

# Food Variety Scores Reflect Diet Quality Better Than Dietary Diversity Scores – A Study on School Children in Mumbai City

## Research Article

G Bhide<sup>1</sup>, A Thorat<sup>2</sup>, A Goyal<sup>3\*</sup> and SA Udipi<sup>4</sup>

<sup>1</sup>Graduate Student, SNDT Women's University, Mumbai, India

<sup>2</sup>Visiting Faculty, SNDT Women's University, Mumbai, India

<sup>3</sup>Research Fellow, Medical Research Centre – Kasturba Healthy Society, Mumbai, India

<sup>4</sup>Research Director and Head, Medical Research Centre – Kasturba Healthy Society, Mumbai, India

**\*Corresponding author:** Goyal A, Research Fellow, Medical Research Centre – Kasturba Healthy Society, Mumbai, India. E-mail Id: goyal.aditi157@gmail.com

**Article Information:** Submission: 15/04/2023; Accepted: 10/05/2023; Published: 17/05/2023

**Copyright:** © 2023 Bhide G, et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

### Abstract

The present study examined the association between dietary diversity (DD), body mass index (BMI), and per cent body fat (PBF) in, 10-11-year-old school children (n=201) from two schools located in a central urban area of Mumbai, India. DD was assessed with FFQ using the FANTA food categories. 20% of the children were underweight, and 13% of the study sample was overweight/obese. Majority of the children were in the normal range of BMI and PBF categories. DD scores were quite high, with the mean DDS being  $12.4 \pm 0.7$  out of a maximum possible score of 13. Mean DDS did not differ between BMI and PBF categories. DD was also assessed by calculating the total dietary score (TDS), its percentage, and food group diversity scores. Processed food items contributed to almost 25% of TDS whereas vitamin A-rich fruits and vegetables contributed very little. Consumption of food group 'fried foods and snacks' was significantly higher among the girls, suggesting they may favour such foods more. The study indicated good DDS, but the TDS indicated some food groups were overemphasized. It is necessary to empower the younger generation about the importance of healthy diet patterns and lifestyle, well-being, and good health in the long term.

**Keywords:** School Age Children; Dietary Diversity; BMI; Percent Body Fat; Food variety

### Abbreviations

CNNS – Comprehensive National Nutritional Survey; BMI – Body Mass Index; PBF – Per cent Body Fat; FFQ – Food Frequency Questionnaire; BIA – Bioelectrical Impedance Analysis; IAP – Indian Association of Paediatrics; DDS – Dietary Diversity Scores; FGS – Food Group Diversity Score; TDS – Total Diversity Scores; SD – Standard Deviation

### Introduction

School age is a critical period covering almost two decades of life. Food and nutrient intakes during this period form the foundation for health and influence overall health status in the short and long term, during adulthood and old age.

The Comprehensive National Nutritional Survey (CNNS) (2016-2018) in India [1] reported that in the 5-9 year-old age group, 22% children were stunted, and 35% were underweight. The percentage of children with low body mass index (BMI) was 15% at 5 years of age, 20% at 7 years of age, and the highest prevalence of 26% at 10 years of age. The increasing prevalence of overweight and obesity is a cause of concern in terms of public health along with undernutrition in India. Lobstein and Jackson-Leach (2016) [2] estimated that by 2025, India is likely to have 17.3 million overweight/obese children, second among all countries in the world.

Growth in young children has been found to be influenced by dietary diversity [3,4]. Dietary diversity implies that a variety of foods from different food groups are consumed thereby ensuring the

intake of various essential nutrients that support health, growth and maintenance [5]. In young Indian and Cambodian children, those with less stunting and better height-for-age were fed more diverse diets [6, 7]. A comparison of primary school children in Iran and Mumbai showed that higher total food group scores were associated with better height status, while severely and moderately stunted as well as wasted children had lower food group scores. Higher BMI was associated with higher scores for cereal foods, fruits and vegetables, as well as beverages, sweets and fats [8, 9].

