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Original Article

Determinants of suboptimal complementary feeding practices among children aged 6–23 months in seven francophone West African countries

Abukari I. Issaka*, Kingsley E. Agho†, Andrew N. Page*, Penelope L. Burns*, Garry J. Stevens* and Michael J. Dibley‡

School of Medicine, University of Western Sydney, Penrith, New South Wales, Australia, †School of Science and Health, University of Western Sydney, Penrith, New South Wales, Australia, and ‡Sydney School of Public Health, University of Sydney, Sydney, New South Wales, Australia

Abstract

Suboptimal complementary feeding practices play a crucial role in the health and development of children. The objective of this research paper was to identify factors associated with suboptimal complementary feeding practices among children aged 6–23 months in seven francophone West African countries, namely, Benin, Burkina Faso, Cote d'Ivoire, Guinea, Mali, Niger and Senegal. This study covered 22 376 children aged 6–23 months from the seven countries surveyed (Benin: 3732 children; Burkina Faso: 4205 children; Cote d'Ivoire: 2109 children, Guinea: 1944 children, Mali: 3798 children, Niger: 3451 children and Senegal: 3137 children). The most recent Demographic and Health Survey datasets of the various countries were used as data sources. A set of individual-, household- and community-level factors were used to examine the four complementary feeding indicators. Multivariate analysis revealed that the youngest age bracket (6–11 months) of children, administrative/geographical region, mother's limited or non-access to the mass media, mothers' lack of contact with a health facility, rural residence, poor households and non-working mothers were the main factors associated with suboptimal complementary feeding in the countries surveyed. Our findings highlight the need to consider broader social, cultural and economic factors when designing child nutritional interventions.

Keywords: dietary diversity, child nutrition, meal frequency, acceptable diet, francophone, West Africa.

Correspondence: Mr Abukari I. Issaka, School of Medicine, University of Western Sydney, Penrith, NSW 2751, Australia. E-mail: ib120@hotmail.com; jagunu@yahoo.com.au

Introduction

Feeding practices are considered to be suboptimal when they do not meet the requirements of all the four complementary feeding indicators recommended by the World Health Organization (WHO). Optimal complementary feeding is critical for the sustenance of the health and well-being of infants. Infants who receive optimal complementary feeding experience better growth and less sickness than those who do not receive this type of feeding (Lutter 2003). In 2012, more than one million children in West Africa were at risk of acute malnourishment – a third of which lived in Niger (a francophone country), one of the poorest countries in the world (Lorenzen 2012). According to an IFRC (International Federation of the Red Cross and Red Crescent Societies) report (Callaghan 2012), Burkina Faso (a francophone country) has an ongoing problem with malnutrition in the country and mothers are not well educated on how to provide the correct nutrition for their babies, especially when the mothers eat poorly themselves. Similar situations exist in other francophone West African countries. According to population-based studies, the greatest risk of nutritional deficiency and growth retardation

occurs in children aged 3–15 months because of poor breastfeeding and complementary feeding practices (Shrimpton *et al*. 2001). Suboptimal complementary feeding arises as a result of complementary foods being of inadequate nutrient quality, being given to infants either too early or too late, or being supplied in quantities that were too small or too infrequent. Because of the important role that complementary feeding plays in the lives of infants, WHO recommended that all infants should be fed with nutritionally adequate and safe complementary foods while still being breastfed for up to 2 years or beyond (World Health Organization 2003). The WHO has also recently introduced complementary feeding indicators to assess feeding practices in children aged 0–23 months (WHO 2010). Using these indicators as yardstick, there is an indication that infants from many low- and middle-income countries do not receive appropriate complementary feeding. This deficiency is a contributory factor to undernutrition, which leads to growth failure, morbidity and mortality among infants in developing countries (WHO 2000). Research has also revealed that apart from physically harming a child's body, nutritionally inadequate feeding during the early stages of a child's life may lead to low intelligence quotient and behavioural problems in childhood and adolescence (Grantham-McGregor 1995; Liu *et al*. 2004).

As the francophone West African countries share many common socio-economic and cultural attributes, it is important to identify the factors associated with suboptimal complementary feeding practices that are common to these countries. It is essential to identify consistent modifiable factors across several of these francophone countries in order to build effective nutritional interventions by targeting individuals, families and communities that are at risk of practising suboptimal feeding behaviours. In spite of the common attributes, some countries are likely to lag behind in their bid to improve complementary feeding practices and consequently lower child undernutrition. Such countries could potentially learn from those that have lower rates of under-nutrition. Identification and assessment of risk factors associated with optimal complementary feeding practices across countries could be crucial in understanding the unique characteristics of each country and developing locally acceptable interventions in order to improve these practices. Regional development assistance partner organisations may benefit from these assessments for the purpose of resource allocation and programme evaluation (Dibley *et al*. 2010).

The aim of the present paper was to explore the socio-demographic factors (as well as other relevant factors) that pose risks to optimal complementary feeding practices among children aged 6–23 months in seven francophone West African countries – Benin, Burkina Faso, Cote d'Ivoire, Guinea, Mali, Niger and Senegal using the most recent available DHS data.

Ethical consideration

This study was based on an analysis of existing public domain survey datasets that is freely available online with all identifier information removed. The first author communicated with MEASURE DHS/ICF International and permission was granted to download and use the data for his doctoral dissertation with the School of Medicine at the University of Western Sydney, Australia.

Key messages

- Regional differences and children of the youngest age bracket (6–11 months) were significant predictors of inappropriate complementary feeding practices across majority of the countries.
- Rural children in Burkina Faso, Guinea, Mali and Niger had a high risk of not meeting the requirement for minimum dietary diversity.
- Children whose mothers had limited or no access to the media reported greater risk of not meeting minimum meal frequency in Benin, Guinea, Mali and Niger.
- Children from mothers with low socio-economic status were associated with inappropriate complementary feeding practices in these francophone countries.

Methods

Data sources

The most recent DHS data for Benin (2011–2012), Burkina Faso (2010), Cote d'Ivoire (2011–2012), Guinea (2012), Mali (2006), Niger (2012) and Senegal (2011) were used in the analyses for this paper. Details of survey methodology, sampling procedure, and questionnaires are available in the respective DHS reports and are also described in the respective country reports (Cellule de Planification et de Statistique (CPS) *et al*. 2008; Agence Nationale de la Statistique et de la Démographie (ANSD) *et al*. 2012; Institut National de la Statistique et de la Démographie (INSD) *et al*. 2012; Institut National de la Statistique *et al*. 2013; Institut National de la Statistique (INS) *et al*. 2013; Ministère du Développement *et al*. 2013; Ministère de la Santé et de la Lutte contre le Sida (MSLS) *et al*. 2013).

Survey designs

A multi-stage cluster sampling design was used for all surveys (which adopted standardised questionnaire). The study was limited to children who were alive, of singleton births, last-born, aged 6–23 months and lived with the respondent (ever-married women aged between 15 and 49 years). The survey yielded a weighted total of 3732 children in Benin, 4205 children in Burkina Faso, 2109 children in Cote d'Ivoire, 1944 children in Guinea, 3798 children in Mali, 3451 children in Niger and 3137 children in Senegal, with an average response rate 94.5%.

Complementary feeding indicators

This study made use of the new and updated Infant and Young Child Feeding (IYCF) indicators recommended by the WHO (Daelmans *et al*. 2009). The study was based on a mother's recall of foods offered to her child in the 24 h before the survey. The complementary feeding indicators are defined below (WHO 2010):

- Introduction of solid, semi-solid or soft foods: the proportion of infants 6–8 months of age who received solid, semi-solid or soft foods
- Minimum dietary diversity: the proportion of children aged 6–23 months who received foods from four or more food groups of the seven food groups. The seven food groups considered were (1) grains, roots and tubers; (2) legumes and nuts; (3) dairy products (milk, yogurt and cheese); (4) flesh foods (meat, fish, poultry); (5) eggs; (6) vitamin A-rich fruits and vegetables; and (7) other fruits and vegetables]
- Minimum meal frequency: the proportion of children aged 6–23 months who received solid, semi-solid or soft foods (including milk feeds for non-breastfed children) the minimum number of times or more. 'Minimum' was defined as: two times for breastfed infants aged 6–8 months; three times for breastfed children aged 9–23 months and four times for non-breastfed children aged 6–23 months. All feeding took place the previous day
- Minimum acceptable diet for the breastfed child: the proportion of breastfed children 6–23 months of age who had at least the minimum dietary diversity and the minimum meal frequency during the previous day. The surveys did not collect the required information, especially about consumption of iron-fortified foods. Because of this, the consumption of iron-rich or iron-fortified was not estimated in this study.

Minimum acceptable diet is a composite indicator, which is calculated from breastfed children aged 6–23 months who had at least the minimum dietary diversity and the minimum meal frequency during the previous day.

Socio-demographic and economic characteristics of children and their parents constituted the independent variables in this study. These variables were classified into three levels: individual-, household- and community-level factors.

