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Original Article

Maternal and child dietary patterns and their determinants in Nigeria

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Abstract

Understanding the overall dietary patterns of a population is a key step in initiating appropriate nutritional interventions and policies. Studies characterising the dietary patterns of Nigerian mothers and children are lacking. Complete dietary data for 13 566 mothers and their 13 506 children were analysed from the 2008 Nigerian Demographic and Health Surveys (NDHS), a nationally representative sample, to identify the overall maternal and child dietary patterns and to study the potential determinants of such dietary patterns. The 2008 NDHS included questions that inquired about the food items mothers and their children had consumed during the 24 h preceding the day of the interview. Factor analysis with the principal component procedure was used to construct the dietary patterns, and multiple multilevel logistic regression was used to investigate the determinants of the dietary patterns. Four ('mixed', 'traditional', 'staple foods and milk products' and 'beverages') and five ('mixed', 'selective', 'beverages and candies', 'gruels, grains and semi-solids' and 'infant formula and cereals') distinct dietary patterns were obtained for the mothers and children, respectively. The key determinants of both maternal and child dietary patterns were month of interview, religion, region of residence, maternal education, maternal occupation, wealth index and maternal body mass index. Marital status additionally predicted maternal patterns, while sex of the child, number of siblings, child's age, maternal age and place of residence additionally determined the child's patterns. This study has identified four and five different dietary patterns to characterise the dietary habits of Nigerian mothers and their children, respectively, and has shown the important socio-economic/demographic factors influencing the dietary patterns, which can guide appropriate nutritional interventions among Nigerian mothers and children.

Keywords: dietary patterns, mother, child, socio-economic/demographic factors, Nigeria, Demographic and Health Surveys.

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Introduction

The nutritional status of the mother and child has been linked to immediate and long-term health effects (Moore 1998; Wells 2003; Knip & Akerblom 2005; Prentice & Moore 2005; Wells *et al*. 2007). An important component of the Millennium Development Goals is the improvement of maternal and child nutritional status (UNICEF 2009). In many developing country settings, undernutrition remains prevalent and is the cause of a number of diseases, particularly among children in these settings (Black *et al*. 2008; UNICEF 2009). In Nigeria, malnutrition contributes to over 50% of mortality among children

under the age of 5 years. In addition, poor feeding practices, inadequate food intake and micronutrient intake are major direct causes of morbidity and mortality among Nigerian mothers and children (African Nutrition Chartbooks 2004).

Although the role of individual nutrient components and foods in the risk of health outcomes is important, and has been well studied, recent perspectives indicate that the overall dietary patterns of a population may be a more important indicator of the population health status (McCann *et al*. 2001; Hu 2002; Hoffmann *et al*. 2004). Consequently, understanding the overall dietary patterns of a population and the factors influencing such patterns will have significant implications in targeting appropriate nutritional interventions and policies (Sonnenberg *et al*. 2005; Sharma *et al*. 2008).

The dietary patterns of Nigerian mothers and children have not been previously characterised. This study utilises the opportunity offered by the 2008 Nigerian Demographic and Health Surveys (NDHS), a nationally representative sample, to study the overall dietary patterns of Nigerian mothers and their children and to investigate the socio-economic/demographic factors influencing the observed dietary patterns.

Materials and methods

Study design and subjects

The present analysis was based on the data from the 2008 NDHS, a national survey implemented by the Nigerian National Population Commission. The aim of the survey was to provide up-to-date data on a number of health issues in the population, including fertility, family planning methods, nutritional status, child and maternal mortality, awareness and behaviour regarding HIV/AIDS, and others. The full report of the 2008 NDHS has been presented elsewhere [National Population Commission (NPC) (Nigeria) and ICF Macro 2009]. Ethics approval for the survey was obtained from the Nigerian National Health Research Ethics Committee and informed consent was obtained from all participants.

The survey involved randomly selected households in all the six geopolitical zones of Nigeria, covering the 36 states of the federation. The sample for the survey was implemented using a stratified two-stage cluster design involving 888 sampling units (286 in the urban and 602 in the rural areas). From these sampling units, 36 800 households were selected for the survey, and a minimum of 950 completed the interviews in each state, with a proportionate distribution of the households among the urban and rural areas of the state. The second stage of the survey involved the selection of an average of 41 households in each sampling unit, using equal probability systematic sampling. All women aged 15–49 who were either permanent residents of the households or visiting the households on the night prior to the survey were eligible for interview. In a subsample of half of the households, all men aged 15–59 who were either permanent residents of the households or visiting the households on the night prior to the survey were also eligible for interview. Data were also collected for children aged 0–5 years in the household. The response rate for the interview for the households, women and men were 98% (of 34 644), 97% (of 34 596) and 93% (of 16 722), respectively.

Key messages

- Studies describing maternal and child dietary patterns in Nigeria are lacking.
- In a nationally representative sample, this study identified four and five dietary patterns to characterise the dietary habits of Nigerian mothers and their children, respectively.
- Several socio-economic, demographic, cultural and lifestyle factors were key determinants of the dietary patterns.
- Understanding the dietary patterns of Nigerian women and children and the factors influencing them will guide the formulation of appropriate nutritional interventions, guidelines and policies.

