Original Research Article

COMPLEMENTARY FEEDING PRACTICES OF SOUTH-EAST NIGERIAN MOTHERS AND EFFECT ON WEIGHT OF CHILDREN AGED 6-23 MONTHS

ABSTRACT

Background: complementary feed has a great impact on growth, development, well-being and long term health outcomes of individuals.

Objective: to examine the complementary feeding practices of southeast Nigerian mothers.

Methods: a cross-sectional study was conducted among 1610 mother-child pairs.

Results: Majority of the mothers were income earners (88.0%), and completed secondary or tertiary education (95.2%). The prevalence of underweight, severe underweight and overweight were 11.2%, 3.7% and 4.5%, respectively, among the children. Untimely initiation of cereal was practiced by 38.9% of mothers. Maternal education (p=0.044), profession (p=0.020), social class (p=0.001) and exclusive breastfeeding (p<0.001) were significantly associated with timing of cereal initiation. The most commonly (97.6%) used cereal was locally prepared pap, predominantly (79.7%) fortified with commercial formula of which a 400g tin lasted beyond 7 days for 40.5% of children. More than half (58.2%) of the mothers were bottle-feeding, 27% did not regularly wash hands before preparing feeds, and 32.6% were not giving the recommended daily complementary feed frequency. Bottle-feeding was mainly due to need to return to work (37.9%), convenience (36.5%) and perception that suckling mother's nipple was inadequate (12.4%). Cereal and family foods were not given fresh by 35.5% and 50.1% of mothers, respectively. Age at complementary (p=0.008) or family feed (p=0.002) initiation, feeding frequency (p<0.001), type of cereal (p<0.001) or pap fortifier (<0.001) timespan one tin of formula (p<0.001) and breastfeeding status (p<0.001) were significantly associated with child's weight-for-age. Apart from timespan of one tin of formula, these factors remained significant after binary logistic regression.

Conclusion/recommendations: The rate of untimely complementary feed initiation, unsafe/unhygienic practices, and fortification with expensive imported formula is high in southeast Nigeria. Urgent innovative interventions are needed to address these potential barriers to optimal complementary feeding.

KEYWORDS Weaning food, determinants, timing, adequacy, nutritional status, South-East Nigeria

INTRODUCTION

Appropriate complementary feeding practice is vital to child's growth, development, survival and long-term health.[1] Globally, malnutrition continues to take its toll among under-five children. At least 1 in 3 under-fives is under- or over-nourished while 1 in 2 is suffering from hidden hunger due to vitamin and mineral deficiencies, globally.[2] The burden of malnutrition is heightened by poor dietary quality and or poor feeding practice especially during the first 24 months of life.[1,2] Breastmilk poses no financial cost to the family, and can meet all nutritional requirements of the infant during the first 6 months of life. However, the infant's energy and nutrient requirements begin to exceed that which can be supplied by breastmilk alone at 6 months. Therefore, complementary feeds become necessary to fill the energy and nutrient gap of the infant from 6 months of age. The energy gap expected to be filled by complementary feeds is 200, 300, and 550 kcal/day between ages 6–8, 9–11, and 12–23 months, respectively.[3] In addition, complementary feed must provide relatively large proportions of micronutrients such as iron, zinc, phosphorus, magnesium, calcium, and vitamin B6.[3,4]

Age 6-23 months is particularly vulnerable to nutritional deficiencies and growth faltering because the nutritional needs for growth and development per kilogram bodyweight is greater at this period compared to any other period of life.[5] Hence the peak incidence of growth faltering, micronutrient deficiencies and infectious illnesses is between 6 to 23 months in most countries.[5] Healthy and diverse range of complementary foods along with breastfeeding is crucial for protecting under-five children against malnutrition which underlies up to 40% of under-five mortality.[6] Unfortunately adequate and appropriate complementary feeding is increasingly inaccessible to children in developing countries like Nigeria. This has been attributed to rising food insecurity occasioned by worsening fiscal and socio-political instability.[2,7,8]