Characteristics of the child, mother and father such as age and sex of the child, mother's marital status, age, occupation, body mass index, level of education, number of antenatal clinic visits, place of delivery of the baby, mode of delivery, type of delivery assistance, birth order, timing of post-natal check-up and mother's access to the media (newspaper/magazine, radio and television) constituted individual-level factors. Household wealth index and source of drinking water constituted household-level factor, whiles

the type of residence (urban/rural) and geographical/administrative regions constituted community-level variables. In the various DHS surveys, the household wealth index was constructed using the principal components analysis (Filmer & Pritchett 2001) to determine the weights for the index based on information collected about several household assets such as ownership of various means of transportation, ownership of durable goods and household facilities. The index was divided into three categories, namely, poor, middle and rich. In order to facilitate comparison across the seven countries, all explanatory variables and their categorisation were made as consistent as possible.

Statistical analysis

The four complementary feeding indicator variables were examined against a set of independent variables in order to determine the factors associated with suboptimal feeding practices. Execution of all statistical analyses was done by the use of Stata version 12.0 (Stata Corp., College Station, TX, USA). 'SVY' commands were used to allow for adjustments for the cluster sampling design, sampling weights and the calculation of standard errors. The Taylor series linearisation method was used by these commands for the estimation of confidence intervals around prevalence estimates. This method was used because it allows for very accurate estimates of common functions, and also provide for integration and differentiation of functions to arrive at representations of other functions. Significance of associations was tested using χ^2 tests. In order to determine the factors significantly associated with not meeting the requirements of the four complementary feeding indicators, stepwise backwards model was used to perform the survey logistic regression analysis. Factors that were not significant ($P \geq 0.05$) were eliminated in a stepwise fashion and those with $P < 0.05$ were retained in the final model. In order to assess the adjusted risk of the independent variables, the odds ratios with 95% confidence intervals were calculated.

An alternative to the method used in this analysis is the multi-level modelling approach. The survey method adopted in this study compares closely with the multi-level modelling approach in terms of the effects of primary interest. This highlights the robustness of the results obtained in this paper.

Results

The characteristics of the study populations are summarised in Table 1. The samples ranged between 1944 children in Guinea and 4205 children in Burkina Faso. With the exception of Niger and Senegal, majority of mothers in the other countries were in paid employment. At least, 1 in 10 mothers had no schooling across all the seven countries. It was not surprising, therefore, that there was a high percentage of illiteracy among the mothers in all the countries. Majority of mothers across all the countries belonged to the 30–39 years age bracket. With the exception of Benin, most of the mothers belonged to the Muslim faith. In all the countries, only a small proportion of babies were perceived to be small at the time of birth. Apart from Guinea, Mali and Niger, most deliveries in the other countries took place at a health facility. This was reflected in the proportions of deliveries by a health professional. Only a small proportion of mothers did not have any antenatal clinic visits in all the countries. An alarmingly low proportion of mothers read newspapers or magazines in all seven countries. The proportion of mothers who watched television was better than those who read newspaper or magazine in all the countries. However, a good majority of mothers in all the countries listened to the radio. Majority of children in all the countries lived in rural areas and belonged to poor households.

Determinants of suboptimal feeding practices

As shown in Table 2, delay in the introduction of complementary feeding within 6–8 months was significantly associated with decreased age of the child. This was consistent across all the seven countries. Regional differences in the introduction rates were seen across majority of the countries (Benin, Burkina Faso, Guinea and Mali), but were more pronounced in Benin, Burkina Faso and Guinea. Other factors significantly associated with delayed introduction of complementary feeding were: non-working mothers

Table 1. Individual-, household- and community-level characteristics of children aged 6–23 months and their parents across seven francophone West African countries (2006–2012)

Characteristic	Benin (n = 3732)		Burkina Faso (n = 4205)		Cote d'Ivoire (n = 2109)		Guinea (n = 1944)		Mali (n = 3798)		Niger (n = 3451)		Senegal (n = 3137)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Individual-level factors														
Mother's working status														
Non-working	2477	66.4	3442	81.9	1401	66.4	1498	77.1	2413	63.6	2675	77.5	2105	67.1
Working (past 12 months)	1255	33.6	762	18.1	708	33.6	446	22.9	1384	36.4	776	22.5	1032	32.9
Father's occupation														
Non-agricultural	1969	52.8	1130	27.3	785	37.2	651	39.4	1207	34.3	1889	54.8	819	26.0
Agricultural	1602	42.9	3010	72.7	991	47.0	937	56.7	2308	65.7	1562	45.3	2318	74.0
Not working	161	4.3												
Mother's education														
No schooling	2594	69.5	3492	83.1	1317	62.5	1470	75.6	3215	84.7	2917	84.6	2176	69.0
Primary	630	16.9	459	10.9	558	26.5	263	13.6	391	10.3	339	9.8	707	23.0
Secondary and higher	508	13.6	253	6.0	233	11.1	211	10.8	192	5.1	192	5.6	254	8.0
Father's education														
No schooling	1882	55.6	3398	82.2	989	56.1	1246	68.3	2940	80.3	2767	81.5	2159	77.6
Primary	695	20.5	478	11.6	393	22.3	229	12.6	426	11.7	393	11.6	327	11.8
Secondary and higher	807	23.8	259	6.2	381	21.6	349	19.1	294	8	235	6.9	296	10.6
Mother's literacy														
No	2812	75.5	3613	85.9	1537	72.9	1666	85.7	3389	89.4	3104	89.9	2316	74.1
Yes	913	24.5	592	14.1	572	27.1	278	14.3	401	10.6	347	10.1	809	25.9
Mother's age (years)														
15–24	1000	26.8	1437	34.2	780	37.0	698	35.9	1389	36.6	1072	31.1	1004	32.0
25–34	2037	54.6	1915	45.5	990	46.9	834	42.9	1687	44.4	1703	49.4	1504	48.0
35–49	695	18.6	854	20.3	339	16.1	412	21.2	722	19	675	19.6	628	20.0
Mother's age at child's birth (years)														
Less than 20	398	10.7	562	13.4	361	17.1	409	21.0	727	19.1	535	15.5	449	14.3
20–29	2161	57.9	2210	52.6	1128	53.5	952	49.0	1979	52.1	1852	53.7	1663	53.0
30–39	1039	27.8	1218	29.0	530	25.1	487	25.0	953	25.1	943	27.3	888	28.3
More than 40	134	3.6	215	5.1	89	4.2	96	5.0	140	3.7	121	3.5	137	4.4
Maternal BMI (kg m^{-2})														
Less than 18	117	3.2	197	9.5	37	3.6	80	7.9	271	7.2	138	9.0	170	14.5
18–25	2635	72.0	1708	82.6	817	77.9	792	77.4	2964	78.7	1122	73.2	768	65.5
More than 25	908	24.8	162	7.8	195	18.6	151	14.7	533	14.1	273	17.8	235	20.0
Mother's marital status														
Currently married	3499	93.8	4086	97.2	1778	84.3	1796	92.4	3693	97.3	3387	98.2	2945	93.9
Formerly married*	233	6.2	118	2.8	331	15.7	148	7.6	105	2.8	64	1.8	192	6.1
Mother's religion														
Muslim	1640	44.0	2682	63.8	1281	60.8	1705	87.7	3470	91.4			3047	97.0
Christian	2092	56.0	1510	35.9	828	39.3	239	12.3	328	8.6			90	3.0
Birth order of child														
First-born	752	20.1	710	16.9	471	22.4	416	21.4	636	16.8	444	12.9	684	21.8
2nd–4th	2003	53.7	1991	47.4	1044	49.5	875	45.0	1670	44.0	1408	40.8	1460	46.5
5th or higher	977	26.2	1504	35.8	594	28.2	653	33.6	1492	39.3	1599	46.3	993	31.7
Preceding birth interval														
No previous birth	752	20.2	710	16.9	471	22.4	416	21.5	636	16.8	444	12.9	684	21.8
<24 months	352	9.5	355	8.5	208	9.9	137	7.0	575	15.2	559	16.3	350	11.2
>24 months	2620	70.3	3136	74.7	1426	67.7	1389	71.6	2583	68.1	2439	70.9	2101	67.0
Sex of baby														
Male	1928	51.7	2131	50.7	1017	48.2	1032	53.1	1937	51.0	1718	49.8	1644	52.4
Female	1804	48.3	2075	49.3	1092	51.8	912	46.9	1861	49.0	1733	50.2	1493	47.6