Table 1. Number and proportion of mothers and children consuming different food items during the day and night preceding the day of the interview by current breastfeeding and pregnancy status: The 2008 Nigerian Demographic and Health Surveys

Foods ate during the day and night preceding the interview	Mother, $N = 13\,556$						Child, $N = 13\,506$		
	n (%)						*n* (%)		
	Breastfeeding			Pregnant			Being breastfed		
	Yes	No	*P*-value*	Yes	No	*P*-value*	Yes	No	*P*-value*
	$n = 8889$	$n = 4667$		$n = 1495$	$n = 12\,061$		$n = 8939$	$n = 4567$	
Tinned or fresh milk	2303 (26)	1297 (28)	0.022	406 (27)	3194 (26)	0.822	2093 (23)	1435 (31)	<0.001
Tea or coffee	2177 (24)	1331 (29)	<0.001	386 (26)	3122 (26)	0.997	1180 (13)	1350 (30)	<0.001
Bread, noodles or other grain foods	7325 (82)	3882 (83)	0.014	1231 (82)	9976 (83)	0.679	4065 (45)	3685 (81)	<0.001
Potatoes, cassava or other tubers	3622 (41)	2104 (45)	<0.001	671 (45)	5055 (42)	0.089	1612 (18)	1846 (40)	<0.001
Eggs	1447 (16)	876 (19)	0.001	287 (19)	2036 (17)	0.081	938 (10)	1009 (22)	<0.001
Meats (beef, pork, lamb, chicken)	3265 (37)	1951 (42)	<0.001	617 (41)	4599 (38)	0.029	1367 (15)	1719 (38)	<0.001
Pumpkins, carrots, yellow or orange squash	1821 (20)	1010 (22)	0.289	338 (23)	2493 (21)	0.198	772 (9)	823 (18)	<0.001
Dark green leafy vegetables	5050 (57)	2774 (59)	0.007	863 (58)	6961 (58)	0.767	2356 (26)	2422 (53)	<0.001
Mangoes, papayas or other vitamin A-based fruits	1548 (17)	876 (19)	0.144	261 (17)	2163 (18)	0.315	629 (7)	723 (16)	<0.001
Other fruits	2756 (31)	1694 (36)	<0.001	548 (37)	3902 (32)	0.002	1304 (15)	1548 (34)	<0.001
Liver, heart or other inside organs of meats	1252 (14)	712 (15)	0.171	212 (14)	1752 (15)	0.882	498 (6)	614 (13)	<0.001
Fish or shellfish	4078 (46)	2475 (53)	<0.001	731 (49)	5822 (48)	0.882	2080 (23)	2305 (50)	<0.001
Beans, peas, lentils, nuts	3578 (40)	1958 (42)	0.152	592 (40)	4944 (41)	0.440	1907 (21)	1827 (40)	<0.001
Cheese, yogurt or other milk products	1846 (21)	886 (19)	0.043	288 (19)	2444 (20)	0.345	1091 (12)	842 (18)	<0.001
Oils, fats, butters or other products made from them	2968 (33)	1758 (38)	<0.001	512 (34)	4214 (35)	0.849	1572 (18)	1593 (35)	<0.001
Chocolates, sweets, candies, pastries or related products	1179 (13)	706 (15)	0.007	213 (14)	1672 (14)	0.191	1371 (15)	1521 (33)	<0.001
Infant formula	–	–		–	–		497 (6)	171 (4)	<0.001
Infant cereals	–	–		–	–		504 (7)	202 (4)	<0.001
Porridges or other gruels	–	–		–	–		4352 (49)	2607 (57)	<0.001
Other solids or semi-solids	–	–		–	–		4451 (50)	3211 (70)	<0.001

**P*-values based on the Pearson chi-square test.

Assessment of maternal and child food consumption

The survey utilised three types of questionnaires: the household questionnaire, the women's questionnaire and the men's questionnaire. The questionnaires were pre-tested before the actual survey. The women's questionnaire was used to collect information on all women aged 15–49 and on their children, and the present analysis utilised the data gathered from that questionnaire. The women's questionnaire included questions that inquired about the foods the mother and child had eaten during the day and night preceding the day of the interview. The food consumption questions were asked only to mothers who had children under the age of 3 years and to their youngest children under 3 years of age who were living with their mothers. The food consumption questions involved a list of several food items (Table 1) and mothers were asked whether a food item was consumed or not. Consequently, only qualitative responses were gathered: the subjects answered 'yes'

if they consumed the food item and 'no' if the food item was not eaten or 'I do not know' if they were not sure. In total, 13 556 mothers and 13 506 children had complete dietary data.

Statistical analysis

The Pearson chi-square test was used to examine the distribution of maternal and child food consumption during the previous 24 h by current breastfeeding and pregnant status. To construct the dietary patterns, the food items were subjected to factor analysis using principal component analysis (PCA) as the extraction procedure. Varimax rotation with Kaiser normalization was used for the final step of interpreting the patterns. Eigenvalue >1 was used as the criteria for extracting the important dietary patterns. In interpreting the patterns, a food item was said to load on a pattern if its factor loading for that pattern was greater or equal to 0.40. Factor-based scores for the patterns were created by summing the values of the subject on the food items loading on a pattern and weighting this total value by the factor scores of the corresponding pattern. The dietary patterns were constructed for the whole study population, but because initial distributions showed some differences in food consumption between breastfeeding mothers/children and non-breastfeeding mothers/children (Table 1), we also examined separate dietary patterns for each of these groups. The generalizability of results of the factor analysis was validated by randomly dividing the study population into two halves and conducting separate PCA on each sample. The results from each of the samples were the same and similar to the results of the whole study population. The reliability of the food items loading on each dietary pattern was examined by calculating the Cronbach's alpha. The alpha value for each of the food items loading on each dietary pattern was ≥ 0.60.

To investigate the important socio-economic/demographic determinants of maternal and child dietary patterns, we applied multilevel logistic regression models, in order to account for the hierarchical nature of the data. All the studied covariates were simultaneously adjusted in a multiple regression model. As the outcome of interest, we modelled the probability of being in the upper median scores of each dietary pattern. The results were similar when the continuous scores were modelled, but the results of the continuous outcome models are not presented because the coefficients are difficult to interpret, considering that scales of the factor scores are usually not meaningful. For simplicity, in examining the determinants of the dietary patterns, we studied only the patterns obtained in the whole study population and not those from the strata of breastfeeding status, but all models were adjusted for current breastfeeding and pregnancy status. The covariates considered were: maternal use of tobacco or tobacco products, parity, month of interview, maternal age, maternal body mass index (BMI), religion, maternal occupation, marital status, number of household members, place of residence, region of residence, maternal education, and wealth index. The models for children additionally included sex of child, age of child and number of older siblings replaced parity. We fitted a two-level model (individuals as level 1 and sampling units as level 2). The results are presented as odds ratios and accompanied by their respective 95% confidence intervals. Statistical significance was set at $P < 0.05$. The random parts of the models are presented as the variance and standard deviation. All statistical analyses were performed by using STATA 11 (StataCorp LP, College Station, TX, USA); the GLLAMM procedure in STATA was used to fit the multilevel models.

