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FACTORS CONTRIBUTING TO CHILD STUNTING IN NIGERIA: A HOLISTIC EXAMINATION OF SOCIOECONOMIC DISPARITIES AND MATERNAL EDUCATION

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Abstract

Child stunting remains a critical public health concern in Nigeria, with far-reaching implications for development, productivity, and overall well-being. This study utilizes data from the 2018 Nigeria Demographic and Health Survey to comprehensively examine factors contributing to child stunting in Ogun State, Nigeria. The prevalence of stunting among children under the age of five in this region is estimated at 23%, classified as medium according to WHO standards. Notably, age emerges as a significant predictor of stunting, with children aged 36 months and older at the highest risk. Surprisingly, sex, maternal education, household income, and residence type do not exhibit significant associations with stunting in this population. These findings underscore the importance of targeted nutritional interventions, with a focus on children aged 3-4 years, to mitigate the prevalence of stunting. Moreover, the relatively lower prevalence of stunting in Ogun State compared to the national average suggests potential regional disparities and the influence of socioeconomic factors. As maternal education and household income do not show direct correlations with stunting, future research should explore the nuanced interplay between these factors and childhood malnutrition in Nigeria. This study contributes valuable insights into the multifaceted nature of child stunting in Nigeria, highlighting the need for holistic approaches that address both regional and age-specific disparities.

1. Introduction

"Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing, medical care and necessary social services" [1]. Yet, this right has been constantly violated, especially in developing countries [2]. Though malnutrition affects people in all age groups, infants and children are mostly affected because of their high nutritional requirements for growth and development [3]. Adequate nutrition during infancy and early childhood is therefore important to help children achieve optimal health, and reach full growth and development [4]. Malnutrition can be present in three forms which are undernutrition (wasting, stunting), hidden hunger and overweight [5]. Of these, stunting (low height-

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for- age) continues to be the most prevalent in Africa and Asia [6]. Stunting is referred to as height-for-age more than two standard deviations below the WHO Child Growth Standards median. Stunting is irreversible [7], begins during gestation, can have long-term effects on brain development, academic performance, financial productivity in adulthood and maternal reproductive outcomes [8]. In 2018, about 149 million under age five children in the world were stunted [5] which was a 1.2% reduction from the previous year estimate. However, Africa remains the only region in the world where the number of stunted children has risen, with Western and Eastern Africa accounting for the highest increase [6]. Nigeria has the second highest number of stunting in children under five in the world, with a higher proportion in the northern region [9], which is home to 87% of the poorest Nigerians [10]. The high level of poverty in this region is due to its arid climate which prevents productive farming [11], a low number of educational institutions and revenue, and a large population size [12].

Various studies have found an association between stunting in children and maternal education, household income, age and sex on country level in Africa and Asia. Stunting was higher in boys, children whose mothers either never attended school or attended primary school only, children aged 6-23 months and 24-59 months, and children in households with middle and poorest wealth indexes [13-16]. One study assessed the prevalence of stunting in Ogun State in Nigeria, but this study only included children from rural communities and did not use data from the most recent 2018 Nigeria Demographic and Health Survey (NDHS), which includes children from both rural and urban areas across the State [17]. Ogun State is the third richest state in Nigeria [18], has the highest number of educational institutions [19], and is among the top ten states in Nigeria for high literacy levels [20]. Thus, we expect that stunting may be lower in Ogun State than in Nigeria as a whole. Furthermore, higher levels of maternal education and household income may contribute to the lower levels of child stunting in Ogun State.

The objectives of this study are therefore to i) assess the prevalence of stunting in under age five children in Ogun State, Nigeria, and ii) assess if and how stunting is related to the children‟s age, sex, household income, maternal education and residence type.

2. Methods

2.1. Study Setting

Ogun State is one of the thirty-six states in Nigeria [21] located in the south-western region of the country [22]. It is bordered to the West by Republic of Benin, which makes it an access route to the expansive markets of the Economic Community of West African State (ECOWAS). Ogun State occupies an area of 16.432sq.km and had a population of 7.1 million at the 2016 census [23]. The four divisions of the State include Remo, Ijebu, Yewa and Egba, altogether known as RIYE [24]. Agriculture provides the major economic revenue in the State with production of rice, corn (maize), cassava (manioc), yams, plantains, and bananas. Cocoa, kola nuts, rubber, palm oil and palm kernels, tobacco, cotton, and timber are the main cash crops [25]. Ogun State is the exclusive producer of Ofada rice, a local type of rice which is difficult to mill and polish thus some or all of the rice bran are left on the grain, making the rice more nutritious. Ofada rice is typically more expensive than the available parboiled rice. It is named after the Ofada town in Ogun State where its cultivation first occurred [26].

