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# Complementary Feeding Practices and their Association with Nutritional Status of 6-23-Month-Old Infants in Chennai, Tamil Nadu: A Cross-Sectional Study

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## ABSTRACT

**Background and Objective:** Adequate complementary feeding is essential for optimal growth, while child food poverty reflects limited access to diverse and nutritious diets under five years. The aim of this study was to find out the appropriate feeding practices and to assess the influence on the status of nutrition of 6-23-month-old infants.

**Methods:** This cross-sectional study was done in the pediatric outpatient department of a tertiary care hospital in Chennai from December 2020 to October 2021. Basic demographic data was collected. Complementary feeding was assessed by time of introduction, frequency of feeds, and diversity of diet, and the complementary feeding index (CFI) was calculated. Detailed anthropometry was recorded. Weight corresponding to age, length corresponding to age, and weight corresponding to length were estimated from the growth standard of the World Health Organization (WHO). The association between CFI and various anthropometry parameters was estimated. A value of $P<0.05$ was considered significant.

**Findings:** Timely initiation of complementary feeding was seen only in 35.5%. Minimum meal frequency among the breastfeeding group was 80.7%. Minimum dietary diversity was 28.1%. The CFI score was associated with length corresponding to age ($p=0.021$) and weight for length. ($p=0.013$).

**Conclusion:** The number of children with appropriate feeding practice was high in infants above 12 months. While the frequency of meals was adequate, the dietary diversity was poor. The CFI score was associated with length corresponding to age and weight corresponding to length. Creating awareness regarding feeding practices is necessary to improve the diversity of the diet.

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## Introduction

The United Nations International Children's Emergency Fund (UNICEF) has defined child food poverty as a condition in which children less than five years of age are unable to eat a diet with a variety of foods that are rich in nutrients [1]. The emphasis is on the nutrition targets of the Sustainable Development Goals by measures to correct dietary deprivation and poor-quality diet in early childhood. The consumption of a diet that is lacking in essential nutrients can negatively influence child survival, growth, and development [1].

Globally, about 440 million children below the age of five do not have access to the right diet, and in about 27 per cent of them (181 million children), the problem is severe. Though a lack of proper diet is universal, more than 68 per cent of the affected children are from certain parts of Asia and Africa. As per the UNICEF survey 2022, there is a moderate lack of an appropriate diet in 39 % and a severe lack in 38% of Asian children. In India, 40 % of children suffer from a severe lack of an appropriate diet. Globally, 46% of children from poor families and 54% from non-poor families suffer from severe child food poverty [2]. Lack of nutrients in the diet has led to malnutrition in Asian children below five years, resulting in stunting [1].

Studies have shown that not only is there a severe lack of essential nutrients, but also the diets contain unhealthy ultra-processed foods, which contain harmful levels of sugar and salt. The majority of the children with food poverty are fed milk and staple grains. Access to fruits and vegetables, and fleshy foods, or eggs, is limited. The main causes of severe dietary deficiency are lack of access to healthy foods and easy availability of ultra-processed foods, inadequate knowledge, lack of time, low maternal education, aggressive marketing of unhealthy foods and beverages. Added to this, there is a failure of health systems to support child nutrition [1].

To combat the growing problem of child food poverty, action must be taken at several levels. The involvement of government, voluntary organizations, the health sector, society, the food and drink industry and the media is necessary to achieve success [1].

The first two years of life are considered a window of opportunity to compensate for nutritional deficiencies and build a strong future. Complementary feeding denotes introducing foods rich in nutrients and suitable for the developmental age of the infant along with breast milk [3]. Complementary feeding should be introduced at the right time, adequate in quantity, frequency, easy to digest, inexpensive, and locally available, applying responsive feeding principles for psychological care [4]. Practices related to complementary feeding are evaluated by the time of introduction of foods other than breast milk, the variety in the diet, the number of times the infant is fed, and the minimum recommended diet [5]. UNICEF and the World Health Organization use the dietary diversity score to measure child food poverty. For achieving optimal growth, the diet should contain a diversity of nutrients and include at least five food groups. When the consumption of food groups is less than two, it denotes a severe degree of lack of an adequate diet [1].