Results

Characteristics of the study population

The distribution of the characteristics of the mothers who responded to the food consumption questionnaire is shown in Table 2 (second column). Of note is that only 1% of the mothers had used any tobacco product; more of them (36%) had five or more children; majority (69%) was between the ages of 20 and 34 years; majority was of normal weight (64%); more than half were Muslims (56%); almost all were married or living together with their partners (97%); majority was living in the rural areas (73%); and the smallest proportion of the women was from the south-eastern region of the country (8%) (Table 2).

Table 2. Determinants of dietary patterns of Nigerian mothers: The 2008 Nigerian Demographic and Health Surveys

	$N = 13\,556$	Adjusted OR (95% CI) for being on the upper median score of the dietary patterns*†			
		Mixed ($n = 4837$)‡	Traditional ($n = 6290$)‡	Staple foods and milk products ($n = 6203$)‡	Beverages ($n = 4552$)‡
Uses tobacco					
No	1 3341 (99)	1	1	1	1
Yes	72 (1)	1.00 (0.56–1.76)	0.91 (0.51–1.62)	0.98 (0.53–1.83)	1.06 (0.56–1.99)
Missing information	33 (0)				
P-value		0.988	0.739	0.955	0.867
Parity					
One	2383 (18)	1	1	1	1
Two	2298 (17)	0.90 (0.76–1.05)	0.99 (0.84–1.18)	1.06 (0.90–1.24)	0.95 (0.80–1.22)
Three	2084 (15)	0.94 (0.79–1.11)	1.02 (0.85–1.23)	1.11 (0.93–1.32)	0.83 (0.70–1.00)
Four	1844 (14)	0.89 (0.73–1.07)	0.96 (0.79–1.18)	0.97 (0.80–1.17)	1.04 (0.85–1.26)
Five+	4947 (36)	0.92 (0.76–1.12)	1.09 (0.89–1.33)	1.10 (0.91–1.34)	0.92 (0.75–1.12)
P-value		0.335	0.422	0.456	0.234
Month of interview					
June	1363 (10)	1	1	1	1
July	3749 (28)	0.71 (0.55–0.91)	0.90 (0.70–1.17)	1.00 (0.76–1.31)	0.84 (0.65–1.08)
August	3968 (29)	0.62 (0.48–0.81)	1.00 (0.77–1.29)	1.11 (0.84–1.46)	0.73 (0.56–0.94)
September	2729 (20)	0.55 (0.42–0.72)	1.13 (0.87–1.47)	0.92 (0.70–1.23)	0.62 (0.47–0.81)
October/November	1747 (13)	0.72 (0.54–0.96)	1.20 (0.90–1.60)	0.92 (0.68–1.26)	0.70 (0.52–0.93)
P-value		<0.001	0.102	0.463	0.004
Maternal age, years					
15–19	1069 (8)	1	1	1	1
20–24	2868 (21)	1.05 (0.87–1.26)	0.96 (0.79–1.17)	0.86 (0.71–1.03)	1.08 (0.89–1.31)
25–29	3835 (28)	1.00 (0.82–1.22)	0.95 (0.77–1.17)	0.81 (0.67–0.99)	1.06 (0.86–1.30)
30–34	2731 (20)	1.07 (0.86–1.34)	0.95 (0.75–1.20)	0.81 (0.65–1.01)	1.05 (0.83–1.32)
35–39	1859 (14)	1.03 (0.81–1.32)	0.89 (0.69–1.16)	0.80 (0.63–1.01)	0.92 (0.71–1.18)
40–44	841 (6)	0.73 (0.55–0.97)	0.78 (0.58–1.05)	0.80 (0.61–1.05)	0.87 (0.65–1.16)
45–49	353 (3)	0.94 (0.67–1.32)	0.95 (0.67–1.36)	0.69 (0.50–0.97)	1.10 (0.77–1.57)
P-value		0.022	0.686	0.443	0.316
Maternal body mass index					
<18.5	1665 (12)	1	1	1	1
18.5–24.49	8616 (64)	0.89 (0.78–1.01)	1.17 (1.02–1.35)	0.99 (0.87–1.12)	1.00 (0.88–1.15)
≥25	2577 (19)	0.93 (0.79–1.10)	1.15 (0.97–1.36)	1.00 (0.85–1.17)	1.22 (1.03–1.43)
Missing information	698 (5)				
P-value		0.173	0.091	0.974	0.004
Religion					
Christianity	5587 (41)	1	1	1	1
Islam	7631 (56)	1.34 (1.14–1.57)	0.74 (0.63–0.87)	1.22 (1.03–1.43)	1.75 (1.48–2.07)
Traditional or others	264 (2)	1.17 (0.84–1.63)	0.95 (0.68–1.34)	0.73 (0.51–1.05)	0.93 (0.63–1.38)
Missing information	74 (1)				
P-value		0.002	0.001	0.006	<0.001
Maternal occupation					
Unemployed	4479 (33)	1	1	1	1
Trader	4136 (30)	1.08 (0.97–1.21)	1.18 (1.04–1.33)	1.17 (1.05–1.31)	1.11 (0.99–1.24)
Others§	4869 (36)	0.99 (0.88–1.11)	1.14 (1.01–1.28)	1.17 (1.04–1.31)	0.84 (0.74–0.94)
Missing information	72 (1)				
P-value		0.239	0.019	0.006	<0.001
Marital status					
Unmarried¶	589 (4)	1	1	1	1
Married**	1 2966 (97)	1.13 (0.91–1.41)	1.10 (0.88–1.38)	1.11 (0.89–1.39)	1.33 (1.06–1.68)
Missing information	1 (0)	0.259	0.408	0.335	0.016
P-value					