In India, the rising prevalence of overweight and obesity has been attributed partly to the easy access and availability of relatively cheap and affordable energy-rich, nutrient-poor foods. Joseph et al (2015) [10] observed that among 300 boys (Mean Age =  $13.5 \pm 0.9$  years), 97.3% of children consumed fast foods and 14.4% consumed these foods daily. More recently, Jain and Mathur (2020) [11], reported from a study of 1030 adolescents, from low and middle-income backgrounds, that ultra-processed foods contributed to 16.2% of their total energy intakes. Also, children from middle-income families consumed more such foods regularly than those from low-income families.

While there are reports in the literature on consumption patterns of school children, particularly fast foods, chips, chocolates, etc., not many studies have been conducted on the dietary diversity of school-aged Indian children and their BMI as well as per cent body fat (PBF). The present study examined dietary diversity and its association with BMI and PBF among school children from Mumbai City, India. However, the dietary diversity scoring pattern that has been widely used [3] gives the same weight age to all food groups regardless of whether they are more or less healthy. Also, this scoring pattern does not reflect the diversity of foods within a specific food group and its contribution to the total diversity scores. Therefore, in the present study, we calculated food variety scores using a scoring system that reflected the per cent contribution of different food groups consumed.

## Research Design and Methodology

**Sample Selection:** The study sample consisted of 201 children aged 10-11 years, who were in the V<sup>th</sup> grade in two schools located in Central Mumbai. These schools were selected based on their willingness to allow the investigators to conduct the study. All the children in the V<sup>th</sup> grade of these two schools were included in the study, after obtaining informed parental written consent and assent from the children.

**Ethics Approval:** The study was approved by the Inter Systems Biomedica Ethics Committee, Mumbai.

**Data Collection:** Weight, height, and dietary data was collected using a Food Frequency Questionnaire (FFQ). The age and gender of students were taken from the school records.

## Anthropometry

The InBody-120 body composition analyzer was used to measure weight, BMI, and PBF using bioelectrical impedance analysis (BIA). Height was measured using a measuring tape fixed to a wall without any skirting. The tape was calibrated against a stadiometer (least count 0.1cm). Children were asked to remove their shoes and stand straight

with heels, buttocks and shoulders touching the wall and the tape, ensuring that the feet are parallel and placed together, arms naturally hanging at the sides. They were instructed to look straight, such that the line of sight is parallel with the floor. A headboard was used, the hair was compressed and two measurements were taken.

BMI was calculated and the per cent categories for each child were determined based on standards for Indian children recommended by the Indian Association of Paediatrics (IAP) [12]. The percentile categories were: underweight (<3<sup>rd</sup> percentile), normal weight (3<sup>rd</sup> – 85<sup>th</sup> percentile), overweight (85<sup>th</sup> – 95<sup>th</sup> percentile) and obese (>95<sup>th</sup> percentile). PBF was categorized into percentiles as given by Khadilkar et al., (2013) [13] and approved by the IAP. The percentile categories were: low fat (<3<sup>rd</sup> percentile), normal fat (3<sup>rd</sup> – 85<sup>th</sup> percentile), high fat (85<sup>th</sup> – 95<sup>th</sup> percentile) and very high fat (>95<sup>th</sup> percentile).

## Dietary Diversity

A food frequency questionnaire (FFQ) consisting of 327 food items was used to assess dietary diversity. The frequency of consumption was recorded as daily, thrice a week, twice a week, once a week, once in fifteen days and occasionally/ seasonally or never.

1) Dietary Diversity Scores (DDS): The scoring was based on the FANTA scoring system (2016) [14]. In the FANTA scoring system, each food item consumed from 10 food groups mentioned is given a score of 1, and those not consumed are given a score of 0. The food groups considered in the FANTA system are (i) grains, white root, tubers, and plantains;

(ii) pulses (beans, peas, lentils); (iii) nuts and seeds; (iv) dairy; (v) meat, poultry, fish; (vi) eggs; (vii) dark green leafy vegetables; (viii) other vitamin A-rich fruits and vegetables;

(ix) other vegetables and (x) other fruits. For this study, the FANTA system was modified slightly to capture the typical diet patterns of children in this city.

