Public Health Nutrition: 20(17), 3135–3144 doi:10.1017/S1368980017002014

Population-attributable risk estimates for factors associated with inappropriate complementary feeding practices in The Gambia

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Submitted 4 October 2016: Final revision received 18 June 2017: Accepted 3 July 2017: First published online 29 August 2017

Abstract

Objective: The present cross-sectional study aimed to determine population-attributable risk (PAR) estimates for factors associated with inappropriate complementary feeding practices in The Gambia.
Design: The study examined the first and most recent Demographic and Health Survey of The Gambia (GDHS 2013). The four complementary feeding indicators recommended by the WHO were examined against a set of individual-, household- and community-level factors, using multilevel logistic analysis. PAR estimates were obtained for each factor associated with inappropriate complementary feeding practices in the final multivariate logistic regression model.
Setting: The Gambia.
Subjects: Last-born children (*n* 2362) aged 6–23 months.
Results: Inadequate meal frequency was attributed to 20 % (95 % CI 15·5 %, 24·2 %) of children belonging to the youngest age group (6–11 months) and 9 % (95 % CI 3·2 %, 12·5 %) of children whose mothers were aged less than 20 years at the time of their birth. Inadequate dietary diversity was attributed to 26 % (95 % CI 1·9 %, 37·8 %) of children who were born at home and 20 % (95 % CI 8·3, 29·5 %) of children whose mothers had no access to the radio. Inadequate introduction of solid, semi-solid or soft foods was attributed to 30 % (95 % CI 7·2 %, 38·9 %) of children from poor households.
Conclusions: Findings of the study suggest the need for community-based public health nutrition interventions to improve the nutritional status of Gambian children, which should focus on sociocultural and economic factors that negatively impact on complementary feeding practices early in infancy (6–11 months).

Keywords
Complementary feeding
The Gambia
Dietary diversity
Meal frequency
Acceptable diet

Appropriate complementary feeding practices are crucial to the health and growth of a child during the first 2 years of life[1], a period usually regarded as the 'critical window' for the promotion of optimal growth, health and development of a child[2]. Globally, poor complementary feeding has been identified as a risk factor for stunting[3]. Moreover, most suboptimal length-for-age growths among children have been found to occur during the complementary feeding period (6–24 months)[4,5]. The WHO recognises the important role that complementary feeding plays in the optimal growth, development and good health of young children aged 6–23 months and therefore recommends that all children should be exclusively breast-fed for the first 6 months, after which they should be given nutritionally safe and adequate complementary foods while still being breast-fed until they are aged 2 years or even older[6].

Despite the recommendation of the WHO, complementary feeding practices among children in many low-income and middle-income countries are still inappropriate, resulting in malnutrition which may result in morbidity or mortality among children in these countries[7]. In The Gambia, only 54 % of breast-feeding children aged 6–8 months received complementary foods in 2013; and only 8 % of children aged 6–23 months were fed according to the WHO recommendations[8], which require children to be fed with solid, semi-solid or soft foods, alongside breast milk, when they attain the age of 6 months and children to have minimum dietary diversity, minimum meal frequency and minimum acceptable diet. Definitions of these indicators are given in a subsequent section of the present paper.

In The Gambia, about 60 % of the population lives below the poverty line and poor child health remains a serious public health challenge. For example, infant and under-5 mortality rates remain high, although a slight improvement has been observed since 2000[9]. Furthermore, a high maternal mortality ratio is observed in the country.

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Although access to health facilities is relatively good, poor quality of services reduces the effectiveness of the health system. This notwithstanding, immunisation coverage among children is expanding.

In The Gambia, the diet is largely based on cereals, mainly rice and millet and, to a lesser extent, sorghum, maize and wheat. These staples are complemented by vegetables, milk, fish and groundnuts. The share of most micronutrient- and protein-rich foods in the dietary energy supply has not increased while that of vegetable oils and sweeteners has increased substantially[9]. Through efficient promotion programmes, young child feeding practices have improved. Efforts are being made to encourage early initiation of breast-feeding, exclusive breast-feeding up to 6 months of age and appropriate complementary feeding practices. Among pre-school children, malnutrition remains a public health problem. More than 25 % of the under-5 children in The Gambia are affected by chronic malnutrition, a prevalence which has slightly increased over recent years[9].