Table 2. Continued

	N = 13 556	Adjusted OR (95% CI) for being on the upper median score of the dietary patterns*†			
		Mixed (*n* = 4837)‡	Traditional (*n* = 6290)‡	Staple foods and milk products (*n* = 6203)‡	Beverages (*n* = 4552)‡
Number of household members					
≤3	1701 (13)	1	1	1	1
4–5	4003 (29)	1.09 (0.93–1.29)	0.94 (0.79–1.12)	1.08 (0.92–1.27)	1.10 (0.93–1.30)
6–8	4514 (33)	1.13 (0.96–1.33)	1.02 (0.86–1.22)	1.15 (0.98–1.36)	1.00 (0.84–1.18)
>8	3338 (25)	1.08 (0.90–1.28)	1.01 (0.84–1.21)	1.08 (0.91–1.29)	0.94 (0.78–1.12)
P-value		0.535	0.589	0.356	0.129
Place of residence					
Urban	3623 (27)	1	1	1	1
Rural	9933 (73)	0.88 (0.73–1.05)	1.06 (0.89–1.27)	1.06 (0.87–1.29)	0.84 (0.70–1.01)
P-value		0.149	0.502	0.549	0.058
Region of residence					
North-central	2371 (17)	1	1	1	1
North-east	3114 (23)	0.29 (0.23–0.37)	0.26 (0.21–0.33)	1.08 (0.83–1.40)	1.01 (0.79–1.30)
North-west	3731 (28)	0.56 (0.44–0.71)	0.14 (0.11–0.18)	1.25 (0.97–1.62)	0.85 (0.67–1.09)
South-east	1104 (8)	1.29 (0.98–1.70)	0.58 (0.44–0.76)	0.30 (0.22–0.41)	0.95 (0.71–1.27)
South-west	1570 (12)	0.59 (0.46–0.77)	1.60 (1.22–2.09)	0.42 (0.32–0.56)	0.97 (0.74–1.27)
South-south	1666 (12)	0.33 (0.26–0.43)	0.95 (0.74–1.22)	2.15 (1.64–2.82)	1.03 (0.80–1.34)
P-value		<0.001	<0.001	<0.001	0.669
Maternal education					
No education	6715 (50)	1	1	1	1
Primary school	3044 (22)	1.13 (0.99–1.29)	1.28 (1.12–1.46)	0.93 (0.82–1.06)	1.15 (1.00–1.32)
Secondary school	3130 (23)	1.20 (1.02–1.40)	1.30 (1.11–1.53)	0.89 (0.76–1.04)	1.66 (1.41–1.95)
Higher education	667 (5)	1.55 (1.20–2.00)	1.28 (0.98–1.67)	1.03 (0.79–1.33)	3.55 (2.71–4.65)
P-value		0.008	0.002	0.321	<0.001
Wealth index					
Poorest	3636 (27)	1	1	1	1
Poorer	3221 (24)	1.09 (0.95–1.25)	1.25 (1.09–1.44)	1.00 (0.88–1.14)	0.91 (0.79–1.05)
Middle	2588 (19)	1.12 (0.96–1.31)	1.71 (1.45–2.02)	0.98 (0.84–1.15)	1.15 (0.97–1.36)
Richer	2283 (17)	1.14 (0.95–1.38)	1.78 (1.47–2.17)	1.29 (1.06–1.56)	2.17 (1.79–2.63)
Richest	1828 (13)	1.28 (1.01–1.61)	1.68 (1.32–2.14)	1.22 (0.96–1.56)	3.80 (3.00–4.83)
P-value		0.342	<0.001	0.016	<0.001

CI, confidence interval; OR, odds ratio. *A multiple multilevel logistic model with simultaneous adjustment for all the covariates. The model was in addition adjusted for current breastfeeding and pregnancy status. †The variance (standard error) for the random part of the models was as follows: mixed 0.71 (0.06); traditional 0.62 (0.06); staple foods and milk products 0.88 (0.07); beverages 0.70 (0.06). ‡The number of those in the upper median score of each dietary pattern. §Includes all other professional occupations. ¶Includes those not married, divorced or not living together in the same household. **Includes those married and cohabiting together with their partners in the same household.

Half of the children were boys; only 1% was of twin birth; and 27% had four or more siblings (data not shown).

Mothers who were not currently breastfeeding were more likely to consume the food items inquired in the questionnaire than breastfeeding mothers, although the relative differences were not substantial (Table 1). There were no differences between pregnant and non-pregnant mothers in food consumption except for the consumption of meats and other fruits. However, except for infant formula and cereals, non-breastfeeding children were more likely to consume all the food items than their breastfeeding counterparts were (Table 1).

Maternal and child dietary patterns

Table 3 shows the dietary patterns obtained from the factor analysis as well as the food items that loaded on the patterns. For the mothers, four dietary patterns

Table 3. Results from the principal component analysis showing the extracted dietary patterns, their eigenvalues and percentage of explained variance: The 2008 Nigerian Demographic and Health Surveys

	Dietary patterns and the food items loading on each dietary pattern*	Eigenvalues of patterns†	% variance of patterns
Mother	*Mixed:*	3.71	14.0
	Eggs; pumpkins, carrots, yellow or orange squash; mangoes, papayas or other vitamin A-based fruits; other fruits; liver, heart or other inside organs of meats; cheese, yogurt, other milk products; chocolates, sweets, candies, pastries or related products		
	Traditional:	1.27	11.0
	Potatoes, cassava or other tubers; meats (beef, pork, lamb, chicken); dark green leafy vegetables; other fruits; fish or shellfish		
	Staple foods and milk products:	1.22	10.3
	Bread, noodles or other grain foods; dark green leafy vegetables; beans, peas, lentils, nuts; cheese, yogurt or other milk products; oils, fats, butters or other products made from them		
	Beverages:	1.08	10.2
	Tinned or fresh milk; tea or coffee		
	Total variance explained by all patterns	–	45.5
Child	*Mixed:*	5.13	15.5
	Bread, noodles or other grain foods; potatoes, cassava or other tubers; meats (beef, pork, lamb, chicken); dark green leafy vegetables; other fruits; fish or shellfish; beans, peas, lentils, nuts; chocolates, sweets, candies, pastries or related products		
	Selective:	1.67	9.7
	Pumpkins, carrots, yellow or orange squash; mangoes, papayas or other vitamin A-based fruits; liver, heart or other inside organs of meats; cheese, yogurt, other milk products		
	Beverages and candies:	1.31	9.7
	Tinned or fresh milk; tea or coffee; eggs; chocolates, sweets, candies, pastries or related products		
	Gruels, grains and semi-liquids:	1.10	8.9
	Porridges and gruels; bread, noodles or other grain foods; beans, peas, lentils, nuts; cheese, yogurt, other milk products; solid and semi-solid foods		
	Infant formula and cereals:	1.01	7.2
	Infant formula; baby cereals		
	Total variance explained by all patterns	–	51.0

