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Impact of dietary diversity on nutritional status of children between 3-5 years of age in selected pre-schools, Bangalore

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ABSTRACT

Background: Malnutrition is a leading cause of childhood mortality and morbidity often referred to as “silent emergency”. Complex interaction of multiple factors makes young children susceptible to its consequences.

Aim: To determine the association between nutritional status and dietary diversity of children between 3-5 years of age.

Methods: The study was conducted among 340 children and their caregivers in five Pre-schools in urban Bangalore. A descriptive research design was employed and a non-Probability Convenient sampling technique was utilised.

Dietary diversity was assessed using Modified Food and Agricultural organization’s Standard Guidelines for Measuring Household and Individual Dietary Diversity. A self-administered questionnaire was used to collect information on socio-demographic variables. Anthropometric measurements (Height and Weight) were recorded following standard guidelines and was interpreted using WHO standard z-score growth charts. Data was analysed using descriptive and inferential statistics using IBM SPSS version 20.

Results: The results revealed, prevalence of underweight (Weight-for-age) 5.6%, stunting (Height-for-age) 3.2%, and wasting (Weight-for-Height) 13.8%. The current study indicated that 62.9% of children had adequate dietary diversity whereas 37.1% had inadequate dietary diversity. Result also revealed no statistical significance between nutritional status and Dietary diversity as p value was >0.05.

Conclusion: The study concluded that there was no association between the dietary diversity and nutritional status of children between 3-5 years of age. Hence, dietary diversity solely doesn’t determine the nutritional status of the children in these age groups, other factors such as child’s age, birth weight, mother’s educational status, mother’s employment status are also to be considered

Keywords: *Malnutrition, Dietary diversity, Nutritional status, Preschooler, Wasting, Stunting, Underweight.*

1. INTRODUCTION

Nutrition is a vital component of child’s development and health. [1] As children grow older their physical activity increases, where body demands for more energy and hence increases the need for intake of nutritious diversified diet.

A diverse diet ensures they receive essential vitamins, minerals, proteins, fats, and carbohydrates. [2] Dietary diversity is a qualitative measure of food consumption that reflects household access to a variety of foods, and is also a proxy for nutrient adequacy of the diet of individuals.[3]

The imbalance between the growth needs of the child and nutritious diet can lead to various disease one of which is malnutrition.

According to WHO's 2021 report globally there are 656.64 million children who are under 5 years of age. Alarmingly, India ranks second in the world for the highest number of deaths in this age group. The report also estimated that 149 million children under five were stunted, 45 million were wasted and 38.9 million were overweight or obese. [4]

The National Family Health Survey (NFHS-5) for 2019-2020 highlights the severity of malnutrition in Karnataka, India. The data indicates that 32.9% of children are underweight, 35.4% are stunted, 20.1% are wasted, and 8.3% are severely wasted. There was a slight improvement in children's nutritional status since NFHS-4 children who were stunted decreased marginally from 36 percent to 35 percent, wasted has decreased substantially from 26 percent to 20 percent and children who are underweight decreased from 35 to 33 percent. However, the continuing high levels of under-nutrition are still a major problem in Karnataka.[5]

With this background this study intended to focus on identifying dietary diversity and its impact on nutritional status of the child aged 3-5 years in selected pre-schools in Bangalore. The results obtained from this study is useful for nutritional policy and to propose interventions that focus on improving the nutritional status through a diversified diet and to work towards SDG-2, which aims to end hunger, achieve food security, and improve

nutrition.

Subjects and Methods:

A descriptive cross-sectional study to evaluate the nutritional status and dietary diversity among children aged 3-5 years. The data was collected in five pre-schools located in urban Bangalore, between January 1st, 2024, and February 4th, 2024. Study population consisted of children aged 3-5 years and their mothers or caregivers by excluding children diagnosed with nutritional disorders or those on dietary restrictions at the time of the study. That ensured that the study accurately reflected the dietary diversity and nutritional status of healthy children in the target age group.

A Non probability convenient sampling technique was employed to select samples for the study. The sample size was calculated using the formula N=z2p (1-p)/ d2, based on literature review from a study conducted in India where the Minimum dietary diversity score was 8.5%. and with 95% confidence level and 3% absolute precision minimum sample size required was 340. [6]

Before commencing the study, necessary permission was obtained from the principals of each school and ethical clearance was obtained from Institutional Ethics Committee. Informed Consent was taken from parents of selected children after explaining the study's objectives and procedures.