Reports indicate worsening complementary food indicators in Nigeria.[7] Complementary feeds are often given too early or late in Nigeria and other West African countries.[7,8] In addition, an alarming low rate of minimum acceptable diet has been reported for infants living in the region, especially among the poor households.[7-9] In Nigeria, only 11% of children aged 6 to 23 months are fed with the minimum acceptable diet.[9] Children aged 6 to 23 months are considered to receive minimum acceptable diet in the country if they meet all the three Infant and Young Child Feeding (IYCF) criteria.[9] These includes being fed two or more times daily with commercial

infant formula, fresh, tinned, or powdered animal milk, or yogurt; fed dietary diverse food from five or more specified food groups; and fed the minimum frequency of feed per day, according to their age and breastfeeding status.[9]

The inadequacy and untimeliness of complementary feeds have been linked with persistence of high levels of under-five undernutrition in Nigeria.[8-10]-This may also account for high rate of under-five morbidity and mortality given the fact that malnutrition underlies a significant proportion of under-five deaths. In 2019, Nigeria accounted for the highest global burden of under-five mortality.[2] Innovative complementary feeding approaches are pertinent to reversing this trend. This study was carried out to examine the complementary feeding practice of mothers in southeast geopolitical zone of Nigeria. Hopefully, findings will inform the adoption of innovative strategies to improve child nutrition, wellbeing and survival.

MATERIALS AND METHODS

Study area

A cross-sectional study was conducted to examine the complementary feeding practice of mothers in the five southeast Nigerian states comprising Anambra, Enugu, Imo, Abia and Ebonyi states. In each of the states, the major Baby friendly health facilities that offered maternal and child health services were selected. The hospitals included Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi; Iyienu Hospital, Ogidi; Waterside Specialist Hospital, Onitsha; Federal Medical Centre, Owerri; Ebonyi State University Teaching Hospital, Abakaliki; Enugu State University Teaching Hospital, Enugu; Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, Awka; St. Charles Borromeo Specialist Hospital, Onitsha; Awka-Etiti Catholic Mission Hospital, Awka-Etiti; Immaculate Heart Hospital, Nkpor; St. Patrick's Hospital, Enugu; Uwani Health Centre, Enugu and Federal Medical Centre, Umuahia. Data was collected from mothers attending well-baby (Immunization) clinics using an interviewer-administered questionnaire. Mothers were enrolled consecutively following a written informed consent. The study was conducted over a period of 3 months between July and September, 2018.

South-East Nigeria is of Igbo tribe and the dominant religion is Christianity. The region occupies a land mass of 28.98m^2 with a population of 16.39 million people (11.68% of national population according to 2006 national population census).[11] According to 2018 National demographic and Health Survey (NDHS) 69.9% of under-fives in the region suffer from any form of anaemia, 24.2% are stunted or severely stunted, 5.5% are thin or severely wasted, 12.9% are underweight or severely underweight and 1.0% are overweight.[9] Apart from the South-South, South-East has a lower rate of underweight among under-fives compared to other geo-political zones in Nigeria.[9]

Data collection

Data was collected using a semi-structured interviewer-administered pre-tested questionnaire. This was designed by the researchers after literature review and interview of experts in pediatric nutrition, and was pretested among ten mother-child pairs seen at the immunization clinic of a primary health care center in Nnewi which was not a study sites. The questionnaire was administered by the researchers and five trained research assistants who were resident doctors in

Pediatrics. The socio-demographic characteristics of the subjects included age of mother and child, educational level of mother and spouse, occupation of mother and spouse and family size. The social class of the subjects were calculated from respondents' and spouses' highest educational attainment and occupation. Data also included the complementary feeding practice of the mothers such as frequency of feeds, time of initiation and type of complementary feeds and complementary feeding hygiene practices. The children were considered to receive recommended daily complementary feeding frequency if they received 2 to 3 complementary feeds on the day preceding the data collection for infants aged 6 to 8 months or 3 to 4 feeds for those aged 9 to 23 months.[1,9]

The children were weighed nude using standard procedures.[12] Weight was recorded to the nearest 100g using SECA electronic weighing scale. Weight-for-age z-scores were calculated using WHO growth standards.[13] Using weight-for-age criteria, their nutritional status was categorized into normal (> -2 to < +2 Z-score), underweight (≤ -2 to > - 3 Z-score), severe underweight (≤ -3 Z-score) and overweight (≥ +2 Z-score).

Data handling and analysis

Data was analyzed using SPSS version 21. The characteristics of the subjects were presented in frequency tables. The relationship between categorical variables was examined using chi-square test. Where the condition for chi-square test was violated, Fishers exact test was used. All complementary feeding practices significantly associated with weight-for-age in chi-square test were further analyzed using binary logistic regression analysis to predict their odds of being associated with abnormal weight-for-age. Any p-value less than 0.05 was considered statistically significant.