Cereals and white roots and tubers were treated as separate groups. Also, sweets and savoury and fried snacks were added because they are popular among large segments of the population in Mumbai city. Thus, foods were categorized into thirteen food groups: (i) Cereals, (ii) Pulses, (iii) White roots and tubers, (iv) Nuts and seeds, (v) Dairy and milk products (vi) Meat, poultry and fish, (vii) Eggs, (viii) Dark green leafy vegetables, (ix) Other vitamin A-rich vegetables and fruits, (x) Other vegetables and fruits, (xi) Oils and fats, (xii) Sweets, (xiii) Fried foods and snacks. DDS was calculated as follows: each group was assigned a score of 1 if it had been consumed and if not, the score assigned was 0. The total maximum possible score was 13.

1) Food Group Diversity Score (FGS) and Total Diversity Score (TDS): These were calculated to assess the contribution of individual food groups and to calculate the total score to reflect dietary diversity. Therefore, in the present study a scoring system was developed for assessing diversity within each food group and to reflect the extent to which different food groups contribute to the diversity scores. Hence the TDS scoring method was developed to calculate the contribution of each food group and to identify whether the children's diets were healthy or not.

TDS was calculated by dividing all the food items that had been consumed at least once in the preceding week by the total number of items (327) listed in the FFQ. This was expressed as a percentage. Each food item that was consumed was given a score of 1 and if it was not eaten, the score was 0.

The FGS was calculated by adding the number of items within each food group consumed and dividing this by the total number of items eaten by the child. Scores were calculated for each food group as a percentage of the total diversity score as follows:

$$\frac{\text{Total number of items consumed within a particular food group}}{\text{Total number of items eaten by the child}} \times 100$$

### Data analysis

Three hundred and forty students were recruited. However, anthropometric body composition measurements could be taken for 324 students, since 16 students were absent on the days of the measurement. One hundred and thirty-nine students did not return the FFQ used to access dietary diversity. Thus, complete data were available for 201 students. Analysis was done using SPSS Version 25. Tests applied were ANOVA, t-test and Pearson's chi-square test.

### Results

Among the 201 children, 105 (52.2%) were girls and 96 (47.8%) were boys. Mean values for anthropometric measurements did not show significant gender differences. The mean height of all children was  $139.9 \pm 6.9$  cm, with not much difference between boys ( $140.3 \pm 6.9$  cm) and girls ( $139.5 \pm 6.9$  cm). Similarly, the mean weights of girls ( $32.8 \pm 7.7$  kg) did not differ from that of boys ( $32.9 \pm 8.9$  kg), the overall mean weight being  $32.8 \pm 8.3$  kg. The mean BMI for all children was  $16.6 \pm 3.3$  kg/m<sup>2</sup>, and the mean BMI for girls was  $16.8 \pm 3.3$  kg/m<sup>2</sup> compared to  $16.5 \pm 3.3$  for boys kg/m<sup>2</sup>. PBF was higher for females ( $25.06 \pm 9.49$ ) than that for males ( $21.95 \pm 9.95$ ), with the overall mean for the entire sample being  $23.57 \pm 9.81$ .

A slightly higher percentage of male children were underweight (< 5<sup>th</sup> percentile of BMI) as compared to females, whereas a slightly higher percentage of the females had normal BMI (Table 1). However, these gender differences were not statistically significant ( $\chi^2 = 4.458$ ,  $p = 0.216$ ). At least three-fourths of both males and females had normal PBF, although a slightly but not significantly higher percentage of boys (25.1%) had high body fat as compared to girls (16.2%) ( $\chi^2 = 2.748$ ,  $p = 0.432$ ). A higher percentage of both girls and boys had

high body fat as compared to the percentage who were found to be overweight or obese, based on their BMI (Table 1).

### Dietary Diversity Scores (DDS)

DDS was quite high, with the overall mean score for all children being  $12.4 \pm 0.7$  out of a maximum score of 13. Mean DDS for males ( $12.4 \pm 0.7$ ) and females ( $12.4 \pm 0.8$ ) did not differ significantly ( $t = 0.542$ ,  $p = 0.716$ ).