A Modified Food and Agricultural Organisation (FAO's) Standard Guidelines for Measuring Household and Individual Dietary Diversity was used to assess dietary diversity of the children. The tool included a 24-hour food recall, followed by scoring based on the food groups consumed by the child. The assessment focused on seven key food groups: cereals; legumes, nuts, and seeds; milk and milk products; flesh meats and eggs; vitamin A-rich fruits; and other fruits and vegetables. Each food group was scored 1 if consumed by the child in the previous 24 hours and 0 if not consumed. A score of less than 4 was classified as indicating inadequate dietary diversity, while a score of 4 or more indicated adequate dietary diversity. A self-administered questionnaire was used to collect data about socio-demographic variables.

Anthropometric measurements (Height and Weight) were taken to assess the nutritional status of the children. Weight was measured using a digital weighing scale placed on a firm, smooth surface, with children instructed to remove shoes and heavy clothing. Height was measured using a measuring tape attached to a vertical flat surface, with the child standing barefoot, upright, and looking straight ahead. These measurements were then plotted on WHO growth charts (Weight-for-Age, Height-for-Age, Weight-for-Height) and classified according to WHO guidelines into categories such as normal, underweight, wasted, stunted, and overweight.

The data collected were initially entered into Microsoft Excel 2021 and subsequently imported into SPSS version 20 for analysis. Descriptive statistics, including frequency and percentage distribution, were used to describe the nutritional status, dietary diversity, and socio-demographic variables. Inferential statistics, including Chi-square and Fisher's exact tests, were employed to determine the association between dietary diversity, nutritional status, and socio-demographic variables

Background characteristics:

Out of 340 children 94.1% (321) children were in age group between 4-5 years, 83.5% (284) were born full term, 62.9% (214) had birth weight between 2.6- 3.5kg, 50.9% (173) of the mothers were >30 years of age, 46.5 % (158) of mothers were

Graduates, 71.2 % (242) of mothers were homemaker, 39.7% (135) of family had monthly income of < Rs 20,000, 86.5% (294) families had 1-5 members in the family, 78.8% (268) consumed non-vegetarian diet.

PERCENTAGE DISTRIBUTION OF CHILDREN ACCORDING TO NUTRITIONAL STATUS:

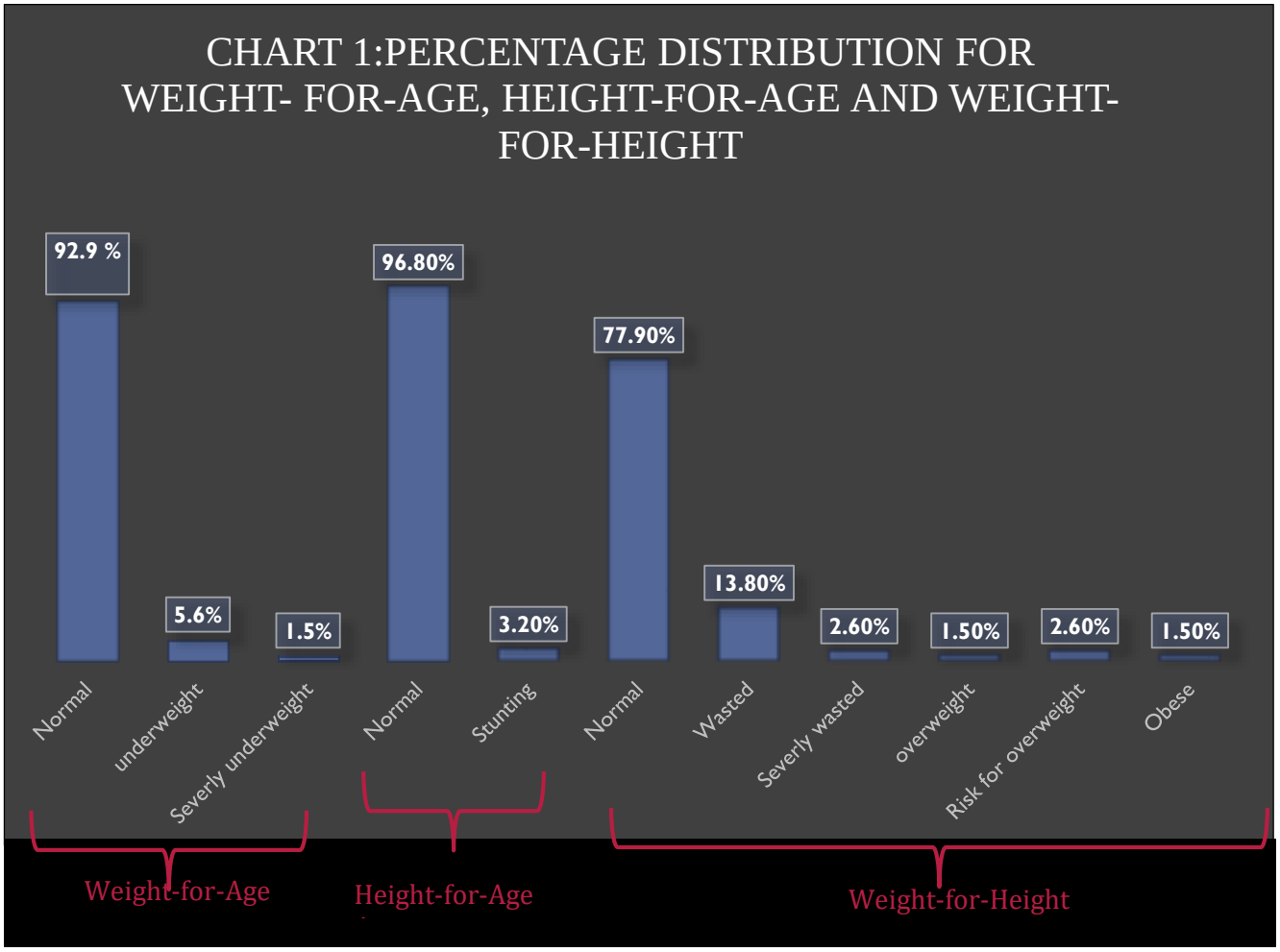
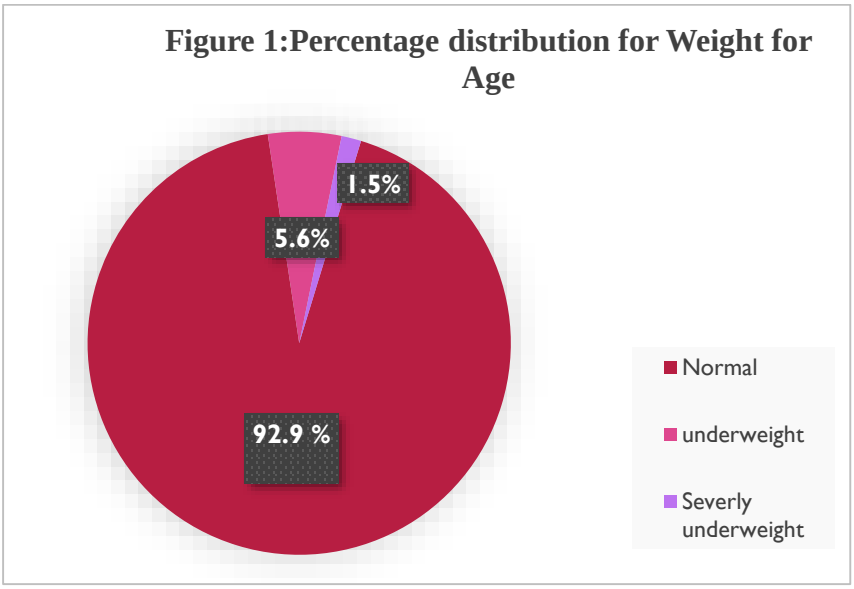


Chart 1: Percentage distribution for weight-for-age, Height-for-age, Weight-for-Height. (n=340)

Chart 1 depicts 92.9% (316) children had normal weight for age while 5.6% (19) were underweight, 1.5% (5) were severely underweight. For Height-for-Age it depicts 96.8% (329) had normal height for age while 3.2% (11) were stunted and for Weight-for-Age it depicts 77.9% (265) had normal weight for height while 13.8% (47) were wasted, 2.6% (9) was severely wasted, 2.6% (9) were at Risk for overweight, 1.5% (5) were overweight and 1.5% (5) were obese.