*Varimax (orthogonal) rotation with the Kaiser normalisation was used to construct the dietary patterns, which implies that the dietary patterns are uncorrelated. †Eigenvalue >1 was used as the criteria for extracting the dietary patterns.

were obtained, namely, 'mixed', 'traditional', 'staple foods and milk products' and 'beverages' patterns. The 'mixed' pattern contained a mixture of most of the different food items studied. The 'traditional' pattern was high in the local foods produced in the country, whereas the 'staple foods and milk products' pattern contained mostly the foods made from confectionery products. The 'beverages' pattern contained only beverage products. The eigenvalues and the variance in food consumption explained by each of the patterns are also shown in Table 3: in total, all the dietary patterns of the mothers accounted for 45.5% of the variance in food consumption.

For the children, five different patterns were obtained, namely, 'mixed', 'selective', 'beverages and candies', 'gruels, grains and semi-solids' and 'infant formula and cereals'. The 'mixed' pattern for the children was similar to that obtained among mothers in terms of the foods it contained. The 'selective' pattern seemed to contain certain foods that are rather not very common. The 'beverages and candies' pattern was also similar to the maternal 'beverages' pattern but in addition contained other food products. The 'gruel, grains and semi-liquids' pattern contained mainly porridges, grains, nuts and some semi-liquid foods. Finally, the 'infant formula and cereals' pattern contained only formula-based foods and baby cereals. In total, the dietary patterns for the children explained 51% of the variance in food consumption (Table 3).

Determinants of maternal and child dietary patterns

Table 2 presents the results of the determinants of maternal dietary patterns. Mothers who had their interview during the months of July–November and those from the north-east, north-west, south-west and south-south regions of the country were less likely to practise the 'mixed' dietary pattern, while it was more likely to be practised by Muslim mothers and mothers with secondary or higher education. The 'traditional' pattern was less likely to be practised by Muslim mothers, mothers from the north-east, north-west and south-east regions, but was more likely to be practised by mothers with trading or other occupation, those from the south-south region, mothers with primary or secondary school education, and mothers in the higher categories of the wealth index. The 'staple foods and milk products' pattern was more likely to be practised by Muslim mothers, traders and those with other occupations, those from the south-south region, and those in the richer category of the wealth index, but was less likely to be practised by those from the south-east and south-west. Participating in the interview during the month of August–November and having other occupations other than trading was associated with less likelihood to practise the 'beverages' pattern, whereas it was more likely to be practised by overweight mothers, married mothers, mothers with any kind of education, and mothers in the richer or richest category of the wealth index (Table 2).

Table 4 presents the results of the determinants of child dietary patterns. Children with one or more siblings, those who were 7 months or older, children whose mothers were traders or had other occupations, those from the south-west and south-south regions, and children in the higher categories of the wealth index were more likely to practise the 'mixed' dietary pattern, while it was less likely to be practised by Muslim children and those from the north-east and north-west regions. Children who were 7 months old or older and those from the south-east region were more likely to practise the 'selective' pattern, but it was less likely to be practised by those who participated in the interview during the months of July–November, those from the north-east, north-west and south-south regions, and those whose mothers had primary school education. The 'beverages and candies' pattern was more likely to be practised by girls, children who were 7 months and older, children of overweight mothers, Muslim children, children whose mothers were traders, children from the south-west and south-south regions, children whose mothers had secondary or higher education, and children in the richer and richest wealth index; whereas it was less likely to be practised by children who participated in the interview during the months of July–November.

The 'gruels, grains and semi-liquids' pattern was more likely to be practised by children who were 7 months or older, those who participated in the interview during the months of August–November, and children whose mothers were traders or of other occupations, but less likely to be practised by children whose mothers were 40–49 years old, those from the north-east, south-east, south-west and south-south regions, and children whose mothers had primary and secondary education. The 'infant formula and cereals' pattern was less likely to be practised by children with two and more siblings, those who were 13 months or older, those who participated in the interview during the months of July–November, Muslim children, those from the rural areas, and those from the north-west and south regions, but more likely to be practised by children who were 7–12 months old, children of overweight mothers, those from the south-east and south-west regions, those whose mothers had any kind of education, and those in the higher categories of the wealth index (Table 4).

Discussion

In this nationally representative sample, we obtained four ('mixed', 'traditional', 'staple foods and milk products' and 'beverages') and five ('mixed', 'selective', 'beverages and candies', 'gruels, grains and semi-solids' and 'infant formula and cereals') distinctive dietary patterns to characterise the food habits of Nigerian mothers and their children, respectively. The dietary patterns for the mothers were similar for breastfeeding and non-breastfeeding mothers, but the patterns obtained for breastfeeding children somewhat differed from non-breastfeeding children. The

Table 4. Determinants of dietary patterns of Nigerian children: The 2008 Nigerian Demographic and Health Surveys

