

RESEARCH ARTICLE



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Speech Development and Nutritional Status Outcomes of Complimentary Feeding Practices in 12-to 36-Month-Old Children: An Observational Study in Northern Haryana

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Abstract

To study the impact of Complimentary feeding practices on Nutritional status and Speech of 12 to 36 months of well nourished children. We took children aged 12 to 36 months who visited paediatric OPD from the month of January to April 2019. Mothers of children who were willing to participate in the study were interviewed on a pre-designed questionnaire which had questions pertaining to socio-demographic characteristics of parents, infants and toddlers characteristics, breastfeeding and complimentary feeding details, infants and toddler environment (Annexure1). Weight, height, head circumference (on WHO Growth charts) and speech development of the child (on LEST scale) were recorded by the paediatrician. Prevalence of malnutrition in our study is 9.2% and speech delay is 29.2%. Malnourished children was significantly associated with maternal education ($p=0.016$), Annual income of parents ($p=0.002$), time of introduction of complimentary feeding ($p=0.040$), food diversity ($p=0.000$) and food frequency ($p=0.000$) (Table 3). Children with speech delay was significantly associated with change of texture of food ($p=0.000$). Maternal education, Annual income of parents, time of introduction of feeding, food diversity and food frequency of complimentary feeding significantly impacts Nutritional status and change of texture of complimentary feeding significantly impacts speech of infants between 12 and 36 months.

Keywords: Complimentary feeding; Speech; Malnutrition

1. Introduction

In India, malnutrition is one of the serious epidemiological problems affecting vast number of infants and children. Malnutrition related problems in developing countries like India is still causing 68% of the total deaths in the group of 6-60 months⁽¹⁾. The leading authorities have identified core factors which precede malnutrition that is lack of knowledge of infant and young child feeding practices and inappropriate breast feeding⁽²⁾.

Complementary foods should be introduced as the child's energy and nutrient requirements increase, and breast milk alone can no longer suffice for the continuing of optimal growth. According to WHO and UNICEF, the child is extra vulnerable in the transition when introduced to complementary feeding, and access to information on what sufficient and safe complementary feeding practices entails is important and complementary feeding should be timely, adequate, and appropriate, meaning a child should receive foods in addition to breastmilk (or formula milk) from six months and onward⁽³⁾. Additionally, it is recommended that a child should receive a diverse diet, at a frequency that is age appropriate (WHO, 2009)⁽³⁾. R.E Black et al mentioned that if the increasing nutrient requirements are not met, over time the child will consequently become undernourished, leading to impaired physical and cognitive development, and a child more prone to disease⁽⁴⁾. Half of the under 5 deaths in 2018 occurred in just five countries: India, Nigeria, Pakistan, Ethiopia and the democratic Republic of Congo. India and Nigeria alone account for one third and the leading causes are diarrhoea, acute respiratory tract infection caused by inappropriate feeding practices (WHO & UNICEF, 2019)⁽⁵⁾.

Prevalence of speech delay in India is high around 27% in children aged 1- to 3-year-old according to recent studies⁽⁶⁾. Undernourishment leads to speech and language delay by causing delayed maturation of auditory pathways which in turn impacts hearing, oral and written language⁽⁷⁾. However, in well nourished children, there are various biological and environment risk factors which determines oral language. One important factor is oral motoricity and chewing which starts at a very early age of 6 to 8 months by providing right textures of food at appropriate times⁽⁸⁾. Speech development which require different oral motor skills are actually followed by different food textures⁽⁹⁾. Solid foods aids in growing jaw, tongue and lips muscles as well as make them stronger which is requisite for speech⁽⁸⁾.

While there is large stock of knowledge on complimentary feeding practices predicting nutritional status of under five children, there is sparsity of data on how complimentary feeding textures connects to speech development. This study seeks to complete the meagreness of knowledge by determining the relation between food textures and speech delay of 12–36-month-old Indian children, with the view that base line data will be generated. So the objectives of the study are to assess

the infant and young child feeding practices and its impact on nutritional status of 12 to 36 month old children and secondly to study the speech development of 12 to 36 months of children and its association with infant feeding practices in children who are otherwise well nourished in terms of weight for age, height for age and weight for height in northern Haryana.