There have been extensive studies on inappropriate complementary feeding practices in low- and middle-income countries[10–15]. These studies examined the association of some sociodemographic factors with inappropriate complementary feeding practices, making use of the four complementary feeding indicators developed by the WHO[16]. However, population-attributable risk (PAR) proportions adjusted for independent predictors of inappropriate complementary feeding practices were not considered in these studies. PAR proportions provide numbers of populations that are attributable to particular independent predictors of inappropriate complementary feeding practices. As a result, the current study estimated the adjusted PAR proportions to measure inappropriate complementary feeding indicators which are attributable to each significant independent covariate in The Gambia. Our study adapted and modified Mosley and Chen's analytical framework for the study of child survival in developing countries[17]. The framework, which incorporates both social and biological factors that may be associated with the survival of an infant, represents a conceptual framework that can allow the estimation of PAR of factors associated with inappropriate complementary feeding practices in The Gambia at three different levels, namely individual-, household- and community-level factors. The main aim of our study was twofold: (i) to determine the sociodemographic factors associated with poor complementary feeding, not meeting the minimum dietary diversity, not meeting the minimum meal frequency and not meeting the minimum acceptable diet criteria among children; and (ii) to estimate the burden of poor complementary feeding indicators attributable to risk factors in The Gambia. Past studies have associated children aged 6–11 months, rural dwelling, lack of maternal education, home delivery of babies, household poverty and lack of access to the mass media with inappropriate complementary feeding practices[1,10–12]. We therefore hypothesised that not meeting the WHO complementary feeding recommendations for children would be associated with younger children (6–11 months), living in rural areas, lower maternal educational attainment, coming from poorer families, home delivery and poorer maternal access to the mass media. Findings from our study would be useful to public health practitioners, policy makers and other stakeholders in monitoring and designing programmes and community-based interventions aimed at improving complementary feeding practices in The Gambia.

Methods

The source of data for the current study was the Demographic and Health Survey of The Gambia (GDHS) 2013[8]. This nationally representative survey was carried out by The Gambia Bureau of Statistics and was funded by the Government of The Gambia, the US Agency for International Development, the United Nations Population Fund, the United Nations Development Programme, UNICEF, the Joint United Nations Programme on HIV/AIDS, the WHO and the Global Fund. Technical assistance was provided by ICF International through its Demographic and Health Survey programme, which is designed to collect data on fertility, family planning, maternal and child health, maternal mortality and domestic violence.

The survey included a nationally representative sample and was designed to produce estimates of the major survey variables at the national, urban and rural areas, and local government area levels (Banjul municipality, Kanifing municipality, Brikama, Mansakonko, Kerewan, Kuntaur, Janjanbureh, and Basse). A two-stage stratified sampling of household was carried out. A total of 10 233 women aged 15–49 years were successfully interviewed from sampled households, yielding a response rate of 92 %. A women's questionnaire was used to gather information regarding maternal and childcare practices including infant feeding, reproduction and application of family planning methods. Sociodemographic data for all household members were recorded on a household questionnaire. Details of sampling and data collection procedure have been described elsewhere[8]. The current analyses were restricted to the youngest living child aged 6–23 months, living with the respondent (ever-married women aged 15–49 years), yielding a weighted total of 2362 children.

Study variables

Dependent variables

The main dependent variables in the current study were the inadequacy of the WHO's four complementary feeding indicators[16]. The indicators are defined as follows:

1. Introduction of solid, semi-solid or soft foods. This is defined as the proportion of infants aged 6–8 months who receive solid, semi-solid or soft foods.

https://doi.org/10.1017/S1368980017002014 Published online by Cambridge University Press

2. Minimum dietary diversity. This is defined as the proportion of children aged 6–23 months who receive foods from four or more of the seven food groups. The food groups are: (i) grains, roots and tubers; (ii) legumes and nuts; (iii) dairy products; (iv) flesh foods; (v) eggs; (vi) vitamin-A-rich fruits and vegetables; and (vii) other fruits and vegetables.
3. Minimum meal frequency. This is defined as the proportion of breast-fed and non-breast-fed children aged 6–23 months who receive solid, semi-solid or soft foods (including milk feeds for non-breast-fed children) the minimum number of times or more in the previous day. The minimum number of times was defined as 2 times for breast-fed infants aged 6–8 months, 3 times for breast-fed children aged 9–23 months, and 4 times for non-breast-fed children aged 6–23 months.
4. Minimum acceptable diet. This is defined as the proportion of children aged 6–23 months who receive both minimum dietary diversity and minimum meal frequency[16].