2.2. Study Design

Cross-sectional. Data for the 2018 NDHS were collected at one time point between August – December 2018.

2.3. Data Source

We performed secondary analysis on the 2018 NDHS open access dataset [27]. The 2018 NDHS was implemented by the National Population Commission (NPC) in collaboration with the National Malaria Elimination Programme (NMEP) of the Federal Ministry of Health, Nigeria, with funding from United States Agency for

International Development, Global Fund, Bill and Melinda Gates Foundation, the United Nations Population Fund, and World Health Organisation [28]. The NDHS collected information on nutritional status of women and children, women‟s empowerment and other health-related issues to provide up-to-date estimates of basic demographic and health indicators.

2.4. Study Sampling and Participants

The NDHS contained data on children aged 0- 59 months, and on men and women aged 15-49, in sample households. A total of 41,668 households in Nigeria were selected through a two-stage stratified cluster sampling. However, only 40,666 households were occupied, from which 40,427 (99%) households were interviewed as part of the NDHS. Target population for the present study were children aged 0-59 months in Ogun State and their mothers. NDHS dataset contained data on 508 under age five children in Ogun State. Sample was then purposively selected (total enumeration) from this population to provide data tailored to meet the objectives of the present study [29], after the dataset for Ogun State had been cleaned to improve its quality [30]. The data cleaning process involved three stages (figure 1):

1) Identification and exclusion of data on dead children.
2) Identification and exclusion of children and mothers with missing or implausible data needed for analysis in the present study including sex, date of birth, date of visit, height, height/length measure, weight, household income and mother‟s highest educational level.
3) As we intended to use the WHO Anthro Survey Analyser to analyse data and calculate stunting prevalence, we needed to use the recommended mapping for age (date of visit-date of birth) [31].

2.5. Study Variables

We extracted data on the body weight of children to allow the generation of prevalence estimates using the WHO Anthro Survey Analyser. Furthermore, the variable of „wealth index for urban/rural‟ in our analysis was used as a proxy for household income, as wealth classification criteria differ in urban and rural areas due to variation in living standards [32]. To use Chi-square test for data analysis, expected frequency in at least 80% of cells must be greater than 5 [33]. Thus, we recoded household income to meet this assumption (Table 1). The poorest and poorer categories were merged and renamed as low income, the middle category was retained as middle income while the richer and richest categories were merged and renamed as high income (Table 1).

2.6. Data Collection The NDHS data were collected in Nigeria between August – December 2018 through a household, woman‟s, man‟s and biomarker questionnaire. Biomarker questionnaire was used to record results on anthropometry in women and children. Laboratory scientists and nurses were trained through standardisation exercises to measure the height and weight of children and adults. Recumbent length (lying down) was measured in children younger than 24 months, whilst height (standing up) was measured in those older than 24 months [28]. Height and length were measured with a Shorr Board® measuring board. Weight was measured with SECA scales with a digital display (model number SECA 878U). Household income was measured as wealth index. Dataset for the present study were accessed from the NDHS website [27]. Children‟s data were stored in a folder (NGKR7ASV) [27] containing a Statistical Package for Social Sciences (SPSS) file (NGKR7AFL.sav) and four other documents. The SPSS file contained data on under age five children in Nigeria and their mothers [34]. Data for this study was extracted in two weeks and stored on the personal computer of corresponding author and on a shared drive at University of Aberdeen.

2.7. Ethical Approval

Ethical approval is not required since we performed secondary analysis on open access dataset. However, access to dataset was granted by Inner City Fund (ICF). We requested access to the dataset from on March 31, 2020, and received a response the same day, granting access to the data through an authorization letter.

2.8. Evaluation of Stunting

Three methods are used to compare children to a reference population include Z-score, percentile and percent of median [35]. Of these, Z-score is the most accurate for analysis and presentation of anthropometric data in population-based assessments [36]. Thus, we identified stunting in the sample using the height-for-age index (Zscore). Children with Z-scores of -2 and above were categorized as not stunted; those whose Z-scores were below 2SD of the WHO reference population median for height-for-age were categorized as moderately stunted, while those whose Z-scores were below -3SD were categorized as severely stunted.

2.9. Data Analysis

WHO Anthro Survey Analyser [37] was used to calculate stunting based on the WHO Child Growth Standards while SPSS (v.25) [38] was used for further data analysis. Association of stunting with age, maternal education and household income was tested using Chi-square test for trend at 95% confidence interval because the independent variables were ordinal [39, 40]. Whereas Continuity Correction test was used to test for the association of stunting with sex and residence type because both variables were binary. P-values lesser than 0.05 were taken as statistically significant [41]. As Chi-square value does not measure net association between variables [42], we accomplished this through simple univariate logistic regression. We chose logistic regression over linear regression because our outcome variable, stunting, was categorical [43].

