4

Results and Discussion

The results of the study entitled **"Digital Technology Assisted Nutrition Support for Children with Attention Deficit Hyperactivity Disorder"** is presented under the following headings:

4.1. General, Health and Nutritional Status of children with ADHD symptoms

4.1.1. Socio-economic Background of children with ADHD symptoms

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4.3. Development of Artificial Intelligence Integrated Dynamic Website

4.4. Impact evaluation of intervention

4.4.1. Changes in Anthropometric Measurements of the Selected Children

4.4.2. Changes in Behaviour functions of the children with ADHD symptoms

4.4.3. Changes in food intake of the children with ADHD symptoms

4.4.4. Changes in Mean Nutrient Intake

4.4.5. Impact of Digital Health Intervention on Knowledge, Attitude and Practice (KAP) Scores of Caregivers

4.1. General, Health and Nutritional Status of children with ADHD symptoms

4.1.1. Socio-economic Background of the children with ADHD symptoms

Table II depicts the Socio-economic background of the children with ADHD symptoms such as family type, size, education and occupation of the family head, income and household amenities.

TABLE II

Socio-economic Background of the Children with ADHD symptoms (N=137)

Socio-demographic details	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Family Type												
Joint	12	26.0	3	6.5	16	34.7	4	8.7	8	17.3	3	6.5
Nuclear	22	24.1	8	8.7	30	32.9	11	12.0	15	16.4	5	5.4
No. of. Members												
2	3	25.0	1	8.3	4	33.3	1	8.3	2	16.6	1	8.3
3	5	26.3	2	10.5	6	31.5	3	15.7	3	15.7	0	-
4	8	27.5	1	3.4	12	41.3	2	6.9	5	17.2	1	3.4
5	10	26.3	2	5.2	15	39.4	3	7.8	7	18.4	1	2.6
Above 5	9	23.0	5	12.8	11	28.2	6	15.3	6	15.3	2	5.1
Order of Children												
1	22	22.9	9	9.3	31	32.2	13	13.5	15	15.6	6	6.2
2	8	25.0	2	6.2	12	37.5	3	9.3	6	18.7	1	3.1
3	3	33.3	0	0.0	4	44.4	0	-	1	11.1	1	11.1
Religion												
Hindu	20	22.7	9	10.2	27	30.6	13	14.7	13	14.7	6	6.8
Muslim	7	20.5	3	8.8	11	32.3	5	14.7	5	14.7	3	8.8
Christian	4	26.6	1	6.6	5	33.3	2	13.3	3	20.0	0	-
Education (FATHER)**												
Professional or honours	3	27.2	0	0.0	5	45.4	0	-	2	18.5	1	9.5
Graduate or postgraduate	10	22.7	6	13.6	12	27.2	6	13.6	7	15.9	3	6.8
Diploma	7	28.0	2	8.0	8	32.0	2	8.0	5	20.0	1	4
High School Certificate	9	23.6	3	7.8	14	36.8	4	10.5	6	15.7	2	5.5
Middle School certificate	5	29.4	1	5.8	6	35.2	2	11.7	3	17.6	0	-
Illiterate	0	0.00	0	0.0	1	50.0	0	-	1	50.0	0	-
Education (MOTHER)**												
Professional or honours	2	40.0	0	0.0	2	40.0	0	0.0	1	20.0	0	-
Graduate or postgraduate	15	23.4	6	9.3	20	31.2	9	14.5	10	15.6	4	6.5
Diploma	1	50.0	0	0.0	1	50.0	0	-	0	0.0	0	-

Socio-demographic details	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
High School Certificate	15	30.6	3	6.1	16	32.6	4	8.5	10	20.4	1	2.0
Middle School certificate	4	28.5	1	7.1	4	28.5	2	14.5	3	21.4	0	-
Primary School certificate	0	0.00	0	0.0	1	33.3	0	-	1	33.3	1	33.3
Occupation (FATHER)**												
Professional	1	50.0	0	0.0	1	50.0	0	-	0	-	0	-
Semi-Professional	7	20.5	3	8.8	11	32.3	5	14.5	5	14.7	3	8.8
Clerical, Shop Owner,	14	20.2	7	10.1	22	31.8	12	17.3	9	13	5	7.2
Skilled Worker	2	25.0	0	0.0	3	37.5	0	-	1	12.5	2	25
Semi-Skilled Worker	1	50.0	0	0.0	1	50.0	0	-	0	-	0	-
Unskilled Worker	0	0.0	0	0.0	1	100.0	0	-	0	-	0	-
Unemployed	6	28.5	1	4.7	8	38.1	1	4.7	4	19	1	4.7
Occupation (MOTHER)**												
Professional	2	28.5	0	0.0	3	42.8	0	-	1	14.5	1	14.5
Semi-Professional	2	22.2	0	0.0	4	44.4	0	-	2	22.2	1	11.1
Clerical, Shop Owner,	6	25.0	2	8.3	8	33.3	3	12.5	4	16.6	1	4.5
Skilled Worker	14	24.1	4	6.9	22	37.9	7	12	9	15.5	2	3.4
Semi-Skilled Worker	4	26.6	1	6.6	5	33.3	1	6.6	3	20.0	1	6.6
Unskilled Worker	2	40.0	0	0.0	2	40.0	0	-	1	20.0	0	-
Unemployed	5	26.3	1	5.2	7	36.8	1	5.5	4	21.5	1	5.5
Family Income**												
Rs ≥ 42,876	1	33.3	0	0.0	2	66.6	0	0.00	0	-	0	-
Rs 21,438-42,875	4	28.5	1	7.1	5	35.7	1	7.1	3	21.4	0	-
Rs 16,078-21,437	7	25.0	3	10.7	8	28.5	3	10.7	5	17.8	2	7.1
Rs 10719-16,077	16	22.2	8	11.1	22	30.5	11	15.2	11	15.2	4	5.5
Rs 6,431-10,718	5	25.0	1	5.0	7	35.0	2	10	4	20	1	5
Socio-Economic Status**												
Upper Lower Class	4	28.6	1	7.1	5	35.7	1	7.1	3	21.4	-	-
Lower Middle Class	16	18.6	11	12.8	24	27.9	14	16.3	13	15.1	8	9.3
Upper Middle Class	8	26.7	3	10.0	8	26.7	4	13.3	5	16.7	2	6.7
Upper Class	1	14.3	1	14.3	2	28.6	1	14.3	1	14.3	1	14.3

**Modified Kuppuswamy's socioeconomic scales (Wani, 2019)

Family type

Among the category of 4–6 year old, 26 per cent of boys were from the joint families, and 25 per cent of boys belonged to nuclear families. For the 7-9 year old category, 35 per cent of boys from joint families, and 33 per cent belonged to nuclear families. For the 10–12 year old category, 17 per cent of the boys belonged to joint families, and 16.48 per cent were under nuclear families. For the 4-6-year-old demographic, seven per cent of girls from joint families and nine per cent from nuclear families. For the 7-9 age group, 12 per cent of the girls belonged to nuclear families and eight per cent from joint families. Boys aged from 10 to 12 years reported belonging to a combined families in seven per cent of cases, compared to nuclear families in six per cent of cases.

For the 4-6 years of age category 26 per cent of the boys were from joint families and nine per cent of girls were from nuclear family whereas for the category of 7-9 years 35 per cent of boys were from joint families and 12 per cent of girls were from nuclear families. In case of 10-12 years of category 17 per cent of boys and seven per cent of girls were from joint families. It showed that all the age category of boys were from joint family type whereas other than 10-12 years of age girls were from the background of nuclear family. Families are crucial to research as they play a role in influencing and shaping an person's growth, behaviour, and wellness. Hareven *et al.,(*2018)

Number of total members in the family size

The number of members in the family of the children showed that for the age group of 4 to 6, majority of them were boys (28 per cent) which had about 4 members in the family and for girls of the same age category about 13 per cent had above 5 family members whereas for the age group 7 to 9 years, for boys 39 per cent had 5 family members and girls showed that 16 per cent had three family members and for the age group of 10 to 14 about 16 percent boys had three family members and two per cent of girls reported of having more than 5 family members. Thus, from the study it can be identified that in the case of boys majority of them had 5 family members and for girls majority of them had above 5 members in their family.

From the study details on the number of family members in the family of Children with ADHD symptoms, the boys from 7 to 9 years of age group reported that they have one family member and for girls category reported the same was equal in all the categories, and the details related to 2 members in the family for boys and girls were high for the age

category 7 to 9 years of age followed by 3 members in the family was high for boys and girls in the age group of 7 to 9 years of age. For 4 members in the family showed that for both the gender respondents 7 to 9 years was dominant and for 5 family members 7 to 9 year of age was high. Thus the number of family members among the selected Children with ADHD symptoms showed that for the age group 7 to 9 years of age had the highest family member contribution irresponsible of their age. A positive relationship with family size and ADHD treatment was observed. (Geuijen *et al*., 2019)

Order of Children

Boys between the ages of 4-6 years occupy positions 1, 2, and 3 in the order of children with respective per centages of 23 per cent, 25 per cent, and 33 per cent. For the age of 7-9 years, boys occupy the position of 1,2, and 3 in an order of children with respective per centages of 32 per cent, 38 per cent, and 44 per cent. Among 10-12 years old boys the position of 1, 2, and 3 in an order of children, with per centages of 16 per cent, 19 per cent, and 11 per cent. Positions 1, 2, and 3 in the children were by girls aged 4-6 years , with respective per centages of 9.38 per cent, and 6 per cent. The girls aged 7-9 years occupy an order of positions in the children 1, 2, and 3 with respective per centages of 14 per cent, and nine per cent. Girls between the age of 10 -12 years are ranked 1, 2, and 3, respectively, with per centages of 6 per cent, 3 per cent, and 11 per cent. Rohrer *et al.*, (2015) reported that the significance of the birth order is also demonstrated by the fact that it affects people in several phases including those who are firstborn, and not only their education level be higher, but their offspring's achievement will likewise be higher.

The order of the children with ADHD symptoms in their family details showed that for boys the first child in the family was found in the age category of 7 to 9 years whereas for the first child among girls the age category was from 4 to 6 years. For the 2nd child order in the case of boys highest per centage was found for the age category 7 to 9 years whereas for girls it was seen in the category 4 to 6 years of age and 3rd child was reported high for boys in the age category of 7 to 9 years and for girls it was in 10 to 12 years. A German study published in the Journal of Attention Disorders, 2023, found that the risk of attention deficit hyperactivity disorder (ADHD) rose for firstborn children compared with the youngest born and single child, which was consistent with the findings presented by Metzger (2015). Additionally, the number of first-born children's younger siblings raises the chance for ADHD.

Religion

In order to organize and define the environment of the religious community, religion can be defined as a system of beliefs and activities linked to supernatural creatures (Sosis, 2019). Regarding religion, 23 per cent of boys aged 4-6 years were identified as Hindus, 21 per cent as Muslims, and 27 per cent as Christians. For boys aged between 7-9 years, 31 per cent, 33 per cent, and 33 per cent were identified as Hindus, Muslims, or Christians. For boys aged between 10-12 years, 15 per cent, 15 per cent, and 20 per cent were identified as Hindus, Muslims, and Christians. The girls between 4-6 years were identified as Hindus, Muslims, and Christians comprised 10 per cent, nine per cent, and seven per cent of the total. Between the ages of 7-9 years, 15 per cent, 15 per cent, and 13 per cent of the girls identified as Hindus, Muslims, and Christians. Between the ages of 10 and 12 years, seven per cent, and nine per cent, of the girls identified as Hindus, Muslims, and Christians.

Education of father

Fathers of boys between the age of 4-6 years had a professional degree, graduate or postgraduate degree, diploma, high school and middle school certificates were found illiterates are 27 per cent, 23 per cent, 28 per cent, 24 per cent, 29 per cent respectively. The fathers of boys between the age group of 7-9 years had a professional honour, graduate or postgraduate degree, diploma, high school and middle school certificates, and illiterates were 45 per cent, 27 per cent, 32 per cent, 37 per cent, 35 per cent, 50 per cent respectively. The fathers of boys between the age category of 10-12 years had professional degree, graduate or postgraduate degree, diploma, high school and middle school certificates, and illiterates were 18 per cent, 16 per cent, 20 per cent, 16 per cent, 18 per cent, 50 per cent respectively. The higher education of children in school was significantly and favourably correlated with parents' educational level.

A professional honour, graduate or postgraduate degree, diploma, high school, and middle school certificates, and illiterates were by the father of girls between the ages of 4 and 6 years, whereas 13 per cent, eight per cent, eight per cent, six per cent, 14 per cent, eight per cent, 11 per cent, 12 per cent, the father of girls between the ages of 7-9 years has professional honours, graduate or postgraduate degree, diploma, high school and middle school certificates, and illiterate. The professional honours, graduate or postgraduate degree, diploma, high school, and middle school certificates, and illiterate per centage for fathers of boys between the ages of 10 and 12 years are all present in nine per cent, seven per cent, four per cent, five per cent of the father population, respectively.

In case of education of the father for both the genders the higher contribution was seen under the age category of 7 to 9 years of age. Most fathers with ADHD symptoms had undergone some kind of primary education irrespective of being illiterate. Low educational attainment in parents is associated with children psychopathology. Associations may be due to risk factors that family members share or due to effects of maternal or paternal education on the offspring (Torvik *et.al.,* 2020).

Education of mother

From Table II, it is clear that the mothers of boys between the ages of 4-6 years has a professional honour, graduate or postgraduate degree, diploma, high school and middle school certificates, and illiterates are in 40 per cent, 23 per cent, 50 per cent, 31 per cent, 29 per cent respectively. The mothers of boys between the age group of 7-9 years has professional honours, graduate or postgraduate degree, diploma, high school and middle school certificates, and illiterates are in 40 per cent, 31 per cent, 50 per cent, 33 per cent, 29 per cent, 33 per cent, respectively. The mothers of boys between the age of 10-12 years has a professional honour, graduate or postgraduate degree, diploma, high school and middle school certificates in 20 per cent, 16 per cent, 20 per cent, 21 per cent, 33 per cent.

The professional honours, graduate or postgraduate degree, diploma, high school, and middle school certificates, and illiterates held by the mothers of girls between the ages of 4 and 6 years, whereas nine per cent, six per cent, and seven per cent. In 14 per cent, eight per cent, 14 per cent, the mothers of girls between the ages of 7-9 years has professional honours, graduate or postgraduate degree, diploma, high school and middle school certificates. The graduate or postgraduate degree, high school, and primary school certificates percentage for mothers of girls between the ages of 10 and 12 years are all present in six per cent, two per cent, and 33 per cent, of the father population, respectively.

Majority of the children with ADHD mothers was found to be educated and higher per centage of children was seen in the age category 7 to 9 years of age. Educational qualification of mother had a positive impact on the lives of children with ADHD symptoms. Torvik *et.al.,* 2020

Occupation of father

The fathers of boys between the ages of 4-6 years had the occupation of professional, semi-professional, clerical, shop owner, skilled worker, semi-skilled worker, unskilled worker, and unemployed with a percentage of 50, 21, 20, 25, 50, and 29 respectively. The percentage of the professional, semi-professional, clerical and shop owner, skilled, semi-

skilled, unskilled, and unemployed occupations held by fathers of boys between the ages of 7-9 years is 50, 32, 32, 38, 50, 100, and 38, respectively. The occupation of the boys fathers between the ages of 10-12 years are semi-professional, clerical and shop owner, skilled, and unemployed, with respective per centages of 15, 13, 13, and 19.

The fathers of girls between the ages of 4-6 years were semi-professional, clerical and shop owner, and unemployed with the percentage of 9, 10, and 5 respectively. The percentage of the semi-professional, clerical and shop owner, and unemployed occupation of girls fathers between the age category of 7-9 years was 15, 17, and 5 per cent, respectively. The occupations of the fathers of girls between the ages of 10-12 years were semi-professional, clerical and shop owner, skilled, and unemployed, with respective percentages of 9, 7, 25, and 4.

The details pertaining to the occupation of the father of children with ADHD showed that majority of the fathers were employed in some kind of profession and very few were found to be unemployed.

Occupation of mother

From Table II, the percentage of the professional, semi-professional, clerical and shop owner, skilled, semi-skilled, unskilled, and unemployed occupations held by mothers of boys between the ages of 4-6 years is 28, 22, 25, 24, 26, 40, and 26, respectively. The percentage of mothers of boys between the ages of 7-9 years who hold professional, semi-professional, clerical and shop owner, skilled, semi-skilled, unskilled, and unemployed occupations is 42, 44, 33, 37, 33, 40, and 36, respectively. The jobs held by mothers of boys aged 10 to 12 years range from professional, semi-professional, clerical and shop owner, skilled, semi-skilled, and unemployed, with corresponding percentages of 14, 22, 16, 15, 20, 20, and 21respectively.

The occupation of the mothers of girls between the ages of 4-6 years are clerical and shop owner, skilled, semi-skilled, and unemployed, with respective per centages of 8, 7, 7, and 5. The percentages of mothers of girls aged 7-9 years who hold clerical and shop owner, skilled, semi-skilled, and unemployed occupations are 13, 12, 7, and 5, respectively. Professional, semi-professional, clerical and shop owner, skilled, semi-skilled, and unemployed are the occupation of the mothers of girls between the age category of 10 and 12 years and their corresponding percentages are 14, 11, 4, 3, 7, and 5 respectively.

Majority of the children mothers with ADHD symptoms were found to be employed in some sector chosen for the study where the percentage of unemployed mothers was very less and the higher contribution was seen in the age group of children of 7 to 9 years of age. To raise a child with special needs disturbs family life and affects everyday life of a mother especially her occupation (Darling Rasmussen *et.al.,* 2021)

Family income

From Table II, it is seen that the family income of the boys of the age between 4-6 years is 33 per cent, 29 per cent, 25 per cent, 22 per cent, 25 per cent, and for the range of Rs ≥ 42,876, 21,438-42,875, 16,078-21,437, 10719-16,077, and 6,431-10,718, For the range of Rs ≥ 42,876, Rs 21,438-42,875, Rs 16,078-21,437, Rs 10719-16,077, and Rs 6,431-10,718 the family income of boys aged 7-9 years is 66 per cent, 36 per cent, 29 per cent, 31 per cent, 35 per cent. Boys aged 10-12 years live in families earning between 21,438-42,875, 16,078-21,437, 10719-16,077, and ₹ 6,431-10,718, which is 21 per cent, 18 per cent, 15 per cent, 20 per cent. (Mesra, 2018). The most significant and essential underlying causes of low nutritional status among children were poverty, prominent families, & women's education. Family income is the total real income received by all family members and used to cover personal and shared expenses. Family income is a response to the labour performed or the payment received due to the contributions made during production activities (Murnane *et al.,* 2018).

The family income of the girls the aged of 4-6 years is 7.1 per cent, 10.71 per cent, 11.1 per cent, 5.00 per cent for the range of 21,438-42,875, 16,078-21,437, 10719-16,077, 6,431-10,718, For the range of ₹ 21,438-42,875, 16,078-21,437, 10719-16,077, and ₹ 6,431-10,718, the family income of girls aged 7-9 years is 7.1 per cent, 10.71 per cent, 15.28 per cent, 10.00 per cent. Girls aged 10-12 years lived in families earning between, ₹ 16,078-21,437, ₹ 10719-16,077, and ₹ 6,431-10,718, which is 7.1per cent, 5.5 per cent, 5.00 per cent for family income.

The highest family income earned was reported by boys with ADHD symptoms was Rs 42,875 and for girls it was Rs 16,078 to 21,437. Children and adults are protected against medical risks and psychiatric conditions by socioeconomic status (Assari *et al.,* 2019)

Socio-economic status

The socio-economic status of the children showed that none of the children belonged to the lower class status whereas for upper lower class for the age group of 4 to 6 years 28.6 per cent of boys and 7.1 per cent of girls were found, for the age category 7 to 9 years of age

35.7 percentage of boys and 7.1 per cent of girls were seen and for the age category 10 to 12 years 21.4 per cent of boys were observed. For lower middle class from the age group of 4 to 6 years 18.6 per cent of boys and 12.8 per cent of girls were reported, for the age group of 7 to 9 years 27.9 per cent of boys and 16.3 per cent of girls were found and for the age category 10 to 12 years 15.1 per cent of boys and 9.3 per cent of girls were studied. For upper middle class 26.7 per cent of boys and 10.0 per cent of girls were identified in the age of 4 to 6 years, for the age 7 to 9 years 26.7 per cent of boys and 13.3 per cent of girls were reported and for the age category 10 to 12 years of age 16.7 per cent of boys and 6.7 per cent of girls were identified. In case of upper class for the age category 4 to 6 years 14.3 per cent of boys and 14.3.per cent of girls was identified for the age of 7 to 9 years of age 28.6 per cent of boys and 14.3 per cent of girls were reported and 14.3 per cent of boys and 14.3.per cent of girls were from the age of 10 to 12 years. Thus from the study, it can be said that most of the selected children were from upper and middle classes.

This study is on par with Russell *et.al.,* 2015 where Financial difficulties, housing tenure, maternal age at birth of children and marital status were significantly associated with an outcome of ADHD.

4.1.2. Family History of ADHD related disorders

TABLE III

Family history of ADHD related disorders

Type of Health status	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Hyperactivity												
Yes	13	29	3	7	15	33	4	9	9	20	1	2
No	25	27	7	8	31	34	9	10	17	19	3	3
Attention Deficit												
Yes	19	24	9	11	22	28	11	14	13	17	5	6
No	13	23	5	9	21	36	8	14	9	16	2	4
Learning Disabilities												
Yes	14	24	5	9	21	36	8	14	9	16	2	3
No	17	22	9	12	22	28	12	15	12	15	6	8

From Table III, the study revealed that the family history of children with ADHD symptoms in which concentration has been made to find if any family member of the child family has been affected with hyperactive, attention deficit and learning disability. The result

showed that for the age group of 4 to 6 years about 29 per cent of boys and seven per cent of girls family members were affected with hyperactivity issues. In contrast, for attention deficit 24 per cent of boys and 11 per cent of girls were affected with attention deficit issue and 24 per cent of boys and nine per cent of girls were affected with learning disabilities and 7 to 9 years of age about 33 per cent of boys and nine per cent of girls family members had faced hyperactivity symptoms. In contrast, for attention deficit about 28 per cent of boys and 14 per cent of girls family members were affected and for learning disability 36 per cent of boys and 14 per cent of girls family members were affected. Around 20 per cent of boys and 2 per cent of girls were found to have hyperactivity when they were 10 to 12 years old, while 17 per cent of boys and 6 per cent of girls were found to have attention deficit disorder, and about 16 per cent of boys and 3 per cent of girls were found to have learning disabilities.

Most of the family members of a child with ADHD have been affected with hyperactivity, attention deficit and learning disabilities by Starck *et al.,* 2016 observed that ADHD occurrence for mothers of children with ADHD was 41.3%, for fathers 51.0%.

4.1.3. PARENTAL PROFILE OF THE CHILDREN

Profiles of the Father of the Children

TABLE IV

Profile of the father of the children

Constructs	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Habits												
Smoking	7	26.9	1	3.8	10	38.4	2	7.6	5	19.2	1	3.8
Alcohol consumption	11	28.2	2	5.1	14	35.9	3	7.6	8	20.5	1	2.5
Smoking & Alcohol consumption	14	22.5	7	11.2	18	29.0	9	14.5	9	14.5	5	8.0
None of the Above	2	20.0	1	10.0	4	40.0	1	10.0	2	20.0	0	-
Frequency of consumption of alcohol and smoking												
Daily	4	25.0	1	6.3	5	31.3	2	12.5	3	18.8	1	6.3
Once in a week	9	21.4	4	9.5	15	35.7	5	11.9	6	14.3	3	7.1
More than 3 times a week	13	29.5	3	6.8	14	31.8	3	6.8	9	20.5	2	4.5
Monthly Twice	6	24.0	2	8.0	8	32.0	4	16.0	4	16.0	1	4.0
Major Health Problems												
CVD related and heart complication	2	25.0	0	-	3	37.5	0	-	2	25.0	1	12.5
Diabetes	3	27.2	0	-	5	45.4	0	-	2	18.1	1	9.0
Respiratory complications	8	27.5	2	6.9	10	34.5	3	10.3	5	17.2	1	3.4
CKD /AKD (kidney Problems)	7	21.2	3	9.5	11	33.3	5	15.1	5	15.1	2	6.0

BP	10	29.4	2	5.8	12	35.5	3	8.8	7	20.5	0	-
Nervous Disorder	2	28.5	0	0.0	3	42.8	0	0.0	2	28.5	0	-
None of the above	4	26.6	1	6.6	5	33.3	1	6.6	3	20.0	1	6.6
Personality												
Very Calm	4	23.5	1	5.8	6	35.5	2	11.7	3	17.6	1	5.8
Stable	10	25.0	5	12.5	11	27.5	5	12.5	7	17.5	2	5.0
Aggressive	17	21.2	8	10.0	26	32.5	13	16.2	11	13.7	5	6.2

Habits of fathers

Sundararajan *et al.,* (2019) mentioned in a study that even though children require both parents, fathers are frequently seen as the family's head of household and authoritative figure who may have the most impact on a child's development. Table III shows that fathers of the boys between the ages of 4-6 years had a habit of smoking 26.3 per cent, drinking alcohol 28.1 per cent, smoking and drinking both 22.5 per cent, and not having any habit at all 20 per cent. Fathers of boys aged 7 to 9 years had a habit of smoking 38.4 per cent, drinking alcohol 35.9 per cent, doing both 29 per cent, or not having any habit at all 40 per cent. Fathers of boys between the ages of 10 – 12 years had one of the following habits: smoking 19.2 per cent, drinking alcohol 20.5 per cent, doing both 14.5 per cent, or having none at all 20 per cent.

Fathers of girls between the ages of 4 and 6 years had a habit of smoking 3.85 per cent, drinking alcohol 5.13 per cent, smoking and drinking both 11.29 per cent and having no habit at all 10.00 per cent. Fathers of girls between the ages of 7 and 9 years reported having a habit of smoking 7.69 per cent, drinking alcohol 7.69 per cent, doing both 14.5 per cent, or not having any habit at all 10 per cent. Smoking, drinking alcohol, doing both, or not doing either was a habit for fathers of girls between the ages of 10-12 years in 3.85 per cent, 2.56 per cent, and 8.06 per cent, respectively. It was found in the study that most of the fathers of the children with ADHD are found to be smoking or drinking alcohol or both smoking and drinking which has impact on the life of the children. Very less per cent of the fathers were found to be without any such habits. Liu *et al.,* (2022) found that fathers of children who smoked before pregnancy had a higher risk of developing ADHD compared to those whose fathers had never exposed themselves to smoking.

Frequency of consumption of alcohol and smoking

In Table III, among the fathers of boys between the ages of 4-6 years 25 per cent consumed daily, 21 per cent drank once per week, 30 per cent consumed more than three

times per week, and 24 per cent consumed twice a month. The frequency per centage of smoking, drinking, or combining the two was questioned by fathers of boys between the ages of 7 and 9 years. Among them, 31.3 per cent consumed every day, 35.7 per cent consumed once per week, 31.8 per cent consumed more than three times per week, and 32 per cent consumed twice a month. Fathers of boys between the ages of 10-12 years were asked how often they smoked, drank, or did both. Among those, 18.8 per cent consumed daily, 14.3 per cent consumed once per week, 20.5 per cent consumed more than three times per week, and 16.0 per cent consumed twice a month.

The frequency percentage of smoking, drinking, or combining the two was questioned by fathers of girls between the ages of 4 and 6 years. Among them, 6.3 per cent consumed every day, 9.5 per cent consumed once per week, 6.8 per cent consumed more than three times per week, and 8.0 per cent consumed twice a month. Fathers of girls between the ages of 7-9 years were asked how frequently they smoked, drank, or combined the two. Among them, 12.5 per cent consumed daily, 11.9 per cent consumed once a week, 6.8 per cent consumed more than three times a week, and 16.0 per cent consumed twice a month. When it came to smoking, drinking, or doing both, fathers of girls between the ages of 10-12 years were questioned. 6.3 per cent of them consumed daily, 7.1 per cent drank once a week, 4.5 per cent consumed more than three times per week, and 4.0 per cent consumed twice a month.

The frequency of consumption of alcohol or smoking among the father of the respondents showed that most of them were found to be consuming either daily or once a week. Among children with ADHD symptoms, 7.0 per cent of fathers smoked before pregnancy, and 7.6 per cent of fathers smoked during pregnancy (Osland *et al.*, 2017) .

Major health problems of the father:

From Table III, the major health problems faced by fathers of boys between the ages of 4-6 years were CVD, diabetes, and respiratory problems, CKD/AKD, B.P, and nervous disorder. Among 25 per cent have CVD, 27.2 per cent have diabetes, 27.5 per cent have respiratory complications, 21.2 per cent have CKD/AKD, 29.4 per cent have B.P, 28.5 per cent have a nervous disorder, and 26.6 per cent do not have any health issues.

Fathers of boys between the ages of 7 and 9 years reported the following major health issues: CVD, diabetes, respiratory problems, CKD/AKD, high blood pressure, and nervous disorder. Among 37.5 per cent have cardiovascular disease, 45.4 per cent have diabetes, 34.4

per cent have respiratory problems, 33.3 per cent have kidney disease or advanced kidney disease, 35.2 per cent have high blood pressure, 42.8 per cent have nervous disorders, and 33.3 per cent are healthy. CVD, diabetes, respiratory problems, CKD/AKD, high blood pressure, and nervous disorders were the main health issues fathers of boys between the ages of 10-12 years affected. Among 25 per cent have CVD, 18.1 per cent have diabetes, 17.2 per cent have respiratory problems, 15.1 per cent have CKD/AKD, 20.5 per cent have high blood pressure, 28.5 per cent have nervous disorders, and 20 per cent are in good health.

The fathers of girls between the ages of 4 and 6 years reported the following major health issues: CVD, diabetes, respiratory problems, CKD/AKD, high blood pressure, and nervous disorder. Among the 6.9 per cent have respiratory problems, 9 per cent have kidney disease or advanced kidney disease, 5.8 per cent have high blood pressure, and 6.6 per cent are healthy. The following severe health conditions were mentioned by fathers of girls between the ages of 7-9 years: CVD, diabetes, respiratory issues, CKD/AKD, high blood pressure, and nervous disorder. Ten per cent have respiratory problems, 15.1 per cent have kidney disease or advanced kidney disease, 8.8 per cent have high blood pressure, and 6.6 per cent are in good health. Fathers of girls between the ages of 10 and 12 were most commonly affected by CVD, diabetes, respiratory issues, CKD/AKD, high blood pressure, and nervous disorders. Among them, 12.5 per cent have cardiovascular disease (CVD), nine per cent have diabetes, 3.4 per cent have respiratory issues, six per cent have kidney disease (CKD/AKD), and 6.6 per cent are in good health. Reiss *et al.,* (2019) reported that parents' health issues significantly influenced children's mental health issues.

Personality of the father

Twenty-three per cent of fathers of boys between the ages of 4-6 years were described as having a very calm personality. 10 per cent of them were described as stable, while 17 per cent of the fathers were described as aggressive. For 7-9 years, fathers of boys were described as 35.2 per cent having a very calm personality, 27.5 per cent of them described as stable, and 32.5 per cent have an aggressive personality. For boys aged 10-12 years, fathers were described as having one of three personalities: 17.6 per cent very calm, 17.5 per cent stable, and 13.7 per cent aggressive.

The personality type of 5.8 per cent of fathers of girls between the ages of 4-6 years was described as very calm. While 10 per cent of the fathers were described as aggressive, 12.5 per cent were described as stable. Fathers of girls aged 7-9 years were described as

having an 11.7 per cent very calm personality, a 12.5 per cent stable personality, and a 16.2 per cent aggressive personality. Fathers were classified as having one of three personalities for girls between the ages of 10 to 12 years: five per cent very calm, five per cent stable, or 6.2 per cent aggressive. Involvement of fathers reduces a children's likelihood of acting out in class or engaging in dangerous conduct during adolescence (Waithaka et al., 2018) .

Pregnancy and Lactation Status of the Mother

TABLE V

Pregnancy and Lactation Status of the Mother

Constructs	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Blood Relation Marriage												
Yes	19	20.6	9	9.7	31	33.7	15	16.3	13	14.1	5	5.4
No	9	20.0	5	11.1	14	31.1	7	15.5	6	13.3	4	8.8
Age at time of Pregnancy (in Years)												
Below 20	17	22.9	9	12.1	21	28.3	10	13.5	12	16.2	5	6.7
20 – 30	11	22.0	5	10.0	17	34.0	8	16.0	7	14.0	2	4.0
Above 30	4	30.7	0	-	5	38.4	1	7.6	2	15.3	1	7.6
Major Complications during Pregnancy												
Anaemia	1	12.5	1	12.5	3	37.5	0	-	2	25.0	1	12.5
Hypertension	3	25.0	1	8.3	4	33.3	1	8.3	2	16.6	1	8.3
Diabetes	1	25.0	0	-	2	50.0	0	-	1	25.0	0	-
Bleeding	0	-	1	25.0	2	50.0	0	-	1	25.0	0	-
Excessive Vomiting	5	29.4	1	5.8	6	35.2	2	11.7	3	17.6	0	-
Abortions	2	25.0	1	12.5	3	37.5	1	12.5	1	12.5	0	-
Epilepsy	2	22.2	0	-	3	33.3	0	-	2	22.2	2	22.2
Hypothyroidism	4	30.7	1	7.6	4	30.7	1	7.6	2	15.3	1	7.6
Hyperthyroidism	3	37.5	0	-	4	50.0	0	-	1	12.5	0	-
Hormonal Problems	1	50.0	0	-	1	50.0	0	-	0	-	0	-
Others	15	28.8	3	5.7	18	34.6	4	7.6	10	19.2	2	3.8
Mode of Delivery												
Normal	15	28.3	4	7.5	18	33.9	5	9.4	10	18.8	1	1.8
C-Section	21	25.0	9	10.7	23	27.3	10	11.9	14	16.6	7	8.3
Term of Baby												
Preterm Baby	22	25.8	7	8.2	28	32.9	9	10.5	15	17.6	4	4.7
Full Term Baby	12	23.0	4	7.6	19	36.5	7	13.4	8	15.3	2	3.8
Breastfeeding												
Yes	34	25.7	12	9.0	41	31.0	14	10.6	23	17.4	8	6.0
No	2	40.0	0	-	2	40.0	0	-	1	20.0	0	-

Constructs	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Duration of breastfeeding												
4 months	19	21.8	8	9.2	30	34.4	13	14.9	13	14.9	4	4.6
6 months	8	22.8	4	11.4	10	28.5	5	14.2	6	17.1	2	5.7
1 year	3	23.0	1	7.6	4	30.7	2	15.3	2	15.3	1	7.6
None	1	50.0	0	-	1	50.0	0	-	0	-	0	-
Any special kind of supplements during pregnancy												
Yes	24	22.2	12	11.1	32	29.6	16	14.8	16	14.8	8	7.4
No	7	24.1	2	6.9	10	34.4	4	13.7	5	17.2	1	3.4

Blood relation marriage

Table V demonstrated that the percentage of mothers of boys between the ages of 4-6 years who were married to blood relations was 20.6 per cent, and not married to blood relations was 20 per cent which indicated that blood relation marriage for the mothers of boys aged 7-9 years who were married to blood relatives made up 33.7 per cent, while those who were not married to blood relatives made up 31.1 per cent and 14.1 per cent of mothers of boys aged 10-12 years were married to blood relatives, while 13.3 per cent were not. 9.7 per cent of mothers of girls aged 4 to 6 years were married to blood relatives, while 11.1 per cent were not. The percentage of mothers of girls aged 7-9 years who were married to blood relatives was 16.3 per cent, while the proportion of mothers who were not married to blood relatives was 15.5 per cent. While 5.4 per cent of mothers of girls aged 10 to 12 years were not married to blood relatives, 8.8 per cent were married to a blood relative. Early maternal childhood shows enhanced hippocampus volume development correlates with support. This development trajectory is linked to subsequent emotional disorders and spans school and early adolescence.