Independent variables

Mosley and Chen's conceptual framework[17] was used as a basis for selecting the independent variables in the present study, which were categorised into individual-, household- and community-level factors. The Mosley and Chen model is a framework used to analyse child survival in developing countries. It was proposed in 1984 by Mosley and Chen, and incorporates both social and biological factors that may be associated with an infant's survival. Details of this model may be found elsewhere[17]. The individual-level variables included all relevant attributes of the child and his/her parents, such as maternal work status, parents' level of education, father's occupation, mother's marital status, mother's age, child's age, child's gender, mother's access to health-care services, place of delivery, type of delivery assistance, mode of delivery, birth order of the child, preceding birth interval, number of antenatal clinic visits by mother, number of postnatal check-ups by mother, mother's access to the print media, mother's access to the radio and mother's access to television. Considering the practical importance of having narrower age intervals in the younger age than the older within the sample, child's age was re-categorised into 6–11 months, 12–17 months and 18–23 months. Information about the child was given by the mother. This was based on a 24 h recall. The size of the baby at birth as perceived by the mother was used as a proxy for birth weight[18]. This variable was used to represent the birth weight, since some mothers delivered their babies outside a health facility and did not receive any health care in the first 2 d[8]. The perceived size of the baby was categorised into 'small', 'average' and 'large'. Acute respiratory infection was defined as a condition of experiencing symptoms of cough accompanied by short, rapid breathing during the 2 weeks prior to the survey. It was categorised into 'No' for not having the disease and 'Yes' for having the disease. A child was considered to have contracted diarrhoea if he/she had watery or blood and mucus stool in the 2 weeks preceding the survey. Diarrhoea was categorised into 'No' for not having the disease and 'Yes' for having the disease.

Household-level factors were categorised into a household wealth index. The household wealth index was the sum of the weighted scores for each item and was used in the analyses as a continuous variable. Household-level variables were made up of source of drinking-water and household wealth index. This index was created by applying a principal components analysis[19] to estimate the weights for the index based on acquired information about various household assets including ownership of various means of transport and other durable household goods. Household facilities and assets of respondents were assigned with weights. The facilities and assets included were those that were featured in the GDHS 2013 data, namely television, radio, refrigerator, car, bicycle, motorcycle, source of drinking-water, type of toilet facility, electricity and type of building materials used in the place of dwelling.

In the GDHS 2013, the household wealth index was divided into five categories (quintiles) and each household was assigned to one of these categories. In the present study, we re-categorised the household wealth index to showcase the bottom 40 % of the households, referred to as the poor households, the next 40 % as the middle-class households, and the top 20 % as rich households. Community-level variables consisted of type of residence (urban/rural) and geographical region. Geographical region refers to the eight administrative regions in The Gambia. These regions are: Banjul, Kanifing, Brikama, Mansakonko, Kerewan, Kuntaur, Janjanbureh and Basse.

Data analysis

All statistical analyses were performed utilizing the statistical software package Stata version 13.0. Cluster sampling design and sampling weights were adjusted for with the Stata 'svy' commands. Generalised linear latent and mixed models (GLLAM) with the logit link and binomial family described by Rabe-Hesketh and Skrondal[20] were used to determine the relationships between study dependent factors and independent factors, starting with crude estimates for each independent factor. Adjusting for confounding factors, a multivariable analysis was conducted.

Multivariable modelling similar to that of Victora *et al.*[21] was adopted for the analyses. This means each of the level factors (individual-, household- and community-level factors) was entered progressively into the model to assess their relationship with the study outcomes. We retained and reported only those factors that were statistically significant (5 % significance level) with the study outcomes in the final model. The OR and 95 % CI

https://doi.org/10.1017/S1368980017002014 Published online by Cambridge University Press

estimated measure the magnitude of risk related to the study outcomes by each of the significant factors.

Using an approach similar to the one by Stafford *et al.*[22], we estimated the adjusted PAR proportions and their 95 % CI. The adjusted PAR estimates were used to measure inappropriate complementary feeding practices attributable to each independent risk factor retained in the final multivariable GLLAM model. The extrapolated total risk was obtained based on PAR proportions and yearly estimated number of children aged 6–23 months (using GDHS 2013 and the estimated general population).

To estimate the contribution of each risk factor to the total risk for inadequacy of the complementary feeding indicators within the period of the survey, the PAR was calculated for the significant risk factors. The PAR and corresponding 95 % CI were obtained by utilising the following equation, similar to that employed by Stafford *et al.*[22,23]:

$$\mathrm{PAR} = \frac{pr(\mathrm{AOR}-1)}{\mathrm{AOR}},$$

where *pr* is the proportion of the population exposed to the risk factors and AOR is the adjusted odds ratio for inadequacy of the complementary feeding indicators.