Table 1. Continued

Characteristic	Benin (*n* = 3732)		Burkina Faso (*n* = 4205)		Cote d'Ivoire (*n* = 2109)		Guinea (*n* = 1944)		Mali (*n* = 3798)		Niger (*n* = 3451)		Senegal (*n* = 3137)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Perceived size of baby														
Small	447	12.6	504	12.0	286	13.9	251	12.9	735	19.7	950	28.2	914	29.3
Average	2449	68.8	2311	55.1	703	34.2	766	39.5	1179	31.6	1771	52.6	1420	45.5
Large	662	18.6	1381	32.9	1066	51.9	925	47.6	1814	48.7	645	19.2	788	25.2
Age of child (months)														
6–11	1304	34.9	1469	34.9	763	36.2	700	36.0	1300	34.2	1279	37.1	1064	33.9
12–17	1210	32.5	1451	34.5	699	33.1	752	38.7	1528	40.2	1331	38.6	1208	38.5
18–23	1218	32.6	1286	30.6	648	30.7	492	25.3	970	25.5	841	24.4	865	27.6
Place of delivery														
Home	441	11.8	1101	26.2	849	40.2	1154	59.3	1957	51.5	2252	65.3	839	26.7
Health facility	3291	88.2	3105	73.8	1260	59.8	790	40.7	1841	48.5	1199	34.7	2299	73.3
Child had diarrhoea (last 2 weeks)														
No	3339	90.1	3202	76.2	1557	73.8	1503	77.3	2960	78.2	2579	74.7	2144	68.4
Yes	369	9.9	998	23.8	552	26.2	441	22.7	825	21.8	872	25.3	992	31.6
Child had ARI (past 2 weeks)														
No	236	59.3	341	58.9	1874	88.9	1637	84.2	372	56.7	3092	89.6	275	35.7
Yes	161	40.7	238	41.1	235	11.1	307	15.8	284	43.3	359	10.4	494	64.3
Child had fever (last 2 weeks)														
No	3264	87.9	2973	70.7	1441	68.3	1261	64.8	2782	73.5	2725	79.0	2175	69.4
Yes	450	12.1	1231	29.3	668	31.7	683	35.2	1006	26.6	726	21.1	961	30.6
Type of delivery assistance														
Health professional	2956	81.0	2955	72.1	1277	60.7	769	45.1	964	29.2	1178	34.2	1704	57.0
Traditional birth attendant	125	3.4	299	7.3	299	14.2	500	29.3	1718	52.1	1038	30.1	239	8.0
Other untrained personnel	567	15.6	848	20.7	529	25.1	437	25.6	619	18.7	1234	35.8	1044	35.0
Mode of delivery														
Non-caesarean	3511	94.1	4115	97.9	2047	97.1	1889	97.2	3738	98.4	3407	98.7	2946	93.9
Caesarean	219	5.9	89	2.1	61	2.9	55	2.8	60	1.6	44	1.3	148	4.7
Antenatal clinic visits														
None	419	11.8	149	3.5	152	7.2	257	13.3	999	26.9	406	11.8	134	4.4
1–3	928	26.1	2672	63.6	1031	49.1	580	30.0	1307	35.2	1823	53.1	1412	45.7
4+	2213	62.1	1381	32.9	918	43.7	1098	56.7	1405	37.9	1207	35.1	1542	49.9
Timing of post-natal check-up														
Missing	2243	60.1	1977	47.0	708	33.6	1262	76.3			2018	58.5	789	25.1
0–2 days	1090	29.2	1621	38.5	1158	54.9	157	9.5			951	27.6	1461	46.6
3–6 days	357	9.6	503	12.0	208	9.9	33	2.0			180	5.2	310	9.9
7th day or later	43	1.1	105	2.5	36	1.7	202	12.2			302	8.7	577	18.4
Mother read newspaper/magazine														
No	3392	90.9	3992	95.1	1871	88.7	1848	95.0	3632	96.1	3364	97.5	2724	86.8
Yes	340	9.1	207	4.9	238	11.3	96	5.0	149	3.9	87	2.5	413	13.2
Mother listened to the radio														
No	1397	37.4	1321	31.5	1272	60.3	724	37.2	781	20.6	1286	37.3	556	17.7
Yes	2335	62.6	2878	68.5	838	39.7	1220	62.80	3009	79.4	2165	62.7	2581	82.3
Mother watched television														
No	2098	56.2	3181	75.9	972	46.1	1197	61.6	1908	50.3	2679	77.6	1055	33.6
Yes	1634	43.8	1013	24.2	1137	53.9	747	38.4	1882	49.7	772	22.4	2082	66.4

Table 1. Continued

Characteristic	Benin (*n* = 3732)		Burkina Faso (*n* = 4205)		Cote d'Ivoire (*n* = 2109)		Guinea (*n* = 1944)		Mali (*n* = 3798)		Niger (*n* = 3451)		Senegal (*n* = 3137)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Household-level factors														
Household Wealth Index														
Poor	1518	40.7	1732	41.2	947	44.9	830	42.7	1527	40.2	1309	37.9	1394	44.4
Middle	1441	38.6	1820	43.3	812	38.5	785	40.4	1592	41.9	1464	42.4	1259	40.1
Rich	773	20.7	652	15.5	350	16.6	329	16.9	679	17.9	678	19.7	485	15.5
Source of drinking water														
Unprotected	903	24.2	1115	26.5	542	25.7	695	35.7	1731	45.6	1116	32.3	819	26.1
Protected	2829	75.8	3091	73.5	1567	74.3	1249	64.3	2067	54.4	2335	67.7	2318	73.9
Community-level factors														
Residence														
Urban	1557	41.7	749	17.8	825	39.1	531	27.3	1025	27.0	498	14.4	1227	39.1
Rural	2175	58.3	3457	82.2	1284	60.9	1413	72.7	2773	73.0	2953	85.6	1910	60.9
Geographical/administrative region														
1	241	6.5	517	12.3	159	7.5	202	10.4	586	15.4	48	1.4	636	22.4
2	357	9.6	152	3.6	55	2.6	292	15.0	658	17.3	80	2.3	99	3.5
3	478	12.8	376	8.9	157	7.5	183	9.4	706	18.6	429	12.4	377	13.3
4	297	8.0	340	8.1	347	16.4	332	17.1	679	17.9	771	22.3	197	7.0
5	214	5.7	313	7.4	134	6.3	296	15.2	402	10.6	752	21.8	167	5.9
6	257	6.9	309	7.3	86	4.1	173	8.9	153	4.0	410	11.9	274	9.7
7	143	3.8	203	4.8	101	4.8	142	7.3	170	4.5	748	21.7	394	13.9
8	434	11.6	459	10.9	285	13.5	324	16.7	10	0.3	213	6.2	218	7.7
9	185	4.9	474	11.3	290	13.8			433	11.4			179	6.3
10	520	13.9	309	7.4	166	7.9							173	6.0
11	274	7.4	187	4.4	330	15.7							121	4.3
12	333	8.9	383	9.1										
13			183	4.4										

*Separated, divorced or widowed.

1 = Alibori (Benin), Boucle de Mouhoun (Burkina Faso), Centre (Cote d'Ivoire), Boké (Guinea), Agadez (Niger), Kayes (Mali) and Dakar (Senegal); 2 = Atacora (Benin), Cascades (Burkina Faso), Centre-Est (Cote d'Ivoire), Conakry (Guinea), Diffa (Niger), Koulikor (Mali) and Diourbel (Senegal). 3 = Atlanti (Benin), Centre (Burkina Faso), Centre-Nord (Cote d'Ivoire), Faranah (Guinea), Dosso (Niger), Sikasso (Mali) and Fatick (Senegal). 4 = Borgou (Benin), Centre-Est (Burkina Faso), Centre-Ouest (Cote d'Ivoire), Kankan (Guinea), Maradi (Niger), Segou (Mali) and Kaolack (Senegal). 5 = Colline (Benin), Centre-nord (Burkina Faso), Nord (Cote d'Ivoire), Kindia (Guinea), Tahoua (Niger), Mopti (Mali) and Kolda (Senegal). 6 = Couffo (Benin), Centre-ouest (Burkina Faso), Nord-est (Cote d'Ivoire), Labé (Guinea), Tillabér (Niger), Tombouct (Mali) and Louga (Senegal). 7 = Donga (Benin), Centre-sud (Burkina Faso), Nord-Ouest (Cote d'Ivoire), Mamou (Guinea), Zinder (Niger), Gao (Mali) and Matam (Senegal). 8 = Littoral (Benin), Est (Burkina Faso), Ouest (Cote d'Ivoire), N'zéréko (Guinea), Niamey (Niger), Kidal (Mali) and Saint-Louis (Senegal). 9 = Mono (Benin), Hauts Bassins (Burkina Faso), Sud sans Abidjan (Cote d'Ivoire), Bamako (Mali) and Tambacounda (Senegal). 10 = Quémé (Benin), Nord (Burkina Faso) Sud-ouest (Cote d'Ivoire) and Thiès (Senegal). 11 = Plateau (Benin), Plateau Central (Burkina Faso) Ville d'Abidjan (Cote d'Ivoire) and Zuguinchor (Senegal). 12 = Zou (Benin), Sahel (Burkina Faso). 13 = Sud-Ouest (Burkina Faso).