2. Methodology

The present cross-sectional study was being conducted on Pediatric OPD basis in Haryana in the year 2019 in the month of January to April. We took 64 children in the age group of 12 months to 36 months who visited OPD in these four months as study subject after excluding children who were born preterm or small for gestational age, children with global development delay, chronic illnesses, hearing problems or any oro-motor congenital anomalies. Mothers of children aged 1 to 3 year who were willing to participate in the study were interviewed on a predesigned questionnaire (See Appendix) which was printed in English after obtaining written informed consent. Appropriate time to fill the questionnaire was 10 minutes which had questions pertaining to five categories.

a) Sociodemographic characteristics of parents: mother and fathers education, their caste, religion, annual gross income.

b) Characteristics of infants and toddlers: age, gender, birth weight.

c) Breastfeeding and complimentary feeding details: time of start of breastfeeding, feeding was done breast milk, cow milk, infant formula or mixed feeding, time of start of complimentary feeding, feeding adequacy with diversity (cereals, legumes, fruits, vegetables, poultry food items) and frequency, change of texture of feeding.

d) Infants and toddler environment: nuclear or joint family, number of hours of watching television or screen time, any family history of speech delay.

e) Reasons for not giving exclusive breastfeeding till 6 months, not starting complimentary feeding by 6 months, and not changing texture of food from pureed to lumpy food by 8 months.

Feeding adequacy is assessed by MDD (Minimum diet diversity), MDF (Minimum diet frequency) and complimentary food texture according to WHO and ESPGHAN guidelines^(10,11)

1. MDD - Minimum diet diversity- Consumption of 4 or more than 4 food groups out of 7 the previous day. Seven food groups are Grains, roots and tubers, Vitamin A rich fruits and vegetables, Legumes and nuts, Dairy products (milk, yoghurt, cheese), Flesh foods (meat, fish, poultry, and liver/organ meats) Eggs, Other fruits and vegetables.
2. MDF - Minimum diet frequency- Minimum food frequency of two or more times according to WHO

guidelines.

3. Food texture - 6-8 months –pureed or mashed food, 8-12 months –lumpy or finger food, >12 months – family food

2.1 Assessment of Nutritional status and speech

Weight, height, head circumference and speech development of the child were recorded by the pediatrician or health personnel at the time of visit to hospital.

The weight and height measurements were converted to three indices of nutritional status: weight for age, height for age, weight for height. According to the WHO criterion based on standard deviation (SD) units (termed as Z scores) children who were more than two standard deviation below reference median on the basis of weight for age, height for age and weight for height indices were considered as underweight, stunted and wasted respectively.

Language and speech development milestones was noted for all enrolled children using Language Evaluation Scale Trivandrum (LEST) (12).

LEST (0-3) is a valid simple Indian tool for identifying children of 0-3 years with speech delay in the community with an acceptable sensitivity, specificity, positive predictive value, and likelihood ratios. First chronological age is noted and then the scale was kept vertically at the point corresponding to the chronological age of child in months given horizontally in the X axis. All the items completed to the left side of the scale were expected to be done by the child. If not attained by the child for that age, that item delay will be assumed for that child (12).

According to the LEST scale they were marked no speech delay (all items done), questionable delay (one item not done), suspect delay (two items not done) and total delay (three or more items not done). (LEST 0-3) (12)

2.2 Statistical analysis

Normal test of proportions (Z- test) to test the significance of difference between proportions and chi square test for testing the association between different attributes were used. Categorical data were reported as count and percentage while continuous data reported as mean +/- standard deviation (SD). Pearson Chi square test/Fischer Exact test was applied to test the variables with nominal/categorical data. P-value less than 0.05 was taken as significant at 95% confidence levels. SPSS version 18.0 software was used to analyze the data. Kaplan-Meier analysis and cox proportional regression analysis was used to understand the probability of malnutrition and speech delay in children with complimentary feeding practices.

3. Results

3.1 Prevalance of malnutrition and speech

In our study, six children (9.3%) were wasted and two (3.1%) were wasted and stunted both. Children who had speech delay were 16.9 % with questionable delay, 7.6 % with suspect delay and 6.1% with total delay. Overall 9.3% of children were malnourished and 30.6% had speech delay in our study.