Results

Characteristics of the sample

Table 1 presents the distribution of the individual-, household- and community-level characteristics for the weighted total of 2362 children aged 6–23 months. While the majority of mothers had no schooling, about 60 % were in paid employment. More than half (52·4 %) of the mothers were aged 20–29 years when they delivered their babies. About 95 % of the mothers were currently married and belonged to the Islamic faith. Male and female children were almost equally represented (51·5 and 48·6 %, respectively). Most children (about 65 %) were delivered by health professionals and almost all of them not by caesarean section. While most mothers (77·9 %) had four or more antenatal clinic visits, the majority of them (84·1 %) did not have more than two postnatal clinic visits. The majority of mothers had limited or no access to print media and television (95 and 61 %, respectively), while more than 55 % had access to the radio. Only 17 % of mothers belonged to rich households and 88 % of households had access to potable water. There were more mothers who lived in rural areas than those who lived in urban areas (55 and 45 %, respectively). Only a small proportion of mothers (1·3 %) lived in the Banjul region.

Table 2 presents the OR of the dependent variables in the current study. The multivariate analysis showed that children from poor households (OR = 3·19; 95 % CI 1·24, 4·12) had higher odds of not meeting the requirement for introduction of solid, semi-solid or soft foods compared

Table 1 Individual-, household- and community-level characteristics of children aged 6–23 months and their parents, The Gambia, 2013 (*n* 2362)

Characteristic	*n**	%
Individual-level factors		
Mother's work status		
Not working	1017	43·1
Working	1345	56·9
Father's occupation		
Non-agricultural	1722	72·9
Agricultural	640	27·1
Mother's education		
No education	1410	59·7
Primary	320	13·5
Secondary or higher	633	26·8
Father's education (*n* 2228)		
No education	1388	62·3
Primary	129	5·8
Secondary or higher	711	31·9
Mother's literacy		
Literate	648	27·4
Illiterate	1714	72·6
Mother's age (years)		
15–24	756	32·0
25–34	1122	47·5
35–49	485	20·5
Mother's age at child's birth (years)		
<20	327	13·8
20–29	1239	52·4
30–39	680	28·8
≥40	117	5·0
Mother's BMI (kg/m^2) (*n* 1092)		
≤18	102	9·3
18·5–25·0	784	71·8
>25·0	207	19·0
Mother's marital status		
Never married	76	3·2
Currently married	2234	94·6
Formerly married†	53	2·2
Mother's religion		
Islam	2313	97·9
Christian and others	49	2·1
Birth order of child		
First born	496	21·0
2nd–4th	1063	45·0
5th or higher	804	34·0
Preceding birth interval (*n* 2357)		
No previous birth	496	21·0
<24 months	217	9·2
>24 months	1644	69·8
Gender of baby		
Male	1215	51·5
Female	1147	48·6
Size of baby (*n* 2356)		
Small	487	20·7
Average	614	26·0
Large	1255	53·3
Age of child (months)		
6–11	795	33·7
12–17	941	39·8
18–23	627	26·5
Place of delivery		
Home	22	0·9
Health facility	2340	99·1
Child had diarrhoea (in last 2 weeks)		
No	1723	72·9
Yes	639	27·1
Child had ARI (in last 2 weeks) (*n* 398)		
No	147	36·8
Yes	252	63·2
Child had fever (in last 2 weeks) (*n* 398)		
No	147	36·8
Yes	252	63·2

https://doi.org/10.1017/S1368980017002014 Published online by Cambridge University Press

Table 1 *Continued*

Characteristic	*n**	%
Type of delivery assistance (*n* 2315)		
Health professional	1495	64·6
Traditional birth attendant	614	26·5
Other/untrained attendant	206	8·9
Mode of delivery (*n* 1876)		
Non-caesarean	2314	98·0
Caesarean	48	2·0
Antenatal clinic visits (*n* 2358)		
None	13	0·6
1–3	509	21·6
≥4	1836	77·9
Timing of postnatal check-up (d) (*n* 1821)		
0–2	1531	84·1
3–6	177	9·7
≥7	113	6·2
Mother's access to print media		
Yes	108	4·6
No	2255	95·4
Mother's access to the radio		
Yes	1350	57·2
No	1012	42·8
Mother's access to television		
Yes	924	39·1
No	1439	60·9
Household factors		
Household wealth index		
Poor	1031	43·7
Middle	939	39·8
Rich	392	16·6
Source of drinking-water		
Unprotected	286	12·1
Protected	2076	87·9
Community-level factors		
Type of place of residence		
Urban	1069	45·3
Rural	1293	54·7
Administrative region		
Banjul	30	1·3
Kanifing	331	14·0
Brikama	830	35·1
Mansakon	117	4·9
Kerewan	301	12·8
Kuntaur	169	7·1
Janjanbureh	207	8·7
Basse	378	16·0

ARI, Acute respiratory infection.
*Weighted total was 2362 unless stated otherwise within parentheses.
†Includes divorced, separated and widowed.

with those from rich households. The odds of not meeting the requirement for introduction of solid, semi-solid or soft foods increased significantly among children whose fathers were not employed in an agricultural industry (OR = 2·71; 95 % CI 1·17, 6·29).