### DDS vis-à-vis BMI and PBF

DDS was not significantly associated with the different categories of BMI and PBF. DDS of children with low BMI was very similar to those who had normal BMI or who were in the overweight or obese BMI categories. Similar trends were observed for PBF as children who had low PBF had similar DDS to those who had normal PBF or PBF above the 85<sup>th</sup> percentile (Table 2).

Total Food Diversity Scores (TDS) and Food Group Diversity Score (FGS).

The overall mean total FGS for all children was  $158.9 \pm 51.5$ , with no significant difference between male ( $152.9 \pm 46.7$ ) and female children ( $164.4 \pm 55.2$ ) ( $t = 1.582$ ,  $p = 0.115$ ). Total FGS did not differ significantly between the different BMI categories ( $F = 0.637$ ,  $p = 0.592$ ) or the PBF categories ( $F = 0.036$ ,  $p = 0.991$ ). Per cent contribution of each food group to total diversity scores was calculated (Figure 1). Per cent contribution was highest from other fruits and vegetables (26.2%) followed by cereals (17.7%) and fried foods and snacks (16.4%). In contrast, pulses contributed only 9.0% to the TDS. Non-vegetarian protein sources, i.e., meat, poultry and fish, milk and dairy products, and eggs individually did not contribute much but together contributed 10.7% to the TDS (Figure 1). All protein sources together including nuts and seeds contributed 22.7% of the TDS. Dark green leafy vegetables and other vitamin A-rich fruits and vegetables contributed only 2.2% and 6.8% of the TDS respectively. In contrast, energy-dense foods like sweets, fats and oils and fried foods and snacks together contributed 32.0% of the TDS.

When FGS was compared by gender, female children had slightly scores than male children. However, this difference was found significant for only fried foods and snacks (Females =  $16.9 \pm 3.4$ , Males =  $15.8 \pm 3.6$ ) ( $t = 0.467$ ,  $p = 0.019$ ).

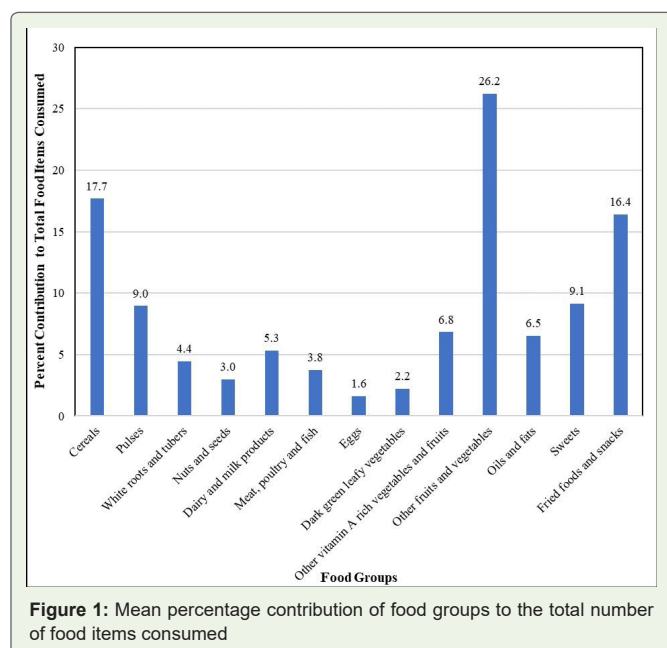
Further, FGS were compared among the different BMI and PBF categories. Analysis of variance indicated that mean per cent scores

**Table 1:** Percentage of children in different categories of BMI and PBF.

Percentile Categories of BMI/ PBF	Boys (N, %)	Girls (N,%)	All Children (N, %)
<b>Body Mass Index (BMI)</b>			
Underweight <5 <sup>th</sup> % ile	24, 25.0	16, 15.2	40, 19.9
Normal 5 <sup>th</sup> – 85 <sup>th</sup> % ile	61, 63.5	74, 70.5	135, 67.2
Overweight >85 <sup>th</sup> – 95 <sup>th</sup> % ile	7, 7.3	6, 5.7	13, 6.5
Obese >95 <sup>th</sup> % ile	4, 4.2	9, 8.6	13, 6.5
<b>Percent Body Fat (PBF)</b>			
Low body fat <5 <sup>th</sup> % ile	2, 2.1	4, 3.8	6, 3.0
Normal 5 <sup>th</sup> – 85 <sup>th</sup> % ile	70, 72.9	84, 80.0	154, 76.6
High fat >85 <sup>th</sup> – 95 <sup>th</sup> % ile	18, 18.8	13, 12.4	31, 15.4
Very high body fat >95 <sup>th</sup> % ile	6, 6.3	4, 3.8	10, 5.0