As per the World Health Assembly, the global prevalence of wasting seen in children of preschool age should be less than 5%, and stunting among children should decrease by 40% by the year 2025 [6]. The aim of the present study was to find out the proportion of children given a recommended diet and to assess the influence of diet on status of nutrition among 6-23-month-old infants.

## Methods

### *Design of the Study and Participant*

The present study was a cross-sectional one done in the paediatric outpatient division of a Government medical college hospital in Chennai, Tamil Nadu, during the period from December 2020 to October 2021. The 6-23-month-old infants attending paediatric OPD were included. Infants with chronic gastrointestinal illness limiting food intake, infants with neurological illness like cerebral palsy and neurodegenerative disorder, and those who were not accompanied by a primary caretaker were excluded. Infants who fulfilled the inclusion criteria were enrolled after obtaining informed consent from parents. Infants were categorized into 3 age groups as 6-8 months, 9- 11 months, and 12-23 months to

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assess the diet taken as per the Infant and Young Child Feeding Practices (IYCF) [7]. The demographic information, like name, age, gender, order of birth, maternal socio-demographic data, and employment status, was collected from the mother. A detailed diet history with information about diet frequency and diversity was collected by the 24-hour recall method, where the mother /primary caregiver was asked to narrate the diet taken by the child throughout the day during the pre-illness period. For infants who were on milk feeds, the type of milk (breast milk or formula) was noted. The variables for complementary feeding were the time of introduction of complementary feeding, bottle feeding, minimum dietary diversity (MDD), minimum meal frequency (MMF), and minimum acceptable diet (MAD) [7].

Timely introduction of complementary feeds: Proportion of infants aged 6-8 months who receive solid, semisolid, or soft foods

Minimum dietary diversity: Proportion of 6-23-month-old infants who receive more than four food groups among cereals, root vegetables, Legumes, nuts, milk and milk products, meat, fish, poultry, Eggs, and fruits and vegetables.

Minimum meal frequency: Breast-fed infants need to receive complementary foods twice a day (6-8 months) and thrice a day (9-23 months) to satisfy the criteria for MMF. Infants who are not on breast milk feeds should receive four or more complementary foods.

Minimum acceptable diet: Proportion of 6-23-month-old infants who were fed an adequate number of times and with the required food groups.

There are 6 variables of complementary feeding practices, used to calculate the complementary feeding index (CFI) by allotting a score of '0' for unhealthy practices and a score of '2' for healthy practices. Score 1 was allotted for practices that are between the two. Healthy practices (score of 2) include: initiation of complementary feeds on completion of six months, absence of bottle feeding, infants between 6 and 8 months who were fed more than three food groups, infants above 9 months who were fed four or more food groups, frequency of feeding in 6- to 8-month-old infants if they were fed two or more times in the last 24 hours and for infants above 9 months, if they have been fed three or more times.

Unhealthy practices (score 0): lack of breastfeeding, not receiving any of the food groups, and not being fed the previous day.

Practices in between healthy and unhealthy (score of 1): infant fed once in the last 24 hours (age=6-8 months), infants fed once or twice in the last 24 hours (age= >9 months), bottle feeding, 6-8-month-old infants who were given one or two food groups the previous day, infants >9 months who were fed one to three food groups the previous day [8].

CFI score was allotted and practices were classified into low=<6, medium=7-16 and high=17-22. Assessment of feeding was done based on breastfeeding rate, proportion of infants who were introduced to complementary feeds at the right time, proportion of infants who had access to diverse food groups, proportion of infants fed the recommended number of times, and proportion of children who were on the minimum recommended diet. Weight was measured in kilograms using an electronic weighing scale. Below the age of 2 years, an Infantometer was used to measure length. Stature below 3SD was considered abnormal. Length for age was used to classify children as normal or stunted. Weight corresponding to age, length corresponding to age, and weight corresponding to length were expressed in standard deviation units (Z scores) as per the child growth standards of WHO [9].