	Adjusted OR (95% CI) for being on the upper median score of the dietary patterns*†				
	Mixed ($n = 5575$)‡	Selective ($n = 3363$)‡	Beverages and candies ($n = 4580$)‡	Gruels, grains and semi-liquids ($n = 6366$)‡	Infant formula and cereals ($n = 1009$)‡
Sex of child					
Boy	1	1	1	1	1
Girl	1.04 (0.94–1.14)	1.00 (0.91–1.10)	1.12 (1.02–1.22)	0.96 (0.88–1.05)	0.87 (0.75–1.02)
P-value	0.443	0.987	0.013	0.370	0.086
Number of older siblings					
None	1	1	1	1	1
One	1.22 (1.02–1.46)	1.03 (0.87–1.22)	0.90 (0.76–1.05)	0.90 (0.77–1.06)	0.81 (0.62–1.04)
Two	1.27 (1.05–1.54)	1.08 (0.89–1.30)	0.90 (0.76–1.08)	1.02 (0.85–1.21)	0.68 (0.51–0.90)
Three	1.25 (1.01–1.55)	1.09 (0.88–1.34)	0.96 (0.79–1.16)	1.23 (1.01–1.50)	0.72 (0.52–1.00)
Four+	1.41 (1.13–1.76)	1.16 (0.93–1.44)	0.92 (0.75–1.13)	1.07 (0.87–1.31)	0.60 (0.42–0.85)
P-value	0.043	0.716	0.691	0.012	0.043
Twin					
No	1	1	1	1	1
Yes	1.06 (0.70–1.61)	0.87 (0.59–1.29)	0.80 (0.55–1.17)	1.24 (0.86–1.80)	1.24 (0.69–2.23)
P-value	0.769	0.491	0.253	0.248	0.465
Child's age, month					
≤6	1	1	1	1	1
7–12	14.88 (12.33–17.96)	4.78 (4.02–5.69)	3.24 (2.82–3.72)	4.82 (4.21–5.51)	1.35 (1.11–1.64)
13–24	38.01 (31.40–46.01)	6.62 (5.6–7.84)	4.17 (3.64–4.78)	6.15 (5.39–7.01)	0.61 (0.48–0.77)
25–35	40.49 (32.12–51.04)	7.26 (5.91–8.92)	4.45 (2.87–4.14)	6.62 (5.54–7.91)	0.29 (0.21–0.42)
P-value	<0.001	<0.001	<0.001	<0.001	<0.001
Uses tobacco					
No	1	1	1	1	1
Yes	1.59 (0.80–3.14)	1.11 (0.60–2.06)	1.00 (0.52–1.89)	0.99 (0.53–1.84)	1.49 (0.51–4.38)
P-value	0.184	0.743	0.988	0.979	0.468
Month of interview					
June	1	1	1	1	1
July	1.04 (0.81–1.34)	0.63 (0.50–0.80)	0.75 (0.59–0.95)	1.25 (0.96–1.64)	0.70 (0.51–0.96)
August	1.06 (0.82–1.36)	0.56 (0.44–0.72)	0.63 (0.50–0.81)	1.43 (1.09–1.88)	0.60 (0.43–0.82)
September	1.17 (0.90–1.52)	0.52 (0.40–0.67)	0.59 (0.46–0.75)	1.48 (1.12–1.96)	0.50 (0.36–0.70)
October/November	1.10 (0.83–1.45)	0.64 (0.49–0.84)	0.62 (0.47–0.82)	1.41 (1.04–1.91)	0.55 (0.38–0.79)
P-value	0.735	<0.001	<0.001	0.046	0.001
Maternal age, years					
15–19	1	1	1	1	1
20–24	0.93 (0.75–1.15)	0.91 (0.74–1.12)	1.02 (0.84–1.24)	0.98 (0.81–1.18)	1.01 (0.72–1.44)
25–29	0.78 (0.62–0.97)	0.97 (0.78–1.21)	1.08 (0.88–1.32)	0.80 (0.65–0.98)	0.90 (0.62–1.30)
30–34	0.78 (0.60–1.00)	0.93 (0.73–1.19)	1.01 (0.80–1.27)	0.81 (0.64–1.01)	1.07 (0.72–1.61)
35–39	0.87 (0.66–1.15)	1.00 (0.76–1.30)	0.95 (0.74–1.22)	0.80 (0.62–1.02)	1.25 (0.81–1.94)
40–44	0.80 (0.58–1.10)	0.79 (0.58–1.08)	0.94 (0.70–1.26)	0.75 (0.57–1.00)	0.75 (0.42–1.33)
45–49	0.90 (0.61–1.31)	0.80 (0.55–1.17)	0.97 (0.68–1.39)	0.64 (0.45–0.91)	1.22 (0.91–1.75)
P-value	0.132	0.362	0.779	0.040	0.157
Maternal body mass index					
<18.5	1	1	1	1	1
18.5–24.49	1.15 (0.99–1.33)	0.92 (0.80–1.07)	0.98 (0.86–1.13)	0.95 (0.83–1.09)	1.26 (0.91–1.75)
≥25	1.17 (0.98–1.41)	0.96 (0.80–1.14)	1.23 (1.04–1.45)	0.94 (0.79–1.11)	1.68 (1.18–2.39)
P-value	0.151	0.512	0.001	0.740	0.001
Religion					
Christianity	1	1	1	1	1
Islam	0.70 (0.59–0.84)	1.18 (0.99–1.40)	1.58 (1.34–1.86)	1.15 (0.97–1.35)	0.72 (0.56–0.94)
Traditional or others	0.85 (0.58–1.24)	1.29 (0.90–1.84)	1.05 (0.72–1.51)	1.18 (0.82–1.72)	0.86 (0.45–1.63)
P-value	<0.001	0.094	<0.001	0.223	0.046