Ethical considerations

Ethical clearance for the study was obtained from the Research and Ethics Committee (REC) of NAUTH, Nnewi. Study was conducted in accordance with Helsinki declaration. Participation was entirely voluntary and did not interfere with services received from the facilities. All data was handled confidentially. Mothers found to have sub-optimal practices were referred to the Nutrition and Dietetics department of their facility for infant feeding counselling while

malnourished children were sent to the Children's out-patients' clinic for further evaluation, appropriate rehabilitative therapy and follow-up.

RESULTS

Socio-demographic characteristics and child's weight-for-age

The study was conducted among 1610 mothers of children aged 6 to 23 months. Table 1 shows the socio-demographic characteristics of the mothers and the nutritional status of their index baby. Majority of the mothers were 20 to 40 years old (93.6%), completed secondary or tertiary education (95.2%), and were income earners (88.0%). About a third of them (36.1%) belonged to upper social class families, and a little above half (54.7%) were Para I or 2 women. Their index babies had a male: female ratio of approximately 1:1 and more than half of them (58.3%) were below the age of 12 months. The prevalence of underweight, severe underweight and overweight among the babies were 11.2%, 3.7% and 4.5%, respectively.

Timing and type of complementary feeds

As shown in Table 2, timely initiation of cereals was practiced by 61.1% of mothers while 24.5% commenced cereals before the 6 months of age. On the other hand, 7.2% of mothers started family diet before the age of six months. The most commonly used cereal (97.6%) was locally prepared maize or millet gruel (pap). The pap was enriched with other food items by 98.6% of mothers. The item used for enriching the pap was predominantly age appropriate commercial formula (79.7%). A tin of 400g commercial cereal or formula cost 5 US Dollars or more in 70.3% of cases and was used for more than 7 days by 40.5% of mothers.

As shown in Table 3, a higher proportion of mothers who were unskilled workers or artisans, had lower level of education, of low social class and did not exclusively breastfeed significantly initiated complementary feeds before their infants attained the age of 6 months.

Table 1: Socio-demographic characteristics of studied South-East Nigerian mothers

Characteristic	Frequency	Percent
Age of mother		
< 20	50	3.1
20-30	849	52.7
31-40	658	40.9
> 40	53	3.3
Educational level of respondents		
No formal education	29	1.8
Primary education	46	2.9
Secondary education	535	33.2
Tertiary education	1000	62.1
Occupation of respondents		
Professional	177	11.0
Civil/public servant	465	28.9
Trader	377	23.4
Artisan	130	8.1
Unskilled worker	74	4.6
Peasant farmer	33	2.0
Unemployed	354	22.0
Socioeconomic class of respondents		
Upper	581	36.1
Middle	712	44.2
Lower	317	19.7
Age of index baby at interview		
6 to 8 months	425	26.4
9 to 11 months	514	31.9
≥12 months	671	41.7
Gender of index baby		
Male	779	48.4
Female	831	51.6
Family size		
≤ 6	1212	75.3
>6	398	24.7
Parity of respondent		
1-2	880	54.7
3-4	614	38.1
5-6	103	6.4
>6	13	0.8
Weight-for-age category of index baby		
Normal	1298	80.6
Underweight	180	11.2
Severe underweight	59	3.7
Overweight	73	4.5
Total	**1610**	**100.0**

Frequency of complementary feeds

As shown in Figure 1, the recommended daily complementary feeding frequency was practiced by 67.4% of the mothers. This was significantly lowest among mothers of children aged 6 to 8 months, amongst whom only a little above half gave the recommended daily complementary feeding frequency while nearly a third exceeded the recommended frequency.

Safety of the complementary feeds

Feeds were predominantly prepared by the mothers (80.1%). Among the studied 1610 mothers, hand was not washed regularly before feed preparation by about a quarter (27%), cereals and family foods were often not given fresh (within 2 hours of preparation) by 35.5% and 50.1%, respectively, and more than half (58.2) were bottle-feeding their babies. Among the 937 mothers who were bottle-feeding, the major reasons cited for using feeding bottle were need to return to work (37.9%), convenience (36.5%), and perception that suckling mother's nipple was inadequate for the baby (12.4%).

