ORIGINAL RESEARCH PAPER

Ophthalmology

IMPACT OF NUTRITION ON VISUAL ACUITY IN PEDIATRIC AGE GROUP

KEY WORDS:

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INTRODUCTION

Nutrition plays a direct role in the growth and development during childhood. Malnutrition (undernutrition) is defined as an imbalance between nutrient requirements and intake that results in cumulative deficits of energy, protein, or micronutrients that may negatively affect growth, development, and other relevant outcomes. Poor nutritional status has been reported to be caused by three main factors: decreased intake of nutrients, altered utilisation, and increased requirements [1]. It has been reported in literature that globally, approximately 60 million and 13 million children are affected with moderate and severe acute malnutrition [2]. Undernutrition is one of the leading risk factors for developing refractive errors amongst children.

visual acuity (VA) commonly refers to the clarity of vision. Visual acuity is dependent on optical and neural factors, i.e., (i) the sharpness of the retinal focus within the eye, (ii) the health and functioning of the retina, and (iii) the sensitivity of the interpretative faculty of the brain. A common cause of low visual acuity is refractive error (ametropia), or errors in how the light is refracted in the eyeball [3]. Causes of refractive errors include aberrations in the shape of the eyeball or the cornea, and reduced flexibility of the lens. Too high or too low refractive error (in relation to the length of the eyeball) is the cause of nearsightedness (myopia) or farsightedness (hyperopia) (normal refractive status is referred to as emmetropia). Other optical causes are astigmatism or more complex corneal irregularities.

Visual impairment often follows malnourishment, and this can be demonstrated by taking visual acuity as a parameter. Taking the pediatric group into consideration, uncorrected refractive error as posed as the most common form of visual impairment. Some 12.8 million in the age group 5–15 years are visually impaired from uncorrected or inadequately corrected refractive errors, a global prevalence of 0.96% [4]."The **Refractive Error** Study in **Children** (RESC)" reported population (**children** aged 5 to 15 years) based **prevalence** of presenting visual acuity ≤ 20/40 in both eyes in urban and rural **India** as 7.4% and 4.9% [5] .Treatable refractive error contributes to 33.3% of blindness in school children only followed by 16.6% of preventable blindness due to Vitamin A deficiency [6].

This study aims at assessing the impact of the nutritional status of children of pediatric age group on visual acuity.

METHODOLOGY

STUDY DESIGN

This is a descriptive cross-sectional study.

STUDY AREA AND POPULATION

This study was conducted in a tertiary care centre, Saveetha Medical College and Hospital, located in Thandalam, a village in Sriperumbudur taluk of Kancheepuram district, Tamil Nadu. The population under study includes children of pediatric age group, 5-15 years.

SAMPLE SIZE AND SAMPLING METHOD

Sample size was calculated to be 120, using formula N = 4 Pq/l^2; prevalence (p) = 59.8%, determined from NFHS-4 (2015-16), and error (l) as 10%.

STUDY PERIOD

The study was conducted in a span of three months (January - March 2019).

STUDY TOOL AND DATA COLLECTION METHOD

A pretested semi-structured questionnaire prepared to collect data from the study participants.

For this study the following definitions and indicators were considered to determine the nutritional status of the child and assess the visual acuity.

Minimal Meal Frequency, is defined as the frequency of consumption of three basic food groups: protein rich; carbohydrate rich; and vegetables and fruits either 2-3 times daily, daily, 2-3 times a week, once a week, once a month or never. The frequency is shown with a score ranging from 0 to 5; 0 being never and 5 being 2-3 times daily. For each food group, the individual food item scores were added to derive the aggregate food scores for the group. The aggregate scores are 25,10, and 35 for Proteins, Carbohydrates and fruits and vegetables respectively.

Foods included under protein rich: Pulses, Lentils, Eggs, Meat, Fish and Dairy products.

Foods included under carbohydrate rich: Rice, Wheat (chapatti) Foods included under vegetables and fruits: Beta carotene rich foods i.e. Carrots, Leafy greens (Spinach, Cabbage), Peas, Sweet potato, Pumpkin, Papaya and Mango.