**Table 2:** Mean Dietary Diversity Scores by BMI and PBF categories.

Percentile Categories of BMI/ PBF	DD Scores (Mean ± SD)	F, p value
Body Mass Index (BMI)		
Underweight <5 <sup>th</sup> % ile	12.6 ± 0.5	1.429, 0.236
Normal 5 <sup>th</sup> – 85 <sup>th</sup> % ile	12.4 ± 0.8	
Overweight >85 <sup>th</sup> – 95 <sup>th</sup> % ile	12.3 ± 0.8	
Obese >95 <sup>th</sup> % ile	12.2 ± 0.7	
Percent Body Fat (PBF)		
Low body fat <5 <sup>th</sup> % ile	12.5 ± 0.8	1.116, 0.344
Normal 5 <sup>th</sup> – 85 <sup>th</sup> % ile	12.4 ± 0.7	
High fat >85 <sup>th</sup> – 95 <sup>th</sup> % ile	12.3 ± 0.8	
Very high body fat >95 <sup>th</sup> % ile	12.1 ± 0.7	



for all food groups differed significantly between the BMI categories only for the cereal and cereal products group, with normal weight (18.0%) and overweight children (18.1%) having significantly higher scores compared to underweight children (16.7%) ( $F = 4.68$ ,  $p = 0.003$ ). Also, underweight children had slightly higher per cent scores (9.6%) for the pulses group compared to children with normal BMI (8.8%), overweight (8.6%) and obese children (8.7%) but these differences were not statistically significant ( $F = 1.51$ ,  $p = 0.213$ ). Those with higher PBF did not have a significantly different FGS compared to those with low or normal PBF.

## Discussion

Poor dietary diversity has been linked with the poor nutritional status of children in low- and middle-income countries. Inappropriate dietary intake during adolescence has serious and adverse implications in terms of compromising physical growth and intellectual capacity as well as delayed sexual maturation. In the present study, therefore, we assessed dietary diversity based on the FANTA scoring system FANTA scoring system [14]. The mean score based on 13 food groups was found to be quite high ( $12.4 \pm 0.7$ ) out of a maximum score of

13, suggesting that the dietary diversity for these children was quite high. Also, no child had a DDS of less than 50%. In comparison to the present study, Nithya et al., (2017) [15] reported that adolescents 12-17 years old from rural areas of Wardha (Maharashtra) and Korapur (Odisha) districts, had lower scores.

Among the studies that have been reported on dietary diversity, those based on food groups are more than those based on food items [16]. These authors observed that most of the indices on dietary diversity reflected dietary diversity to a limited extent. In the present study, the high scores suggested that dietary diversity was good. However, when we considered both food items within food groups as well as food groups per se, we found that almost half of the total scores were contributed by energy-dense foods and cereals. Whereas, Vitamin A-rich vegetables and fruits and dark green leafy vegetables along with milk and dairy products contributed only 13.7-15.2% of the TDS.

There are limited studies on Indian children of school age/ adolescents and the diversity of their diets. Nithya and co-workers (2017) [15] reported that dietary diversity indices for adolescents from two rural locations in India were correlated with the nutrient adequacy ratio and nutritional status of the participants. Majority of the adolescent boys and girls had low dietary diversity. Their report indicated that a lack of food diversity is of concern in countries like India. However, in the present study, diet diversity scores did not differ by nutritional status category based on the BMI of the participants.