Table 2: Complementary feeding practice of mothers of South East Nigerian children aged 6-23 months

Complementary feeding practice	Frequency	Percent
Age at which cereal was initiated		
< 3 months	65	4.0
3 to < 6months	345	21.4
At 6 months	983	61.1
>6 months	217	13.5
Type of cereal used as complementary feed		
Fortified pap	1530	95.0
Plain pap	22	1.4
Commercial cereal	41	2.4
Fortified pap + commercial cereal	17	1.1
Item used for pap fortification (n=1557)		
Infant formula	1097	70.4
Follow-up/Growing up formula	145	9.3
Regular full cream milk powder	74	4.8
Locally prepared soya bean flour	235	15.1
Cocoa beverage	6	0.4
Cost of one 400g tin formula or commercial cereal (N=1273)		
<5 USD	378	29.7
5-8 USD	520	40.8
>8	375	29.5
How long does a 400g tin of formula or commercial cereal last (n=1273)		
≤4 days		
5-7 days	166	13.0
8-14 days	592	46.5
> 14 days	380	29.9
	135	10.6
Age at which family diet was initiated (n=1610)		
< 3 months	17	1.1
3 to < 6 months	98	6.1
At 6 months	513	31.9
7 to < 12 months	837	52.0
≥12 months	145	9.0

Table 3: Factors associated with timing of cereals initiation among South-East Nigerian children aged 6-23 months

Characteristics	Timing of cereal complementary feeds initiation			Total (%)	P-value
	< 6 months	At 6 months	After 6 months		
Sex of baby					
Male	197(25.3)	466(59.8)	116(14.9)	779(48.4)	0.110
Female	213(25.6)	517(62.2)	101(12.2)	831(51,6)	
Family Size					
≤6	316(26.1)	733(60.5)	163(13.4)	1212(75.3)	0.613
>6	94(23.6)	250(62.8)	54(13.6)	398 (24.7)	
Mother's Educational Level					
None or primary	21(28.0)	48(64.0)	6(8.0)	75(4.6)	0.044*
Secondary	158(29.5)	310(57.9)	67(12.5)	535 (33.2)	
Tertiary	231(23.1)	625(62.5)	144(14.4)	1000 (62.1)	
Mother's occupation					
Professionals	43(24.3)	112(63.3)	22(12.4)	177 (11.0)	0.020*
Civil/public servants	94(20.2)	291(62.6)	80(17.2)	465 (28.9)	
Traders	96(25.5)	237(62.9)	44(11.7)	377 (23.4)	
Artisans	39(30.0)	79(60.8)	12(9.2)	130 (8.1)	
Unskilled workers	29(39.2)	35(47.3)	10(13.5)	74 (4.6)	
Peasant farmers	8(24.2)	20(60.6)	5(15.2)	33 (2.0)	
Unemployed	101(28.5)	209(59.0)	44(12.4)	354 (22.0)	
Social class					
Upper	126(21.7)	376(64.7)	79(13.6)	531 (36.1)	0.001*
Middle	176(24.7)	433(60.8)	103(14.5)	712 (44.2)	
Lower	108(34.1)	174(54.9)	35(11.0)	317 (19.7)	
Parity of respondents					
1-2	214(24.3)	541(61.5)	125(14.2)	880 (54.7)	0.497
3-4	160(26.1)	374(60.9)	80(13.0)	614 (38.1)	
≥5	26 (31.0)	67 (58.6)	12 (10.3)	116 (6.2)	
Exclusively breastfed?					
Yes	6(1.0)	479(80.5)	110(18.5)	595 (37.0)	<0.001*
No	404(39.8)	504(49.7)	107(10.5)	1015 (63.0)	
Breastfeeding frequency					
On demand	271(24.8)	684(62.7)	136(12.5)	1091 (67.8)	0.101
At regulated times	139(26.8)	299(57.6)	81(15.6)	519 (32.2)	