Figure 1: Percentage distribution for weight-for-age. (n=340)



DIETARY DIVERSITY SCORE

Analysis of Figure 1 Depicts majority of children that is 63% (214) had Adequate dietary diversity, while 37 % (126) had inadequate dietary diversity.

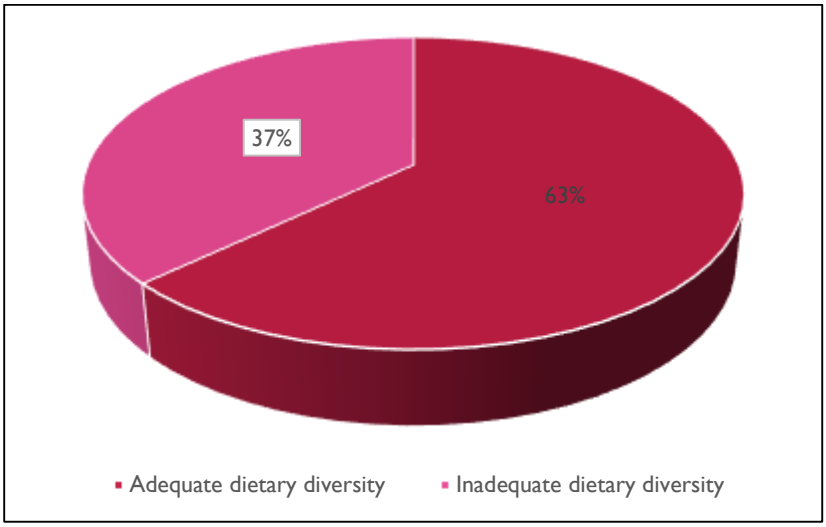


Figure 1: Percentage and frequency distribution of dietary diversity score. (n=340)

Figure 2: Percentage distribution for Height-for-age. (n=340)

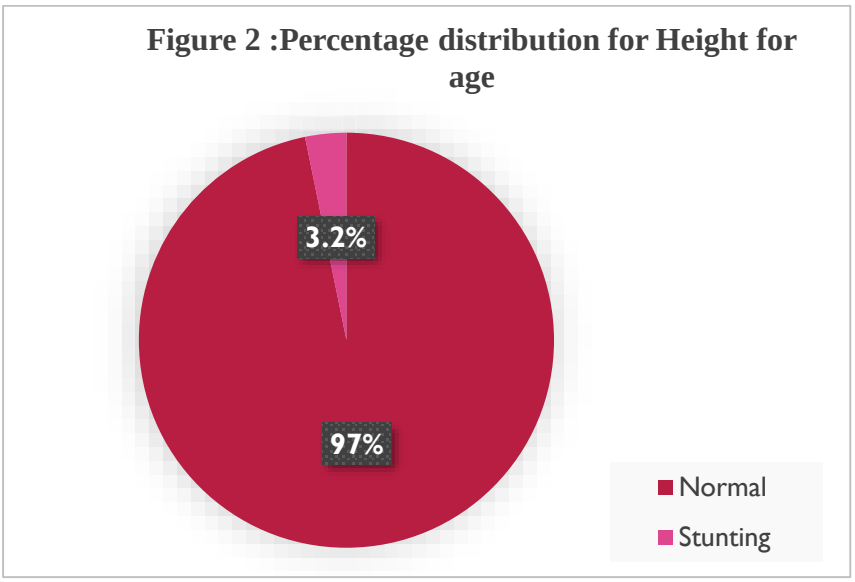


Figure 3: Percentage distribution of Weight-for-Height. (n=340)