We analysed sociodemographic variables in our study as mentioned in Table 1 and among all the variables mother's education ($p=0.003$) and gross annual income ($p=0.000$) are associated with malnutrition and no variable is associated with speech delay.

Mean age of the children were 22 months and Mean birth weight was 2.7 kg. Majority of the children had favourable family environment in the form of adequate screen time i.e. <1 hour per day (67.2%), more number of family members (51.6%) and no family history of speech delay (87.5%) (Table 2). None of these factors were statistically associated with malnutrition or speech delay (Table 2).

In our study, 35.9 % of babies started breastfeeding within 6 hours, and 68.8 % were exclusively breastfed till 6 months or beyond. In our study it was found that 20.3% continued breastfeeding till 12-15 months (Table 3) and while assessing complimentary feeding factors, 68.8% of the infants were started on complimentary feeding by 6 months, 85.9 % had adequate food diversity score of 4 or more, 90.6% had minimum meal frequency of two times or more and 45.3% changed the texture of food from pureed to lumpy food by 8 months.

3.2 Complimentary feeding practices and malnutrition

In Kaplan-Meier analysis, Children who were malnourished were associated with time of introduction of complimentary feeding ($p=0.040$), food diversity ($p=0.000$), food frequency ($p=0.000$) and change of texture of food ($p=0.022$) of complimentary feeding as shown in curves (Figure 1). In Figures 1D, 1E, 1F, 1G Kaplan-meier curves, more the curves on the left side more it is associated with malnutrition.

3.3 Complimentary feeding practices and speech

In Kaplan-Meier analysis, Children with speech delay were only associated with change of texture of food ($p=0.000$). (Figure 2). In Figure 2F, curve on the extreme left that is pureed food given even after 12 months is associated with speech delay and curve on the extreme right that is change of texture of food from pureed to lumps by 8-10 months have proportion of speech delay.

When we assess speech in children with LEST scale, more severity of speech delay in the form of suspect delay and total