The same has been reported in a study made by Ansari (2019) revealed that inquiry, that 76 per cent of the ADHD patients had a parental history of consanguinity.

Age at the time of pregnancy

From Table V, it is evident that the mothers of boys aged 4-6 years, 22.9 per cent, had conceived at the age below 20. 2 per cent of the mothers of boys between the ages of 4-6 years were born when they were between 20–30-year-old. 30.7 per cent of the mothers of boys 4-6 years were born when they were above 30 years old. Mothers of boys at the age of

7-9 years, 28.3 per cent were conceived at the age below 20 years. Thirty four per cent were conceived at the age of 20-30 years, and 38.4 per cent were conceived above the age of 30 years. Mothers of boys at the age of 10-12 years, 16.2 per cent were conceived at the age below 20 years, 14 per cent were conceived at the age of 20-30, and 15.3 per cent were conceived at the age above 30 years.

A ten percentage of boys between the ages of 4-6 years were born between 20-30 years, and 12.1 per cent of the mothers of boys at this age were born when they were under 20 per cent of mothers of boys ages 4-6 years were born when they were older than 30 years. 13.5 per cent of mothers of boys between the ages of 7-9 years were under the age of 20 years, 16 per cent were between the age of 20 and 30 years, and 7.6 per cent were over the age of 30. Regarding the mothers of boys between the ages of 10 and 12 years, 16.2 per cent were born before the age of 20 years, 14 per cent were born between the ages of 20 and 30 years, and 15.3 per cent were born after the age of 30 years.

The results were consistent with a study by Min *et al*. (2021), which found that the lowest parental age group was linked to a higher risk of ADHD in the offspring.

Major complications during pregnancy

From major pregnancy complication was experienced by 22.3 per cent of mothers of boys between the ages of 4-6 years, while 25 per cent of these mothers did not. 38.4 per cent of mothers of 7–9-year-old boys have not experienced a significant pregnancy complication, compared to 35.2 per cent of those mothers who did. 15.2 per cent of mothers of 10-12 years old boys experienced significant complications, while 17.3 per cent did not experience a major complication during pregnancy. 8.2 per cent of mothers of boys between the ages of 4-6 years suffered a severe pregnancy problem, whereas 5.7 per cent of these mothers did not. Mothers of 7-9-year-old boys who suffered a major complication during pregnancy were 14.1 per cent of the population; those who did not have a severe pregnancy issue made up 35.2 per cent of the population. While 3.8 per cent of the mothers did not have a severe pregnancy issue, 4.7 per cent of mothers of boys between the ages of 10 and 12 years.

The percentage of pregnant women who encountered serious complications were anaemia, high blood pressure, diabetes, excessive vomiting, abortion, epilepsy, hypothyroidism, hyperthyroidism, and other hormonal issues. The average per centage of mothers of a children between the ages of 4 – 12 years who experienced a significant anaemia-related complication was 37.5 per cent. The maximum percentage of hypertension

relation complications experienced by mothers of the Children between the ages of 4-12 years was 33.3 per cent. For mothers of the Children between the ages of 4 to 12 years, the maximum percentage of diabetes- complications was 50 per cent. The maximum number of problems caused by bleeding among mothers of the Children between the ages of 4 and 12 was 50 per cent. The maximum number of problems caused by excessive vomiting experienced by mothers of children aged between 4-12 was 35.2 per cent. Mothers of children between the ages of 4 and 12 reported the highest per centage of difficulties related to abortion, which was 37.5 per cent. Mothers of children reported the maximum per centage of difficulties related to epilepsy between the ages of 4 - 12 (33.3 per cent). Mothers of children between the ages of 4 to 12 years suffered the highest per centage of complications related to hypothyroidism (30.7 per cent), the maximum 50 per cent of mothers suffered from hyperthyroidism, the maximum 50 per cent of mothers suffered from other hormonal problems, and 34.6 per cent of maximum mothers were suffered from other problems.

According to Grinzenko *et al.,* (2020) maternal stress is associated with behavioural disturbances in children exposed to moderate and severe stress during pregnancy.

Mode of delivery

For mothers with children between the ages of 4 and 12 years, the maximum per centage of standard deliveries was 33.9 per cent, while the maximum C-sections was 27.3 per cent. For the mother with a children between the age of 4-12, the maximum per centage of having a preterm baby was 32.9 per cent, and the maximum percentage of the full-term baby was 36.5 per cent. Birth by CS is associated with a small increased risk of ADHD. However, among siblings the association only remained for emergency CS. If this were a causal effect by CS, the association would be expected to persist for both types of CS, suggesting the observed association is due to confounding.

Duration of breastfeeding

The maximum per centage of children mothers aged between 4 -12 who breastfed their children was 31 per cent, while the maximum per centage of those who did not was 40 per cent. The maximum per centage of mothers who breastfed their children for four months between the ages of 4 and 12 was 34.5 per cent (7-9 years of boys). For six months, 28.5 per cent (7-9 years of boys). For one year, 30.7 per cent (7-9 years of boys) and 50 per cent are not breastfed. For four-six months, most of the mothers who just fed their babies were 34.8

and 28.5 (4-6 and 7-9 years). The same was noted in the study by Rouw *et al*. (2018), which found that breastfed children had a significantly reduced incidence of gastroenteritis, otitis media, and lower respiratory tract infections than non-breastfed children. Furthermore, breastfeeding significantly reduces the likelihood of sudden infant death syndrome. According to (Ostovic *et al*., 2020), moms who resided in urban slums did not frequently practice exclusive breastfeeding.

TABLE VI

Health status of the mother

Health Status Parameters	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Major Health Problems												
CVD (Heart issues)	2	28.5	0	-	3	42.8	0	-	2	28.5	0	-
Diabetes	4	33.3	0	-	5	41.6	0	-	2	16.6	1	8.3
Respiratory issues	1	50.0	0	-	1	50.0	0	-	0	-	0	-
CKD /AKD (kidney Problems)	8	25.0	2	6.2	12	37.5	3	9.3	5	15.6	2	6.3
BP	8	23.5	2	5.8	13	38.2	3	8.8	6	17.6	2	5.8
Nervous Disorder	8	25.0	1	3.1	13	40.6	2	6.2	6	18.7	2	6.3
None of the above	5	27.7	1	5.5	6	33.3	2	11.1	3	16.6	1	5.5
Personality												
Very Calm	17	27.4	3	4.8	23	37.1	5	8.5	11	17.7	3	4.8
Stable	16	25.4	5	7.9	22	34.9	7	11.1	11	17.4	2	3.5
Aggressive	3	25.0	1	8.3	4	33.3	1	8.3	2	16.6	1	8.3

Supplements during pregnancy

Mothers of children between the ages of 4 to 12 years used the highest per centage of special supplements while pregnant, which was 29.6 per cent. (7-9 years of boys). Moreover, among the boys aged 7-9, a maximum of 34.4 per cent do not take any extra supplements. The same was found in the study by Soundarer *et al.,* (2021) indicated that early-pregnancy vitamin B12 deficiency has specificity for various diseases but not for offspring ADHD.

Major health problems of the mother

As per Table VI, the mother of the children had the highest rate of CVD health issues at 42.8 per cent. (7–9-year-old boys), mothers who had diabetes at the highest percentage of 41.6 per cent (7-9 years of boys), Mothers highest percentages for respiratory problems, kidney/CKD problems, high blood pressure, and nervous disorders were 50 per cent, 37.5 per

cent, 38.2 per cent, and 40.63 per cent, (7-9 years of boys) respectively. The majority of mothers, 33.3 per cent (boys aged 7-9), are unaffected by any severe health problems.

Families of children with ADHD had lower socioeconomic status, and both mothers and fathers of the same families reported higher scores for depression and familial and parental factors contributed to the increased risk of belonging to the clinical group, specifically both mothers and fathers depressive symptoms (Mazzeschi *et al*., 2021) .

Personality of the mothers

Table VI shows that a mothers impact is felt physically and intellectually. Support from mothers also has an impact on brain growth. From the above table VI, the mothers of the children described them as being, at most 37.1 per cent (7-9 years of boys), extremely calm, a Maximum of 36.5 per cent (7-9 years of boys) of them were regarded as aggressive people, while 33.3 per cent (7-9 years of boys) of them were described as stable people. This was on par with a study by Miguel *et al.*, (2019) were Early maternal children hood enhanced hippocampus volume development is correlated with support; this development trajectory is linked to subsequent emotional disorders and spans school age and early adolescence.

4.1.4. HEALTH PROFILE OF THE CHILD

A children's life history, current role, and special requirements are all summarized in detail in this profile section.

TABLE VII

Blood groups of the child

Blood Groups	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
O+	12	26.6	5	11.1	13	28.8	5	11.1	8	17.7	2	4.4
O-	0	-	0	-	2	66.6	0	-	1	33.3	0	-
B+	3	25.0	1	8.3	4	33.3	1	8.3	2	16.6	1	8.3
A+	4	28.5	1	7.1	5	35.7	1	7.1	3	21.4	0	-
B-	2	18.5	0	-	5	45.4	0	0.0	2	18.1	2	18.5
AB+	12	23.5	5	9.6	16	30.7	8	15.4	8	15.3	3	5.7

Blood groups of the child

From Table VII, the children's blood groups were as follows: O+ children's were boys aged 7-9 years, with a maximum per centage of 28.8. O- children were boys aged 7-9 years with a maximum per centage of 66.6. The maximum per centages for B+, A+, B-, and AB+ were 33.3, 35.7, 45.4, and 30.7, respectively. Almost the children with ADHD was found to be distributed in all blood group in the current study. Significant differences in the allele of ABO between the 96 children with ADHD and within-family controls was observed. The frequencies of O and A genes were higher than that of B gene in ADHD children. ABO blood type gene and ADHD in children correlated the risk of ADHD increased in the presence of alleles O and A, and reduced with allele B. (Pisk *et al.*, 2019)

TABLE VIII

Signs and Symptoms of children with ADHD

Signs and Symptoms of children with ADHD	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Allergic symptoms												
Daytime in attention	17	22.6	6	8.0	26	34.6	10	13.3	12	16.0	4	5.3
Rhinitis	8	25.0	2	6.2	12	37.5	3	9.3	6	18.7	1	3.1
Cold	1	25.0	0	-	2	50.0	0	-	1	25.0	0	-
Irritability	1	25.0	0	-	2	50.0	0	-	1	25.0	0	-
Hyperactivity	0	-	0	-	1	100.0	0	-	0	-	0	-
Nil	7	33.3	1	4.7	7	33.3	1	4.7	5	23.8	0	-
Sensitive to certain smells												
Hair sprays	3	33.3	0	-	4	44.4	0	-	1	11.1	1	11.1
Detergents	16	21.3	7	9.3	25	33.3	11	14.6	11	14.6	5	6.6
Perfumes	2	33.3	0	-	3	50.0	0	-	1	16.6	0	-
Noises	10	21.7	6	13.0	12	26.5	7	15.2	7	15.2	4	8.7
None of the above	0	-	0	-	1	100.0	0	-	0	-	0	-
Signs of the child when hungry												
Having headaches	2	33.3	0	-	3	50.0	0	-	1	16.6	0	-
Dizzy	4	25.0	1	6.2	5	31.2	2	12.5	3	18.7	1	6.2
Moody	0	-	0	-	2	66.6	0	-	1	33.3	0	-
Irritable	19	25.6	7	9.4	23	31.5	9	12.5	13	17.5	3	4.0
Shaky	3	30.0	0	-	4	40.0	0	-	1	10.0	2	20.0
Tired	6	27.2	2	9.0	7	31.8	2	9.0	4	18.1	1	4.5

Signs and Symptoms of children with ADHD	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Hyperactivity	1	33.3	0	-	1	33.3	0	-	0	-	1	33.3
Normal	1	33.3	0	-	2	66.6	0	-	0	-	0	-
Difficulty in sleeping												
Yes	19	24.3	7	8.9	26	33.3	9	11.5	13	16.6	4	5.1
No	13	22.0	7	11.8	17	28.8	9	15.2	9	15.2	4	6.7
Health problems of the child												
Insomnia	1	16.7	0	-	3	50.0	0	-	2	33.3	0	-
Epilepsy	6	22.2	5	18.5	6	22.2	4	14.8	3	11.1	3	11
Seixures	7	19.4	4	11.1	10	27.8	6	16.7	7	19.4	2	6
Asthma	1	14.3	0	-	3	42.9	0	-	2	28.6	1	14
Wheezing	0	-	0	-	1	100.0	0	-	0	-	0	-
Hypoglycaemic	0	-	0	-	1	100.0	0	-	0	-	0	-
Lazy eye	0	-	0	-	1	100.0	0	-	0	-	0	-
Hearing Loss	2	15.4	0	-	5	38.5	1	7.7	3	23.1	2	15
None of the Above	10	22.2	5	11.1	14	31.1	7	15.6	7	15.6	2	4
Major injuries of the child												
Head	12	25.5	4	8.5	16	34.0	5	10.6	8	17.0	2	4
Neck	7	24.1	2	6.9	10	34.5	4	13.8	5	17.2	1	3
Sprains of Joints	1	14.3	0	-	3	42.9	0	-	2	28.6	1	14
Upper / Lower Limb Fractures	1	16.7	0	-	3	50.0	0	-	1	16.7	1	17
None of the Above	10	20.8	5	10.4	16	33.3	8	16.7	7	14.6	2	4
Surgeries in the past												
Yes	7	21.2	3	9.0	11	33.3	5	15.1	5	15.1	2	6.0
No	23	22.1	12	11.5	30	28.8	16	15.3	15	14.4	8	7.6

Symptoms of allergy

Children with ADHD have been impacted by allergy symptoms: daytime inattention, rhinitis, cold, irritability, and hyperactivity. Common comorbidities or biochemical risk factors for attention deficit hyperactivity disorder include allergic illness, anaemia, inflammation, and changes in neurotransmitters (ADHD). The highest percentage of the children with a symptom of daytime in attention was 34.6 per cent, with 37.5 per cent of them having the symptoms of rhinitis, 50 per cent having cold, 50 per cent having irritability, and 100 per cent of them having hyperactivity. The highest of 33.3 per cent of children between

the age of 4-12 years had no symptoms of allergy. Most of the children were found to be having some kind of allergies and symptoms in the current study which was similar to that of the result of Chen *et al.,* (2019), Allergic rhinitis and ADHD affect children of similar ages and Symptoms of allergic rhinitis may lead to daytime inattention, irritability and hyperactivity, which is commonly observed in ADHD children. Almost all the children with ADHD were found to be being sensitive towards certain things in the current study.

Sensitive to specific smells and noise

Children with ADHD were sensitive to specific smells, including perfume (50 per cent), hairspray (44.4 per cent), detergents (33.3 per cent), and noises (26.5 per cent). The per centage of children not sensitive to particular smells was frequency 1 with 100 per cent of them. The findings related to ADHD children's attitude when he or she becomes hungry showed that their nature's gets changed. Hyperactivity/inattention during late childhood indirectly predicted binge eating during mid-adolescence due to late-childhood overeating and early-adolescent strong desire for food. (Sonneville , 2015)

Signs of the child when hungry

The maximum age group affected had headaches when he/she becomes hungry was 7-9 years old boys at 50 per cent, the highest percentage of children had dizzy when he/she becomes hungry was 7–9-year-old boys at 31.2 per cent, 66.6 per cent of them had moody when he/she becomes hungry, 31.0 per cent, 40 per cent, 31.8 per cent and 33.3 per cent of the children had irritable, shaky, tired and hyperactive when he/she becomes hungry. When they feel hungry, 66.6 per cent of children’s usual behaviour.

Difficulty in sleeping

Thirty-three per cent of children were had difficulty in going to bed, and 28.8 per cent of children who do not have difficulty in going to bed. (Tso *et al.,* 2022) found that too much screen time before bed or a lack of time set out in the night-time routine for relaxing, peaceful activities. Emotional problems, such as stress, anxiety in children, depression in children, anxiety in adolescents, or depression in adolescents. Majority of the children with ADHD in the current study was found to be having difficulty in going to bed, the same was reported by a study made by Weiss (2015) where the author found that at the group level, there is a bidirectional impact of sleep and ADHD on each other and that both sleep and ADHD impairments may stem from common pathways.

Health problems of the child

The health problem of the child in the study population was examined and the findings are been given in table above. The result was observed on the basis of insomnia, epilepsy, seizures, asthma, wheezing, hypoglycaemia, lazy eye, hearing loss and none of the above. In the age category of 4 to 6 years about 22.2 per cent of boys were suffering with epilepsy whereas in case of girls the same problem is been faced among 18.5 per cent. for the age category 7 to 9 years 50 per cent of boys were suffering with insomnia and 43 per cent of girls were affected with asthma and for the age category 10 to 14 years 16.7 per cent of boys were suffering from seizures and 28.6 per cent of girls were suffering from asthma. Thus from the study it can be identified that among the selected respondents majority of them were suffering from asthma and insomnia.

Major Injuries of the child

The major injuries of the children with ADHD were seen in the study on the criteria neck, sprains of joint, upper/lower limb fracture and none of the above. in case the age 4 to 6 years about 24 per cent of boys had injury in the neck where 10.4 per cent girls did not face any injury whereas for the age of 7 to 9 years of boys 34.5 per cent had injury in their neck and 16.7 per cent girls did not get any injury and for the age 10 to 14 years 16.7 per cent of boys did not get any injury whereas for girls about 17.2 per cent stated that they got injury in neck. Thus, from the study it was identified that among the selected sample respondents the most affected injury was in their neck. It was shown that the majority of children with ADHD have some sort of health issue. According to (Pan *et al.,* 2021), people with ADHD are more likely to experience neurological issues, thus clinical therapy for this population should include a complete neurological examination. Furthermore, digestive system issues might be regarded as a non-shared environmental component for the behavioral phenotypes of ADHD. It supports, at least for a subgroup of people with specific genetic propensity, the idea that the gut-brain axis may play a role in the underlying causes of ADHD symptoms.

Surgeries in the past

Up to 33.3 per cent of children have had surgery in the past, while up to 28.8 per cent have never had any surgeries.

Diagnosis of ADHD and Intervention

TABLE IX

Diagnosis of ADHD and Intervention

Constructs	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Year of Diagnosis												
2 years	16	24.24	4	6.06	24	36.36	7	10.61	11	16.67	4	6.06
3 years	8	24.24	3	9.09	11	33.33	4	12.12	5	15.15	2	6.06
5 years	7	26.92	2	7.69	8	30.77	2	7.69	5	19.23	2	7.69
6 years	3	25.00	0	0.00	5	41.67	0	0.00	3	25.00	1	8.33
Comorbid conditions diagnosed along with ADHD												
Autism	8	23.5	2	5.9	13	38.2	4	11.8	6	17.7	1	3
Oppositional	2	20.0	0	0.0	4	40.0	0	0.0	2	20.0	2	20
Conduct disorder	2	20.0	1	10.0	4	40.0	1	10.0	2	20.0	0	0
Learning disability	9	29.0	1	3.2	12	38.7	2	6.5	6	19.4	1	3
Tourette's syndrome	2	25.0	0	0.0	3	37.5	0	0.0	2	25.0	1	13
Anxiety	1	10.0	1	0.0	5	50.0	2	20.0	1	10.0	0	0
None of the Above	10	29.4	2	5.9	11	32.4	3	8.8	7	20.6	1	3
Other intervention for children with ADHD symptoms												
Special education	10	31.3	2	6.3	9	28.1	3	9.4	7	21.9	1	3.1
Occupational therapy	9	25.0	3	8.3	13	36.1	4	11.1	6	16.7	1	2.8
Physiotherapy	0	0.0	0	0.0	1	33.3	0	0.0	1	33.3	1	33.3
Cognitive – Behavioural therapy	11	22.0	4	8.0	16	32.0	7	14.0	9	18.0	3	6.0
Nutrition intervention	1	11.1	2	22.2	2	22.2	1	11.1	1	11.1	2	22.2
yoga	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
None of the Above	1	16.7	0	0.0	2	33.3	1	16.7	1	16.7	1	16.7

Year of Diagnosis

A maximum of 36.3 per cent of children between the ages of 7-9 years were diagnosed with attention-deficit/hyperactivity disorder within two years of age. 33.3 per cent of the children between the ages of 7-9 years were recognized with attention deficit/hyperactivity disorder within three years of age 30.7 per cent of the children were recognized within 5 years of age and 41.6 per cent were recognized within 6 years of age. Majority of the children with ADHD in the selected study, showed that most of their identification to be affected with ADHD was from the year of 2 to 6 years of age. This was

consistent with (Anchari *et al.,* 2019), which stated that "ADHD symptoms begin before the age of 12, and in some children, they become apparent as early as three years of age." Mild, moderate, or severe symptoms of ADHD may persist until adulthood.

Comorbid conditions Diagnosed along with ADHD.

The co morbidity diagnosed along with ADHD among the selected respondents were identified with consideration to autism, oppositional, conduct disorder, learning disability, Tourette's syndrome, anxiety and none of the above. From the study, it was identified that among the selected respondents about 29 per cent of boys suffered with learning disability along with their ADHD and for girls they were affected with conduct disorder with their ADHD whereas for the age category 7 to 9 years about 80 per cent of the respondents were affected with oppositional and conduct disorder among boys and for girls 10 per cent stated that they suffered from autism along with their ADHD. In case of the age category, 10 to 14 years 20 per cent of boys were affected with anxiety and 40 per cent of girls were affected with oppositional and conduct disorder. Thus from the study it was identified that among the sample respondents, majority of them were affected with oppositional and conduct disorder along with their ADHD. Kumar & Kelly (2017) described that, at some point in their lives, at least one other mental disease was identified in about 80 per cent of those with ADHD. Autism, Oppositional, conduct disorder, learning disability, Tourette's syndrome, and anxiety are the most typical comorbidities of ADHD.

Other intervention for children with ADHD symptoms:

The intervention method adopted by the children with ADHD was observed in special education, occupational therapy, physiotherapy, cognitive behavioural therapy, nutrition intervention, yoga and none of the above. for the age category 4 to 6 years about 31.3 per cent of boys undergo special education. In contrast, in case of girls about 22.2 per cent underwent nutrition intervention. In contrast, for the age of 7 to 9 years 36.1 per cent of boys undergo occupational therapy and 16.7 per cent of girls did not undergo any intervention. For the age category 10 to 14 years, 16.7 per cent of boys did not undergo any intervention and for girls about 21.9 per cent under went special education for their intervention. Thus, the study identified that most of the selected respondents experienced special education and occupational therapy for their intervention. Majority of the children in the selected study was found to be diagnosed with some other disease along with their ADHD problem. This was noted in the (Radmanovic *et al.,* 2020) study, which indicated that children with vision issues

had a higher frequency of ADHD in a large cross-sectional survey of 75,171 children without any intellectual impairment. In comparison to children without visual issues, those who had ADHD were more likely to have been diagnosed. Additionally, children with visual issues were more likely to have ever had an ADHD diagnosis.

An effective behavioural intervention can help children with ADHD manage their behaviour and reduce their symptoms. These results persisted for at least a year and it offers a viable strategy for enhancing treatment effectiveness with pre-schoolers who have ADHD symptoms.

4.1.5. Relationship between ADHD Symptoms with demographic variables

The relationship between the dependent (ADHD Symptoms) and independent variable (demographic variables like Income, Birth order of the child, Blood relation marriage, personality of father and mother, blood group of the child and mode of delivery) among boys and girls in the age group of 4 – 6 years, 7 – 9 years and 10 – 12 years were found through regression analysis and the results are presented in Table X

TABLE - X

Relationship between ADHD Symptoms with demographic variables

Variables	Boys				Girls			
	R	R^2	T-Value	Sig.	R	R^2	T-Value	Sig.
4 – 6 years of Age								
Income	.802	.712	3.856	.036*	.715	.612	3.256	.068^{NS}
Birth Order			5.623	.002**			2.019	044*
Blood Relation Marriage			5.999	.000**			3.123	.036*
Personality of Father			3.125	.047*			4.213	.028*
Personality of Mother			4.965	.007*			4.263	.018*
Blood Group of Child			5.123	.006*			2.896	.072^{NS}
Mode of Delivery			5.965	.002**			2.986	.082^{NS}
7 – 9 years of Age								
Income	.899	.745		.000**	.711	.603		.046*
Birth Order				.001**				.099^{NS}
Blood Relation Marriage				.002**				.048*
Personality of Father				.000**				.033*
Personality of Mother				.000**				.123^{NS}

Blood Group of Child				.002**				.098^{NS}
Mode of Delivery				.000**				.049*
10 – 12 years of Age								
Income				.043*				.096^{NS}
Birth Order				.036*				.012*
Blood Relation Marriage				.003**				.032*
Personality of Father	.789	.601		.000**	.723	.603		.003**
Personality of Mother				.002**				.019*
Blood Group of Child				.007*				.039*
Mode of Delivery				.010*				.123^{NS}

*Significant at 1%; Significant at 5 %; NS – Not significant;

The R value in the table represents correlation and R square value represents degree of determination. The degree of determination shows the extent how their behavioural pattern were influenced with the demographic variable.

From R value it is clear that there is a relationship between the dependent and independent variable that the behavioural pattern changes according to the demographic variables. The R-value and R^2 value for boys were 0.802 (0.712) and for girls it is 0.715 (0.612). It shows that 71.2 % of behavioural changes occur through demographic variables in boys and 612 % of the changes occur in girls for children in the age group of 4 – 6 years. For children in the age group of 7 – 9 years, the R – value and R2 value were 0.899 (0.745) for boys and 0.711 (0.603) for girls. It shows that 74.5% and 60.3% of behavioural changes occur through demographic variables for boys and girls. For children in the age group of 10 – 12 years, R value and R2 value were 0.789 (0.601) for boys and 0.723 (0.603) for girls. It explains that 60.1% and 60.3% of behavioural changes occur due to the demographic variables. Thus, the Null hypothesis is rejected as the relationship exists between dependent and independent variables.

The relationship between the behavioural pattern with individual variables shows through their t-value and its significance. The relationship between variables among boys in the age group of 4 – 6 years shows that there is a perfect relationship between birth order of the child, marrying with blood relatives, the mode of delivery and behavioural symptoms of children at 1% level as their p-value 0.002, 0.000 and 0.002. Personality of the father and mother, Blood group of the child and income of the family were also related to the

behavioural pattern of the child at 5% level as their p-value were 0.007, 0.006, 0.036 and 0.047. Thus, the result shows noted independent variables had impact on the behavioural pattern of the child. Among girls in the age group of 4 – 6 years shows that Birth order, blood relation marriage, personality of father and mother related with the behavioural pattern at 5 % level as their p-value were 0.044, 0.036, 0.028 and 0.018. Family income, blood group of the child and mode of delivery do not have relationship with behavioural pattern as there is no statistical significant between these variables.

The relationship between variables among boys in the age group of 7 – 9 years shows that there is a perfect relationship between family income, order of the child, blood relation marriage, personality of father and mother, blood group of child and mode of delivery and behavioural symptoms of children at 1% level as their p-value 0.000, 0.001, 0.002, 0.000, 0.000, 0.002 and 0.000 and among girls income, blood relation marriage, personality of father and mode of delivery related with the behavioural pattern at 5 % level as their p-value were 0.046, 0.048, 0.033 and 0.049. Birth order, personality of mother and blood group of the child do not have relationship with behavioural pattern as there is no statistically significant between these variables.

The relationship between variables among boys in the age group of 10 – 12 years shows that there is a relationship between blood relation marriage, personality of father and mother and behavioural symptoms of children at 1% level as their p-value 0.003, 0.000 and 0.002. Family income, order of the child, blood group and mode of delivery were also related to the behavioural pattern of the child at 5% level as their p-value were 0.043, 0.036, 0.007 and 0.010 and among girls except income and mode of delivery other variables such as birth order, blood relation marriage, personality of father and mother and blood group of child were related with the behavioural pattern at 1 % and 5 % level as their p-value were < 0.05.

Thus, from the regression analysis it is clear that the demographic variables like family income, birth order of the child, marrying within blood relation, personality of father and mother, blood group of the child and mode of delivery have impact of the behavioural pattern of ADHD children. The relationship exist mainly among boys in the age group of 7 - 9 years. According to El-Deen ,2021, the study stated that mothers of children with ADHD symptoms had significantly lower scores of over-protections parenting style than the fathers; the current study showed a significantly higher level of total parenting scores and warmth/support in mild ADHD cases than in moderate and severe ones; and there is a

significantly higher level of the mothers' positive parenting style toward children with ADHD. Parents from high social classes who have advanced degrees and are employed professionally as well as working mothers from rural areas have much more favourable parenting approaches to children with ADHD symptoms. The warmth/support of a mother and IQ are positively correlated.

4.1.6. Clinical Symptoms of the Children

From table XI, the maximum percentage of Loss of appetite (33.33 per cent), Muscle wasting/Apathy/Irritability (28.13 per cent), Hair changes- Loss of lustre/ discoloured/ Dandruff (36.36 per cent), Skin changes dry and rough /Hyperkeratosis (50 per cent), Eyes-pale/dull (33.33 per cent), Bleeding gums (100 per cent), Night blindness/Bitot"s spots/Conjunctival xerosis (33.33 per cent) of boys between the ages of 7-9 years having significant clinical symptoms. (O'Malley *et al*., 2021) demonstrated that the evidence supporting clinical assessment in children and adolescents is growing, and it is unquestionably necessary to learn competent clinical skills integrated into the foundational children health, teaching and assessment

TABLE XI

Clinical Symptoms of the Children

Clinical Symptoms	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Loss of appetite	1	33.3	0	-	1	33.3	0	-	0	-	1	33.3
Muscle wasting/Apathy/Irritability	7	21.8	4	12.5	9	28.1	5	15.6	5	15.6	2	6.2
Hair changes- loss of luster/discoloured/Dandruff	3	27.2	0	-	4	36.3	1	9.0	2	18.1	1	9.0
Skin changes dry and rough /Hyperkeratosis	0	-	0	-	1	50	0	-	1	50	0	-
Eyes-pale/dull	6	25	2	8.3	8	33.3	3	12.5	4	16.6	1	4.1
Angular stomatitis	0	-	0	-	0	-	0	-	0	-	0	-
Bleeding gums	0	-	0	-	1	100.0	0	-	0	-	0	-
Night blindness/Bitot‟ s spots/Conjunctival xerosis	4	22.2	1	5.5	6	33.3	2	11.1	3	16.6	2	11.1

Most of the children in the study has undergone clinical examination and the findings were similar to the study of Buntle *et.al*., 2013 where participants were referred preschool children with externalizing behavioural problems (N = 193; 83 per cent male) and typically developing children (N = 58; 71 per cent male). In view of the clinical validity study each children was given a diagnosis of either DBD (N = 40), or ADHD (N = 54) or comorbid (DBD + ADHD; N = 66) based on best-estimate diagnosis. The DB-DOS demonstrated good interrater and test-retest reliability for DBD and ADHD symptom scores. Confirmatory factor analysis demonstrated an excellent fit of the DB-DOS multidomain model of DBD symptom scores and a satisfactory fit of ADHD symptom scores. The DB-DOS demonstrated good convergent validity, moderate divergent validity, and good clinical validity on a diagnostic group level for DBD and ADHD symptom scores. The Receiver Operating Characteristic curve analysis revealed that for DBD the sensitivity and specificity are moderate and for ADHD good to excellent. The presumption of a diagnosis were based on information from parents, teachers, and cognitive assessment was supported by the DB-DOS in 60 per cent for DBD and 75 per cent for ADHD. The DB-DOS can be used to help support a presumption of a DBD and/or ADHD diagnosis in preschool children.

4.1.7. Physical activity pattern of the children

TABLE XII

Physical activity pattern of the Children

Constructs	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Children participate in any form of physical activity												
Yes	24	20.6	13	11.2	35	30.1	20	17.2	16	13.7	8	6.9
No	5	23.8	2	9.5	7	33.3	3	14.2	3	14.2	1	4.7
Forms of Physical Activity												
Focus & Concentration skills Therapy	3	27.2	1	9.0	4	36.3	1	9.0	2	18.1	0	-
Watching Tv	5	27.7	1	5.5	7	38.8	1	5.5	3	16.6	1	5.5
Others	0	-	0	-	3	50.0	0	-	2	33.3	1	16.6
Computer games /Mobile	3	18.7	1	6.2	5	31.2	2	12.5	3	18.7	2	12.5
Indoor games	11	25.5	3	6.9	15	34.8	5	11.6	7	16.2	2	4.6

Outdoor games	7	22.5	3	9.6	9	29.0	4	12.9	5	16.1	3	9.6
Dancing	2	28.5	0	-	3	42.8	0	-	1	14.2	1	14.2
Music	2	40.0	0	-	2	40.0	0	-	1	20	0	-
Duration												
6-7 days/week	5	33.3	1	6.6	5	33.3	1	6.6	3	20	0	-
3 days / week	19	23.4	8	9.8	25	30.8	11	13.5	13	16	5	6.1
1-2 days /week	8	19.5	4	9.7	12	29.2	7	17	6	14.6	4	9.7

Form of physical activity

From Table XII, there is a maximum of 30.1 per cent of the boys between the ages of 7-9 years and 17.2 per cent of the girls between the ages of 7-9 years have participated in physical activity, and 33.3 per cent, 14.2 per cent of the boys and girls between the ages of 7-9 have not participated in any form of physical activity.