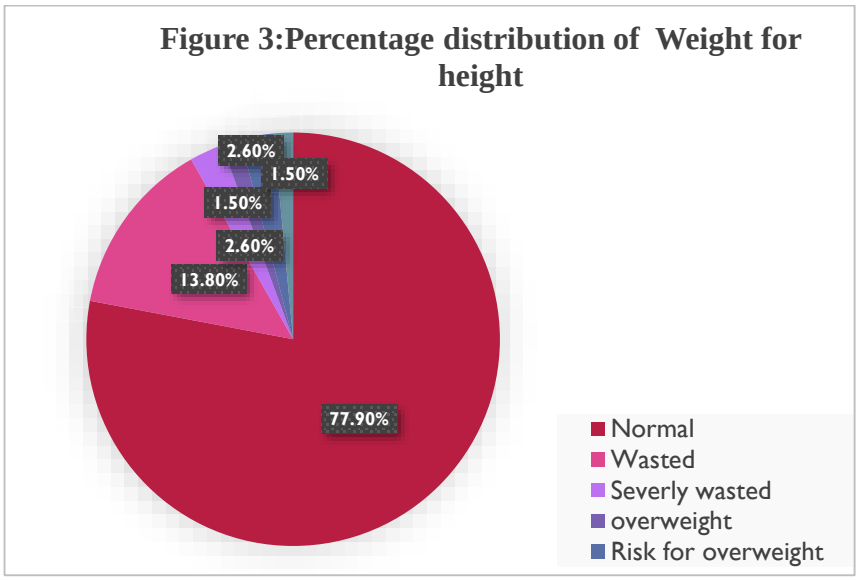


Figure 4: Percentage and frequency distribution of dietary diversity score. (n=340).

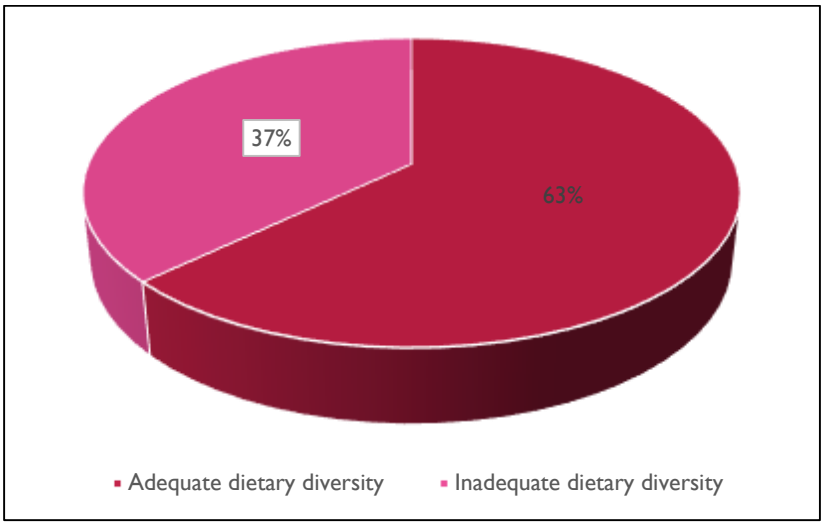


Table 1: FREQUENCY AND PERCENTAGE DISTRIBUTION OF CHILDREN BASED ON DIETARY DIVERSITY (FOOD GROUPS).
(n=340)

Food groups	Cereals	Legumes, nuts, seeds	Milk and milk products	Flesh meat	Eggs	Vitamin A rich fruits	Others fruits and vegetables
Frequency	335	188	238	48	26	192	273
Percentage	98.5	55.2	70	14	7.6	56.4	80.2

Table 1 reveals that majority of children that is 98.5% consumed cereals, 80.2% consumed other fruits and vegetables 70% consumed milk and milk products, 56.4% consumed Vitamin A rich fruits, 55.2% consumed legumes, nuts and seeds, 14.1% consumed Flesh meat, 7.6% consumed Eggs

ASSOCIATION BETWEEN DIETRAY DIVERSITY AND NUTRITIONAL STATUS

Table 2: ASSOCIATION BETWEEN NUTRITIONAL STATUS (WEIGHT FOR AGE, HEIGHT FOR AGE, WEIGHT FOR HEIGHT) AND DIETARY DIVERSITY SCORE. (n=340)

SL.NO	Category of malnutrition	Dietary Diversity Score		Statistical test used	Interpretation
		Adequate dietary diversity (≥4)	Inadequate dietary diversity (<4)		
1.	**Weight for Age:**			$\chi 2$ value -1.854 df (2) P value- 0.173	Not significant
	Normal	202	114		
	Underweight	8	11		

