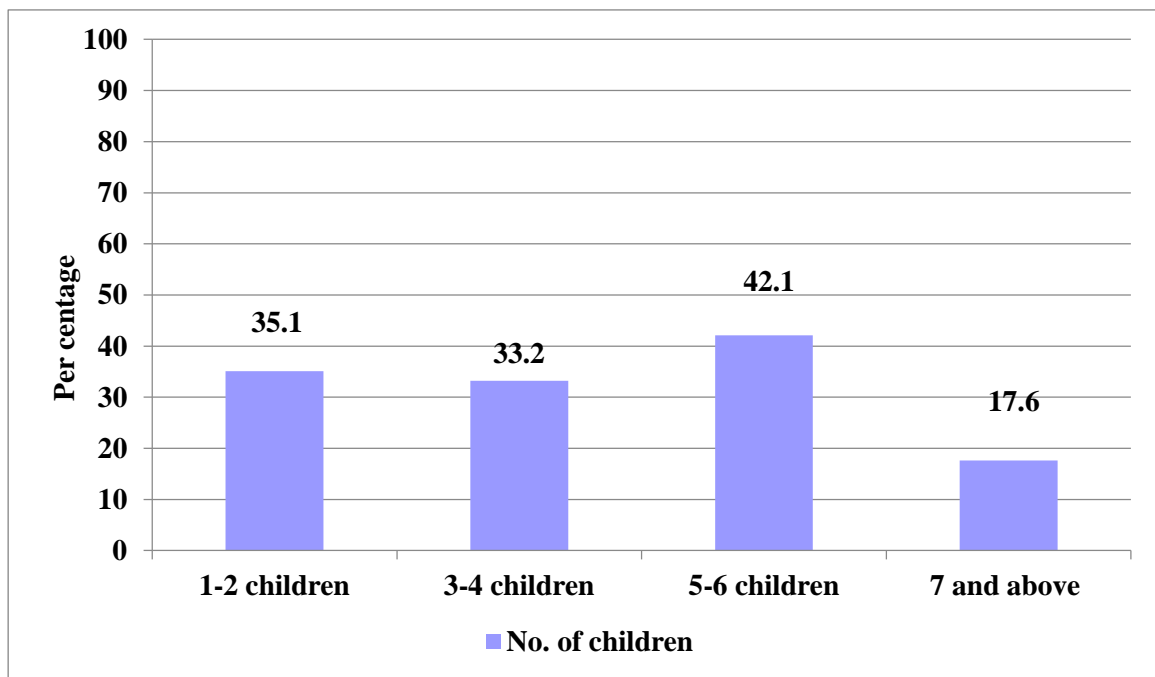


Figure 10: No. of children per Selected Fishermen's Household

From the Table IX and Figure 10, it is evident that 351 households of fishermen had 1-2 children, 332 households had 3-4 children, 421 households had 5-6 children and 176 households had seven children and above.

8. Monthly income range of fisher folk families

Fishing income depends on fish prices, fishing costs and catch which always fluctuates. The primary and secondary data were employed in the collection of data regarding income generated by the family. The primary data was collected from respondents and the secondary data was sourced from the published data from the

Department of Fisheries, Government of Andhra Pradesh. It was identified and measured by a detailed study of cost and earnings of fishermen which was discussed during the interview with the head of the family with the help of a pre-designed interview schedule. The same method of collection of data was employed by Marimuthu, et al., (2015) in their study on Income and Expenditure of Inland Fishermen in Theni Province, India..

Table X depicts the monthly income range of the selected fisherfolk children's families

Table X
Monthly Income Range of the Selected Fisherfolk Children's Families

Monthly Income	Total Families (N =1000)	
	No.	%
INR		
< 2000	35	3.5
2001 -5000	907	90.7
5001- 10000	58	5.8
Total	1000	100

The number of earning members in the fishermen families vary from a minimum of one to a maximum of three and their source of income was fishing. It was observed that, among the earning members, men play a dominant role whereas the women were not regular earning members. Fisher folk women though they participate in drying fish, sell fresh fish and dry fish earn very little money as they do not participate in major fishing activities. 3.5 per cent were earning less than Rs. 2000, 90.7 per cent earned between Rs. 2000-5000 and 5.8 per cent earned an income of Rs. 5000-10000.

The present study was in coherence with the data of Shailendra Sharma, et al., (2010) that traditional fishermen have fishing as the only source of income and do not frequently participate in the fishing related works and non-fishing activities.

9. Monthly expenditure range of fisherfolk families

Table XI and Figure 11 revealed that monthly expenses of fisherfolk families.

Table XI

Monthly Expenditure of the Fisherfolk Families

Details of expenditure	Mean expenditure	
	INR	per cent
Food	1363	14.5
Paan/Betel Nut/Tobacco and Alcoholic Drinks	3308.9	35.6
Clothing	533.1	5.7
Purchase of household needs	593.3	6.4
Transport	691.6	7.5
House Rent /boat rent	1568.1	16.4
Debts	1258.3	13.6
Total expenditure per month	9316.3	100

In the present study it can be evidently seen that almost every fisherfolk family spent a considerable part of their income, i.e., 35.6 per cent on alcohol, tobacco, paan, and betel nut. It could be clearly understood that both men and women of the fisherfolk community were addicted to these bad habits in spite of their low income and poverty.

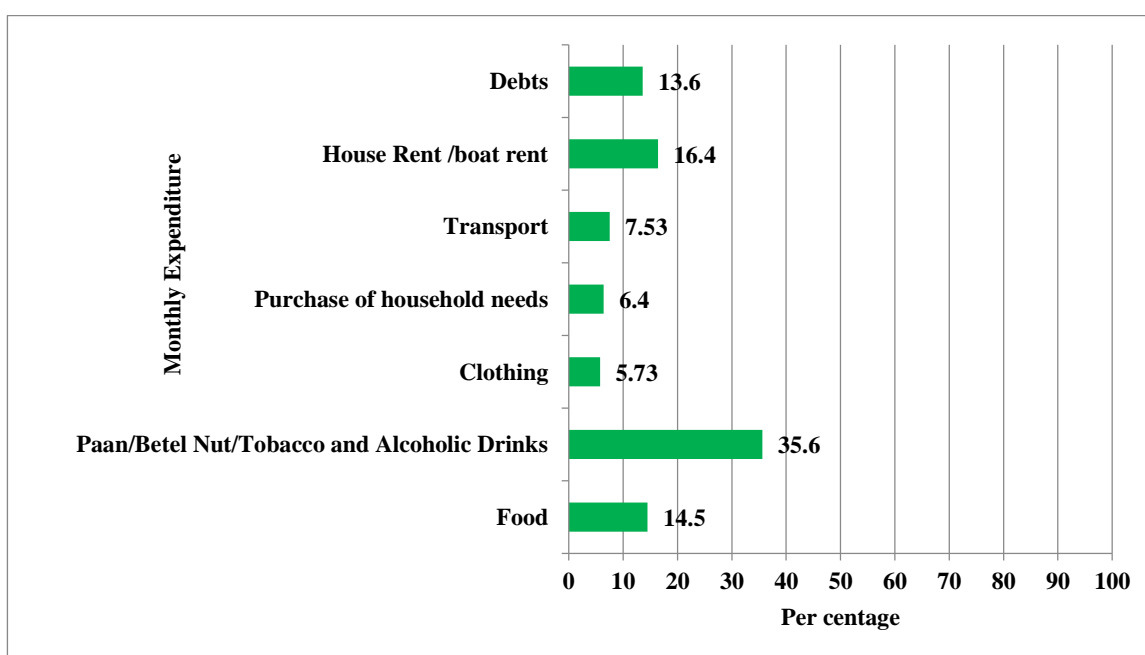


Figure 11: Average Monthly Expenditure of the Fisherfolk Families

These debilitating addictions makes the fisherfolk more vulnerable to various health problems which in turn cripples their income generating opportunities and makes

them more impoverished. The second major expenditure has been observed to be spent on house or boat rent or both together sometimes which is an average of Rs.1568.1/- i.e., around 16.4 per cent in a month. 14.5 per cent of the expenditure is on food purchases, 13.6 per cent is paid for interests towards loans or debts, 7.5 per cent spent on travel fare or for daily commute, 6.4 per cent of the expenditure is for household purchases like toiletries, cleaning agents, etc., and 5.7 per cent on clothing.

Similar results were projected by Karuppusamy and Karthikeyan (2017) in their study that most of the fishermen (69%) were addicted to liquor. Out of which, 67 per cent of fishermen go to local bars for liquor in-take, rest of them consume liquor in their home only. More than 30 per cent of their total income is spent for consumption of liquor. This is the cause of concern for this community.

On calculation, if we compare between the income generated and the expenditure of the fisherfolk of the study area, it is clearly evident that their income meets only up to 48.8 per cent of the total expenditure in 91 per cent of the fishermen families. This indicates that the fishermen are drowning more and more into debts to sustain a living.

The study results matchup with the study of Karthikeyan (2017), which reveals that the majority of the fisherfolk earn less than Rs.5000 per month in peak season and less than Rs.3000 during lean season. Their study also revealed that 79.9 per cent of the fishermen were in debt.

B. Clinical Symptoms of VAD and IDA among Fisherfolk Children

Table XII and Figure 12 depicts the particulars of occurrence of clinical manifestations of vitamin A disorders and iron deficiency anaemia in the fisherfolk children (n= 1000) aged 6 – 8 years of the selected areas.

Table XII

Clinical Symptoms of VAD and IDA among Fisherfolk Children

Clinical Symptoms	Chollangi (n=158)		Vakalapudi (n=147)		Uppada (n=178)		Valasapaka (139)		Mulapeta (n=119)		Ponnada and Konapaapapeta (n=156)		Nemam (n=103)		Total (n=1000)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bitot's spot	2	0.2	3	0.3	1	0.1	1	0.1	0	0	1	0.1	0	0	8	0.8
Conjunctival Xerosis	1	0.1	1	0.1	1	0.1	0	0	2	0.2	1	0.1	1	0.1	7	0.7
Koilonychias	2	0.2	3	0.3	4	0.4	5	0.5	2	0.2	2	0.2	3	0.3	21	2.1
Emaciation	3	0.3	3	0.3	3	0.3	0	0	3	0.3	1	0.1	3	0.3	16	1.6
Dry, brittle hair	2	0.2	5	0.5	2	0.2	8	0.8	3	0.3	6	0.6	6	0.6	33	3.3
Bleeding gums	1	0.1	3	0.3	1	0.1	2	0.2	3	0.3	0	0	1	0.1	11	1.1
Glossitis	2	0.2	1	0.1	3	0.3	2	0.2	3	0.3	1	0.1	3	0.3	16	1.6
Phrynoderma	1	0.1	1	0.1	2	0.2	1	0.1	3	0.3	0	0	1	0.1	9	0.9
Gingivitis	2	0.2	2	0.2	1	0.1	1	0.1	2	0.2	1	0.1	0	0	9	0.9
Dental caries	7	0.7	11	1.1	6	0.6	8	0.8	9	0.9	5	0.5	7	0.7	53	5.3
Dermatitis	5	0.5	3	0.3	3	0.3	4	0.4	2	0.2	4	0.4	5	0.5	26	2.6
Angular stomatitis	9	0.9	8	0.8	8	0.8	7	0.7	11	1.1	3	0.3	4	0.4	50	5.0

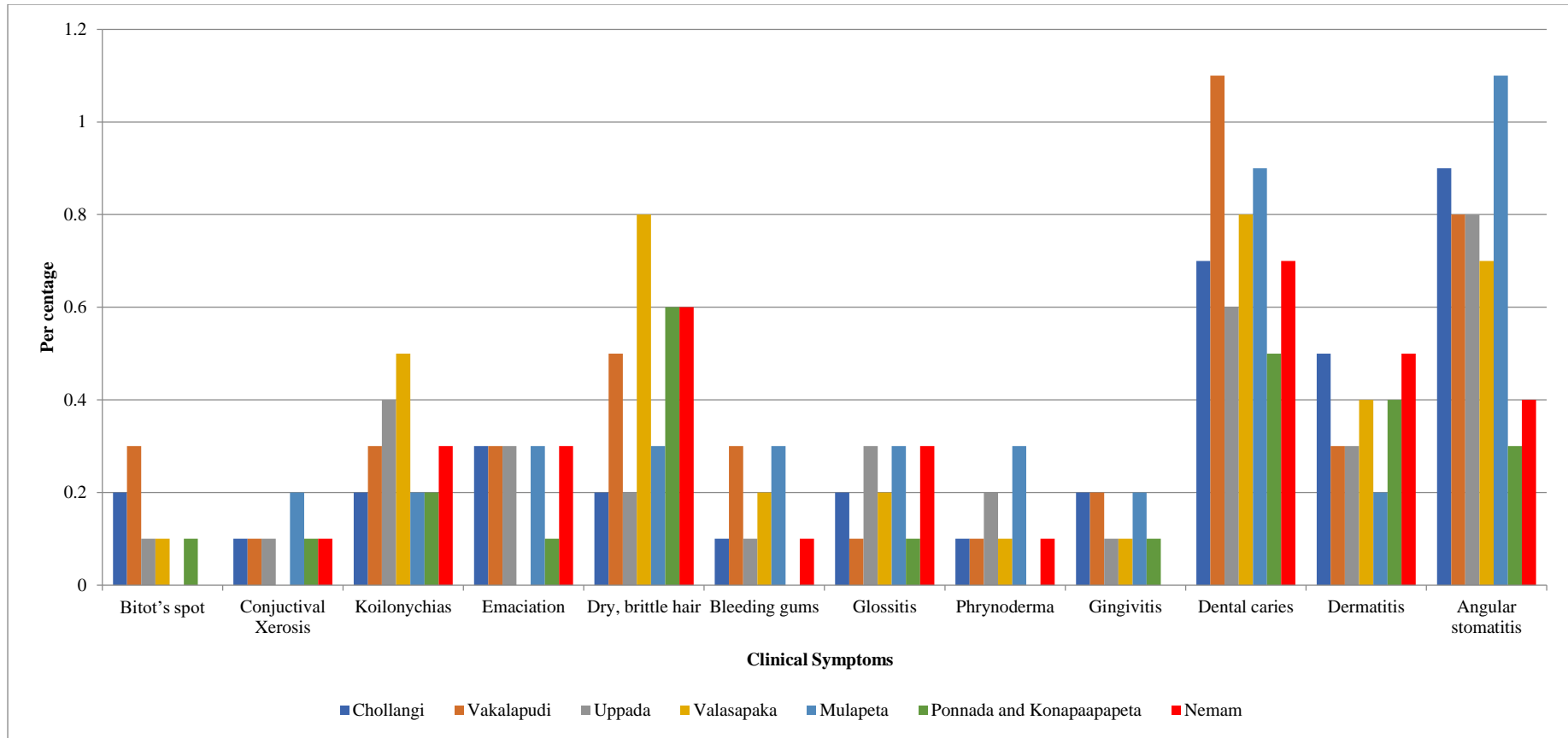


Figure 12: Clinical Symptoms of VAD and IDA among Fisherfolk Children

The mean presence of Bitot's spots in fisherfolk children, a typical indication of vitamin A disorder with an average occurrence was 0.8 per centage with Chollangi having 0.1 per centage, Vakalapudi 0.3 per centage, Uppada 0.1 per centage, Valasapaka 0.1 per centage, Ponnada and Konapaapeta 0.1 per centage. The average occurrence value of 0.8 per centage Bitot's spots is clearly over the cut off points ($> 0.5\%$) suggested by WHO (2007). Therefore, VAD is a national health issue among the children of the fisherfolk community examined in the current research. Bitot's spots and Night blindness might be considered mild stages of eye disorder, but they predict and signify the level of severity of vitamin A disorders and are determined by the presence of low serum retinol concentrations (Sommer et al., 1980).

The average occurrence of conjunctival xerosis in fisherfolk children, a symptom of VAD was 0.7 per centage, with Chollangi having 0.1 per centage, Vakalapudi 0.1 per centage, Uppada 0.1 per centage, Mulapeta 0.2 per centage, Ponnada and Konapaapeta 0.1 per centage and Nemam having 0.1 per centage.

The average occurrence of Koilonychia, a symptom of Iron Deficiency Anaemia in fisherfolk children was 2.2 per cent with Chollangi having 0.2 per cent, Vakalapudi 0.3 per cent, Uppada 0.4 per cent, Mulapeta 0.2 per cent, Valasapaka 0.5 per cent, Ponnada and Konapaapeta 0.2 per cent and Nemam having 0.3 per cent.

The average occurrence of Emaciation, a symptom of Protein Energy Malnutrition in fisherfolk children was 1.6 per cent, with Chollangi having 0.3 per cent, Vakalapudi 0.3 per cent, Uppada 0.3 per cent, Mulapeta 0.3 per cent, Valasapaka 0.3 per cent, Ponnada and Konapaapeta 0.1 per cent and Nemam having 0.3 per cent.

Other than the Vitamin A and Iron deficiency symptoms, other nutritional disorders were also noticed among children. The prevalence of B-complex deficiencies of phrynoderma was 0.9 per cent. Bleeding gums, a vitamin C deficiency was seen in 1.1 per cent children.

Similar findings were reported by Kumar, et al., (2000), on preschool children that 89.5 per cent of the children had signs of nutritional deficiencies. Above 60 per cent of the children had signs of protein-energy malnutrition and 50 per cent had vitamin B complex deficiencies.

Lack of hygiene has been anticipated by symptoms such as Gingivitis in 0.9 per cent children and dental caries in 4.3 per cent. Dermatitis was observed in 2.7 per cent children and angular stomatitis, a B-complex deficiency in 5.1 per cent of the fisherfolk children of the present study.

In the present study, out of 1000 fisherfolk children aged between 6-8 years, 258 children had clinical symptoms showcasing multiple vitamin and mineral deficiencies and protein energy malnutrition.

Naidu (1999) also presented similar findings that 0.1 per cent children had protein-energy malnutrition, 0.5 per cent had vitamin A deficiencies and 0.01 per cent had vitamin B complex deficiencies among preschool children in India.

C. Nutritional Anthropometry of the Fisherfolk Children

In the present study, out of 1000 fisherfolk children aged between 6-8 years, 547 were boys and 453 were girls. The mean anthropometrical readings namely height of the body and body weight of the children were measured separately according to age and gender. The gender wise and age wise distribution of the subjects is represented in Table XIII.

Table XIII
Distribution of Boys and Girls according to Age

age-group	No. of boys	No. of girls
6 years	182	148
7 years	197	173
8 years	168	132
Total	547	453

1. Mean height of the children

The average body length of the children in this current research was significantly less than the standards specified by both the WHO and ICMR in respect to their age 6,7 and 8 years. It is presented in Tables XIV, XV and Figures 13 and 14.

Table XIV
Mean Height (cm) of the Boys in Comparison with WHO and ICMR Standards
(N=547)

Age in years	sample size	Standard Height (cm)		Height (cm)	Difference		t value Mean Vs. WHO
		WHO (2006)	ICMR (2020)	Mean±SD	Mean Ht vs WHO	Mean Ht vs ICMR	
				Boys (n=547)			
6+	n=182	117.15	115.8	101.8±1.68	-15.4	-14	122.22*
7+	n=197	124.3	121.7	111.6±2.3	-12.7	-10.1	78.815*
8+	n=168	130.1	127	121.0±2.44	-9.1	-6.0	53.428**

** - Significant at 1 per cent level; * - Significant at 5 per cent level

The mean height of 6-year-old boys in the study was 101.8 ± 1.68 cm which when compared to the standards of WHO and ICMR was much less ($p < 0.05$). In the 7-year-old age-group the mean height of boys is observed to be 111.6 ± 2.3 cm ($p < 0.05$) which was 10- 13 cm down the grade compared to the standards. Though not up to the mark, the 8-year-old group of boys mean height was observed to be 121.01 ± 2.44 cm which was lower ($p < 0.01$) than the standard height by 6-9.1 cm. As can be observed, the higher t- value indicate that a large difference exists between the mean height of the boys and the WHO standard.

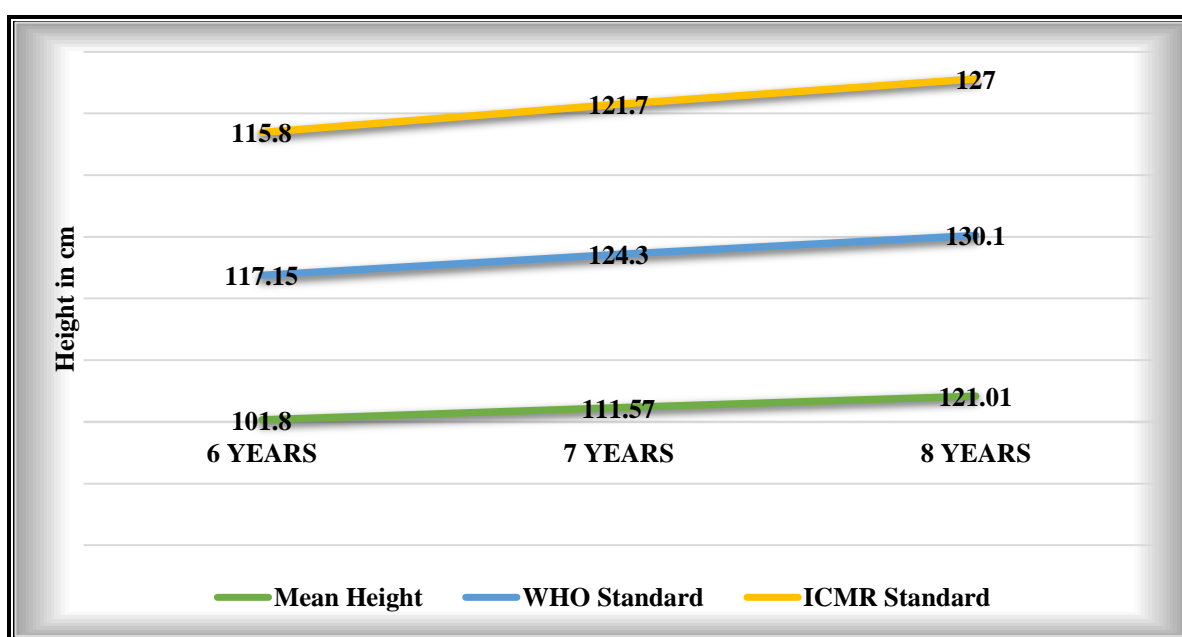


Figure 13: Mean Height of the Boys in comparison with WHO and ICMR Standards

Table XV

Mean Height (cm) of the Girls in Comparison with WHO and ICMR Standards

(N = 453)

Age in years	sample size	Standard Height (cm)		Height(cm)	Difference		t value Mean Vs. WHO
		WHO (2006)	ICMR (2020)	Mean±SD	Mean ht vs WHO	Mean ht vs ICMR	
				Girls (n=453)			
6+	n=148	116.5	114.5	101.5±1.8	-15.0	-13.0	100.588*
7+	n=173	123.6	120.6	105.4±1.6	-22.2	-19.2	149.311*
8+	n=132	129.2	126.4	118.4±2.44	-10.8	-8.0	50.816**

** - Significant at 1 per cent level, * - Significant at 5 per cent level

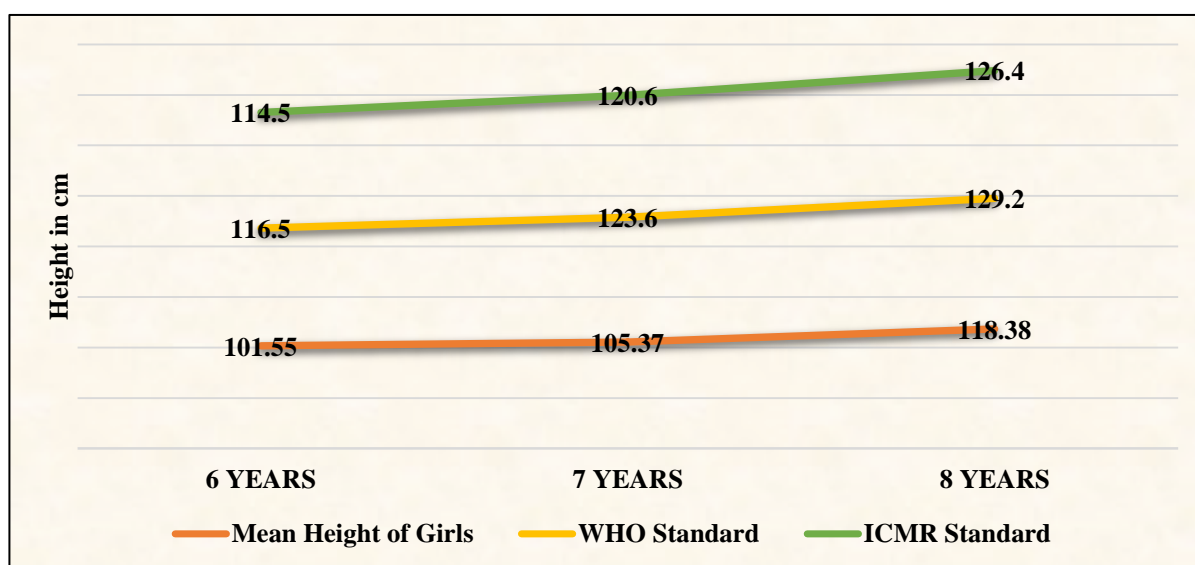


Figure 14: Mean Height of the Girls in comparison with WHO and ICMR Standards

The mean height of the girls of all age-groups in the study has been observed to be on a lower side of the suggested standard height by the ICMR and the WHO. The observed mean height of the 6-year age-group was 101.5 ±1.8 cm, which was 15 cm less ($p < 0.05$) when compared to the standard WHO height of girls of that particular age. The mean height of the 7-year-old girls was more stunted than all the children, which was 105.4 ±1.6 cm ($p < 0.05$), showing a huge variation of -22.2 cm when compared with the WHO standards. The 8-year age-group were below the standard height but when compared with the other two age-groups showed lesser stunting. Their mean height was observed to be 118.4 ±2.44 cm with a deficit ($p < 0.01$) of 8.0 cm when compared with the WHO standards.