The maximum percentage of boys between the ages of 7-9 years have participated in Focus & Concentration skills Therapy (36.3 per cent), and girls between the ages of 7-9 years have participated in Focus & Concentration skills Therapy with (9 per cent), boys and girls between the year of 7-9 having a maximum percentage of Watching Tv-38.8 per cent and 5.56 per cent, Others-50 per cent of boys between the ages of 7-9 and 16.6 per cent of girls between the ages of 10-12 years, Computer games/mobile- maximum of 31.2 per cent and 12.5 per cent of the boys and girls between the ages of 7-9 years. Indoor games- maximum of 34.8 and 11.6 per cent, outdoor games- maximum of 29 per cent and 12.9 per cent of the boys and girls between the ages of 7-9 years, dancing- maximum of 42.8 per cent of the boys between the ages of 7-9 years, and a maximum of 14.2 per cent of the girls between the ages of 10-12 years and Music- maximum of 40 per cent of the boy's ages between 4-9 years have participates the activities. Thus, the findings showed that most children in the study had taken up some kind of physical activity in focus and concentration therapy.

Duration of physical activity

From above Table XII it is evident that the amount of time that children can spend participating in an activity at a maximum, 33.3 per cent, and 6.6 per cent of the boys and girls between the ages of 4-6 years have spent 6-7 days/ week participating in an activity. 30.8 per cent and 13.5 per cent of the boys and the girls between the ages of 7-9 years have spent three days/week participating in an activity. 29.2 per cent and 17 per cent of the

boys and the girls between the ages of 7-9 years have spent 1-2 days/week participating in an activity. (Chodkiewicz & Boyle, 2020) Mentioned that regular exercise helps enhance children's cardiorespiratory fitness, strengthen their bones and muscles, manage their weight, lessen their anxiety and sadness, and lower their chance of contracting diseases like heart disease. The findings showed that the selected children with ADHD were engaged in physical activity for about 6 to 7 days in a week while compared to other duration of the study

4.1.8. DIETARY PATTERN OF THE CHILDREN

TABLE XIII

Dietary Pattern of the Children

Dietary Pattern	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Type of Diet												
Vegetarian	11	23.4	6	12.7	13	27.6	6	12.7	8	17.0	3	6.3
Non-vegetarian	23	28.0	7	8.5	25	30.4	8	9.7	15	18.2	4	4.8
Ovo-vegetarian	3	37.5	0	-	3	37.5	0	-	1	12.5	1	12.5
Meal consumption per day												
2 meals	3	33.3	0	-	4	44.4	0	-	1	11.1	1	11.1
3meals	19	25	8	10.5	22	28.9	10	13.1	13	17.1	4	5.2
4meals	12	23	4	7.6	18	34.6	7	13.4	8	15.3	3	5.7
Number of snacks												
One	12	23.0	4	7.6	19	36.5	6	11.5	8	15.3	3	5.7
Two	16	23.5	5	7.3	24	35.2	8	11.7	11	16.1	4	5.8
Three	3	27.2	1	9	4	36.3	1	9	2	18.1	0	-
No Snacks	1	16.6	0	-	3	50	0	-	2	33.3	0	-
Preference of meals												
Meals	12	27.2	3	6.8	15	34.0	4	9.0	8	18.1	2	4.5
Snacks	22	27.8	6	7.5	26	32.9	6	7.5	15	18.9	4	5.0
Tiffin	3	21.4	1	7.1	5	35.7	2	14.2	2	14.2	1	7.1
Skipping of meals												
Yes	24	21.6	12	10.8	33	29.7	17	15.3	16	14.4	9	8.1
No	6	23.0	2	7.6	8	30.7	4	15.3	4	15.3	2	7.6
Meal Skipped												
Breakfast	6	26	1	4.3	9	39.1	2	8.7	4	17.3	1	4.3

Dietary Pattern	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
Lunch	4	25	1	6.2	5	31.2	2	12.5	3	18.7	1	6.2
Dinner	17	23.6	5	6.9	27	37.5	8	11.1	12	16.6	3	4.1
Foods avoided by children												
wheat	19	24.4	9	11.5	21	26.9	10	12.8	13	16.7	6	8
milk	7	26.9	2	7.7	8	30.8	3	11.5	5	19.2	1	4
soya	2	28.6	0	-	3	42.9	0	-	2	28.6	0	-
corns	0	-	0	-	1	50.0	0	-	1	50.0	0	-
chocolate	1	33.3	0	-	2	66.7	0	-	0	-	0	-
None of the Above	5	23.8	2	9.5	7	33.3	3	14.3	3	14.3	1	5
Specific likes of children												
Sweets	8	24.2	3	9	10	30.3	4	12.1	5	15.1	3	9
Chips	5	25	1	5	7	35	2	10	3	15	2	10
Briyani	2	25	0	-	3	37.5	0	-	2	25	1	12.5
Burger	2	40	0	-	2	40	0	-	1	20	0	-
Pizza	2	40	0	-	2	40	0	-	1	20	0	-
Chocolate	17	25.7	4	6.5	24	36.3	7	10.6	11	16.6	3	4.5
Specific dislikes of children												
Rasam & Curd rice	0	-	0	-	2	66.6	0	-	1	33.3	0	-
Leafy vegetables	14	20.2	8	11.5	20	28.9	12	17.3	10	14.4	5	7.2
Chapathi	2	28.5	0	-	3	42.8	0	-	2	28.5	0	-
Rice variety	14	24.1	5	8.6	19	32.7	7	12.5	10	17.2	3	5.1
Awareness of caregivers on special diets												
Sugar free /low sugar diet	20	27	7	9.4	22	29.7	8	10.8	13	17.5	4	5.4
Feingold diet	5	22.7	2	9.5	8	36.3	3	13.6	4	18.1	0	-
Casein free diet	1	25	0	-	2	50	0	-	1	25	0	-
Gluten free diet	9	29	2	6.4	10	32.2	3	9.6	6	19.3	1	3.2
None of the above	1	16.6	0	-	3	50	0	-	2	33.3	0	-
Restricted diet												
Low calorie	1	14.3	1	14.3	2	28.6	1	14.3	1	14.3	1	14.3
Low Cholesterol	1	50.0	0	-	1	50.0	0	-	0	-	0	-
Low fats	1	20.0	1	20.0	2	40.0	0	0.0	1	20.0	0	-
Low protein	1	33.3	0	-	1	33.3	1	33.3	0	0.0	0	-
High fiber	1	25.0	0	-	1	25.0	1	25.0	1	25.0	0	-
Low Sugar	1	33.3	0	-	1	33.3	0	0.0	1	33.3	0	-

Dietary Pattern	4 – 6 years				7 – 9 years				10 – 12 years			
	Boys		Girls		Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%	N	%	N	%
None of the above	27	23.9	8	7.1	42	37.2	13	11.5	18	15.9	5	4.4
Type of Snacks consumed												
Fruits, fruit juice, milk shakes, Burger, Pizza	2	16.6	0	-	5	41.6	1	8.33	2	16.6	2	16.6
Biscuits, crackers, bread, stick bread	20	22.9	10	11.5	25	28.7	13	14.9	13	14.9	6	6.9
Hot chips, popcorn, peanuts, chips, soft drinks	6	26.0	1	4.3	9	39.1	2	8.7	4	17.3	1	4.3
Sweets, chocolates, ice cream, cakes	4	26.6	1	6.6	5	33.3	1	6.6	3	20	1	6.6

Dietary patterns are the amount, variety, or mix of meals and beverages a person regularly consumes (Pfeiffer *et al*., 2017). The development of neurodegenerative disorders may be significantly influenced by dietary patterns as a whole rather than specific food components. People acquire a variety of components every day as part of a composite diet, in addition to consuming nutrients independently, which may account for this (Samadi *et al*., 2019).

Type of diet for Children

From the above Table XIII it is revealed that the maximum vegetarian percentages for boys and girls between the ages of 4 and 12 years are 27.7 per cent and 12.7 per cent, respectively. The maximum non-vegetarian percentage for boys and girls between the ages of 4-12 years is 30.4 per cent and 9.7 per cent. Maximum the ovo-vegetarian percentage of boys and girls between the ages of 4-12 is 37.5 per cent and 12.5 per cent. The study has found that among the children taken for the study majority of them are non-vegetarian. (Dallacker *et al*., 2018).It also reported that wealthy, healthy families regular family dinners while encouraging more frequent family meals to improve the family's nutritional health.

Meal consumption per day

The maximum two meals/day percentage of boys and girls between the ages of 4-12 years is 44.4 per cent and 11.1 per cent, respectively. The maximum three meals/day percentage of boys and girls between the ages of 4-12 years is 28.9 per cent and 13.1 per cent. The maximum of 4 meals/day percentage of boys and girls is between the ages of 4-12 years is 34.6 per cent and 13.4 per cent. In the study, majority of the respondents were found to be having either 3 meals or 4 meals in a day.

Number of snacks

Boys and girls between the ages of 4 and 12 years who eat the maximum per centage of one snack per day, two snacks per day, and three snacks per day are respectively 36.5 per cent and 11.5 per cent, 35.2 per cent and 11.7 per cent, and 36.3 per cent and 9 per cent. Fifty per cent and 33.3 per cent of boys and girls between the ages of 4-12 years do not eat snacks. From this it is understandable that most of the selected children were found to be consuming snacks often which is either 2 or three times in a day.

Preference for meal

Boys and girls between the ages of 4 and 12 years had a maximum preference for meals of 34 per cent and 9 per cent, respectively. Maximum preference for snacks of 32.9 per cent and 7.9 per cent, respectively. Maximum preference for tiffin of 35.7 per cent and 14.2 per cent, respectively. Most of the children in the study are found to be preferring either meal or snacks for their needs.

Skipping of meals

A maximum of 29.7 per cent and 15.3 per cent of the boys and girls between the ages of 4-12 years skipped their meals, and a maximum of 30.7 per cent and 15.3 per cent of boys and girls who do not skipped their meals. A maximum of 39.1 per cent of boys and 8.7 per cent of girls between the ages of 4-12 years skip their breakfast frequently, 34.2 per cent of boys and 12.5 per cent of girls skipped their lunch, and 37.5 per cent of boys and 11.1 per cent of girls skipped their dinner . It was found from the study that majority of the children prefer skipping their meal and without big difference another large group does not prefer to skipped their meals. According to Zipp & Eissin (2019), eating breakfast may help primary school pupils perform better on standardised cognition tests and they also recommended eating breakfast with a high intake of whole grains and low sugars, which positively affects elementary school student's academic performance and suggested that missing breakfast can impact children's academic performance and nutritional state.

Foods avoided by children

Food avoided by the children with ADHD in the current study was examined on basis of wheat, milk, soya, corn, chocolate and none of the above. For the age 4 to 6 years about 33.3 per cent of boys were found to be avoiding chocolate and 11.5 per cent of girls were avoiding wheat in their regular diet. Whereas for the age category 7 to 8 years about 50 per cent of the boys were found to be avoiding corns and 12.9 per cent of girls were avoiding

wheat in their diet and for the age category 10 to 12 years about 50 per cent of boys were avoiding corn in their diet and eight per cent of girls were found to be avoiding wheat in their diet. Thus from the study it was identified that among the selected respondents, majority of them were found to be avoiding corn and wheat.

A maximum of 27.59 per cent of children avoid foods, while a maximum of 33.33 per cent of children do not avoid any foods at all. (Nekitsing *et al*., 2018). The findings of the children avoid some kind of food in their diet showed that most of the children with ADHD was found to be avoiding some foods in their diet. This was on par with the findings of Essway *et al.,* 2020, a positive association between food approach and BMI, and a negative association between food avoidant and BMI z-scores was found. Similarly, there was a noteworthy positive relation between emotional overeating and BMI. Sixty-eight of children with ADHD symptoms were high emotional eaters, mainly inattentive and combined types. Others, mainly hyperactive type, were low-emotional eaters. Only ESS-C total score was confirmed as an independent factor for higher BMI risk.

Specific likes of Children

A maximum of 30.3 per cent, 35 per cent, 37.5 per cent, 40 per cent, 40 per cent, and 36.3 per cent of boys between the ages of 4-12 years had a specific like of sweets, chips, biriyani, burger, pizza, and chocolate. Girls between the ages of 4 and 12 years exhibited particular preferences for sweets, chips, biriyani, and chocolate in the maximum amounts of 12.1 per cent, 10 per cent, 12.5 per cent, 40 per cent, and 4.5 per cent.

Rasam & curd rice (66.6 per cent), leafy vegetables (28.9 per cent), chapati (42.8 per cent), and rice variety (32.7 per cent) are the items that boys between the ages of 4 and 12 years most frequently expressed a strong dislike. Girls between the ages of 4 and 12 years usually indicated a severe dislike for rasam & curd rice, leafy vegetables (17.3 per cent), chapati (0 per cent), and rice variety (12.0 per cent). This showed that the children had their own uniqness in choosing their food based on their likes.

Specific Dislikes of Children

Boys between the ages of 4 and 12 years who knew the most about sugar-free/low-sugar diets, the Feingold diet, casein-free diets, and gluten-free diets are at the highest levels of 29.7 per cent, 36.3 per cent, 50 per cent, and 32.2 per cent. Girls between the ages of 4 and 12 years have the highest levels of awareness regarding the Feingold diet, sugar-free/low-

sugar diets, casein-free diets, and gluten-free diets, at 13.6 per cent, 10.8 per cent, and 9.6 per cent, respectively as compared to liking a food majority of the children are found to be disliking food based on their preference.

Caregivers aware of the following diets

Between the ages of 4 and 12 years, 33.3 per cent of boys and 7.8 per cent of girls follow a particular diet, compared to 37.2 per cent and 9 per cent of boys and girls who did not follow a particular diet. And also, 33.3 per cent and 12.5 per cent of the boys and girls follow a restricted diet, compared to 37.1 per cent and 11.5 per cent of boys and girls who do not follow a restricted diet. Due to their age in the current study most of the respondents did not have much awareness on diet and following diet in their lifestyle.

Restricted diets

A restricted diet consists of low calories, low cholesterol, low fats, protein, high fibre, and low sugar. 83 per cent of the respondents do not follow the restricted diet pattern, and only 17% of the respondents follow the restricted diet. The children in the age group of 7 – 9 years were more in fowling diet and in all the age groups boys were the predominant in following the diet. the study was similar with the findings made by Marticiella *et al., (*2022) where the study involved 259 preschoolers aged 3 to 6 years old (57 with ADHD and 202 controls) and 475 elementary-school-age children, aged 10 to 12 years old (213 with ADHD and 262 controls) from Spain. ADHD was diagnosed in accordance with the Diagnostic and Statistical Manual of Mental Disorders (5th edition) from Schedule for Affective Disorders and Schizophrenia for School-Age Children interviews. Eating data were collected using a food consumption frequency questionnaire, and principal component analysis was carried out to analyze dietary patterns. Western-like, sweet, and healthy patterns were identified. The ADHD group was negatively associated with the healthy pattern ($p < 0.001$) and positively associated with the Western-like diet ($p = 0.004$). Children with inattentive presentation showed lower adherence (12.2%) to a healthy pattern than that of the control group (39.9%) ($p < 0.001$). There is an association between ADHD and dietary habits; children with inattentive presentation may particularly be at risk of unhealthy eating habits.

Type of Snacks consumed

Most of the snacks eaten by boys and girls, 41.6 per cent and 16.6 per cent, are made of fruits, fruit juice, milkshakes, hamburgers, and pizza. 28.7 per cent of boys and 14.9 per cent of girls eat Biscuits, crackers, bread, and stick bread. 39.1 per cent of boys and 8.7 per

cent of girls eat Hot chips, popcorn, peanuts, and soft drinks. 33.33 per cent of boys and 6.67 per cent of girls eat Sweets, chocolates, ice cream, and cakes. from this, it is understood that preference of snacks among the selected children varies and it's mixed with healthy snacks and junk snacks.

4.1.9. Behaviour Function of children with ADHD symptoms

Behaviour function of children with ADHD symptoms as per DSM-V criteria are depicted in Table XIV.

TABLE XIV

Subtypes of behaviour symptoms of children with ADHD symptoms

Subtypes of ADHD based on number of symptoms	Level of symptoms	**4 – 6 years**				**7 – 9 years**				**10 – 12 years**			
		Boys		**Girls**		**Boys**		**Girls**		**Boys**		**Girls**	
Inattention (ADHD-I)	Mild	**0**	-	**0**	-	**1**	100.0	**0**	-	**0**	-	**0**	-
> 6 symptoms in inattention category	Moderate	**2**	28.5	**0**	-	**3**	42.8	**0**	-	**2**	28.5	**0**	-
	Severe	**3**	33.3	**0**	-	**4**	44.4	**0**	-	**2**	22.2	**0**	-
Hyperactivity (ADHD-H)	Mild	**2**	40	**0**	-	**2**	40	**0**	-	**1**	20	**0**	-
> 6 symptoms in hyperactivity category	Moderate	**4**	25	**1**	6.2	**6**	37.5	**2**	12.5	**3**	18.7	**0**	-
	Severe	**6**	28.5	**1**	4.7	**8**	38.1	**1**	4.7	**4**	19	**1**	4.7
Combined type (ADHD-C) (Inattention and hyperactivity)													
> 6 symptoms in inattention and hyperactivity category	Mild	**3**	33.3	**0**	-	**4**	44.4	**0**	-	**2**	22.2	**0**	-
	Moderate	**4**	20	**2**	10	**7**	35	**3**	15	**3**	15	**1**	5
	Severe	**14**	28.5	**3**	6.1	**17**	34.6	**4**	8.1	**9**	18.3	**2**	4.0

Symptoms of ADHD_I (Inattention):

Children showing Mild, Moderate, severe and no symptoms of ADHD – I are shown in Table XIV. 4–6-year-old boys and girls showed no mild symptoms. Boys under 4-6 years

showed 28.5 per cent of moderate and 33.3 per cent of severe symptoms, and no one was included in the no-symptom category. Boys under 7–9-year-old showed 100 per cent mild, 42.8 per cent Moderate, and 44.4 per cent severe symptoms. Also, girls under 10-12 year showed 28.5 per cent of Moderate and 22.2 per cent of Severe symptoms, and 10–12-year-old boys have no symptoms at all.

Along with poor academic performance, problematic relationships, & low self-esteem, children with ADHD may also have these issues. Sometimes, symptoms become better as we mature. However, some individuals never fully outgrow their ADHD symptoms.

Symptoms of ADHD_H (Hyperactivity):

Children showing Mild, Moderate, severe and no symptoms of ADHD – H are shown in the above Table XIV. 4–6-year-old boys showed 40 per cent Mild, 28.5 per cent Severe and 25 per cent Moderate Symptoms. Also, girls under the 4–6-year category exhibited 6.2 per cent of moderate 4 and 4.7 per cent of Severe symptoms. 7–9-year-old boys showed 40 per cent mild, 37.5 per cent moderate and 38.1 per cent severe symptoms. Girls under age 7-9 years exhibited 12.5 per cent moderate and 4.7 per cent severe symptoms. Boys between 10-12 years showed 4.7 per cent of Severe symptoms, and the boys under the age group 10-12 years showed 20 per cent of mild, 19 per cent of severe and 18.7 per cent of moderate symptoms.

Symptoms of ADHD_C (Hyperactivity and Inattention):

Children showing Mild, Moderate, severe and no symptoms of ADHD – C are shown in the above Table XIV. 4–6-year-old boys show 33.3 per cent Mild, 28.5 per cent Severe and 20 per cent Moderate Symptoms. Also, girls under the 4–6-year category were 10 per cent moderate and 6.12 per cent severe symptoms. 7–9-year-old boys show 44.4 per cent mild, 35 per cent moderate and 34.6 per cent severe symptoms. Girls under age 7-9 years were 15 per cent moderate and 8.1 per cent severe symptoms. Boys between 10-12 year exhibited 22.2 per cent Severe, 15 per cent moderate and 18.3 per cent Severe symptoms, and finally, the boys under the age group 10-12 years were 5 per cent moderate and 4 per cent of severe symptoms. (Sayal *et al*., 2017) The diagnosis of attention-deficit hyperactivity disorder (ADHD), a common childhood behavioural condition affecting between 3 and 5 per cent of children, is made based on pervasive, excessively high levels of overactivity, inattention, and impulsivity that are of poor developmental nature.

The above findings was similar to Colomer *et al.*, (2017) Children diagnosed with attention deficit/hyperactivity disorder (ADHD) are at risk of experiencing lower academic achievement compared to their peers without ADHD. The behavioural regulation index of the BRIEF predicted the search for strategies, and the metacognition index was a good predictor of motivation. However, attitude toward learning was predicted by metacognition only in the group with ADHD. Therefore, the executive functions had greater power than the typical symptoms of inattention and hyperactivity/impulsivity in predicting learning behaviours of children with ADHD.

4.1.10. Assessment of the Nutritional Status of the Children

The Mean Height of the Children with ADHD are presented in Table XV and Figure 6.

TABLE XV

Mean height of the children

Age category (N=137)	Gender	ICMR # Cut off (cm)	MEAN HEIGHT(cm)	SD	Mean Difference	"t" Test
4-6 Years	Boys (32)	111.6	103.67	1.345	7.93	9.234**
	Girls (8)	110.5	98.57	1.023	11.93	7.961**
7-9 years	Boys (48)	126.3	118.20	0.968	8.1	5.265**
	Girls (34)	125.4	112.79	1.582	12.61	11.629**
10-12 years	Boys (9)	142.7	135.30	1.402	7.4	8.054**
	Girls (6)	143.0	147.80	0.893	4.8	10.268**

** - Significant at 1% level (p<0.01) #ICMR 2020

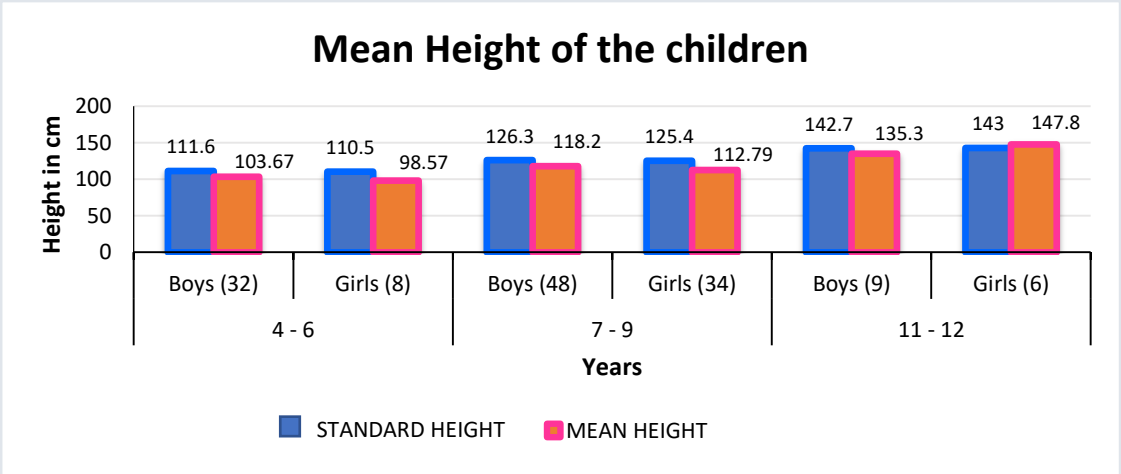

Figure 6

Mean height of the children

The mean height of boys (103.7 cm) was found to be more than girls (98.6 cm) in the age category of 4 to 6 years. The mean height of boys (118.2 cm) was found to be more than girls (112.8 cm) in the age category of 7 to 9 years. On the other hand, girls (147.8 cm) were marginally taller than boys in the age 10 to 12 years, which may be due to the pubertal growth spurt. Overall, this study population was shorter than the 50th per centile ICMR reference cut-off value, and a significant difference exists at less than 1% (P=0.0001). It has been observed, on average, a steady increase in height as the increase in age indicating gradual growth. The t-values also shows that there is an association between the mean heights of boys and girls in all three age group at 1% level. The outcome of the present study is on par with the research by Singh and Singh (2017) that the boys were found to be taller than girls at all ages except 7, 10 and 12 years, and girls were taller at 7 and 15 years of age. Mitiku *et al.*,, (2019) stated that, children aged 10 to 12 years were more stunted than the children aged 6 to 9 years compared to their standard values.

Mean Weight of the Children

The mean weight of the study population is given in Table XVI and Figure 7.

TABLE XVI

Mean weight of the children

Age category (N=137)	Gender	ICMR# Cut off	MEAN weight(Kg)	SD	Mean Difference	"t" Test
4-6 Years	Boys (32)	18.3	14.40	0.732	3.9	5.168**
	Girls (8)	18.3	16.25	0.854	2.05	6.427**
7-9 years	Boys (48)	25.3	20.75	0.951	4.55	9.383**
	Girls (34)	25.3	23.50	0.685	1.8	4.925**
10-12 years	Boys (9)	34.9	37.85	0.829	2.95	6.371**
	Girls (6)	36.4	43.60	1.057	7.2	11.413**

** - Significant at 1% level (p<0.01) #ICMR 2020

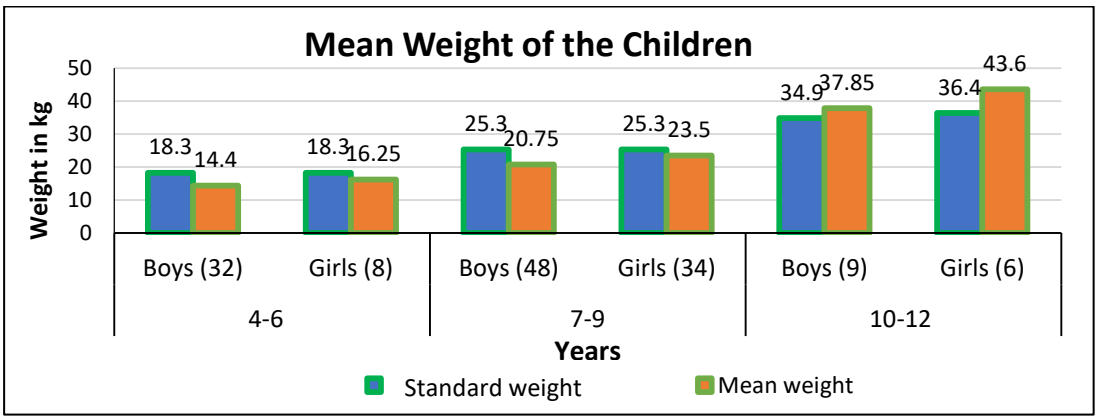

Figure 7

Mean Weight of the children

The present study revealed that the mean weight of boys was 14.4 kg in 4 to 6 years, 7 to 9 years they were in 20.8 kg, and they were 37.9 kg in 10 to 12 years, respectively. Similarly, the mean weight of girls was 16.3 kg in 4 to 6 years, in 7 to 9 years they were in 23.5 and 43.6 kg in 10 to 12 years. For the mean weight of the children, a significant P value of < 0.001 was derived. Female children had a higher mean weight than male children at all age groups. The t-values also showed that there is an association between the mean weights of boys and girls in all three-age group at 1% level. A study conducted in Bangladesh by Sultana *et al.*,, (2019) among school children found that the mean Height, Weight, Body Mass Index, Mid Upper Arm Circumference, Waist Circumference and Hip Circumference values were found to be higher in boys than in girls, except in the age group of twelve years.

Mean Body Mass Index (BMI) of the Children

The Mean Body Mass Index (BMI) of the boys and girls shown in Table XVII and Figure 8.

Table XVII

Mean Body Mass Index (BMI) of the Children

Age category (N=137)	Gender	ICMR# Cut off	MEAN BMI	SD	Mean Difference	"t" Test
4-6 Years	Boys (32)	14.8	11.75	0.562	3.05	4.684**
	Girls (8)	14.4	12.60	0.714	1.8	3.725*
7-9 years	Boys (48)	15.5	13.60	0.490	1.9	4.369**
	Girls (34)	15.3	13.72	0.597	1.58	4.617**
10-12 years	Boys (9)	17.0	20.30	0.682	3.3	3.963**
	Girls (6)	17.2	22.40	0.574	5.2	5.485**

** - Significant at 1% level (p<0.01) #ICMR 2020

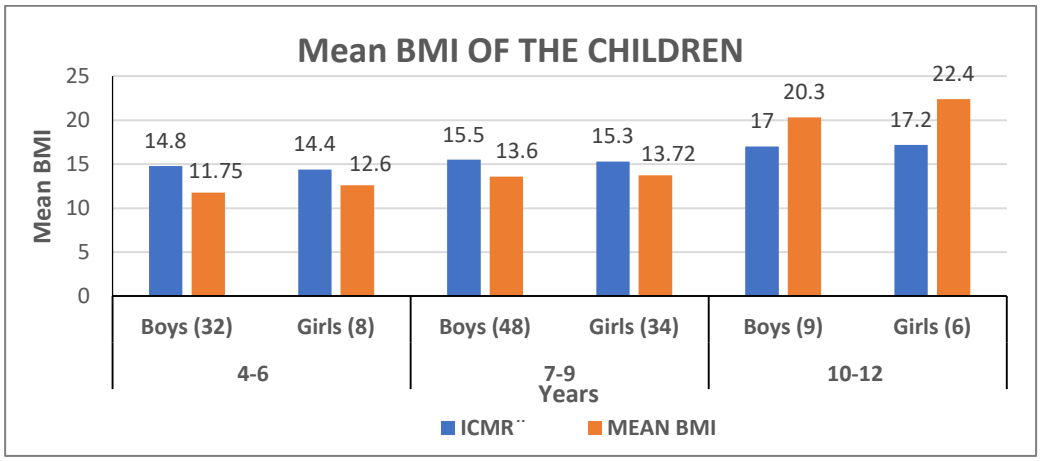

Figure 8

Mean Body Mass Index of the children

The mean Body Mass Index in the age category of 4 to 6 years was found to be 11.8 for boys and 12.6 for girls, respectively. In the age category of 7 to 9 years mean BMI for boys was found to be 13.6 and for girls it is 13.7. The mean BMI was almost similar in the lower age group of 4 to 9 years between genders. In contrast, the mean BMI of boys (20.3) was lower than that of girls (22.4) in the upper age category of 10 to 12 years, respectively. A significant difference was noted between the schools at less than 1 per cent level among boys and girls regardless of age, while it was seen among girls only in the age category of 6 to 9 years. The t-values also shows that there is an association between the mean BMI among boys and girls in all three age group at 1% level and 5 % level. A similar study conducted by Gupta *et al.*,, (2015) found that undernourished children were 51.1 per cent, and well-nourished children were 48.9 per cent, according to the z-score of BMI for age. The proportion of undernourished children was evenly distributed throughout the 6 to 15 age group, which was significantly higher among boys.

BMI Percentiles of the children with ADHD symptoms

The BMI Percentiles of the children with ADHD symptoms are presented in Table XVIII

TABLE XVIII

BMI Percentiles of the children with ADHD symptoms

Age category (N=137)	Gender	BMI percentiles			
		Under Weight (< 5th Percentile) (N=59)	Normal (5th and < 85th Percentile) (N =35)	Over Weight (≥ 85th and < 95th Percentile) (N=32)	Obesity (≥ 95th Percentile) (N=11)
4-6 Years	Boys (32)	11	10	3	8
	Girls (8)	2	3	1	2
7-9 years	Boys (48)	27	12	2	7
	Girls (34)	10	6	5	13
10-12 years	Boys (9)	5	3	-	1
	Girls (6)	4	1	-	1

***WHO classification (2007)**

BMI percentiles classification found the boys who were in the age group of 4 – 6 years were mostly underweight and normal weight and for girls most of them were in normal weight. In the age group of 7 – 9 years most of the boys and girls were found to be underweight and have obesity. At 10 – 12 years of age only few were in underweight

category and no one is in over weight. From the result it is clear that the children at the age of 7 – 9 years were found underweight.

The findings was par with the study by Ellen et.al, 2014 where they examined the Body Mass Index (BMI) in children with ADHD and its relationship with age, gender, ADHD and comorbid symptom severity, inhibitory control, developmental coordination disorder (DCD), sleep duration and methylphenidate use. Boys and girls of 10–12 years of age were more likely to be overweight than children in the general Dutch population. Younger girls and female teenagers, however, seemed to be at lower risk for being overweight. Higher oppositional behaviour and social communication problems related to higher BMI-SDS scores, whereas more stereotyped behaviours related to lower BMI-SDS scores. We found no effects of the other examined associated risk factors on BMI-SDS.ADHD in boys is a risk factor for overweight. In girls with ADHD, the prevalence of overweight is age-dependent and most pronounced in girls 10–12 years of age. They have a fourfold risk of being obese. Higher oppositional and social communication problems pose an increased risk for overweight, whereas sleep duration, motor coordination problems and methylphenidate use do not.