Factors that had higher odds of not meeting the requirement for minimum dietary diversity included children who were delivered at home, children of the youngest age bracket (6–11 months), children whose fathers had no schooling and those who resided in the Basse region of The Gambia.

The odds of not meeting the minimum acceptable diet criterion were significantly higher among children of the youngest age bracket (6–11 months), children whose fathers did not have any schooling, children who were perceived to be small at birth, rural children, children from households with unprotected drinking-water sources and children whose mothers had no access to the radio.

Factors associated with not meeting the requirements for minimum meal frequency included children of the youngest age bracket (6–11 months) and those whose mothers were aged less than 20 years when they were born.

Adjusted PAR estimates (Table 3) showed that inadequacy of the three complementary feeding indicators was attributable to infants who were aged between 6 and 11 months (PAR = 0·20; 95 % CI 0·16, 0·24 for not meeting minimum meal frequency; PAR = 0·25; CI 0·18, 0·31 for not meeting minimum acceptable diet; PAR = 0·29; 95 % CI 0·25, 0·33 for not meeting minimum dietary diversity). Outcomes in the present study also indicated that inappropriate complementary feeding practices were attributed to infants whose mothers were aged less than 20 years at the time of their birth (PAR = 0·09; 95 % CI 0·03, 0·13 for not meeting the minimum meal frequency criterion), living in a rural area (PAR = 0·29; 95 % CI 0·09, 0·46 for not meeting the minimum acceptable diet criterion) and infants delivered at home (PAR = 0·26, 95 % CI 0·02, 0·38 for not meeting the requirement for minimum dietary diversity).

Discussion

The current study, which used the first and most recent nationally representative survey data for The Gambia and the WHO complementary feeding indicators to analyse complementary feeding in The Gambia, revealed that the key factors associated with inappropriate complementary feeding included children of the youngest age group (6–11 months), children whose parents had no schooling, children whose mothers had no access to the radio, children from rural areas and those from poor households. The study presents the OR, which indicate the likelihood of association between each of the potential determinants and the each of the complementary feeding indicators. A higher OR is an indication of a higher association. Additionally, the study presents the PAR, which indicate the number in the population that is attributable to not meeting the requirement for each of the complementary feeding indicators.

The PAR estimates obtained in the current study showed that children of the youngest age bracket (6–11 months) were possibly associated with 31 222, 21 278 and 26 757 infants not meeting the requirements for minimum dietary diversity, minimum meal frequency and minimum acceptable diet, respectively. The finding may be attributed to mothers perceiving their children to be 'too young' to be given foods other than breast milk. Such mothers should be encouraged through community-level interventions to offer their young children complementary foods when they attain the age of 6 months. This finding is

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Table 2 Multiple logistic regression modelling of a child not currently receiving adequate complementary feeding, The Gambia, 2013