	Severely underweight	4	1		
2.	**Height for Age:**			Fishers Exact test value -0.108 df (1)	Not significant
	Normal	210	119		
	Stunted	4	7		
	Severely stunted	0	0		
3	**Weight for Height:**			$\chi 2$ value -1.297 df (5) P value- 0.255	Not significant
	Normal	171	94		
	Wasted	29	18		
	Severely Wasted	5	4		
	Risk for overweight	2	7		
	Overweight	3	2		
	Obese	4	1		

df = degree of freedom, t-value at df(1) =3.841, df(2)= 5.991, df(5)= 11.07 , p <0.05 level of significance.

According to the data obtained, there was no statistical significance between nutritional status (Weight-for-age, Height-for-age, Weight-for-Height) and Dietary diversity as table value obtained was more than p value at degree of freedom 1, 2 and 5 is 3.841, 5.991, 11.07 respectively at 0.05 level of significance as depicted in Table 2.

Table 3: ASSOCIATION BETWEEN NUTRITIONAL STATUS (WEIGHT FOR AGE, HEIGHT FOR AGE, WEIGHT FOR HEIGHT) AND SOCIO-DEMOGRAPHIC VARIABLES. N=340

S/N	Sociodemographic variable	Weight for age		Statistical test used	Height for age		Statistical test used	Weight for Height			Statistical test used
		Normal	Underweight/ Severely underweight		Normal	Stunted		Normal	Wasted/ Severely wasted	overweight/ Obese	
1.	**Child's Age:**			χ2 value-.369 df(1) P value-.544			**χ2 value - 10.13 df(1) *P value - 0.001**				χ2 value-1.384 df(2) P value-.501
	3-4 years	17	2		16	3		25	4	0	
	4-5 years	299	22		313	8		250	52	19	
2.	**Gender:**			χ2 value-.280 df(1) P value-.597			χ2 value-.037 df(1) P value-.848				χ2 value-31.396 df 2) P value-.498
	Male	180	15		189	6		151	35	9	
	Female	136	9		14	5		114	21	10	
3.	**Gestational age at birth-** Was child born before 37 weeks?			χ2 value-3.025 df(1) P value-.082			Fisher's Exact test value 0.89 df(1)				χ2 value-4.346 df(5) P value-.499
	Yes	49	7		52	0		47	9	0	
	No	267	17		277	7		218	47	19	
4.	**Birth weight:**			**χ2**			Fisher				χ2

				value			's				value-
	1.5-2.5 kg	87	9	-	120	6	Exact	32	11	1	3.479
	2.6-3.5 kg	204	8	**5.011**	209	5	test	229	44	18	df(2)
	3.6-4.5 kg	25	2	**df(2)**			value-				P
				***P**			.341				value-
				value			df(1)				.176
				-							
				0.025							
5.	**Age of the mother:**						Fisher				χ2
				χ2			's				value-
	<25 years	39	3	value-	40	2	Exact	32	10	0	4.264
				0.001			test				df(2)
	>25 years	277	21	df (1)	289	9	value-	233	46	1	P
				P			.633				value-
				value-			df(1)				.119
				.982							
6.	**Educational status of the mother:**						Fisher				**χ2**
				χ2			's				**value**
				value-			Exact				-
	No formal education	24	0	2.154	143	4	test	23	1	0	**16.45**
				df(2)			value-				**df(2)**
	Primary-Higher education	147	11	P	186	7	763	209	54	18	***P**
				value-			df(1)				**value**
				.341							-
	Graduate and above	145	13								**0.006**