*Statistically significant

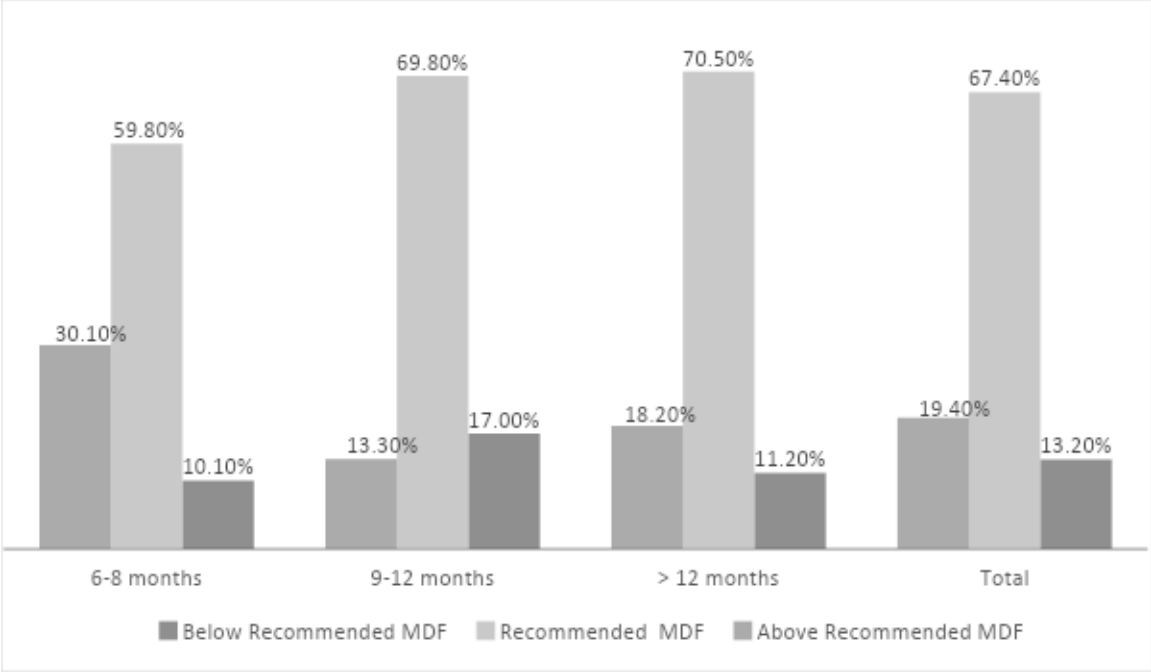

Figure 1: Relationship between age and minimum daily frequency (MDF) of complementary feeds among south-east Nigerian children 6 to 23 months (P<0.001)

Relationship between complementary feeding practices and child's weight-for-age

As shown in Table 4, age at introduction of cereal or family feed, type of cereal or item used in fortification of pap, timespan of one tin of formula, adherence to minimum daily complementary feed frequency and breastfeeding status were significantly associated with weight-for-age.

Among children who had stopped breastfeeding as at the time of interview, the rate of underweight varied inversely with age category (p<0.001). Among non-breastfeeding, infants aged 6 to 8 months, the rate of moderate to severe underweight was 78.6% (33/42), compared to 22.2% (36/162) and 7.6%(33/433) among those who were 9 to 12 months or above 12 months of age, respectively. The reverse was the case in the rate of overweight which was significantly lower (p<0.001) among non-breastfeeding children aged 6 to 8 months (4.8% [2/42]) compared to those who were 9 to 12 months (5.6% [9/162]) or above 12 months (8.3%[36/433]) of age.

Apart from timespan of one tin of formula, the above factors remained significant after logistic regression as shown in table 5. Mothers who had stopped breastfeeding as at the time of interview, did not initiate cereal at 6 months, were not giving recommended daily complementary feed frequency, fortified pap with items other than age appropriate formula or started adult feeds before 6 months significantly had 37%, 25%, 41%, 37% and 52% higher odds of having a baby with abnormal weight-for-age, respectively.

Table 4: Relationship between some complementary feeding practice or age and weight-for-age of South-East Nigerian children aged 6-23 months