4.1.11. Mean Food Intake of the children

The mean food intake of the children is categorized on the age and gender categoryare presented in Tables XIX to XXI and Figure 9-11

TABLE XIX

Mean Food Intake of the children (4-6 years)

Food groups	4-6 years				
	RDA**	Boys Mean ±S.D	% Excess Deficit	Girls Mean ±S.D	% Excess Deficit
Cereals (g)	300	163.7 ± 1.67	-45.6	179.2 ±12.4	-40.2
Pulses (g)	60	27.5 ±3.08	-54.1	33.3 ±1.49	-44.5
Green Leafy Vegetables (g)	100	36.8±2.1	-63.2	41.6±1.92	-58.4
Other vegetables (g)	100	28.4 ±0.92	-71.6	35.9 ±0.99	-64.1
Fruits (g)	100	26.5±1.27	-73.5	33.2±2.03	-66.8
Milk and milk products (ml)	500	222.6 ± 7.05	-55.48	246.5± 5.03	-50.7
Fats and Oils (ml)	25	18.1 ±0.69	-27.6	21.9 ±1.19	-12.4

** ICMR (2020)

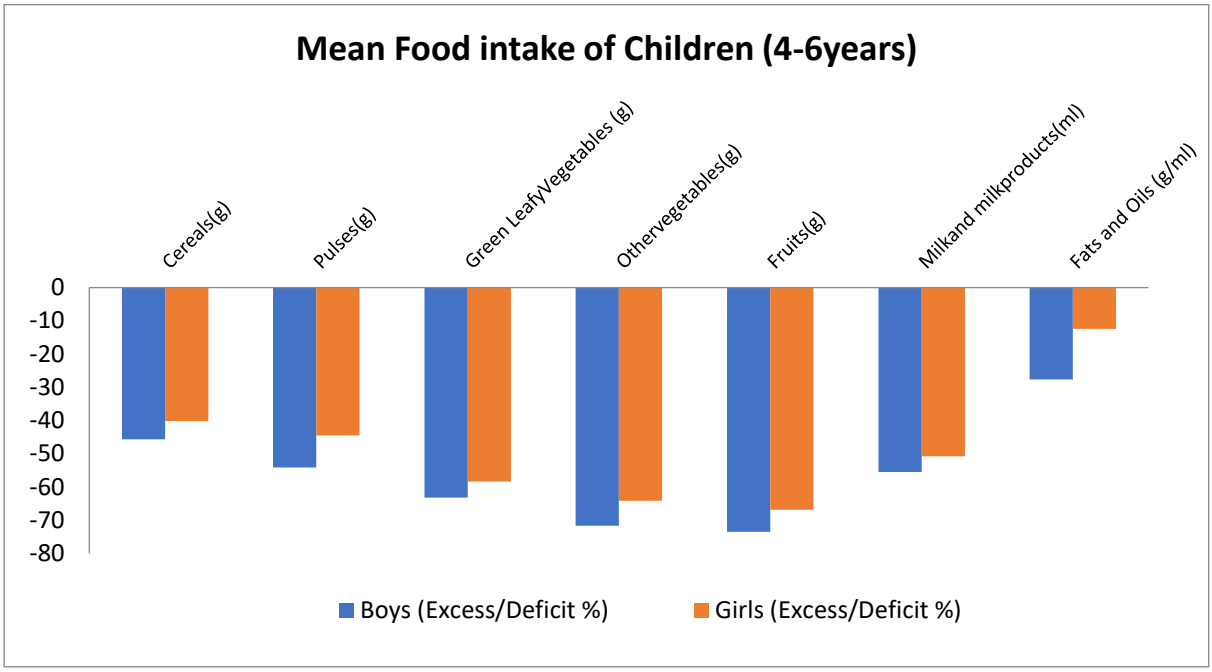

Figure 9

Mean Food Intake of the children (4-6 years)

TABLE XX

Mean Food Intake of the children (7-9 years)

Food Groups	7-9 years				
	RDA**	Boys Mean ±S.D	**% Excess Deficit**	Girls Mean ±S.D	**% Excess Deficit**
Cereals (g)	300	154.9 ±3.76	-48.3	195.6 ±3.33	-34.8
Pulses (g)	60	43.6 ±2.26	-27.3	45.2 ±2.03	-24.6
Green Leafy Vegetables (g)	100	46.3±1.56	-53.7	53.1±1.62	-46.9
Other vegetables (g)	100	25.8 ±1.66	-74.2	31.9 ±5.07	-68.1
Fruits (g)	100	41.9±2.77	-58.1	48.5±0.80	-51.5
Milk and milk products (ml)	500	236.5±2.18	-52.7	221.2±8.03	-55.76
Fats and Oils (ml)	25	26.6 ±2.01	+6.4	27.9 ±1.03	+11.6

** ICMR (2020)

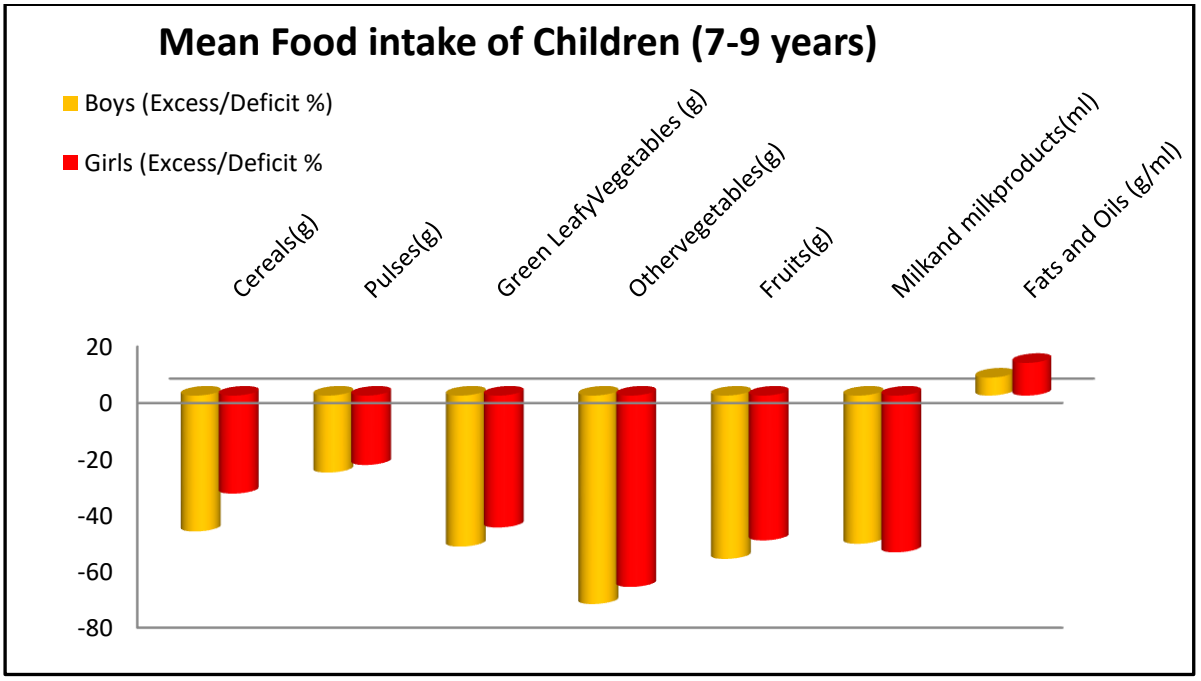

Figure 10

Mean Food Intake of the children (7-9 years)

Mean Food Intake of the Children

The consumption patterns of various food groups by different age groups of children were almost similar. The mean food intake of different food items was lower than the prescribed dietary allowances, with standard value for cereals (300 g), pulses (60 g), green leafy vegetables (100 g), other vegetables (100 g), fruits (100 g), milk and milk products (500 ml) and fats and oils (25 ml), respectively. The consumption pattern of various food groups were increased according to their age group and it was found high in girl than boys in all age group that the food intake were more among female children. The green leafy vegetables (52.1%) and other vegetables (64.6%) were consumed more among 6 – 9 years than 10 – 12 years to the suggested allowances of the ICMR (2020). Milk intake was very low among children in all the age groups compared to the recommended allowances.

TABLE XXI

Mean Food Intake of the children (10-12 years)

Food Groups	10-12 years				
	RDA**	Boys Mean ±S.D	% Excess Deficit	Girls Mean ±S.D	% Excess Deficit
Cereals (g)	300	247.4 ±6.79	-17.3	262.7 ±11.9	-12.4
Pulses (g)	60	40.8 ±2.08	-32	46.4 ±1.36	-22.6
Green Leafy Vegetables (g)	100	65.2±2.92	-34.8	57.2±2.37	-42.8
Other vegetables (g)	100	46.3 ±1.68	-53.7	56.1 ±2.50	-43.9
Fruits (g)	100	64.4±1.98	-35.6	56.5±1.42	-43.5
Milk and milk products (ml)	500	283.8±5.96	-43.24	294.1±2.67	-41.18
Fats and Oils (ml)	25	29.3 ±2.41	+17.2	26.2 ±4.70	+4.8

** ICMR (2020)

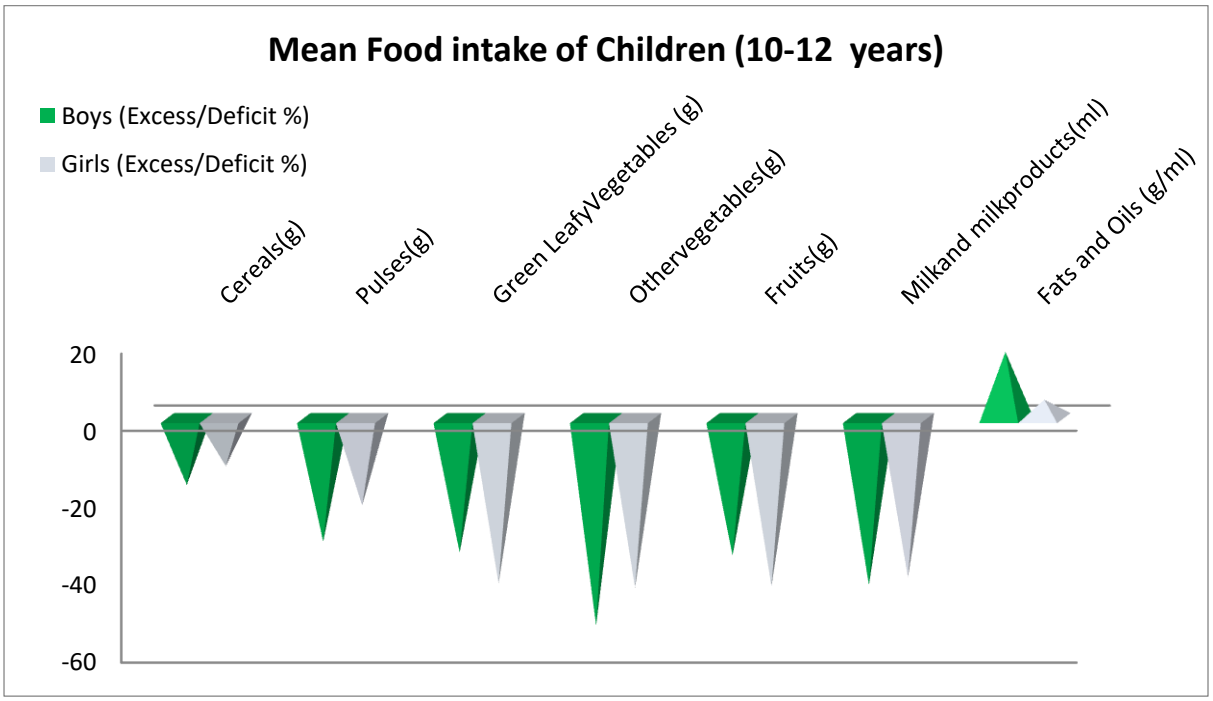

Figure 11

Mean Food Intake of the children (10-12 years)

4.1.12. Mean Nutrient Intake of the Children

Mean nutrient intake of the children of different age groups is given in Table XXII to XXIV and Figure 12-14.

TABLE XXII

Mean Nutrient intake of the children 4-6 years

Nutrients	4-6years					
	RDA##	Boys Mean SD	% Excess Deficit	RDA##	Girls Mean SD	% Excess Deficit
Energy (kcal)	1360	1045 ± 8.94	-23.1	1360	1105.1 ± 13.4	-18.75
Carbohydrate (g)	100	66.2 ± 3.33	-33.8	100	73.7 ± 2.58	-26.3
Protein (g)	12.8	7.32 ± 1.89	-42	12.8	10.0 ± 0.77	-21.8
Fats (g)	25	18.5 ± 2.06	-26	25	21.7 ±1.71	-13.2
Calcium (mg)	450	194 ±5.43	-56.8	450	178 ± 4.21	-60.4
Magnesium (mg)	131	65.3 ± 2.89	-50	131	74.6 ± 2.59	-43
Iron (mg)	8	3.10 ± 0.83	-61	8	4.89 ±0.54	-38.8
Zinc (mg)	3.7	0.20 ± 0.14	-94.5	3.7	0.67 ± 0.21	-81.8
Vitamin B_6 (mg)	1.0	0.09 ± 0.08	-91	1.0	0.54 ± 0.13	-46
Vitamin B_{12} (µg)	1	0.05 ± 0.04	-95	1	0.24 ± 0.16	-76
Vitamin C (mg)	27	16.0± 0.90	-40.7	27	19.5±0.67	-27.7
Vitamin A (µg)	240	116.0±3.02	-51.6	240	126.5±1.21	-47.2
Vitamin D (µg)	400	127.1±3.02	-68	400	134.5±2.67	-66.3

ICMR (2020)

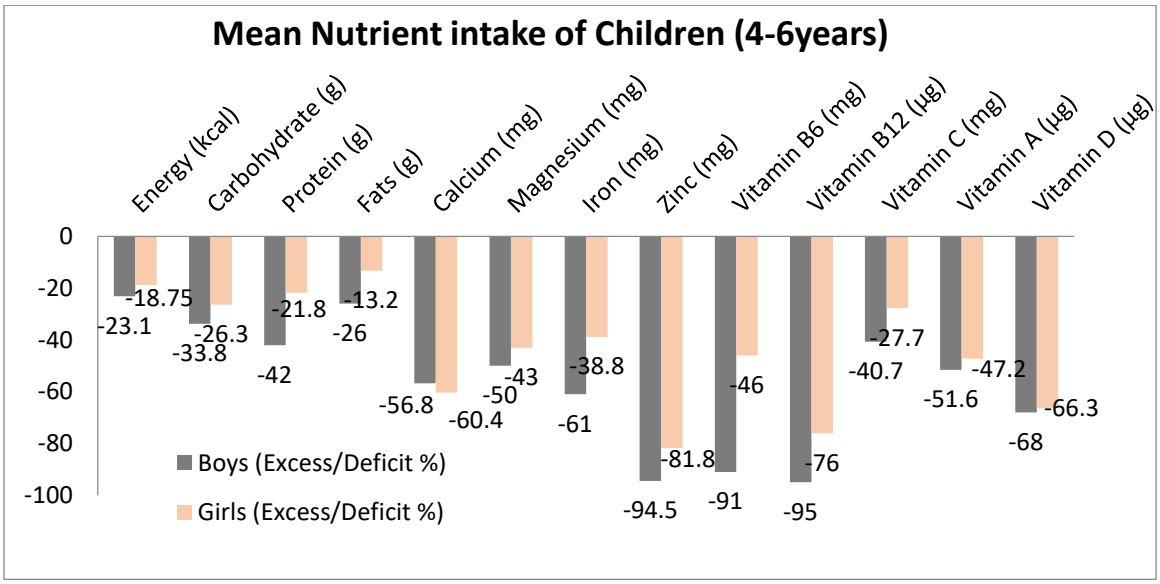

Figure 12

Mean Nutrient intake of the children 4-6 years

TABLE XXIII

Mean Nutrient intake of the children 7-9 years

Nutrients	7-9 years					
	RDA[##]	Boys Mean SD	**% Excess Deficit**	**RDA[##]**	**Girls Mean SD**	**% Excess Deficit)**
Energy (kcal)	1700	1255.3 ± 40.9	-26	1700	1393 ± 56.6	-18
Carbohydrate (g)	100	83.4 ±1.67	-16.6	100	89.3 ±3.06	-10.7
Protein (g)	19	14.2 ± 0.87	-25	19	14.0 ± 2.14	-26
Fats (g)	30	24.4 ± 2.58	-18.6	30	31.4 ± 3.62	+ 4.6
Calcium (mg)	500	241.6 ± 7.82	-51.6	500	336.3±25.7	-32.7
Magnesium (mg)	178	103 ± 4.62	-42	178	126±7.91	-29
Iron (mg)	10	5.57 ± 1.28	-44	10	7.11 ± 0.69	-28.9
Zinc (mg)	4.9	1.30 ± 0.26	-73	4.9	2.05 ± 0.18	-58
Vitamin B_6 (mg)	1.3	0.37 ± 0.11	-71.5	1.3	0.79 ± 0.10	-39
Vitamin B_{12} (µg)	2	0.70± 0.06	-65	2	0.97±0.08	-51.5
Vitamin C (mg)	36	25.5±1.79	-29	36	30.2±1.79	-16
Vitamin A (µg)	290	140.5±8.28	-51.5	290	168.5±1.51	-41.8
Vitamin D (µg)	400	155±1.89	-61	400	165±3.00	-58.7

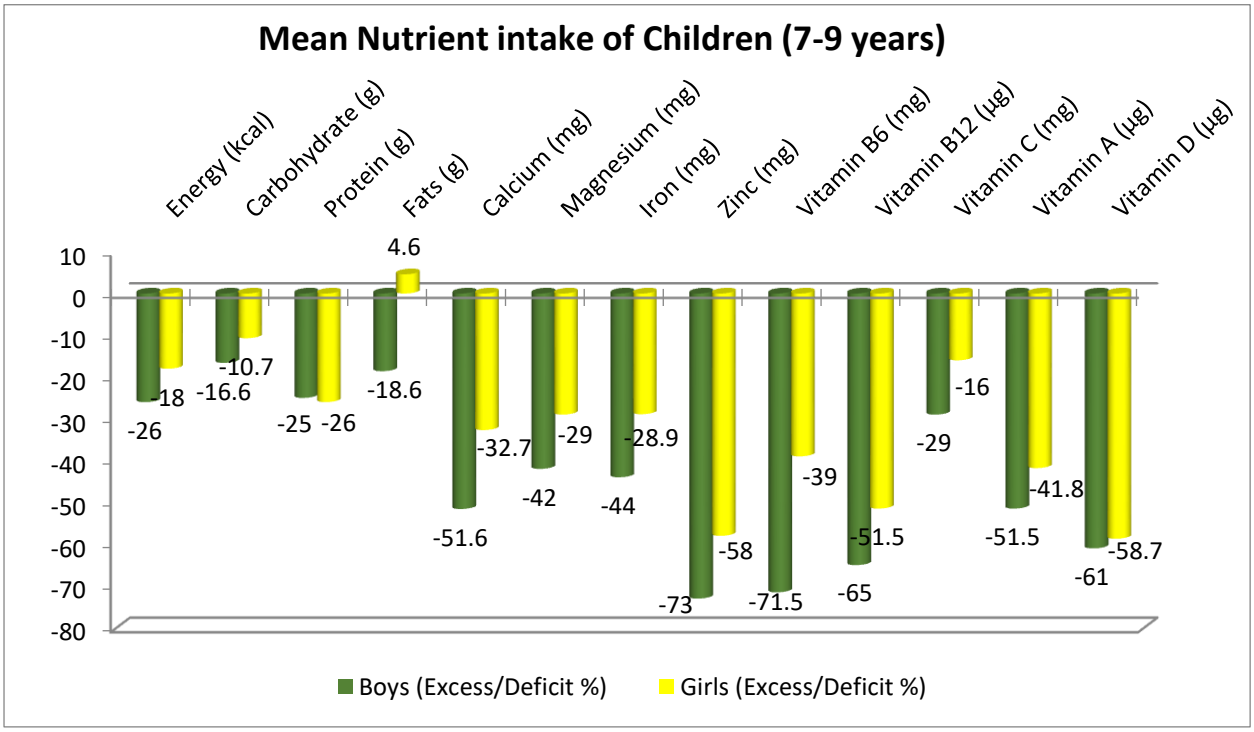

Figure 13

Mean Nutrient intake of the children 7-9 years

TABLE XXIV

Mean Nutrient intake of the children 10-12 years

Nutrients	10-12 years					
	RDA##	Boys Mean SD	% Excess Deficit	RDA##	Girls Mean SD	% Excess Deficit
Energy (kcal)	2220	1723 ± 75.6	-22	2060	1854 ± 25.3	-10
Carbohydrate (g)	100	95.5 ± 5.92	-4.5	100	93.6 ±1.61	-6.4
Protein (g)	26.2	20.7 ± 1.41	-20.9	26.6	21.4 ± 1.21	-19.5
Fats (g)	35	30.3 ± 2.78	-13.4	45	41.8 ± 2.59	-7.1
Calcium (mg)	650	430.3 ± 7.32	-33.8	650	448.3 ±46.2	-31
Magnesium (mg)	223	158 ± 1.83	-29	214	147.8 ± 13.3	-30.9
Iron (mg)	12	6.91 ± 1.13	-42.4	16	10.6± 0.63	-33.7
Zinc (mg)	7.0	2.23 ± 0.19	-68	7.1	2.85 ± 0.16	-59.8
Vitamin B_6 (mg)	1.7	0.94 ± 0.09	-44.7	1.6	1.02 ± 0.06	-36
Vitamin B_{12} (**µg**)	2	1.19±0.09	-40.5	2	1.56±0.11	-22
Vitamin C (mg)	45	31.4±1.78	-30.2	44	37.6± 1.02	-14.5
Vitamin A (**µg**)	360	220±5.36	-38.8	370	253±5.52	-31.6
Vitamin D (µg)	400	191.8±1.13	-52	400	227.1±2.66	-43

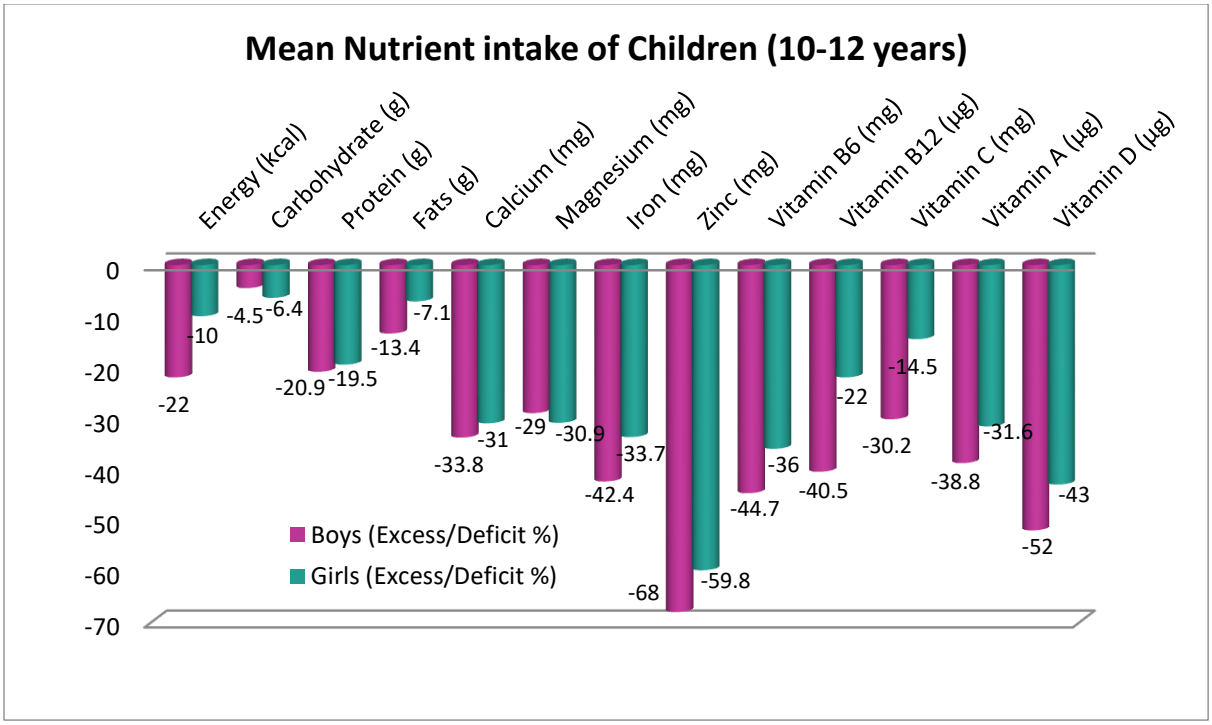

Figure 14

Mean Nutrient intake of the children 10-12 years

The nutrient consumption of children was below the recommended allowances (ICMR, 2020). The standard value of nutrients such as energy (1360 kcal), fats (25 g), protein (12.8 g), carbohydrate (100 g), calcium (450 mg), magnesium (131 mg), iron (8 mg), zinc (3.7 mg), vitamin B6 (1.0 mg), Vitamin B12 (1 µg), Vitamin C (27 mg), Vitamin A (240 µg) and Vitamin D (400 µg) were found to be insufficient in children aged 4 to 6 years, 7 to 9 years and 10 – 12 years respectively than recommended dietary allowances according to their age group. The per cent adequacy of many nutrients was higher among 10 – 12 years old children when compared to 7 to 9 years and 4 to 6 years. The nutrient intake was found to be higher in girls than boys in all age group. Chin *et al.*, (2020) also stated that median daily energy intake was 25% lower than the age-appropriate RNI, while median intakes of calcium, iron, zinc, and vitamins C and E ranged from 52%-73% of the RNI. Vitamin D intake was only 37% of the RNI.

Phase II

4.2. Formulation and standardization of snacks

4.2.1. Organoleptic evaluation of the micronutrients based snacks

Tables XXV presents the sensory evaluation carried out on the basis of appearance, colour, flavour, taste, and texture for the formulated snacks. The results are presented as follows,

The sensory evaluation for curry stalk pakodi, Rajkira crackers, Amaransu smoothie, Checkbox Nuggets, Scopy Urdu Muffins, Nut coated little millet cookie, Quinoea Yam cutlet, Trevally Nuggets, Round Nut Bag and Energy Seed Coat snack incorporated in the study has undergone sensory evaluation and the result is been given in the following table.

The result showed that variation II of Rajkira Crackers had high acceptability in appearance, colour, flavour, taste, and texture with a mean value of 4.60. This shows that variation II to be highly accepted variation in the preparation of rajkira crackers while compared to the standard value, variation I and variation III. This was on par with the findings by Akonor *et al*., (2017) where scores for taste of the crackers ranged between 3.0 and 6.5, with a mean of 4.77, suggesting that the taste of the newly developed snack was generally acceptable in the variation II. In a study made by Pragathi *et al.*, (2021) it was observed that the score of overall acceptability of crackers was significantly ($p< 0.05$) highest in variation II (7.66±0.81) than variation I (7.60±0.82) and variation III (7.33±0.98).

Table XXV Organoleptic evaluation of the micronutrients based snacks

SCORES	RAJKIRA CRACKERS				AMARANSU SMOOTHIE				CURRY STALK PAKODI				CHECKBOX NUGGETS				SCOPY URDU MUFFINS			
	Standard	Variation I	Variation II	Variation III	Standard	Variation I	Variation II	Variation III	Standard	Variation I	Variation II	Variation III	Standard	Variation I	Variation II	Variation III	Standard	Variation I	Variation II	Variation III
Appearance	3.36±0.92	4.56±0.62	4.56±0.56	4.43±0.62	4.16±0.69	4.63±0.55	4.70±0.46	4.80±0.40	3.40±0.81	4.70±0.53	4.90±0.30	4.66±0.47	3.53±0.68	3.93±0.69	4.33±0.47	4.56±0.50	2.80±0.76	4.03±0.55	4.86±0.34	4.83±0.37
Colour	2.96±0.80	4.33±0.60	4.43±0.67	4.53±0.62	3.70±0.83	4.63±0.66	4.63±0.55	4.73±0.52	3.26±1.01	4.70±0.46	4.86±0.34	4.86±0.34	3.10±0.80	3.96±0.66	4.63±0.49	4.50±0.50	3.86±0.73	4.13±0.43	4.73±0.44	4.60±0.49
Flavour	3.23±0.81	4.60±0.56	4.46±0.68	4.40±0.67	2.83±0.94	4.73±0.44	4.66±0.47	4.86±0.34	3.13±0.57	4.56±0.56	4.83±0.37	4.73±0.44	2.46±0.62	4.23±0.62	4.60±0.49	4.60±0.49	3.10±1.02	4.26±0.44	4.70±0.46	4.73±0.44
Taste	3.23±0.97	4.40±0.67	4.36±0.61	4.43±0.56	3.53±0.68	4.76±0.43	4.76±0.43	4.80±0.40	3.83±0.83	4.66±0.54	4.80±0.40	4.56±0.50	3.86±0.73	4.1±0.66	4.80±0.40	4.66±0.47	3.63±0.71	4.06±0.78	4.86±0.34	4.80±0.40
Texture	2.80±0.84	4.56±0.50	4.33±0.66	4.36±0.49	3.66±0.80	4.70±0.53	4.66±0.47	4.63±0.49	3.63±1.15	4.73±0.52	4.76±0.50	4.60±0.56	3.26±0.94	4.63±0.49	4.40±0.49	4.50±0.50	2.96±0.85	4.9±0.30	4.90±0.30	4.73±0.44
Overall	2.70±0.79	4.50±0.50	**4.60±0.49**	4.40±0.56	2.50±0.50	4.70±0.53	4.60±0.49	**4.86±0.34**	2.83±1.20	4.76±0.43	**4.96±0.18**	4.90±0.30	3.10±1.02	3.9±0.60	**4.70±0.46**	4.53±0.50	3.53±0.73	3.7±0.59	**4.90±0.30**	4.83±0.37

SCORES	NUT COATED LITTLE MILLET COOKIE				QUINOEA YAM CUTLET				TREVALLY NUGGETS				SQUARE NUT BAG				ENERGY SEED COAT			
	Standard	Variation I	Variation II	Variation III	Standard	Variation I	Variation II	Variation III	Standard	Variation I	Variation II	Variation III	Standard	Variation I	Variation II	Variation III	Standard	Variation I	Variation II	Variation III
Appearance	3.36±1.06	4.16±0.74	4.23±0.72	4.10±0.71	3.53±0.73	4.20±0.55	4.13±0.73	4.16±0.64	3.90±0.95	4.90±0.30	4.86±0.43	3.8±0.87	3.80±0.84	4.56±0.50	4.63±0.61	4.33±0.71	2.36±0.99	4.56±0.56	3.56±0.72	4.53±0.62
Colour	2.90±0.75	4.16±0.74	4.40±0.56	4.23±0.72	3.83±0.83	4.00±0.58	4.20±0.55	4.16±0.64	4.80±0.48	4.66±0.47	4.76±0.43	4.23±0.72	3.26±0.90	4.60±0.56	4.53±0.57	4.53±0.68	2.66±1.29	4.46±0.57	3.73±0.73	4.53±0.57
Flavour	3.43±1.00	4.13±0.73	4.30±0.65	4.13±0.62	3.73±0.98	4.13±0.68	4.16±0.74	4.36±0.61	4.06±0.86	4.53±0.57	4.60±0.62	4.73±0.44	3.73±0.94	4.46±0.73	4.53±0.50	4.36±0.66	4.26±0.82	4.50±0.62	4.46±0.50	4.33±0.66
Taste	3.60±0.67	4.16±0.79	4.30±0.74	4.26±0.78	3.70±0.83	3.93±0.78	4.13±0.62	4.40±0.62	2.86±0.62	4.66±0.47	4.43±0.50	4.63±0.55	4.16±0.64	4.56±0.56	4.33±0.71	4.43±0.72	3.56±0.81	4.36±0.55	3.93±0.63	4.20±0.71
Texture	3.70±1.05	4.23±0.62	4.36±0.66	4.26±0.78	3.96±0.88	4.00±0.64	4.00±0.69	4.13±0.73	3.46±0.97	4.83±0.37	4.86±0.34	4.76±0.43	3.30±1.05	4.20±0.66	4.26±0.58	4.33±0.66	3.50±0.97	4.53±0.62	4.43±0.67	4.40±0.85
Overall	3.90±0.84	4.26±0.69	**4.53±0.50**	4.33±0.60	3.16±1.36	4.06±0.52	4.06±0.63	**4.33±0.60**	3.63±0.99	4.76±0.43	**4.83±0.37**	3.96±0.61	3.90±1.21	**4.56±0.50**	4.40±0.56	4.46±0.68	3.46±0.62	4.50±0.57	4.16±0.53	**4.53±0.57**

Variation III of Amaransu Smoothie had higher acceptability of the recipe on the basis of its appearance, colour, flavour, taste and texture as the mean score was 4.86. This showed that while formulating the amaransu smoothie variation III is highly considered and it was found to be having high acceptability, which was similar to the study of Kidon *et al.,* 2022 where the mean value was found to be high in variation III with the mean value 5.45 while compared to other variations of the study.

The sensory evaluation of curry stalk pakodi was identified on the basis of its appearance, colour, flavour, taste, texture and overall evaluation. The result showed that variation II of the curry stalk pakodi to be having good sensory evaluation as the mean value was 4.96. This showed that variation II has good appearance, colour, flavour, taste and texture, when compared to other variations incorporated in the study which is similar to the study of Panphut et.al 2018, which stated that Curry was a favourite dish in Thai restaurants throughout the world and for a good reason. Based on a delicious paste of fresh and dried herbs and spices, the curry was unique and unlike any dish in Western cuisine, and the study found that the result of sensory evaluation from the qualified tester was not statistically significantly different (0.05, α) represented in colour, smelling, and taste.

The check box nuggets was evaluated on the basis of appearance, colour, flavour, taste, texture and overall evaluation. The findings showed that variation II had a good appearance, colour, flavour, taste, texture for the check box nuggets as the mean value was 4.70, which was high while compared to other variations taken for the study, which was similar to a study by Richa *et al.,* (2021) where nuggets were prepared with the formulations i.e. control (0% black rice flour), T1 (1% black rice flour), T2 (3% black rice flour) and T3 (5% black rice flour) and the sensory evaluation showed that addition of black rice flour at 1,3 and 5 per cent level resulted no adverse effect on physicochemical qualities of nuggets. Sensory evaluation revealed that nuggets could be prepared satisfactorily with addition of upto 5 per cent black rice flour without adversely affecting the organoleptic qualities of the products.

The sensory evaluation of scopy Urdu muffins was carried out on the basis of appearance colour, flavour, taste, texture and overall evaluation. result showed that variation II had a high level of acceptability with the mean value being 4.90. This showed that in variation II, the scopy Urdu muffins had the acceptable appearance, colour, flavour, taste and texture while compared to other variation this was same as the study shown in Loncar *et al.,* 2022 in which the author has found that sensory evaluation of the muffins, per centage

increases in apple powder and osmotically treated apple powder positively affect taste and smell, while slightly reducing the appearance grade of the product and it has high acceptability in the variation II with the mean value of 5.67.