1. Mean weight of the children

The average body weight of children is presented in Tables XVI, XVII and Figures 15 and 16.

Table XVI

Mean Weight (kg) of Boys (N=547) in Comparison with WHO and ICMR Standards

Age in years	sample size	Standard Weight (kg)		Weight (kg)	Difference		t value Mean Vs. WHO
		WHO (2006)	ICMR (2020)	Mean±SD	Mean Ht vs WHO	Mean Ht vs ICMR	
				Boys (n=547)			
6+	n=182	20.5	20.8	18.1±1.55	-2.4	-2.7	20.468**
7+	n=197	22.7	22.9	19.5±1.00	-3.2	-3.4	44.19*
8+	n=168	25.2	25.3	21.8±0.98	-3.4	-3.5	44.848*

** - Significant at 1 per cent level, * - Significant at 5 per cent level

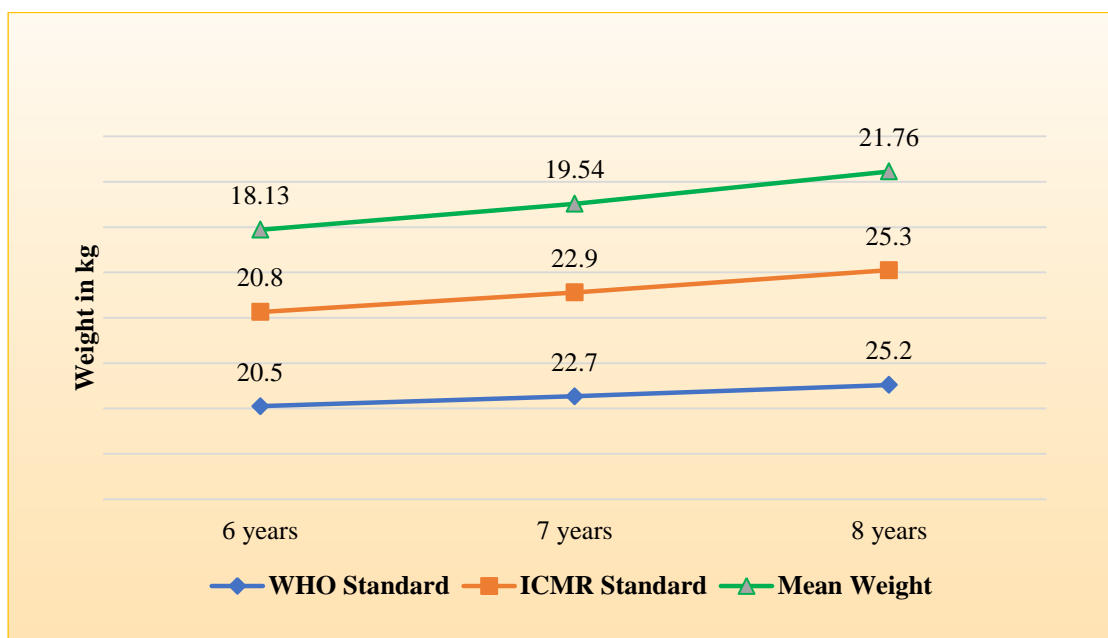


Figure 15: Mean Weight of the Boys in comparison with WHO and ICMR Standards

The average body weight of boys in the study has been observed to be lesser than the comparative standards of WHO and ICMR. The mean weight of 6 years age-group boys was 18.1 ±1.55 kgs (p<0.05), 7 years boys was 19.5 ±1.00 kgs (p< 0.05) and the mean of 8 years age-group boys weighed 21.8 ±0.98 kg (p < 0.01) which was lesser by 2.4 kg, 3.2 kg and 3.5 kg respectively in comparison with the WHO standard weights.

Table XVII

Mean Weight (kg) of Girls (N=453) in Comparison with WHO and ICMR Standards

Age in years	sample size	Standard Weight (kg)		Weight(kg)	Difference		t value Mean Vs. WHO
		WHO (2006)	ICMR (2020)	Mean±SD	Mean ht vs WHO	Mean ht vs ICMR	
				Girls(n=453)			
6+	n=148	20.45	19.75	15.0±0.93	-5.4	-4.7	70.823*
7+	n=173	22.3	21.8	16.8±0.71	-5.5	-6.1	100.415*
8+	n=132	25	24.8	19.8±1.02	-5.2	-5	57.893**

** - Significant at 1 per cent level, * - Significant at 5 per cent level

The fisherfolk children were observed to weigh less than the standard weight recommended by WHO and ICMR. The mean weight of 6 years age-group girls was 15.0 ±0.93 kgs ($p < 0.05$), 7 years girls was 16.8 ±0.71 kgs ($p < 0.05$) and the mean of 8 years age-group girls weighed 19.8 ±1.02 kg ($p < 0.01$) which was lesser by 5.4 kg, 5.5 kg and 5.2 kg respectively when compared with the WHO standard weights.

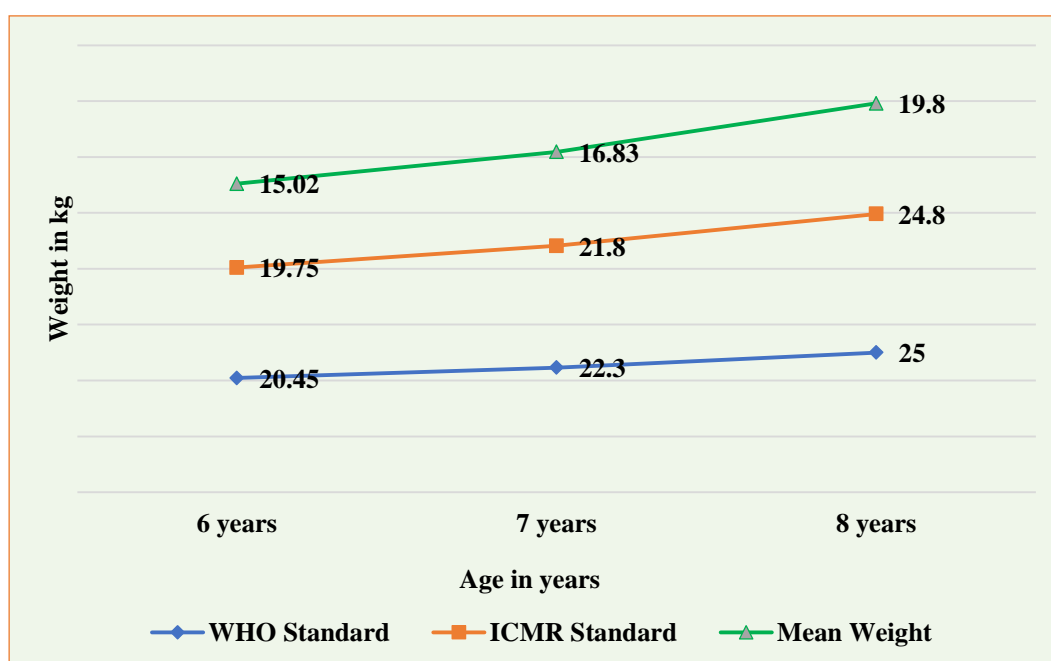


Figure 16: Mean Weight of the Girls in comparison with WHO and ICMR Standards

Therefore, it was significantly clear that the weight of all the children in this study irrespective of age and gender was less than the respective standard values. When compared, anthropometrical measurements of fisherfolk children were lower than their respective standards and it was observed the boys growth was one step ahead than that of girls. It reflects the gender bias among the fisherfolk community. This result is supported with a press report by Tina Edwin in The Hindu Business line on Jan20th 2018, on

international four-nation longitudinal study of childhood poverty in association with Oxford University revealed that in India nutritional inconsistency or inequality based on gender becomes more prominent at teenage. They have reported that in today's world, in many regions, the male siblings often get to eat first and girls were given food only after the former finishes to eat which was less nutritious than the food served to the boys (<https://www.thehindubusinessline.com/specials/india-interior/are-boys-fed-better-than-girls/article8566303.ece>).

2. Grading of children according to height for age

Table XVIII depicts the categorizing of children according to their height for their present age. Prevalence of stunting among children was calculated with the aid of the WHO Child Growth Standards (2006).

Table XVIII
Grading of Children according to Height for Age

(N=1000)

Age(yr.)	Normal (Z-Score -2.00 to +2.00)		Moderate (Z-Score-3.00 to <-2.00)		Severe (Z- Score < -3.00)	
	No.	%	No.	%	No.	%
Boys 6	0	0	0	0	182	100
Boys 7	1	0.6	0	0	196	99.4
Boys 8	0	0	2	0.2	166	98.8
Girls 6	0	0	1	0.7	147	99.3
Girls 7	0	0	0	0	173	100
Girls 8	0	0	1	0.8	131	99.2
Total	1	0.1	4	0.4	995	99.5

It was observed that none of the boys in age-groups 6 and 8 and none of the girls of all age-groups had normal height for age where the z-score lies in between +2.00 and less than - 2.00. Moderate stunting where the z-score is between -3.00 and less than -2.00, was not observed in boys of 6 and 7 age-groups and girls of 7 years age-group. But severe stunting, where the z-score is less than -.300, was noted in all children. Shockingly, all boys of age-group 6 and all girls of age-group 7 had severe stunting. 0.6 per cent of boys in age-group 7 had normal height for age. 0.2 per cent of 8-year age-group boys showed moderate stunting. Likewise, 0.7 per cent of the in 6-year age group and 0.8 per cent of girls in 8 years age group showed moderate stunting. Severe stunting (z-score <-.300) was

noted in 100 per cent of boys and 99.3 per cent of girls of age-group 6. Severe stunting was observed in 99.4 per cent of boys and 100 per cent of girls in the age-group 7. Coming to the age group 8, severe stunting (z-score $<-.300$) was observed in 98.8 per cent of boys and 99.2 per cent of girls. The majority of the children in the study showed severe stunting.

Mean HAZ was lower in comparison with NCHS for all children of both sexes and ages. The general prevalence of growth decelerating (Height for age $<$ Median $-2SD$) in fisher-folk offspring was 99.9 per cent in which 0.4 per cent of children had moderate stunting and 99.5 per cent had severe stunting.

Tyler Vaivada et al. (2020) pin pointed that the main determinants of stunting were open defecation, poor sanitation and poor maternity health services including poor antenatal care and delivery in poor health facility or with unskilled birth attendant, all accounted for substantial stunt growth in children. Ponum et al., (2020) revealed that the impact of parent's education, family size and occupation had a big influence on growth and blooming of children and might be the reason for stunting. Reports revealed that most of the children who were diagnosed with moderate and severe stunting had either parent with low education, father's occupation as laborer or employer and family size with more than 5.

3. Grading of children according to weight for age

Categorization of children in respect of their weight for age is shown in Table XIX. Prevalence of wasting among children was calculated with the aid of the WHO Child Growth Standards (2006).

Table XIX
Grading of Children according to Weight for age

(N=1000)

Age(yr.)	Normal (Z-Score -2.00 to +2.00)		Moderate (Z-Score- 3.00 to <-2.00)		Severe (Z- Score < -3.00)	
	No.	%	No.	%	No.	%
Boys 6	1	0.6	7	3.8	174	95.6
Boys 7	1	0.5	7	3.6	188	95.4
Boys 8	3	1.7	1	0.6	164	97.7
Girls 6	0	0	0	0	148	100
Girls 7	0	0	0	0	173	100
Girls 8	0	0	0	0	132	100
Total	4	0.4	22	2.2	974	97.4

Weight for age results revealed similarities to height for age in fisherfolk children. It was observed that 0.4 per cent of the fisher-folk off-springs had normal weight for age. The occurrence of moderate-wasting (Weight for height < Median -2SD) was seen in 2.2 per cent of the children and 97.4 per cent have severe-wasting (weight for height < Median -3SD). In the 6 years age-group of boys 0.6 per cent were normal with a z-score between +2.00 and <-2.00, 3.8 per cent were moderately underweight with a z-score between -3.00 and <-2.00. and 95.6 per cent were severely underweight having a z-score less than -3.00. In the 7 years age-group of boys 0.5 per cent were normal, 3.6 per cent were moderately underweight falling in z-score between -3.00 to <-2.00 and 95.4 per cent were severely underweight with a z-score < -3.00 which is much similar to the 6 years old boys. Though not much improvement is seen as age increases, in the boys in 8 years age-group, 1.7 per cent were normal, 0.6 per cent were moderately underweight (z-score between -3.00 to <- 2.00) and 97.7 per cent were severely underweight (z-score <-3.00). Coming to girls, all of them, irrelevant of age-groups fall under severely underweight category (z-score <-3.00). Not even one of them met the standard weight for age. Among the children of the fishermen community, it was observed that stunting was mostly seen in girls than boys due to gender discrimination.

Khan et al. (2019) revealed that the impact of rural residence, poorest wealth index, mother's employment status, consanguineous marriage and male sex of the child

were the risk factors on growth and development of children and might be the reason for wasting. Reports revealed that many of the children who suffer from moderate and severe stunting had either mother with low education, child's height at birth and mother's nutritional stature had direct influence on child's low weight-for-age status. Children whose mothers were short in height and had a BMI <18.5 were more likely be underweight.

4. Grading of children according to BMI for age

BMI categorized in relation to age in school children is recommended as appropriate tool for assessment of both under and over-nutrition in preschool children by WHO (2006). Table XX shows the categorization of children according to their BMI in relation to their age.

Table XX
Grading of Children according to BMI for Age

(N=1000)

Age(yr.)	Normal (Z-Score -2.00 to +2.00)		Moderate (Z-Score- 3.00 to <-2.00)		Severe (Z- Score < -3.00)	
	No.	%	No.	%	No.	%
Boys 6	24	13.3	65	35.9	93	50.8
Boys 7	32	16.2	128	65.0	37	18.8
Boys 8	12	7.1	11	6.5	145	86.4
Girls 6	20	13.3	13	8.6	115	78.1
Girls 7	10	5.6	19	11.1	144	83.3
Girls 8	18	13.4	38	28.6	76	68.0

As seen in the previous discussions, the height and weight for age in most of the children has been on a lower side representing stunting and underweight. When BMI for age has been computed using sex-specific World Health Organization (WHO) growth reference data, it has been observed that 13.3 per cent of the 6 years old group of boys, 16.2 per cent of the 7-year-old boys and 7.1 per cent of the 8-year-old boys had normal BMI for age (z-score between +2.00 to < - 2.00). 35.9 per cent of the 6-year-old boys, 65 per cent of boys in 7-year age group and 6.5 per cent boys of 8-year age-group were observed to have moderately low BMI for age (z-score between -3.00 to <-2.00). Severely

low BMI for age (z-score < -3.00) has been recorded in 50.8 per cent of boys belonging to 6- years age group, 18.8 per cent belonging to 7 years age-group and 86.4 per cent of boys belonging to 8 years age-group. It has been observed that 13.3 per cent of the 6 years old group of girls, 5.6 per cent of the 7-year-old girls and 13.4 per cent of the 8-year-old girls had normal BMI for age (z-score between $+2.00$ to < -2.00). 8.6 per cent of the 6-year-old girls, 11.1 per cent of girls in 7-years age group and 28.6 per cent girls of 8 years age-group were observed to have moderately low BMI for age (z-score between -3.00 to < -2.00). Severely low BMI for age (z-score < -3.00) has been recorded in 78.1 per cent of girls belonging to 6 years age-group, 83.3 per cent belonging to 7 years age-group and 68 per cent of girls belonging to 8 years age-group.

Dar (2016) highlighted in the study that malnutrition has been a huge problem in India. Though there were general improvements in the food availability, malnutrition in children at a high level as reported by various national surveys. The study revealed that malnutrition with wasting (21 per cent), stunting (23.8 per cent) and underweight (17.5 per cent) was seen among children surveyed.

Capanzana, et al. (2018) showed up similar results that coincide with the present study. They reported that children in fisherfolk community in Philippines had higher prevalence of malnutrition with a magnitude of underweight (26.4 per cent), stunting (37.7 per cent) and wasting (11.2 per cent) which were all alarmingly high and pose a serious issue in public health.

D. Dietary Pattern of the Fisherfolk Children

1. Dietary habits

Every community has its unique food habits depending on their culture, traditions, availability and other resources. Mostly fishermen engage themselves in multi-day fishing and are away from land for couple of days and sometimes even weeks to get their catch. In such conditions, they carry food sufficient for their whole trip. They carry foods which are high in starch and protein but lack other nutrients. The women and children though not allowed to go fishing on sea, they had to work on other fishing related activities like drying, selling of fish, etc.

In the current research, all the fisher-folk subjects were non-vegetarians and followed a three meal schedule every day. Rice is the staple food of the fishermen. Dried fish and dried shrimp is the most regularly eaten food but in less quantity. Though fresh

fish is their catch, many of the fishermen hardly get to eat it regularly as they need to sell it off for their living.

Most of the fisher-folk rely on rice for their three meals. Many fishermen households cook rice at night and after consuming their dinner, they eat the left-over rice with rice starch or buttermilk along with raw onion and chilies or left-over curries of the previous night for breakfast. Lunch and dinner are almost the same which comprised of mostly dried fish or shrimp in a gravy and occasionally a few vegetables or dal. Children mostly eat what is served at home and also junk food such as chips or bajjis sold at nearby vendors. If attending school, the school provides upma for breakfast and rice with dal and vegetable for lunch to the children. But children who skip school usually rely on junk foods available outside in their neighborhood which may be one of the causes of malnutrition prevailing among the fisherfolk children.

5. Food frequency of fishermen families

Fishermen community's diet is solely based on the fish which they harvest in various forms either the left over after selling, dried fish or salted fish. They rarely consume vegetables and dal. The intake of other foods is very meagre. The details of food items consumed are given in the tables XXI (a), XXI(b), XXI(c), XXI(d)

Table XXI(a) reveals the food consumption frequency of cereals and pulses.

Table XXI (a)
Frequency of consumption of Cereals and Pulses

(N=1000)

Food items	Frequency of Consumption of Cereals and Pulses									
	Daily		Weekly		Monthly		Occasionally		Not at all	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cereals										
Raw rice	797	79.7	91	9.1	112	11.2	-	-	-	-
Puffed rice	-	-	174	17.4	95	9.5	412	41.2	731	73.1
Par-boiled rice	-	-	120	12	387	38.7	246	24.6	247	24.7
Maize	-	-	-	-	214	21.4	180	18	606	60.6
Jowar	-	-	-	-	-	-	165	16.5	835	83.5
Ragi	-	-	-	-	213	21.3	340	34	447	44.7
whole wheat flour	-	-	245	24.5	530	53	112	11.2	113	11.3
refined wheat flour	-	-	146	14.6	257	25.7	342	34.2	255	25.5
Semolina	481	48.1	214	21.4	300	30	5	0.5	-	-
Vermicelli	-	-	-	-	128	12.8	-	-	872	87.2
Bread	-	-	-	-	243	24.3	359	35.9	398	39.8
Pulses										
Red gram dhal	345	34.5	428	42.8	227	22.7	-	-	-	-
bengal gram dhal	-	-	-	-	216	21.6	701	70.1	83	8.3
roasted bengal gram dhal	-	-	-	-	214	21.4	147	14.7	639	63.9
Black gram dhal	-	-	-	-	521	52.1	479	47.9	-	-
whole green dal	-	-	-	-	138	13.8	51	5.1	811	81.1
green gram dhal	-	-	-	-	-	-	412	41.2	588	58.8

Raw rice is the staple for all the fisher folk and is the only cereal consumed by 79.7 per cent children every day. Puffed rice was consumed by 17.4 per cent weekly, 9.5 per cent monthly and 73.1 per cent do not consume puffed rice. Parboiled rice is also consumed weekly by 12 per cent, monthly by 38.7 per cent and 24.7 per cent do not consume it at all. Maize was consumed on monthly basis by only 21.4 per cent of the children, occasionally by 18 per cent while 60.6 per cent did not consume maize. 16.5 per cent of the children consumed jowar occasionally while the remaining 83.5 per cent did not consume jowar in their diet. Ragi was consumed monthly by 21.3 per cent, 34 per cent had it occasionally while 44.7 per cent families don't use ragi. Whole wheat flour was consumed by 24.5 per cent on weekly basis, 53 per cent use it

monthly, 11.2 per cent take it occasionally and 11.3 per cent don't eat it. Refined wheat flour is also consumed by 14.6 per cent children on weekly basis, 25.7 per cent consume it monthly, 34.2 have it occasionally while 25.5 never ate it. Semolina consumption has been confirmed by 48.1 per cent on daily basis, 21.4 per cent consumed preparations of semolina every week, while 30 per cent prepared it monthly and 0.5 per cent occasionally. Vermicelli was used monthly by 12.8 per cent and 87.2 per cent don't eat it. Bread was consumed by 24.3 per cent monthly; 35.9 children ate it occasionally while 39.8 per cent don't eat it.

Pulses are not cooked at fishermen households on a regular basis but the children get to eat them for meal at school. So, children attending school get to eat dal almost daily. Red gram dal was consumed by 34.5 per cent children daily, 42.8 per cent consume it weekly and 22.7 per cent consume it monthly. Bengal gram dal is also 21.6 per cent monthly while 70.1 per cent consumed it occasionally. Black gram and green gram were used barely once a month or occasionally by a few.

Table XXII(b) depicts that the frequency of consumption roots and tubers and green leafy vegetables.

Table XXI (b)**Frequency of Consumption of Roots and Tubers and Green Leafy Vegetables**

Food Items	Frequency of Consumption of Roots and Tubers and Green Leafy Vegetables									
	Daily		Weekly		Monthly		Occasionally		Not at all	
	No.	%	No.	%	No.	%	No.	%	No.	%
Roots and tubers										
Beet root	-	-	-	-	-	-	239	23.9	761	76.1
Carrot	-	-	-	-	-	-	212	21.2	788	78.8
Onion	448	44.8	581	58.1	71	7.1	-	-	-	-
Potato	-	-	214	21.4	467	46.7	319	31.9	-	-
Radish	-	-	-	-	-	-	357	35.7	643	64.3
Sweet potato	-	-	-	-	-	-	138	13.8	862	86.2
Yam	-	-	-	-	-	-	52	5.2	948	94.8
Tapioca	-	-	-	-	-	-	68	6.8	932	93.2
Green leafy vegetables										
Amaranth	-	-	-	-	247	24.7	614	61.4	339	33.9
Cabbage	-	-	-	-	-	-	145	14.5	855	85.5
Coriander	-	-	346	34.6	541	54.1	113	11.3	-	-
Curry leaves	854	85.4	146	14.6	-	-	-	-	-	-
Drumstick leaves	-	-	-	-	157	15.7	-	-	843	84.3
Fenugreek	-	-	-	-	-	-	216	21.6	784	78.4
Mint leaves	-	-	-	-	-	-	341	34.1	659	65.9
Ponnangani	-	-	-	-	-	-	362	36.2	638	63.8
Spinach	-	-	-	-	24	2.4	236	23.6	740	74

Big onions are the only tuber consumed by all children. 44.8 per cent consumed it daily, 58.1 per cent consumed it weekly while 7.1 per cent consumed it monthly. The next predominantly eaten tuber is the potato which is consumed by 21.4 per cent weekly, 46.7 per cent monthly and 31.9 per cent occasionally. Other roots and tubers such as beetroot, carrot, radish, tapioca, sweet potato and yam were consumed occasionally by some of the children.

Green leafy vegetables are hardly found to be included in the diets of the fisherfolk children except for the use of curry leaves (*Murraya koenigii*) which was used by

85.4 per cent in the curries daily and 14.6 weekly, but unfortunately removed while eating. Coriander leaves (*Coriandrum sativum*) is also used in curries or dal on a weekly basis by 34.6 per cent, 54.1 per cent monthly and 11.3 per cent occasionally. Amaranth (*Amaranthas caudatus*) was consumed by 24.7 per cent children monthly, 61.4 per cent occasionally and 33.9 per cent do not consume it. Drumstick leaves (*Moringa oleifera*) was also consumed by the fisherfolk children on a monthly basis by 15.7 per cent and 84.3 per cent do not consume it. Spinach (*Spinacia oleracea*) was consumed by 2.4 per cent of the children monthly, 23.6 per cent occasionally and 74 per cent do not consume it. Mint leaves (*Mentha spicata*), Fenugreek leaves (*Trigonella foenum graecum*), Ponnanganni (*Alternathera sesslis*) and Cabbage were consumed occasionally by 34.1 per cent, 21.6 per cent, 36.2 per cent and 14.5 per cent respectively.

Table XXII(c) shows that the frequency of consumption of vegetables and fruits.