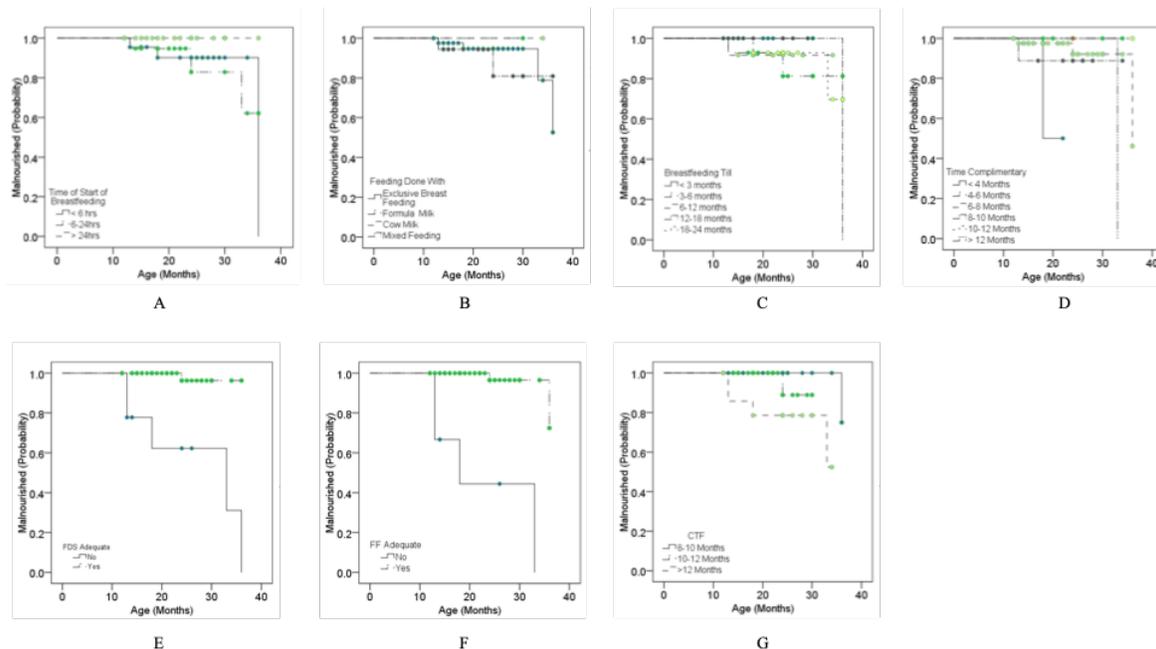


Fig 1. Kaplan-Meier curves showing probability of malnutrition with time of start of breast feeding (p=0.142), breastfeeding continued till how many months (p=0.738), feeding was done with breast milk (p=0.928), time of introduction of complimentary feeding (p=0.040), feeding diversity (p=0.000), feeding frequency (p=0.000) and time of change of texture of food (p=0.022)

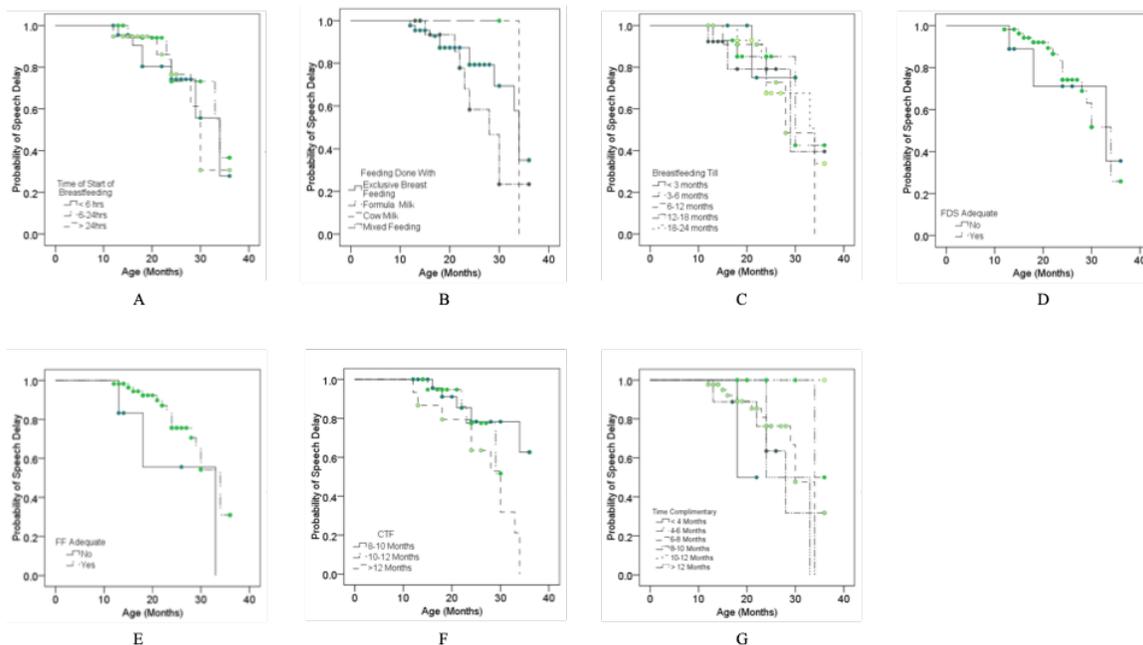


Fig 2. Kaplan-Meier curves showing probability of speech with time of start of breastfeeding (p=0.154), breast feeding continued till how many months (p=0.672), feeding was done with breast milk (0.253), time of introduction of complimentary feeding (p=0.263), feeding diversity (p=0.980), feeding frequency (p=0.546) and time of change of texture of food (p=0.000)

Table 1. Sociodemographic variables of parents

Variable	Number (%)	Malnutrition (p value)	Speech delay (p value)
Gender - male	40 (62.5%)	0.664	0.340
Caste - general category	48 (75%)	0.453	0.108
OBC	11 (17.2)		
SC/ST	5 (7.8%)		
Religion - hindu	57 (89%)		
Muslim	4 (6.3%)	0.476	0.308
Christians	3 (4.7%)		
Mothers education -graduate / post graduate	52 (81.3%)	0.003	0.629
Secondary or high school	8 (12.5%)		
Primary or middle school	3 (4.6%)		
illiterate	1 (1.5%)		
Fathers education - graduate / post graduate	54 (84.4%)	0.413	0.423
Secondary or high school	6 (9.4%)		
Primary or middle school	4 (6.3%)		
illiterate			
Yearly income - <1 lakh	4 (6.3%)		
1-3 lakh	10 (15.6%)		
3-5 lakh	20 (31.3%)	0.000	0.547
5-10 lakh	17 (26.6%)		
>10 lakh	13 (20.3%)		