Table 4. Continued

	Adjusted OR (95% CI) for being on the upper median score of the dietary patterns*†				
	Mixed ($n = 5575$)‡	Selective ($n = 3363$)‡	Beverages and candies ($n = 4580$)‡	Gruels, grains and semi-liquids ($n = 6366$)‡	Infant formula and cereals ($n = 1009$)‡
Maternal occupation					
Unemployed	1	1	1	1	1
Trader	1.42 (1.25–1.61)	0.97 (0.86–1.10)	1.20 (1.06–1.34)	1.35 (1.20–1.52)	1.12 (0.91–1.37)
Others§	1.51 (1.33–1.71)	1.01 (0.89–1.15)	0.94 (0.84–1.06)	1.38 (1.22–1.55)	1.01 (0.83–1.24)
P-value	<0.001	0.804	<0.001	<0.001	0.480
Marital status					
Unmarried¶	1	1	1	1	1
Married**	0.80 (0.62–1.03)	1.12 (0.93–1.35)	1.21 (0.96–1.52)	1.07 (0.85–1.34)	0.94 (0.66–1.32)
P-value	0.086	0.353	0.104	0.570	0.709
Number of household members					
≤3	1	1	1	1	1
4–5	1.05 (0.87–1.27)	1.12 (0.88–1.43)	0.90 (0.76–1.06)	1.05 (0.88–1.24)	0.88 (0.67–1.15)
6–8	1.05 (0.87–1.28)	1.08 (0.90–1.30)	0.89 (0.75–1.05)	1.00 (0.84–1.19)	0.96 (0.73–1.27)
>8	1.04 (0.85–1.27)	1.08 (0.88–1.31)	0.83 (0.69–0.99)	1.06 (0.88–1.27)	0.77 (0.56–1.06)
P-value	0.953	0.665	0.246	0.767	0.241
Place of residence					
Urban	1	1	1	1	1
Rural	1.07 (0.89–1.28)	0.88 (0.74–1.04)	0.93 (0.79–1.11)	0.99 (0.82–1.20)	0.74 (0.59–0.93)
P-value	0.466	0.138	0.430	0.942	0.009
Region of residence					
North-central	1	1	1	1	1
North-east	0.74 (0.58–0.93)	0.43 (0.34–0.55)	0.89 (0.70–1.12)	0.65 (0.50–0.84)	0.70 (0.48–1.03)
North-west	0.32 (0.25–0.40)	0.54 (0.43–0.67)	0.97 (0.77–1.22)	0.85 (0.66–1.10)	0.57 (0.39–0.85)
South-east	0.83 (0.63–1.10)	1.33 (1.02–1.73)	1.18 (0.90–1.54)	0.19 (0.14–0.26)	2.78 (2.00–3.86)
South-west	1.65 (1.27–2.15)	0.78 (0.61–1.01)	1.84 (1.44–2.35)	0.33 (0.25–0.44)	2.63 (1.92–3.58)
South-south	1.35 (1.05–1.73)	0.39 (0.31–0.50)	1.91 (1.51–2.42)	0.26 (0.20–0.34)	0.70 (0.50–0.97)
P-value	<0.001	<0.001	<0.001	<0.001	<0.001
Maternal education					
No education	1	1	1	1	1
Primary school	1.14 (0.98–1.32)	0.85 (0.73–0.98)	1.10 (0.96–1.26)	0.84 (0.74–0.96)	1.66 (1.25–2.21)
Secondary school	1.03 (0.86–1.23)	0.94 (0.79–1.12)	1.42 (1.21–1.67)	0.77 (0.66–0.91)	2.09 (1.55–2.81)
Higher education	1.00 (0.75–1.34)	1.15 (0.87–1.51)	2.04 (1.57–2.66)	0.95 (0.73–1.23)	3.41 (2.34–4.97)
P-value	0.309	0.032	<0.001	0.007	<0.001
Wealth index					
Poorest	1	1	1	1	1
Poorer	1.41 (1.22–1.63)	1.01 (0.87–1.17)	0.87 (0.75–1.00)	0.96 (0.84–1.10)	2.07 (1.42–3.03)
Middle	1.45 (1.22–1.72)	0.98 (0.83–1.17)	1.08 (0.91–1.27)	0.86 (0.73–1.02)	2.93 (2.01–4.27)
Richer	1.79 (1.46–2.20)	1.15 (0.95–1.41)	1.96 (1.62–2.37)	0.85 (0.70–1.04)	3.87 (2.61–5.74)
Richest	1.52 (1.17–1.97)	1.19 (0.93–1.52)	3.19 (2.52–4.04)	0.79 (0.62–1.01)	5.40 (3.52–8.30)
P-value	<0.001	0.354	<0.001	0.319	<0.001

CI, confidence interval; OR, odds ratio. *A multiple multilevel logistic model with simultaneous adjustment for all the covariates. The model was in addition adjusted for current breastfeeding and pregnancy status. †The variance (standard error) for the random part of the models was as follows: mixed 0.51 (0.05); selective 0.50 (0.05); beverages and candies 0.52 (0.05); gruels, grains and semi-liquids 0.77 (0.07); infant formula and cereals 0.50 (0.10). ‡The number of those in the upper median score of each dietary pattern. §Includes all other professional occupations. ¶Includes those not married, divorced or not living together in the same household. **Includes those married and cohabiting together with their partners in the same household.

results indicate that for both mothers and children, the key socio-economic/demographic determinants were month of interview, religion, region of residence, maternal education, maternal occupation, wealth index and maternal BMI. Marital status was in addition associated with maternal patterns, while sex of the child, number of siblings, child's age, maternal age and place of residence additionally determined the child's patterns. These factors, however, were somewhat differentially related to the dietary patterns: For some patterns, some of the factors were positively associated but negatively associated with other patterns.

Some of the strengths of this study include the large sample size, being nationally representative, and included subjects covering a wide spectrum of demographic characteristics, such as age, education, religion, region. The study is limited, however, by the fact that it was based on secondary data, thus we did not have the actual data on the frequency of dietary intakes and possible dietary composition of the foods consumed by the mothers and their children, because these were not asked in the questionnaire. Understandably, the Demographic Health Survey questionnaire was not specifically designed for a detailed assessment of the dietary history of the population, but the inclusion of the various questions on food consumption provided an explorative opportunity to describe the dietary patterns of the population. Nevertheless, the principal component procedure is robust to accommodate qualitative responses, as it was the case with the answers provided in the 2008 NDHS questionnaire on the food items consumed. The various steps undertaken in the PCA to ascertain the validity of the results and reliability of the food items showed an adequate validation. The assessment of food consumption during the past 24 h prior to the interview ensured recent memory, hence minimised bias due to recall. Further studies will be required to confirm the present findings, particularly, to clarify whether the dietary patterns we have observed can be generalised to long-term food habits of the mothers and children.