Table XXI (c)

Frequency of Consumption of Vegetables and Fruits

Food items	Frequency of Consumption of Vegetables and Fruits									
	Daily		Weekly		Monthly		Occasionally		Not at all	
	No.	%	No.	%	No.	%	No.	%	No.	%
Other vegetables										
Beans	-	-	-	-	-	-	341	34.1	659	65.9
Bitter gourd	-	-	-	-	-	-	56	5.6	944	94.4
Bottle gourd	-	-	-	-	145	14.5	513	51.3	342	34.2
Brinjal	-	-	-	-	756	75.6	244	24.4	-	-
Cauliflower	-	-	-	-	-	-	316	31.6	684	68.4
Cluster beans	-	-	-	-	-	-	236	23.6	764	76.4
Cucumber	-	-	-	-	213	21.3	481	48.1	306	30.6
Drumstick	-	-	-	-	432	43.2	512	51.2	66	6.6
Ladies finger	-	-	-	-	324	32.4	418	41.8	258	25.8
Pumpkin	-	-	-	-	164	16.4	354	35.4	482	48.2
Ridge gourd	-	-	-	-	-	-	211	21.1	789	78.9
Snake gourd	-	-	-	-	26	2.6	361	36.1	613	61.3
Tomato	-	-	649	64.9	351	35.1	-	-	-	-
Fruits										
Amala	-	-	-	-	468	46.8	215	21.5	317	31.7
Apple	-	-	-	-	-	-	52	5.2	948	94.8
Banana	-	-	-	-	379	37.9	259	25.9	362	36.2
Grapes	-	-	-	-	-	-	63	6.3	957	95.7
Guava	-	-	-	-	325	32.5	542	54.2	133	13.3
Jack fruit	-	-	-	-	-	-	138	13.8	862	86.2
Lemon	-	-	-	-	254	25.4	746	74.6	-	-
Mango	-	-	-	-	-	-	716	71.6	284	28.4
Papaya	-	-	-	-	-	-	238	23.8	762	76.2
Pineapple	-	-	-	-	-	-	59	5.9	941	94.1
Water melon	-	-	-	-	128	12.8	613	61.3	259	25.9

Other vegetables such as Bottle gourd (*Lagenaria siceraria*) was consumed by 14.5 per cent children on monthly basis and 51.3 per cent consumed it occasionally. Brinjal (*Solanum melongena*) was consumed by 75.6 per cent children monthly and 24.4 per cent consumed it occasionally. Cucumber (*Cucumis sativas*) was listed by 21.3 per cent for monthly consumption and 48.1 per cent occasionally. Drumstick (*Moringa olifera*) was consumed monthly by 43.2 per cent and occasionally by 51.2 per cent. Ladies' fingers (*Abelmoschus esculentus*) have been reported to be consumed by 32.4 per cent of children monthly and occasionally by 41.8 per cent.

Pumpkin (*Cucurbita maxima*) was consumed monthly by 16.4 per cent while 35.4 per cent consumed it occasionally. Snake gourd (*Trichosanthes cucumerina*) was consumed by 2.6 per cent monthly and 36.6 per cent occasionally by fisherfolk children. Beans, bitter gourd, cluster beans, cauliflower and ridge gourd were also consumed occasionally by fisherfolk children. Fruits such as amla, banana, guava, lemon and watermelon were consumed by the children monthly and fruits like apple, grapes, jackfruit, mango, papaya and pineapple occasionally. Dates, musk melon, pears, sapota, custard apple were not consumed at all.

Table XXI(d) presents the frequency of consumption of non-vegetarian foods, fats and oils, milk and milk products.

Table XXI (d)
Frequency of Consumption of Non-Vegetarian Foods, Fats and Oils, Milk and Milk Products

Food items	Frequency of Consumption of Non-Vegetarian Foods, Nuts, Fats and Oils, Milk and Milk Products									
	Daily		Weekly		Monthly		Occasionally		Not at all	
	No.	%	No.	%	No.	No.	%	No.	%	No.
Non-Vegetarian Foods and Nuts										
Chicken	-	-	-	-	394	39.4	-	-	606	60.6
Egg	-	-	854	85.4	100	10	-	-	46	4.6
Fish (fresh catch)	-	-	167	16.7	614	61.4	219	21.9	-	-
Fish (dried)	751	75.1	249	24.9	-	-	-	-	-	-
shrimp fresh)	-	-	-	-	154	15.4	846	84.6	-	-
shrimp dried	-	-	315	31.5	421	42.1	264	26.4	-	-
Crabs	-	-	-	-	980	98	20	2	-	-
Mutton	-	-	-	-	265	26.5	735	73.5	-	-
Coconut	-	-	-	-	286	28.6	459	45.9	255	25.5
Ground nut	-	-	-	-	29	2.9	372	37.2	599	59.9
Fats and Oils										
Palm oil	1000	100	-	-	-	-	-	-	-	-
Refined oil	-	-	-	-	-	-	316	31.6	684	68.4
Sugar										
Jaggery	-	-	-	-	125	12.5	308	30.8	567	56.7
Sugar	-	-	698	69.8	302	30.2	-	-	-	-
Milk and milk products										
Milk.	-	-	5	0.5	138	-	210	21	647	64.7
Curd	-	-	-	-	-	-	51	5.1	949	94.9
Buttermilk	864	86.4	129	12.9	-	-	-	-	7	0.7

Non-vegetarian foods like dried fish was eaten daily by 75.1 per cent of fisherfolk children, while 24.9 per cent consumed it weekly. Fresh fish which is very much the fishermen's catch is surprisingly not consumed by them daily. Only 16.7 per cent of the children consume it once a week, 61.4 per cent have it once a month and 21.9 per cent occasionally. Egg was served once a week at school, so 85.4 per cent children ate it once a week while 10 per cent ate it monthly and 4.6 per cent occasionally. Dried shrimp was also weekly consumed by 31.5 per cent, monthly by 42.1 per cent and occasionally by 26.4 per cent. Crabs, chicken and mutton was eaten occasionally by the children.

Coconut and peanut were occasionally consumed by some of the children. Palm oil is the daily consumed cooking oil used by all the families of fisher folk. Refined oil is occasionally used by some. Sugar was used by 69.8 per cent weekly and 30.2 per cent monthly. Jaggery was consumed by some occasionally. Milk and curd aren't consumed on regular basis but buttermilk is taken daily by 86.4 per cent of the children, while 12.9 per cent children drank it weekly, while 0.7 per cent do not like consuming it.

Similar results on the milk and fish consumption was reported by Bappa et al., (2014) in their study on socioeconomic status of fishermen, where it was revealed that only 2 per cent of the fisherfolk consumed milk and 60 per cent consumed fish.

3. Mean food intake

The average food consumed by the fisher-folk children and the adequacy per cent along with comparison with standards of ICMR (2020) is presented in the table XXII and Figure 17.

Table XXII
Mean Food Intake of Children

(N= 1000)

Food Stuffs	Mean Food Intake of Children (6-8yrs)											
	6 years intake				7 years intake				8 years intake			
	ICMR	Actual	Adequacy	deficit	ICMR	Actual	Adequacy	Deficit	ICMR	Actual	Adequacy	deficit
	Allowances	Intake (g)	(%)	(%)	Allowances	Intake (g)	(%)	(%)	Allowances	Intake (g)	(%)	(%)
Cereals and Millets	120	102	85	-15	180	124	68.8	-31.20	180	131	72.7	-27.30
Pulses	30	17	56.6	-43.40	60	42	70	-30	60	47	78.3	-21.70
Green Leafy Vegetables	50	9	18	-82	100	15	15	-85	100	17	17	-83
Roots and tubers	100	47	47	-53	100	51	51	-49	100	52	52	-48
Other vegetables	100	52	52	-48	100	46	46	-54	100	19	19	-81
Fruits	100	11	11	-89	100	17	17	-83	100	16	16	-84
Milk and Milk products	500	120	24	-76	500	150	30	-70%	500	150	30	-70
Sugar and Jagerry	20	15	75	-25	20	15	75	-25	20	10	75	-25
Fats and Oil	25	15	60	-40	30	15	50	-50	30	15	50	-50

Suggested allowance source: ICMR (2020)

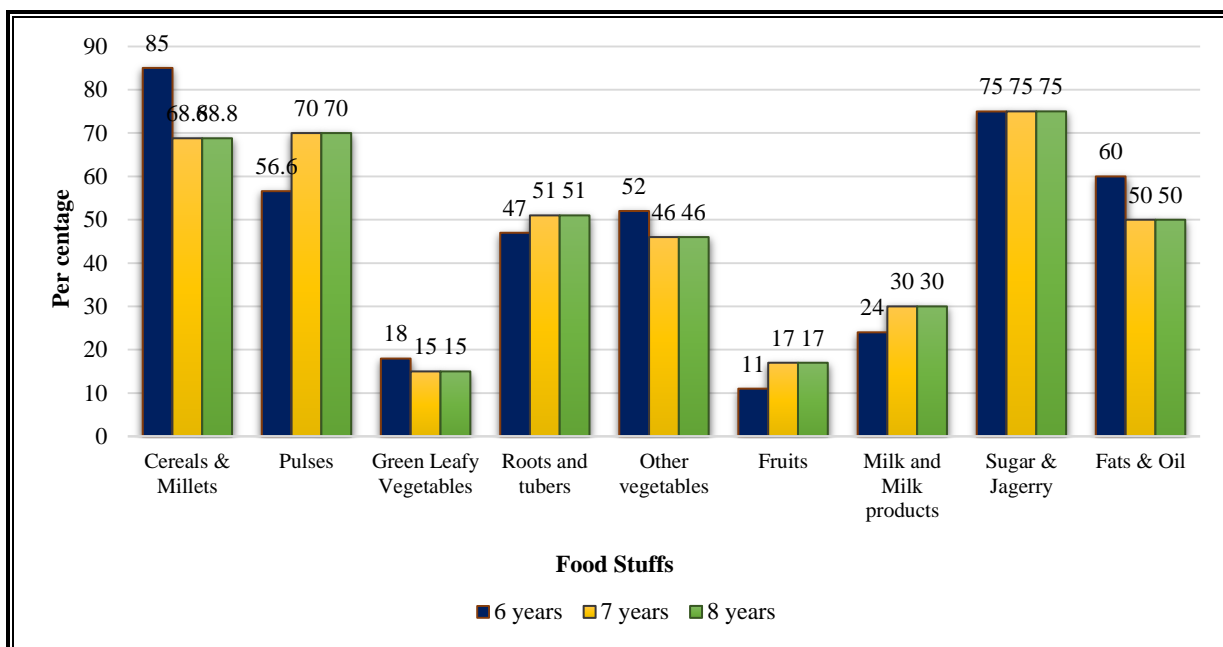


Figure 17: Percentage Adequacy of Mean Food Intake

The amount of every food eaten by fisher-folk off-springs of age-groups 6, 7 and 8 years was found to be way below the recommended dietary allowances suggested by ICMR (2020). The cereals and millets consumption met only 85 per cent of the standard requirement in the 6 years group, 68.8 per cent in the 7 years group and 72.7 per cent in the 8 years group. Insufficient intake of pulses was noted in all the age-groups where the adequacy intake was only 56.6 per cent for the 6 years group, 70 per cent in the 7 years group and 72.7 in the 8 years old group. It can be clearly noticed that there was so much deficit seen in the green leafy vegetable's consumption in all the children regardless of age. In the 6-, 7- and 8-years age-group, the consumption of green leafy vegetables percentages observed were only 18, 15 and 17 per cent respectively. The same goes with the intake of roots and tubers and an average of 50 per cent of the recommended dietary allowance only was met with 47, 51 and 52 per cent consumption in the 6, 7 and 8-year group has been observed. The intake of other vegetables has also been unsatisfactory when compared with standards of ICMR (2020).

The consumption of fruits was observed to be almost once a month or occasional. Fruits like Amla, Banana, Guava, Lemon and watermelon were observed to be occasionally consumed. But fruits such as apple, grapes, jackfruit, mango, papaya and pineapple are rarely consumed. Usage of sugar was noted to be 75 per cent of the recommended allowance. Milk and milk products consumption in all age-groups can

hardly add up to 25–30 per cent compared with the recommended dietary allowance. The consumption of fats and oils was also observed to meet only 50 – 60 per cent the suggested dietary allowances.

Investigation was carried out on intake of some major food items like fish, meat, vegetable, pulse, milk and egg. It was recorded that maximum 60 per cent respondent took fish and only two per cent took milk. Investigation was carried out on intake of some major food items like fish, meat, vegetable, pulse, milk and egg. It was recorded that maximum 60 per cent respondent took fish and only two per cent took milk.

4. Mean nutrient intake

The table XXIII and Figure 18 represent the mean nutrient intake of the children.

Table XXIII
Mean Nutrient Intake of the Children

(N=1000)

Nutrient	Mean Nutrient Intake											
	6 years				7 years				8 years			
	RD A	Actual	Adequacy	deficit	RDA	Actual	Adequacy	deficit	RDA	Actual	Adequacy	deficit
		Intake (g)	(%)	(%)		Intake (g)	(%)	(%)		Intake (g)	(%)	(%)
Energy (kcal)	1350	1150	85.1	-14.9	1690	1170	69.2	-30.80	1690	1405	83.1	-16.90
Protein (g)	20.1	9	44.7	-55.3	29.5	11	37.2	-62.80	29.5	16	54.2	-45.85
Fat (g)	25	10	40	-60	30	10	33.3	-66.70	30	15	50	-50
Calcium (mg)	600	315	52.5	-47.8	600	354	59	-41	600	377	62.8	-37.20
Iron (mg)	13	8	61.5	-38.5	16	8.5	53.1	-46.90	16	9.6	60	-40
Vitamin A (IU)	400	210	52.5	-47.5	600	236	39.3	60.70	600	229	38.1	-61.90
b-Carotene (mcg)	3200	1525	47.6	-52.5	4800	1547	32.2	-67.80	4800	1530	31.8	-68.20
Thiamine (mg)	0.7	0.4	57.1	-42.4	0.8	0.4	50	-50	0.8	0.5	62.5	-37.50
Vitamin C (mg)	40	25	62.5	-37.5	40	24	60	-40	40	26	65	-35

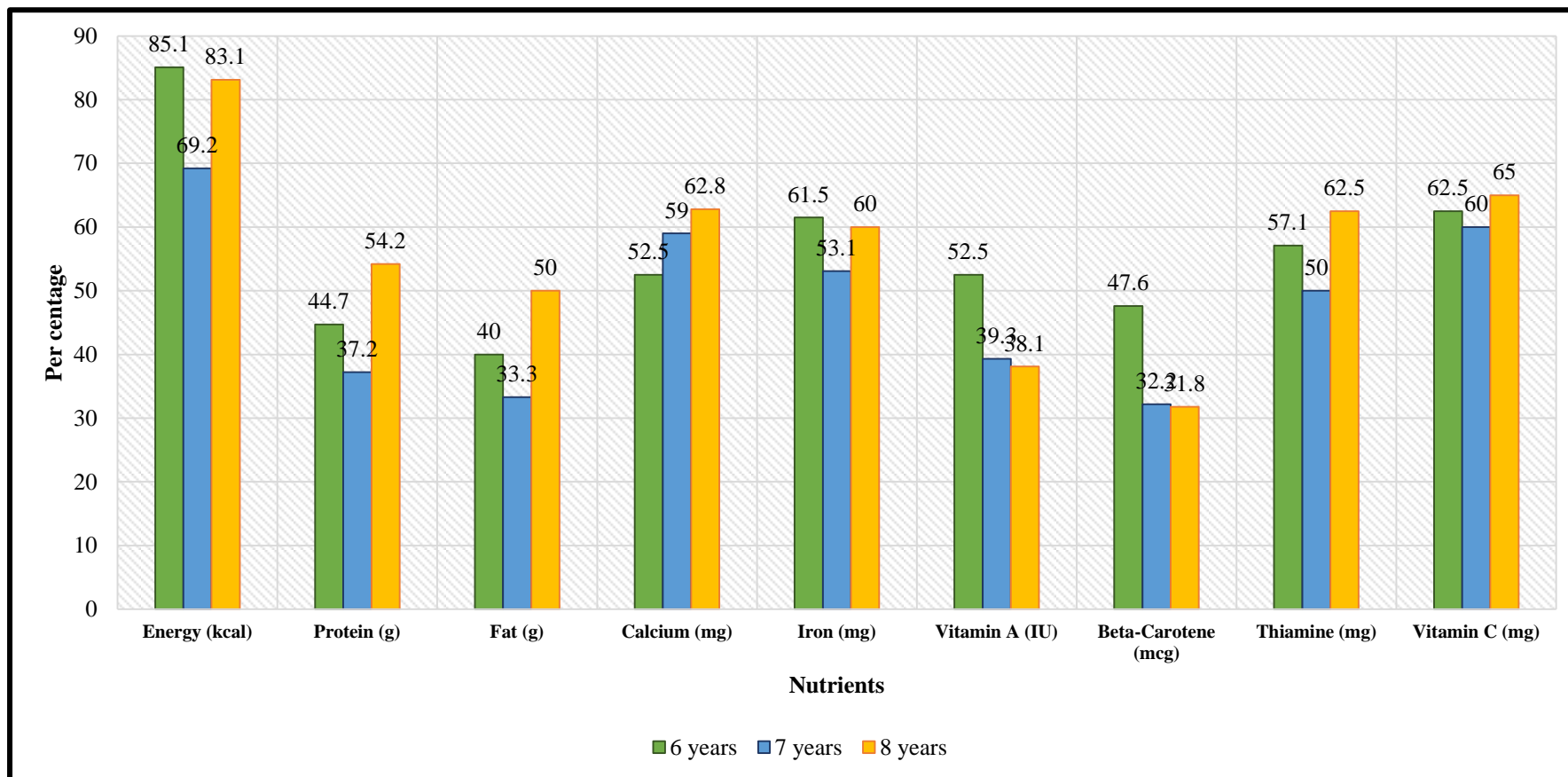


Figure 18: Percentage of Mean Nutrient Intake

Insufficient intake lower than the recommended dietary allowances of all the nutrients was observed. The average energy from the food intake for 6,7- and 8-years age-group was observed to be in a range of 69.2 – 85.1 per cent. Protein intake was in between 44.7 – 62.8 per cent and Fat 33.3 – 50 per cent. With regard to micro-nutrients, the intake of all micronutrients were for calcium 52.5 – 62.8 per cent, Vitamin A 38.1- 52.5 per cent, β - carotene 31.8 – 52.5 per cent, Vitamin C 60–65 per cent, Iron 53.1 – 61.5 per cent, and Thiamine 50 – 62.5 per cent was observed. The intake of all the macro-nutrients was deficit which may be the cause for stunted growth in these children. Hence it could be said that the diets of fishermen children lack nutrients, both macro and micro-nutrient reflecting the poor food intake pattern of the children.

5. Correlation between Energy intake and BMI

Table XXIV shows the correlation between energy intake and BMI.

Table XXIV
Correlation between Energy intake and BMI

Gender/Age in years	N=1000	Energy Intake and BMI	'p' value
		Correlation coefficient of 'r'	
Boys/ 6 years	182	0.0118	0.8747*
Boys/ 7 years	197	-0.0869	0.2295*
Boys/ 8 years	168	0.0787	0.3105*
Girls/ 6 years	148	0.1202	0.1456*
Girls/ 7 years	173	0.0213	0.7808*
Girls/ 8 years	132	-0.0083	0.9274*

**-Significant at 1 per cent level, * - Significant at 5 per cent level

Energy intake and BMI in 6-year-old girls have a statistically significant relationship and has a moderate positive correlation ($r = 0.1202$) between them. The direction of the relationship is positive which means that the energy intake and the BMI tend to increase together. Boys of age-groups 6 and 8 and girls of age-group 7 ($r = 0.0118$, $r = 0.0787$ and $r = 0.0213$, respectively) have a weak correlation between their energy intake and BMI. A very weak or no correlation was observed in the variables of 7 years old boys ($r = -0.0869$) and 8 years ($r = -0.0083$) old girls.

Phase II: Background Information and Nutritional Status of the Supplementation

Group Children

A. Socio-Economic Background of the Supplementation Group Children

1. Background information of the supplementation group children

Two hundred and thirty-four children selected for supplementation were placed in 4 different groups (3 experimental groups and 1 control group). The selected 234 subjects comprise 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. Group 1 comprised of 56 children (31 boys and 25 girls), Group 2 had 59 children (29 boys and 30 girls), Group 3 comprised of 61 children (30 boys and 31 girls) and Group 4 had 58 children (31 boys and 27 girls).

Details on the background information of the supplementary group children are presented in the table XXV.

Table XXV

Background Information of the Children Selected for Supplementation

Family Details	Group 1 (N=56)		Group 2 (N=59)		Group 3 (N=61)		Group 4 (N=58)		Total (N =234)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Type of Family										
Joint	31	55.4	36	61	40	65.6	38	65.5	145	62
Nuclear	25	44.6	23	39	21	34.4	20	34.5	89	38
Total	56	100	59	100	61	100	58	100	234	100
Gender										
Boys	31	55.4	29	49.2	30	49.2	31	53.4	121	51.7
Girls	25	44.6	30	50.8	31	51.8	27	46.6	113	48.3
Total	56	100	59	100	61	100	58	100	234	100

The survey about the children selected for supplementation revealed that in the Group1, 55.4 per cent abided in joint families and 44.6 per cent abided in nuclear families. In Group 2, 61 per cent in joint families and 39 per cent abided in nuclear families. 65.6 per cent of the children in Group 3 abided in joint families and 34.5 per cent abided in nuclear families. In Group 4, 62 per cent lived in joint families and 38 per cent abided in nuclear families. Thus, it is evident that even in today's modern civilization, joint-family is still prevalent in the fishermen community.

In the current study the number of boys and girls were almost in equal numbers (51.7 per cent boys and 48.3 per cent girls). In Group 1, there were 55.4 per cent boys and 44.6 per cent girls. Group 2, comprised of 49.2 per cent boys and 50.8 per cent girls. In Group 3, there were 49.2 per cent boys and 51.8 per cent girls. In Group 4 there were 53.4 per cent boys and 46.6 per cent girls.

2. Monthly income and expenditure of the fishermen families before the supplementation

Tables XXVI, XXVII and Figure 19 gives the categorization of the families depending upon their monthly-income and the particulars of their monthly-expenditure on various needs.

Table XXVI

Monthly Income of the Fishermen Families of Children Selected for Supplementation
(N=234)

Income/ Month	Group 1 (N=56)		Group 2 (N=59)		Group 3 (N=61)		Group 4 (N=58)		Total (N=234)	
	No.	%	No.	%	No.	%	No.	%	No.	%
< 2000	1	1.8	2	3.4	1	1.6	2	3.5	6	2.6
2001 -5000	51	91.2	54	91.5	57	93.4	51	87.9	213	91
5001- 10000	4	7	3	5.1	3	5	5	8.6	15	6.4
Total	56	100	59	100	61	100	58	100	234	100

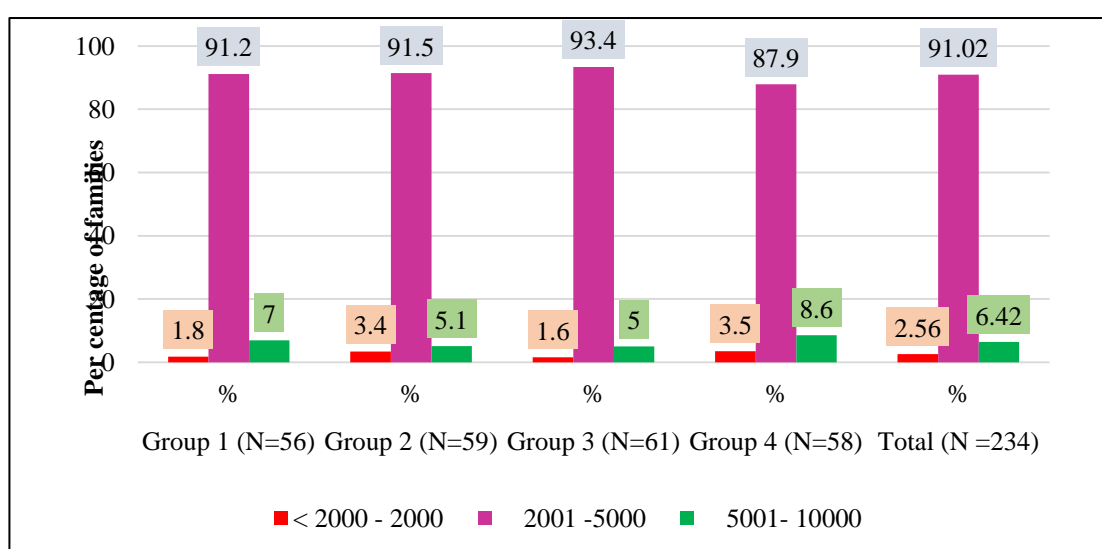


Figure 19: Monthly Income of the Fishermen Families of Children Selected for Supplementation

Monthly income pattern of the children's family revealed that families which earned less than Rs.5000 per month were 93 per cent in Group 1, 94.9 per cent in Group 2, 95 per cent in Group 3 and 91 per cent in Group 4. They belonged to the economically weaker section and were categorized in BPL (Below Poverty Line) category.

On the whole, 93.6 per cent of the families belonged to the BPL and only 6.4 per cent were in the low-income group.