Outcome variable	Characteristic	AOR	95 % CI	*P* value
Not complementarily fed	Father's occupation			
	Agricultural	1·00	Ref.	
	Non-agricultural	2·71	1·17, 6·29	0·004
	Wealth index			
	Rich	1·00	Ref.	
	Middle	2·26	1·42, 7·15	0·005
	Poor	3·19	1·24, 4·12	0·008
Not meeting minimum dietary diversity	Place of delivery			
	Health facility	1·00	Ref	
	Home	3·37	1·06, 10·67	0·039
	Child's age (months)			
	12–17	1·00	Ref.	
	18–23	2·49	1·73, 3·58	<0·001
	6–11	7·6	4·65, 12·41	<0·001
	Maternal access to radio			
	Yes	1·00	Ref.	
	No	1·86	1·27, 2·72	0·001
	Father's education			
	Primary	1·00	Ref.	
	Secondary or higher	1·11	0·59, 2·12	0·741
	No schooling	1·94	1·02, 3·69	0·042
	Administrative region			
	Kanifing	1·00	Ref.	
	Brikama	1·48	0·39, 5·61	0·563
	Mansakonko	2·03	0·58, 7·07	0·265
	Kerewan	2·54	0·61, 10·54	0·198
	Janjanbureh	3·75	0·97, 14·50	0·055
	Basse	11·23	2·08, 60·69	0·005
	Kuntaur	4·59	1·07, 19·66	0·04
	Banjul	4·66	1·20, 18·06	0·026
Not meeting minimum meal frequency	Child's age (months)			
	12–17	1·00	Ref.	
	18–23	1·14	0·90, 1·45	0·261
	6–11	2·45	1·97, 3·04	<0·001
	Maternal age at child's birth (years)			
	≥ 40	1·00	Ref.	
	30–39	1·52	0·93, 2·47	0·093
	20–29	1·65	0·93, 2·92	0·088
	<20	2·62	1·35, 5·09	0·004
Not meeting minimum acceptable diet	Child's age (months)			
	12–17	1·00	Ref.	
	18–23	1·25	0·80, 1·95	0·327
	6–11	3·91	2·27, 6·73	<0·001
	Father's education			
	Secondary or higher	1·00	Ref.	
	Primary	1·52	0·63, 3·69	0·351
	No schooling	1·82	1·18, 2·80	0·007
	Size of baby			
	Large	1·00	Ref.	
	Average	1·38	0·83, 2·29	0·208
	Small	1·86	1·06, 3·26	0·03
	Type of place of residence			
	Urban	1·00	Ref.	
	Rural	2·17	1·23, 3·84	0·008
	Source of drinking water			
	Protected	1·00	Ref.	
	Unprotected	1·84	1·01, 3·39	0·048
	Maternal access to the radio			
	Yes	1·00	Ref.	
	No	1·58	1·01, 2·47	0·045

AOR, adjusted OR; Ref., reference category.

consistent with findings from recent studies in some Francophone[24] and Anglophone[25] West African countries. Previous studies in Bangladesh[12], India[15] and Tanzania[26] showed similar findings.

The current study is similar to several other previous studies, as such studies also examined factors associated with inappropriate complementary feeding practices in the various countries. However, the difference and the novelty

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Table 3 Estimated population-attributable risk (PAR) and projected number of infants for each of the factors significantly associated with inappropriate child feeding (ICF) practices in The Gambia, 2013

Variable	%*	AOR†	PAR‡	95 % CI	No. of children aged 6–23 months significantly associated with ICF practices	
					Estimate	Range
Not complimentarily fed						
Father's occupation						
Agricultural	28·9	Ref.				
Non-agricultural	71·1	2·71	45·0	9·50, 64·1		
Wealth index						
Rich	22·6	Ref.				
Middle	33·1	2·26	18·0	8·31, 33·2		
Poor	44·3	3·19	30·0	7·24, 38·9		
Not meeting minimum dietary diversity						
Place of delivery						
Health facility	62·6	Ref.				
Home	37·4	3·37	26·0	1·88, 37·8	28 060	2134–40 540
Child's age (months)						
12–17	39·5	Ref.				
18–23	26·5	2·49	16·0	10·4, 20·6	16 917	10 668–22 404
6–11	33·7	7·60	29·0	24·7, 33·1	31 222	26 671–35 206
Maternal access to the radio						
Yes	57·2	Ref.				
No	42·8	1·86	20·0	8·29, 29·5	21 112	8535–32 005
Father's education						
Primary	5·5	Ref.				
Secondary or higher	30·1	1·11		–		
No schooling	58·8	1·94	28·0	1·08, 45·3	30 395	1067–48 008
Administrative region						
Kanifing	14·0	Ref.				
Brikama	35·1	1·48		–		
Mansakonko	4·9	2·03		–		
Kerewan	12·7	2·54		–		
Janjanbureh	8·7	3·75		–		
Basse	16·0	11·20	15·0	6·54, 19·8	15 549	7468–21 337
Kuntaur	7·1	4·59	6·0	0·37, 8·54	5924	0–9602
Banjul	1·3	4·66	1·0	0·18, 1·51	1089	0–2134
Not meeting minimum meal frequency						
Child's age (months)						
12–17	39·8	Ref.				
18–23	26·5	1·14		–		
6–11	33·7	2·45	20·0	15·5, 24·2	21 278	16 003–25 604
Mother's age at child's birth (years)						
≥40	5·0	Ref.				
30–39	28·8	1·52		–		
20–29	52·4	1·65		–		
<20	13·8	2·62	9·0	3·19, 12·5	9103	3201–13 869
Not meeting minimum acceptable diet						
Child's age (months)						
12–17	39·5	Ref.				
18–23	26·5	1·25		–		
6–11	33·7	3·91	25·0	17·6, 30·7	26 757	19 203–33 072
Father's education						
Secondary or higher	30·1	Ref.				
Primary	5·5	1·52		–		
No education	58·8	1·82	26·0	8·42, 39·9	28 263	8535–42 673
Mother's perceived baby size						
Large	53·1	Ref.				
Average	26·0	1·38				
Small	20·6	1·86	10·0	1·04, 15·9	10 161	1067–17 069
Type of place of residence						
Urban	45·3	Ref.				
Rural	54·7	2·17	29·0	8·88, 45·7	31 464	9602–49 074
Source of drinking-water						
Protected	87·9	Ref.				
Unprotected	12·1	1·84	6·0	0·00, 10·86	5893	0–11 735
Maternal access to the radio						
Yes	57·2	Ref.				
No	42·8	1·58	16·0	0·00, 27·8	16 761	0–29 871