Assessing visual acuity, using Snellen's chart. Visual impairment caused by uncorrected or inadequately corrected refractive errors is defined as visual acuity of less than 6/18 in the better eye that could be improved to equal to or better than 6/18 by refraction or pinhole, thus spanning the low vision and blindness categories as currently defined in the ICD-10 [4]. There are two categories moderate visual impairment (presenting visual acuity less than 6/18 but equal to or better than 6/60) and severe visual impairment (presenting visual acuity less than 6/60 but equal to or better than 3/60).[4]

Visual acuity was measured in a quiet room using a properly illuminated Snellen chart at 6 m to discriminate different letters:

- Each eye is assessed separately, and procedure repeated three times.
- A child with glasses was assessed with glasses appropriately placed.
- Letters in the charts are of a size that can be seen by the normal eye at 6 m (20 feet) from the chart
- Letters appear in rows and arranged such that a normal eye can see it from 9m, 12m, 15m.
- A person who could find the letters of the size 6 at 6 m (20 at 20 feet) has a vision of 6/6 (20/20).
- The results from the best of two eyes was used to

determine visual acuity.

Anthropometric measurements, of children of pediatric age group was conducted using a weighing machine, to check the weight; Stadiometer to measure the height and inch tape to measure the chest and mid-arm circumference respectively. These values are used to determine malnutrition in these children.

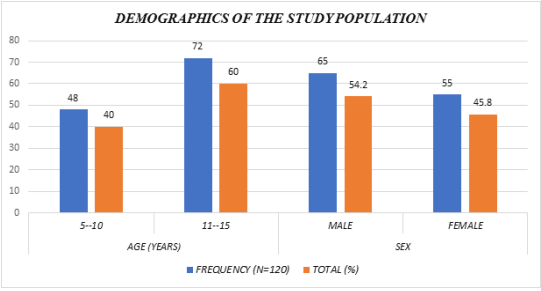
STATISTICAL ANALYSIS

Data entered in Microsoft excel and analyzed using SPSS version 22. Descriptive and analytical statistics along with Spearman Rank correlation test done to find association between visual acuity and food intake.

RESULTS

In this study, conducted on 120 children of pediatric age group 5-15 years, 55 (45.8%) were females and 65 (54.2%) males and 72 (60%) children were found to be between the ages of 11 and 15 years. **Figure 1** illustrates the basic information on the study population.

FIGURE 1



The results from Table 1.A reveal that the lentils and dairy products are the most common food items among the protein food group followed by eggs, fish, and meat.

TABLE 1.A Minimal Meal Frequency: Protein intake

Variables	Frequency		Mean	Standard Deviation
	Minimum	Maximum		
LENTILS	0/5		3.76	1.08
EGGS	0/4		2.63	1.23
MEAT	0/3		1.49	1.05
FISH	0/3		1.95	0.81
DAIRY PRODUCTS	0/5		3.52	1.36

Among the carbohydrate food group, as shown in Table 1.B, rice was popular followed by chapatti, a wheat-based food item.

TABLE 1.B Minimal Meal Frequency: Carbohydrate intake

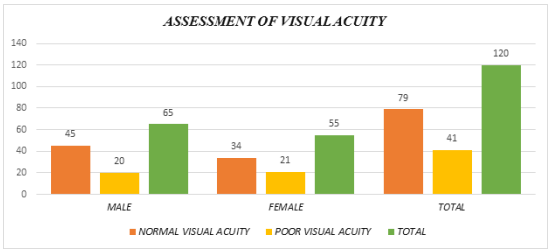
VARIABLES	FREQUENCY		MEAN	STANDARD DEVIATION
	Minimum	Maximum		
RICE	3/5		4.15	0.56
CHAPATHI	0/5		2.34	1.66

According to Table 1.C, the most frequently consumed fruits and vegetables are carrots, pumpkin followed by leafy greens, peas sweet potato and papaya.

TABLE 1.C Minimal Meal Frequency: Vegetables and Fruits.

VARIABLES	FREQUENCY		MEAN	STANDARD DEVIATION
	Minimum	Maximum		
CARROTS	0/4		3.03	0.83
LEAFY GREENS (SPINACH/ CABBAGE)	0/3		2.37	0.83
PEAS	0/3		2.13	0.90
SWEET POTATO	0/3		1.82	0.88
PUMPKIN	0/4		2.53	1.13
PAPAYA	0/3		1.42	0.98
MANGO	0/3		2.25	0.95

FIGURE 2



The visual acuity was assessed using the Snellen's chart and among the 120 children evaluated, 79 (65.8%) were found to be normal and 41 (34.2%) with poor visual acuity, of the 41 with poor acuity, 20 (16.6%) were male and 21 (17.5%) female. Table 2 illustrates the association between visual acuity and food intake. The results given in the table below suggest a statistically significant relation between gender and visual acuity (P=0.00). Out of 120 study participants, 64 males and 14 females were found to have normal visual acuity.