Table XXVII
Monthly Expenditure of the Fishermen Families of Children Selected for
Supplementation
(N=234)

Expenditure/ Month	Group 1 (N=56)		Group 2 (N=59)		Group 3 (N=61)		Group 4 (N=58)		Total (N =234)	
	INR	%	INR	%	INR	%	INR	%	INR	%
Food	1255	14.8	1205	13.7	1320	14.4	1280	14.5	1265	14.3
Paan/Betel Nut/Tobacco and Alcoholic Drinks	2647	31.2	3155	35.8	3019	32.96	3105	35.1	3004	34.0
Clothing	455	5.3	355	4.03	396	4.3	450	5.1	414	4.7
Purchase of household needs	510	6.0	508	5.8	490	5.4	420	4.7	482	5.4
Transport	525	6.2	425	4.8	530	5.8	480	5.4	490	5.5
House Rent /boat rent	1670	19.7	1550	17.5	1600	17.5	1540	17.4	1590	18.0
Debts	1420	16.7	1610	18.3	1802	19.7	1580	17.8	1603	18.1
Total expenditure per month	8482	100	8808	100	9157	100	8855	100	8848	100

The average expenditure on food of all the families is about 14.8 per cent, 13.7, 14.4 and 14.45 per cent in Group1, Group2, Group3 and Group 4 respectively. Though the majority of these fishing households were poor and categorized as population below poverty line, it was to noted that on an average 34 per cent of the expenditure was on paan, betelnut, tobacco and alcoholic drinks. In detail, 31.2, 35.8, 34 and 35.1 per cent of the expenses of Group1, 2, 3 and 4 respectively was on these unhealthy habits. As noted, 5.4, 4.0, 4.3 and 5.1 per cent of the expenditure was on clothing in Group1, 2, 3 and 4 respectively. For daily household needs like cleaning agents, toiletries, etc., families belonging to Group 1 spent 6.0 per cent of their money, Group 2 spent 5.8 per cent, Group 3 spent 5.4 per cent and Group 4 spent 4.7 per cent. Transportation is an unavoidable expenditure for the fisherfolk as they hardly own any vehicle. So, the expenditure of the

fishermen families of the supplementation groups was noted to be 6.2, 4.8, 5.8 and 5.4 per cent in Group1, Group2, Group3 and Group 4 respectively. Expenses on house/boat rent constituted up to 19.7, 17.5, 17.5 and 17.4 per cent in Group 1, Group 2, Group 3 and Group 4 respectively. All the families of the Supplementation group had debts to pay on a monthly basis as their income was fluctuated and insufficient for their livelihood. An average monthly expenditure of 18.1 per cent was paid for debts by the supplement group families. In detail, 16.7, 18.3, 19.7 and 17.8 per cent was paid by Group 1, 2, 3 and 4 fishermen families respectively for debts.

B. Nutritional Status of the Selected Fisherfolk Children before Supplementation

1. Mean anthropometry of the children before supplementation (N=234)

The mean anthropometrical readings, the length of the body and body weight of the children were presented according to the age and gender and compared to ICMR and WHO standards in the Tables XXVIII, XXIX and Figures 20 and 21.

i) Mean height of the children before supplementation

Table XXVIII depicts the average height (cm) of boys prior to supplementation and compared with ICMR and WHO standards.

Table XXVIII

Mean Height (cm) of boys Before Supplementation in Comparison with ICMR and WHO Standards

Age (yr)	Groups	No.	ICMR (2020)	WHO (2006)	Mean Height(cm) ± SD	Difference with ICMR	Difference with WHO	T- Value Mean vs WHO
6	Gp 1	11	115.8	117.15	100.1±1.07	-15.7	-17.0	-52.79**
	Gp 2	8	115.8	117.15	101.4±1.86	-14.4	-15.7	-23.94**
	Gp3	11	115.8	117.15	100.3±1.00	-15.5	-16.9	-55.95**
	Gp4	10	115.8	117.15	100.8±0.69	-15.0	-16.4	-75.02**
7	Gp 1	9	121.7	124.3	110.0±0.65	-11.7	-3.2	-20.24**
	Gp 2	11	121.7	124.3	111.4±0.86	-10.3	-4.0	-21.61**
	Gp3	9	121.7	124.3	110.0±1.05	-11.7	-3.7	-14.3**
	Gp4	12	121.7	124.3	109.9±1.19	-11.8	-3.6	-15.21**
8	Gp 1	11	127	130.1	120.1±2.02	-6.8	-3.8	-15.14**
	Gp 2	10	127	130.1	120.1±1.34	-6.9	-3.9	-19.42**
	Gp3	10	127	130.1	116.27±2.45	-10.73	-5.47	-9.3**
	Gp4	9	127	130.1	120.82±1.02	-6.18	-4.38	-12.88**

** - Significant at 1 per cent level, * - Significant at 5 per cent level

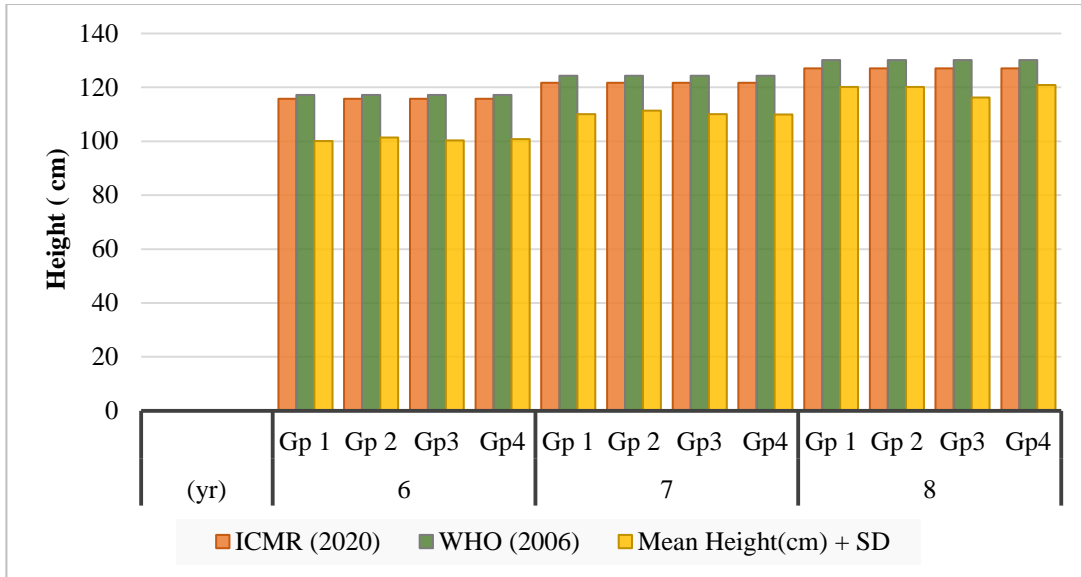


Figure 20: Mean Height (cm) of the Boys Before Supplementation in Comparison with ICMR and WHO Standards

The mean height range of the boys of 6 years old selected for the supplementation was 100.1 ± 1.07 cm to 101.4 ± 1.86 cm, while the boys who were 7 years old was 109.9 ± 1.19 cm to 111.4 ± 0.86 cm, and boys of 8 years was 116.3 ± 2.45 cm to 120.8 ± 1.02 cm. A clear difference between the standards and the mean heights of the boys in all age-groups at a significance level of 1 per cent ($p < 0.01$) was observed.

Aneena (2003), in her study also came up with similar readings that the averages of height and weight of both male and female children were found to be below ICMR standards. The study revealed that 47.6 per cent of boys and 43.2 per cent of girls have heights below 85 per cent of their standard height. Prevalence of moderate malnutrition with respect to their height for age was 11.9 per cent in boys and 32.7 per cent in girls.

Table XXIX

Mean Height (cm) of Girls before Supplementation in Comparison with ICMR and WHO Standards

Age	Groups	No.	ICMR (2020)	WHO (2006)	Mean Height (cm) ± SD	Difference with ICMR	Difference with WHO	T- Value Mean vsWHO
6	Gp 1	10	114.5	116.5	99.8±1.28	-14.7	-16.7	-42.21**
	Gp 2	9	114.5	116.5	99.7±0.89	-14.9	-16.9	-56.8**
	Gp3	12	114.5	116.5	101.3±1.35	-13.2	-15.2	-38.95**
	Gp4	9	114.5	116.5	101.4±1.20	-13.1	-15.1	-37.82**
7	Gp 1	8	120.6	123.6	104.3±1.89	-16.3	-19.3	-28.93**
	Gp 2	11	120.6	123.6	104.6±0.60	-16.0	-19.0	-14.92**
	Gp3	9	120.6	123.6	105.1±0.93	-15.5	-18.3	-59.77**
	Gp4	7	120.6	123.6	105.4±1.4	-15.3	-18.25	-34.49**
8	Gp 1	7	126.4	129.2	116.7±1.57	-9.7	-12.5	-21**
	Gp 2	10	126.4	129.2	118.3±1.44	-8.1	-10.9	-23.94**
	Gp3	10	126.4	129.2	116.0±1.19	-10.4	-13.2	-35.13**
	Gp4	11	126.4	129.2	117.0±1.08	-9.4	-12.2	-37.34**

** - Significant at 1 per cent level, * - Significant at 5 per cent level

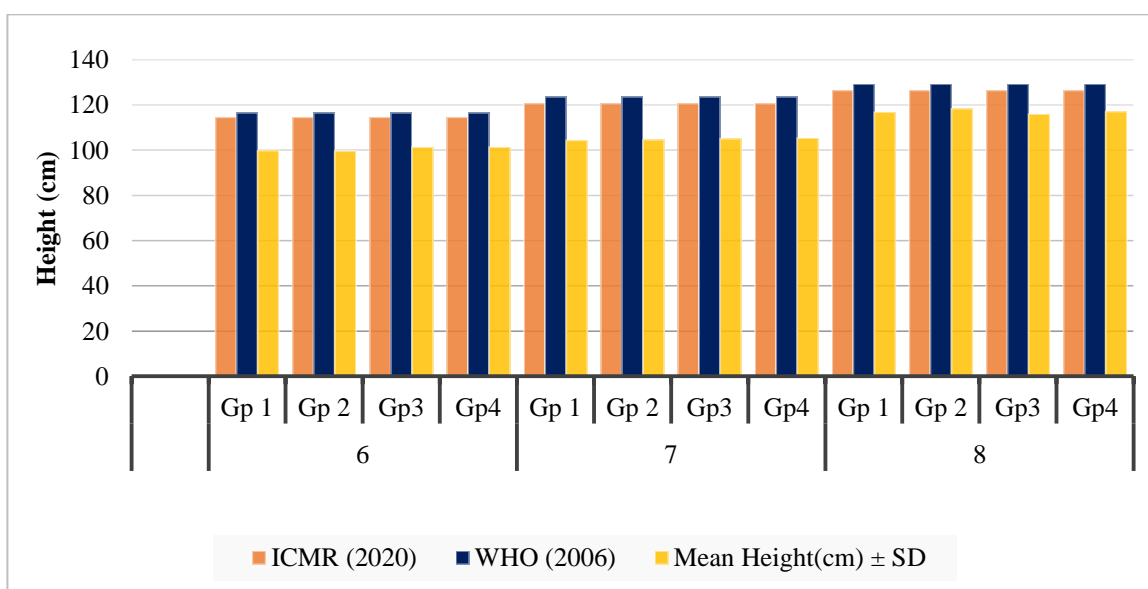


Figure 21: Mean Height (cm) of the Girls Before Supplementation in Comparison with ICMR and WHO Standards

The mean height range of the girls of 6 years old selected for the supplementation was 99.7±0.8 cm to 101.4±1.20 cm, while the mean height of the girls who were 7 years old was 104.3±1.89 cm to 105.4±1.4 cm and girls of 8 years was 116±1.19 cm to 118.3±1.44 cm. The absolute value of the T-test has a larger deviation from zero with a significance level of all the compared sample sets at 1 per cent ($p < 0.01$). So, it can be interpreted that all girls in all the four groups were below the standard height.

A striking difference between standard values and measured heights could be seen in all children who were included for supplementation. The average heights of all children irrespective of age and gender, were noted to be lower than the standard values by a difference ranging from 10.9 cm to 19.3 cm.

Similar readings were reported by Jose (1998) that the height and weight of preschool children of Thrissur district were below the Indian standards.

ii) Mean weight (kg) of the children before supplementation

The average weights of the fisherfolk off-springs before supplementation are presented in Tables XXX, XXXI and Figures 22 and 23.

Table XXX
Mean Weight (kg) of Boys before Supplementation in Comparison with ICMR and WHO Standards

Age	Groups	No.	ICMR (2020)	WHO (2006)	Mean Weight(kg) ± SD	Difference with ICMR	Difference with WHO	't' - Value Mean vsWHO
6	Gp 1	11	20.8	20.5	15.8±0.64	-5.0	-4.7	-24.25**
	Gp 2	8	20.8	20.5	17.9±1.57	-2.9	-2.9	-4.63*
	Gp3	11	20.8	20.5	16.1±0.89	-4.7	-4.4	-16.4**
	Gp4	10	20.8	20.5	17.1±1.11	-3.7	-3.4	-9.57*
7	Gp 1	9	22.9	22.7	19.5±0.51	-3.4	-3.2	-20.24**
	Gp 2	11	22.9	22.7	18.7±0.62	-4.2	-4.0	-21.61**
	Gp3	9	22.9	22.7	19.0±0.77	-3.9	-3.7	-14.3**
	Gp4	12	22.9	22.7	19.1±0.82	-3.8	-3.6	-15.21**
8	Gp 1	11	25.3	25.2	21.4±0.83	-3.9	-3.8	-15.14**
	Gp 2	10	25.3	25.2	21.3±0.64	-4.0	-3.9	-19.42**
	Gp3	10	25.3	25.2	19.7±1.86	-5.6	-5.5	-9.3*
	Gp4	9	25.3	25.2	20.8±1.02	-4.5	-4.4	-12.88**

** - Significant at 1 per cent level, * - Significant at 5 per cent level

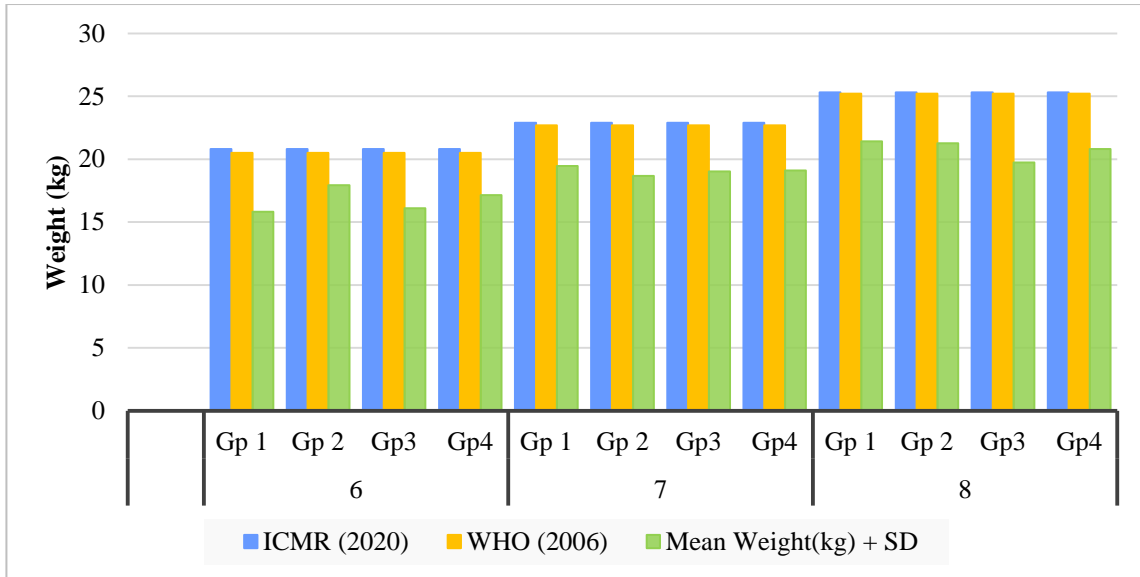


Figure 22: Mean Weight (kg) of Boys Before Supplementation in Comparison with ICMR and WHO Standards

Table XXXI

Mean Weight (kg) of Girls before Supplementation in Comparison with ICMR and WHO Standards

Age	Groups	No.	ICMR (2020)	WHO (2006)	Mean Weight(kg) ± SD	Difference with ICMR	Difference with WHO	't' Value Mean vsWHO
6	Gp 1	10	19.75	20.45	14.9±0.73	-4.9	-5.6	-24.04**
	Gp 2	9	19.75	20.45	15.0±0.87	-4.8	-5.5	-18.93**
	Gp3	12	19.75	20.45	14.6±1.62	-5.2	-5.9	-12.59**
	Gp4	9	19.75	20.45	15.1±1.10	-4.7	-5.4	-12.82**
7	Gp 1	8	21.8	22.3	16.8±1.43	-5.0	-5.5	-10.94**
	Gp 2	11	21.8	22.3	16.7±0.69	-5.1	-5.6	-26.92**
	Gp3	9	21.8	22.3	16.6±0.74	-5.3	-5.8	-23.31**
	Gp4	7	21.8	22.3	16.9±0.44	-4.9	-5.4	-32.23**
8	Gp 1	7	24.8	25	19.5±0.78	-5.3	-5.5	-17.84**
	Gp 2	10	24.8	25	19.7±1.08	-5.1	-5.3	-15.49**
	Gp3	10	24.8	25	19.1±0.73	-5.7	-5.9	-25.56**
	Gp4	11	24.8	25	19.2±1.01	-5.6	-5.8	-19.18**

** - Significant at 1 per cent level; * - Significant at 5 per cent level

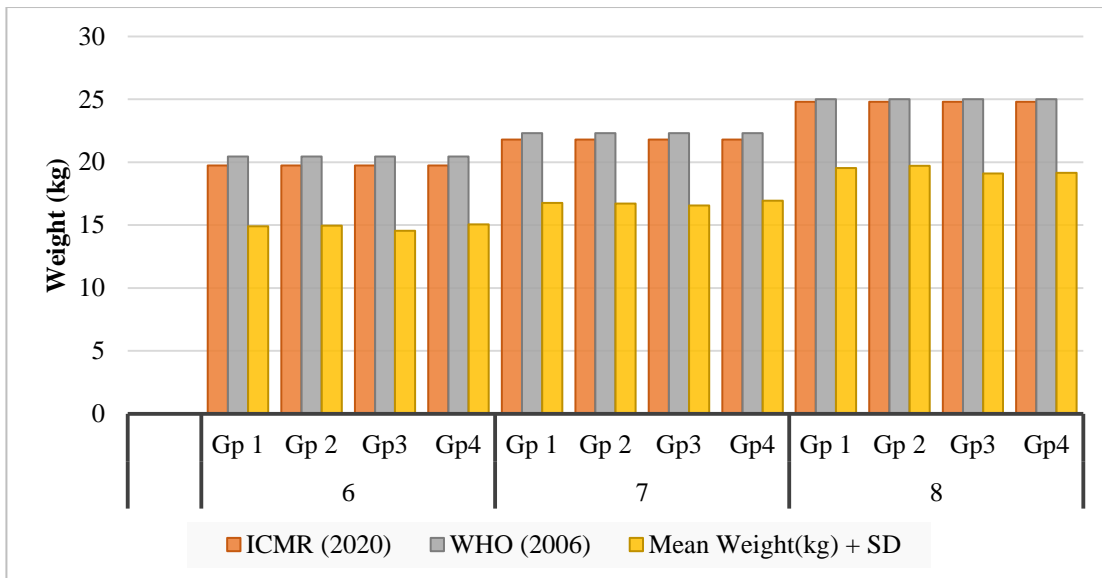


Figure 23: Mean Weight (kg) of Girls Before Supplementation in Comparison with ICMR and WHO Standards

The average body weight of the boys of 6 years old selected for the supplementation was 15.8 ± 0.64 kg to 17.9 ± 1.57 kg, while the boys who were 7 years old were 18.7 ± 0.62 kg to 19.5 ± 0.51 kg and boys of 8 years was 19.7 ± 1.86 kg to 21.4 ± 0.83 kg. The mean weight of the girls of 6 years old selected for the supplementation was 14.6 ± 1.62 kg to 15.0 ± 1.10 kg, while the girls who were 7 years old were 16.6 ± 0.74 kg to 16.9 ± 0.44 kg and girls of 8 years was 19.1 ± 0.73 kg to 19.7 ± 1.08 kg. A deficient could be seen in the weights of all children who were included for supplementation. The mean weights of all children of all age-group and both the genders were below the standard values by a difference ranging from 2.9 kg to 5.9 kg. The 't'-test values were largely deviated from zero with a significance level of the compared sample sets at 1 per cent and 5 per cent ($p < 0.01$ and 0.05).

Similarity of findings could be seen between the present study and the study by Rao and Vijayaraghavan (1998). They revealed that 60 per cent of the children in rural households in India were under-weight and 62 per cent were stunted.

2. Biochemical profile

i) Mean haemoglobin of children

The average blood haemoglobin of the selected subjects for supplementation is presented in the Tables XXXII, XXXIII and Figures 24 and 25.

Table XXXII

Mean Haemoglobin (g/dl) of Boys Before Supplementation in Comparison with WHO Standard

(N=121)

Age	Groups	No.	WHO Standard	Mean Haemoglobin Level \pm SD	Difference	T- Value Mean vsWHO
6	Gp 1	11	≥ 11.5	9.9 \pm 0.77	-1.6	-6.72**
	Gp 2	8	≥ 11.5	10.6 \pm 0.53	-0.9	-4.75**
	Gp3	11	≥ 11.5	10.3 \pm 0.54	-1.2	-7.25**
	Gp4	10	≥ 11.5	9.9 \pm 0.45	-1.	-11.03**
7	Gp 1	9	≥ 11.5	11.1 \pm 1.26	-0.4	-1*
	Gp 2	11	≥ 11.5	10.7 \pm 0.30	-0.8	-8.62**
	Gp3	9	≥ 11.5	11.1 \pm 1.39	-0.4	-0.8 *
	Gp4	12	≥ 11.5	10.0 \pm 1.33	-1.5	-3.85*
8	Gp 1	11	≥ 11.5	10.8 \pm 0.55	-0.8	-4.34**
	Gp 2	10	≥ 11.5	10.5 \pm 0.61	-1.0	-5.03**
	Gp3	10	≥ 11.5	10.4 \pm 0.92	-1.1	-3.68**
	Gp4	9	≥ 11.5	9.9 \pm 0.77	-1.6	-6.08**

**-Significant at 1 per cent level; * - Significant at 5 per cent level; NS – Not significant

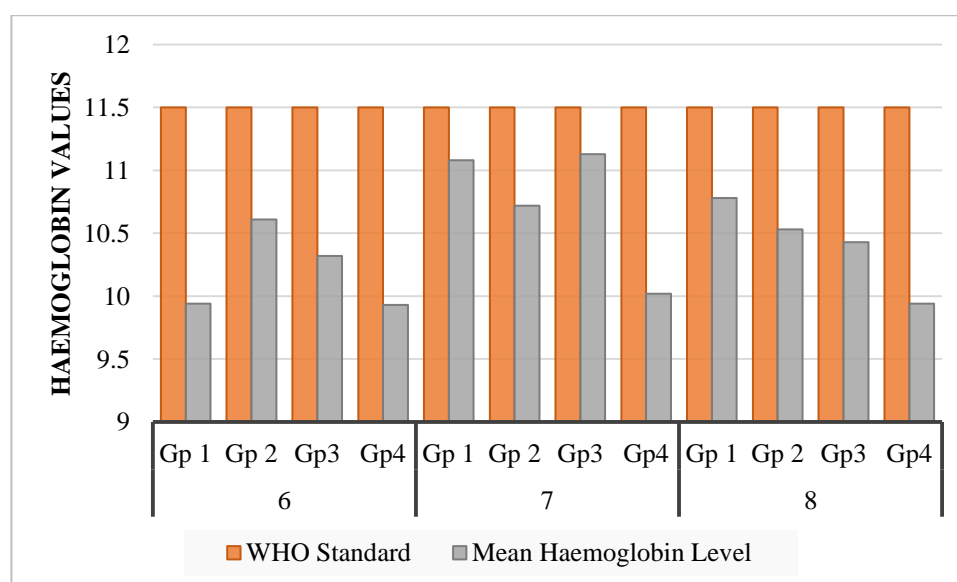


Figure 24: Mean Haemoglobin (g/dl) of Boys Before Supplementation in Comparison with WHO Standard

The average blood haemoglobin levels of the boys of 6 years old of all the four groups ranged from 9.9 \pm 0.45 g/dl to 10.6 \pm 0.53 g/dl ($p < 0.01$), while the hemoglobin values of boys who were 7 years old ranged from 10.02 \pm 1.33 g/dl to 11.1 \pm 1.39 g/dl ($p < 0.01$ and 0.05), and boys of 8 years ranged from 9.9 \pm 0.77 g/dl to 10.8 \pm 0.55 g/dl ($p < 0.01$). The significance levels (α) were at 1 per cent and 5 per cent with the t-values

lesser than α indicating a positive difference between our sample data and the null hypothesis.