(Burkina Faso and Niger), middle-level households, illiterate mothers and no antenatal clinic visits (Benin and Burkina Faso). In the modelling, in Burkina Faso, when household wealth index was replaced with mother's access to television, it was found to be significant [adjusted odds ratio (AOR) = 0.75, 95% confidence interval (CI): (0.50, 1.12) for middle-level households and AOR = 0.49, 95% CI: (0.26, 0.92) for rich households]. Children whose mothers belonged to the Christian faith (Cote d'Ivoire), who were born at home (Guinea), whose mothers had no schooling (Mali), who contracted acute respiratory infection in the past 2 weeks, were male, were delivered by traditional birth attendants and whose mothers resided in

Table 2. Factors associated with not introducing solid, semi-solid or soft foods among children aged 6–8 months across seven francophone West African countries. Adjusted odds ratios by multivariate logistic regression analysis (2006–2012)

Country	Variable	Odds ratio	95% CI	*P*-value
Benin	Household Wealth Index			
	Poor	1.00		
	Middle	1.57	[1.04, 2.36]	0.033
	Rich	1.20	[0.60, 2.42]	0.607
	Administrative region	See details below*		
	Age of child (in months)	0.75	[0.61, 0.94]	0.012
	Antenatal clinic visits			
	None	1.00		
	1–3	0.33	[0.17, 0.63]	0.001
	4+	0.35	[0.19, 0.65]	0.001
	Mother's literacy			
	No	1.00		
	Yes	0.55	[0.32, 0.92]	0.024
Burkina Faso	Age of child (in months)	0.53	[0.43, 0.66]	<0.001
	Mother's working status			
	Non-working	1.00		
	Working (past 12 months)	0.58	[0.37, 0.91]	0.018
	Geographical region	See details below†		
	Mother watched television			
	No	1.00		
	Yes	0.40	[0.25, 0.63]	<0.001
Cote d'Ivoire	Mother's religion			
	Muslim	1.00		
	Christian and other	2.17	[1.21, 3.90]	0.010
	Age of child (in months)	0.43	[0.31, 0.61]	<0.001
Guinea	Age of child (in months)	0.64	[0.47, 0.87]	0.004
	Place of delivery			
	Home	1.00		
	Health facility	0.34	[0.20, 0.58]	<0.001
	Administrative region	See details below‡		
Mali	Age of child (in months)	0.53	[0.41, 0.70]	<0.001
	Mother's education			
	No education	1.00		
	Primary	0.79	[0.40, 1.57]	0.507
	Secondary and higher	0.30	[0.11, 0.84]	0.022
	Father's education			
	No education	1.00		
	Primary	2.11	[1.10, 4.06]	0.025
	Secondary and higher	1.02	[0.40, 2.60]	0.960
	Geographical region	See details below§		
Niger	Age of child (in months)	0.47	[0.36, 0.62]	<0.001
	Mother's working status			
	Non-working	1.00		
	Working (past 12 months)	0.57	[0.37, 0.88]	0.011
Senegal	Child had ARI (past 2 weeks)			
	No	1.00		
	Yes	2.20	[1.20, 4.01]	0.011
	Gender of baby			
	Male	1.00		
	Female	0.56	[0.34, 0.93]	0.025
	Type of delivery assistance			
	Health professional	1.00		
	Traditional birth attendant	2.71	[1.34, 5.49]	0.006
	Other untrained personnel	0.81	[0.47, 1.40]	0.446
	Age of child (in months)	1.76	[1.30, 2.38]	<0.001
	Residence			
	Urban	1.00		
	Rural	0.47	[0.27, 0.82]	0.008

*Compared with the Alibori region, the odds for not meeting the requirements for introduction of solid, semi-soli or soft foods was significantly lower in Borgou [OR = 0.07, 95% CI: (0.03, 0.19)], the Colline [OR = 0.17, 95% CI: (0.06, 0.47)], the Couffo [OR = 0.15, 95% CI: (0.05, 0.44)], the Donga [OR = 0.25, 95% CI: (0.08, 0.71)], the Littoral [OR = 0.22, 95% CI: (0.07, 0.63)], the Mono [OR = 0.21, 95% CI: (0.07, 0.67)] and the Quémé [OR = 0.26, 95% CI: (0.11, 0.65)] regions in Benin. †Compared with the Boucle de Mouhoun region, the odds for not meeting the requirements for introduction of solid, semi-solid or soft foods was significantly lower in the Centre [OR = 0.17, 95% CI: (0.07, 0.47)], Centre-Est [OR = 0.28, 95% CI: (0.11, 0.68)], Centre-Sud [OR = 0.14, 95% CI: (0.05, 0.38)], Est [OR = 0.41, 95% CI: (0.19, 0.90)] and Sud-Est [OR = 0.35, 95% CI: (0.16, 0.78)] regions in Burkina Faso. ‡Compared with the Boké region, the odds for not meeting the requirement for introduction of solid, semi-solid or soft foods was significantly lower in the Conakry [OR = 0.12, 95% CI: (0.04, 0.39)], Faranah [OR = 0.14, 95% CI: (0.04, 0.45)], Kankan [OR = 0.32, 95% CI: (0.11, 0.98)], Labé [OR = 0.04, 95% CI: (0.01, 0.13)], Mamou [OR = 0.19, 95% CI: (0.06, 0.62)] and N'zéréko [OR = 0.11, 95% CI: (0.03, 0.37)] regions in Guinea. §Compared with the Kayes region, the odds for not meeting the requirement for introduction of solid, semi-solid or soft foods was significantly lower in the Kidal [OR = 0.33, 95% CI: (0.15, 0.75)] region in Mali.

urban areas (Senegal) were significantly associated with delayed introduction of solid, semi-solid or soft foods.

As indicated in Table 3, dietary diversity was poor among children of the youngest age bracket (6–11 months) in all seven countries. Regional differences were a significant predictor of poor dietary diversity in majority of the countries (Benin, Burkina Faso, Cote d'Ivoire, Mali and Niger). Rural mothers were significant determinants of inadequate dietary diversity among children in Burkina Faso, Guinea, Mali and Niger. In contrast, urban mothers were found to be significantly associated with inadequate dietary diversity in Benin. Children from poor households did not have adequate dietary diversity in all the countries except Burkina Faso. In the final model for Mali, we checked for collinearity by replacing mother's education with household wealth index, and it was found to be significant [(AOR) = 1.17, 95% (CI): (0.67, 2.01) for middle-level households; and AOR = 0.46, 95% CI: (0.22, 0.98) for rich households]. Other factors that were found to be significantly associated with inadequate dietary diversity were lack of antenatal clinic visits (Benin and Senegal), babies delivered at home (Benin), children whose mothers had limited or no access to the media such as radio, television or newspaper/magazine (Benin and Burkina Faso), children born to non-working mothers (Benin and Senegal), children born to mothers with no schooling (Cote d'Ivoire, Mali, Niger and Senegal) and children who did not contract acute respiratory infection and fever in the past 2 weeks and who were delivered by a health professional (Benin). Babies whose mothers perceived them to be small at birth in Niger were found to be significantly associated with poor dietary diversity. Inadequate dietary diversity was also found to be significantly associated with children whose mothers had a BMI of less than 18 kg m^{-2} (Mali) and whose mothers were illiterate (Guinea).

Table 4 reveals that being in the youngest age bracket (6–11 months) was a significant risk factor for inadequate meal frequency in four countries, namely, Benin, Burkina Faso, Mali and Niger. Regional differences were significantly associated with inadequate meal frequency in majority of the countries. Non-working mothers were significantly associated with suboptimal meal frequency in Benin and Burkina Faso. Limited or no access to media was a risk factor for suboptimal meal frequency in Benin, Guinea, Mali and Niger. In the final model for Guinea, when we replaced television with household wealth index, it was found to be significant [AOR = 0.97, 95% CI: (0.74, 1.28) for middle-level households and AOR = 0.66, 95% CI: (0.47, 0.94) for rich households]. Other factors that were found to be significantly associated with inadequate meal frequency were first-born children (Benin and Cote d'Ivoire), children whose mothers did not attend antenatal clinics (Benin and Guinea) and those who did not have fever in the past 2 weeks (Benin).In the final model for Benin, when birth interval was replaced by birth order, it was found to be significant [AOR = 0.79, 95% CI: (0.64, 0.98) for 2nd–4th-born children and AOR = 0.61, 95% CI: (0.48, 0.77) for 5th-born children or higher]. Children in Burkina Faso, Guinea and Senegal whose mothers did not have any post-natal check-up were significantly associated with inadequate meal frequency. Babies whose mothers perceived them to be small at birth were significantly associated with inadequate meal frequency in Niger and Senegal. When birth order of the child was replaced with birth interval preceding in the final model for Benin, it was found to be significant. In Senegal, rural mothers and children who were delivered through caesarean sections were significant risk factors to adequate meal frequency.