3. Results and Discussion

3.1. Cleaning and Preparation of the Dataset

We excluded data on 234 children from the initial dataset (Figure 1), resulting in the full records for 274 children and mothers whose data were used for data analysis. A summary of data extracted from the dataset is shown in Table 1.

3.2. Descriptive Statistics

More than half of mothers had at least secondary education. Majority of the study population had a high household income (Table 2).

In Ogun State, the prevalence of moderately stunted children was 16%, and that of severely stunted children was 7%. Our analysis indicated that 77% of children were not stunted (Table 3). We recoded stunting into two categories: we combined the moderately and severely stunted group and renamed it as stunted and retained the not stunted group.

There was significant trend of higher stunting rates with increasing age (p=0.001). No child under 1 year of age was severely stunted. Whereas 37% of children aged 1 year and older were severely stunted. There was a trend of stunting being higher in boys compared with girls (p=0.079), and a trend for stunting being higher in children whose mothers had no education and lower in children those whose mother had higher education (p=0.079). Stunting was not affected by type of residence (p=0.299) or household income (p=0.183) (Table 4).

Simple Univariate Logistic Regression analysis indicated that children aged 36-47 months and 48-59 months were 23 and 9 times more likely to be stunted, respectively, compared to those younger than 6 months (Table 5). We could not perform multivariable logistic regression because the number of children with the outcome (stunting) was too small to fit all predictors in one model.

The overall prevalence of stunting in this study was 23%, which is medium according to the WHO classification [35]. In this dataset, stunting was not significantly associated with the child‟s sex, maternal education, household income and type of residence, but it was significantly associated with age. Children aged 36 months and older had a significantly higher odds of stunting.

Stunting in under age five children in Nigeria is slowly decreasing, however, despite this, its prevalence of stunting is still one of the highest in the world [9]. A prevalence of 41% [44] and 37% [45] were reported in the 2008 and the 2013 NDHS, respectively. The National Nutrition and Health Survey (NNHS), conducted in 2015, found a prevalence of stunting of 33% [46]. The most recent national health surveys NNHS and NDHS, both conducted in 2018, reported a stunting prevalence of 32% [47] and 37% [28], respectively. The disparity in stunting prevalence in both surveys may be explained by different periods of data collection and a different sample size; whilst the NNHS data were collected between February and June 2018 with 19,471 children being assessed for anthropometry, the NDHS data were collected between August and December 2018 with 12,422 children being assessed for anthropometry. Stunting prevalence in Nigeria is noticeably higher than the average stunting prevalence in developing countries, which is 25% [48], and also higher than those reported for many other West African countries including Ghana (18% in 2018) [49], Senegal (19% in 2019) [50], Mali (27% in 2018) [51] and Sierra Leone (30% in 2019) [52]. Thus, there are increased concerns about the effectiveness of the scaling up of nutrition interventions in Nigeria since 2011 [53], which have been mostly concentrated in the Northern region of the country due to its high burden of malnutrition.

We expected the prevalence of stunting in Ogun State to be lower than the average of Nigeria [35], considering that Ogun State is in the Southwestern region of Nigeria [22], which is more affluent. Also, Ogun State started a school feeding programme for children in January 2017 [54]. Indeed, we found that majority of children were from high-income households (77%) and more than half (60%) had mothers with at least secondary education. Stunting prevalence of 23% in this study was slightly lower than the reported stunting prevalence of 27% for Ogun State in the 2018 NDHS report. This difference may be attributed to the fact that we performed data cleaning, whereas this may not have been done for the 2018 NDHS report. The prevalence of stunting in Ogun state in this study is lower than the prevalence in other, mostly poorer states in Nigeria, between 2012 and 2019, including Kano (49%) [55], Kaduna (45%) [56], Oyo (34%) [57], Cross River (28%) [58] and Imo (28%) [59] States. However, the stunting prevalence in Ekiti (20%) [60], Ondo (19%) [61], Rivers (14%) [62] and Enugu (4%) [63] States were lower than that of Ogun State, possibly due to differences in wealth or higher sampling from urban and more affluent areas.