Table XXXIII
Mean Haemoglobin (g/dl) of Girls before Supplementation in
Comparison with WHO Standard

(N=113)

Age	Groups	No.	WHO Standard	Before	Difference	't' Value Mean vsWHO
6	Gp 1	10	≥ 11.5	10.5 \pm 0.51	-1.0	-6.51**
	Gp 2	9	≥ 11.5	10.2 \pm 0.68	-1.3	-2.51*
	Gp3	12	≥ 11.5	10.2 \pm 0.72	-1.3	-6.11**
	Gp4	9	≥ 11.5	9.8 \pm 0.65	-1.7	-7.89**
7	Gp 1	8	≥ 11.5	10.9 \pm 0.53	-0.6	-3.31*
	Gp 2	11	≥ 11.5	10.6 \pm 0.80	-0.9	-3.34*
	Gp3	9	≥ 11.5	10.3 \pm 0.72	-1.2	-4.88**
	Gp4	7	≥ 11.5	10.1 \pm 1.37	-1.4	-2.68*
8	Gp 1	7	≥ 11.5	10.5 \pm 0.73	-1.0	-3.7*
	Gp 2	10	≥ 11.5	10.7 \pm 0.74	-0.8	-3.33*
	Gp3	10	≥ 11.5	10.5 \pm 1.0	-1.0	-3.19*
	Gp4	11	≥ 11.5	9.5 \pm 0.65	-2.0	-2.68*

**-Significant at 1 per cent level; * - Significant at 5 per cent level

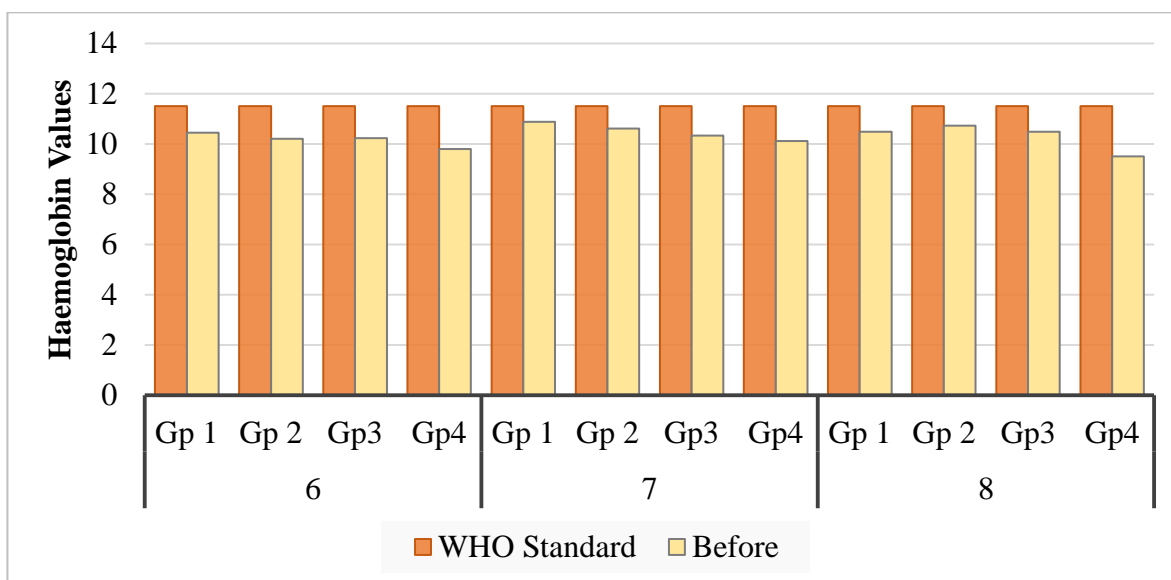


Figure 25: Mean Haemoglobin (g/dl) of Boys Before Supplementation in Comparison with WHO Standard

The average blood haemoglobin levels of the girls of 6 years old was ranged from 9.8 \pm 0.65 g/dl to 10.5 \pm 0.51 g/dl, while the haemoglobin values of girls who were 7 years

old ranged from 10.1 ± 1.37 g/dl to 10.9g/dl and girls of 8 years ranged from 9.5 ± 0.65 g/dl to 10.7 ± 0.74 g/dl. The mean haemoglobin values of all children of all age-group and both the genders were below the standard value ($p < 0.01$ and 0.05), which were < 11.5 g/dl (WHO 2001) by a difference ranging from 0.6 g/dl to 2 g/dl. The average blood haemoglobin count of all the subjects was significant at 1 per cent and 5 per cent levels.

The blood haemoglobin count of all subjects is an indicative signal of anaemia, which is a problem of public health.

ii) Grouping of children according to degree of anaemia

Table XXXIV represents the categorization of children on the basis of their degree of anaemia.

Table XXXIV
Grouping of Children according to Degree of Anaemia

(N=234)

Age in years / Gender	No.	Degree of Anaemia							
		Normal (Hb >11.5g/dl)		Mild (Hb: 11-11.4 g/dl)		Moderate (Hb: 8-10.9 g/dl)		Severe (Hb: < 8 g/ dl)	
Boys		No.	%	No.	%	No.	%	No.	%
6+	40	0	0	2	5	22	55	16	40
7+	41	5	12.2	1	2.4	25	61	10	24.4
8+	40	0	0	5	12.5	33	82.5	2	5
Girls									
6+	40	0	0	1	2.5	25	62.5	14	35
7+	35	2	5.7	3	8.6	23	65.7	7	20
8+	38	1	2.6	2	5.3	35	92.1	0	0
Total	234	8	3.4	14	6	163	69.7	49	20.9

All the boys and girls of age-group 6 were noted to be anemic with various degrees of anaemia. All boys of age-group 8 were also anemic. While 5 per cent of the boys in the age-group of 6 had mild anaemia, 55 per cent had moderate and 40 per cent had severe anaemia. In boys of the age-group 7, 12.2 per cent were normal, 2.4 per cent had moderate anemia and 61 per cent had moderate anaemia and 24.4 per cent had severe anaemia. In 8-year-old boys, 12.5 per cent were mildly anemic, 82.5 per cent moderately anemic and 5 per cent had severe anemia.

While in girls, normal hemoglobin levels were seen in 5.7 per cent in 7 years and 2.63 per cent in 8 years. Mild anaemia in the age-groups 6, 7 and 8 was observed to be 2.5 per cent, 6.6 per cent and 8.3 per cent respectively. Moderate anemia was seen in

62.5 per cent, 65.7 per cent and 92.1 per cent in 6,7 and 8 age-groups respectively. Severe anaemia was noted to be prevalent in 35 per cent of the girls of 6 years age-group and 20 per cent in 8 years age-group respectively.

World Health Organization (WHO) has categorized the presence of 40 per cent anaemia to be a serious health problem. In this study, anaemia can be a significant health problem as 96.6 per cent of the children were identified to be anaemic. A total of 3.4 per cent of the children had normal haemoglobin levels, 6 per cent had mild-anaemia, 69.7 per cent had moderate-anaemia and 20.9 per cent children had severe-anaemia.

Similar prevalence was noted in the study of Shuchismitha Behera and Gandham Bulliyya (2016) among school going children. They reported that school age children were found to be more anaemic than other children with 68.9 per cent being anaemic, of which 27.4 per cent were mildly, 23.6 per cent moderately and 17.9 per cent severely anaemic. Khosla et al. (2000) revealed that 30 per cent of preschool children in Ludhiana district, Punjab were mildly anemic, 62 per cent moderately anaemic and 8 per cent severely anaemic. Similar results were shown by Lakshmi et al.,(2001), that 75 per cent of children had signs of iron deficiency anaemia and 99 per cent among them were suffering from moderate anaemia to severe anaemia in rural households of Mysore.

iii) Correlation between iron intake and haemoglobin

The correlation between iron intake and haemoglobin is given in the Table XXXV and Figure 26.

Table XXXV
Correlation between Iron Intake and Haemoglobin

(N=234)

Iron intake vs Haemoglobin					
age-group (in years)	N	Mean Iron Intake (mg)	Mean Haemoglobin Level (gm/Dl)	Correlation coefficient of 'r'	p value
6 years	80	7.39±0.73	10.19±0.66	-0.1394	0.2188**
7 years	76	8.02±0.35	10.60±1.07	-0.1194	0.3058**
8 years	78	8.80±0.63	10.38±0.82	0.186	0.103**

** - Significant at 1 per cent level, * - Significant at 5 per cent level

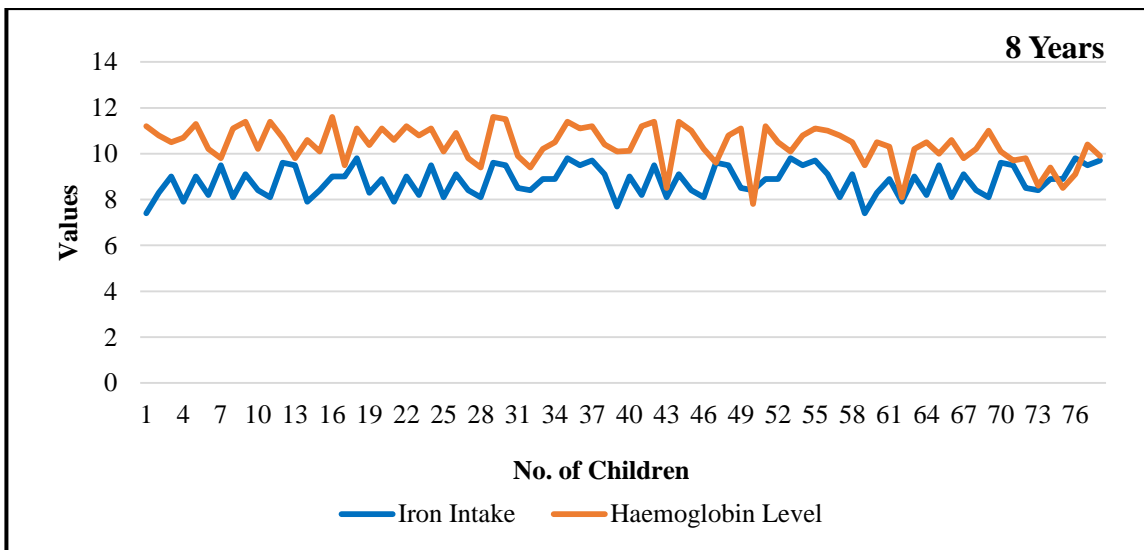
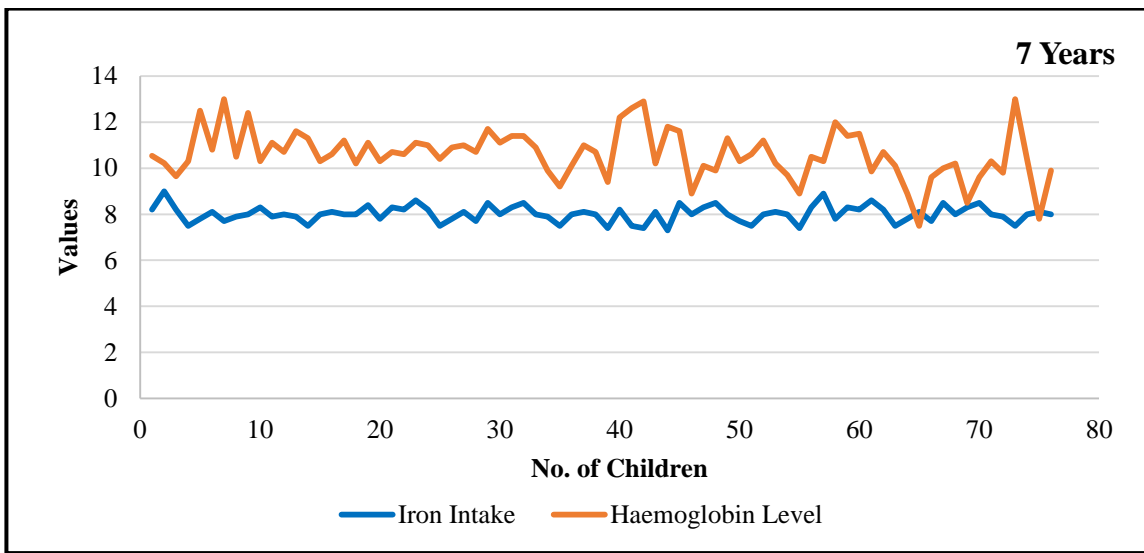
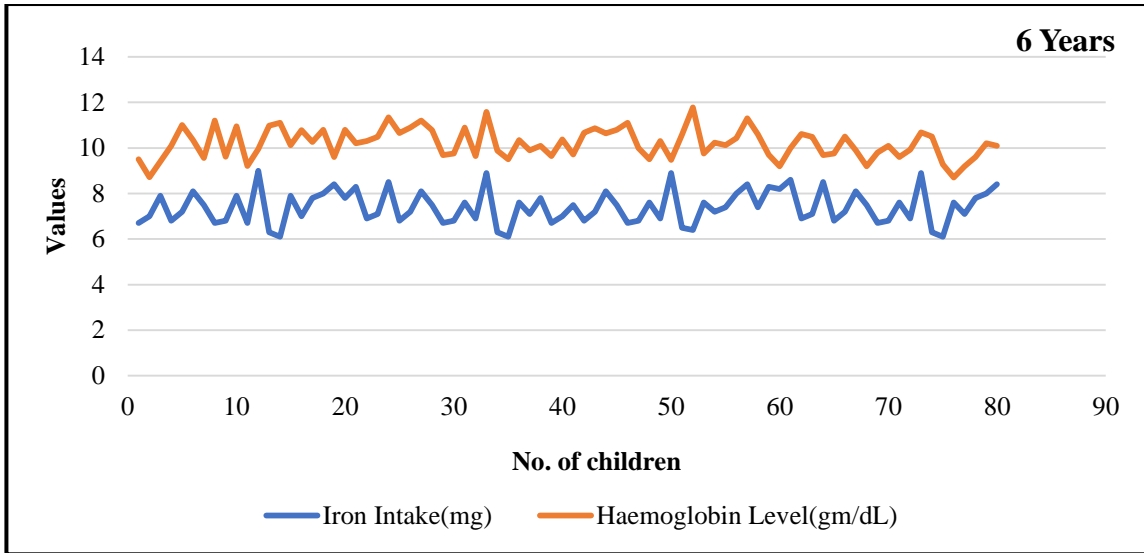


Figure 26: Correlation Graphs between Iron Intake and Haemoglobin Levels of Children before Supplementation

Iron intake and haemoglobin have a relevant linear relationship with $p < 0.005$ with a positive correlation in 8 years age-group which means that both iron intake and haemoglobin tend to rise together. In 6- and 7-years age-group, there is a weak correlation between the variables. The children consumed very less of heme iron and non-heme iron in their diets, that might have been the cause for low haemoglobin levels. Tiffany, et al., (2019) in their research revealed that more consumption of heme iron and consuming less of non-heme iron resulted in higher haemoglobin levels. This sort of intake may be useful in the prevention of low Hb levels.

iv) Mean Serum Retinol of children before supplementation

The average serum retinol of subjects is presented in the Tables XXXVI, XXXVII and Figures 27 and 28.

Table XXXVI
Mean Serum Retinol (mg/L) of Boys Before Supplementation in Comparison with WHO Standard

(N=121)

Age	Groups	No.	WHO Standard	Mean \pm SD	Difference	't' - Value Mean vsWHO
6	Gp 1	11	0.20-0.50	0.16 \pm 0.014	-0.04	-9.48**
	Gp 2	8	0.20-0.50	0.15 \pm 0.014	-0.05	-10.1**
	Gp3	11	0.20-0.50	0.15 \pm 0.01	-0.05	-16.58**
	Gp4	10	0.20-0.50	0.14 \pm 0.008	-0.04	-20.16**
7	Gp 1	9	0.20-0.50	0.16 \pm 0.01	-0.04	-12**
	Gp 2	11	0.20-0.50	0.15 \pm 0.016	-0.05	-10.36**
	Gp3	9	0.20-0.50	0.16 \pm 0.01	-0.04	-12**
	Gp4	12	0.20-0.50	0.15 \pm 0.015	-0.05	-11.55**
8	Gp 1	11	0.20-0.50	0.15 \pm 0.01	-0.05	-16.58**
	Gp 2	10	0.20-0.50	0.15 \pm 0.020	-0.05	-7.91**
	Gp3	10	0.20-0.50	0.15 \pm 0.01	-0.05	-15.81**
	Gp4	9	0.20-0.50	0.15 \pm 0.015	-0.05	-9.4**

** - Significant at 1 per cent level ($p < 0.01$); * - Significant at 5 per cent level

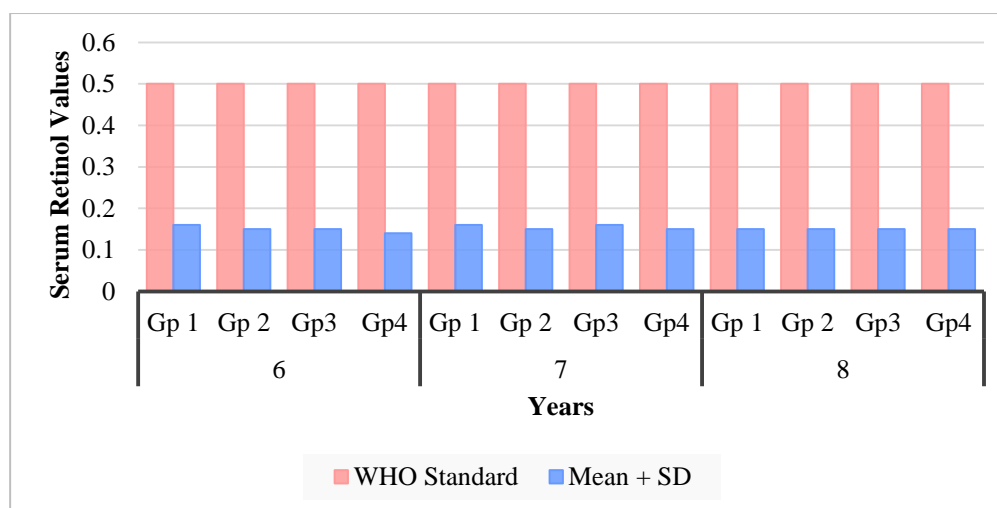


Figure 27: Mean Serum Retinol (mg/L) of Boys Before Supplementation in Comparison with WHO Standard

The average serum retinol levels in boys of 6 years old of all the four groups ranged from 0.14 ± 0.008 mg/l to 0.16 ± 0.014 mg/l, while the serum retinol values of boys who were 7 years old ranged from 0.15 ± 0.01 mg/l to 0.16 ± 0.01 mg/l and boys of 8 years was 0.15 ± 0.01 mg/l. The significance levels(α) were at 1 per cent ($p < 0.01$) with the t-values lesser than α . The contrast between the specimen data and the null hypothesis is escalated and the numerical value of the 't' is escalated which indicates a clear difference in between the average serum retinol levels of the subjects and standards.

Table XXXVII
Mean Serum Retinol (mg/L) of Girls before Supplementation in Comparison with WHO Standard

(N=113)

Age	Groups	No.	WHO Standard	Mean \pm SD	Difference	't' - Value Mean vsWHO
6	Gp 1	10	0.20-0.50	0.14 \pm 0.01	-0.06	-18.97**
	Gp 2	9	0.20-0.50	0.16 \pm 0.01	-0.04	-12**
	Gp3	12	0.20-0.50	0.15 \pm 0.01	-0.05	-17.32**
	Gp4	9	0.20-0.50	0.15 \pm 0.01	-0.05	-15**
7	Gp 1	8	0.20-0.50	0.14 \pm 0.01	-0.06	-16.97**
	Gp 2	11	0.20-0.50	0.15 \pm 0.017	-0.05	-9.45**
	Gp3	9	0.20-0.50	0.14 \pm 0.01	-0.04	-18**
	Gp4	7	0.20-0.50	0.16 \pm 0.02	-0.04	-5.29**
8	Gp 1	7	0.20-0.50	0.14 \pm 0.014	-0.06	-15.87**
	Gp 2	10	0.20-0.50	0.15 \pm 0.02	-0.05	-6.8**
	Gp3	10	0.20-0.50	0.15 \pm 0.01	-0.05	-15.81**
	Gp4	11	0.20-0.50	0.16 \pm 0.02	-0.05	-7.3**

** - Significant at 1 per cent level ($p < 0.01$); * - Significant at 5 per cent level

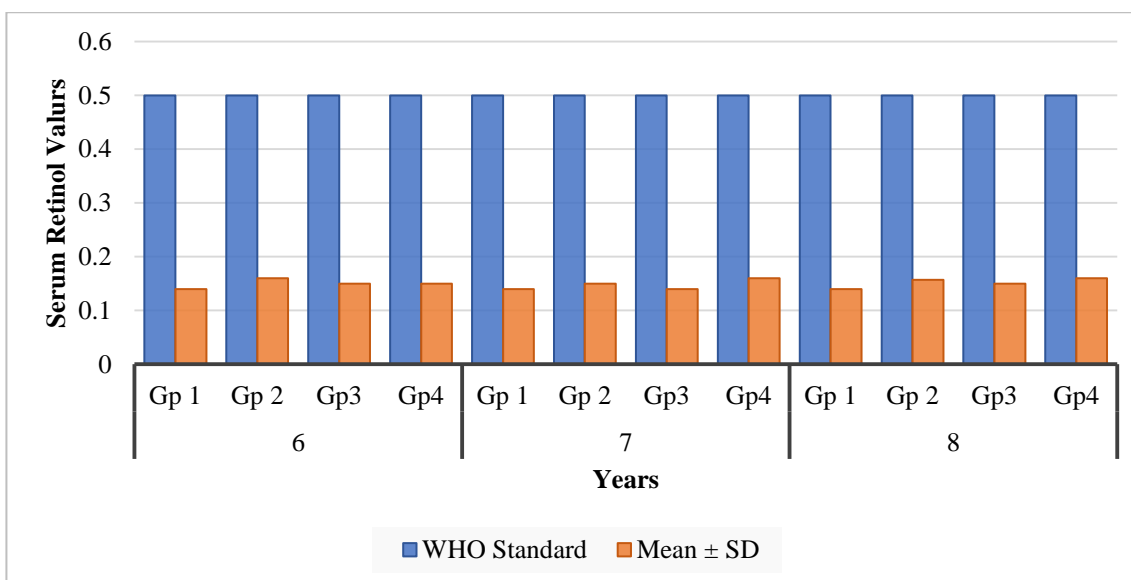


Figure 28: Mean Serum Retinol (mg/L) of Girls Before Supplementation in Comparison with WHO Standard

The mean serum retinol levels of the girls of 6 years old ranged from 0.14 ± 0.01 mg/l to 0.16 ± 0.01 mg/l ($p < 0.01$), while the serum retinol level of girls who were 7 years old ranged from 0.14 ± 0.01 g/dl to 0.16 ± 0.02 mg/l ($p < 0.01$) and girls of 8 years ranged between 0.14 ± 0.014 mg/l to 0.16 ± 0.02 mg/l ($p < 0.01$).

The mean serum retinol of the subjects was relevantly lower ($p < 0.01$) the standard values (0.2-0.5 mg/L) in all boys and girls of all age groups.

i) Correlation between vitamin A intake and serum retinol

Table XXXVIII and Figure 29 depicts the correlation between vitamin A intake and serum retinol.

Table XXXVIII

Correlation between Vitamin A Intake and Serum Retinol

(N=234)

Vitamin A intake vs Serum Retinol					
age-group (in years)	N	Mean Vitamin A Intake (IU)	Mean Serum Retinol Level(mg/L)	Correlation coefficient of 'r'	p value
6 years	80	218.03±8.85	0.154±0.01	0.2914	0.0087*
7 years	76	231.8±9.78	0.155±0.01	0.395	0.0004*
8 years	78	236.4±11.13	0.153±0.01	0.1688	0.1395**

** - Significant at 1 per cent level; * - Significant at 5 per cent level

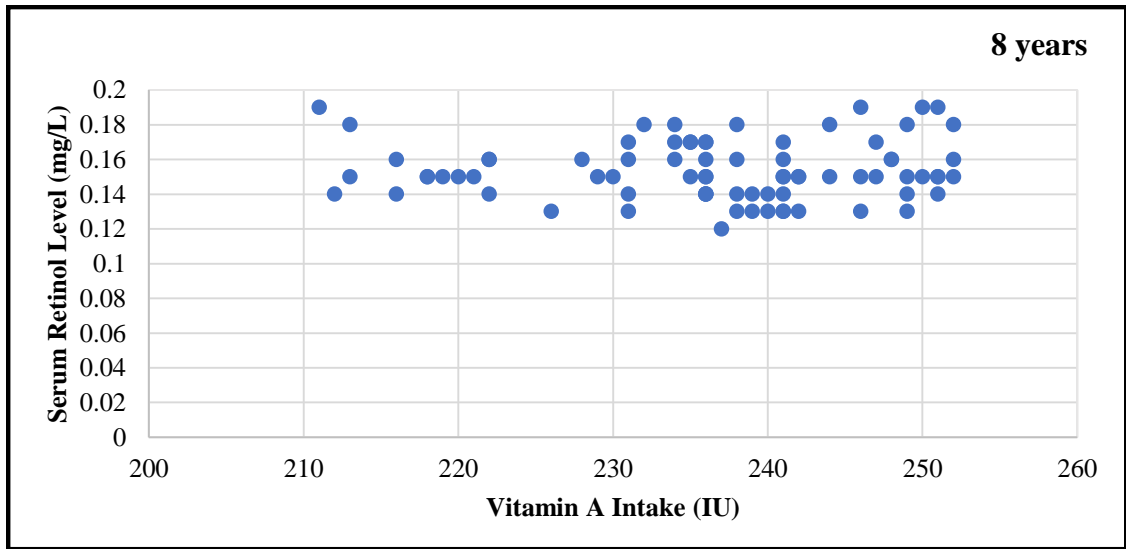
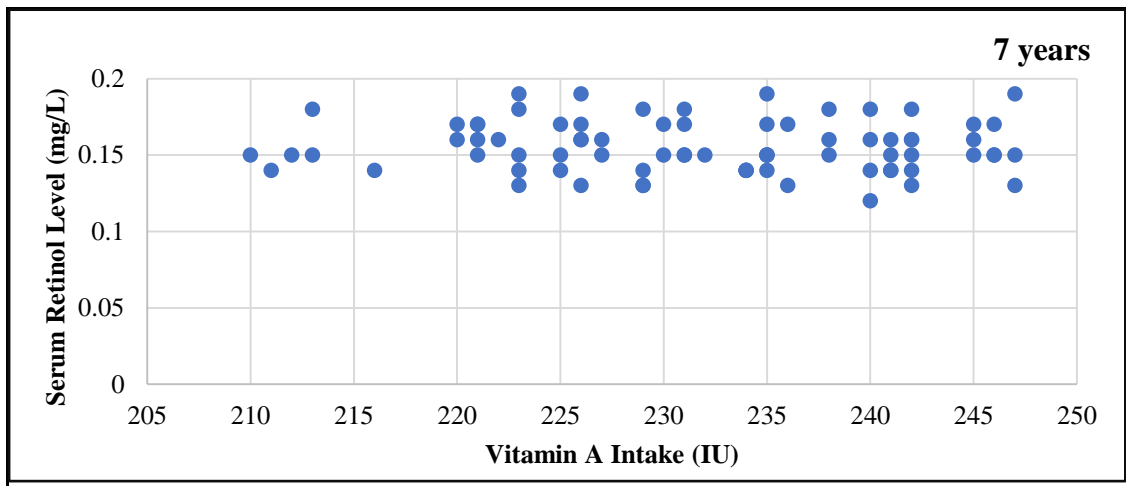
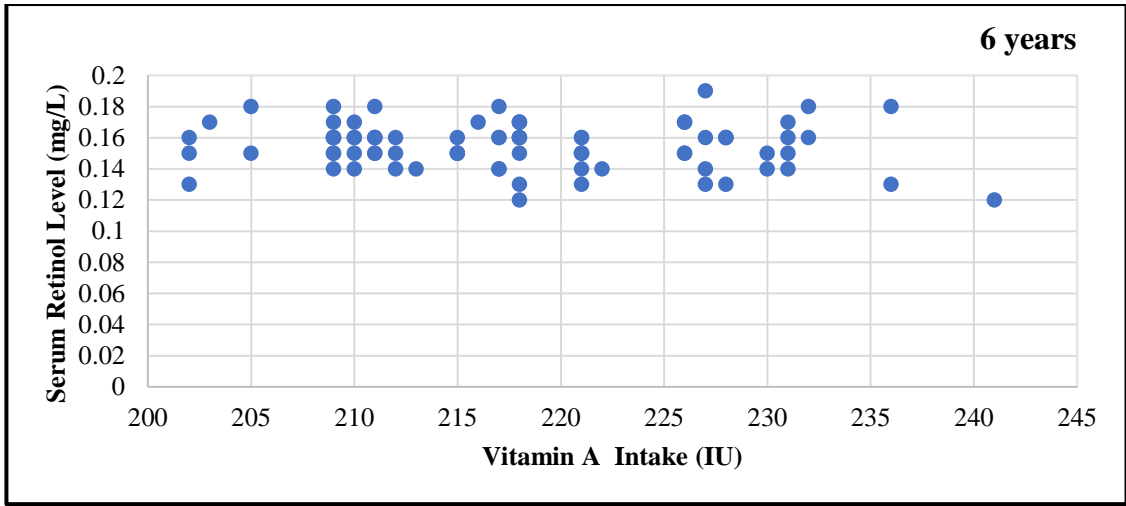


Figure 29: Correlation Graphs between Vitamin A Intake and Serum Retinol in Children

In these results, the p-values for the correlation between vitamin A intake and serum retinol levels are less than the significance level of 0.05, which indicates that the

correlation coefficients are relevant. As there is a conclusive evidence about the significance of the association between the variables, it can be said that vitamin A and serum retinol have a statistically relevant straight-line relationship. There is a weak positive correlation which signifies that the two variables have a tendency to go hand in hand. This clearly proves that vitamin A intake may improve the vitamin A nutritional status.