Factors that were associated with failure to receive the minimum acceptable diet among breastfed children are summarised in Table 5. A significantly higher percentage of children from the youngest age bracket (6–11 months) failed to receive the minimum acceptable diet in Benin, Burkina Faso, Guinea, Niger and Senegal. Regional differences in three of the countries (Benin, Burkina Faso and Cote d'Ivoire) were significantly associated with poor acceptable diet. Limited or no access to mass media was found to be a risk in Benin, Burkina Faso, Mali and Senegal. Unemployed mothers were significantly associated with inadequate acceptable diet in Benin and Mali. The risk of insufficient acceptable diet was significantly high among children whose mothers were literate in Burkina Faso and Niger, who came from poor

Table 3. Factors associated with inappropriate dietary diversity among children aged 6–23 months across seven francophone West African countries. Adjusted odds ratios by multivariate logistic regression analysis

Country	Variable	Odds ratio	95% confidence interval	*P*-value
Benin	Place of delivery			
	Home	1.00		
	Health facility	0.55	[0.35, 0.85]	0.007
	Age of child (months)			
	6–11	1.00		
	12–17	0.41	[0.33, 0.51]	<0.001
	18–23	0.33	[0.27, 0.41]	<0.001
	Antenatal clinic visits			
	None	1.00		
	1–3	0.55	[0.37, 0.81]	0.002
	4+	0.50	[0.34, 0.73]	<0.001
	Administrative region	See details below*		
	Residence			
	Urban	1.00		
	Rural	0.81	[0.64, 1.03]	0.082
	Mother listened to the radio			
	No	1.00		
	Yes	0.61	[0.49, 0.76]	<0.001
	Mother watched television			
	No	1.00		
	Yes	0.78	[0.63, 0.97]	0.028
	Household Wealth Index			
	Poor	1.00		
	Middle	0.88	[0.72, 1.08]	0.223
	Rich	0.69	[0.49, 0.96]	0.028
	Mother's working status			
	Non-working	1.00		
	Working (past 12 months)	0.63	[0.51, 0.77]	<0.001
	Type of delivery assistance			
	Health professional	1.00		
	Traditional birth attendant	0.28	[0.16, 0.50]	<0.001
	Other untrained personnel	0.75	[0.55, 1.03]	0.073
	Child had fever (last 2 weeks)			
	No	1.00		
	Yes	0.65	[0.50, 0.85]	0.001
	Child had ARI (past 2 weeks)			
	No	1.00		
	Yes	0.65	[0.44, 0.95]	0.027
Burkina Faso	Age of child (months)			
	6–11	1.00		
	12–17	0.34	[0.20, 0.56]	<0.001
	18–23	0.22	[0.14, 0.36]	<0.001
	Father's education			
	No schooling	1.00		
	Primary	0.67	[0.42, 1.06]	0.087
	Secondary and higher	0.41	[0.26, 0.66]	<0.001
	Father's occupation			
	Non-agricultural	1.00		
	Agricultural	1.74	[1.16, 2.60]	0.007
	Mother listened to the radio			
	No	1.00		
	Yes	0.62	[0.39, 0.97]	0.035
	Mother watched television			
	No	1.00		
	Yes	0.51	[0.34, 0.78]	0.002
	Residence			
	Urban	1.00		
	Rural	1.74	[1.12, 2.71]	0.014
	Geographical region	See details below†		

Table 3. Continued

Country	Variable	Odds ratio	95% confidence interval	*P*-value
Cote d'Ivoire	Age of child (months)			
	6–11	1.00		
	12–17	0.39	[0.23, 0.64]	<0.001
	18–23	0.23	[0.14, 0.38]	<0.001
	Geographical region	See details below[‡]		
	Household Wealth Index			
	Poor	1.00		
	Middle	0.41	[0.25, 0.69]	0.001
	Rich	0.22	[0.12, 0.40]	<0.001
	Mother's education			
	No schooling	1.00		
	Primary	0.87	[0.53, 1.44]	0.597
	Secondary and higher	0.60	[0.37, 0.99]	0.045
Guinea	Age of child (months)			
	6–11	1.00		
	12–17	0.59	[0.27, 1.29]	0.185
	18–23	0.22	[0.11, 0.46]	<0.001
	Household Wealth Index			
	Poor	1.00		
	Middle	0.48	[0.19, 1.18]	0.110
	Rich	0.36	[0.16, 0.82]	0.015
	Residence			
	Urban	1.00		
	Rural	2.16	[1.12, 4.15]	0.021
	Timing of post-natal check-up			
	No check-up/missing	1.00		
	0–2 days	1.04	[0.59, 1.82]	0.895
	3–6 days	1.60	[0.56, 4.61]	0.381
	7th day or later	0.41	[0.20, 0.86]	0.018
	Mother's literacy			
	No	1.00		
	Yes	0.43	[0.25, 0.72]	0.001
Mali	Age of child (months)			
	6–11	1.00		
	12–17	0.46	[0.28, 0.76]	0.002
	18–23	0.24	[0.14, 0.38]	<0.001
	Maternal BMI (kg m^{-2})			
	Less than 18	1.00		
	18–25	0.39	[0.17, 0.89]	0.026
	More than 25	0.39	[0.17, 0.92]	0.032
	Geographical region	See details below[§]		
	Residence			
	Urban	1.00		
	Rural	2.82	[1.55, 5.12]	0.001
	Mother's education			
	No schooling	1.00		
	Primary	0.56	[0.33, 0.94]	0.028
	Secondary and higher	0.39	[0.23, 0.65]	<0.001
Niger	Age of child (months)			
	6–11	1.00		
	12–17	0.33	[0.23, 0.46]	<0.001
	18–23	0.29	[0.21, 0.42]	<0.001
	Mother's education			
	No schooling	1.00		
	Primary	0.86	[0.58, 1.28]	0.459
	Secondary and higher	0.52	[0.34, 0.78]	0.002
	Father's occupation			
	Non-agricultural	1.00		
	Agricultural	0.51	[0.35, 0.74]	<0.001

Table 3. Continued

Country	Variable	Odds ratio	95% confidence interval	*P*-value
	Perceived size of baby			
	Small	1.00		
	Average	0.62	[0.40, 0.97]	0.036
	Large	0.49	[0.31, 0.77]	0.002
	Administrative region	See details below[¶]		
	Residence			
	Urban	1.00		
	Rural	2.62	[1.64, 4.18]	<0.001
	Household Wealth Index			
	Poor	1.00		
	Middle	1.00	[0.58, 1.71]	0.997
	Rich	0.52	[0.33, 0.82]	0.005
Senegal	Birth order of child			
	First-born	1.00		
	2nd–4th	1.27	[0.95, 1.68]	0.101
	5th or higher	1.66	[1.20, 2.31]	0.002
	Age of child (months)			
	6–11	1.00		
	12–17	0.51	[0.37, 0.69]	<0.001
	18–23	0.40	[0.29, 0.55]	<0.001
	Mother's working status			
	Non-working	1.00		
	Working (past 12 months)	0.72	[0.55, 0.95]	0.022
	Antenatal clinic visits			
	None	1.00		
	1–3	0.72	[0.37, 1.40]	0.327
	4+	0.49	[0.25, 0.96]	0.038
	Mother's education			
	No schooling	1.00		
	Primary	0.67	[0.48, 0.94]	0.020
	Secondary and higher	0.52	[0.31, 0.87]	0.013
	Household Wealth Index			
	Poor	1.00		
	Middle	0.44	[0.31, 0.63]	<0.001
	Rich	0.30	[0.22, 0.41]	<0.001

ARI, acute respiratory infection. *Compared with the Alibori region, the odds for not meeting the requirement for minimum dietary diversity was significantly lower in the Atacora [OR = 0.48, 95% CI: (0.24, 0.97)], Borgou [OR = 0.41, 95% CI: (0.21, 0.81)], Couffo [OR = 0.39, 95% CI: (0.19, 0.80)], Littoral [OR = 0.28, 95% CI: (0.14, 0.57)], Mono [OR = 0.47, 95% CI: (0.23, 0.96)] and Quémé [OR = 0.46, 95% CI: (0.23, 0.91)] regions in Benin. [†]Compared with the Boucle Mouhoun region, the odds for not meeting the minimum dietary diversity requirement was significantly higher in the Centre-Est [OR = 4.73, 95% CI: (1.58, 14.15)], Centre Nord [OR = 4.12, 95% CI: (1.35, 12.56)], Centre-Ouest [OR = 7.99, 95% CI: (2.73, 23.33)], Hauts Bassins [OR = 2.23, 95% CI: (1.14, 4.37)], Nord [OR = 3.02, 95% CI: (1.24, 7.34)], Plateau Central [OR = 2.98, 95% CI: (1.10, 8.08)] and Sahel [OR = 12.31, 95% CI: (2.37, 63.92)] regions in Burkina Faso. [‡]Compared with the Centre region, the odds for not meeting the requirement for minimum dietary diversity was significantly lower in Centre-Nord [OR = 0.40, 95% CI: (0.17, 0.93)], Nord-Est [OR = 0.41, 95% CI: (0.18, 0.95)], Ouest [OR = 0.39, 95% CI: (0.18, 0.85)], Sud Sans Abidjan [OR = 0.26, 95% CI: (0.11, 0.59)] and Ville d'Abidjan [OR = 0.27, 95% CI: (0.12, 0.60)] regions in Cote d'Ivoire. [§]Compared with the Kayes region, the odds for not meeting the requirement for minimum dietary diversity was significantly higher in the Koulikor [OR = 2.35, 95% CI: (1.09, 5.03)], Segou [OR = 4.15, 95% CI: (1.74, 9.94)], Mopti [OR = 9.13, 95% CI: (2.90, 28.74)], Tombouct [OR = 5.82, 95% CI: (2.22, 15.23)] and Kidal [OR = 10.80, 95% CI: (1.87, 62.27)] regions in Mali. [¶]Compared with the Agadez region, the odds for not meeting the requirement for minimum dietary diversity was significantly higher in the Dosso [OR = 1.05, 95% CI: (0.52, 2.13)] and lower in the Diffa [OR = 0.41, 95% CI: (0.20, 0.85)] regions in Niger.

households in Cote d'Ivoire, Guinea and Mali and whose mothers resided in rural areas in Niger and Senegal. Children in Guinea and Niger whose fathers worked in a non-agricultural sector were a significant risk factor to optimal acceptable diet. In contrast to this, the risk of suboptimal acceptable diet was high among children in Burkina Faso whose fathers worked in an agricultural sector. Other factors significantly associated with suboptimal acceptable diet were delivery by a health professional (Benin), households with unprotected sources of drinking water (Niger), formerly married mothers (Niger) and