### *Anthropometry* [9]

Stunting – length/height corresponding to age is more than two SD below the median in the WHO Child Growth Standard.

Wasting - weight corresponding to length/height is more than two SD below the median of the WHO Child Growth Standard.

Underweight - weight corresponding to age is more than two SD below the median in the WHO Child Growth Standard.

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### *Sample size and sampling*

Using the National Family Health Survey (NFHS) 4 prevalence of recommended dietary practices among 6 to 23-month-old infants in the state of Tamil Nadu of 30%, [10] with an error margin of 5% the sample size required was estimated to be 330.

All eligible children satisfying the inclusion criteria attending paediatric OPD were included if the parents were willing to participate in the study.

### *Statistical analysis*

The proportion of infants with the recommended dietary pattern was indicated as frequency and percentage. The association between CFI and anthropometry was established by the chi-square test. The association between the various sociodemographic variables and the complementary feeding index was assessed by the chi-square test. A value of P<0.05 was considered significant.

## Results

The present study included 330 infants aged 6-23 months, divided into 3 equal age groups (110 infants in each group).

In our study population, the majority were girls (59.7%). The breastfeeding rate was high (83%). The breastfeeding rate was higher (95.4 %) in the 6-8 months age group compared to 12-23 months (62.7%). The CFI score was high in 15.1%, medium in 41.8% and low in 43%. The CFI score was high in infants between 6 and 8 months (Table 1).

Bottle feeding usage was higher in 12-23-month-old (12%) infants. The timely introduction of complementary feeding was low, only 35.5% among infants between 6 and 8 months. MMF among the breastfed group was adequate in 80.7%. MMF adequacy was higher in 6 to 8 months of age (98%) compared to 12 to 23 months of age (50%). Among the non-breastfeeding group, it was adequate in 61.1%. It was lower in 12-23-month-old infants (56%) compared to others (Table 2). Minimum dietary diversity was achieved in only 28.1%. MDD was lower in the 6 to 8-month age group compared to 12-23-month-old infants. MAD was achieved in 79.6%. It was higher in infants above one year (Table 2).

In the current study, the CFI score was statistically significant and had an association with length corresponding to age (p=0.021) and weight corresponding to length (p=0.013) (Table 3). In this study, the proportion of infants who were underweight, stunting, and wasting was 5.4%, 4.5% and 15.4% respectively. The proportion of children with high CFI scores was found to increase with increasing maternal educational status, which was not statistically significant. Socio-economic class [11] and maternal employment did not have any significant association with CFI scores (Table 4).

**Table 1. Breastfeeding practice across various age groups**

| Breast feeding | | Age in months, N (%) | | | Total |
|---|---|---|---|---|---|
| | | 6 to 8 months | 9 to 11 months | 12 to 23 months | |
| Breast feeding | No | 5 (4.5) | 8(7.2) | 41(37.2) | 54(16.3) |
| | Yes | 105(95.4) | 102(92.7) | 69(62.7) | 276(83) |
| CFI score | High | 44(40 ) | 3(2.7 ) | 3(2.7 ) | 50(15.1 ) |
| | Medium | 43(39 ) | 49(44.5 ) | 46(41.8 ) | 138(41.8 ) |
| | Low | 23(20.9 ) | 58(52.7 ) | 61(55.4 ) | 142(43 ) |