Similar findings were seen in the study done by Sireesha (2015) in school going children of Tirupathi. They revealed that the low input of vitamin A rich foods resulted in high occurrence of vitamin A disorders. It was observed by them that 56 per cent of the children had low serum retinol levels < 20 µg/dl whose had less of vitamin A rich foods than the required dietary allowances.

ii) Correlation between haemoglobin and serum retinol level

Table XXIX and Figure 30 represents the correlation between the haemoglobin and serum retinol level of the children.

Table XXXIX
Correlation between Haemoglobin and Serum Retinol Level
(N=234)

Haemoglobin vs Serum Retinol					
age-group (in years)	N	Mean Haemoglobin Level (gm/Dl)	Mean Serum Retinol Level (mg/L)	Correlation coefficient of 'r'	p value
6 years	80	10.19±0.66	0.154±0.01	0.0599	0.5976*
7 years	76	10.60±1.07	0.155±0.01	-0.047	0.6868*
8 years	78	10.38±0.82	0.153±0.01	0.0168	0.8839**

** - Significant at 1 per cent level; * - Significant at 5 per cent level

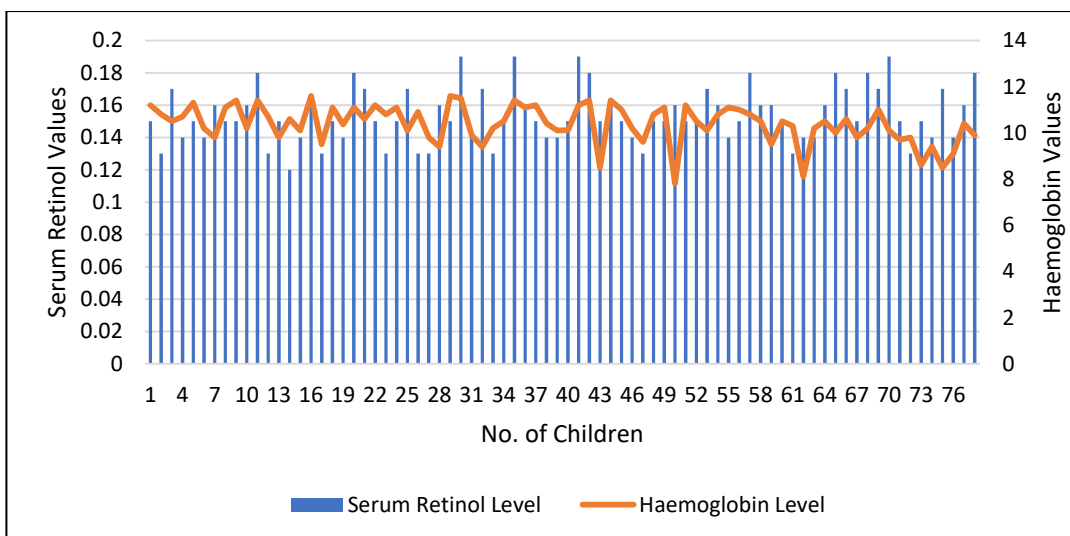
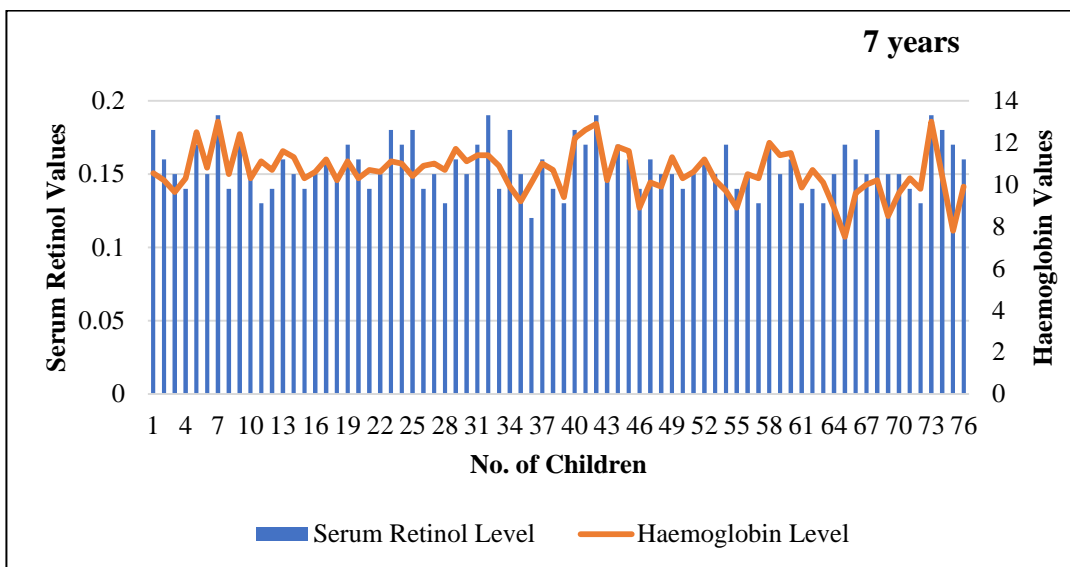
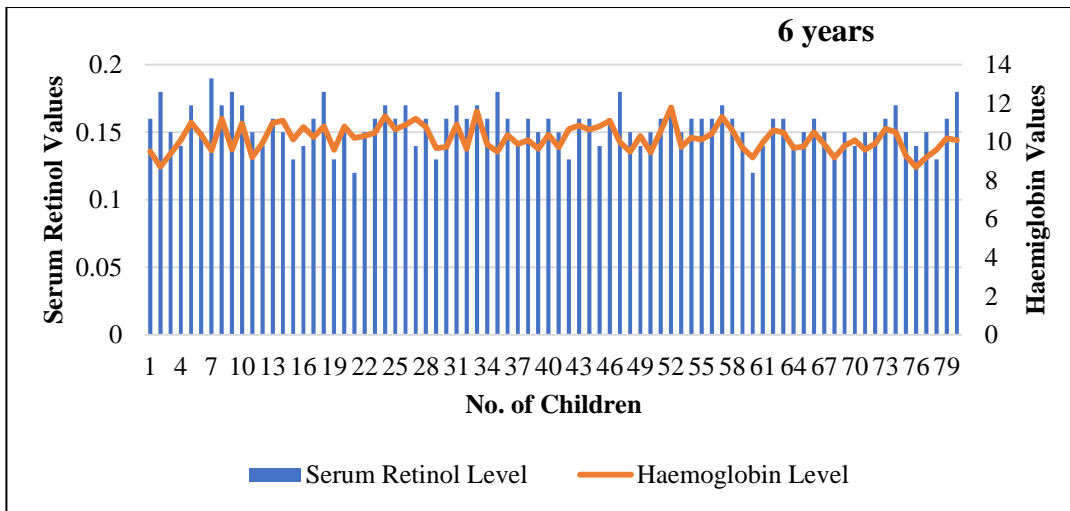


Figure 30: Correlation Graphs between Serum Retinol and Haemoglobin levels in Children

The correlation coefficient between haemoglobin levels and serum retinol levels is 0.059 with p-value of 0.59 in six years age-group, 0.047 in seven years age-group with the p-value of 0.68 and 0.016 in eight years age-group with a p-value of 0.88. Because the correlation coefficient ‘r’ is more inclined towards zero than +1 or -1 but not completely zero, we could say that the significance of the association between the variables is weak but not undeniable. This proves the fact that low serum retinol may be associated with anaemia.

The study done by Onyeneho (2019) revealed that anemia’s association with vitamin A, iron intake and worm infestation in children were directly proportional to each other ($p < 0.01$).

1. Clinical picture of the children before supplementation

The clinical picture of the children is presented in the Table XL.

Table XL

Clinical Symptoms in Children before Supplementation

(N=234)

Clinical Symptoms	Group 1	(N=56)	Group 2	(N=59)	Group 3	(N=61)	Group 4	(N=58)
	No.	%	No.	%	No.	%	No.	%
Bitot’s spot	2	3.57	3	5.08	1	1.63	2	3.44
Conjunctival Xerosis	1	1.78	2	3.38	2	3.27	2	3.44
Koilonychias	5	8.92	6	10.16	7	11.47	5	8.62
Emaciation	4	7.14	5	8.47	5	8.19	2	3.44
Dry, brittle hair	9	16.07	10	16.94	8	13.11	6	10.34
Bleeding gums	4	7.14	3	5.08	2	3.27	2	3.44
Glossitis	3	5.35	4	6.77	4	6.55	4	6.89
Phrynoderma	2	3.57	3	5.08	3	4.91	1	1.72
Gingivitis	1	1.78	3	5.08	2	3.27	2	3.44
Dental caries	15	26.78	13	22.03	11	18.03	14	24.13
Dermatitis	9	16.09	6	10.16	7	11.47	4	6.89
Angular Stomatitis	13	23.21	11	18.64	14	22.90	12	20.68

Bitot’s spots, a major symptom of vitamin A disorder was seen among 3.6, 5.1, 1.6 and 3.4 per cent of children in Group 1, 2, 3 and 4 respectively. Conjunctival xerosis was observed among 1.8, 3.4, 3.3 and 3.4 per cent of Group1, Group2, Group3 and Group 4 children respectively. Koilonychias, also known as spoon nails, a prominent

symptom of iron deficiency anaemia was seen in 8.9, 10.2, 11.5 and 8.6 per cent in Group 1, Group 2, Group 3 and Group 4 respectively. Emaciation or wasting was observed in 7.1 per cent in Group 1, 8.5 per cent in Group 2, 8.2 per cent in Group 3 and 3.4 per cent in Group 4 children. Dry, brittle hair was seen in 16.1, 16.9, 13.1 and 10.3 per cent in Group 1, 2, 3 and 4 respectively. Bleeding gums was observed in 7.1, 5.1, 3.3 and 3.4 per cent of children in Group 1, 2, 3 and 4 respectively. Glossitis, a deficiency of vitamin B12 was seen in 5.4 per cent in Group 1, 6.8 per cent in Group 2, 6.6 per cent in Group 3 and 6.9 per cent in Group 4 children. Phrynoderma, a vitamin A deficiency symptom was observed in 3.6 per cent in Group 1, 5.1 per cent in Group 2, 4.9 per cent in Group 3 and 1.7 per cent in Group 4 children. Gingivitis was seen in 1.8, 5.1, 3.3 and 3.4 per cent children of Group 1, 2, 3 and 4 respectively. Dental caries was observed in 26.8 per cent children in Group 1, 22.0 per cent in Group 2, 18.0 per cent in Group 3 and 24.1 per cent in Group 4 children. Dermatitis was seen in 16.1, 10.2, 11.5 and 6.9 per cent of children of Group 1, 2, 3 and 4 respectively. Angular stomatitis was observed in 23.2 per cent in Group 1, 18.6 per cent in Group 2, 22.1 per cent in Group 3 and 20.7 per cent in Group 4 children.

Naidu (1999) also presented similar findings on occurrence of night blindness in children (5-6 years age-group) in India was found to be 1 per cent, bitot's spots in 0.5 per cent children and 0.01 per cent were suffering from xerosis. Another study by Khandait et al. (2000), also revealed that the prevalence of vitamin A deficiencies in preschool children in Nagpur was estimated to be 35.7 per cent. Chirumalay and Bhagavat (1998) in their study on children came up with the findings that 2.8 per cent of children in India had Bitot's spots. Khandait et al. (1999) also revealed that the occurrence of xerophthalmia was figured to be 8.7 per cent among preschoolers.

Dietary Patterns

i) Dietary Habits

In the current research, all the fisher-folk were non-vegetarians and they ate three meals per day which was mostly rice. Rice is the staple food of the fishermen's children. Dried fish and dried shrimp is the most regularly eaten food but in less quantity. Though fresh fish is their catch, many of the fishermen hardly get to eat it regularly as they need to sell it off for their living.

Phase III: Acceptability and Nutritive Value of Orange Fleshed Sweet Potato

A. Acceptability Trails of Orange fleshed sweet potato

Orange fleshed sweet potato is natural food, rich source of β -carotene and relatively a good source of minerals such as calcium, iron, magnesium, sodium, potassium, phosphorus and zinc. When cooked, its soft texture, bright colour and sweet taste makes the orange fleshed sweet potato a delicious food. The mean values of scores for appearance, colour, texture, flavour, taste and overall acceptability are presented in the table below.

Table XLI
Acceptability Trails of Orange fleshed sweet potato

(N=75)

Type of volunteers	No. of volunteers	Appearance	Colour	Texture	Flavour	Taste	Overall Acceptability
Children (6-8year)	25	4.21 \pm 0.217	3.58 \pm 0.147	3.66 \pm 0.542	4.12 \pm 0.342	4.17 \pm 0.305	3.88 \pm 0.220
Mothers	25	4.03 \pm 0.403	3.63 \pm 0.416	3.44 \pm 0.317	4.16 \pm 0.320	4.09 \pm 0.296	3.83 \pm 0.165
Teachers	25	3.65 \pm 0.325	4.17 \pm 0.413	4.11 \pm 0.375	4.31 \pm 0.379	4.22 \pm 0.337	4.20 \pm 0.184

It was acceptable by all and the overall acceptability score was 3.88 \pm 0.220 in children aged 6-8 years, 3.83 \pm 0.165 among mothers and 4.20 \pm 0.184 among teachers. The children gave a mean score of 4.21 \pm 0.217 for appearance, 3.58 \pm 0.147 for the colour, 3.66 \pm 0.542 for texture, 4.12 \pm 0.342 for flavour and 4.17 \pm 0.305 for the taste of boiled orange fleshed sweet potato. The mothers gave a mean score of 4.03 \pm 0.403 for appearance, 3.63 \pm 0.416 for the colour, 3.44 \pm 0.317 for texture, 4.16 \pm 0.320 for flavour and 4.09 \pm 0.296 for the taste of boiled orange fleshed sweet potato. The teachers gave a mean score of 3.65 \pm 0.325 for appearance, 4.17 \pm 0.413 for the colour, 4.11 \pm 0.375 for texture, 4.31 \pm 0.379 for flavour and 4.22 \pm 0.337 for the taste of boiled orange fleshed sweet potato.

B. Nutrient Content of Boiled Orange Fleshed Sweet Potato supplement

The boiled orange fleshed sweet potatoes were subjected to nutrient analysis namely moisture, energy, protein, fat, carbohydrate, fibre, calcium, iron, vitamin C, thiamine, riboflavin, vitamin B₆ and vitamin A was estimated.

Table XLII**Nutrient Content of Boiled Orange Fleshed Sweet Potato (100g)**

Nutrient	Nutritive value
Energy (Kcal)	77.3
Moisture (g)	72
Protein (g)	1.4
Fat (g)	0.1
Carbohydrates (g)	17.7
Fibre (g)	2.5
Vitamin A (RAE)	788
Vitamin C (mg)	12.8
Vitamin B6	0.17
Riboflavin (mg)	0.05
Thiamine (mg)	0.06
Iron (mg)	0.7
Calcium (mg)	27

As per the ICMR (2020) guidelines for Indians, the daily recommended allowance of Vitamin A 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 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 has high amounts of beta- carotene, it is not completely absorbed.

So, each child has been given 100 gm of Orange fleshed sweet potato which provides 788 µg RAE which is more than the required dietary allowance suggested by the ICMR, NIN and also provides 77.3 Kcal of energy, 72gm of moisture, 1.4g of protein, 0.1g of fat, 17.7g of carbohydrates, 2.5g of fibre, 12.8mg of vitamin C, 0.17mg of Vitamin B6, 0.05mg of riboflavin, 0.06mg of thiamine, 0.7mg of iron and 27mg of calcium. This intervention was carried on a daily basis from Monday to Saturday for 6 months.

The results in this study can be paired with the study done by Gurmu et al., (2014) on Orange-fleshed sweet varieties and reported that they have around 250 to 1300 µg /100 g retinol activity equivalents (RAE). They revealed that consumption of orange-fleshed sweet potato improves vitamin A status and enhances the absorption of different micro-

nutrients such as iron, zinc, calcium and magnesium, thus, diminishing vitamin A disorders and decreases child mortality rates by 23 to 30 per cent.

Phase IV: Impact of Interventions on Nutritional Status and KAP

C. Impact of Supplementation of Orange Fleshed Sweet Potato on Nutritional Status, Clinical and Biochemical Profile

1. Nutritional Anthropometry

a) Mean height of boys before and after supplementation

The Table XLIII and Figure 31 present the mean height of the boys before and after supplementation.

Table XLIII
Mean Height (cm) of Boys Before and After Supplementation

(N=121)

Age in Years	Groups	No.	WHO Standard(cm) 2006	ICMR Standard (cm) 2020	Mean Height \pm SD (cm)		Difference in Mean Heights	T - Value Before and After
					Before Supplementation	After Supplementation		
6	Gp 1	11	117.15	115.8	100.1 \pm 1.07	102.4 \pm 0.81	2.3 \pm 0.59	12.25**
	Gp 2	8	117.15	115.8	101.4 \pm 1.86	103.2 \pm 0.77	1.8 \pm 0.42	11.55*
	Gp3	11	117.15	115.8	100.3 \pm 1.00	102.3 \pm 0.84	2.0 \pm 0.41	15.3**
	Gp4	10	117.15	115.8	100.8 \pm 0.69	101.6 \pm 0.67	0.8 \pm 0.26	10.51**
7	Gp 1	9	124.3	121.7	110.0 \pm 0.65	112.3 \pm 0.71	2.3 \pm 0.21	12.63**
	Gp 2	11	124.3	121.7	111.4 \pm 0.86	113.4 \pm 0.93	2.0 \pm 0.44	14.58**
	Gp3	9	124.3	121.7	110 \pm 1.05	112.6 \pm 1.22	2.6 \pm 0.39	12.99**
	Gp4	12	124.3	121.7	109.9 \pm 1.19	110.9 \pm 1.09	1.0 \pm 0.39	8.79*
8	Gp 1	11	130.1	127	120.1 \pm 2.02	122.3 \pm 1.45	2.2 \pm 0.71	9.73*
	Gp 2	10	130.1	127	120.1 \pm 1.34	122.4 \pm 1.08	2.3 \pm 0.59	12.55**
	Gp3	10	130.1	127	116.3 \pm 2.45	118.2 \pm 2.42	1.9 \pm 0.36	16.59**
	Gp4	9	130.1	127	120.8 \pm 1.02	121.9 \pm 1.13	1.1 \pm 0.50	7.08*

** - Significant at 1 per cent level, * - Significant at 5 per cent level

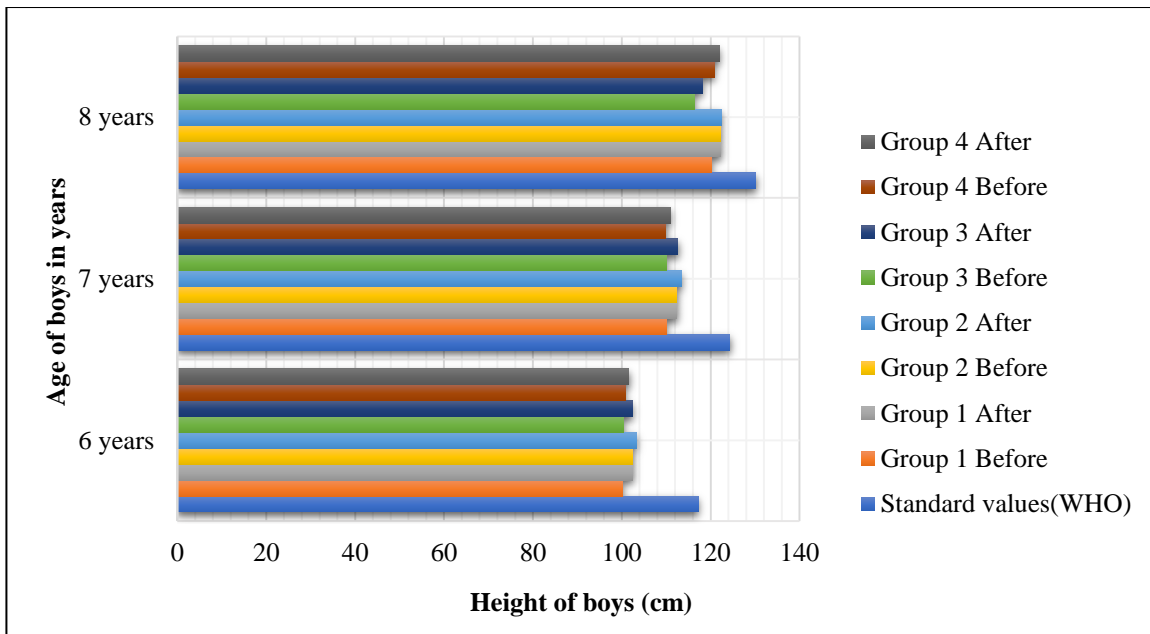


Figure 31: Mean Height of Boys Before and After Supplementation

The average heights of boys in Group 1 were lower than the standards. The average final height of boys has show that grew taller than their previous measured heights. Yet, the final height was lower than the standard height values recommended by WHO (2006). The range of height increase in a duration of 6 months was 2.2 ± 0.71 cm to 2.3 ± 0.59 cm ($p < 0.01$ and 0.05) in Group 1. In the Group 2, the range in height increase was 1.8 ± 0.42 to 2.3 ± 0.59 cm ($p < 0.01$ and 0.05). Though a significant increase was observed, the standard height required was not attained. In the Group 3 boys, the range in height increase was 1.9 ± 0.36 to 2.2 ± 0.44 cm ($p < 0.01$ and 0.05). In the Group 4 boys, the range in height increase was 0.8 ± 0.26 to 1.1 ± 0.5 cm ($p < 0.01$ and 0.05). As the Group 4 was a control group, the boys of this group haven't received any intervention.

Keeping in view the range of height of boys of all group, it could be evaluated that Groups 1,2, and 3 who received intervention of orange fleshed sweet potato, both orange fleshed sweet potato and nutrition education and only nutrition education respectively, showed almost twice the increase in height when compared to the Group 4 (control group). These figures prompt to interpret that a longer period of intervention could have had a better impact on growth.

b) Average height (cm) of girls before and after supplementation

The Table XLIV and Figure 32 depicts the average height of the girls prior to and completion of supplementation. Comparison was made with ICMR and WHO standards.