7.	**Employment status of the mother:**			χ2			**χ2**				χ2
				value-			**value**				value-
				.948			**- 3.66**				1.804
	Homemaker	227	15	df(1)	237	5	**df (1)**	185	44	13	df(2)
				P			***P**				P
	Private employee/ Governmen	89	9	value-	92	6	**value**	80	12	6	value-
				.330			-				.406
							0.049				

	t employee										
8.	**Monthly family income (Rs):**			χ^2 value-1.245 df(1) P value-.265			Fisher's Exact test value-.746 df(1)				χ^2 value-1.107 df(2) P value-.575
	≤40000	219	14		226	7		179	39	15	
	>40000	97	10		103	4		86	17	4	
9.	**Total family members:**			Fisher's Exact test .347 df(1)			Fisher's Exact test value-1.000 df(1)				χ^2 value-.479 df(2) P value-0.512
	≤5	275	15		284	10		230	47	17	
	>5	41	4		45	1		35	9	2	
10.	**Religion:**			Fisher's Exact test Value .435 df(1)			Fisher's Exact test value-.472 df (1)				χ^2 value-3.192 df(2) P value-.203
	Hindu	249	26		260	10		205	49	16	
	Muslim Christian/ Buddhist/Sikh/ other	49	2		69	1		60	7	3	
11.	**Type of diet:**			Fisher's Exact test Value .563 df(1)			Fisher's Exact test value-.395 df (1)				χ^2 value-1.684 df(2) P value-.431
	Vegetarian	50	4		52	3		41	12	2	
	Non vegetarian/ Eggetarian	266	19		277	8		224	44	17	
12.	**Birth order of child:**			χ^2 value-.312 df(2) P			χ^2 value-.729 df(1) P				χ^2 value-2.718 df(2) P
	1	155	13		162	6		137	24	7	
	2	137	9		67	5		128	32	12	
	3 and more	24	2								
				value-.856			value-.729				value-.257

df = degree of freedom, t-value at df(1) =3.841, df(2)= 5.991, df(5)= 11.07 , p <0.05 level of significance.

*P value indicates significant association.

Table 3 depicts there was statistically significant association between weight for age and Birth weight of the child (p=0.025), height for age and employment status of mother (p=0.049), between height for age and child's age (p=0.001) and between

weight for height and educational status of the mother (p= 0.006). However, no statistically significant association was found between Nutritional status and other socio- demographic variables. P value was less than 0.05 .

2. DISCUSSION

The findings from present study revealed that wasting (WFH-13.8 %) as prevalent form of malnutrition followed by underweight (WFA-5.6%) and then stunting (HFA-3.2%) [Chart 1]. The result obtained was higher than that of NFHS-5 report which showed 4.2% for underweight and lower for Wasting and stunting (i.e.,18.5% ,30.1% respectively). [3] The disparity may be attributed to differences in the age groups and study environments. The present study focused exclusively on children aged 3–5 years from urban areas, whereas the NFHS survey encompassed children under five years of age from both urban and rural populations. In contrast, a cross-sectional study by Kini et al. in coastal Karnataka reported higher rates of malnutrition—stunting at 25.9%, underweight at 22%, and wasting at 27.8%. [2]

In terms of dietary diversity, the study found that 62.9% of children had adequate dietary diversity, while 37.1% had inadequate dietary diversity [Figure no 1]. This finding aligns with Sarvar et al.'s study in North Karnataka, where 71.7% of children had good dietary diversity, contrasting with 28.3% that had poor dietary diversity. [8]

Government initiatives, such as the Integrated Child Development Services (ICDS) provides supplementary nutrition for children under six years and the Mid-Day Meal Scheme (MDM), offers free meals to school-aged children, which are designed to meet at least one-third of the daily nutritional requirements, including a variety of food groups. Additionally, the Poshan Abhiyaan (National Nutrition Mission) aims to improve nutritional outcomes have been instrumental in improving dietary diversity among children in India. [9][10]

However, the findings of the present study differ from those of Jana et al., who reported that a significant portion of children across India's states and union territories did not meet the recommended Minimum Dietary Diversity (MDD) of more than four food groups in a day. Jana et al.'s study indicated that less than 25% of children in India received a minimum diversified diet. This discrepancy could be due to differences in study populations and focus on urban versus broader national samples. Additionally, the effectiveness of government programs may vary based on regional implementation and accessibility, which could influence dietary diversity outcomes. [11]

The present study also revealed that plant-based foods were more commonly consumed than animal-based foods among children aged 3–5 years. Higher consumption rates were observed for cereals (98.5%), milk and milk products (70%), and other fruits and green leafy vegetables (80.2%). In contrast, the consumption of legumes and nuts (55.2%), flesh foods (14.1%), eggs (7.6%), and vitamin A-rich foods (56.7%) was lower [Table 1]. The preference for plant-based foods could be influenced by cultural beliefs, as the majority of the population in the study were Hindus, as well as the affordability and accessibility of plant-based foods compared to flesh meat and eggs.