The table showed that in variation II, the nut coated little millet cookies had good appearance, colour, flavour taste and texture while compared to other variation as the mean value was 4.53. This was similar to the findings made by Thejaswani *et al.*,(2017), where scores for all sensory attributes of cookies ranged from 9.0-9.1± 0.8. Sensory evaluation of cookies for appearance, colour, texture and flavour showed no significant difference between the nut cookies and millet cookies. A study by Ani *et al.*, (2021) found that the moisture, protein, fat, ash and crude fibre contents of the cookie samples increased significantly ($p \leq 0.05$) from 7.66±0.11 - 10.34±0.17%, 10.66 - 15.11±0.4%, 2.28±0.01 - 2.50±0.03%, 3.25 ± 0.16 - 3.71± 1.36% and 1.31± 0.01 - 2.37± 0.04% with increased substitution of African walnut and unripe plantain flours, while the carbohydrate and energy contents decreased from 74.84± 0.06 - 65.97 ± 0.08% and 362.52± 0.16 - 346.82 ± 3.22 KJ/100g, respectively.

The sensory evaluation for quinoea yam cutlet was done in the current research on the criteria of appearance, colour, flavour, taste, texture and overall evaluation. Result showed that variation III had good sensory evaluation as the mean score was high while compared to other variation as the mean value was 4.33. This showed that variation III has good appearance, colour, flavour, taste and texture which is similar to the finding of Barbera *et al.*, (2021) where the sensory characteristic were studied in four batches (control and 8% concentration of quinoa seed, flour and wet-milling coproducts added) at 30, 60 and 90 days of freezing (−20 ± 1 °C). Different black quinoa fraction addition affected ($p < 0.05$) physiochemical properties, improved cooking properties and reduced lipid oxidations during freezing storage. Batches with flour and wet-milling coproducts added were the most stable for texture parameters and lipid oxidation during freezing and had better acceptability in the variation III where the mean value was 7.32.

The sensory evaluation of Trevally nuggets was studied on the basis of appearance, colour, flavour, taste, texture and overall evaluation. Result showed that variation II has high acceptability as the mean value was 4.83 which was high compared to other variation. This indicated that variation II has good appearance colour, flavour, taste and texture which resembles the findings of the Lertinmogstol *et al.*, (2021) study showed a significance ($p \leq 0.05$), the lowest scores of the colour and texture were exhibited in variation with the

scores of 5.96±1.16 and 5.90±1.16, respectively. In contrast, the highest preference scores in aroma, taste, and overall acceptability were shown in other variation, but the scores did not have any significant differences ($p \leq 0.05$) when compared with variation 1 to 3. Therefore, fish tofu supplemented with malva nut gum formula variation 4 was the chosen recipe in terms of the high acceptance score in aroma, taste, and overall acceptability.

The result for Round Nut Bag showed that variation I had a high acceptability as the mean score was 4.56 which was high while compared to other variation in the study. This showed that for Round Nut Bag in variation I, it has acceptable appearance, colour, flavour, taste and texture and this was similar to the findings of Mohammed *et al.,* (2019) where the raw dried pistachio nuts (flavour, texture, and overall acceptability), analysis of variance (ANOVA) showed that the effect of all factors (packaging, temperature, and storage time) and their interaction were not significant ($p > 0.05$) and variation showed that the nut bar found to be having greatest acceptability when it is been made with the variation I with the mean value of 5.43.

The result showed that variation III had high acceptability as it has a good appearance, colour, flavour, taste and texture while compared to other variations which is similar to the finding of Mazumder *et al.,* 2021 where the study stated that the mixed flour nutrition bar had significantly higher total phenolic content and antioxidant activity than the bar with banana flour and the bar with pumpkin seed flour. The mixed flour sample also had better sensory parameters. The mixed flour demonstrated good quality. Hence, both banana and pumpkin seed flour has the potential to be used in bar formulations.

4.2.2. Quality Assessment of the formulated micronutrient rich snacks

Physical, Colour and Textural analysis, Nutrient content and Microbial analysis of the developed snacks was carried out for the selected recipes namely muffins, veg nuggets, energy seed, fish nuggets, horse gram cookies, pakoda, crackers, cutlets, smoothie and nut bar.

TABLE XXVI

Physical parameter of the formulated snacks

Physical Parameters	Scopy Urdu Muffins	Amaransu Smoothie	Quinoea Yam Cutlet	Curry Stalk Pakodi	Checkbox Nuggets	Trevally Nuggets	Rajkira Crackers	Nut Coated Little Millet Cookie	Energy Seed Coat	Round Nut Bag
Weight (g)	45.11±0.14	68.37±0.07	52.65±0.04	13.26±0.01	71.27±0.04	67.84±0.02	13.27±0.14	18.13±0.05	55.75±0.03	50.85±0.03
Diameter (mm)	70.49±0.04	0.85±0.02	2.23±0.01	1.94±0.03	2.06±0.05	1.20±0.01	69.16±0.06	53.54±0.04	3.17±0.02	2.25±0.03
Thickness (mm)	62.55±0.04	2.07±0.02	11.15±0.04	22.10±0.01	6.55±0.03	5.56±0.03	4.97±0.05	8.13±0.02	12.55±0.01	10.56±0.02
Spread ratio	1.13±0.00	0.41±0.01	0.16±0.05	0.08±0.00	0.31±0.00	0.21±0.00	13.91±0.13	6.59±0.02	0.25±0.00	0.21±0.00

The Table XXVI provides information about the physical parameters of the selected recipes in terms of weight (gm), diameter (mm) and spread ratio.

The weight of muffins was 45.11gm whereas diameter was 70.49mm with thickness of 62.55mm and the spread ratio was 1.13. Information for smoothie showed that weight was 68.37gm diameter was 0.85 mm with thickness about 2.07mm and spread ratio of 0.41. For the recipe of cutlet the weight was observed to be 52.65gm, diameter was 2.23mm, thickness was 11.15mm and spread ratio was 0.16. In the physical parameters of pakoda had a weight of 13.26gm, diameter was 1.94mm, thickness was 22.10mm and spread ratio was 0.08. Veg nuggets showed weight of 71.27gm, diameter of 1.20mm, thickness of 6.55mm and spread ratio was 0.21. Crackers in the study was with weight of 13.27gm, diameter of 69.16mm, thickness of 4.97mm and spread ratio was 13 91. in case of cookies the weight was observed to be 18.13gm, diameter was 53.54mm, thickness of 8.13mm and spread ratio 6.59. For seed bar the weight was 55.75gm, diameter was 3.17mm, thickness was 12.55mm and spread ratio 0.25 and for nut bar the weight was 50.85gm, diameter was 2.25mm, thickness was 10.56 and spread ratio was 0.21. thus from the study it was observed that different recipes had different physical properties whereas in case of weight the highest weighted recipe was found for smoothie with weight of 68.37gm, for diameter the highest proportion was seen in recipe muffin with 70.49mm. For thickness the large size is for the recipe muffin and for spread ratio the high ratio is seen in crackers with ratio of 13.91. This was similar to the findings of Adiola 2017. The physical properties, nutrient composition, and sensory characteristics of the biscuits were evaluated using standard methods. The hardness of the biscuit samples decreased as PPF increased, while the fracturability decreased with increase in UBF. Biscuits were significantly ($p < .05$) different in their nutrient composition, with the crude protein, crude fiber, ash contents, and dietary fibre content increasing as the PPF level increased. Cookies are rich in magnesium (576.54–735.06 mg/100 g) with favourable Na/K ratio (<1.0). The antinutritional factors in the biscuit samples were within permissible levels. Biscuits prepared from flour blend of 21.67% unripe cooking banana, 21.67% pigeon pea, and 56.67% sweet potato were the most preferred in terms of shape, mouthfeel, taste, crunchiness, and overall acceptability. Flour blends of unripe cooking banana, pigeon pea, and sweet potato could therefore be used as raw materials for the production of biscuits, with high protein, total dietary, and energy content.

Microbial count

The microbial concentration is determined by counting the colonies on the part of the petri dish where they are easily countable. It was noted that the product was safe and free from total bacterial count on the first day of the formulated recipes because the snacks enriched the flavor of dishes to the children. The microbial count of the recipes formulated in the study was examined. The microbial count is one of the convenient methods in order to examine the nutritional value the of the formulated recipe. In the study the investigator had adopted this method to find the nutritional value of recipes developed for which the microbial count was taken within 24hrs of the formulation of recipes. When children with ADHD consume this recipe ,it can have a great impact positively for their health as the recipes has great nutritional value. The Total plate count for muffin was 24×10^1 cfu/g, veg nuggets was 16×10^1 cfu/g, energy seed 17×10^1 cfu/g, fish nuggets count was estimated to 18×10^1 cfu/g, horse gram cookies count was 21×10^1 cfu/g, for pakoda the count 6.0×10^1 cfu/g, crackers had count of 3.0×10^1 cfu/g, cutlet 9.0×10^1 cfu/g, smoothie microbial count 2×10^1 cfu/g and nut bar 23×10^1 cfu/g. the microbial count was found to be high in muffin which is similar to the studies done by Kupiec *et al.*,2020 .The observation of the microbial count is presented in Plate 8.

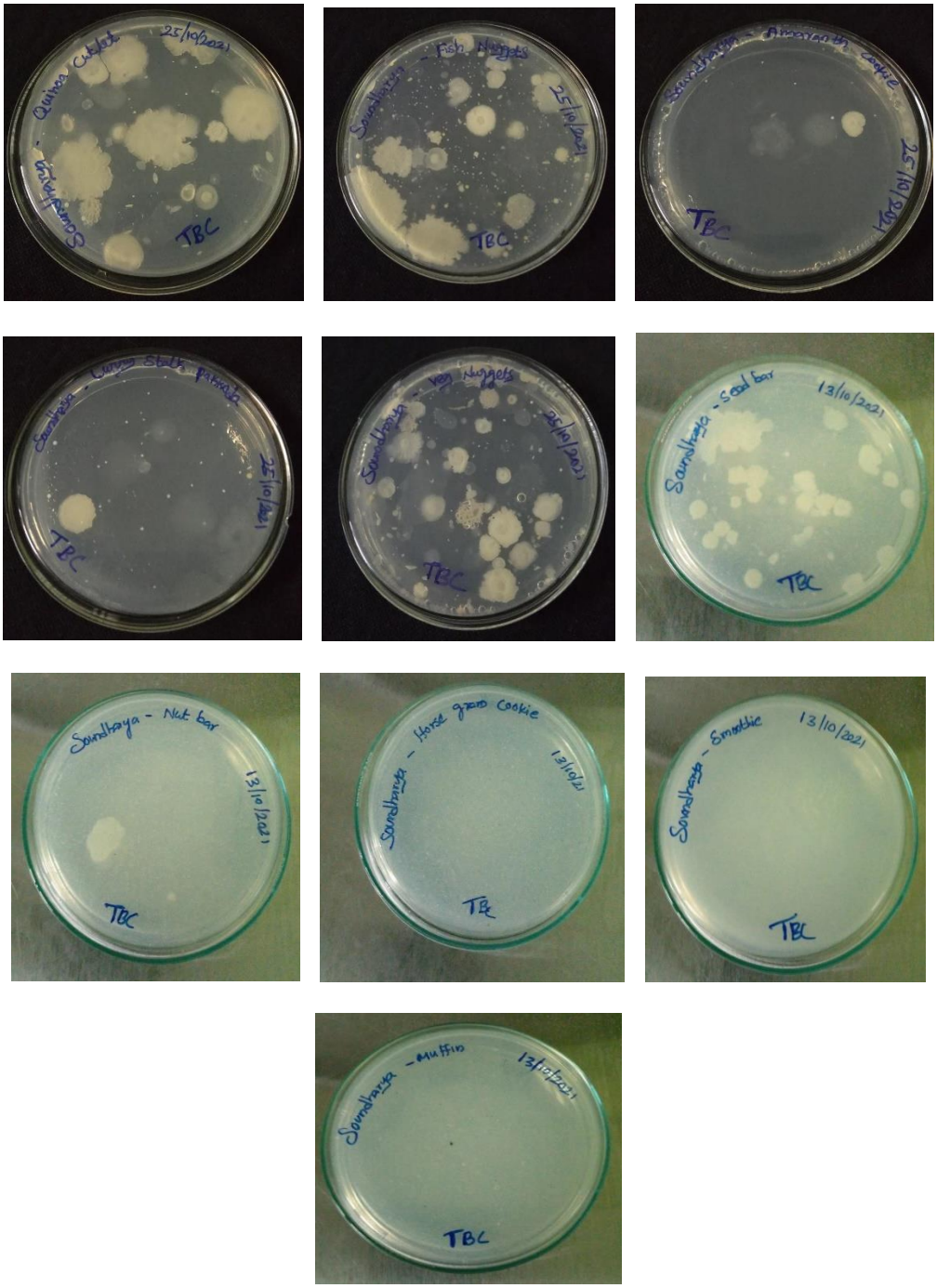

Plate 8

Microbial count in the formulated Snacks

Chemical Analysis

The ash content was found to be high in energy seed recipe formulated whereas the moisture content was found to be high in smoothie and pH level was found to be high in muffin and crackers. This in the current chemical analysis of the recipes formulated by the investigator is found to be having higher content of ash, moisture and pH level was energy seed, smoothie, muffins and horse gram cookies. This was similar to the findings made by Heo *et al.,*2019 where the study has found that the diameter of muffins with a 1–3% addition of β-glucan did not differ statistically significantly from the control variant (MBG0). Bakery goods were even less varied in thickness. However, it was found that 2–4% addition of microbial preparation had an impact on the spread ratio of muffins Kulczynski *et al.,(*2019) found that the chemical analysis of recipes were having high per cent of nutrition in energy seed, smoothie, muffins and horse gram cookies and introduction of larger amounts of β-glucan into products resulted in the binding of a larger amount of water introduced into the dough together with the raw materials, and less moisture loss during baking the batter. Based on this, the study was chemical analysis for the recipes formulated was conducted. The findings are presented in Table XXVII

TABLE XXVII

Ash, Moisture and pH content of the formulated snacks

Nutrients	Scopy Urdu Muffins	Checkbox Nuggets	Energy Seed Coat	Trevally Nuggets	Nut Coated little Millet Cookie	Curry Stalk Pakodi	Rajkira Crackers	Quinoea Yam Cutlet	Amaransu Smoothie	Round Nut Bag
Ash(%)	0.96±0.00	1.02±0.00	3.34±0.02	0.93±0.00	1.29±0.01	2.32±0.00	1.52±0.00	0.41±0.00	0.75±0.00	1.72±0.02
Moisture (%)	9.89±0.00	41.8±0.00	2.71±0.00	59.0±0.01	3.06±0.01	31.7±0.00	1.91±0.01	45.9±0.00	66.5±0.00	5.51±0.01
pH	6.53±0.05	5.66±0.05	6.16±0.05	6.06±0.05	6.53±0.05	5.46±0.05	6.36±0.05	5.53±0.05	5.46±0.05	6.06±0.05

Textural analysis

Textural analysis for the selected recipes were carried out and the mean scores of the muffin was 838.31 in case of veg nuggets, the mean was 1.93 followed by energy seed value being 1101.42 whereas for fish nuggets the mean value was 1.50 for horse gram cookies the hardness was found to be 1.7 the recipe pakoda had the mean value 100.90, crackers had 1.27 mean score, cutlet had mean value of 319.157± 0.04 and amaransu smoothie had a mean

value of 2.37±0.01 and nut bar had value as 109.9. This showed that energy seed had a high mean value that was in the recipes formulated in the study and this was similar to the findings made by Heo *et al.*,(2019) where textural characteristics are of prime importance since they can affect consumer acceptance of the products. The control showed the lowest hardness value (412 N), and as the KBP content increased, the hardness values of the muffins gradually increased. With the addition of KBP, the gluten in the dough was diluted and thereby, it might cause a decreased gas-capturing ability and increased density of the muffins. The findings are presented in Table XXVIII

TABLE XXVIII

Texture Analysis of the formulated snacks

Nutrient	Muffin	Veg nuggets	Energy seed	Fish nuggets	Horse gram cookies	Pakoda	Crackers	Cutlet	Smoothie	Nut bar
Hardness	838.31 ± 9.0	1.93 ± 0.02	1101.42 ± 22.63	1.50 ± 0.01	1.71 ± 0.05	100.90 ± 3.52	1.27 ± 0.10	319.157 ± 0.04	2.37 ± 0.01	109.90 ± 0.78

Colour Analysis:

Colour is a sensory attribute of food that can be used to determine its quality and consumer acceptability. As per Table XXVIX the colour analysis of the formulated recipes showed that horse gram cookies mean value to dominate all the other recipes with the mean value of 78.392 in 'L'. The mean value of Pakodi showed the best in all recopied in terms of 'a' and the mean value of Veg Nuggets shows as the best in all recipe in terms of 'b' and the result was similar to the findings made by Pathare *et al.*, (2013) where colour is one of the most widely measured product quality attributes in postharvest handling and in the food processing research and industry. Apart from differences in instrumentation, colour measurements are often reported based on different colour indices even for the same product, making it difficult to compare results in the literature. There is a need for standardisation to improve the traceability and transferability of measurements. The correlation between colour and other sensory quality attributes was well established and associated.

TABLE XXVIX

Colour analysis of the formulated snacks

	Scopy Urdu Muffins	**Checkbox Nuggets**	**Energy Seed Coat**	**Trevally Nuggets**	**Nut Coated little Millet Cookie**
Colour analysis	L-67.96±2.46 a-0.61±0.23 b-26.63±0.21	L 58.30 ± 6.51 a 11.00 ± 2.00 b 52.33 ± 4.90	L 33.55±1.2 a 3.67±0.23 b 11.23±0.59	L 62.30 ± 5.51 a 10.00 ± 3.00 b 50.67 ± 1.15	L 78.392 ± 1.70 a 5.334 ± 1.04 b 12.991 ± 0.13
	Curry Stalk Pakodi	**Rajkira Crackers**	**Quinoea Yam Cutlet**	**Amaransu Smoothie**	**Round Nut Bag**
	L 46.87 ± 4.01 a 16.56 ± 0.15 b 19.60 ± 4.02	L 43.79 ±0.06 a 14.12 ±0.05 b 35.21 ±0.02	L -67.07 ±0.058 A-2.70± 0.102 B- 15.09± 0.277	L 34.13±1.98 a 15.89±5.54 b 4.69±1.62	L 68.25 ±0.55 a 6.15 ±1.30 b 27.62 ±1.47

Macronutrient content of the formulated snacks

The energy level of the recipes incorporated for the study was identified on basis of kcal. The findings showed that crackers mean score to be high with the value 521.36 Kcal compared to other recipes in the study whereas the carbohydrates of the recipes based on grams showed that energy seed to be dominating other recipes with the mean value of 65.94 Kcal. The protein content of the recipes showed that the gram of the recipes showed that horse gram was high with the mean value of 16.83 g. The fat content in the recipes indicated that crackers fat content to be adequate with the mean value of 27.02 g. The crude fibre content in the recipes showed that crackers mean (4.31 g) value was high when compared to other recipes in the study. The dietary fibre content in the recipes showed that crackers to be having high value as the mean score was 12.82 g. From this it can be incurred that horse gram cookies, energy seed and crackers to be having high content of energy, carbohydrates, protein, fat, crude fibre and dietary fibre indicating that these recipes will have high energy content for the children resulting in improving their health condition the same has been found in studies carried by Kumar *et al.,(*2010) and Sudha (2015). The findings are presented in Table XXX

TABLE XXX

Macronutrient content of the formulated snacks

Nutrients	Scopy Urdu Muffins	Checkbox Nuggets	Energy Seed Coat	Trevally Nuggets	Nut Coated little Millet Cookie	Curry Stalk Pakodi	Rajkira Crackers	Quinoea Yam Cutlet	Amaransu Smoothie	Round Nut Bag
Energy (Kcal)	489.23±0.15	333.16±0.05	439.77±0.06	233.28 ±0.10	474.09 ±0.01	389.36±0.05	521.36 ±0.15	304.74±0.07	136.83±0.20	489.12±0.08
Carbohydrate (g)	47.3±0.04	19.90 ± 0.03	65.94±0.04	8.73 ±0.01	60.49 ±0.03	32.22±0.01	58.03 ±0.02	26.17±0.01	26.7±0.04	55.05 ±0.03
Protein (g)	15.38±0.01	16.32 ± 0.02	15.19±0.01	16.71 ±0.01	16.83 ±0.01	8.61±0.01	11.51 ±0.01	9.52±0.01	4.82±0.02	14.11 ±0.01
Fat (g)	26.50±0.02	20.92 ± 0.02	12.8±0.02	14.61 ±0.01	18.31 ±0.01	25.11±0.01	27.02 ±0.02	17.99±0.01	1.19±0.01	23.60 ±0.01
Crude Fibre (g)	0.99±0.01	1.18 ± 0.02	3.77±0.02	0.20 ±0.01	3.78 ±0.02	6.85±0.01	4.31 ±0.01	3.55±0.01	0.80±0.02	4.25 ± 0.01
Dietary Fibre(g)	2.69±0.01	4.92 ± 0.02	9.45±0.01	0.65 ±0.01	10.35 ±0.02	12.12±0.02	12.82 ±0.01	6.20±0.01	2.99±0.01	8.54 ±0.01

Mineral content of the formulated snacks

The mineral content in the developed snacks by the researcher for the study was examined and results were tabulated in Table XXXI

The mineral content for the formulated recipes muffins, veg nuggets, energy seed, fish nuggets, horse gram cookies, pakoda, crackers, cutlet, smoothie and nut bar was studied for calcium, iron, phosphorus, magnesium and zinc. The findings showed that energy seed to having high calcium content with the mean score of 67.5 mg whereas iron content was found to be high same with energy seed as the mean score value was 12.2 mg while compared to other recipes incorporated in the study. In case of phosphorus the recipe crackers was dominating other recipes with the mean score 268.73 mg whereas the mean value of magnesium was high in the recipe pakoda incorporated in the study as the value was 130.33 mg and zinc content was high in the recipe muffin with value 20.83 mg. Thus from the mineral content examination it can be identified that energy seed, crackers, muffins to be having high level of mineral content when compared to other recipes in the study and it can be very beneficial in the consumption of children to develop their health by providing proper minerals needed. This is similar to the finding of Coello *et al.*,(2022) where 8MSP bar exhibited higher protein, ash and fat and lower total carbohydrate contents than control, and was a good source of B_1 and B_2 vitamins (983.0 and 94.1 μg/100 g dry matter, dm, respectively) and minerals. 18% MSP inclusion significantly ($p \leq 0.05$) enhanced the contents of total amino acid (80.8 mg/g dm), the relative content of unsaturated fatty acids (FA) (64.0 g/100 g of total FA), γ-aminobutyric acid (GABA, 43.3 mg/100 g dm), and total and individual glucosinolates (GLS) (29.6, 1.1, 0.21 and 30.9 μmol/g dm for glucomoringin, glucosinalbin, glucotropaeolin and total GLS, respectively), as well as the antioxidant activity (647.2 mg TE/100 g dm). 18MSP had good sensory acceptability, mainly due to its appearance, texture and odour.

TABLE XXXI

Mineral content of the formulated snacks

Nutrients	Scopy Urdu Muffins	Checkbox Nuggets	Energy Seed Coat	Trevally Nuggets	Nut Coated little Millet Cookie	Curry Stalk Pakodi	Rajkira Crackers	Quinoea Yam Cutlet	Amaransu Smoothie	Round Nut Bag
Calcium (mg)	64.03±0.15	50.56 ±0.25	67.5±0.26	41.73 ± 0.15	77.92 ±0.02	47.46±0.15	49.69 ±0.02	40.43±0.30	104.33±1.15	48.53 ±0.02
Iron (mg)	3.22±0.02	3.2 ± 0.20	12.2±0.20	2.66 ±0.01	7.32 ±0.00	7.66±0.01	5.69 ±0.01	3.03±0.01	3.68±0.03	3.86 ±0.01
Phosphorus (mg)	39.43±0.20	87.3 ± 0.26	52.8±0.20	105.36 ±0.15	240.50 ±0.10	80.16±0.15	268.73 ±0.11	213.33±1.52	153.00±1.00	69.24 ±0.02
Magnesium (mg)	17.23±0.25	112.56 ± 0.05	75.8±0.10	87.36 ±0.15	86.22 ±0.01	130.33±0.57	51.72 ±0.02	86.23±0.25	71.26±0.25	15.61 ±0.01
Zinc (mg)	20.83±0.15	14.16 ±0.20	18.33±0.15	8.40 ±0.10	13.04 ±0.01	4.21±0.01	18.42 ±0.02	5.40±0.02	2.00±0.10	10.51 ±0.01

Vitamin content of the formulated snacks

The vitamin content of the developed snacks was identified in the study and the result is been given in Table XXXII

The vitamin content of the developed snacks was studied for Vitamin B_6, Vitamin C, Vitamin B_{12} and β -carotene for the recipes muffins, veg nuggets, energy seed, fish nuggets, horse gram cookies, pakoda, crackers, cutlet, smoothie and nut bar. The findings showed that Vitamin B_6 was high in fish nuggets with the mean value of 1.30 mg whereas Vitamin C was high in the recipe energy seed with the mean score 6.53 mg in case of Vitamin B_{12} the content was found to be high in energy seed with mean value 1.43 (µg) and β -carotene was high in smoothie with mean score 332.33 (µg). Thus through the vitamin content of the developed snacks it can be identified that fish nuggets, energy seed and smoothie had a high level of Vitamin content and through regular consumption the vitamin content in the children can be improved this was similar to the findings made in study done by Bhati and Raghuvanshi (2020) where the authors stated that when any recipe is formulated it should have rich content of vitamins so as to provide best health benefits for the respondents.

TABLE XXXII

Vitamin content of the formulated snacks

Nutrients	Scopy Urdu Muffins	Checkbox Nuggets	Energy Seed Coat	Trevally Nuggets	Nut Coated little Millet Cookie	Curry Stalk Pakodi	Rajkira Crackers	Quinoea Yam Cutlet	Amaransu Smoothie	Round Nut Bag
VitaminB_6 (mg)	0.19±0.01	0.72 ± 0.02	0.83±0.02	1.30 ±0.10	1.04 ±0.02	1.21±0.01	0.59 ±0.01	0.17±.01	0.17±0.00	0.12 ±0.01
Vitamin C (mg)	2.62±0.02	1.81 ±0.01	6.53±0.15	0.32 ±0.02	8.13 ±0.01	4.04±0.01	4.24 ±0.01	5.25±0.01	0.30±0.01	2.06 ± 0.01
Vitamin B_{12} (µg)	0.43±0.05	0.13 ±0.05	1.43±0.05	1.46 ±0.05	0.16 ±0.05	0.76±0.05	0.36 ±0.05	0.26±0.05	0.53±0.05	1.13 ±0.05
β-Carotene (µg)	7.63±0.15	6.03 ±0.05	11.1±0.11	10.50±0.50	6.56 ±0.05	66.3±1.5	2.96 ±0.05	4.73±0.11	332.33±2.51	12.86 ±0.11

4.2.3. Fatty Acid Composition of formulated snacks

The fatty acid composition of the various formulated snacks was analysed using GC-MS method and the results were enumerated with molecular formula, retention time, molecular weight and peak area. The identification of fatty acid compounds were based on peak area and molecular formula. Interpretation of mass spectrum of GC – MS was done using the data base of National Institute Standard and Technology (NIST4) and WILEY9. The spectrum of the known component was compared with the spectrum of the known components stored in the inbuilt library.

Fatty acid composition of Quinoea cutlet

Fatty acid composition of Quinoea cutlet analysed using GC-MS is presented in Table XXXIII and Figure 15.

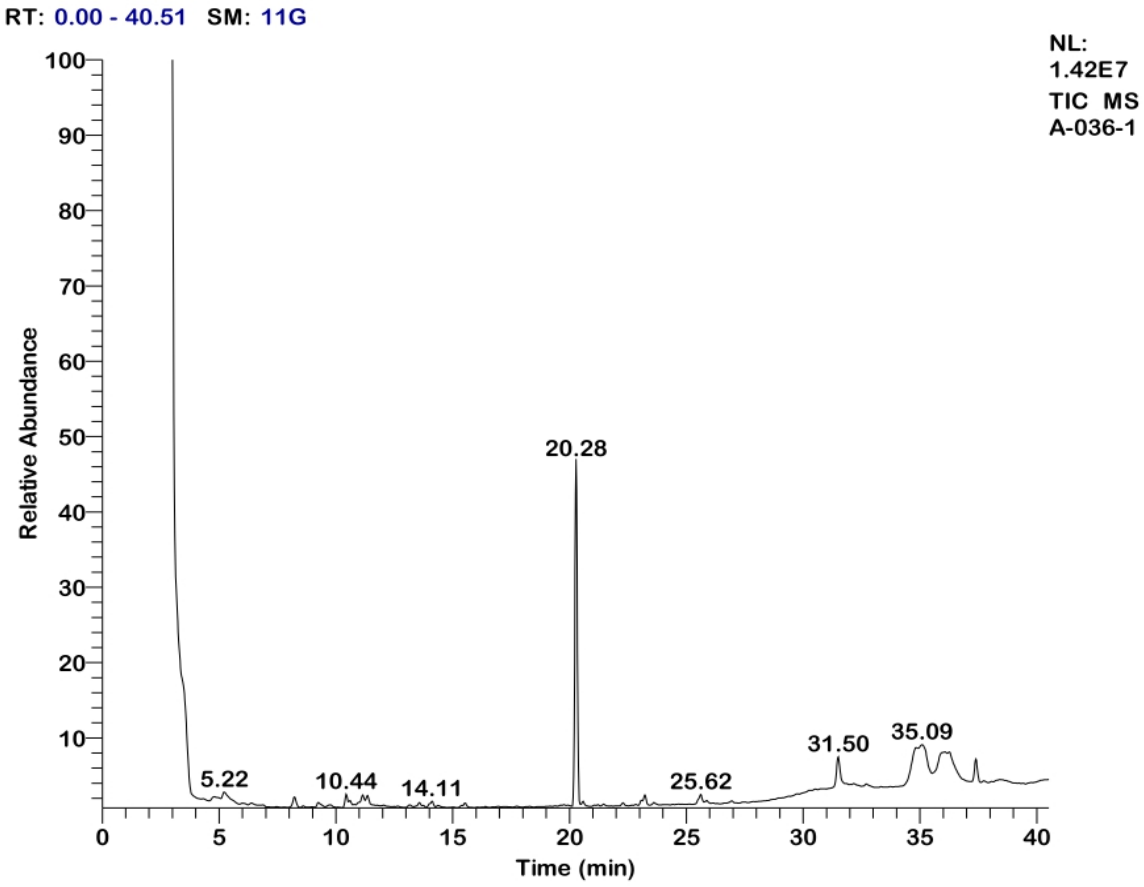

Figure 15

GC-MS Chromatogram of the n-Hexane extract of Quinoea Cutlet

TABLE XXXIII

Compounds identified in the n-Hexane extracts of the quinoea cutlet

S.NO	RT	NAME OF THE COMPOUND	MOLECULAR FORMULA	MOLECULAR WEIGHT	PROBABILITY	PEAK AREA %
1	3.53	2-Butanone, 3,3-dimethyl-1-(methylsulfonyl)-, O-[(methylamino)carbonyl]oxime	$C_9H_{18}N_{2O}4S$	250	1.25	0.47
2	4.77	L-Serine, O-(phenylmethyl)-	$C_{10}H_{13}NO_3$	195	8.93	0.79
3	5.22	Benzene, 1,3,5-trimethyl	C_9H_{12}	120	8.34	0.04
4	6.38	(3R)-3-Phenyl-2,3-dihydro-1H-isoindol-1-one	$C_{14}H_{11}NO$	209	2.56	0.31
5	8.22	Dodecane	$C_{12}H_{26}$	170	3.64	1.61
6	9.24	Memantine	$C_{12}H_{21}N$	173	1.69	0.88
7	9.77	Octacosahexaenoic acid	$C_{28}H_{44}O_2$	413	25.25	0.39
8	10.44	Hexacosahexaenoic acid	$C_{26}H_{44}O_2$	387	36.14	2.25
9	11.15	Triacontahexaenoic acid	$C_{30}H_{48}O_2$	441	23.59	3.30
10	13.15	Docosatrienoic acid	$C_{22}H_{38}O_2$	335	36.45	3.37
11	13.58	Octacosapentaenoic acid	$C_{28}H_{46}O_2$	415	28.12	2.94
12	14.11	Dotriacontahexaenoic acid	$C_{32}H_{52}O_2$	467	30.15	3.14
13	15.53	Triacontapentaenoic acid	$C_{34}H_{56}O_2$	497	45.21	3.84
14	19.77	Eicosatetraenoic acid	$C_{20}H_{32}O_2$	305	47.26	4.44
15	**20.28**	**à-Linolenic acid (octadeca-9,12,15-trienoic acid)**	$\mathbf{C_{18}H_{30}O_2}$	**278**	**69.25**	**14.49**
16	20.58	Octadeca-6,9,12,15-tetraenoic acid	$C_{18}H_{28}O_2$	276	45.08	2.43
17	21.22	Eicosa-8,11,14,17-tetraenoic acid	$C_{20}H_{32}O_2$	305	25.18	2.28
18	22.30	Eicosa-5,8,11,14,17-pentaenoic acid	$C_{20}H_{30}O_2$	303	39.18	1.90
19	23.23	Docosa-7,10,13,16,19- pentaenoic acid	$C_{22}H_{34}O_2$	331	37.56	1.96
20	23.62	Docosa-4,7,10,13,16,19- Hexaenoic acid	$C_{22}H_{32}O_2$	329	33.14	1.38
21	25.62	Hexatriacontahexaenoic acid	$C_{36}H_{62}O_2$	527	29.19	1.13
22	26.94	Ocratriacontahexaenoic acid	$C_{38}H_{66}O_2$	555	28.14	1.33
23	31.50	Tetracosahexaenoic acid	$C_{24}H_{36}O_2$	357	25.19	4.17
24	32.71	Docosapentaenoic acid	$C_{22}H_{34}O_2$	331	36.10	1.47
25	35.07	Hexacosahexaenoic acid	$C_{26}H_{40}O_2$	385	24.19	4.91

The above table brings out the components identified in the n-Hexane extracts of the Quinoa cutlet by GC-MS. The maximum peak area represented in the Quinoa cutlet is à-Linolenic acid (octadeca-9,12,15-trienoic acid)- $C_{18}H_{30}O_2$ which has the molecular weight of 278 and the peak area percentage was 14.49. Linolenic Acid is an essential fatty acid belonging to the omega-3 fatty acids group. It is highly concentrated in certain plant oils and has been reported to inhibit the synthesis of prostaglandin resulting in reduced inflammation and prevention of certain chronic diseases. The nutritional quality of quinoa is often related to the high protein content of their seeds. However, and despite not being an oilseed crop, the oil composition of quinoa seeds is remarkable due to its profile, which shows a high proportion of polyunsaturated fatty acids (PUFAs), particularly in essential fatty acids such as linoleic (ω-6) and α-linolenic (ω-3) which was mentioned by da Silva *et.al,* 2021

Fatty acid composition of Rajkira Crackers

Fatty acid composition of Rajkira Crackers analysed using GC-MS is presented in Table XXXIV and Figure 16.