**Table 2. Indicators of child feeding practices among the study population**

| Indicators | | Age groups, N (%) | | | Total |
|---|---|---|---|---|---|
| | | 6 to 8months | 9 to 11 months | 12 to 23 months | |
| Minimum meal frequency in breast breastfed group | Adequate | 103(98 ) | 85(83 ) | 35(50 ) | 223(80.7 ) |
| | Not adequate | 2(2 ) | 17(17 ) | 34(50 ) | 53(19.2 ) |
| Minimum meal frequency in the non-breastfed group | Adequate | 4(75 ) | 6(75 ) | 23(56 ) | 33(61.1 ) |
| | Not adequate | 1(25 ) | 2(25 ) | 18(44 ) | 21(38.8 ) |
| Minimum Dietary Diversity | <4 Food Groups | 87(79 ) | 92(83.6 ) | 58(52.7 ) | 237(71.8 ) |
| | >4 Food Groups | 23(20.9 ) | 18(16.3 ) | 52(47.2 ) | 93(28.1 ) |
| Minimum Acceptable Diet | Yes | 84(76.3 ) | 85(77.2 ) | 94(85.4 ) | 263(79.6 ) |
| | No | 26(23.6 ) | 25(22.7 ) | 16(14.5 ) | 67(20.3 ) |

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**Table 3. Association between CFI and nutritional assessment by anthropometric parameters**

| Anthropometric parameters | CFI score | Grade 1 | Grade 2 | Grade 3 | chi square | P-value |
|---|---|---|---|---|---|---|
| | | Low Weight | Normal | Excessive Weight | | |
| Weight for age | Low (<6) | 10 | 131 | 1 | 3.252 | 0.517 |
| | Medium (7 -16) | 7 | 131 | 0 | | |
| | High (17-22) | 1 | 49 | 0 | | |
| | CFI score | Normal | MAM* | SAM* | chi square | P-value |
| Weight for length | Low (<6) | 109 | 23 | 10 | 12.744 | 0.013 |
| | Medium (7-16) | 123 | 12 | 3 | | |
| | High (17-22) | 47 | 2 | 1 | | |
| | CFI score | Short | Normal | Tall | chi square | P-value |
| Length for age | Low (<6) | 12 | 130 | 0 | 11.529 | 0.021 |
| | Medium (7-16) | 3 | 134 | 1 | | |
| | High (17-22) | 0 | 49 | 1 | | |

* Moderate Acute Malnutrition (MAM), Severe Acute Malnutrition (SAM)

**Table 4. Demographic variables and Complementary feeding index**

| Demographic Variables | | CFI score | | | P-value |
|---|---|---|---|---|---|
| | | Low | Medium | High | |
| Maternal education | No education | 6(1.81%) | 2(0.6%) | 3(0.9%) | 0.420 |
| | Primary education | 53(16%) | 60(18%) | 18(5.4%) | |
| | Secondary or higher Education | 83(25%) | 76(23%) | 29(8.7%) | |
| Type of Family | Nuclear | 123(37%) | 128(38.7%) | 45(13.6%) | 0.451 |
| | Joint | 19(5.7%) | 10(3%) | 5(1.5%) | |
| Socio-economic class | Upper | 3(0.9%) | 2(0.6%) | 0 | 0.773 |
| | Upper middle | 15(4.5%) | 7(2.1%) | 3(0.9%) | |
| | Lower middle | 74(22.4%) | 77(23.3%) | 29(8.7%) | |
| | Upper lower | 49(14.8%) | 51(15.4%) | 18(5.4%) | |
| | Lower | 1(0.3%) | 1(0.3%) | 0 | |
| Maternal Working Status | Non-working | 130(39%) | 127(38%) | 48(14.5%) | 0.093 |
| | Currently working | 12(3.6%) | 11(3.3%) | 2(0.6%) | |

## Discussion

This study observed that the timely introduction of complementary feeding (34.5%) was low among 6 to 8 months of age. Rates higher than our observations (50.3% to 98%) were made by other studies [12- 18]. The common factors observed were high literacy rates of the mothers and the opportunity for better child-rearing practices, as many of them were unemployed.