Table 2. Infant characteristics and family environment factors

Characteristics	Mean or percentage	Malnutrition (p value)	Speech delay (p value)
Age of children	22 months	0.619	0.462
Birth Weight	2.7 kg	0.259	0.259
Screen time adequate - yes	67.2%	0.325	0.325
Joint family - yes	51.6%	1.000	0.540

Table 3. Assessment of IYCF practices

Breast feeding and complimentary feeding factors	Yes	No
Breastfeeding within 6 hours	35.9%	64.1%
Exclusive breastfeeding at 6 months	68.8%	31.2%
Continued breast feeding at 12-15 months	20.3%	79.7%
Time of start of complimentary feeding by 6 months	68.8%	31.2%
MDD	85.9%	14.1%
MDF	90.6%	9.4%
Change of texture of food from pureed to lumpy food by 8 months	45.3%	54.7%

delay is seen in children who were given pureed food even after 12 months (Figure 3)

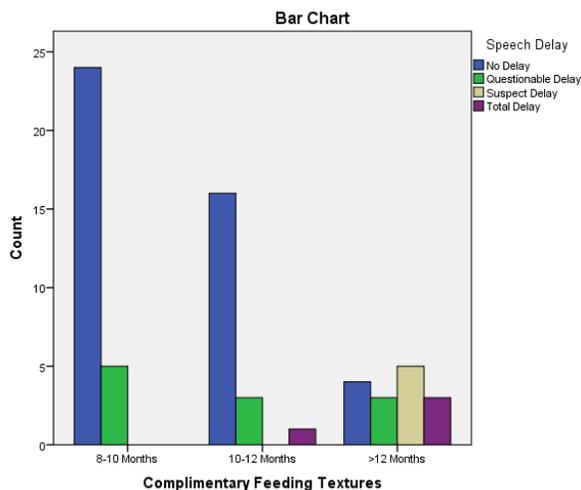


Fig 3. Speech assessment in children according to LEST scale with change in feed texture from pureed to lumpy food

4. Discussion

Prevalence of underweight, wasting and stunting in our study is 7.6 % and 9.3 % and 9.2% respectively. WHO data published in 2018 says 7.3% of the children are wasted and 21.9 % of the children are stunted⁽¹³⁾. In India, it was revealed that underweight , stunting and wasting among under-five children ranged from 39% to 75%, 15.4% to 74% and 10.6% to 42.3% respectively across different regions of the country⁽¹⁴⁾. The lower rates of wasting and stunting in our study can be explained by the fact that we had more number of children with upper and middle socioeconomic status and 87.6 % of mothers and 84 % of fathers were graduate, post graduate or

having professional degree.

Prevalance of speech delay in children in our study is 29.2% which is comparable to previous studies of speech delay in children 12 to 36 month age using LEST scale in India⁽⁶⁾.

In our study, lower maternal education, lower annual income of parents, food diversity score less than 4 and inadequate food frequency were the core factors leading to malnutrition. Edem M.A.Tette also stated that poverty remains an important underlying cause of malnutrition⁽¹⁵⁾. Joyce Nankumbi and Joshua K Mullira also concluded the fact that knowledge, culture, social status of primary caregivers are the elements behind malnutrition in children across the world⁽¹⁶⁾. Previous studies also concluded that lack of knowledge and barriers of practicing complimentary feeding practices are the core factors leading to malnutrition⁽¹⁷⁾. Although Malnourished children are also associated with change of texture of food ($p=0.022$), as most of them were on predominantly cow milk, and they were not introduced diverse diet and texture of food is definitely not considered.