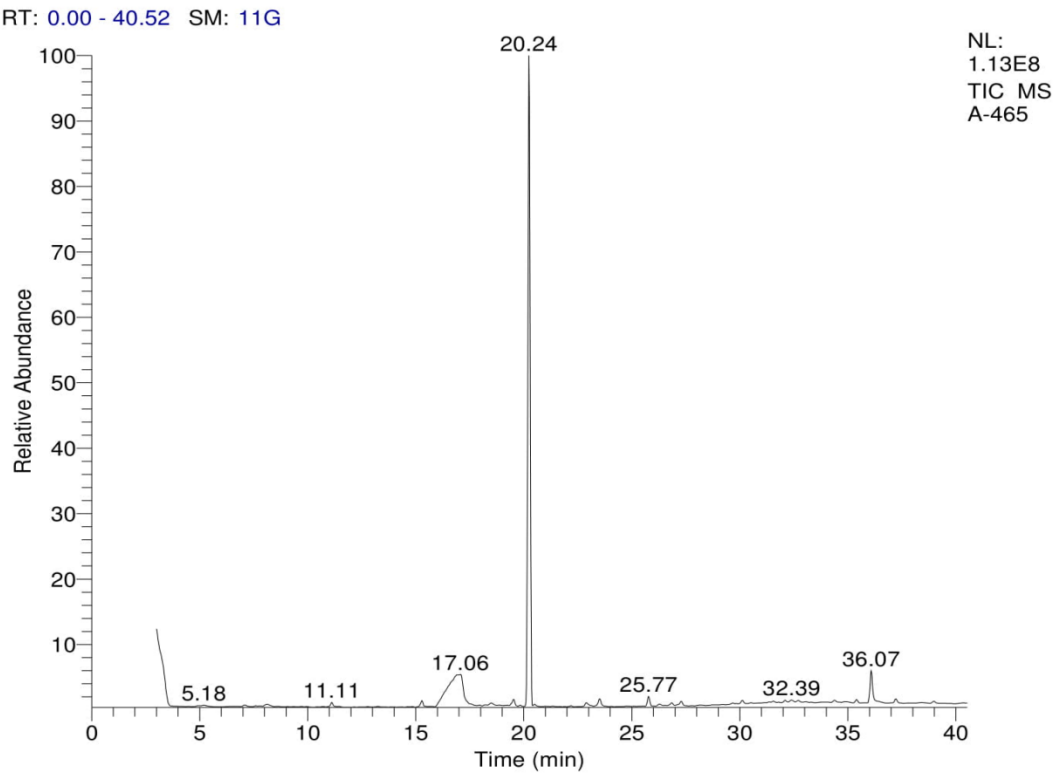

Figure 16

GC-MS Chromatogram of the n-Hexane extract of Rajkira crackers

TABLE XXXIV

Compounds identified in the n-Hexane extracts of the Rajkira crackers

S.NO	RT	NAME OF THE COMPOUND	MOLECULAR FORMULA	MOLECULAR WEIGHT	PROBABILITY	PEAK AREA %
1	7.08	Oxiranepentanoic acid, 3-undecyl-, methyl ester, trans	$C_{19}H_{36}O_3$	312	3.42	0.24
2	8.12	dl-2,6-Diaminoheptanedioic acid	$C_7H_{14}N_2O_4$	190	6.36	0.33
3	11.11	Hexadecen-1-ol, trans-9-	$C_{16}H_{32}O$	240	4.56	0.48
4	15.29	Triacontapentaenoic acid	$C_{34}H_{56}O_2$	497	25.15	3.84
5	17.06	Docosa-7,10,13,16,19- pentaenoic acid	$C_{22}H_{34}O_2$	331	16.21	1.96
6	18.49	Docosa-4,7,10,13,16,19- Hexaenoic acid	$C_{22}H_{32}O_2$	329	29.45	1.38
7	19.53	Octacosahexaenoic acid	$C_{28}H_{44}O_2$	413	10.02	0.39
8	19.83	Hexacosahexaenoic acid	$C_{26}H_{44}O_2$	387	31.25	2.25
9	20.24	Triacontahexaenoic acid	$C_{30}H_{48}O_2$	441	56.18	3.30
10	20.51	Docosatrienoic acid	$C_{22}H_{38}O_2$	335	23.48	3.37
11	22.20	Octacosapentaenoic acid	$C_{28}H_{46}O_2$	415	19.57	2.94
12	22.89	Dotriacontahexaenoic acid	$C_{32}H_{52}O_2$	469	15.09	3.14
13	23.51	Hexacosahexaenoic acid	$C_{26}H_{40}O_2$	385	21.48	4.91
14	**25.77**	**à-Linolenic acid (octadeca-9,12,15-trienoic acid)**	**$C_{18}H_{30}O_2$**	**278**	**79.25**	**13.48**
15	26.27	Eicosatetraenoic acid	$C_{20}H_{32}O_2$	305	19.78	5.44
16	26.86	Octadeca-6,9,12,15-tetraenoic acid	$C_{18}H_{28}O_2$	276	46.12	5.42
17	27.28	Eicosa-8,11,14,17-tetraenoic acid	$C_{20}H_{32}O_2$	305	38.18	4.27
18	29.66	Eicosa-5,8,11,14,17-pentaenoic acid	$C_{20}H_{30}O_2$	303	38.14	4.91
19	31.55	Lucenin 2	$C_{27}H_{30}O_{16}$	610	19.54	0.23
20	32.10	Colchifoleine	$C_{21}H_{23}NO_7$	401	17.99	0.28
21	32.39	17-Pentatriacontene	$C_{35}H_70$	490	4.90	0.21
22	32.69	2-Nonadecanone 2,4-dinitrophenylhydrazine	$C_{25}H_{42}N_4O_4$	462	4.62	0.27
23	34.38	Narceine	$C_{23}H_{27}NO_8$	445	13.74	0.24
24	34.85	Pseudojervine	$C_{33}H_{49}NO_8$	587	12.59	0.35
25	35.40	13-Docosenamide	$C_{22}H_{43O}N$	337	16.80	0.55

GC-MS Chromatogram of the n-Hexane extract of Rajkira crackers was found to be high in **à-Linolenic acid (octadeca-9,12,15-trienoic acid)- $C_{18}H_{30}O_2$ with the molecular weight of 278 and the peak percentage was 13.48.** The oil of amaranth grain (*Amaranthus* spp.) is a rich source of poly-unsaturated fatty acids and with high linolenic acid in the Rajkira crackers there is greater change in the positive side of growth of health.

Fatty acid composition of Nut coated little millet cookie

Fatty acid composition of Nut coated little millet cookie analysed using GC-MS is presented in Table XXXV and Figure 17.

.

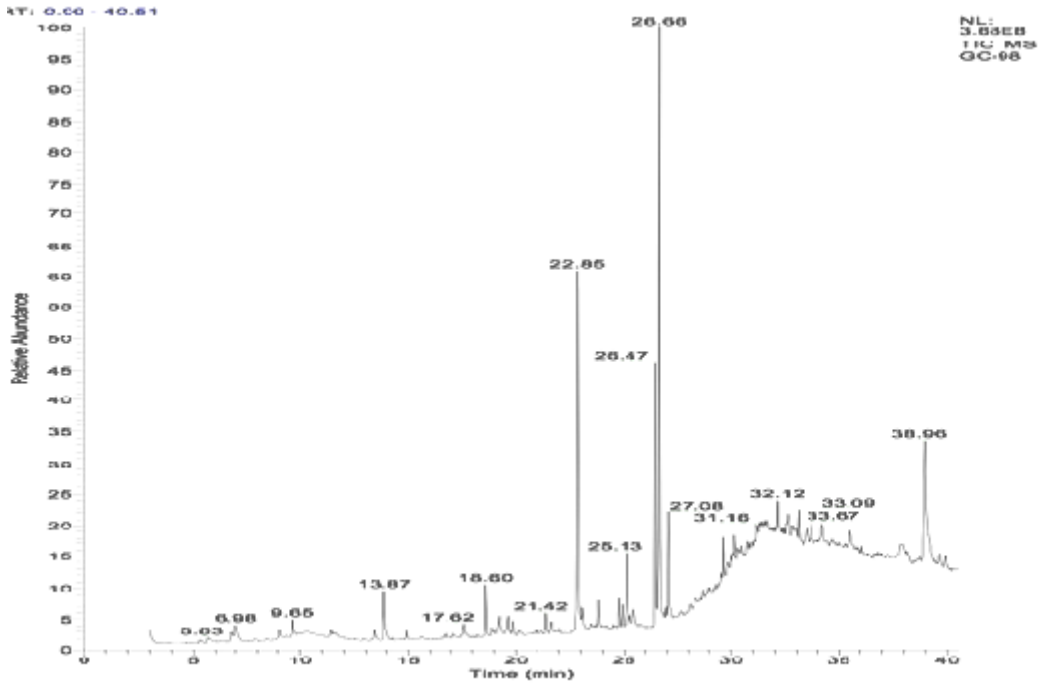

Figure 17

GC-MS Chromatogram of the n-Hexane extract of Nut coated little millet cookie

TABLE XXXV

Compounds identified in the n-Hexane extracts of the Nut coated little millet cookie

S.No	Rt	Name of the compound	Molecular formula	Molecular weight	Probability	Peak area %
1	7.00	Acetic acid, 2-ethylhexyl ester	$C_{10}H_{20}O_2$	172	6.50	1.86
2	9.67	Cyclotetradecane	$C_{14}H_{28}$	196	7.48	1.11
3	10.31	Methyl 4-hydroxypentanoate	$C_6H_{12}O_3$	132	9.57	0.88
4	11.45	5,5'-difluoro-2,2'-(propane-1,3-diyldiimino)bis(benzyl alcohol)	$C_{17}H_{20}F_2N_2O_2$	322	5.11	0.90
5	13.90	Octacosahexaenoic acid	$C_{28}H_{44}O_2$	413	25.25	0.39
6	17.62	Hexacosahexaenoic acid	$C_{26}H_{44}O_2$	387	36.14	2.25
7	18.60	Triacontahexaenoic acid	$C_{30}H_{48}O_2$	441	33.59	3.30
8	19.23	2-Hexadecen-1-ol, 3,7,11,15-tetramethyl	$C_{20}H_{40}O$	296	8.92	1.47
9	21.66	N-[3'-Cyano-6'-(3"-methyl-5"-oxo-1"-phenyl-2"-pyrazolin-4"-yl)-4'-phenylpyridin-2'-yl]benzamide	$C_{29}H_{21}N_5O_2$	471	5.45	1.12
10	22.87	Hexadecanoic acid, ethyl ester	$C_{18}H_{36}O_2$	284	20.90	14.40
11	23.82	7,9-di-tert-butyl-1-oxaspiro[4.5]deca-6,9-diene-2,8-dione	$C_{17}H_{24}O_3$	276	5.37	1.69
12	24.74	6-Iodoacetoveratrone	$C_{10}H_{11}IO_3$	306	5.34	1.29
13	25.13	2-Hexadecen-1-ol, 3,7,11,15-tetramethyl	$C_{20}H_{40}O$	296	4.83	2.88
14	25.47	Tetradecanal	$C_{14}H_{28}O$	212	6.47	0.92
15	26.66	**à-Linolenic acid (octadeca-9,12,15-trienoic acid)**	**$C_{18}H_{30}O_2$**	**278**	**89.25**	**11.56**
16	27.06	Octadeca-6,9,12,15-tetraenoic acid	$C_{18}H_{28}O_2$	276	65.08	3.15
17	29.65	Eicosa-8,11,14,17-tetraenoic acid	$C_{20}H_{32}O_2$	305	45.18	3.67
18	30.14	Eicosa-5,8,11,14,17-pentaenoic acid	$C_{20}H_{30}O_2$	303	49.25	2.48
19	31.34	2à,3á,4à,6á,11,19-hexahydroxy-9,11-secocholest-(22E,24S)-24-methylen-9-one (Eurypongiol A3)	$C_{28}H_{48}O_7$	496	38.16	4.05
20	32.59	3,4,6,7,12,12b-Hexahydro-2-methoxy-4-(4'-bromophenyl)indolo[2,3-a]quinolizine	$C_{22}H_{21}BrN_2O$	408	15.84	0.85
21	33.09	Phthalic acid, 2-ethylhexyl pentadecyl ester	$C_{31}H_{52}O_4$	488	12.77	1.88
22	33.44	5-(Ethoxycarbonyl)-7-[(4-fluorophenyl)amino]thieno[3,2-d][1,3]diazepine	$C_{16}H_{14}FN_3O_2S$	331	20.80	0.87
23	33.67	3á-Acetoxy-2'-cyclohexyl-2",3",4",5",16á,17á-hexahydro-2'H-5à-androstano[16,17-e]furo[3",4"-c][1',2']oxazin-2"-one	$C_{31}H_{47}NO_5$	513	29.63	0.83
24	34.19	Docosapentaenoic acid	$C_{22}H_{34}O_2$	331	40.25	5.63
25	35.56	Hexacosahexaenoic acid	$C_{26}H_{40}O_2$	385	35.78	6.71

GC-MS Chromatogram of the n-Hexane extract of Nut coated little millet cookie showed that it has higher peak for **à-Linolenic acid (octadeca-9,12,15-trienoic acid) - $C_{18}H_{30}O_2$ with the peak percentage 11.56.** Horse gram [Macrotyloma uniflorum (Lam.) Verdc.] seeds containing high concentrations of fatty acids, flavonols and minerals should provide government, public and private organizations with a nutritious and healthy food for use by malnourished and food deprived people worldwide. Seeds from seven horse gram accessions, geographically adapted to Griffin, GA, USA were analyzed for fatty acid, flavonol, and mineral concentrations using gas chromatography, reverse-phase high performance liquid chromatography, and inductively coupled plasma-optical emission spectroscopy, respectively. Significant year effects occurred for stearic, oleic, linoleic, arachidic, gadoleic, and lignoceric acids. Oleic, linoleic, and linolenic acid ranged from 8.9%–16.8%, 40.3%–45.6%, and 11.6%–14.3%, respectively, as percent of total fatty acids measured (total oil ranged from 2.32% to 2.87%) as stated by Morris *et.al,* 2013.

Fatty acid composition of Amaransu smoothie

Fatty acid composition of Amaransu smoothie analysed using GC-MS is presented in Table XXXVI and Figure 18.

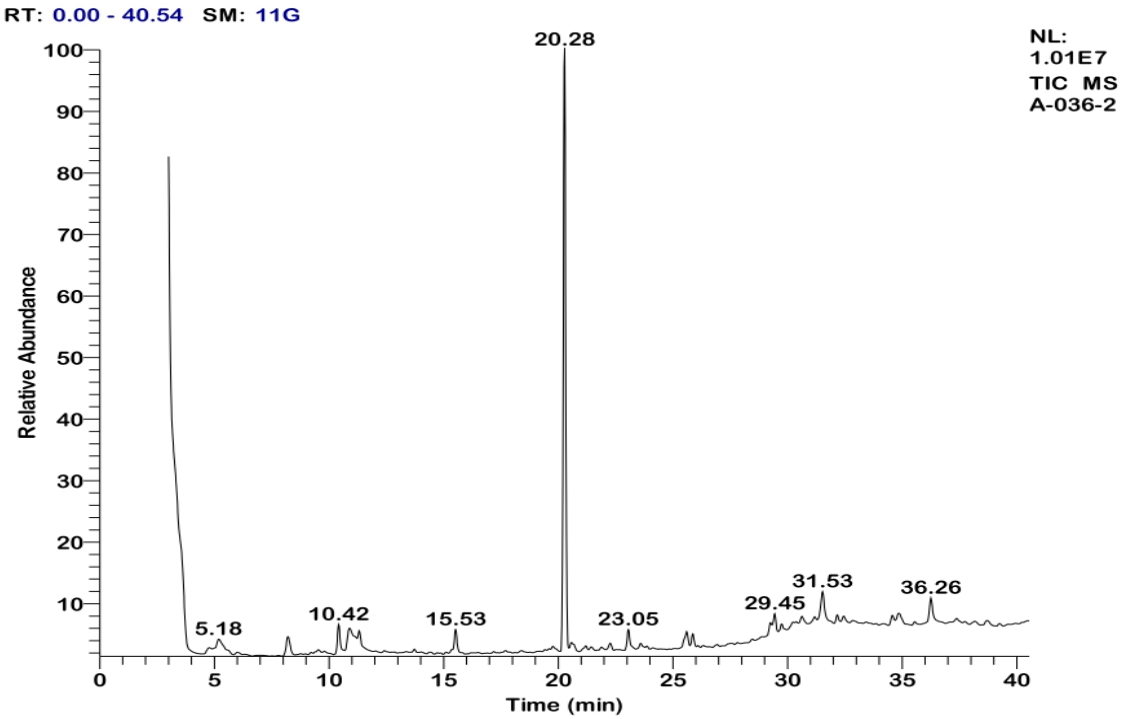

Figure 18

GC-MS Chromatogram of the Methanol extract of Amaransu smoothie

TABLE XXXVI

Compounds identified in the n-Hexane extracts of the Amaransu smoothie

S.no	Rt	Name of the Compound	Molecular formula	Molecular weight	Probability	Peak area %
1	3.35	Benzene, methyl-	C_7H_8	92	5.28	0.47
2	8.20	Dodecane	$C_{12}H_{26}$	170	0.56	0.79
3	10.42	(1R*,3aR*/S*)-1-Ethyl-1,2,3,3a,4,5-hexahydropyrrolo[1,2-a]quinolone	$C_{14}H_{19}N$	201	15.72	0.04
4	10.89	Ethyl 2-tetralone-1-carboxylate	$C_{13}H_{14}O_3$	218	14.81	0.31
5	11.31	Diethyl2-(tricyclo[3.3.0.0(3,7)]octan-2'-ylidene)propanedioate	$C_{15}H_{20}O_4$	264	4.55	1.61
6	15.51	4-Azido-2-methylbenzoic Acid	$C_8H_7N_3O_2$	177	16.47	0.88
7	19.77	Docosatrienoic acid	$C_{22}H_{38}O_2$	334.5	30.25	2.58
8	20.28	**à-Linolenic acid (octadeca-9,12,15-trienoic acid)**	**$C_{18}H_{30}O_2$**	**278**	**75.12**	**12.99**
9	20.58	Octadeca-6,9,12,15-tetraenoic acid	$C_{18}H_{28}O_2$	277	18.59	5.32
10	21.20	Eicosa-8,11,14,17-tetraenoic acid	$C_{20}H_{32}O_2$	305	65.25	9.21
11	22.28	Eicosa-5,8,11,14,17-pentaenoic acid	$C_{20}H_{30}O_2$	303	46.18	5.66
12	23.05	Docosa-7,10,13,16,19- pentaenoic acid	$C_{22}H_{34}O_2$	331	54.19	8.79
13	23.60	Docosa-4,7,10,13,16,19- Hexaenoic acid	$C_{22}H_{32}O_2$	329	55.36	4.91
14	25.60	9-Octadecenoic acid (Z)-, methyl ester	$C_{19}H_{36}O_2$	296	19.63	4.44
15	25.86	Lactaropallidin	$C_{15}H_{24}O_3$	252	15.60	**13.51**
16	29.45	Fenretinide	$C_{26}H_{33}NO_2$	391	36.28	2.43
17	29.75	7-Methyl-Z-tetradecen-1-ol acetate	$C_{17}H_{32}O_2$	268	28.93	2.28
18	30.24	Hexatriacontahexaenoic acid	$C_{36}H_{62}O_2$	527	34.53	1.90
19	30.63	Ocratriacontahexaenoic acid	$C_{38}H_{66}O_2$	555	19.50	1.96
20	31.53	2-Pyridineethanol, 1-oxide	$C_{22}H_{23}N$	301	2.26	1.38
21	32.17	2,6-dimethyl-N-(2-methyl-à-phenylbenzyl)aniline	$C_{15}H_{24}O_4$	268	14.17	1.13
22	32.46	Cholic acid	$C_{24}H_{40}O_5$	408	14.76	1.33
23	34.57	Dotriacontane	$C_{32}H_{66}$	450	7.59	4.17
24	34.86	Hexacosahexaenoic acid	$C_{26}H_{40}O_2$	385	44.94	1.47

The components identified in the n-Hexane extracts of the Amaransu smoothie showed that it had peak for à-Linolenic acid (octadeca-9,12,15-trienoic acid)- $C_{18}H_{30}O_{2-}$ with molecular weight 278 and peak percentage 12.99 which was similar to the findings of Kayat *et al.,* 2016.

Fatty acid composition of Scopy Urdu Muffins

Fatty acid composition of scopy urdu muffins analysed using GC-MS is presented in Table XXXVII and Figure 19.

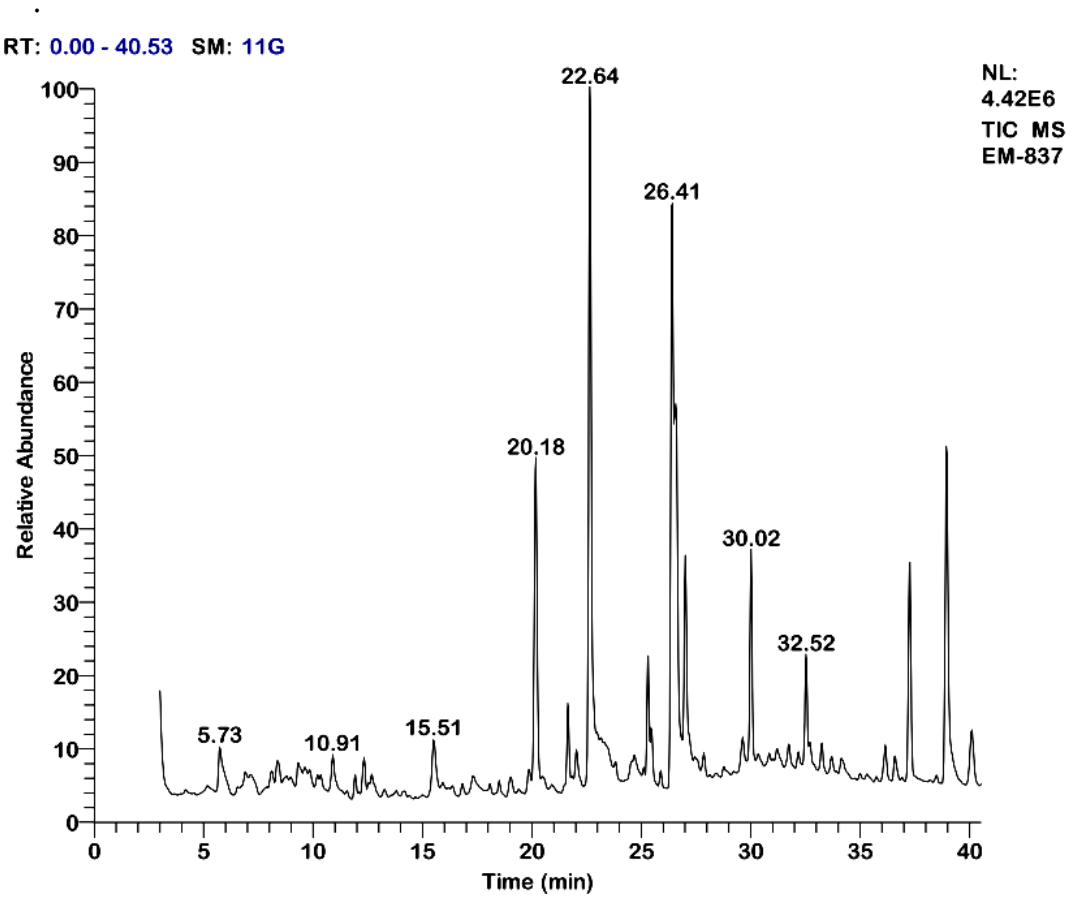

Figure 19

GC-MS Chromatogram of the n-Hexane extract of Scopy Urdu Muffins

TABLE XXXVII

Compound identified in the n-Hexane extracts of Scopy Urdu Muffins

S.NO	RT	NAME OF THE COMPOUND	MOLECULAR FORMULA	MOLECULAR WEIGHT	PROBABILITY	PEAK AREA %
1	7.0	(1R*)-Hexahydro-4'-(1"-hydroxy-2"-octenyl)-5,5-di methylspiro[1,3-dioxane-2,2'-(1'H)-pentalen]-5'-ol	$C_{21}H_{36}O_4$	352	2.50	2.06
2	8.22	2-(Bisacetylamino)-4-trifluoromethyl- ,7,8,9,10,11-hexahydro-5,9;7,11- dimethano-5H-[9]annuleno[d]pyrimidine	$C_{18}H_{20}F_3N_3O_2$	367	12.78	3.14
3	9.58	5-Methoxypyrrolidin-2-one	$C_5H_9NO_2$	115	7.87	1.66
4	11.58	6-[(2'-Propionyloxy)propyl]-2,3,5-trimethyl-1,4-benz Oquinone	$C_{15}H_{20}O_4$	264	8.88	2.83
5	15.10	cis-4-(Carbazol-9-yl)-6-methyl-2-(p-nitrophenyl)-1, 2,3,4-tetrahydroquinoline	$C_{28}H_{23}N_3O_2$	433	12.42	2.35
6	15.37	1-Propyl-1-[(tert-butyldimethylsilyl)oxy]perfloroheptene	$C_{16}H_{22}F_{12}OSi$	486	25.70	3.90
7	16.57	4-ACETOXY-D-MANDELIC ACID-NITRITE-B-D- GLUCOPYRANOSIDE	$C_{24}H_{27}NO_{12}$	521	24.68	2.34
8	17.32	(1-CYCLOXEXEN-1-YL)-DIPHENYLPHOSPHA NOXIDE	$C_{18}H_{19}OP$	282	13.33	1.80
9	20.18	Eicosatetraenoic acid	$C_{20}H_{32}O_2$	305	57.08	2.83
10	**22.64**	**à-Linolenic acid (octadeca-9,12,15-trienoic acid)**	$\mathbf{C_{18}H_{30}O_2}$	**278**	**73.45**	**6.43**
11	26.41	Octadeca-6,9,12,15-tetraenoic acid	$C_{18}H_{28}O_2$	276	49.17	2.39
12	27.51	Eicosa-8,11,14,17-tetraenoic acid	$C_{20}H_{32}O_2$	305	36.57	5.68
13	28.75	Eicosa-5,8,11,14,17-pentaenoic acid	$C_{20}H_{30}O_2$	303	25.38	4.15
14	29.06	Docosa-7,10,13,16,19- pentaenoic acid	$C_{22}H_{34}O_2$	331	30.24	4.08
15	30.02	Docosa-4,7,10,13,16,19- Hexaenoic acid	$C_{22}H_{32}O_2$	327	47.18	5.32
16	31.14	Ppropiolic acid, 3-(1-hydroxy-2-isopropyl-5-methylcyclohexyl)	$C_{13}H_{20}O_3$	224	16.72	2.48
17	32.22	N1-Allyl-N2-hydroxy-N2-methylpropane-1,2-diamine	$C_7H_{16}N_2O$	144	9.82	4.89
18	32.50	5-Pentylporphyrin	$C_{25}H_{24}N_4$	380	17.83	2.43
19	33.15	1,2-Benzenedicarboxylic acid, dibutyl ester	$C_{16}H_{22}O_4$	278	18.23	6.83
20	34.03	1,1,2,3-Tetrachloro-1,2-dimethoxypropane	$C_5H_8C_{l4}O_2$	240	21.28	3.59
21	34.44	2-exo-Amino-5,6-endo-dideuterionorbornan-3-one	$C_7H_9D_2NO$	125	9.86	2.42
22	34.97	Ocratriacontahexaenoic acid	$C_{38}H_{66}O_2$	555	26.52	5.56
23	35.29	Tetracosahexaenoic acid	$C_{24}H_{36}O_2$	357	28.53	2.94
24	35.70	Bis(3,4-dimethoxycinnamoyl)-L-tartaric acid	C26H26O12	530	10.91	2.10
25	36.03	Octacosahexaenoic acid	$C_{28}H_{44}O_2$	413	16.55	1.59

The components identified in the n-Hexane extracts of the Scopy Urdu Muffins by GC-MS showed that it had peak in à-Linolenic acid (octadeca-9, 12, 15-trienoic acid)- $C_{18}H_{30}O_2$ with molecular weight 278 and the peak percentage estimated was 6.43 which was similar to the findings given by Ambigaipalan *et al.*, (2020).

Fatty acid composition of Checkbox Nuggets

Fatty acid composition of Checkbox Nuggets analysed using GC-MS is presented in Table XXXVIII and Figure 20.

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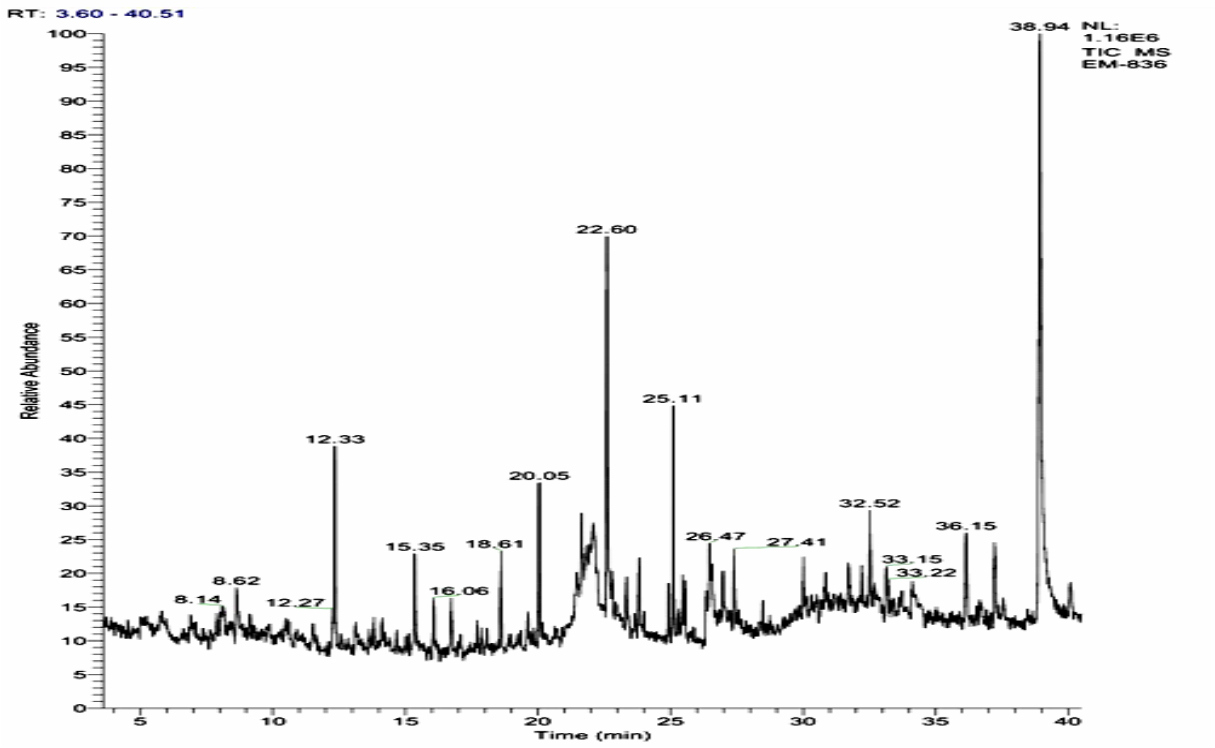

Figure 20

GC-MS Chromatogram of the n-Hexane extract of Checkbox Nuggets

TABLE XXXVIII

Compounds identified in the n-Hexane extracts of the Checkbox Nuggets

S.NO	RT	NAME OF THE COMPOUND	MOLECULAR FORMULA	MOLECULAR WEIGHT	PROBABILITY	PEAK AREA %
1	3.27	5-Cyano-1,2-dimethyl-4,5-diphenyl-4-à-pyridyl-. DE LTA.2-imidazoline	$C_{23}H_{20}N_4$	352	2.12	2.46
2	4.10	3,5-Dideoxy-5-dimethyloxyphosphinoyl-1,2-O-isopropylidene-à,D-ribo-hexofuranose	$C_{11}H_{21}O_7P$	296	1.60	1.98
3	6.59	2-Trifluoroacetyl-1-[(ethoxycarbonyl)carbonyl]-1-m ethyl-1,2,3,4-tetrahydro-á-carboline	$C_{18}H_{17}F_3N_2O_4$	382	10.88	2.43
4	7.97	Dimethyl2-phenyl-c-5-(3'-pyridyl)pyrrolidine-r-2,c-4-dicarbo xylate	$C_{19}H_{20}N_2O_4$	340	5.06	2.88
5	8.52	Cyclopentolate	$C_{17}H_{25}NO_3$	291	16.57	3.33
6	12.29	1,2-Pentadiene, 4-methoxy-4-methyl	$C_7H_{12}O$	112	7.39	4.11
7	14.55	2-[Bis[2-(trimethylsilyl) ethoxy]methyl]propanol	$C_{14}H_{34}O_3Si_2$	306	2.59	2.40
8	15.10	2-[(E)-2-(1-Benzylamino) -3-phenylprop-2-enyl]phenol	$C_{22}H_{21}NO$	315	40.0	4.29
9	18.89	Imidazolidine, 1-benzyl-2-tert.butyl-3-methyl-4-one-	$C_{15}H_{22}N_2O$	246	5.05	4.44
10	19.61	12-ZABICYCLO(9.2.1)TETRADECA-1(14)-ENE-13-ONE	$C_{13}H_{21}NO$	207	6.68	2.37
11	20.62	Triacontapentaenoic acid	$C_{34}H_{56}O_2$	497	42.99	2.24
12	21.89	Eicosatetraenoic acid	$C_{20}H_{32}O_2$	305	43.50	4.18
13	**22.60**	**à-Linolenic acid (octadeca-9,12,15-trienoic acid)**	**$C_{18}H_{30}O_2$**	**278**	**94.29**	**12.96**
14	22.76	Octadeca-6,9,12,15-tetraenoic acid	$C_{18}H_{28}O_2$	276	37.06	3.48
15	24.11	Eicosa-8,11,14,17-tetraenoic acid	$C_{20}H_{32}O_2$	305	67.92	2.57
16	25.17	Eicosa-5,8,11,14,17-pentaenoic acid	$C_{20}H_{30}O_2$	303	30.24	7.08
17	25.64	Docosa-7,10,13,16,19- pentaenoic acid	$C_{22}H_{34}O_2$	331	43.70	5.85
18	26.02	Docosa-4,7,10,13,16,19- Hexaenoic acid	$C_{22}H_{32}O_2$	329	75.97	4.21
19	29.18	Bis(3,4-dimethoxycinnamoyl)-L-tartaric acid	$C_{26}H_{26}O_{12}$	530	70.91	6.34
20	29.61	2-Bromo-1-(2',2'-bis(methoxycarbonyl)-12'-tridecenyl)-5,5-bis(methoxycarbonyl)-3-methylenecyclohexene	$C_{28}H_{41}BrO_8$	584	52.95	2.82
21	30.28	1,9-Dimethyl-4-(hydroxymethyl)-5-oxatricyclo[6.4.0.0(2,6)]dodec-9-ene	$C_{14}H_{22}O_2$	222	52.87	2.51
22	30.67	Isopropyl (Z)-chloro-(3'-oxo-3',4'-dihydro-2'H-1',4'-benzoxazin -2'ylidene)acetate	$C_{13}H_{12}ClNO_4$	281	34.39	4.30
23	31.04	1-[(hexadeuterio)phenyl] Naphthalene	$C_{16}H_6D_6$	204	48.83	7.30
24	31.91	3-(2'-Hydroxyphenyl)-1-phenyl-2-propen-1-ol	$C_{15}H_{14}O_2$	226	31.80	2.67
25	32.52	Octadecane, 2-methyl	$C_{19}H_{40}$	268	6.33	3.49

The components identified in the n-Hexane extracts of the Checkbox Nuggets by GC-MS showed a peak for à-Linolenic acid (octadeca-9,12,15-trienoic acid)- $C_{18}H_{30}O_2$ with molecular weight 278 with the peak percentage e 12.96 which was similar to the study carried by Gu *et.al.,* 2021.