The individual scores for each food item on the food group were considered and the results were tabulated, given in the table below. It was seen that poor intake of protein, fruits and vegetables had statistically significant association with poor vision and increased intake of carbohydrate had an inverse relation.

TABLE 2: Association between visual acuity and food intake of different food groups.

VARIABLES	VISUAL ACUITY		CHI-SQUARE	P VALUE
	Normal (N=79)	Poor (N=41)		
Gender			73.602	0.00*
Male	65	0	0	
Female	14	41	41	
Nutrition				
a. Proteins				
• Lentils		52.848	52.848	0.00*
0-2	12	28	28	
3-5	67	13	13	
• Eggs		81.855	81.855	0.00*
0-2	40	1	1	
3-4	39	40	40	
• Meat		72.005	72.005	0.00*
0-1	54	2	2	
2-3	25	39	39	
• Fish		73.588	73.588	0.00*
0-1	26	31	31	
2-3	53	10	10	
• Dairy		85.646	85.646	0.00*
0-2	28	2	2	
3-5	51	39	39	
b. Carbohydrate				
• Rice		74.653	74.653	0.00*
3-4	79	12	12	
5	0	29	29	
• Chapatti		108.768	108.768	0.00*
0-2	63	2	2	
3-5	16	39	39	
a. Vegetables and fruits				
• Carrots		92.393	92.393	0.00*

0-2	24	21	21	
3-5	55	20	20	
• Leafy Green		50.955	50.955	0.00*
0-1	17	36	36	
2-3	62	5	5	
• Peas		100.187	100.187	0.00*
0-1	19	9	9	
2-3	60	32	32	
• Sweet Potato		64.815	64.815	0.00*
0-1	33	28	28	
2-3	46	13	13	
• Pumpkin		86.656	86.656	0.00*
0-2	59	15	15	
3-4	20	26	26	
• Papaya		99.727	99.727	0.00*
0-1	7	37	37	
2-3	72	4	4	
• Mango		58.261	58.261	0.00*
0-1	22	5	5	
2-3	57	36	36	

**p<0.05 is statistically significant.*

The Spearman Rank correlation test is conducted to obtain the correlation coefficient "r", that measures the strength and direction of a linear relationship between two variables on a scatterplot.

Table 3 shows that the three food groups have a significant effect on the visual acuity.

TABLE 3: rs value obtained from Spearman Rank Correlation tests.

VARIABLES	R VALUE
Proteins	
X= Mean score of protein food group Y= Visual acuity	0.73029*
Carbohydrates	
X= Mean score of carbohydrate food group Y= Visual acuity	0.79973*
Fruits and Vegetables	
X= Mean score of fruits and vegetables Y= Visual acuity	0.82222*

R value greater than 0.7 is significant.

DISCUSSION

In this study, we determine the association of visual acuity with nutrition by analyzing the consumption frequencies of different food groups. A statistically significant association was found between visual acuity and food intake.

In this study, it was found that most of the study population was between the age group 11-15 years (60%) and 54.2% males and 45.8% female. After further analysis it was found that 65.83% had normal vision and 34.6% had poor visual acuity amongst which 16% were males and 17.5% females. The data obtained is comparable to a cross-sectional study conducted by B.Thomas et al.[7], where, 16% of the males and 14.5% of the females showed poor visual acuity. Kakali Mondal et al.[8], conducted a study on rural girls in West Bengal, to assess their visual acuity, and found that 68.9% students had visual acuity 6/6 (normal) and 31.1% had visual acuity <6/6 (poor) with best available correction in both eyes.

Amongst the 41 children with poor visual acuity, 12.8% had substandard protein intake and 20.8% lacked the necessary requirement of fruits and vegetables. A similar study conducted by Kakali Mondal et al.[8] showed that 65.3% of study population with visual acuity of 6/6 and 34.7% with visual acuity < 6/6 were taken green leafy vegetable 5-7 days weekly.

In a study conducted by Dandona R et al.[9] to assess the prevalence, distribution, and demographic associations of refractive error in an urban population in southern India, those < or = 15 years of age with age-gender- adjusted prevalence of myopia was 4.44%, higher in those between the ages of 10 and 15 years of hyperopia 59.37% and astigmatism 6.93%.

CONCLUSION

Deficient intake of proteins, fruits and vegetables and increased intake of carbohydrate was found to have an adverse effect on the pediatric age group, resulting in poor vision. From the above study it can be concluded that there is need for regular surveillance and screening programmes to correct early stages of visual impairment in the pediatric age group. It is important to include health education and practice in these young individuals and in their home to prevent risk factors from setting in.

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