Characteristics	Normal	Underweight	Severe underweight	Overweight	Total	P-value
Cereal initiation age		.				
< 3 months	46(70.8)	11(16.9)	7(10.8)	1(1.5)	65 (3.1)	0.008*
3 to < 6months	270 (78.3)	52(15.1)	10(2.9)	13(3.8)	345(21.4)	
At 6 months	807 (82.1)	93(9.5)	34(3.5)	49(5.0)	983(61.1)	
>6 months	175 (80.6)	24(11.1)	8(3.7)	10(4.6)	217(13.5)	
Cereal type						
Fortified pap ± commercial cereal	1266(81.8)	161(10.4)	50(3.2)	70(4.5)	1547(96.1)	<0.001†
Plain pap	2(9.1)	14(63.6)	6(27.3)	0(0.0)	22 (1.4)	
Commercial cereal	30(73.2)	5(12.2)	3(7.3)	3(7.3)	41(2.4)	
Adult feed initiation age						
< 6 months	78(67.8)	26(22.6)	6(5.2)	5(4.3)	115(7.1)	0.002*
At 6 months	412(80.3)	63(12.3)	16(3.1)	22(4.3)	513(31.9)	
>6 months	808(82.3)	91(9.3)	37(3.8)	46(4.7)	982(61.0)	
Cost of 400g formula or commercial cereal						
<5 USD	320(84.7)	31(8.2)	10(2.6)	17(4.5)	378 (29.7)	0.356
5-8 USD	438(84.2)	42(8.1)	14(2.7)	26(5.0)	520(40.8)	
>8 USD	295(78.7)	45(12.0)	12(3.2)	23(6.1)	375(29.5)	
400g Formula or commercial cereal duration (n=1273)						
≤4 days	138(83.1)	6(3.6)	1(0.6)	21(12.7)	166 (13.0)	<0.001*
5-7 days	498(84.1)	41(6.9)	9(1.5)	44(7.4)	592(46.5)	
≥8 days	417(81.0)	17(13.8)	26(5.0)	1(0.2)	515 (40.5)	
Pap fortifier (n=1557)						
Age appropriate formula	1031(83.0)	114(9.2)	34(2.7)	63(5.1)	1242(79.8)	<0.001*
Full cream milk powder	58(78.4)	3(4.1)	7(9.5)	6(8.1)	74(4.8)	
Soya bean flour or cocoa beverage	185(76.8)	45(18.7)	10(4.1)	1(0.4)	241(15.4)	
Minimum dietary frequency						
< recommended for age	143(67.5)	45(21.2)	18(8.5)	6(2.8)	212(13.2)	<0.001*
Recommended for age	905(83.4)	97(8.9)	36(3.3)	47(4.3)	1085(67.4)	
> recommended for age	250 (79.9)	38(12.1)	5(1.6)	20(6.4)	313(19.4)	
Breast feeding status						
Still breastfeeding	810(83.2)	105(10.8)	32(3.3)	26(2.7)	973(60.4)	<0.001*
Not breastfeeding	488(76.6)	75(11.8)	27(4.2)	47(7.4)	637(39.6)	
Age (months)						
6 t0 8	296(69.6)	80(18.8)	38(8.9)	11(2.6)	425(26.4)	<0.001*
9 to 12	527(84.3)	69(11.0)	12(1.9)	17(2.7)	625(31.9)	
12 to 23	475(84.8)	31(5.5)	9(1.6)	45(8.0)	560(41.7)	

*Statistically significant chi-square test †Statistically significant Fisher's exact tes

Table 5: logistic regression result for complementary feeding practice associated with abnormal weigh-for-age (underweight, severe underweight or overweight)

Predictor	p-value	Odds ratio (OR)	95% CI for OR
Not breastfeeding	0.001	0.63	0.48 - 0.82
Cereal initiation before or after 6 months	0.037	0.75	0.58 – 0.98
Lower or excessive dietary frequency	<0.001	0.59	0.45 – 0.77
Pap fortification with items other than age appropriate milk formula	0.004	0.64	0.47 -0.87
Adult feed initiation before 6 months	0.001	0.48	0.31 - 0.75
400g tin of milk lasting beyond 1 week	0.175	0.82	0.61- 1.094

DISCUSSION

Findings from this study agree with previous reports on the untimeliness and suboptimal nature of complementary feeding practices in Nigeria.[7,8,14] Only 61% of infants were commenced on complementary feeds in a timely manner. When complementary feeds are initiated too early, it can interfere with breastmilk production, and can displace breastmilk which is most suited for all the nutritional needs of infants less than 6 months.[15] In developed countries, the major concern with early complementary feeding is excessive weight gain.[15] This was contrary to the findings of our study and other African studies which show a negative association between early introduction of cereals and undernutrition. [7,8,14]-The disparity may be attributed to the difference in the quality of complementary foods in developed and developing countries. Conversely, late introduction of complementary feeds can result in unmet nutrient and energy gaps. This was corroborated by the finding of a higher rate of undernutrition among children who were initiated on cereals after 6 months of age compared to those who were initiated in a timely manner. This brings to the fore the need for adequate infant feeding counselling with emphasis on the introduction complementary feeds in a timely manner. Counselling sessions should clearly address the major reasons previously cited to be responsible for early complementary feeding such as the need to return to work and perception that breast milk supply is inadequate for the

infant thereby resulting in excessive crying or poor weight gain. Special attention should be paid to mothers with lower educational or income level as they were found to be more likely to start complementary feeds earlier.