AOR, adjusted OR; –, PAR was not obtained because factors were not significantly associated with ICF practices; Ref., reference category.
*Weighted proportion of infants who had ICF between 6 and 23 months. Proportion varies between groups due to missing values.
†Adjusted independent variables were: place of residence, administrative region, source of drinking-water, household wealth index, mother's characteristics (education, antenatal clinic visit, religion, literacy, working status, age, BMI, marital status, access to radio, access to television, access to print media), father's characteristics (education, occupation), child's gender, age of child, place of delivery, delivery assistance, mode of delivery, child's body size at birth, birth order, preceding birth interval, child had diarrhoea, fever or acute respiratory infection.
‡PAR was obtained using a formula similar to that described by Stafford *et al.*[22] and Ezeh *et al.*[23]: PAR = [*pr*(AOR − 1)/AOR], where *pr* is the proportion of the population exposed to the risk factors derived based on the estimated number of children (6–23 months) using the Demographic and Health Survey of The Gambia 2013 and the estimated general population.

https://doi.org/10.1017/S1368980017002014 Published online by Cambridge University Press

aspect of our study is that it provides numbers of populations that are attributable to particular independent predictors of inappropriate complementary feeding practices. This would give public health professionals and other stakeholders a sense of numbers when implementing interventions to tackle problems of infant and young child feeding practices. The study also provides the approximate sample size required for future cross-sectional studies aimed at improving child health in The Gambia.

In the present study, we found that children whose fathers had no schooling were significantly more likely not to meet the requirements for minimum dietary diversity and minimum acceptable diet. We estimated that 30 395 and 28 263 children whose fathers had no schooling could be attributed to not meeting the requirements for minimum dietary diversity and minimum acceptable diet, respectively. This finding is consistent with findings from a previous study in Bangladesh[1], in which children whose mothers had no formal education were twice as likely not to meet the minimum dietary diversity requirement, compared with those whose mothers had higher levels of education. Additionally, a previous study in Indonesia[14] found that mothers with no schooling were significantly associated with inadequate complementary feeding practices. Similar findings have been found in Uganda[27] and Pakistan[28]. These findings highlight the significant role that parental education plays in meeting the requirements for appropriate child feeding practices. Interventions to increase awareness of nutrition and appropriate child feeding practices should target parents with no schooling or those with low levels of education.

Our study also found that children who were born at home were significantly less likely to receive adequate dietary diversity compared with those who were born at a health facility, which is consistent with findings from previous studies in Indonesia[14] and Bangladesh[1]. Our study estimated that 28 060 children who were born at home could be attributed to inadequate dietary diversity. This finding may be due to the fact that mothers whose babies were delivered at a health facility may have had good contacts with health workers through antenatal care services and might have received information and support on appropriate child feeding practices through such services[29–31].

We also found that children whose fathers worked in an agriculture-related industry were positively associated with introduction of solid, semi-solid or soft food, consistent with a study in India[15]. This finding may be attributed to the fact that households where fathers worked in an agricultural sector may have better food security compared with those where fathers worked in a non-agricultural sector. The agriculture industry encompasses food and cash crop cultivation as well as livestock production. This sector drives food availability and access by interacting with other contextual conditions such as the environment and political economy. Similarly, food systems underlie nutritional outcomes through food processing, markets and food safety pathways. Numerous past studies have revealed the relationships between agriculture, food systems and nutrition, although few have focused on impact pathways during the complementary feeding period[31–34].