In the present study, minimum meal frequency (MMF) among breastfed infants was 80.7%. MMF adequacy was higher in 6-8-month-old infants when compared to infants above 12 months. Minimum meal frequency among the non-breastfeeding group was adequate in 61.1%. It was higher in 12-23-month-old infants (56%) compared to others. Previous studies have observed that similar rates of MMF were between 74% and 77.7% [19- 21]. Appropriate feeding practices were attributed to factors like maternal education, socio-cultural factors, better awareness and urban residence. Prasad et al. found a wide variation in the MMF rates

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between the breast-fed and non-breastfed groups (69.8% versus 16.7%) [16] and attributed it to interventions like Poshan Abhiyaan by the Government of India and community health worker participation. Kimwele et al. revealed that the majority of breastfed children received an MMF at 6-8 months of age (95.9%) and at 9-23 months of age (96.4%), which can be attributed to better maternal awareness [15]. Other studies have identified MMF between 23 % and 57.6% [22- 24]. A study done in Malawi has observed that variations in ethnicity, region, and exposure to media (radio) seem to play a role [22].

In the present study, MDD was achieved in only 28.1% MDD was lower in infants between 6 and 11 months when compared to older infants. Besides the poor affordability and lack of knowledge, cultural beliefs may also have influenced the feeding practices. Similar rates were observed by Mya et al. [24]. Lower rates were observed by Prasad et al. (4.1%) [16] who observed that the diet had fewer than recommended food groups, though frequency was appropriate, and Chhabra et al. (15.1%) [25] who found that children were fed ready-to-eat foods. Other studies have found MDD rates between 32% and 79%, which was [15, 19, 22, 23, 26] mainly due to socio-cultural factors, household food insecurity, food taboos, and high food prices. The current study observed a minimum acceptable diet (MAD) in 79.6%. It was higher in infants older than 12 months. As per the NFHS in India, the proportion of MAD among infants below two years has only marginally risen from 9.6% to 11% [5]. Our results were better than the data observed in the NFHS-5 5 which showed that less than 20 % of children received MAD in Tamil Nadu. The current study was conducted in an urban area where the mothers were beneficiaries of the Government health schemes. Study in Myanmar by Mya KS observed very low rates of MAD (16%) [24] related to variation in the level of maternal education and adequacy of antenatal visits. Similarly, low rates of MAD were observed by Jeyakumar et al. (14.9%) [20] due to short interpregnancy interval, large family size, and low birth weight.

Wu et al. in their study in China found MAD in 39.2% due to participation in a child care programme [26]. Studies done in India have observed rates from 9% to 12% [22, 25, 27] due to a lack of awareness of the recommended diet.

In the present study breastfeeding rate was high (83%) as the study centre had a breastfeeding supportive policy, and the majority of the mothers were motivated to practice breastfeeding. Policies like maternity leave for employed mothers may have facilitated the practice. Lower rates of breastfeeding (29.5%) were observed in a study by Wu et al. done in urban China, despite higher literacy rates of mothers [26]. Ahmed et al. found that only 39% were exclusively breastfed as infants were introduced on complementary feeds very early in life and only 61% received prolonged breastfeeding [19] while higher rates (89%) were identified by Walters et al. among infants less than one year, yet 40% were not given breast feeds exclusively till 6 months due to early introduction of formula feeds and inadequate knowledge. Jeyakumar et al. demonstrated that continued breastfeeding at 2 years was practiced by 94%, and factors like advanced maternal age and short birth spacing were found to decrease rates of continued breastfeeding [20].