The observed frequency of feeds agrees with previous reports.[12] However, an improving trend in this indicator has been described.[7-9,14] This is often the indicator which most mothers are able to come to par with. It has been shown that either lower or higher frequency than recommended has implications for being under- or over-nourished. Therefore, frequency of feeds should be a key component of messages delivered during infant feeding counselling. In view of the positive association between breastfeeding and weight-for-age, mothers should also be encouraged to continue breastfeeding beyond 6 months of age while giving safe and adequate complementary foods.

The fallouts of this study buttress the need for intensification of efforts at making complementary feeds more hygienic and safe. Concerted efforts should be geared towards avoidance of bottle feeding, promotion of regular hand washing with soap and water, as well as feeding the infants with fresh feeds. Apart from the risk of diarrhea from microbial contamination of the bottles, feeds given with feeding bottles may be of lower consistency resulting in less energy density and probably inadequate protein intake.

Our findings are in agreement with reports that cereal gruels constitute the initial and predominant complementary food in Nigeria and other West African countries.[8,14,15,18] In Nigeria, this is often made from milled fermented maize and or millet, and is commonly referred to as “akamu” or “ogi”. Previous reports indicate that these gruels are bulky, and of low protein, fat and nutrient density.[19-22] Besides, the high phytate content of these cereal gruels impair the absorption of micronutrients especially iron.[21] Hence they often fail to meet the protein and micronutrients needs of the infant, and have been associated with high rate of malnutrition when solely used as complementary foods. This was substantiated by the finding that most infants fed with plain unenriched pap were undernourished.

Fortification of the cereal gruel provides the opportunity to improve overall calorie, protein and micronutrients availability.[23] Commercial formula has been previously reported to serve as the commonest item for complementary cereal fortification in Nigeria in agreement with the findings

of this study.[7] Among all the items used for cereal fortification, commercially prepared formula (infant, follow-up/growing up) had greatest positive effect child's weight. This can be attributed to the fact that most commercial formulas are rich in micronutrients and protein. However, their use by majority of the mothers implies over dependence on expensive products rather than suitable nutrient rich locally available home prepared options. Mothers who cannot afford adequate supplies may resort to dispensing small aliquots to prolong the duration of the milk thereby jeopardizing the nutritional status of their children. This could explain the use of one tin of formula for more than 7 days by 40.5% of mothers in this study, and the higher rate of undernutrition among the infants of such mothers.

It is pertinent to identify affordable locally available nutrient rich alternatives for fortifying cereals used in complementary feeding. According to WHO low-cost complementary foods made with locally available ingredients, using suitable small-scale production technologies obtainable in community settings are necessary to meet the nutritional needs of older infants and young children.[24] However, mothers should be discouraged from using unsuitable items such as cocoa beverages or full cream milk as fortifiers. Cocoa beverages are low in protein content and the micronutrient composition may not be optimal for infants. Their use may translate to high rate of undernutrition among infants as observed in the index study. On the other hand, unmodified cow's milk is a poor source of iron and when consumed in large amounts, provide excess protein, fat and energy and is not recommended during the first year of life.[18] This may explain the high rate of overweight among the children who received full cream milk powder.

A higher rate of undernutrition was found among infants whose pap was fortified with locally prepared soya bean powder compared to commercial formula (22.8% versus 11.9%). Soya bean is a commonly available and relatively cheap plant protein with relatively high protein (40%–50%) and fat (20%), but low carbohydrates (35%) content.[19] However, there are concerns about its safety in infants. More so, it is deficient in micronutrients. Studies have found combinations of soya beans with cereal, staple starchy roots, legumes, and plant proteins (groundnut) suitable for complementary feeding.[19,22] However, these are yet to be scaled up in Africa. Further research is needed on how to make soya bean powder safer and more nutritive as a component of complementary feeds.