Table XLIV

Mean Height (cm) of Girls Before and After Supplementation

(N=113)

Age in Years	Groups	No.	WHO Standard(cm) 2006	ICMR Standard (cm) 2020	Mean Height \pm SD (cm)		Difference in Mean Heights	T - Value Before and After
					Before Supplementation	After Supplementation		
6	Gp 1	10	116.5	114.5	99.8 \pm 1.28	102.2 \pm 0.94	2.4 \pm 0.98	7.13**
	Gp 2	9	116.5	114.5	99.7 \pm 0.89	102.3 \pm 0.55	2.6 \pm 0.67	11.22**
	Gp3	12	116.5	114.5	101.3 \pm 1.35	103.2 \pm 1.27	1.9 \pm 0.72	8.64**
	Gp4	9	116.5	114.5	101.4 \pm 1.20	102.1 \pm 1.12	0.7 \pm 0.38	7.16**
7	Gp 1	8	123.6	120.6	104.3 \pm 1.89	106.7 \pm 2.70	2.4 \pm 0.99	6.31**
	Gp 2	11	123.6	120.6	104.6 \pm 0.60	106.6 \pm 0.41	2.0 \pm 0.48	11**
	Gp3	9	123.6	120.6	105.1 \pm 0.93	106.7 \pm 0.72	1.6 \pm 0.40	11.73**
	Gp4	7	123.6	120.6	105.4 \pm 1.4	106.5 \pm 1.32	1.1 \pm 0.29	7.57**
8	Gp 1	7	129.2	126.4	116.7 \pm 1.57	118.9 \pm 2.14	2.2 \pm 1.20	4.82*
	Gp 2	10	129.2	126.4	118.3 \pm 1.44	119.8 \pm 1.60	1.5 \pm 0.51	9.46**
	Gp3	10	129.2	126.4	116 \pm 1.19	117.7 \pm 1.06	1.7 \pm 0.79	6.81**
	Gp4	11	129.2	126.4	117.0 \pm 1.08	118.1 \pm 0.26	1.1 \pm 0.36	8.69**

** - Significant at 1 per cent level; * - Significant at 5 per cent level

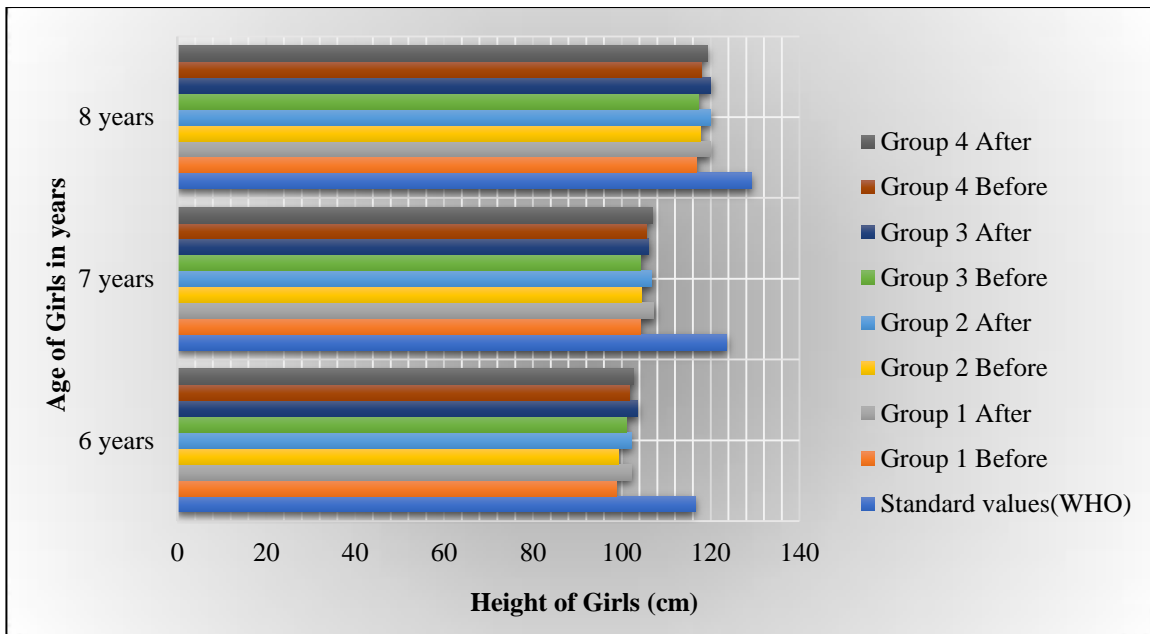


Figure 32: Average Height (cm) of Girls Before and After Supplementation

The mean heights of girls in Group I was much lower than the standards. The average final height of girls has shown that they have put up height than their previous measured one. Yet, the final height was lower than the standard height values recommended by WHO (2006). The range of height increase in a duration of 6 months was 2.2 ± 1.2 cm to 2.4 ± 0.99 cm ($p < 0.01$ and 0.05). In the Group 2, the range in height increase in girls was 1.5 ± 0.51 to 2.6 ± 0.67 cm ($p < 0.01$). Though a relevant increase was noted, the standard height required was not attained. In the Group 3 girls, the range in height increase was 1.6 ± 0.4 to 1.9 ± 0.72 cm ($p < 0.01$). In the Group 4 girls, the range in height increase was 0.7 ± 0.38 to 1.1 ± 0.29 cm ($p < 0.01$). The height graph which was skewed initially significantly paced up towards the completion of intervention. The control group hadn't made much improvement in comparison to groups. Girls of Group 1 and 2 showed significant height increase preceding by Group 3. Group 4 (control group) girl's increase in height was less dominant when compared to the groups who received supplementation.

c) Mean weight (kg) of boys before and after supplementation

The Table XLV and Figure 33 depicts the average weight of the boys prior to and completion of supplementation. Comparison was made with ICMR and WHO standards.

Table XLV
Mean Weight (kg) of Boys Before and After Supplementation

(N=121)

Age in Years	Groups	No.	WHO Standard(kg) 2006	ICMR Standard (kg) 2020	Mean Weight \pm SD (kg)		Difference in Mean Weights	T - Value Before and After
					Before Supplementation	After Supplementation		
6	Gp 1	11	20.5	20.8	15.8 \pm 0.64	17.2 \pm 0.54	1.4 \pm 0.34	13.16**
	Gp 2	8	20.5	20.8	17.9 \pm 1.57	19.3 \pm 1.37	1.4 \pm 0.43	8.75*
	Gp3	11	20.5	20.8	16.1 \pm 0.89	17.4 \pm 0.97	1.3 \pm 0.29	17.05**
	Gp4	10	20.5	20.8	17.1 \pm 1.11	17.8 \pm 0.92	0.7 \pm 0.38	5.62*
7	Gp 1	9	22.7	22.9	19.5 \pm 0.51	21.0 \pm 0.48	1.5 \pm 0.34	15.32**
	Gp 2	11	22.7	22.9	18.7 \pm 0.62	20.2 \pm 0.53	1.5 \pm 0.33	14.1**
	Gp3	9	22.7	22.9	19.0 \pm 0.77	20.3 \pm 0.67	1.3 \pm 0.67	16.99**
	Gp4	12	22.7	22.9	19.1 \pm 0.82	19.3 \pm 0.81	0.2 \pm 0.19	3.27*
8	Gp 1	11	25.2	25.3	21.4 \pm 0.83	22.8 \pm 1.07	1.4 \pm 0.39	11.69*
	Gp 2	10	25.2	25.3	21.3 \pm 0.64	22.7 \pm 0.68	1.4 \pm 0.35	15.78**
	Gp3	10	25.2	25.3	19.7 \pm 1.86	21.4 \pm 1.71	1.7 \pm 0.81	6.74*
	Gp4	9	25.2	25.3	20.8 \pm 1.02	21.9 \pm 1.13	1.1 \pm 0.50	2.21*

** - Significant at 1 per cent level; * - Significant at 5 per cent level

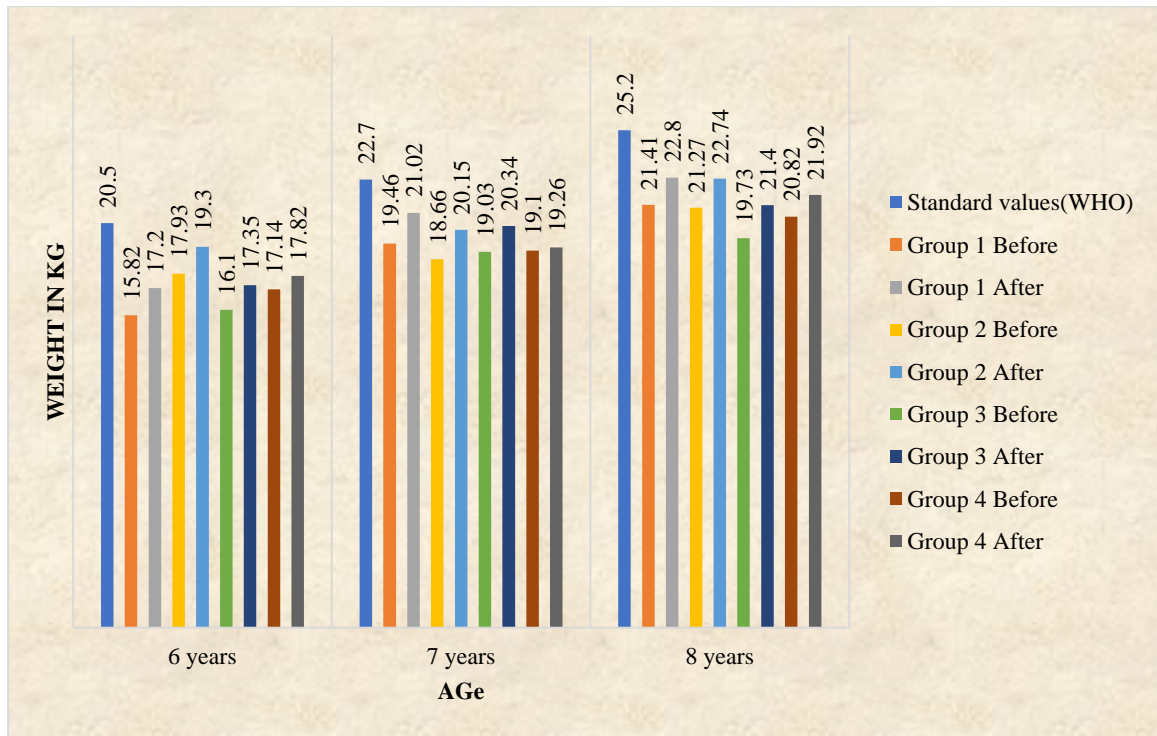


Figure 33: Mean Weight (kg) of Boys Before and After Supplementation

In Group 1, the radius of weight elevation in boys was 1.4 ± 0.34 to 1.5 ± 0.34 kg ($p < 0.01$ and 0.05) which was statistically significant. The average final weight of boys in the Group 2 relevantly increased from 1.4 ± 0.43 to 1.5 ± 0.33 kgs ($p < 0.01$ and 0.05). Both Group 1 and 2 showed almost the same improvement in weight gain. Group 3 boys mean final weight radius between 1.3 ± 0.29 to 1.7 ± 0.81 kgs ($p < 0.01$ and 0.05) which was good sign of improvement, especially in the 8-year age-group who showed an improvement from 19.7 kgs before supplementation to 21.4 kgs after supplementation. The Group 4 boys mean final weight ranged between 0.2 ± 0.19 to 1.1 ± 0.5 kg ($p < 0.01$ and 0.05) which wasn't a remarkable improvement when compared with other groups. It's clearly evident that Group 1, 2 and 3 showed better weight gain when provided with the supplementation of orange fleshed sweet potato than the fisherfolk children of Group 4 which was a control group.

d) Mean weight (kg) of the girls before and after supplementation

The Table XLVI and Figure 34 depict the average weight of the boys prior to and completion of supplementation. ICMR and WHO standards were taken for comparison.

Table XLVI

Mean Weight (kg) of Girls Before and After Supplementation

Age in Years	Groups	No.	WHO Standard(kg) 2006	ICMR Standard (kg) 2020	Mean Weight \pm SD (kg)		Difference in Mean Weights	T-Value Before and After
					Before Supplementation	After Supplementation		
6	Gp 1	10	20.45	19.75	14.9 \pm 0.73	15.8 \pm 0.71	0.9 \pm 0.43	7.04**
	Gp 2	9	20.45	19.75	15.0 \pm 0.87	16.4 \pm 0.92	1.4 \pm 0.27	17.09**
	Gp3	12	20.45	19.75	14.6 \pm 1.62	15.6 \pm 1.86	1.0 \pm 0.54	6.68**
	Gp4	9	20.45	19.75	15.1 \pm 1.10	15.5 \pm 0.97	0.4 \pm 0.30	4.22*
7	Gp 1	8	22.3	21.8	16.8 \pm 1.43	18.0 \pm 1.54	1.2 \pm 0.40	8.54**
	Gp 2	11	22.3	21.8	16.7 \pm 0.69	18.1 \pm 0.78	1.4 \pm 0.55	8.12**
	Gp3	9	22.3	21.8	16.6 \pm 0.74	17.7 \pm 0.78	1.1 \pm 0.27	12.14**
	Gp4	7	22.3	21.8	16.9 \pm 0.44	17.0 \pm 0.39	0.1 \pm 0.21	1.05*
8	Gp 1	7	25	24.8	19.5 \pm 0.78	20.6 \pm 1.02	1.1 \pm 0.44	6.1*
	Gp 2	10	25	24.8	19.7 \pm 1.08	21.3 \pm 0.98	1.6 \pm 0.42	11.46**
	Gp3	10	25	24.8	19.1 \pm 0.73	19.6 \pm 0.78	0.5 \pm 0.35	3.19*
	Gp4	11	25	24.8	19.2 \pm 1.01	19.4 \pm 1.23	0.2 \pm 0.30	3.08*

** - Significant at 1 per cent level; * - Significant at 5 per cent level

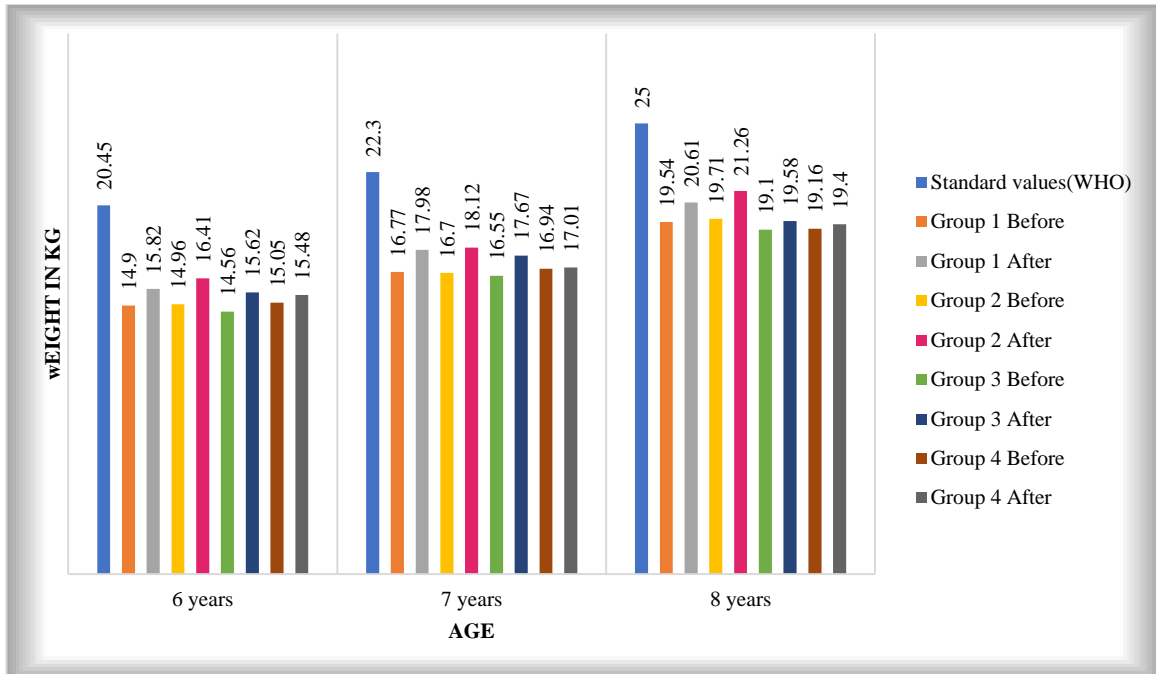


Figure 34: Mean Weight (kg) of Girls Before and After Supplementation

In the Group 1, the weight increase among girls was observed to be ranging between 0.9 ± 0.43 to 1.2 ± 0.4 kg ($p < 0.01$ and 0.05) which was statistically significant. The average final weight of girls of Group 2 relevantly increased from 1.4 ± 0.27 to 1.6 ± 0.42 kgs ($p < 0.01$). Group 3 girls gained weight between 0.5 ± 0.35 to 1.1 ± 0.27 kgs ($p < 0.01$ and 0.05) which was good sign of improvement. Group 2 girls had a remarkable improvement, especially in the 8-year age-group who showed a weight gain from 19.7 kgs before supplementation to 21.3 kgs after supplementation than Groups 1 and 3 who did showed improvement in weight gain but not as much as the Group 2. The Group 4 girls increase in weight ranged between 0.1 ± 0.21 to 0.4 ± 0.3 kgs ($p < 0.01$ and 0.05) which wasn't good enough when compared with other groups. It's clearly evident that girls of Groups 1, 2 and 3 showed better weight gain when provided with the supplementation of orange fleshed sweet potato than the boys of Group 4 which was a control group.

Fred Ouma, (2019) in his article "Orange Flesh Sweet Potatoes Improve Micronutrient Deficiency Among Ugandan Children" mentioned that after the implementation of Orange fleshed sweet potato programme, the per centage of underweight children under the age of 5 declined from 9.5 per cent in 2015 to 6.9 per cent in 2018, while stunting in children under five declined from 30.7 per cent in 2015 to 23.2 per cent in 2018.

2. biochemical picture

a) Mean haemoglobin of the children before and after supplementation

The Table XLVII and XLVIII presents the mean haemoglobin of the children before and after the supplementation.

Table XLVII

Mean Haemoglobin of Boys Before and After Supplementation

Age in Years	Groups	No.	WHO Standard	Mean Hb (g/dl) \pm SD		Difference in the Mean Hb levels	't' Value Before and After
				Before Supplementation	After Supplementation		
6	Gp 1	11	≥ 11.5	9.94 \pm 0.77	10.62 \pm 1.17	0.68 \pm 0.47	3.02*
	Gp 2	8	≥ 11.5	10.61 \pm 0.53	11.46 \pm 0.44	0.85 \pm 0.35	6.85**
	Gp3	11	≥ 11.5	10.32 \pm 0.54	11.12 \pm 0.80	0.8 \pm 0.66	3.49*
	Gp4	10	≥ 11.5	9.93 \pm 0.45	10.27 \pm 0.63	0.34 \pm 0.4	2.5*
7	Gp 1	9	≥ 11.5	11.08 \pm 1.26	11.52 \pm 0.94	0.44 \pm 0.52	2.72*
	Gp 2	11	≥ 11.5	10.72 \pm 0.30	11.09 \pm 0.33	0.37 \pm 0.31	3.88*
	Gp3	9	≥ 11.5	11.13 \pm 1.39	11.6 \pm 1.17	0.47 \pm 0.38	3.68*
	Gp4	12	≥ 11.5	10.02 \pm 1.33	10.17 \pm 1.38	0.15 \pm 0.09	1.72*
8	Gp 1	11	≥ 11.5	10.78 \pm 0.55	11.04 \pm 0.49	0.26 \pm 0.25	3.44*
	Gp 2	10	≥ 11.5	10.53 \pm 0.61	11.15 \pm 0.67	0.62 \pm 0.36	5.59**
	Gp3	10	≥ 11.5	10.43 \pm 0.92	10.74 \pm 0.73	0.31 \pm 0.25	3.86*
	Gp4	9	≥ 11.5	9.94 \pm 0.77	10.07 \pm 0.81	0.13 \pm 0.13	3.02*

** - Significant at 1 per cent level; * - Significant at 5 per cent level

Table XLVIII

Mean Haemoglobin of Girls Before and After Supplementation

Age in Years	Groups	No.	WHO Standard	Mean Hb (g/dl) \pm SD		Difference in the Mean Hb levels	't' Value Before and After
				Before Supplementation	After Supplementation		
6	Gp 1	10	≥ 11.5	10.45 \pm 0.51	11.14 \pm 0.49	0.69 \pm 0.34	3.99**
	Gp 2	9	≥ 11.5	10.2 \pm 0.68	10.85 \pm 0.72	0.65 \pm 0.43	3.99**
	Gp3	12	≥ 11.5	10.23 \pm 0.72	10.96 \pm 0.86	0.73 \pm 0.64	3.93*
	Gp4	9	≥ 11.5	9.79 \pm 0.65	10.13 \pm 0.79	0.34 \pm 0.31	3.14*
7	Gp 1	8	≥ 11.5	10.88 \pm 0.53	11.18 \pm 0.60	0.3 \pm 0.28	3.38*
	Gp 2	11	≥ 11.5	10.61 \pm 0.80	10.96 \pm 0.55	0.35 \pm 0.35	3.08*
	Gp3	9	≥ 11.5	10.33 \pm 0.72	10.64 \pm 0.77	0.31 \pm 0.21	4.35**
	Gp4	7	≥ 11.5	10.11 \pm 1.37	10.27 \pm 1.26	0.16 \pm 0.14	3.27*
8	Gp 1	7	≥ 11.5	10.48 \pm 0.73	10.74 \pm 0.56	0.26 \pm 0.23	2.87*
	Gp 2	10	≥ 11.5	10.72 \pm 0.74	10.92 \pm 0.62	0.2 \pm 0.19	3.25*
	Gp3	10	≥ 11.5	10.49 \pm 1.0	10.73 \pm 0.99	0.24 \pm 0.13	5.62**
	Gp4	11	≥ 11.5	9.5 \pm 0.65	9.58 \pm 0.65	0.08 \pm 0.09	3.19*

** - Significant at 1 per cent level; * - Significant at 5 per cent level

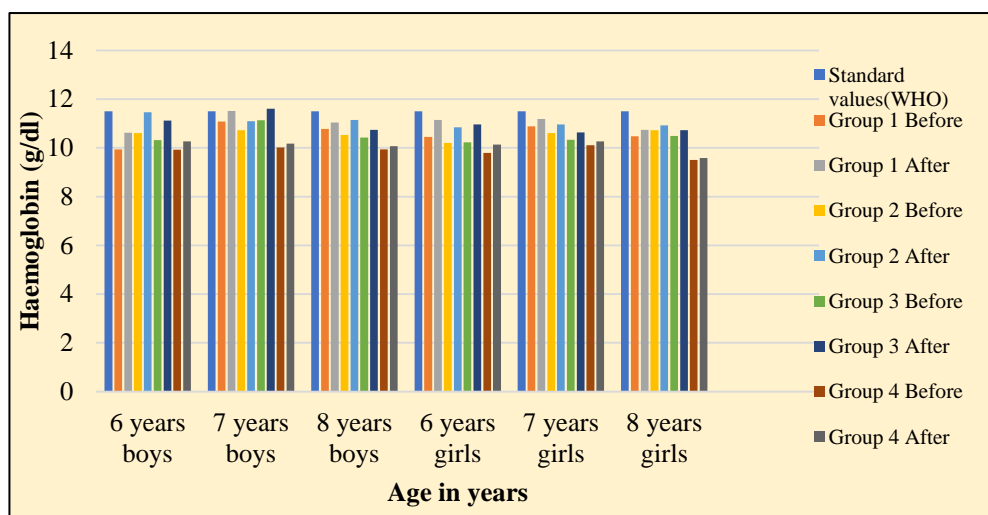


Figure 35: Mean Haemoglobin Values (g/dl) of Children Before and After Supplementation

When compared with standard values, the average preliminary haemoglobin count in all four groups were identified to be below than required amounts. But the eventual average haemoglobin had elevated relevantly ($p \leq 0.05$). In the Group 1, range of haemoglobin increase in boys was 0.26 ± 0.25 to 0.68 ± 0.47 gm/dl ($p < 0.05$) which was relevant at one and five per cent levels. The range in haemoglobin increase of girls of group 1 is 0.26 ± 0.23 to 0.69 ± 0.34 gm/dl ($p < 0.01$ and 0.05) which was relevant at one and five per cent levels. Similarly, the average eventual haemoglobin value in boys of Group 2 also increased to a significant extent ranging from 0.37 ± 0.31 to 0.85 ± 0.35 gm/dl ($p < 0.01$ and 0.05) and in girls the increase in the range of haemoglobin value was 0.26 ± 0.23 to 0.65 ± 0.43 gm/dl ($p < 0.01$ and 0.05). Group 3 boys mean final haemoglobin increase ranged between 0.31 ± 0.25 to 0.8 ± 0.66 gm/l ($p < 0.05$) which was good sign of improvement and the range in haemoglobin increase of girls was 0.2 ± 0.19 to 0.73 ± 0.64 gm/dl ($p < 0.05$) which was relevant at one and five per cent levels. The Group 4 boys mean final haemoglobin increase ranged between 0.13 ± 0.13 to 0.34 ± 0.4 gm/dl ($p < 0.05$) and in girls it was 0.08 ± 0.09 to 0.34 ± 0.31 gm/dl ($p < 0.05$) which wasn't a remarkable improvement when compared with other groups. Especially in the 6-year age-group in both boys and girls showed a remarkable improvement after supplementation. It's clearly evident that Group 1, 2 and 3 showed improvement in their haemoglobin levels when provided with the supplementation of orange fleshed sweet potato than the boys of Group 4 which was a control group.