Bernadette Marriott et al concluded timely introduction of complimentary feeding ,early initiation of breast feeding, dietary diversity ,iron rich foods are associated with reduced wasting and stunting in children till 24 months in low income countries⁽¹⁰⁾. In our study, time of introduction of solid food, food diversity and food frequency are associated with malnutrition in children 12-36 months ($p=0.000$) however early initiation of breastfeeding, breastfeeding at 1 year, were not statistically associated with wasting and stunting. Reasons could be that in our set up, breastfeeding could not be started within one hour after caesarean sections due to pain and other practical problems so , early breastfeeding for the study is kept as six hours.

WHO guidelines for food consistency recommend slow increment in the food consistency as the infant gets older, adjusting to infants needs and efficiency in chewing. Infants can eat pureed or mashed food beginning at 6 months, by eight months infants can have finger foods or lumpy foods and by 12 months they can have family food as consumed by rest of family⁽¹¹⁾. Evidence from several sources indicates many children are still offered pureed food by 12 months (presumably because the caregiver believes that the child eats more and it is less time-consuming), there is a suggestive evidence of a crucial window period for introducing lumpy food, if these are delayed beyond ten months, it can lead to feeding difficulties later on⁽¹⁸⁾. The European society of Pediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) committee on nutrition emphasized that there may be a critical window for introducing solid foods before the age of 10 months⁽¹⁹⁾. Its recently updated recommendations are widely developed: foods should be of an appropriate texture and consistency for the infant's developmental stage, ensuring timely progression to finger foods and self-feeding. Prolonged use of pureed foods should be dis-

couraged, and infants should be eating lumpy foods by 8–10 months at the latest.

In our study, 45.3% of the mothers changed the texture of food from pureed to lumpy food by 8-10 months. 31.3% changed it in 10-12 months and 23.4 % were given pureed food even after 12 months. Delayed introduction of lumpy food was associated with speech delay ($p=0.000$). Various authors in the literature have concluded that different food textures progressively augment the maturation of the maxilla and the dento-alvéolar framework⁽²⁰⁾. Chewing function and constant pressure on the growth process will be inadequate in children who are given pureed food beyond 12 months. Paucity of the development of dental arches which includes central and lateral incisors lead to atrophied maxilla⁽²¹⁾. Absence of natural grinding of primary teeth and the atrophied maxilla will result in poorly developed mastication. The soft tissues and the mandible, which are required to perform the efficient masticatory function during administration of most solid consistency food, are basically the same structures that will modify the sound originated from the larynx by variations of the oral cavity spaces, produced by the speech. Failures in the biomechanics of this mechanism can affect the production of specific phonemes⁽²²⁾.

Numerous publications have reported the key role of the introduction of particular food textures and its relation to acquiring oral skills development during the first years of life especially between 6 and 12 months⁽⁸⁾. Speaking function that is enunciation require correct development of praxis which will be followed by complementary feeding recommendations (including food texture introduction)⁽²³⁾.

In our study 64.6% of parents were following screen time recommendation according to WHO recommendations with their children but remaining children (35.3%) who had screen time more than 1 hour per day, were not statistically significantly associated with speech delay ($p=0.490$) as published in previous studies⁽²⁴⁾. 12.5% of the children had a positive family history of speech delay, however it is not also statistically significant with speech delay ($p=0.835$) as suggested by US Preventive task force recommendation that positive family history of speech delay is a strong risk factor for speech delay in children⁽²⁵⁾.

While evaluating reasons for not giving exclusive breastfeeding till 6 months, majority (91.3%) of mothers stated the belief that breast milk was not enough for the baby, and they have to top up with infant formula or cow milk. Reasons for not starting complimentary feeding by 6 months was lack of information in 60% of mothers. Three mothers reported that baby was not ready to take semi-solid food even if they tried to compliment them. And one mother reported illness of the baby at 6 months for not starting complimentary feeding.

While asking for reasons for not changing texture of food from pureed to lumpy food, 48.2 % mothers expressed fear

of choking, 34.4% mothers were unaware about this and were not educated by primary care givers or paediatricians and 5 mothers felt that its not required to change texture as it is less time-consuming to give pureed food.