Table 4. Factors associated with not meeting the requirements for minimum meal frequency among children aged 6–23 months across seven francophone West African countries. Adjusted odds ratios by multivariate logistic regression analysis (2006–2012)

Country	Variable	Odds ratio	95% confidence interval	*P*-value
Benin	Administrative region	See details below*		
	Age of child (months)			
	6–11	1.00		
	12–17	0.77	[0.64, 0.93]	0.007
	18–23	0.82	[0.67, 0.98]	0.034
	Preceding birth interval			
	No previous birth	1.00		
	<24 months	0.69	[0.50, 0.93]	0.017
	>24 months	0.74	[0.60, 0.91]	0.004
	Mother listened to the radio			
	No	1.00		
	Yes	0.69	[0.57, 0.82]	<0.001
	Antenatal clinic visits			
	None	1.00		
	1–3	0.51	[0.37, 0.71]	<0.001
	4+	0.60	[0.44, 0.81]	0.001
	Mother's working status			
	Non-working	1.00		
	Working (past 12 months)	0.69	[0.57, 0.83]	<0.001
	Child had fever (last 2 weeks)			
	No	1.00		
	Yes	0.73	[0.58, 0.91]	0.006
Burkina Faso	Age of child (months)			
	6–11	1.00		
	12–17	0.66	[0.54, 0.79]	<0.001
	18–23	0.56	[0.47, 0.67]	<0.001
	Mother's age (years)			
	15–24	1.00		
	25–34	0.87	[0.73, 1.04]	0.124
	35–49	0.80	[0.65, 0.98]	0.032
	Timing of post-natal check-up			
	No check-up/missing	1.00		
	0–2 days	0.81	[0.68, 0.98]	0.028
	3–6 days	0.87	[0.69, 1.11]	0.258
	7th day or later	0.95	[0.56, 1.60]	0.844
	Father's occupation			
	Non-agricultural	1.00		
	Agricultural	1.25	[1.04, 1.49]	0.016
	Mother's working status			
	Non-working	1.00		
	Working (past 12 months)	0.65	[0.52, 0.82]	<0.001
	Geographical region	See details below†		
Cote d'Ivoire	Birth order of baby			
	First-born	1.00		
	2nd–4th	1.12	[0.84, 1.48]	0.440
	5th or higher	0.74	[0.55, 1.00]	0.050
	Age of child (months)			
	6–11	1.00		
	12–17	0.83	[0.65, 1.07]	0.155
	18–23	0.94	[0.69, 1.28]	0.683

Table 4. Continued

Country	Variable	Odds ratio	95% confidence interval	*P*-value
	Geographical region	See details below‡		
	Household Wealth Index			
	Poor	1.00		
	Middle	0.71	[0.56, 0.91]	0.006
	Rich	0.72	[0.48, 1.08]	0.115
Guinea	Mother watched television			
	No	1.00		
	Yes	0.65	[0.48, 0.88]	0.005
	Geographical region	See details below§		
	Antenatal clinic visits			
	None	1.00		
	1–3	0.81	[0.51, 1.26]	0.345
	4+	0.61	[0.41, 0.90]	0.014
	Timing of post-natal check-up			
	No check-up/missing	1.00		
	0–2 days	0.63	[0.44, 0.91]	0.014
	3–6 days	0.88	[0.46, 1.69]	0.694
	7th day or later	0.60	[0.40, 0.91]	0.017
Mali	Age of child (months)			
	6–11	1.00		
	12–17	0.14	[0.03, 0.59]	0.007
	18–23	0.03	[0.01, 0.10]	<0.001
	Mother's age at child's birth (years)			
	Less than 20	1.00		
	20–29	1.91	[1.15, 3.18]	0.013
	30–39	2.77	[1.53, 5.03]	0.001
	More than 40	1.58	[0.38, 6.66]	0.532
	Mother read newspaper/ magazine			
	No	1.00		
	Yes	0.39	[0.20, 0.78]	0.007
	Mother listened to the radio			
	No	1.00		
	Yes	0.45	[0.22, 0.91]	0.027
Niger	Age of child (months)			
	6–11	1.00		
	12–17	0.76	[0.63, 0.92]	0.005
	18–23	0.86	[0.68, 1.09]	0.215
	Mother's marital status			
	Currently married	1.00		
	Formerly married	1.86	[1.03, 3.37]	0.04
	Mother's education			
	No schooling	1.00		
	Primary	0.68	[0.52, 0.89]	0.005
	Secondary and higher	0.76	[0.51, 1.13]	0.182
	Mother listened to the radio			
	No	1.00		
	Yes	0.77	[0.64, 0.94]	0.009
	Perceived size of baby			
	Small	1.00		
	Average	0.61	[0.49, 0.76]	<0.001
	Large	0.66	[0.50, 0.87]	0.004
	Administrative region	See details below¶		

Table 4. Continued

Country	Variable	Odds ratio	95% confidence interval	*P*-value
Senegal	Geographical region	See details below**		
	Perceived size of baby			
	Small	1.00		
	Average	0.85	[0.67, 1.08]	0.191
	Large	0.61	[0.44, 0.84]	0.002
	Timing of post-natal check-up			
	No check-up/missing	1.00		
	0–2 days	0.72	[0.53, 0.98]	0.038
	3–6 days	0.85	[0.53, 1.35]	0.487
	7th day or later	0.51	[0.38, 0.69]	<0.001
	Residence			
	Urban	1.00		
	Rural	1.54	[1.20, 1.99]	0.001
	Mode of delivery			
	Non-Caesarean	1.00		
	Caesarean	2.14	[1.11, 4.13]	0.023

*Compared with the Alibori region, the odds for not meeting the requirements for minimum meal frequency was significantly lower in the Borgou [OR = 0.27, 95% CI: (0.16, 0.44)], Colline [OR = 0.39, 95% CI: (0.23, 0.66)], Couffo [OR = 0.36, 95% CI: (0.22, 0.61)], Donga [OR = 0.46, 95% CI: (0.28, 0.76)], Littoral [OR = 0.41, 95% CI: (0.24, 0.68)], Quémé [OR = 0.29, 95% CI: (0.18, 0.48)] and Zou [OR = 0.29, 95% CI: (0.18, 0.47)] regions in Benin. †Compared with the Boucle Mouhoun region, the odds for not meeting the requirement for minimum meal frequency was significantly higher in Centre [OR = 1.77, 95% CI: (1.15, 2.74)], Centre-Est [OR = 1.56, 95% CI: (1.05, 2.32)], Centre-Nord [OR = 2.06, 95% CI: (1.36, 3.13)], Centre-Ouest [OR = 2.24, 95% CI: (1.54, 3.26)], Centre-Sud [OR = 1.66, 95% CI: (1.13, 2.43)], Plateau central [OR = 2.12, 95% CI: (1.41, 3.17)] and Sud-Est [OR = 2.08, 95% CI: (1.26, 3.43)] regions in Burkina Faso. ‡Compared with the Centre region, the odds for not meeting the requirement for minimum meal frequency was significantly lower in the Centre-Nord [OR = 0.46, 95% CI: (0.240.90)] and Nord [OR = 0.48, 95% CI: (0.29, 0.80)] regions in Cote d'Ivoire. §Compared with the Boké region, the odds for not meeting the requirement for minimum meal frequency was significantly lower in the Conakry [OR = 0.44, 95% CI: (0.24, 0.83)], Faranah [OR = 0.52, 95% CI: (0.28, 0.95)], Kankan [OR = 0.34, 95% CI: (0.20, 0.60)], Kindia [OR = 0.48, 95% CI: (0.26, 0.86)], Labé [OR = 0.18, 95% CI: (0.09, 0.30)] and Mamou [OR = 0.27, 95% CI: (0.15, 0.47)] regions in Guinea. ¶Compared with the Agadez region, the odds for not meeting the requirement for minimum meal frequency was significantly lower in the Diffa [OR = 0.32, 95% CI: (0.15, 0.69)], Dosso [OR = 0.27, 95% CI: (0.14, 0.53)], Maradi [OR = 0.30, 95% CI: (0.16, 0.56)], Tahoua [OR = 0.35, 95% CI: (0.19, 0.65)], Tillabér [OR = 0.17, 95% CI: (0.09, 0.32)] and Zinder [OR = 0.41, 95% CI: (0.22, 0.79)] regions in Niger. **Compared with the Dakar region, the odds for not meeting the requirement for minimum meal frequency was significantly lower in the Dourbel [OR = 0.16, 95% CI: (0.09, 0.28)], Fatick [OR = 0.28, 95% CI: (0.14, 0.55)], Kaolack [OR = 0.54, 95% CI: (0.30, 0.97)], Louga [OR = 0.40, 95% CI: (0.23, 0.71)], Matam [OR = 0.26, 95% CI: (0.15, 0.45)], Saint-Loius [OR = 0.17, 95% CI: (0.09, 0.32)], Tambacounda [OR = 0.39, 95% CI: (0.21, 0.73)] and Thiès [OR = 0.21, 95% CI: (0.11, 0.40)] regions in Senegal.

children whose mothers perceived them to be small at birth (Niger). As minimum acceptable diet is a composite indicator comprising minimum dietary diversity and minimum meal frequency, one would have expected an overlap in the factors that influence minimum dietary diversity and minimum meal frequency in minimum acceptable diet. The absence of a clear overlap of these indicators calls for future research.