Fatty acid composition of Trevally Nuggets

Fatty acid composition of Trevally Nuggets analysed using GC-MS is presented in Table XXXIX and Figure 21.

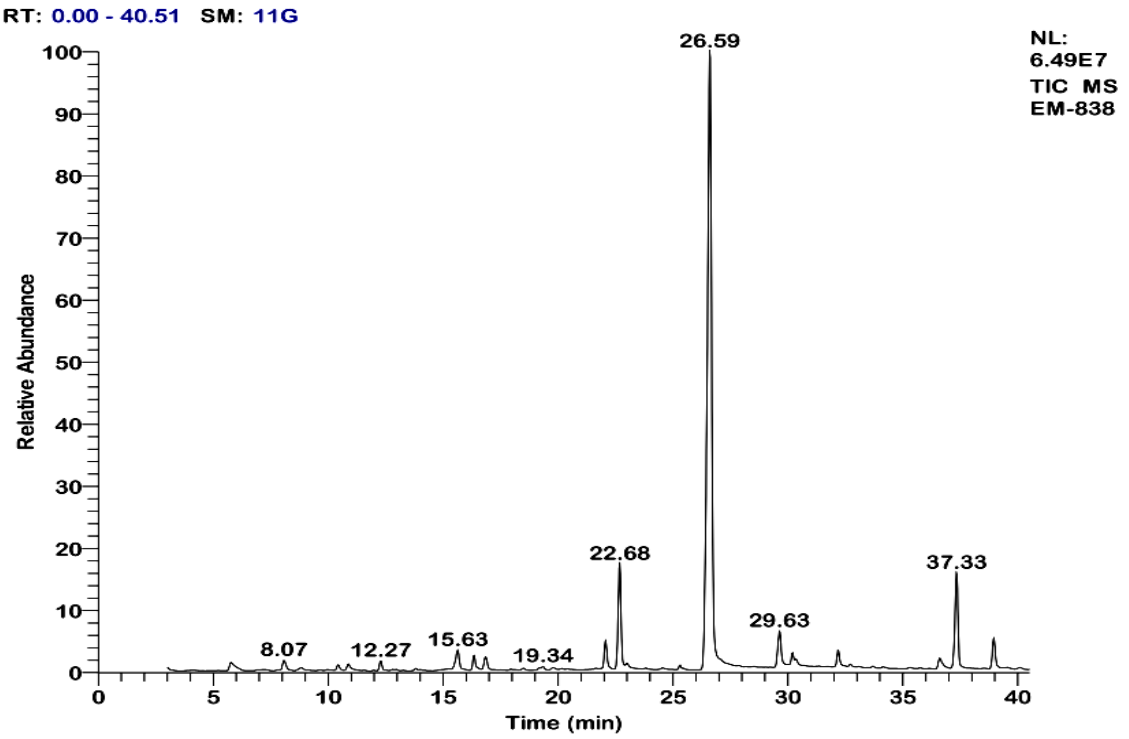

Figure 21

GC-MS Chromatogram of the n-Hexane extracts of Trevally Nuggets

TABLE XXXIX

Compound identified in the n-Hexane extracts of the Trevally nuggets

S.NO	RT	NAME OF THE COMPOUND	MOLECULAR FORMULA	MOLECULAR WEIGHT	PROBABILITY	PEAK AREA %
1	5.41	3-Carbamoyl-4-(p-chlorophenyl)-5,6-dihydrobenzo[h]thiochroman	$C_{20}H_{18}ClNOS$	355	9.08	1.62
2	6.51	1-Methoxycarbonyl-2-methylbenzimidazole	$C_{10}H_{10}N_2O_2$	190	3.93	2.67
3	9.56	Methyl 2-oxo-2-[(4-isobutyryl)phenyl]acetate	$C_{13}H_{14}O_4$	234	4.90	2.37
4	13.17	1,2,5-Oxadiazol-3-amine, 4-(4-fluorophenyl)	$C_8H_6FN_3O$	179	7.70	4.71
5	15.92	3-(2'-Methoxy-1'-methyl-2'-phenyl)ethyl-4-hydroxy-1 -oxaspiro[4.5]dec-3-en-2-one	$C_{19}H_{24}O_4$	316	0.24	3.21
6	18.53	Tetradecanoic acid	$C_{14}H_{28}O_2$	228	42.82	2.13
7	19.83	á-Cyano-2-styrylstilbene	$C_{23}H_{17}N$	307	3.28	2.56
8	21.44	5-(Methoxymethoxy)-2,2-dimethyl-2H-chromene	$C_{13}H_{16}O_3$	220	2.32	2.09
9	**22.68**	**à-Linolenic acid (octadeca-9,12,15-trienoic acid)**	**$C_{18}H_{30}O_2$**	**278**	**91.85**	**15.03**
10	23.29	Octadeca-6,9,12,15-tetraenoic acid	$C_{18}H_{28}O_2$	276	30.55	3.22
11	26.56	Eicosa-8,11,14,17-tetraenoic acid	$C_{20}H_{32}O_2$	305	41.96	10.67
12	27.37	Eicosa-5,8,11,14,17-pentaenoic acid	$C_{20}H_{30}O_2$	303	66.34	2.06
13	29.49	Docosa-7,10,13,16,19- pentaenoic acid	$C_{22}H_{34}O_2$	331	49.92	4.65
14	30.08	Docosa-4,7,10,13,16,19- Hexaenoic acid	$C_{22}H_{32}O_2$	329	33.25	1.79
15	30.32	Hexatriacontahexaenoic acid	$C_{36}H_{62}O_2$	527	32.25	3.51
16	31.30	Ocratriacontahexaenoic acid	$C_{38}H_{66}O_2$	555	54.74	3.55
17	31.77	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl)Ester	$C_{16}H_{22}O_4$	278	6.79	2.49
18	32.63	N-2,4-Dnp-L-arginine	$C_{12}H_{16}N_6O_6$	340	0.72	2.31
19	33.75	o-Hydroxybenzaldehyde thiosemicarbazone	$C_8H_9N_3OS$	195	3.43	2.59
20	33.93	N-(3-Bromobenzoyl)alanine	$C_{10}H_{10}BrNO_3$	271	31.76	6.59
21	35.40	3-(2'-Allylphenyl)-5-(t-butylamino)-4-[4'-(dimethyla mino)phenyl]-2-(phenylthio)thiazolium chloride	$C_{30}H_{34}ClN_3S_2$	535	5.28	4.70
22	35.56	1,9-Dimethyl-7-chloroalloxazine-5-oxide	$C_{12}H_9ClN_4O_3$	292	4.51	3.00
23	36.01	3à,12à-Diacetoxy-5á-cholan-24-oic acid	$C_{28}H_{44}O_6$	476	47.23	14.66
24	36.64	2-(o-Hydroxymethylbenzyl)naphtho[1,2-b]thiophene	$C_{20}H_16OS$	304	0.35	3.60
25	37.49	trans-2,3-dihydro-2,3-dihydroxybenzo[j]fluoranthene	$C_{20}H_{14}O_2$	286	0.48	1.95

The components identified in the n-Hexane extracts of the Trevally Nuggets by GC-MS found to have peak in à-Linolenic acid (octadeca-9,12,15-trienoic acid)- $C_{18}H_{30}O_2$ with molecular weight 278 with peak percentage 15.03 which was similar to the finding of Moosavi *et al.*,2019.

Fatty acid composition of Energy Seed Coat

Fatty acid composition of Energy Seed Coat analysed using GC-MS is presented in Table XL and Figure 22.

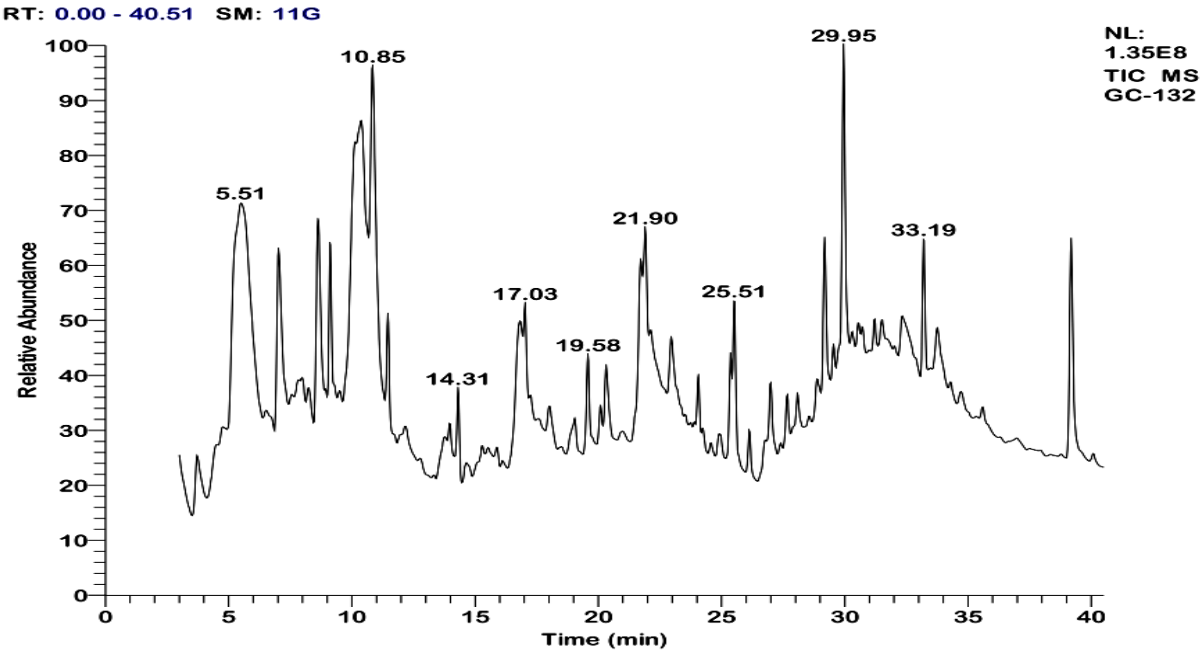

Figure 22

GC-MS Chromatogram of the n-Hexane extract of Energy Seed Coat

The maximum peak area represented in the energy seed coat was 9,12,15-Octadecatrienoic acid, (C18H30O2) with a retention time of 22.96 and a peak area of 11.57%. This compound is called as Alpha-Linolenic acid. Alpha-linolenic acid is a kind of omega-3 fatty acid found in plants. Linolenic acid, an n-3 fatty acid is a member of the group of Essential Fatty Acids (EFAs), because it cannot be produced within the body and must be acquired through diet. Linolenic acid is the most abundant unsaturated component of several seeds and oils particularly flaxseeds and its oil. In recent years there has been considerable interest in the beneficial physiological effects of omega-3 fatty acids (Brotas *et al*., 2020)

TABLE XL

Compound identified in the n-Hexane extracts of the Energy Seed Coat

S.NO	RT	NAME OF THE COMPOUND	MOLECULAR FORMULA	MOLECULAR WEIGHT	PROBABILITY	PEAK AREA %
1	3.73	2-Furanmethanol	C5H6O2	98	8.17	1.58
2	4.47	o-Acetyl-L-serine	C5H9NO4	147	5.48	1.25
3	5.48	Glyceraldehyde	C3H6O3	90	0.28	14.45
4	7.03	4,5,6,8-PTetramethoxy-2,3-dihydroindeno[1,2,3-ij]isoquinol in-9-ol	C19H19NO5	341	0.04	4.52
5	7.99	Isovaleric acid, 3-methylbutyl-2 ester	C10H20O2	200	3.63	1.75
6	8.63	l-Alanyl-l-alanine ethylamide	C8H17N3O2	187	0.37	4.77
7	10.11	D-Mannopyranose	C6H12O6	180	2.82	0.27
8	10.85	Octacosahexaenoic acid	$C_{28}H_{44}O_2$	413	5.04	5.85
9	11.46	Hexacosahexaenoic acid	$C_{26}H_{44}O_2$	387	1.44	1.33
10	13.97	Triacontahexaenoic acid	$C_{30}H_{48}O_2$	441	6.86	2.86
11	14.31	1,3-Bis(4-chlorobenzyl)-5,6-dihydrobenzo[f]quinazoline	C26H20Cl2N2	430	3.69	1.53
12	15.28	d-Xylose	C5H10O5	150	5.87	1.58
13	16.80	1H-Purin-6-amine, [(2-fluorophenyl)methyl]	C12H10FN5	243	3.82	3.47
14	18.02	à-D-Glucopyranoside, O-à-D-glucopyranosyl-(1.fwdarw.3)-á-D-fructofuranosyl	C18H32O16	504	4.90	0.91
15	19.04	Oxiraneundecanoic acid, 3-pentyl-, methyl ester, cis	C19H36O3	312	6.06	1.10
16	20.90	Pentadecanoic acid	C15H30O2	242	69.43	2.28
17	**22.96**	**à-Linolenic acid (octadeca-9,12,15-trienoic acid)**	**$C_{18}H_{30}O_2$**	**278**	70.95	11.57
18	25.51	Octadeca-6,9,12,15-tetraenoic acid	$C_{18}H_{28}O_2$	276	44.57	4.16
19	27.00	Eicosa-8,11,14,17-tetraenoic acid	$C_{20}H_{32}O_2$	305	30.21	2.14
20	29.18	Eicosa-5,8,11,14,17-pentaenoic acid	$C_{20}H_{30}O_2$	303	81.14	2.69
21	29.95	Docosa-7,10,13,16,19- pentaenoic acid	$C_{22}H_{34}O_2$	331	68.14	6.07
22	32.34	Docosa-4,7,10,13,16,19- Hexaenoic acid	$C_{22}H_{32}O_2$	329	41.59	4.58
23	33.19	Hexatriacontahexaenoic acid	$C_{36}H_{62}O_2$	527	31.37	5.97
24	33.76	20-Methyl-5-pregnene-3,20-diol	C22H36O2	332	2.34	1.41
25	39.18	13-Docosenamide, (Z)-	C22H43NO	337	0.88	0.26

Fatty acid composition of Round Nut Bag

Fatty acid composition of Trevally Nuggets analysed using GC-MS is presented in Table XLI and Figure 23.

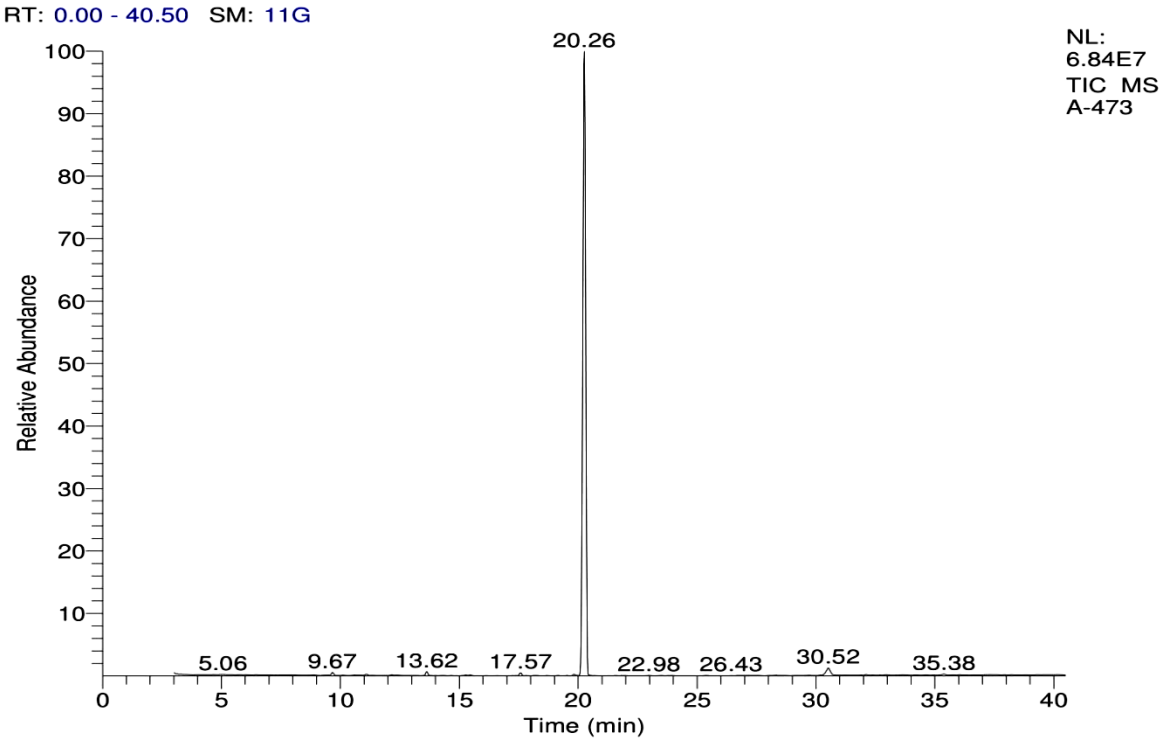

Figure 23

GC-MS Chromatogram of the n-Hexane extract of Round Nut Bag

TABLE XLI

Compounds identified in the n-Hexane extracts of the Round Nut Bag

S.NO	RT	NAME OF THE COMPOUND	MOLECULAR FORMULA	MOLECULAR WEIGHT	PROBABILITY	PEAK AREA %
1	3.15	1,2-Ethanediamine, N-(2-aminoethyl)	$C_4H_{13}N_3$	103	1.49	0.02
2	5.06	(3à,4Z,5á)-4-ethylidene-5-methyl-1-oxaspiro[2.5]octane	$C_{10}H_{16}O$	152	1.54	0.07
3	8.89	3-(Phenylethyl)tetrahydrofuran-2-one	$C_{12}H_{14}O_2$	190	0.17	0.05
4	9.67	Phenol, 5-methyl-2-(1-methylethyl)-	$C_{10}H_{14}O$	150	0.09	0.34
5	10.62	t-Butylthiothioacetic acid, S-t-butyl ester	$C_{10}H_{20}OS_2$	220	0.99	0.03
6	11.09	1-Tridecanol	$C_{13}H_{28}O$	200	0.57	0.15
7	12.15	Indolizine, 8-methy	C_9H_9N	131	0.09	0.07
8	13.62	2-tert-Butyl-4-trifluoromethyl-1-methylimidazole	$C_9H_{13}F_3N_2$	206	0.75	0.44
9	14.35	1,3-Dihydro-1-ethylbenzo(c)thiophene,2,2-dioxide	$C_{10}H_{12}O_2S$	196	0.19	0.02
10	14.66	Anthracene,2,7-bis(1,1-dimethylethyl)-	$C_{22}H_{26}$	290	1.67	0.03
11	15.45	ethyl1,2,3,4,5,6,7,8-octahydro-8-oxo-1-naphthalenecarboxylate	$C_{13}H_{18}O_3$	222	3.58	0.15
12	17.57	1-Propyl-1-cyclohexanol	$C_9H_{18}O$	142	0.80	0.34
13	18.22	2,5- dimethyloxazolidine	$C_5H_{11}NO$	101	2.57	0.07
14	19.16	(2S,3R,4aS,8aR)-2-[(Methoxycarbonyl)methyl]octahydropyrano[3,2-b]pyran-3-yl Benzoate	$C_{18}H_{22}O_6$	334	1.93	0.03
15	19.53	butyl 2-nitropropanoate	$C_7H_{13}NO_4$	175	0.76	156
16	19.83	Tridec-2-en-11-ynedial	$C_{13}H_{18}O_2$	206	1.49	0.19
17	**20.26**	**à-Linolenic acid (octadeca-9,12,15-trienoic acid)**	$\mathbf{C_{18}H_{30}O_2}$	**278**	**92.24**	**16.97**
18	22.98	Octadeca-6,9,12,15-tetraenoic acid	$C_{18}H_{28}O_2$	276	65.72	4.04
19	23.50	Eicosa-8,11,14,17-tetraenoic acid	$C_{20}H_{32}O_2$	305	60.63	3.05
20	23.95	Eicosa-5,8,11,14,17-pentaenoic acid	$C_{20}H_{30}O_2$	303	58.30	5.05
21	29.70	Docosa-7,10,13,16,19- pentaenoic acid	$C_{22}H_{34}O_2$	331	30.28	6.04
22	30.52	Docosa-4,7,10,13,16,19- Hexaenoic acid	$C_{22}H_{32}O_2$	329	45.74	5.23
23	32.10	4-n-Butylbenzopyran-4-ol	$C_{13}H_{18}O_2$	206	1.69	0.09
24	32.94	Hexanoic acid, 4-methyl	$C_7H_{14}O_2$	130	3.82	0.06
25	33.71	2-(-N,N-Di-isopropylaminomethyl)-1-methylpyrrole	$C_{12}H_{22}N_2$	194	1.05	0.07

The components identified in the n-Hexane extracts of the Round Nut Bag by GC-MS showed to have peak in à-Linolenic acid (octadeca-9,12,15-trienoic acid)- $C_{18}H_{30}O_2$ with molecular weight 278 and peak percentage was 16.97 which was similar to the finding for Rubab *et.al,* 2020.

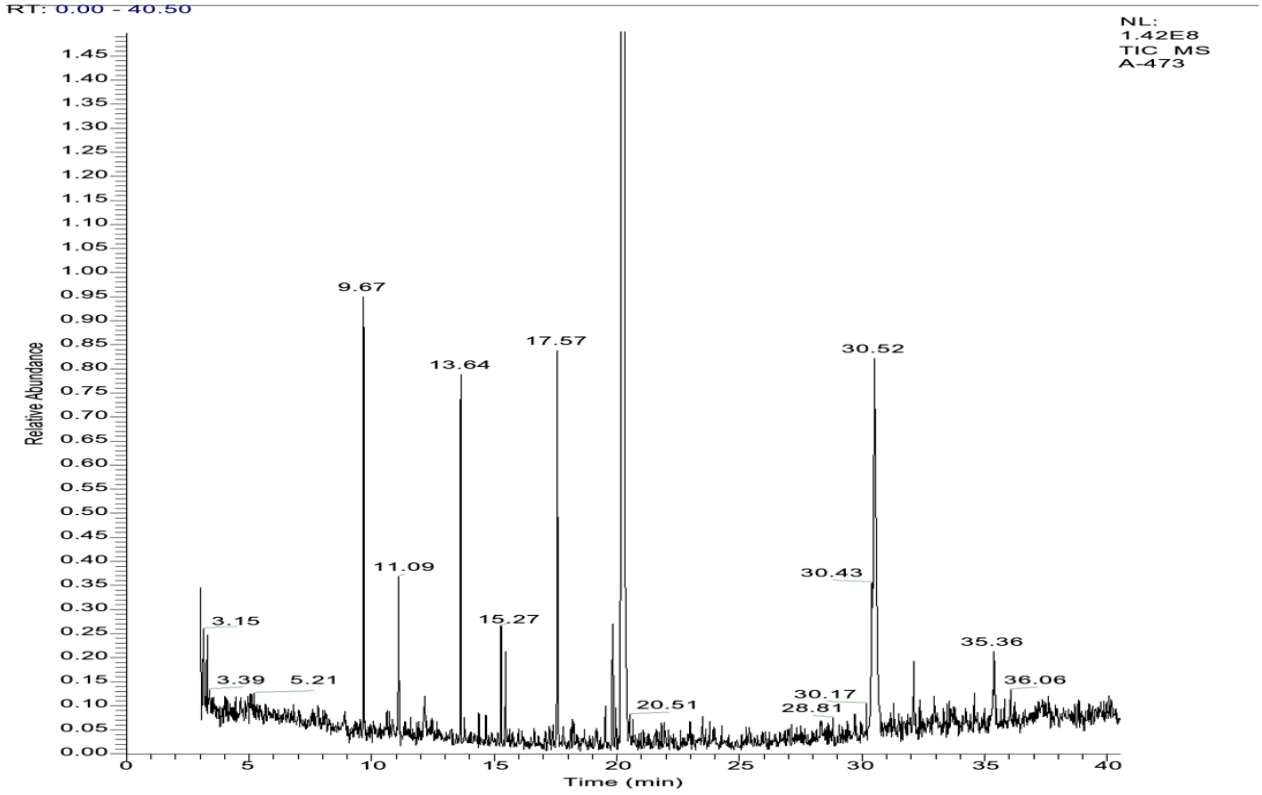

Figure 24

GC-MS Chromatogram of the n-hexane extract of curry stalk pakodi

The components identified in the n-Hexane extracts of the curry stalk pakodi showed to have peak in à-Linolenic acid (octadeca-9,12,15-trienoic acid)- $C_{18}H_{30}O_2$ with molecular weight 278 with peak percentage 19.49 which was similar to the findings of Truzzi *et.al,* (2018)

TABLE XLII

Compound identified in the n-Hexane extracts of the curry stalk pakodi

S.NO	RT	NAME OF THE COMPOUND	MOLECULAR FORMULA	MOLECULAR WEIGHT	PROBABILITY	PEAK AREA %
1	3.15	3-(10'-methyl-trans-2'decalinyl)butyronitrile	$C_{15}H_{25}N$	219	1.25	0.47
2	3.39	N-2,4-di-tert-Butyl-6-cyano-N-thiosulfinylaniline	$C_{15}H_{20}N_2S_2$	292	8.93	0.79
3	5.21	cis-Vaccenic acid	$C_{18}H_{34}O_2$	282	8.34	0.04
4	6.38	7-Methyl-4-(4-methylphenyl)-1H-1,5-benzodiazepin-2(3H)-one	$C_{17}H_{16}N_2O$	264	2.56	0.31
5	8.22	Ethyl 5-Allyl-5,6-dihydrophenanthridinecarboxylate	$C_{19}H_{19}NO_2$	293	3.64	1.61
6	9.24	1,1'-Bicyclohexyl, 2-(1-methylethyl)-, trans	$C_{15}H_{28}$	208	1.69	0.88
7	9.67	Cyclopentolate	$C_{17}H_{25}NO_3$	291	25.25	0.39
8	10.44	1,2-Pentadiene, 4-methoxy-4-methyl	$C_7H_{12}O$	112	36.14	2.25
9	11.01	2-[Bis[2-(trimethylsilyl) ethoxy]methyl]propanol	$C_{14}H_{34}O_3Si_2$	306	23.59	3.30
10	13.15	2-[(E)-2-(1-Benzylamino)-3-phenylprop-2-enyl]phenol	$C_{22}H_{21}NO$	315	36.45	3.37
11	13.64	Imidazolidine, 1-benzyl-2-tert.butyl-3-methyl-4-one-	$C_{15}H_{22}N_2O$	246	28.12	2.94
12	14.11	Dotriacontahexaenoic acid	$C_{32}H_{52}O_2$	469	30.15	3.14
13	15.27	Triacontapentaenoic acid	$C_{34}H_{56}O_2$	497	45.21	3.84
14	17.57	Eicosatetraenoic acid	$C_{20}H_{32}O_2$	305	47.26	4.44
15	**20.08**	**à-Linolenic acid (octadeca-9,12,15-trienoic acid)**	**$C_{18}H_{30}O_2$**	**278**	**86.15**	**19.49**
16	20.51	Octadeca-6,9,12,15-tetraenoic acid	$C_{18}H_{28}O_2$	277	45.08	9.43
17	21.22	Eicosa-8,11,14,17-tetraenoic acid	$C_{20}H_{32}O_2$	305	35.18	7.28
18	22.30	Eicosa-5,8,11,14,17-pentaenoic acid	$C_{20}H_{30}O_2$	303	39.18	5.90
19	23.23	Docosa-7,10,13,16,19- pentaenoic acid	$C_{22}H_{34}O_2$	331	47.56	6.96
20	23.62	Docosa-4,7,10,13,16,19- Hexaenoic acid	$C_{22}H_{32}O_2$	329	33.14	4.38
21	25.62	Hexatriacontahexaenoic acid	$C_{36}H_{62}O_2$	527	49.19	5.13
22	26.94	Ocratriacontahexaenoic acid	$C_{38}H_{66}O_2$	555	68.14	6.33
23	30.43	Cholic acid	$C_{24}H_{40}O_5$	408	15.19	4.17
24	30.52	4-Azido-2-methylbenzoic Acid	$C_8H_7N_3O_2$	177	6.10	1.47
25	32.36	cis-11-Eicosenamide	$C_{20}H_{39}NO$	309	4.19	4.91

4.3 Development of Artificial Intelligence Integrated Dynamic Website

According to the intervention group, all responders from several nations, particularly India, preferred pictorial shots on the web page, nutrient calculators, and documentaries for kids. Recipes and YouTube Videos on cooking demonstrations and meal planning were liked by 100% of psychologists and 82% of nutrition experts. The website's information was 80% instructive regarding how diet plays a part in Attention Deficit Hyperactivity Disorder, according to 1000 caregivers and nutrition specialists who gave it a 63.2% informative rating for parents and society. Nearly 93.3% of respondents think the website's dietary information is helpful. Most respondents—between 60 and 80 per cent—liked the website's colour and snapshots, and the study might be a resource for nutrition-related topics. A website was developed for middle and high school students to increase their self-efficacy and understanding of nutritional issues, improve their nutrition management abilities, and encourage a culture of healthy eating. Public health and nutrition are positively affected by the nutritional extension. With gained nutrition knowledge, parents will contribute to their homes, and a healthy generation can be developed for children's optimum growth (Sukandar *et al.*,, 2015).

Information obtained from the respondents about the website and the findings has been tabulated in Table XLIII and Figure 25.

TABLE XLIII

Information Obtained from the respondents about the website

Constructs	SA		A		N		D		SD	
	No	%	No	%	No	%	No	%	No	%
Control paying attention	12	22.6	10	18.8	19	35.8	8	15.0	4	7.5
Identification of ADHD Symptoms	9	16.9	13	24.5	17	32	9	16.9	5	9.4
Continuous tracking of work	11	20.7	15	28.3	16	30.1	8	15.0	3	5.6
Increasing academic performance	8	15.0	15	28.3	17	32	9	16.9	4	7.5
Brain Break	12	22.6	14	26.4	19	35.8	6	11.3	2	3.7
Improvement of knowledge	13	24.5	6	11.3	24	45.2	6	11.3	4	7.5
Engagement through the audio-video method	14	26.4	12	22.6	18	33.9	5	9.4	4	7.5

SA: Strongly Agree on A: Agree N: Neutral D: Disagree SD: Strongly Disagree

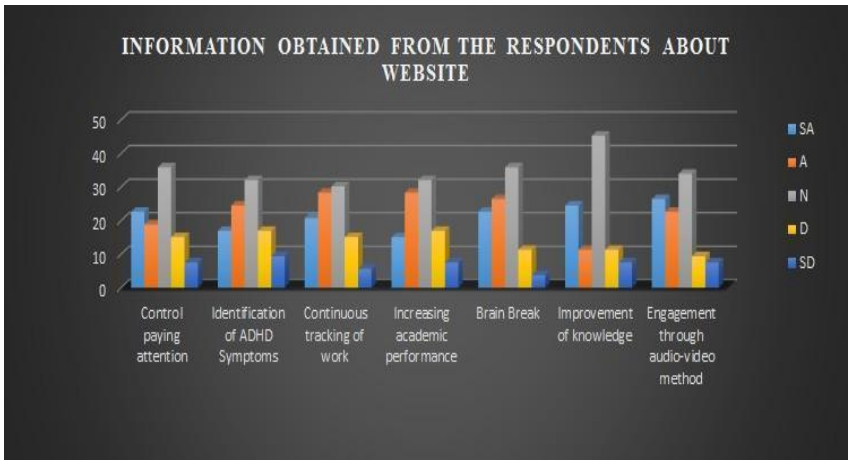

Figure 25

Information Obtained from the respondents about the website

Following the usage of the website, the responses in paying attention were: strongly agreed: 22.6 per cent; agreed: 18.8 per cent; neutral: 35.8 per cent; others: strongly disagreed or disagreed. This represents changes in the mean scores of knowledge of ADHD caregivers among the surveyed samples. 16.9 per cent and 24.5 per cent strongly agreed with the website's ability to identify ADHD symptoms, whereas 32 per cent disagreed. Continuous monitoring of work via the website was strongly endorsed by 20.7 per cent, 28.3 per cent, and 30.1 per cent, while the remaining per centages were neutral or strongly opposed while 32 per cent either strongly disagreed or agreed with the assertion, 15 per cent and 28 per cent strongly agreed that using the website will increase academic performance. The per centage of those who strongly agreed with the expression "brain break" was 22.6 per cent, followed by 11.3 per cent who also agreed and 35.8 per cent who were neutral. A strong agreement with the assertion that knowledge can be improved through the website was expressed as 24.5 per cent, followed by a strong disagreement by 11.3 per cent, and a neutral opinion by 45.3 per cent. In the case of statement involvement via audio-video, 26.4 per cent highly agreed, 22.6 per cent agreed, and 34 per cent were neutral about it, while the remaining participants either strongly objected or agreed. Digital platforms promoted improvements in nutrition and physical activity, as well as occasionally in body weight or BMI, according to a clinical evaluation of interventions using websites, mobile applications, and text messaging to promote better diet, physical activity or BMI (Lappan *et al.*, 2015).