Roelinda Jongstra et al. (2020) reported that orange fleshed sweet potato which has 0.97mg Fe /100g in breakfast meal covered 18 per cent of the iron requirement. They suggested that high polyphenol concentrations were likely the major inhibitors of iron absorption. Neela et al., (2019) reported that orange fleshed sweet potato is an excellent food for iron also. Orange-fleshed sweet potato has around 0.63–15.26 mg/100 g of iron.

Categorization of children according to degree of anaemia

Table XLIX depicts the categorization of children according to degree of anaemia before and after supplementation.

Table XLIX

Categorization of Children according to Degree of Anaemia

(N=234)

Degree of Anaemia	Group 1 (N=56)				Group 2 (N=59)				Group 3 (N=61)				Group 4 (N=58)			
	Before		After		Before		After		Before		After		Before		After	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Normal (Hb>12g/dl)	2	0.85	9	3.84	2	0.85	8	3.4	3	1.3	6	2.56	1	0.42	1	0.4
Mild anaemia (Hb 11-11.9g/dl)	4	1.7	3	1.28	5	2.13	3	1.3	13	5.55	12	51.2	8	3.4	10	4.3
Moderate anaemia (Hb 8-10.9g/dl)	35	14.9	31	13.2	42	17.9	41	18	34	14.5	33	14.1	38	0.16	38	0.2
Severe anaemia (Hb < 8g/dl)	15	6.41	13	5.55	10	4.27	7	3	11	4.7	10	4.27	11	4.7	9	3.8

Before supplementation, two children each from Group 1 and 2, three from Group 3 and one child from Group 4 were normal. Initially mild anaemia was seen in four from Group 1, five from Group 2, thirteen from Group 3 and eight from Group 4. Moderate anaemia was observed in 35 in Group 1, 42 in Group 2, 34 in Group 3 and 38 in Group 4 before supplementation. Initially severe anaemia was noted in 15 from Group 1, 10 in Group 2, 11 children each from Group 3 and Group 4. After six months of intervention with orange fleshed sweet potato and nutrition education, nine children from Group 1, eight from Group 2, six from Group 3 and one child from Group 4 had normal haemoglobin levels. After supplementation, reduction in anaemia was seen in the number of children having mild, moderate and severe anaemia. Three children had mild anaemia, 41 had moderate anaemia and seven had severe anaemia in Group 1. In Group 2, three children had mild anaemia, 31 had moderate anaemia and 13 had severe anaemia. Twelve children had mild anaemia, 33 had moderate anaemia and 10 had severe anaemia in Group 3. In Group 4, ten children had mild anaemia, 38 had moderate anaemia which was same as initial observation also and nine children had severe anaemia in Group 4. Children of Group 4 which was a control group had mild improvement in their haemoglobin level when compared to the other supplemented groups.

b) Mean serum retinol of children before and after supplementation

The Table L and LI presents the Serum Retinol levels of the children prior to and end of the intervention.

Table L

Mean Serum Retinol (mg/L) of Boys Before and After Supplementation

Age	Groups	No.	WHO Standard	Mean Serum Retinol (mg/l) ± SD		Difference in Mean Serum Retinol Levels	't' Value Before and After
				Before supplementation	After supplementation		
6	Gp 1	11	0.20-0.50	0.16±0.014	0.17±0.015	0.009±0.005	5.59**
	Gp 2	8	0.20-0.50	0.15±0.014	0.18±0.015	0.028±0.08	9.74**
	Gp3	11	0.20-0.50	0.15±0.01	0.16±0.01	0.016±0.007	5.16**
	Gp4	10	0.20-0.50	0.149±0.008	0.157±0.01	0.01±0.008	2.45*
7	Gp 1	9	0.20-0.50	0.16±0.01	0.17±0.02	0.014±0.01	4.27**
	Gp 2	11	0.20-0.50	0.15±0.016	0.17±0.014	0.020±0.009	6.64**
	Gp3	9	0.20-0.50	0.16±0.01	0.18±0.02	0.01±0.009	5.49**
	Gp4	12	0.20-0.50	0.15±0.015	0.16±0.013	0.006±0.012	2*
8	Gp 1	11	0.20-0.50	0.15±0.01	0.16±0.01	0.012±0.006	6.53**
	Gp 2	10	0.20-0.50	0.15±0.020	0.17±0.012	0.021±0.01	5.55**
	Gp3	10	0.20-0.50	0.15±0.01	0.16±0.01	0.006±0.005	3.67*
	Gp4	9	0.20-0.50	0.153±0.015	0.155±0.012	0.006±0.007	2.83*

**-Significant at 1 per cent level; * - Significant at 5 per cent level

Table LI

Mean Serum Retinol (mg/L) of Girls Before and After Supplementation

Age in Years	Groups	No.	WHO Standard	Mean Serum Retinol (mg/l) ± SD		Difference in Mean Serum Retinol Levels	't' Value Before and After
				Before supplementation	After supplementation		
6	Gp 1	10	0.20-0.50	0.14±0.01	0.16±0.01	0.015±0.007	6.71**
	Gp 2	9	0.20-0.50	0.16±0.01	0.17±0.01	0.011±0.009	3.35*
	Gp3	12	0.20-0.50	0.15±0.01	0.165±0.006	0.01±0.01	3.22*
	Gp4	9	0.20-0.50	0.15±0.01	0.16±0.01	0.007±0.006	3.5*
7	Gp 1	8	0.20-0.50	0.14±0.01	0.15±0.015	0.011±0.007	3.81*
	Gp 2	11	0.20-0.50	0.15±0.0170	0.177±0.015	0.023±0.008	8.48**
	Gp3	9	0.20-0.50	0.14±0.01	0.16±0.01	0.014±0.01	4.27**
	Gp4	7	0.20-0.50	0.16±0.02	0.167±0.021	0.007±0.014	1.51*
8	Gp 1	7	0.20-0.50	0.14±0.014	0.16±0.013	0.02±0.01	5.3**
	Gp 2	10	0.20-0.50	0.157±0.02	0.18±0.017	0.022±0.009	7.57**
	Gp3	10	0.20-0.50	0.15±0.01	0.167±0.09	0.01±0.00	4.74**
	Gp4	11	0.20-0.50	0.156±0.02	0.162±0.01	0.005±0.005	3.46*

**-Significant at 1 per cent level; * - Significant at 5 per cent level

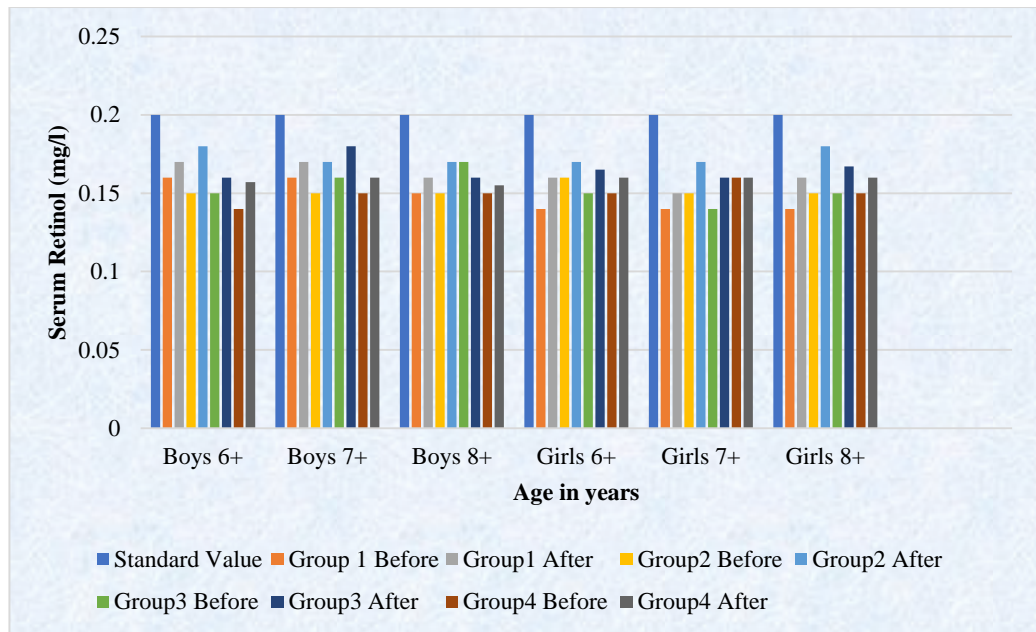


Figure 36: Mean Serum Retinol Values (mg/l) of Children Before and After Supplementation

When compared with standard values, the mean initial serum retinol levels in all four groups were identified to be below than the required. But after supplementation, an increase in the average final serum retinol level in supplemented subjects has been observed. In the Group 1, range in hemoglobin increase of boys was 0.009 ± 0.005 to 0.014 ± 0.01 mg/l ($p < 0.01$) which was relevant at one and five per cent levels. The range in serum retinol increase in girls of Group 1 was 0.011 ± 0.007 to 0.02 ± 0.01 mg/l ($p < 0.01$ and 0.05). Similarly, the mean final value of serum retinol in boys in the Group 2 also increased to a significant extent with a range of 0.02 ± 0.009 to 0.028 ± 0.08 mg/l ($p < 0.01$) and in girls also an increase in serum retinol levels ranging between 0.011 ± 0.009 to 0.023 ± 0.008 mg/l ($p < 0.01$ and 0.05) was observed. Group 3 boys the rise in mean serum retinol after supplementation was between 0.006 ± 0.005 to 0.016 ± 0.007 mg/l ($p < 0.01$ and 0.05) which was good sign of improvement and the radius of elevation of serum retinol values in girls was 0.01 ± 0.0 to 0.014 ± 0.01 mg/l ($p < 0.01$ and 0.05) which was relevant at one and five per cent levels. In the Group 4 boys and girls, increase in serum retinol levels was noted to be very minimal which ranged between 0.006 ± 0.007 to 0.01 ± 0.008 mg/l ($p < 0.05$) and 0.005 ± 0.005 to 0.007 ± 0.006 ($p < 0.05$) respectively. Especially the 6-year age-group boys and girls showed a remarkable improvement in their serum retinol levels after supplementation. It was clearly evident that Group 1, 2 and 3 showed improvement in their serum retinol levels when provided with

the supplementation of orange fleshed sweet potato and nutrition education than the children in Group 4, which was a control group.

The present study depicts the same results as the study done by Low et al., (2007) which revealed that the occurrence of low serum retinol levels held out the same in control groups while it came down from 60 to 38 per cent among supplemented children. The mean serum retinol raised about $0.100\mu\text{m/L}$ ($P<0.001$) in supplemented subjects and showed no significant change in control subjects. In control groups, the occurrence was nearly same to initial levels even though all children had facility to use vitamin A supplements.

Another study done by Faber et al., (2002) showcased similar results supporting the present study, that growing plants which gives vitamin A rich foods in kitchen garden schemes significantly decreased the occurrence of low serum retinol from 58 to 34 per cent after one and a half year in children and the control group showed no change.

The present study results matched up with Van Jaarsveld et al., study which reported that the estimated intervention indicated a good development in vitamin A liver stores in the supplemented subjects than in the control group. The increase of vitamin A stature in children with normal vitamin A status in the treatment group was 78 to 87 per cent and showed a negligible change from 86 to 82 per cent in the control group.

3. Clinical examination of children before and after supplementation

Table LII and Figure 37 depicts the impact of supplementation on the appearance of clinical symptoms in the children.

Table LII
Clinical Examination of Children Before and After Supplementation

(N=234)

Clinical Picture	Group 1 Before	(N=56)	Group 1 After	(N=56)	Group 2 Before	(N=59)	Group 2 After	(N=59)	Group 3 Before	(N=61)	Group 3 After	(N=61)	Group 4 Before	(N=58)	Group 4 After	(N=58)
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bitot's spot	2	3.57	2	3.57	3	5.08	2	3.38	1	1.63	1	1.63	2	3.44	2	3.44
Conjunctival Xerosis	1	1.78	0	0	2	3.38	1	1.69	2	3.27	2	3.27	2	3.44	2	3.44
Koilonychias	5	8.92	3	5.35	6	10.16	3	5.08	7	11.47	5	8.19	5	8.62	4	6.89
Emaciation	4	7.14	2	3.57	5	8.47	2	3.38	5	8.19	5	8.19	2	3.44	2	3.44
Dry, brittle hair	9	16.07	3	5.35	10	16.94	2	3.38	8	13.11	5	8.19	6	10.34	4	6.89
Bleeding gums	4	7.14	1	1.78	3	5.08	1	1.69	2	3.27	1	1.63	2	3.44	2	3.44
Glossitis	3	5.35	1	1.78	4	6.77	2	3.38	4	6.55	3	4.91	4	6.89	3	5.17
Phrynoderma	2	3.57	0	0	3	5.08	1	1.69	3	4.91	2	3.27	1	1.72	1	1.72
Gingivitis	1	1.78	0	0	3	5.08	1	1.69	2	3.27	2	3.27	2	3.44	2	3.44
Dental caries	15	26.78	5	8.92	13	22.03	6	10.16	11	18.03	8	13.11	14	24.13	13	22.41
Dermatitis	9	16.09	3	5.35	6	10.16	2	3.38	7	11.47	4	6.55	4	6.89	3	6.89
Angular Stomatitis	13	23.21	4	7.14	11	18.64	3	5.08	14	22.90	10	16.39	12	20.68	11	18.96

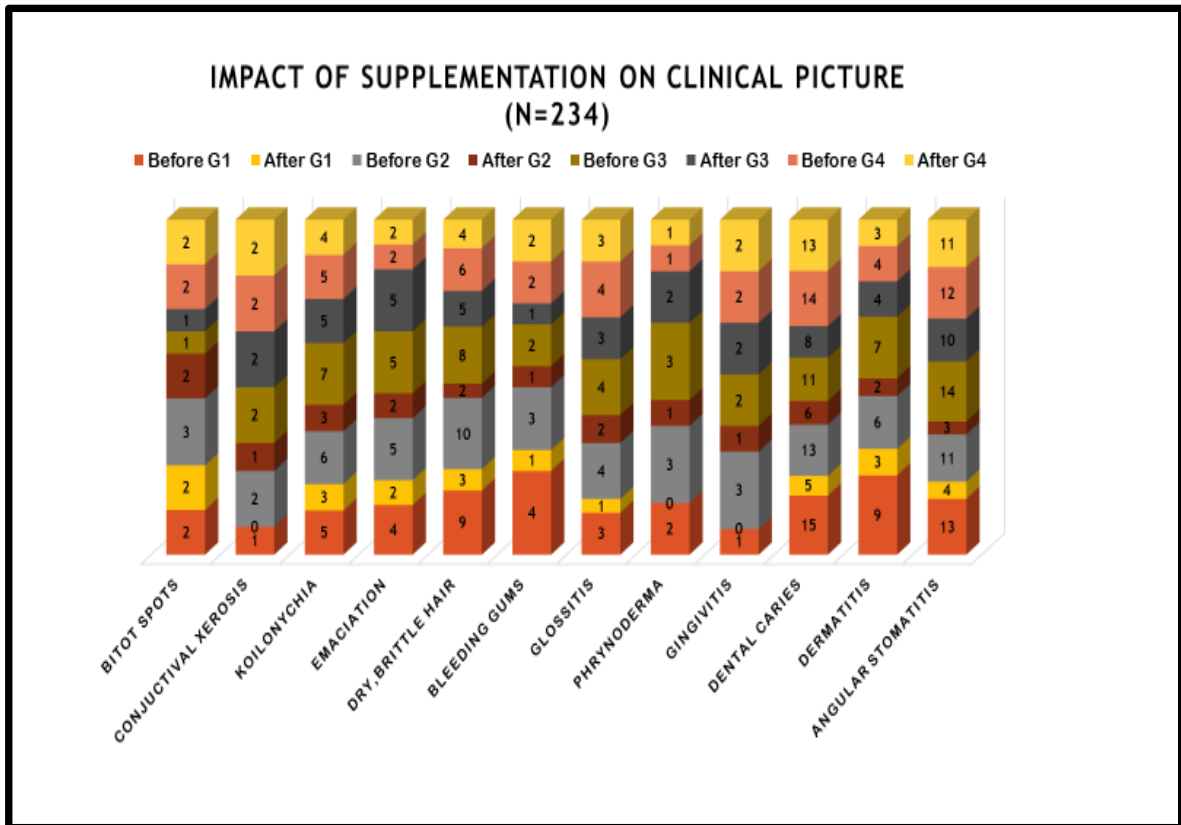


Figure 37: Clinical Symptoms of Children Before and After Supplementation

The above table reveals the prevalence of Bitot’s spots, a major symptom of Vitamin A Deficiency before supplementation was seen to be 3.6, 5.1, 1.6 and 3.4 per cent in children in Group 1, 2, 3 and 4 respectively. After supplementation for 6 months, it was reduced to 3.4 per cent in only Group 2 children while the it remained the same in other groups. Conjunctival xerosis before was observed among 1.8, 3.4, 3.3 and 3.4 per cent of Group 1,2, 3 and 4 children respectively. After supplementation group 1 children had zero per cent, Group 2 had 1.7 per cent, Group 3 and 4 remained unchanged. Koilonychias, a prominent symptom of iron deficiency anaemia before was seen to be 8.9, 10.2, 11.5 and 8.6 per cent in Group 1, 2, 3 and 4 respectively, which reduced to 5.4, 5.1, 8.2 and 8.6 per cent respectively after supplementation. Emaciation or wasting before was observed in 7.5 per cent in Group 1, 8.5 per cent in Group 2, 8.2 per cent in Group 3 and 3.4 in per cent in Group 4 children. After supplementation the symptoms dropped to 3.6 and 3.4 in group 1 and 2 respectively whereas Group 3 and 4 showed no difference. Dry, brittle hair was seen in 16.1, 16.9, 13.1 and 10.3 per cent in Group 1, 2, 3 and 4 respectively before supplementation. After supplementation, the symptoms in children reduced to 5.4 per cent in Group1, 3.4 per cent in Group 2, 8.2 per cent in Group

3, and 6.9 per cent in Group 4. Bleeding gums was observed before in 7.1, 5.1, 3.3 and 3.4 per cent of children and after supplementation it decreased to 1.8, 1.7, 1.6, and 3.4 per cent respectively in Group 1, 2, 3 and 4 respectively. Before supplementation, glossitis, a deficiency of vitamin B 12 was observed in 5.4 per cent in Group 1, 6.8 per cent in Group 2, 6.6 per cent in Group 3 and 6.9 per cent in Group 4 children. After supplementation, the symptoms in children reduced to 1.8 per cent in Group1, 3.4 per cent in Group 2, 4.2 per cent in Group 3, and 5.2 per cent in Group 4. Phrynoderma, a vitamin A deficiency symptom was not observed in Group 1, 1.7 per cent of Group 2 in, 3.3 per cent in Group 3 and 1.7 per cent in Group 4 children after supplementation which was initially 3.6 per cent in Group 1, 5.1 per cent in Group 2, 4.9 per cent in Group 3 and 1.7 per cent in Group 4 children. Gingivitis was before seen in 1.8, 5.1, 3.3 and 3.4 per cent children and after supplementation it was completely resolved in Group 1 and reduced to 1.7, 3.3, and 3.4 per cent of Group 2, 3 and 4 respectively. Dental caries initially was observed in 26.8 per cent children in Group 1 and after supplementation it was seen only in 8.9 per cent. Group 2 had 22.03 per cent with dental caries initially which decreased to 10.16 per cent after supplementation. In Group 3, 18.03 per cent were detected and after supplementation it was 13.11 per cent in Group 4 children it was seen in 24.13 per cent initially and after supplementation it was 22.41 per cent. Dermatitis was seen initially in 16.1, 10.2, 11.5 and 6.9 per cent before supplementation which was noted to be 5.4 per cent, 3.4 per cent, 6.6 per cent and 6.9 per cent after supplementation in children of Group 1, 2, 3 and 4 respectively. Angular stomatitis was observed in 23.2, 18.6, 22.1 and 20.7 initially which decreased to 7.14, 5.1, 16.4 and 19.0 per cent after supplementation in Group 1,2, 3 and 4 respectively.

Dietary Pattern

i) Mean food intake of children before and after supplementation

Table LIII represents the average daily food intake of the children prior to and at the end of intervention.

Table LIII
Mean Food Intake of Children Before and After Supplementation

(N=234)

Mean Food Intake Before and After Supplementation (N=234)												
	Group 1			Group 2			Group 3			Group 4		
Food stuff	Before	After	Difference	Before	After	Difference	Before	After	Difference	Before	After	Difference
Cereals & Millets	102	130	28	124	150	26	120	130	20	125	125	0
Pulses	35	40	11	42	55	13	35	40	5	30	35	5
Green Leafy Vegetables	9	10	1	15	25	10	12	15	3	10	10	0
Roots and tubers	47	105	58	51	110	59	40	60	20	45	50	5
Other vegetables	52	60	8	46	60	14	55	59	4	50	55	5
Fruits	11	15	4	17	20	3	15	18	3	15	15	0
Milk and Milk products	120	200	80	150	250	100	120	180	60	130	130	0
Sugar and Jaggery	15	20	5	15	20	5	15	18	3	18	20	2
Fats and Oil	15	20	5	15	20	5	12.5	15	2.5	15	15	0

The amount of mean food consumption by each group before supplementation was more or less the same. But after supplementation there was an increase in consumption of cereals and millets by 28g, consumption of pulses was also increased by 11g, 13g, 5g, and 5g in Groups 1,2,3 and 4 respectively. Intake of green leafy vegetables, roots and tubers, other vegetables, fruits, milk and milk products, sugar and jaggery and fats and oils has incredibly increased in the Groups 1,2, and 3 but no change has been noted in the consumption of green leafy vegetables, fruits, milk and milk products and fats and oils in Group 4.

ii) Mean nutrient intake of children before and after supplementation

Table LIV represents the average daily food intake of the subjects initially and prior to intervention.

Table LIV

Mean Nutrient Intake of Children Before and After Supplementation

(N=234)

Mean Nutrient Food Intake Before and After Supplementation (N=234)												
	Group 1			Group 2			Group 3			Group 4		
Nutrient	Before	After	Difference	Before	After	Difference	Before	After	Difference	Before	After	Difference
Energy (kcal)	1290	1420	130	1220	1510	290	1250	1460	210	1245	1310	65
Protein (g)	9.5	14.5	5	10.9	17.5	6.6	12.9	13	0.1	10.5	11	0.5
Fat (g)	10.5	12.5	2	10.5	13	2.5	10	11	1	11	11.5	0.5
Calcium (mg)	310	350	40	354	365	11	377	380	3	350	360	10
Iron (mg)	8	9	1	8.3	9.2	0.9	8	9	1	8	8	0
Vitamin A (IU)	240	850	610	256	910	654	229	250	21	235	240	5
Thiamine (mg)	0.4	0.6	0.2	0.4	0.6	0.2	0.5	0.6	0.1	0.4	0.4	0
Vitamin C (mg)	25	32	7	24	36	12	20	30	10	25	25	0

The nutrient intake of all nutrients before supplementation was below the recommended dietary allowances suggested by ICMR (2020). An increase in the intake of all nutrients has been observed in Group 1, 2, and 3, but in Group 4, no increase has been recorded in the intake of iron, thiamine and vitamin C intake.

D. Impact of Nutrition Education on KAP

Table LV depicts the impact of nutrition education on KAP.

Table LV
Impact of Nutrition Education on KAP

Parameters	Nutrition Education for Mothers, Caretakers and Teachers			Nutrition Education for Children		
	Initial	Final	Difference	Initial	Final	Difference
Knowledge	3.5 ± 0.33	8.2 ± 0.43	4.7 ± 0.34	2.1 ± 0.41	7.9 ± 0.33	5.8 ± 0.44
Attitude	3.1 ± 0.46	7.9 ± 0.38	4.8 ± 0.41	2.9 ± 0.66	8.0 ± 0.52	5.1 ± 0.28
Practice	4.6 ± 0.63	7.2 ± 0.50	2.6 ± 0.26	3.6 ± 0.47	7.6 ± 0.38	4.0 ± 0.56

Nutrition education has shown a very good impact on knowledge, attitude and practice of the mothers or care takers, teachers and the children. The scores observed initially and after intervention in mothers / care takers, teachers and children clearly show that there was a lot of improvement. The scores of mothers, care takers and teachers in knowledge has increased from 3.5 ± 0.33 to 8.2 ± 0.43. The scores in attitude had increased from an initial score of 3.1 ± 0.46 to 7.9 ± 0.38. The scores in practice have shot up from 4.6 ± 0.63 to 7.2 ± 0.50 with a difference of 2.6 ± 0.26. The scores of children in knowledge have increased from 2.1 ± 0.41 to 7.9 ± 0.33. The scores in attitude have increased from an initial score of 2.9 ± 0.66 to 8.0 ± 0.52. The scores in practice have shot up from 3.6 ± 0.47 to 7.6 ± 0.38. It has been observed that a significant increase in knowledge, attitude and practice has been evolved in the mothers, caretakers, teachers and children of the fisherfolk.

Similar results were observed in the study done by Mbela et al. (2021), which reported that the knowledge on orange-fleshed sweet potato (OFSP) nutrition value increased from 0.40 to 74.21 per cent for students and from 5.30 per cent to 97.72 per cent for teachers. Both students and teachers showed to score high dietary diversity. Teachers and farmers/women of reproductive age practiced boiling OFSP with peels which is the appropriate method for preventing nutrient loss. These results show that students and teachers gained knowledge of the nutrition benefits of OFSP.

This study lies in tune with the study done by Debnath and Agrawal (2016). Their study on the impact of nutrition education and dietary modification on the health stature of kinder garden children have revealed that their study resulted in 74 per cent increase in nutritional intake in subjects after a trail period of one month. They have also observed a prominent upgradation in the anthropometric stature of the subjects particularly height and chest circumference whereas no much changes were noted among the control.