5. Limitation

Single centric observational study with small sample size is the limitation of the study however, counselling of mothers regarding complimentary feeding in terms of time of introduction of complimentary food, food diversity ,food frequency , food texture is recommended to prevent malnutrition and speech delay in 12-36 month old children in North-ern Haryana

6. Conclusion

Given the fact that maternal education and poverty are two socio demographic variables and time of introduction of complimentary feeding, food diversity and food frequency of complimentary feeding impacts nutritional status of children between 12-36 months. Lack of change of texture of complimentary feeding from pureed to lumpy food by 10 months will lead to speech delay in children of 12-36 months.

Appendix

QUESTIONNAIRE COMPLIMENTARY FEEDING PRACTICE?
General Information

AGE OF THE CHILD

GENDER
 Male
 Female

MOTHER'S EDUCATION
 Illiterate
 Primary and middle school
 Secondary, plus, post high school diploma
 Graduate, Post Graduate, professional degree

CASTE
 General
 SC/ST
 OBC

RELIGION
 Hindu
 Muslim
 Christian
 Others

FAMILY TYPE
 Nuclear Family
 Joint Family

FATHER'S EDUCATION
 Illiterate
 Primary and middle school
 Secondary, plus, post high school diploma
 Graduate, Post Graduate, professional degree

BIRTH WEIGHT OF CHILD
 2.5kg
 2.5 - 3.5kg
 3.5kg

TIME OF START OF BREAST FEEDING AFTER BIRTH OF CHILD
 0 hrs
 0-24hrs
 24hrs

YEARLY INCOME
 Less than 1 Lakh
 1-3 Lakh
 3-5 Lakh
 5-10 Lakh
 10 Lakh

FEEDING WAS DONE WITH
 Exclusive breast feeding
 Formula Milk
 Cow milk
 Mixed Feeding

EXCLUSIVE BREAST FEEDING WAS CONTINUED TILL
 6 Months
 6-12 Months
 12-18 Months
 18-24 Months

TIME OF START OF COMPLIMENTARY FEEDING
 4 months
 4-6 months
 6-8 months
 8-10 months
 10-12 months
 >12 months

COMPLIMENTARY FEEDING WAS DONE WITH

	< 4 MONTHS	4-6 MONTHS	6-8 MONTHS	8-10 MONTHS	10-12 MONTHS	> 12 MONTHS
GRAIN (WHEAT, RICE, MAIZE, PULSES)						
VEGETABLES						
FRUITS						
DAIRY PRODUCTS						
EGG						
MEAT/FISH/SEAFOOD						

FREQUENCY OF COMPLIMENTARY FEEDING

	< 4 MONTHS	4-6 MONTHS	6-8 MONTHS	8-10 MONTHS	10-12 MONTHS	> 12 MONTHS
1-3						
3-4						
4-5						
5-6						

CHANGE OF TEXTURE OF FEEDING

	< 10 MONTHS	10-12 MONTHS	> 12 MONTHS
PUREED LIQUID			
SOFT LUMPY/TEXTURED/CHUNKY/CHUNKY/CHUNKY			
FRAGMENTS/SMALLER/SMALLER/SMALLER			
TEXTURED/CHUNKY/CHUNKY			

REASON OF NOT GIVING EXCLUSIVE BREAST FEEDING TILL 6 MONTHS

- LACK OF INFORMATION
- TRADITIONAL / ETHNIC
- FEELING THAT IT IS NOT REQUIRED FOR THE BABY
- OTHERS

REASON OF NOT STARTING COMPLIMENTARY FEEDS BY 6 MONTHS

- LACK OF INFORMATION
- TRADITIONAL / ETHNIC
- FEELING THAT IT IS NOT REQUIRED FOR THE BABY
- OTHERS SPECIFY

REASON FOR NOT CHANGING TEXTURE OF FOOD BY 8 MONTHS

- LACK OF INFORMATION
- TRADITIONAL / ETHNIC
- FEELING THAT IT IS NOT REQUIRED FOR THE BABY
- FEAR OF CHOKING
- OTHERS SPECIFY

NUMBERS OF HOURS OF WATCHING TELEVISION / MOBILE PER DAY

- 0-1 HRS
- 1-2 HRS
- 2-3 HRS
- 3-4 HRS
- 4 HRS

FAMILY HISTORY OF SPEECH AND LANGUAGE DELAY
 YES NO

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