Children who were perceived to be small at birth by their mothers were found to be a predictor of inadequate acceptable diet, consistent with a past study in Ghana[11] where mothers who perceived the size of their babies to be smaller than average were found to be more likely not to meet the minimum dietary diversity requirement. It was estimated that about 10 161 children who were perceived to be small when they were born could be attributed to inadequate acceptable diet. Perceived size of a baby has been found to be a proxy to the mean birth weight of a baby[19]. The likelihood of such small children not meeting the requirement for adequate complementary feeding may be due to the fact their mothers considered them to be 'too small' to be given solid foods.

We further tested for association of some household-level factors with inappropriate complementary feeding and found that children whose mothers had no access to the radio were significantly less likely to meet the requirements for minimum dietary diversity and minimum acceptable diet. About 16 761 and 21 112 children whose mothers did not have access to the radio were estimated to be attributed to inadequate acceptable diet and dietary diversity, respectively. This is consistent with findings from past studies that the mass media is an effective intervention tool for improving complementary feeding practices[35–37]. Additionally, our finding is consistent with findings from a recent study[25] in which Sierra Leonean mothers' limited access to the radio was significantly associated with inadequate complementary feeding practices. Nigerian children whose mothers had limited or no access to newspapers/magazines were found to be significantly less likely to receive adequate complementary feeding[25]. In another recent study[24], children in Burkina Faso whose mothers had limited or no access to the television were found to be significantly less likely to meet the requirement for introducing solid, semi-solid or soft foods. A past study in India[15] found that there was a significantly high likelihood of not meeting the requirement for minimum acceptable diet among children whose mothers had limited access to mass media. These findings highlight the crucial role that could be played by the mass media in promoting adequate complementary feeding practices among young children in The Gambia. If Gambian women have access to radio and television, they can benefit from health and child nutrition programmes when such programmes are aired through such media. In an effort to promote optimal infant and young child feeding in The Gambia, the National Nutrition Agency developed and aired radio and television spots on infant

and young child feeding[38]. The Gambian Government and other stakeholders should therefore consider making the prices of radios and televisions affordable to Gambian mothers. Additionally, consistent with results from previous studies[1,14,15], we found household poverty to be negatively associated with introduction of solid, semi-solid or soft foods.

Additionally, we tested for the association of some community-level factors with inappropriate complementary feeding and found that children born in rural areas had significantly higher odds of not meeting the requirement for minimum acceptable diet, compared with their urban counterparts, consistent with findings from a past study on rural–urban residence involving thirty-six developing countries[39]. This finding may be attributed to the availability of better socio-economic facilities (mother's education and status, access to better health facilities and household wealth) and the nutritional status of a child. It was estimated that about 31 464 children who lived in rural areas were attributed to inadequate acceptable diet. In The Gambia, any community member can correct any child or commandeer it for any reasonable help[40]. Therefore, appropriate child feeding (such as meeting the requirement for minimum acceptable diet) intervention programmes should be community-based.

We found that children from the Basse region of Gambia had significantly higher odds of not meeting the requirement for minimum dietary diversity, consistent with findings from past studies[1,15,41] in which inadequate complementary feeding practices have found to be significantly associated with children from specific geographic/administrative regions. This finding may highlight the limited access to the determinants of adequate child feeding practices such as appropriate health-care facilities, mother's education and household wealth in the region. Stakeholders should therefore focus on these determinants in this region.

The main strengths of our study were the large nationally representative survey sample, the comprehensive data on complementary feeding indicators and the appropriate adjustments for sampling design made use of in the analyses. The study was, however, limited in a number of ways. First, the complementary feeding indicators were based on a 24 h recall by mothers, which is prone to recall bias. Second, there were limited variables available for measuring household- and community-level factors. Third, due to its cross-sectional design, we could not establish causal factors for inadequate complementary feeding.

Conclusion

Despite the limitations of our study, the reported findings make a contribution to appropriate young child feeding in a low-income country such as The Gambia.

Our findings suggest that addressing inappropriate complementary feeding in The Gambia should involve community-based interventions which should target the sociodemographic factors that impact negatively on young child feeding practices, such as young children, lack of formal education for parents and limited access to the mass media.

Acknowledgements

Acknowledgements: The authors thank ICF Macro for making the GDHS 2013 data set available. *Financial support:* This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors. *Conflict of interest:* The authors declare no conflict of interest. *Authorship:* A.I.I. and K.E.A designed the study and performed the analysis; A.I.I. prepared the manuscript; K.E.A. and A.M.N.R provided advice on the study design, data analysis and revision of the final manuscript. All authors read and approved the manuscript. *Ethics of human subject participation:* Not applicable.

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