Discussion

Complementary feeding indicators were used as the main outcome variables in this study and in other papers included in the present series of articles. Various countries can improve complementary feeding practices by effectively addressing factors that posed risks to optimal complementary feeding practices. The main factors that posed risks to optimal complementary feeding in the seven francophone West African countries were child's age, geographical/administrative region, access to the media, household wealth, mothers' work status, access to health facility, perceived size of the child at birth and the type of residence (rural or urban).

Our study had several strengths. Firstly, the DHS data for the seven countries were all constructed from population-based surveys. The surveys used

Table 5. Factors associated with not meeting the requirements for minimum acceptable diet among children aged 6–23 months across seven francophone West African countries. Adjusted odds ratios by multivariate logistic regression analysis (2006–2012)

Country	Variable	Odds ratio	95% confidence interval	*P*-value
Benin	Age of child (months)			
	6–11	1.00		
	12–17	0.70	[0.54, 0.90]	0.006
	18–23	0.92	[0.71, 1.19]	0.525
	Administrative region	See details below*		
	Antenatal clinic visits			
	None	1.00		
	1–3	0.37	[0.21, 0.65]	0.001
	4+	0.34	[0.20, 0.57]	<0.001
	Birth order			
	First-born	1.00		
	2nd–4th	0.81	[0.62, 1.06]	0.122
	5th or higher	0.68	[0.50, 0.92]	0.013
	Mother listened to the radio			
	No	1.00		
	Yes	0.57	[0.45, 0.74]	<0.001
	Mother's working status			
	Non-working	1.00		
	Working (past 12 months)	0.66	[0.50, 0.87]	0.003
	Type of delivery assistance			
	Health professional	1.00		
	Traditional birth attendant	0.39	[0.21, 0.72]	0.003
	Other untrained personnel	1.03	[0.72, 1.48]	0.859
	Child had fever (last 2 weeks)			
	No	1.00		
	Yes	0.73	[0.54, 0.99]	0.045
Burkina Faso	Age of child (months)			
	6–11	1.00		
	12–17	0.35	[0.20, 0.61]	<0.001
	18–23	0.32	[0.17, 0.59]	<0.001
	Father's education			
	No schooling	1.00		
	Primary	0.61	[0.33, 1.14]	0.121
	Secondary and higher	0.47	[0.23, 0.96]	0.037
	Mother's literacy			
	No	1.00		
	Yes	3.39	[1.59, 7.25]	0.002
	Mother read newspaper/ magazine			
	No	1.00		
	Yes	0.26	[0.10, 0.62]	0.003
	Father's occupation			
	Non-agricultural	1.00		
	Agricultural	1.96	[1.19, 3.24]	0.008
	Mother watched television			
	No	1.00		
	Yes	0.47	[0.29, 0.77]	0.003
	Geographical region	See details below†		
Cote d'Ivoire	Household Wealth Index			
	Poor	1.00		
	Middle	0.45	[0.21, 0.96]	0.040
	Rich	0.29	[0.12, 0.70]	0.006
	Geographical region	See details below‡		
	Father's occupation			
	Non-agricultural	1.00		
	Agricultural	0.48	[0.19, 1.23]	0.126
	Not working	0.33	[0.12, 0.90]	0.030

Table 5. Continued

Country	Variable	Odds ratio	95% confidence interval	*P*-value
Guinea	Age of child (months)			
	6–11	1.00		
	12–17	0.58	[0.23, 1.51]	0.266
	18–23	0.37	[0.17, 0.82]	0.014
	Source of drinking water			
	Unprotected	1.00		
	Protected	0.40	[0.17, 0.98]	0.044
	Household Wealth Index			
	Poor	1.00		
	Middle	0.41	[0.15, 1.11]	0.079
	Rich	0.24	[0.11, 0.55]	0.001
	Father's occupation			
	Non-agricultural	1.00		
	Agricultural	0.04	[0.00, 0.49]	0.011
	Not working	0.40	[0.18, 0.92]	0.032
Mali	Mother's age (years)			
	15–24	1.00		
	25–34	0.33	[0.16, 0.69]	0.003
	35–49	0.55	[0.21, 1.39]	0.203
	Mother listened to the radio			
	No	1.00		
	Yes	0.41	[0.17, 0.96]	0.040
	Mother's working status			
	Non-working	1.00		
	Working (past 12 months)	0.36	[0.17, 0.76]	0.007
	Household Wealth Index			
	Poor	1.00		
	Middle	1.64	[0.89, 3.00]	0.110
	Rich	0.35	[0.14, 0.86]	0.023
Niger	Age of child (months)			
	6–11	1.00		
	12–17	0.39	[0.26, 0.60]	<0.001
	18–23	0.72	[0.42, 1.25]	0.24
	Mother's marital status			
	Currently married	1.00		
	Formerly married	4.05	[1.26, 12.97]	0.019
	Birth order of child			
	First-born	1.00		
	2nd–4th	0.50	[0.28, 0.88]	0.016
	5th or higher	0.58	[0.32, 1.03]	0.063
	Mother's education			
	No schooling	1.00		
	Primary	0.50	[0.29, 0.87]	0.015
	Secondary and higher	0.16	[0.06, 0.44]	<0.001
	Mother's literacy			
	No	1.00		
	Yes	3.19	[1.40, 7.24]	0.006
	Father's occupation			
	Non-agricultural	1.00		
	Agricultural	0.52	[0.33, 0.81]	0.004
	Perceived size of baby			
	Small	1.00		
	Average	0.56	[0.34, 0.94]	0.028
	Large	0.52	[0.29, 0.95]	0.032
	Residence			
	Urban	1.00		
	Rural	3.10	[1.98, 4.87]	<0.001

Table 5. Continued

Country	Variable	Odds ratio	95% confidence interval	*P*-value
Senegal	Age of child (months)			
	6–11	1.00		
	12–17	0.64	[0.46, 0.89]	0.009
	18–23	1.27	[0.77, 2.09]	0.356
	Residence			
	Urban	1.00		
	Rural	1.90	[1.13, 3.19]	0.016
	Mother watched television			
	No	1.00		
	Yes	0.59	[0.39, 0.89]	0.013

*Compared with the Alibori region, the odds for not meeting the requirements for minimum acceptable diet was significantly lower in the Borgou [OR = 0.40, 95% CI: (0.18, 0.89)], Littoral [OR = 0.41, 95% CI: (0.19, 0.92)], Quémé [OR = 0.42, 95% CI: (0.19, 0.93)] and Zou [OR = 0.43, 95% CI: (0.19, 0.96)] regions in Benin. †Compared with the Boucle Mouhoun region, the odds for not meeting the minimum acceptable diet requirement was significantly higher in Centre Est [OR = 5.00, 95% CI: (1.10, 22.81)] and lower in Centre-Sud [OR = 0.20, 95% CI: (0.09, 0.47)] regions in Burkina Faso. ‡Compared with the Centre region, the odds for not meeting the requirement for minimum acceptable diet was significantly lower in the Centre-Nord [OR = 0.19, 95% CI: (0.04, 0.92)] region in Cote d'Ivoire.

standardised methods that yielded high individual and household response rates. Secondly, our analyses used the recently recommended WHO infant feeding indicators (WHO 2010). To the best of our knowledge, these indicators have never been analysed for the seven countries considered in this study. The indicators could be of immense help in guiding the development of appropriate programmes to improve complementary feeding in the seven francophone West African countries studied. Thirdly, our study was able to determine the most susceptible age bracket as well as the modifiable factors that affect suboptimal complementary feeding practices in large sample sizes, which allowed for control of confounders. Policy makers and researchers can use these results to design interventions aimed at improving infant and young child feeding practices in these francophone West African countries.

One limitation of our study, however, was that because of the cross-sectional nature of the survey design, cause and effect relationships could not be established. Another limitation of this study was that variables used to measure household- and community-level factors were limited. Our study also relied on a 24-h recall by mothers of different types of food groups and the frequency with which these foods were administered. The past feeding experience of infants may not have been accurately reflected. Prospective data collection to address these limitations should be considered in future studies.

Our study found that one of the factors that significantly posed a risk to non-introduction of solid, semi-solid or soft foods was a low level of maternal education, particularly in Mali. This finding is consistent with previous studies (Kabir *et al*. 2012; Senarath *et al*. 2012). In the short term, programmes designed to improve timely complementary feeding practices should target families with no or low levels of education. In the long term, better complementary feeding practices can be realised from higher levels of education as a result of improvements in education. A previous study (Arimond & Ruel 2004) found that the effect of mothers' education on child nutritional status is conditioned by the availability of resources at the household level and that only households that have access to at least a minimum level of resources can boast of improved child nutrition. We found that children born to non-working mothers were at a higher risk of not meeting the requirement for timely complementary feeding compared with those whose mothers were engaged in paid work. This refers particularly to Burkina Faso and Niger. The reason for this risk factor may be that as the mothers do not work outside the home, they have more time at their

disposal and would continue to breastfeed the child without thinking of giving them complementary foods. On the other hand, working mothers have to introduce timely complementary feeding so that they can go to work without the child having to rely on breast milk. This finding was contrary to a finding in a previous study in Nepal (Senarath *et al*. 2012) in which working mothers rather were associated with delayed introduction of complementary feeding.