In the present study, the problem of underweight, stunting, and wasting were 5.4%, 4.5%and 15.4% respectively. This was low compared to the other studies, as our study was done in an urban area, and mothers were provided adequate antenatal and postnatal support. Though Joshi PA et al. reported higher rates, they were below the observations made by NHFS 4 due to better literacy rates of the mothers [21]. Observations by Shrivastava et al. were comparable to the prevailing rates of the country at the time of the study [28] Ahmed et al. indicated that factors like birth order, birth weight, parental education, family size, and so on influence the rates of wasting and stunting [19]. Kimwele et al. observed that underweight (16.8%), stunting (13.3%), and wasting (11.9%) among children who were fed fewer meals per day [15]. Anin et al. from Northern Ghana showed that the prevalence of underweight, stunting, and wasting was 27%, 33.2% and 14.1%, respectively, attributed to food scarcity and frequent illness like malaria [29]. Prasad et al. represented that the prevalence of underweight (30%), wasting (25%) and stunting (15%) had a significant association with the age of the parents [16]. Garg et al. suggested that

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underweight, wasting, and stunting were due to the low socio-economic status of the study population [8]. Ezmareh et al., in their study done on Iranian infants, found very low rates compared to most studies done in other parts of the world. Their study concluded that the nutritional status of children can be improved by necessary education through the use of mobile phones [30].

In the present study, it was found that the CFI score was high in 15.1%, medium in 41.8% and low in 43%. The CFI score was higher in 6-8 months of age. However, a study by Garg et al. observed that the dietary practices were not compliant with the recommendations, and the CFI score was between 7.09 and 9.69 [8]. Using the CFI score, it was clear that dietary diversity was poor and was only achieved in 31% of 6-8-month-old infants and 18% of 9-12-month-old infants.

In the current study, it was found that the CFI score was significantly associated with length for age (p value 0.021) and weight for length (p value 0.013). The CFI score was found to have a significant association with stunting in the study by Joshi et al. [21]. Weight corresponding to height was found to have a significant association with CFI score (p=0.011) by Shrivastava et al. [28]. Garg et al. observed that the CFI score had a significant association with only length for age, but not with the other anthropometric parameters ($p<0.05$) [8].

In the present study, the risk factors affecting practices of complementary feeding, like maternal education, employment status, type of family, and socioeconomic status, were compared with various CFI scores. The proportion of children with high CFI scores was found to increase with maternal education, which was not statistically significant. However, NFHS-5 observed a strong link between maternal education and access to MAD. Children from nuclear families had a higher CFI score, though not statistically significant. Socio-economic class and maternal employment did not have any significant association with CFI scores. This was similar to the observations made in the NFHS-5 conducted in India. In a study by Varghese et al., appropriate complementary feeding had a significant association with maternal education [12]. Similar observations were made in other studies [20, 30, 31]. Tadesse et al. in Ethiopia indicated that the working status of the mother had a negative association with inappropriate dietary practices, while the father's employment had a positive correlation [32]. Paternal education was observed to be a significant factor with adequate dietary practices (P=0.02) [17].

Abate et al. represented that maternal occupation influences the timely initiation of complementary feeding [14]. Yunitasari et al. observed that MMF and MAD were met by children from households with an upper wealth index [31]. Jeyakumar A found that better economic status increased the odds of achieving MMF [20].

In the study by Mirzaei A., the perceived barriers to appropriate feeding practices were inadequate support from family members, lack of knowledge and skills, and the child's lack of desire for complementary feeding [33].

### *Limitation*

As details of the diet were obtained by questioning the mothers, there may be a possibility of recall bias. As the study was conducted in a hospital catering to children from middle and lower-income families, the practice of the higher-income group was not studied. The association between the type of milk and growth was not assessed separately. As it was a hospital-based study, the findings cannot be generalized to the population in the community.

### *Conclusion*

The current study found that rates of breastfeeding were favourable. Though the rates of underweight, stunting, and wasting were lower compared to earlier similar studies, the number of children with appropriate feeding practices was not uniform across all age groups. Even though the minimum meal frequency was above average, the diversity in the diet was poor. The CFI score was associated with length corresponding to age and weight corresponding to length. Creating awareness regarding appropriate feeding practices is necessary to improve the diversity of the diet.

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## Ethical considerations

The current study was commenced after obtaining necessary sanction from the ethics committee of the Institution (protocol ID 425/2020, meeting held on 03/12/2020).

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## Conflict of interest

There is no conflict of interest.

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