To our knowledge, this is the first attempt in characterising nationally representative dietary patterns of Nigerian mothers and their children using a data-driven technique such as factor analysis. However, a limitation of the factor analysis procedure, which is the case with several of the data-driven techniques used to identify population dietary patterns, is the subjective decisions involved in several stages of the process, including the choice of the dietary variables studied, the number of factors to be retained and the criteria for retention, as well as the names assigned to the factors obtained. As this decision processes are not done *a priori*, they may affect the final results of the analysis, thus may not be reproduced in populations with different food habits. Nevertheless, the 'mixed' pattern obtained among the mothers in the present study is similar to a 'mixed diet' pattern identified in a Brazilian population of men and women aged 20–60 years old, which constituted a mixture of most of the foods examined in that study (Sichieri 2002). Similarly, the 'mixed' pattern among the children is comparable with a mixed pattern observed among pre-school Korean children aged 1–5 years in a study of children and adolescents (Lee *et al*. 2007).

The maternal 'traditional' pattern was similar to the 'traditional' pattern earlier reported by Northstone *et al*. (2008) among pregnant women with similar food constituents. Likewise, the 'staple foods and milk products' and 'beverages' patterns have been similarly identified as the 'bread and confectioneries' (Okubo *et al*. 2010) and 'coffee and dairy products' (Okubo *et al*. 2007), respectively, with similar food constituents among Japanese women. Among British children aged 3 years, 'junk food' and 'health conscious' patterns were obtained (Feinstein *et al*. 2008), which were loaded with similar foods as our 'beverages and candies' and 'selective' dietary patterns, respectively. Two additional dietary patterns identified in the present study among the children were the patterns related to gruels and porridges and the pattern on infant formula and baby cereals, which are usually the prominent foods consumed by breastfeeding children or those recently weaned. Although the dietary patterns for breastfeeding and non-breastfeeding mothers were similar, those of breastfeeding children slightly differed from those of non-breastfeeding children. While four patterns were observed for the breastfeeding children, five patterns (similar to the patterns obtained for the whole study

population) were obtained for the non-breastfeeding children. Initial distributions did not show any major differences in food consumption between pregnant and non-pregnant women, hence we did not examine separate dietary patterns for pregnant and non-pregnant mothers. Although it is known that the dietary intakes may differ by pregnancy status, it seems that such differences are mainly on the frequency of intake and dietary composition than on intake or non-intake of foods as available in the present study.

In a number of previous studies, several socio-economic, demographic, cultural and lifestyle factors have been shown to be important determinants of dietary patterns of populations (Northstone & Emmett 2005; Northstone *et al*. 2008; Ambrosini *et al*. 2009; Kourlaba *et al*. 2009; Craig *et al*. 2010; Smithers *et al*. 2012). Our results indicate that for both the mother and child, the key determinants of the dietary patterns were month of interview, religion, region of residence, maternal education, maternal occupation, maternal BMI and wealth index. Maternal marital status was in addition associated with maternal dietary patterns, while sex of child, number of siblings, child's age, maternal age and place of residence were additionally associated with the child's dietary patterns. However, the influence of these factors was somewhat different for each of the dietary patterns: While some factors were positively associated with some patterns, they had opposite effect on other patterns. Of interest is that while the month of interview was associated with less likelihood for maternal 'mixed' and 'beverages' patterns and the child's 'selective', 'beverages and candies' and 'infant formula and cereals' patterns, it was associated with higher likelihood for the child's 'gruels, grains and semi-liquids' pattern. These results highlight the strong influence of seasonality on the choices of foods, which may also indicate the availability of the foods.

Also of interest is that religion was a key influencing factor of all maternal dietary patterns, with Muslim mothers more likely to practise the maternal 'mixed', 'staple foods and milk products' and 'beverages' patterns, but less likely to practise the 'traditional' pattern. Muslim children were less likely to practise the 'mixed' and 'infant formula and cereals' patterns, but more likely to practise the 'beverages and candies' pattern. It is unclear why religious affiliation influenced the dietary patterns of the mothers and that of their children in opposite directions, but it may reflect the general cultural perceptions of the child feeding practices as determined by the age of the child and number of older siblings in the home. Interestingly, older children were more likely to practise all of the child's dietary patterns except for the 'infant formula and cereals' pattern. Similarly, the more siblings in the home, the more likely a child practised the 'mixed' dietary pattern, but less likely to practise the 'infant formula and baby cereals' pattern. Further evidence established in this study is the strong influence of maternal occupation, education and wealth index on the dietary patterns of both the mother and the child. Finally, the region of residence was an important determinant of both maternal and child dietary patterns, although the influence of each region differed substantially for most dietary patterns.

Conclusions

The present study has identified four and five different dietary patterns to characterise the dietary habits of Nigerian mothers and their children, respectively. Several socio-economic, demographic, cultural and lifestyle factors were identified as key determinants of maternal and child dietary patterns. In designing appropriate nutritional interventions and policies for Nigerian mothers and their children, it is recommended that the dietary patterns identified in this study and their determinants should be taken into account. In other words, by understanding the dietary patterns of Nigerian mothers and their children and the demographic characteristics that predict each dietary pattern, it will help in targeting nutritional interventions to meet the needs of specific population groups. Finally, dietary patterns present a framework for subsequent research on the effects of diet on health outcomes both in mothers and in children. Hence, in subsequent studies, we aim to study the associations between the identified dietary patterns and indicators of maternal and child health.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Contributions

BIN analysed and interpreted the data and wrote the initial draft of the manuscript. INO, CN, DOE, EKN and SNO assisted in the interpretation of results. All co-authors participated in manuscript preparation and critically reviewed all sections of the text for important intellectual content.

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