Industrially processed complementary foods is an option for some mothers who have the means to buy them. However, these are often expensive. Therefore, mothers who are unable to afford adequate supplies may resort to giving over diluted preparations thereby making their use counterproductive. This may explain the high rate of undernutrition among children fed with only commercially prepared cereals. On the other hand, these cereals have been reported to have high protein contents, hence, the high rate of overweight among those that were fed with them. The best way of using them in order to avoid obesity and underweight should be clearly communicated to mothers.

It was not surprising to find the highest rate of undernutrition among infants who were initiated on family foods before 6 months of age (27.8%). However, the slightly higher undernutrition rate among those who were initiated at 6 months (15.4%) compared to those initiated after 6 months was unexpected and in contrast to the pattern observed with timing of cereal introduction. Family foods were expected to make up for the nutrient diversity of complementary feeds as it creates opportunity to feed the infant with food from different food groups. To meet nutrient needs, an infant should consume a variety of complementary foods every day. It is recommended that breastfed infants above 6 months should be fed with food from at least 4 out of 7 food groups in order to meet dietary diversity.[1] These food groups include: grains, roots and tubers; legumes, nuts and seeds; dairy (milk, yoghurt, cheese); flesh foods (meat, fish, poultry, and liver or organ meats); eggs; vitamin A-rich fruits and vegetables (carrots, mangoes, dark green leafy vegetables, pumpkins, orange sweet potato); other fruits and vegetables.[1] In Nigeria, most staple family food belong to the grains (rice), tubers (yam) and roots (cassava, cocoyam) which may be eaten with soup or sauce. Although these foods are rich in carbohydrate, they are often low in protein and energy density.[8,14] Therefore large amounts are required to achieve adequate protein/energy intake. Due to their bulkiness, achieving adequate energy/protein intake is almost impossible for infants and young children given their limited stomach capacity. Hence, introducing them early may displace more nutritive complementary feeds. Family foods can be made more useful to the child by ensuring an adequate and varied nutrient admixture and pulverizing for ease of digestion. However, most children are given unmodified portions from the family pot.[8] This may explain the inverse relationship between timing of family food introduction and undernutrition. Therefore, there is dire need to educate mothers on preparation

of special nutritious complementary diets from staples and avoidance of their introduction before 6 months of age.

CONCLUSION/RECOMMENDATION

Complementary feeding practices are not optimal in South-East Nigeria. Many mothers commence complementary feeds in an untimely manner and do not adhere to recommended minimum daily complementary feeding frequency. The predominant complementary feed was local cereal gruels but these were fortified with expensive commercial formula which was inadequately used by many mothers. In addition, the safety of the complementary feeds could not be guaranteed due to high rate of bottle feeding, and failure of many mothers to wash hands regularly before feed preparation or feed their babies with fresh feeds. Early complementary feeding, use of plain or poorly fortified cereal gruel, use of formula for more than 7 days, and not adhering to recommended minimum daily complementary feeding frequency were significantly associated with being underweight.

Our findings provide insight on the state of complementary feeding in other parts of Nigeria given the fact that the southeast geo-political zone has one of the lowest rate of under-weight among under-fives, according to the 2018 NDHS report. Therefore, urgent innovative interventions are needed to improve complementary feeding practices in Nigeria. Serious attention should be paid to production of diverse inexpensive nutritious feeds from staples to complement the traditional cereal based complementary gruels. Efforts should be intensified at improving the quality of family diets given to infants, educating mothers on optimal complementary feeding practices, food hygiene and ensuring household food security.

LIMITATIONS

Complementary feeding practices of the mothers was based on verbal report rather than direct observation. This is prone to recall bias or tendency to report practices perceived to be good. In addition, specific information was not obtained on the constituents of the family foods or the quantity of milk used for pap fortification so as to enable the determination of dietary adequacy

or diversity. However, findings highlight some key areas that need serious interventions in order to optimize complementary feedings in our environment.

DECLARATIONS

Ethics approval and consent to participate: Ethical approval for the study was obtained from the Research and Ethics Committee (REC) of Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi. All aspects of the study were carried out in accordance with relevant guidelines and regulations/declaration of Helsinki. All participants gave a written informed consent. All data obtained during the study was kept confidential.

Consent for publication: Not applicable

Availability of data and materials: The dataset is available from the corresponding author on reasonable request.

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