TABLE XLIV

Changes in Mean Score for Attributes of the caregivers of Children with ADHD symptoms before and after website usage

Mean Score=3

Constructs		Mean ± SD	T-value	.sig
Knowledge	Before	1.96±0.97	12.075	.000*
	After	2.56±0.99		
Attitude	Before	1.97±0.86	9.125	.003*
	After	2.03±0.65		
Relationship with ADHD Children	Before	1.74±0.72	6.548	.004*
	After	2.95±0.99		
Organization Skills	Before	2.09±0.82	10.562	.000*
	After	2.89±0.97		
Academic Performance	Before	1.82±0.26	4.023	.006**
	After	2.48±0.68		

*= Significant at 1% level, **= Significant at 5% level

The findings revealed the website content in the output of paired sample t-tests for attributes of the caregivers before and after usage of the website. Changes in the scores of Knowledge, Attitude, Relationship with ADHD Children, and Organization Skills (P=0.000, 0.003, 0.004, 0.000) are statistically significant at 1% level of significance, and Academic Performance (p=0.006) is statistically significant at 5% level of significance. The results found effective changes in the attributes of the caregivers' Children with ADHD symptoms before and after using the website. Grimes *et al.,* (2018), while determining the efficacy of a Web-based salt reduction program on knowledge, attitudes, behaviours, self-efficacy, and salt intake, observed a significant improvement among individuals who took up a weekly online interactive website-based program for five weeks. A study analysing different classes of websites using approval criteria for web information, namely the JAMA score, has determined that commercial websites scored lower in comparison with health-based websites, reporting better trustworthiness in health-based websites (Yaqub *et al.,* 2015).

After developing the website **www.nutritionadhd.com** to provide information about Indian diets for parents of children with ADHD, 60 parents provided feedback on the

website. In order to qualitatively assess the efficacy of web-based nutrition

.n programs created for kids with signs of ADHD, this part offered a summary of their reviews and feedback. The study findings are comparable to Lee and colleagues' work on creating an educational model for food safety and nutrition (2016). The table displays the per centage distribution of caregivers' comments regarding the website's information on diet for children with ADHD.

TABLE XLV

Percentage distribution feedback of the selected caregivers about the website

Feedback responses from caregivers about the website	N=60	Percentage
Excellent	56	93.3
Very good	2	3.33
Good	1	1.66
Average	1	1.66

The information in the above table indicated that the parents and other caregivers commented on the website www.nutritionadhd.com and promoted the Indian diet-based portal for children with ADHD symptoms. Caretakers of children exhibiting ADHD were used to evaluate the website. It was pleasing to discover that 93.3% of parents of children with ADHD were satisfied with the website's Indian-inspired design. Notably, none of the caregivers offered any unfavorable input that could be classified as terrible or worse. The website's aim of raising nutrition awareness in ADHD symptomatology was well received overall by the respondents.

Feedback of caregivers about the website are shown in Figure 26.

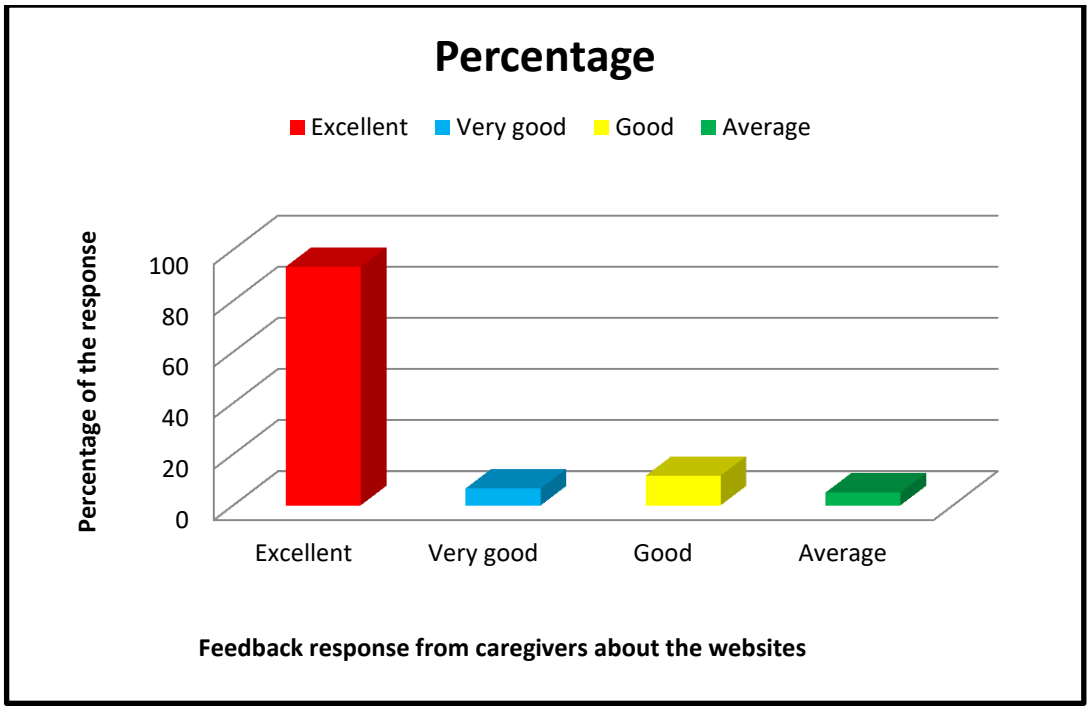

Figure 26

Feedback response from caregivers about the websites

4.4. Impact evaluation of intervention

The children were chosen from special schools for the intervention study. They were classified into two groups namely Experimental Group I (EG I) and Experimental Group II (EG II), who received diet modification and digital health intervention in the age group of 4-6 and 7-9 years respectively and Control Group (CG I and CG II) received nutrition education using intervention for a period of five months. The changes was assessed through nutritional anthropometry, dietary profile, assessment of Behaviour function for the children and the Knowledge, Attitude and Practices (KAP) for caregivers.

4.4.1 Changes in Anthropometric Measurements of the Selected Children

Changes in Anthropometric measurements of the selected children before and after the intervention are presented in Table XLVI and XLVII

TABLE XLVI

Mean anthropometric measurements of the selected children before and after intervention (4-6 years)

(N = 60)

Anthropometric Measurements	ICMR* (2020)	(4-6 years)	Mean±S.D		T value	Pvalue
			PRE	POST		
WEIGHT (kg)	**18.3**	**Experimental group**	**13.7±1.28**	**17.8±1.3427**	**2.648**	**0.023**
		Control group	**14.33±0.45**	**15.68±0.81**	1.206	**NS**
HEIGHT (cm)	**111.6-110.5**	**Experimental group**	**103.2±3.43**	**116.8±1.75**	**29.319**	**.000**
		Control group	**104.8±0.92**	**106.8±1.36**	**1.562**	**NS**
BMI	**14.8-14.4**	**Experimental group**	11.6±**0.28**	15.3±**0.31**	-68.287	0.000
		Control group	12.43±0.79	13.29±0.93	1.614	NS

*ICMR (2020) *Significant at 1%; Significant at 5 %; NS – Not significant

TABLE XLVII

Mean anthropometric measurements of the selected children before and after intervention (7-9 years)

(N = 60)

Anthropometric Measurements	ICMR*	(7-9 years)	Mean±S.D		T value	P value
			PRE	POST		
WEIGHT (kg)	**25.3**	**Experimental group**	**19.9±1.45**	**24.2±1.16**	**16.537**	**0.000**
		Control group	**18.76±1.08**	**20.5±1.47**	**1.156**	**NS**
HEIGHT (cm)	**126.3-125.4**	**Experimental group**	**113.8±9.66**	**122.1±2.18**	**4.284**	**0.000**
		Control group	**117.1±1.20**	**119.8±1.03**	**1.368**	**NS**
BMI	**15.5-15.3**	**Experimental group**	**13.5±0.30**	**15.1±0.17**	28.498	0.000
		Control group	17.2±0.82	16.34±0.95	0.954	NS

*ICMR (2020) *Significant at 1%; Significant at 5 %; NS – Not significant;

The anthropometric measurement for the children in the age group of 4 – 6 years revealed that there is an increase in body weight from 13.7 kg to 17.8kg in the experimental group in terms of height from 103cm to 116.8cm and for BMI it increases from 11.6 to 15.3. Only slight changes were noted in the control group for weight it is 14.33 kg in the pre and 15.68 kg in the post. For height it is 104.8cm in the pre and 106.8 in the post and the BMI values are 12.43 in the pre and 13.29 in the post intervention group.

The anthropometric measures for the experimental group of 7 – 9 years of children, in terms of weight is increased from 19.9kg to 24.2 kg in the post, as in terms of height 113.8cm to 122.1cm and in terms of BMI it is 13.5 in the pre and 15.1 in the post intervention group. The measurement in the control group showed that there is a very little increase in weight it is 18.8kg to 20.5kg in the post, for height it is 117.1cm in the pre and 119.8 in the post and for BMI it is 17.2 in the pre and 16.34 in the post intervention group.

4.4.2 Changes in Behaviour functions of the children with ADHD symptoms:

The changes in the behavioural function of the children in the age group of 4 – 6 years and 7-9 years were calculated in pre and post intervention for control group and experimental group. The value of experimental group showed that the mean value decreased from 8.8 to 8.1 among 4 – 6 years and 7.0 to 6.7 among 7 – 9 years that the supplementation with nutrition and health education resulted in bringing the changes in the behaviour of the children. As in control group without the supplementation and education there is an increase in the behavioural pattern from 5.9 to 7.4 in 4 - 6 years age group and 6.8 to 7.7 in the 7 – 9 years age group.

TABLE XLVIII

Changes in Behaviour functions of the children with ADHD symptoms

Groups	Pre Mean±SD	Post Mean±SD	T value	Sig. (2-tailed)
Experimental Group (4-6)	8.76±0.31	8.13±0.45	**2.968**	**(0.05*)**
Control Group (4-6 years)	5.90±0.86	7.43±0.91	**0.862**	**NS**
Experimental Group(7-9 years)	7.00±0.75	6.66±0.69	**2.978**	**(0.032*)**
Control Group(7-9 years)	6.83±0.75	7.73±0.89	**1.058**	**NS**

*Significant at 1%; Significant at 5 %; NS – Not significant;

4.4.3. Changes in food intake of the children with ADHD symptoms:

The **impact on food intake** of the selected Children with ADHD symptoms after nutrition intervention is given in the following Table XLIX

TABLE XLIX

Changes in food intake of the children with ADHD symptoms (4-6years)

FOOD GROUPS		Experimental group (4-6yrs)		Df "T value"	Control group (4-6yrs)		Df "T value"
	RDA*	PRE	POST		PRE	POST	
Cereals(g)	300	173.4±6.38	204.1±8.19	**-30.7** (-17.668)	185.9±3.97	193.4±4.38	**-7.5** 1.537NS
Pulses (g)	60	36.0±1.27	43.7±2.25	**-7.7** (-14.432)	37.9±2.65	40.1±3.52	**-2.2** 1.182NS
Green Leafy Vegetables (g)	100	31.2±6.06	53.9±2.01	**-22.7** (-23.666)	33.5±1.67	40.0±2.56	**-6.5** 1.526NS
Other Vegetables (g)	100	27.0±1.43	57.0±2.57	**-30** (-61.289)	25.1±0.52	30.6±1.30	**-5.5** (-20.686)
Fruits (g)	100	27.2±1.68	55.2±3.19	**-28** (-44.727)	24.5±1.29	29.9±2.57	**-5.4** (-10.465)
Milk and milk products (ml)	500	210.2±4.16	238.7±12.7	**-28.5** (-11.751)	198.3±5.12	224.6±2.26	**-26.3** (-22.219)
Fats and oils (ml)	25	18.0±1.37	20.6±1.52	**-2.6** (-6.774)	21.2±1.54	23.8±1.30	**-2.6** (1.295NS)

*Significant at 1%; Significant at 5 %; NS – Not significant;

TABLE XXL

Changes in food intake of the children with ADHD symptoms (7-9years)

FOOD GROUPS	RDA*	Experimental group		Df	Control group		Df
		PRE	POST		PRE	POST	
Cereals(g)	300	221.6±5.27	266.8±4.19	**-45.2 (-**72.863)	233.1±12.93	254.4±132.76	**-21.3 (1.**523NS)
Pulses (g)	60	45.9±3.11	52.3±1.49	**-6.4** (-10.225)	44.2±1.40	46.2±2.56	**-2 (-**1.029NS)
Green Leafy Vegetables (g)	100	45.0±2.17	71.2±3.54	**-26.2** (-44.000)	47.8±5.70	54.4±8.39	**-6.6 (1.**746NS)
Other Vegetables (g)	100	34.0±2.84	65.1±8.06	**-31.3** (-14.931)	36.5±5.88	43.8±8.91	**-7.3 (**1.104NS)
Fruits (g)	100	39.8±4.12	63.7±2.23	**-23.9** (-35.384)	45.9±8.52	52.4±7.06	**-6.5 (-**1.309NS)
Milk and milk products (ml)	500	234.8±2.69	264.9±4.19	**-30.1 (-**32.274)	244.7±12.14	254.9±13.28	**-10.2 (1.**105NS)
Fats and oils (ml)	25	**28.6±1.05**	**23.2±1.26**	**5.4 (-**4.741)	24.8±1.89	26.7±3.75	**-1.9** (1.715NS)

*Significant at 1%; Significant at 5 %; NS – Not significant;

The cereal intake pattern of children in the Experimental Group (4 to 6 years old) increased from 173.4g to 204.1g as a result of health and nutrition education provided to selected Children with ADHD symptoms and their mothers. Similarly, the consumption pattern of cereals in the Experimental Group (7 – – 9 years of age) increased from 221.6g to 266.8g as a result of the health mix supplementation accompanied by nutrition and health education to mothers, and the cereals intake increased slightly among children in the control group from 185.9g in Pre and 193.4g in Post (4 – 6 years of age) and 233.1g to 254.4g (7 – 9 years of age) at the end of the intervention, the average intake of pulses among children aged 4 to 6 years increased from 36.0g to 43.7g and from 45.9g to 52.3g in the experimental group of 7 to 9 years. After nutrition intervention, the consumption patterns of green leafy vegetables, other vegetables, fruits, milk and milk products, and oils increased in the experimental groups of children aged 4 to 6 and 7 to 9 years. According to Shaik *et al*., (2020), supplemental diets comprised of diverse combinations of cereals and grains had an effect on the body composition of rural Bangladeshi youngsters, which is consistent with the findings of the present study.

4.4.4. Changes in Mean Nutrient Intake

The **mean nutrient intake** of the children before and after nutrition intervention is shown in the Table XXLI and XXLII .

Mean energy intake increased from 1152 kcal to 1328 kcal in the Experimental Group (4 – 6 years of age) and from 1482 kcal to 1728 kcal in the Experimental Group (7 – 9 years of age). Mean energy intake increased from 1294 kcal to 1308 kcal in the Control Group (4 – 6 years of age) and from 1574 kcal to 1612 kcal in the Control Group (7-9 years).

The average intake of fats, protein, carbohydrate, calcium, magnesium, iron, zinc, vitamin B6, vitamin B12, vitamin C, vitamin A, and vitamin D in the experiment group of 4 – 6 year olds increased from 17.3g, 10.1g, 77.5g, 307.0mg, 94.1mg, 3.11mg, 0.83mg, 0.19mg, 0.08g, 16.4mg, 130.1g, and 194 mcg in the pre-intervention group.

Similarly, the average intake of Fats, Protein, carbohydrate, calcium, magnesium, iron, zinc, vitamin B6, vitamin B12, vitamin C, vitamin A, and vitamin D in the experiment group of 7 to 9-year-olds increased from 23.5g, g, 15.1g, 87.4mg, 354.0mg, 130.4mg, 5.48mg, 1.93mg, 0.69mg, 0.77g, 23.0mg, 156.2g The control group exhibited no significant difference in nutrient consumption and a lower mean intake in the final evaluation. The effect of supplementation with nutrition and health education resulted in the highest nutrient intake among children aged 7 to 9 years.

Tucci *et al.*, (2022) in their study stated that Healthy diets played a key role in improving ADHD symptoms. Magnesium, zinc, iron, and omega-3 fatty acids and B-complex vitamins are nutrients that are linked to ADHD and are critical to brain function. A diet of fruits and vegetables; healthy proteins including lean meat and fish/seafood; eggs; and a variety of seeds and nuts will naturally contain higher amounts of magnesium, zinc, iron, B-vitamins, and omega-3 fatty acids. Increasing consumption of these foods while reducing consumption of nutrient-poor foods and snacks can help ADHD to avoid nutrient deficiencies and develop healthier habits later in life.

Before intervention, it was identified that the selected children with ADHD was lacking in adequate nutrition and with intake of the recipes their health condition was found to be increasing and with regular consumption their ADHD symptoms may be reduced as the recipes are rich with the needed nutrients especially for children with ADHD. The overall

outcome of the study has showed that the selected respondents had positive change in their behaviour pattern after intervention as their diet was found to be enriched with all adequate nutrition needed for their healthy life through the recipes incorporated in the study

TABLE XXLI

Changes in Nutrient intake of the children with ADHD symptoms (4-6 yrs)

NUTRIENTS	EAR	Experimental group		df	Control group		Df
		PRE	POST		PRE	POST	
Energy (Kcal)	**1360**	**1152.1±72.5**	**1328.4±19.7**	**- 176.3** (-14.944)	**1294.3±16.23**	**1308.6±13.27**	**- 14.3** (**0**.483ns)
Fats (g)	**25**	**17.3±0.77**	**24.5±1.68**	**- 7.2** (-19.826)	**19.0±0970**	**21.0±1.12**	**-2** (1.238ns)
Protein (g)	**12.8**	**10.1±1.53**	**14.3±0.77**	**- 4.42** (-17.212)	**10.4±1.37**	**12.7±1.56**	**- 2.3** (1.341ns)
Carbohydrate (g)	**100**	**77.5±0.81**	**93.4±3.68**	**- 15.9** (-27.104)	**82.8±3.49**	**89.9±4.70**	**- 7.1** (1.563)
Calcium (mg)	**450**	**307.0±73.6**	**435.1±20.3**	**- 128.1** (-11.081)	**326.1±12.35**	**361.4±16.40**	**- 35.3** (**1**.862)
Magnesium(mg)	**131**	**94.1±11.0**	**154.2±5.22**	**- 60.1** (-24.292)	**93.0±7.24**	**106.7±9.58**	**- 31.7** (1.821ns)
Iron (mg)	**8**	**3.11±1.07**	**10.8±0.59**	**- 7.69** (-36.750)	**4.80±0.90**	**6.51±1.20**	**- 1.71** (**0**.753ns)
Zinc (mg)	**3.7**	**0.83±0.35**	**5.15±0.49**	**- 4.32** (-33.656)	**1.46±0.62**	**2.29±0.82**	**- 0.83** (**0**.548ns)
Vitamin B_6 (mg)	**1.0**	**0.19±0.17**	**1.00±0.28**	**- 0.81** (-11.307)	**0.23±0.18**	**0.88±0.33**	**- 0.05** (1.354ns)
Vitamin B_{12} (µg)	**1**	**0.08±0.10**	**1.36±0.60**	**- 1.28** (-12.820)	**0.90±0.45**	**1.71±0.47**	**- 0.81** (-1.884ns)
Vitamin C (mg)	**27**	**16.4±1.33**	**30.0±1.19**	**- 13.6** (-39.140)	**17.7±1.45**	**22.1±1.83**	**- 4.4** (1.627ns)
Vitamin A (µg)	**240**	**130.1±11.2**	**258.7±7.55**	**- 128.6** (-42.477)	**134.8±12.14**	**145.2±11.49**	**- 30.4** (1.827ns)
Vitamin D (mcg)	**400**	**194.9±23.6**	**321.9±21.8**	**- 127** (-17.562)	**184.0±12.84**	**206.6±14.90**	**- 42.6** (**1**.832ns)

TABLE XXLII

Changes in Nutrient intake of the children with ADHD symptoms (7-9 years)

NUTRIENTS	EAR	Experimental group		Df	Control group		
		PRE	POST		PRE	POST	Df
Energy (Kcal)	1360	1482.6±50.8	1728.5±38.5	- 265.9 (-22.890)	1574.8±26.5	1612.35±5.29	-37.7 (-1.529NS)
Fats (g)	25	23.5±4.86	29.2±1.29	- 5.7 (-7.003)	24.7±1.42	26.0±1.76	-1.3 (-1.182NS)
Protein (g)	12.8	15.1±1.42	22.2±1.31	- 7.1 (-17.290)	17.0±1.45	19.6±1.47	-2.6 (-0.893NS)
Carbohydrate (g)	100	87.4±5.97	106.3±5.29	- 18.9 (-14.573)	96.0±5.62	101.3±8.84	-5.3 (1.22NS)
Calcium (mg)	450	354.0±57.0	489.6±12.2	- 135.6 (-11.518)	372.4±3.30	384.9±3.20	-12.5 (-12.976)
Magnesium(mg)	131	130.4±13.6	190.6±6.44	- 60.2 (-19.434)	124.9±7.87	134.2±9.36	-19.3 (-1.627NS)
Iron (mg)	8	5.48±1.09	14.1±1.37	- 8.62 (-23.084)	6.20±0.80	7.74±0.94	-1.54 (-0.972)
Zinc (mg)	3.7	1.93±0.22	6.52±0.31	- 4.59 (-54.183)	1.93±0.65	3.22±0.90	-1.29 (1.103)
Vitamin B_6 (mg)	1.0	0.69±0.14	1.54±0.09	- 0.85 (-38.013)	0.53±0.31	0.80±0.56	-0.27 (1.218NS)
Vitamin B_{12} (µg)	1	0.77±0.33	1.96±0.13	- 1.19 (-23.748)	1.05±0.66	1.70±0.73	-0.65 (-1.240)
Vitamin C (mg)	27	23.0±2.79	38.1±2.37	-15.1 (-15.969)	25.8±2.40	29.3±3.56	-3.2 (1.581NS)
Vitamin A (µg)	240	156.2±12.5	309.2±3.56	-153 (-62.034)	152.9±9.06	173.3±10.26	-40.4 (1.368NS)
Vitamin D (mcg)	400	237.1±21.7	356.0±10.0	-118.9 (-23.824)	253.4±11.12	279.8±12.64	-40.4 (1.943NS)

*Significant at 1%; Significant at 5 %; NS – Not significant;

4.4.5. Impact of Digital Health Intervention on Knowledge, Attitude and Practice (KAP) Scores of Caregivers

The table and figure below present the impact assessment of the nutrition intervention on the caregivers' knowledge, attitudes, and practices regarding child nutrition.

TABLE XXLIII

Impact of digital health intervention on KAP scores of caregivers

Groups	Before Mean ± SD	After Mean ± SD	Mean Difference	't' value
Knowledge				
EG I	3.33 ± 0.51	6.46 ±1.68	4.13	2.952*
CG I	2.86 ±0.94	4.93 ± 1.82	2.87	1.849NS
EG II	3.46 ± 0.97	8.06 ± 1.81	5.6	7.936**
CG II	2.23 ± 0.82	3.96 ± 1.06	1.73	0.821NS
Attitude				
EG I	3.13 ± 1.07	6.33 ± 1.62	4.2	2.918*
CG I	3.56 ± 0.72	5.03 ± 1.27	2.47	2.38*
EG II	2.93 ± 1.28	8.43 ± 1.19	5.5	11.93**
CG II	3.23 ± 0.72	4.13 ± 1.56	0.9	1.983NS
Practice				
EG I	1.73 ± 1.38	7.23 ± 1.10	5.5	19.34**
CG I	2.66 ± 0.94	3.80 ± 1.88	1.37	1.925NS
EG II	2.73 ± 0.71	8.93 ± 1.20	6.2	14.27**
CG II	3.16 ± 0.94	5.56 ± 1.62	2.4	1.890NS

NS- Not Significant *** P = < 0.05** **** P = < 0.0001**

EG- Experimental group **CG- Control Group**

It was encouraging to notice that KAP scores of caregivers had improved as a result of nutrition education. After nutrition education was consistently imputed with the aid of telephonic counselling for a period of five months, the mean scores of EG I and EG II increased from 3.3 to 6.5 and 3.5 to 8.1 in terms of nutritional knowledge, respectively. For caregivers' KAP of children in EG II and EG II before and after the nutrition intervention, statistical significance at less than 1% level of difference was obtained. Between the control groups before and after the five-month intervention, there was no statistically significant change. The greatest mean difference in nutrition knowledge was discovered among EG II, demonstrating the impact of dietary supplements as well as nutrition and health education.

After receiving nutrition education and intervention, the mothers attitude increased from its initial mean scores in EG I, EG II, and CG I of 3.1, 2.9, and 3.6 to 6.3, 8.4, and 5.0, respectively. After the study period, the control group II showed no noteworthy changes, and no statistical significance was found. Caregivers in EG II had the highest mean difference in attitude score. According to statistical significance, there was a 5% level difference for EG I before nutrition and a 1% level difference for EG II before nutrition.

The mean starting value of the mean practice score among the selected caregivers in EG I increased from 1.7 to 7.2 following dietary modification. The success of the intervention programme was indicated by the quality of the nutrition intervention, which also led to an increase in the mean practice score of EG II from 2.7 to 8.9 following dietary modification and nutrition education. The control group showed no alterations after the research period. Overall, the results demonstrated that experimental groups outperformed the control group in a significant way.

It may be concluded that the five-month nutrition intervention, which used specially designed digital health nutrition education tools and was based on the scheduled, structured nutrition education classes for caregivers, was very successful in changing and imparting nutrition-related knowledge, attitudes, and practices. The findings of Drammeh *et al.*, (2019) are consistent with the findings of the current study in that an integrated intervention involving home gardening and changes in nutrition behaviour helped to improve household food security, reduced neurodevelopmental disorder, personal hygiene, child health, and prevention of mental retardation. Micronutrient and Omega-3 fatty acids -based nutrition education for caregivers led to a significant improvement in children's nutritional status, according to a cluster-randomized intervention study in Southern India. This finding raised the possibility that nutrition education for caregivers may be an effective method for enhancing the health and nutritional status of children from Indian communities.

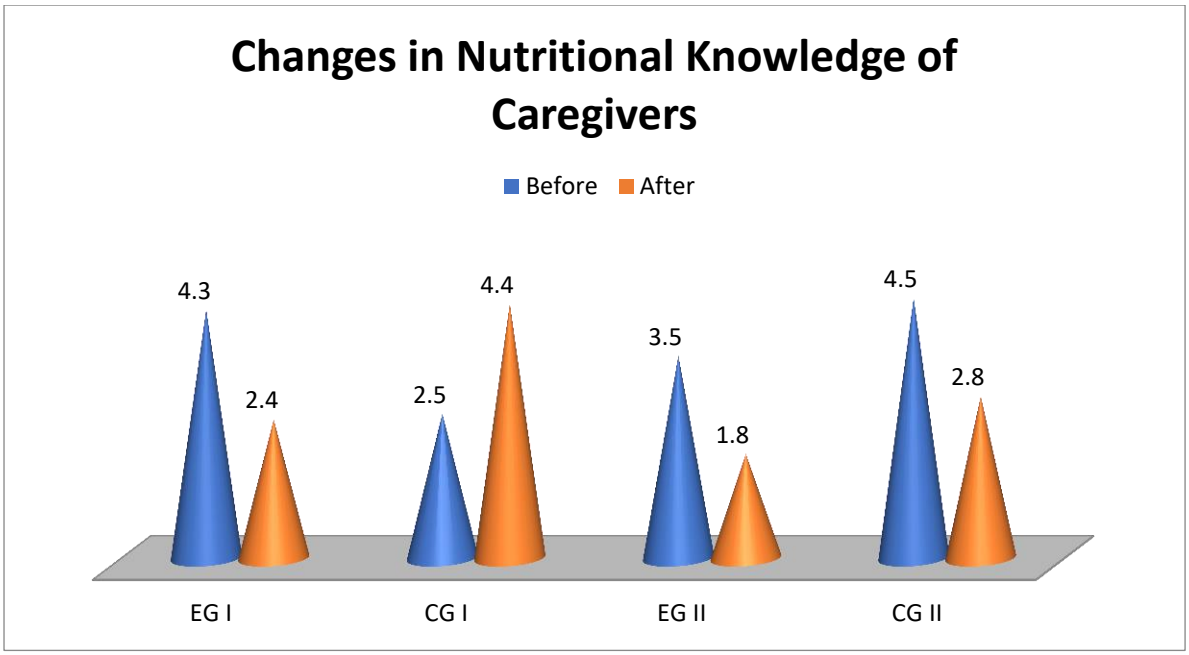

Figure 27

Changes in Nutritional Knowledge of Caregivers

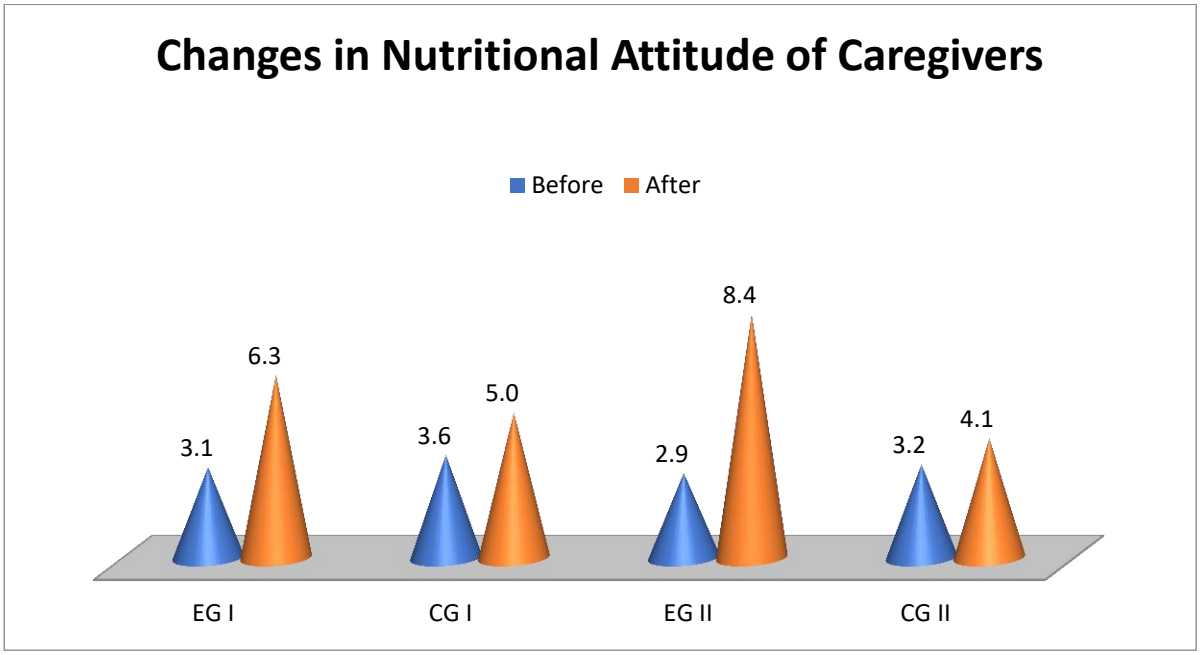

Figure 28

Changes in Nutritional Attitude of Caregivers

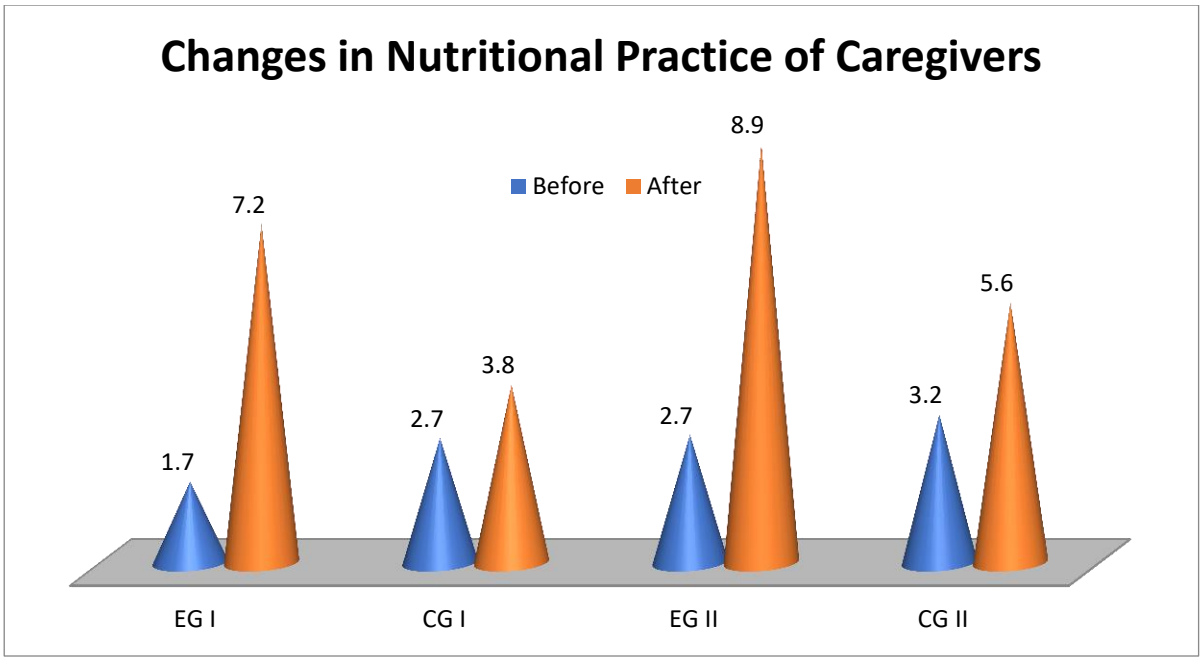

Figure 29

Changes in Nutritional Practice of Caregivers