Hooshmand and Udipi (2013) [9] compared the dietary diversity and nutritional status of urban primary school children from Iran and India. The Indian children had better dietary diversity than the Iranian children and taller children tended to have higher diversity scores. Higher scores for almost all individual food groups were associated with higher body weight. In Iran, mean scores for vegetables, beverages, sweets and fats were higher for children with higher body weight. Children with higher z-scores for height for age also had higher mean scores for pulses, dairy products, beverages and fats, in both countries. Whereas those with higher BMI had higher scores for cereals, fruits, vegetables, dairy products, mixed dishes, beverages, sweets and fats.

The FANTA scoring system [14] does not provide an opportunity to discern which food groups are underemphasized or consumed in larger amounts. Therefore, we developed a total food diversity total score and food group diversity score using data from a food frequency questionnaire. In contrast to the overall high scores with the FANTA system, the food group diversity scores indicated that the children tended to consume fewer pulses, milk and dairy products. Also, the per cent scores for vitamin A-rich vegetables and fruits were relatively low whereas high-fat, high-sugar and/or fried foods and snacks contributed almost one-third of the total food diversity score.

These findings indicate that urban children tend to consume diets that overemphasize energy-dense foods. In a cross-sectional study conducted on 1800 children aged 9-18 years in four Indian cities, Gulati et al., (2013) [17] observed that the dietary patterns such as snacking and fast food consumption of the children were significantly



associated with the mothers' dietary patterns. In cities, processed foods like biscuits, ready-to-eat foods including wafers/chips, and many Indian snacks that are high in carbohydrates, contain salt, and are deep-fried, highly palatable, and easily available and accessible at relatively affordable costs. Rath, Riddell and Worsley (2017) [18] who studied 1026 students aged 14–16 years and were attending private, English-speaking schools in Kolkata, India, reported that 70% had consumed three or more servings of energy-dense snacks the day before the survey. They also reported that the adolescent's consumption of vegetables, pulses and legumes, animal foods was less, which is similar to our observations. In a study on secondary school students conducted almost a decade earlier in New Delhi, Singh and co-workers (date) made similar observations about the frequent consumption of fast foods [19].

Sashindran and Dudeja (2020) [20] pointed out that rapid urbanization has also fostered eating out and consumption of fast foods. In urban homes, it is not surprising that women spend less time in food preparation and they may offer convenience foods that are most often energy dense. Further, these authors noted that Indian children in senior secondary schools become more sedentary and tend to include more energy-dense, high-fat, sugar and salt-containing foods. Such foods may be habit-forming and children could get addicted to their flavours and tastes. Reliance on such foods would increase the risk of weight gain, fat gain and poor metabolic health [21].

In our study, we assessed dietary diversity using the FANTA system and developed a method of scoring that helped us assess the contribution of different food groups to the total diversity score. Our method appears to have an advantage over that of the FANTA system because it takes into account the total number of items consumed and the items within each food group, rather than only assigning a score of one to each food group. Our method helped to identify the under consumption of specific groups and those that are emphasized more. Thus, this method has better potential to identify the intake of those foods that compromise the nutrient quality of diets in terms of fiber and important micronutrients [22]. One major limitation is that it cannot be used for rapid assessment in its present form, although with further refinement, it may be possible.

The scoring pattern developed in the present study showed that there was higher inclusion of ultra-processed foods and other fast foods in the children's diets. It can help identify deficiencies in dietary practices that can be focused upon for counselling and nutrition education. The results point out the need for parents in particular to be educated about the long-term adverse effects of purchasing high-energy, high-fat/sugar and high-salt foods.

It would be worthwhile to validate the tool with a larger sample and across socio-economic groups, from urban and rural populations. This will help in the assessment of the impact of nutrition transition as well as the impact of nutrition education on dietary patterns.

## Acknowledgements

The authors thank the children's parents and teachers for their support. Profound appreciation is extended to all the school children who participated in the study, S.N.D.T. Women's University,

Mumbai, India, and also, InBody Pvt. Ltd. for providing the InBody-120 machine.