These findings are consistent with those of Jana et al., who also reported higher consumption of grains, roots, tubers, and other fruits and vegetables, while legumes, nuts, dairy products, flesh foods, eggs, and vitamin A-rich foods were consumed in lower proportions. [11]

Interestingly, the study found no statistically significant association between nutritional status and dietary diversity among the children ($P > 0.05$). However, among underweight and stunted children (5.6% and 3.2%, respectively), approximately three-fourths had lower dietary diversity scores, suggesting that low dietary diversity may contribute to undernutrition [Table 2]. This lack of statistical significance might be due to the quantitative approach used to assess dietary diversity, which relied solely on a 24-hour food recall. It is important to note that dietary diversity alone may not fully determine a child's nutritional status, as other factors such as portion size, food quality, cultural practices, socioeconomic status, and caregiver knowledge also play critical roles.

The findings coincide with study conducted in Kenya by Bukania et al., on-Food Insecurity and Dietary Diversity a Predictor of Nutrition Status in Children where it was seen that there was no significant association of dietary diversity score with underweight (p-0.783), stunting (p value- 0.392) and wasting (0.596). [12]

This finding is in line with a study conducted in Kenya by Bukania et al., which found no significant association between dietary diversity score and underweight, stunting, or wasting. However, it contradicts other studies conducted in India by Jana et al. and Marriotte et al., which found a significant relationship between dietary diversity score and children's nutritional status. [12][13]

The present study also found a statistically significant association between the child's age and the employment status of the mother with stunting (Height-for-Age) [Table 3]. Stunting was more prevalent among younger children (3–4 years old, 15.8%) compared to older children (4–5 years old, 2.5%), indicating that younger children may be more susceptible to malnutrition. Additionally, children of employed mothers exhibited a higher prevalence of stunting than those of homemakers, possibly due to time constraints, economic pressures, and stress associated with balancing work and childcare. This finding aligns with a case-control study conducted in Karachi, Pakistan, which found that younger children were more

vulnerable to malnutrition due to their higher nutritional needs and greater susceptibility to infections and inadequate weaning practice. [14]

Programs promoting breastfeeding support in the workplace, establishment of crèche facilities, Flexible working arrangements, such as work-from-home options and part-time work, further assist mothers in balancing professional responsibilities with childcare, enabling mothers to attend to their children's nutritional needs while at work.

Finally, the study found a significant association between the child's birth weight and weight-for-age (underweight) (P value - 0.025) [Table 3]. Children with low birth weight (<2.5 kg) were more likely to be underweight (9.1%) compared to those with normal birth weight (2.5–3.5 kg) (3.7%). This could be due to the developmental challenges associated with prematurity, increased susceptibility to infections, feeding difficulties, and persistent nutritional deficits. This finding is consistent with evidence from the National Family Health Survey 2019–2021, which found that infants born with low birth weight were more likely to be stunted, wasted, and underweight in childhood. [11]

In response to this pressing issue, comprehensive measures like early initiation of breastfeeding, exclusive breastfeeding for the first six months and supplementary feeding, health check-ups, and educational support for mothers on infant and young child feeding practices collectively strive to enhance the growth and development of low-birth-weight children. [15]

In conclusion, the present study highlights the complex interplay of factors influencing malnutrition and dietary diversity among urban children aged 3–5 years. While dietary diversity is an important factor, it cannot be the sole determinant of nutritional status. Other factors, such as maternal education, employment status, birth weight, and cultural practices, also significantly impact children's nutritional outcomes. Addressing malnutrition requires a multifaceted approach that considers these various factors and tailor's interventions to the specific needs of the population being studied.

The limitations of the study were that dietary data was collected for only one recall (24 hour). This can potentially limit the true dietary diversity on different days of the week. Only quality of food was assessed and not the quantity, which also could be contributing factor to assess the true nutritional status of the children.

Recommendations from the study are future studies can concentrate more on comparing the dietary diversity and variation in variables among children living in urban and rural areas. Mother/ caregiver education regarding dietary food groups and their significance can be the primary focus of intervention studies

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