The risk of delayed introduction of solid, semi-solid or soft foods was higher among children whose mothers had limited access to the television, particularly in Burkina Faso. This indicated that limited access to the media is a risk for non-introduction of complementary feeding among children in some of the francophone West African countries. Similar findings have been reported in previous studies in Tanzania (Victor *et al*. 2012) and India (Patel *et al*. 2012; Senarath *et al*. 2012). The impact of television on improving introduction of solid foods could be related to the standard of living as well as improved awareness (because of educational health messages channelled through media) among mothers who have access to the media (Patel *et al*. 2012).

Dietary diversity is associated with the overall dietary quality, micronutrient intake of young children, household food security and better nutritional status of children in developing countries (Tulloch 1999; Hatløy *et al*. 2000; Arimond & Ruel 2004; Sawadogo *et al*. 2006; Steyn *et al*. 2006; Kennedy *et al*. 2007; Moursi *et al*. 2008). It is therefore an important component of infant and young child feeding. One factor that posed risk for not meeting the minimum dietary diversity criterion among children in all seven countries in our study was the youngest age bracket (6–11 months) of children. This finding showed that older children were more likely to meet the minimum dietary diversity compared with their younger counterparts; our finding is similar to that reported in previous studies in India (Patel *et al*. 2012), Bangladesh (Kabir *et al*. 2012), Indonesia (Ng *et al*. 2012) and Tanzania (Victor *et al*. 2012). One possible reason for this scenario may be that some mothers might perceive their 6–11-month-old children as being too 'small' to be fed foods other than breast milk. This stance by mothers could have negative implications for IYCF programmes in the different countries as the children in this age bracket are the ones who would benefit most from early identification and encouragement of their mothers to introduce solid foods by 6–8 months (Dewey & Brown 1998). Mothers should therefore be encouraged to feed their infants with solid and semi-solid foods once they attain the age of 6 months, and should not assume that such infants are too small to eat such foods. Our study found that children in Benin and Senegal whose mothers did not make any antenatal clinic visits were at a significantly higher risk of not meeting the requirement for minimum dietary diversity. There is evidence from the literature to support this finding (Patel *et al*. 2012). In a number of previous studies, low maternal education and mothers' illiteracy have been linked to poor dietary diversity rates among children (Kabir *et al*. 2012; Ng *et al*. 2012; Patel *et al*. 2012). This was supported by our study in which children in Cote d'Ivoire, Niger and Senegal whose mothers had no schooling at all had a significantly higher risk of not meeting the minimum dietary diversity criterion compared with those whose mothers attained secondary education or higher. The risk of not meeting minimum dietary diversity was significantly higher among children born to illiterate mothers in Guinea. Consistent with previous studies (Patel *et al*. 2012) (Joshi *et al*. 2012), this study found limited access to the media (newspaper/magazine, radio and television) was significantly associated with poor dietary diversity; children in Benin and Burkina Faso whose mothers did not have access to the radio had a higher risk of not meeting the dietary diversity requirement. The risk of not meeting the minimum dietary diversity criterion was significantly higher among children in Benin and Burkina Faso whose mothers did not have access to television.

Recent studies from Bangladesh (Kabir *et al*. 2012), India (Patel *et al*. 2012), Indonesia (Ng *et al*. 2012), Nepal (Joshi *et al*. 2012) and Tanzania (Victor *et al*. 2012) have revealed large regional variations of complementary feeding practices. Our study also found significant regional variations in dietary diversity rates among children in Benin, Burkina Faso, Cote d'Ivoire, Mali and Niger.

Our study found that with the exception of Guinea and Senegal, children in the youngest age bracket (6–11 months) in the rest of the countries showed a significantly higher risk of not meeting the requirement for minimum meal frequency compared with their counterparts in the oldest age bracket (18–23 months). This is consistent with previous studies in Bangladesh (Kabir *et al*. 2012), India (Patel *et al*. 2012) and Indonesia (Ng *et al*. 2012). However, a recent study in Tanzania (Victor *et al*. 2012) made a finding that was contrary to ours. That study found that children in the highest age bracket (18–23 months) had a higher risk of not meeting the minimum meal frequency requirement. Consistent with recent studies in India (Patel *et al*. 2012) and Indonesia (Ng *et al*. 2012), this study found that children in Benin and Burkina Faso whose mothers were not engaged in paid employment had a significantly high risk of not meeting the requirement for minimum meal frequency. Children in Niger and Benin whose mothers did not have access to the radio, those in Guinea whose mothers had no access to television and those in Mali whose mothers did not have access to magazine/newspaper had a significantly higher risk of not meeting the minimum meal frequency requirement. Similar findings have been found in previous surveys in India (Patel *et al*. 2012) and Indonesia (Ng *et al*. 2012). We found large variations in minimum meal frequency requirements across the administrative/geographical regions of all the countries except Mali, which is consistent with findings from recent studies in Tanzania (Victor *et al*. 2012), Bangladesh (Kabir *et al*. 2012), Indonesia (Ng *et al*. 2012) and India (Patel *et al*. 2012).

According to the present analysis, children in the youngest age bracket (6–11 months) in Benin and Burkina Faso, Guinea, Niger and Senegal had a significantly high risk of not meeting the requirement for minimum acceptable diet. This finding is consistent with findings from previous studies in India (Patel *et al*. 2012), Indonesia (Ng *et al*. 2012) and Bangladesh (Kabir *et al*. 2012). This may be due to a delay in introducing solid foods, infrequent feeding or lack of diversity in the child's diet. A recent survey in India (Patel *et al*. 2012) found that children whose mothers had no access to the mass media had a significantly high risk of not meeting the minimum acceptable diet requirement. This was confirmed by our study in which children whose mothers had limited access to the television (Burkina Faso and Senegal), those whose mothers had limited access to newspapers and/or magazines (Burkina Faso) and those whose mothers had limited or no access the radio (Benin and Mali) had a significantly high risk of not meeting the minimum acceptable diet rate. We found in our study that children from poor households (Cote d'Ivoire, Guinea and Mali) had a significantly high risk of not meeting the minimum acceptable diet requirement. Similar findings have been found in recent studies in Tanzania (Victor *et al*. 2012) and India (Patel *et al*. 2012). Large variations in meeting the minimum acceptable diet requirement across the various administrative/geographical regions of Benin, Burkina Faso and Cote d'Ivoire were found in this study. These are consistent with findings from previous surveys in Indonesia (Ng *et al*. 2012), Tanzania (Victor *et al*. 2012), Bangladesh (Kabir *et al*. 2012) and India (Patel *et al*. 2012).

One of the most prominent findings in this study was the large regional variations in the four complementary feeding indicators among children from all seven countries. These variations across the countries could be as a result of different cultural feeding practices as well as different levels of maternal education (Kabir *et al*. 2012; Ng *et al*. 2012). A recent study found that cultural beliefs that prohibit young children from eating some selected nutritious foods (Paul *et al*. 2011) may also contribute to variation in complementary feeding patterns. The variations may also be due to different agro-ecological characteristics, ethnicity and taboos in the various countries (Victor *et al*. 2012). This calls for educational strategies to change some of the beliefs that hamper the implementation of optimal complementary feeding practices in different administrative regions in the various countries. Limited access to the mass media (radio, television and newspapers/magazines) was another factor that posed risk to optimal complementary feeding practices in most of the countries studied. This may be due to household poverty or proximity to these resources. For mothers who reside in areas where there is no television coverage or newspapers,

information, education and community materials in the form of brochures and leaflets about optimal complementary feeding could be made available in all health facilities for easy accessibility to mothers/caregivers (Victor *et al*. 2012). Mothers/caregivers who reside in areas where there is access to radio and television should be encouraged to patronise programmes that are tailored to teach them about optimal complementary feeding practices. Stakeholders and other non-governmental organisations should consider training people to become ITCF practices professionals. These professionals should operate separately from the traditional health facilities and mothers could visit such facility not to treat a child of a sickness but just to learn more about optimal complementary feeding practices.

As the youngest age bracket (6–11 months) seemed to be a risk factor to optimal complementary feeding in almost all six countries, mothers/caregivers should be mentored to pay particular attention to this age bracket when it comes to feeding the child with foods other than breast milk.

Conclusion

Our study revealed that complementary feeding practices among children aged 6–23 months were not optimal across the seven francophone West African countries (all the four complementary feeding indicators in all the countries had less than 90% coverage). The factors that posed risks to optimal complementary feeding practices in these countries were identified. Nutrition education interventions to improve child feeding in these countries should target these risk factors.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Contributions

A.I.I. designed the study, performed the analysis and prepared the manuscript; K.E.A. provided advice on the study design and data analysis. P.L.B., A.N.P., G.J.S. and M.J.D. provided revision of the final manuscript. All authors read and approved the manuscript.

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