## References

1. Ministry of Health and Family Welfare (MoHFW), Government of India, UNICEF and Population Council (2019) Comprehensive National Nutrition Survey (CNNS) National Report. New Delhi.
2. Lobstein T, Jackson-Leach R (2016) Planning for worst: estimates of obesity and comorbidities in school-age children in 2025. *Pediatric Obesity* 11: 321-325.
3. Swindale A, Bilinsky P (2006) Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide (v.2). Washington, D.C.: FHI 360/FANTA.
4. Santika O, Fahmida U, Ferguson E (2009) Development of food-based complementary feeding recommendations for 9- to 11-month-old peri-urban Indonesian infants using linear programming. *The Journal of Nutrition* 139: 135-141.
5. Ruel M (2003) Operationalizing dietary diversity: A review of measurement issues and research priorities. *The Journal of Nutrition* 133.
6. Menon P, Bamezai A, Subandoro A, Ayoya M, Aguayo V (2013) Age-appropriate infant and young child feeding practices are associated with child nutrition in India: Insights from Nationally Representative Data. *Marten Child Nutrition*. 11: 73- 87.
7. Darapheak C, Takano T, Kizuki M, Nakamura K, Seino K (2013) Consumption of animal source foods and dietary diversity reduce stunting in children in Cambodia. *International Archives of Medicine* 6-29.
8. Hooshmand S, Marhamati F (2018) High dietary diversity is associated with child obesity in Iranian school children: An evaluation of dietary diversity score. *Journal of Nutrition and Human Health* 2: 46-51.
9. Hooshmand S, Udipi S (2013). Dietary diversity and nutritional status of urban primary school children from Iran and India. *Journal of Nutritional Disorders & Therapy*.
10. Joseph N, Nelliyanil M, Rai S, Babu R, Kotian S (2015) Fast food consumption pattern and its association with overweight among high school boys in Mangalore City of Southern India. *Journal Of Clinical And Diagnostic Research* 9: 13-17.
11. Jain A, Mathur P (2020) Intake of ultra-processed foods among adolescents from low- and middle-income families in Delhi. *Indian Pediatrics* 57: 712-714.
12. Khadilkar V, Yadav S, Agrawal K, Tamboli S, Banerjee M (2015) Revised IAP growth charts for height, weight and body mass index for 5- to 18-year-old Indian children. *Indian Pediatrics* 52: 47-55.
13. Khadilkar AV, Sanwalka NJ, Chiplonkar SA, Khadilkar VV, Pandit D (2013) Body fat reference percentiles on healthy affluent Indian children and adolescents to screen for adiposity. *International Journal of Obesity* 37: 947-953.
14. FAO (2016) Minimum Dietary Diversity for Women: A Guide for Measurement.
15. Nithya DJ, Bhavani RV (2017) Dietary diversity and its relationship with nutritional status among adolescents and adults in rural India. *Journal of Biosocial Science* 50: 397-413.
16. Verger E, Le Port A, Borderon A, Bourbon G, Moursi M (2021) Dietary diversity indicators and their associations with dietary adequacy and health outcomes: A systematic scoping review. *Advances in Nutrition* 12 :1659-1672.
17. Gulati S, Misra A, Colles S, Kondal D, Gupta N (2013) Dietary intakes and familial correlates of overweight/obesity: A four-cities study in India. *Annals of Nutrition Metabolism* 62: 279-290.
18. Rath N, Riddell L, Worsley A (2017) Food consumption patterns of adolescents aged 14-16 years in Kolkata, India. *Nutrition Journal* 16: 50.
19. Singh A, Maheshwari A, Sharma N, Anand K (2006) Lifestyle Associated Risk

- Factors in adolescents. The Indian Journal of Pediatrics 73 : 901-906.
20. Sashindran V, Dudeja P (2020) Obesity in School Children in India. In: Public Health in Developing Countries - Challenges and Opportunities.
  21. Khandpur N, Neri D, Monteiro C, Mazur A, Frelut M (2020) Ultra-processed food consumption among the paediatric population: An overview and call to action from the European Childhood Obesity Group. Annals of Nutrition Metabolism 76: 109-113.
  22. Liberali R, Kupek E, Assis M (2020) Dietary patterns and childhood obesity risk: A systematic review. Childhood Obesity 16: 70-85.