In our study, children aged 36 months and older had a significantly higher risk of stunting than children younger than 5 months. The prevalence and odds of stunting were highest in children aged 36-47 months. This finding is in agreement with findings in studies in Kenya [64] and Bangladesh [65], and in Cross River State [58], which also found that stunting was significantly higher in children aged 36-48 months. However, the stunting prevalence in two other States, Oyo and Imo, was highest in children aged 13-24 months [57, 59]. The fact that stunting prevalence is higher in older children may be linked to the self-feeding tendencies and food preferences of children aged 36 months and older [66-68]. Additionally, at 36 months, most children have younger siblings [69] and start school [70, 71], which may reduce the attention they get from parents [72, 73] and the number of healthy meals eaten at home [74-76]. A study in Taiwan confirmed that children who were picky eaters were more likely to be stunted than those who were not picky eaters [77]. Another study in Ethiopia found that children belonging

to large-sized households (≥8 members) were significantly more stunted than those belonging to smaller households (1-4 members) [78].

Although there was a trend of stunting being higher in boys than in girls in our study, our dataset may have been too small to establish a significant difference between sexes, as found in previous studies in Ogun and Rivers States [62, 79]. Studies conducted in Oyo, Imo and Ekiti States [57, 59, 60] found a significantly higher prevalence of stunting in boys. This may be linked to the assertion that boys are more susceptible to disease than girls [80, 81]. On the other hand, stunting was higher in females in studies conducted in Cross River and River States [58, 62], which may be related to the long-practised culture of male preference in the States [82-86], where girls get less food and nutrition and less access to education compared with boys [87].

We also observed a trend that stunting declined with increasing maternal education. Some other studies in Nigeria [59, 88] and Ghana [89] found that stunting was significantly higher in children whose mothers had no education, and lowest in children whose mothers had at least secondary education. A possible explanation for this could be that education improves conceptual understanding [90]. Thus, educated mothers may be better able to understand the importance of an adequate diet, and make healthy food choices [91]. Educated mothers also have more capacity to earn higher incomes than uneducated mothers [92] which may improve food security and reduce the chances of their children being stunted.

In our study, the prevalence of stunting could not be explained by household income, whilst in the 2020 Global Nutrition Report [93], the prevalence of stunting increased by 15% in under age five children from the poorest households in Nigeria, but decreased by 9% in those from the richest households. Also, Etim and colleagues found a significantly higher prevalence of stunting in children from low income households (18%) compared with children from high income households (2%) in Cross River [58]. This may reflect the financial capability of parents from high income households to buy or prepare more healthy meals [94-98] compared to those from lower incomes households. In our study, the prevalence of stunting could also not be explained by type of place of residence. It is currently not clear if and how differences between urban and rural communities could contribute to differential levels of stunting. Most rural dwellers practise agriculture more than those living in urban areas [99], thus children living in rural areas often have increased access to food [100]. This may explain why Samuel et al found a significantly higher prevalence of stunting in children from high-density urban areas compared to those living in rural areas in Oyo State [57]. On the other hand, agricultural produce may only supply one nutrient out of the several nutrients required for growth and development, and a higher level of poverty often present in rural areas may prevent farmers from cultivating a variety of crops [101], which could be conducive to higher levels of stunting.

The strengths of this study include the timeliness of the research as this was the first study that established the relationship of stunting with child‟s age, sex, household income, maternal education and residence type in Ogun State, Nigeria, using the 2018 NDHS dataset, which is the most recent dataset available. Another strength is that analyses was performed in a cleaned dataset, eliminating the chance of erroneous findings. Limitations of our study include a relatively low sample size after data cleaning, resulting in a lower precision and larger 95% confidence intervals for the odds ratios [102], potentially leading to an overestimation of stunting in the logistic regression analysis, as children with missing data who were excluded during data cleaning may be different to those with complete data. Indeed, Hosmer and Lemeshow [103] have recommended a sample size of at least 400 for using Hosmer-Lemeshow test to calculate odds of stunting in logistic regression. Future research should aim to identify measures that could be taken to address the increased prevalence of stunting in children aged 3-4 years.

4. Conclusions

The prevalence of stunting in under age five children in Ogun State was 23%, which is medium according to WHO classification [35]. This prevalence is lower than the average observed for Nigeria – which is 34%. The stunting prevalence was linked to age, with children aged 36 months and older more likely to be stunted than younger children. Thus, it may be advisable that that current intervention programmes - Focusing on the young, Education, Nutrition, Early treatment and Women empowerment (FYENEW) [104] to promote nutritional status in under age five children, focus their valuable resources on this older age group.

Competing Interests

The Authors declare that they have no competing interests.

Authors' Contributions

TBA conceived the study, collected data, and performed statistical analysis and developed the first draft of the manuscript. BD reviewed the first draft and drafted subsequent versions of the manuscript. All authors read and approved final manuscript.

Figure-1. Flow diagram of dataset cleaning process

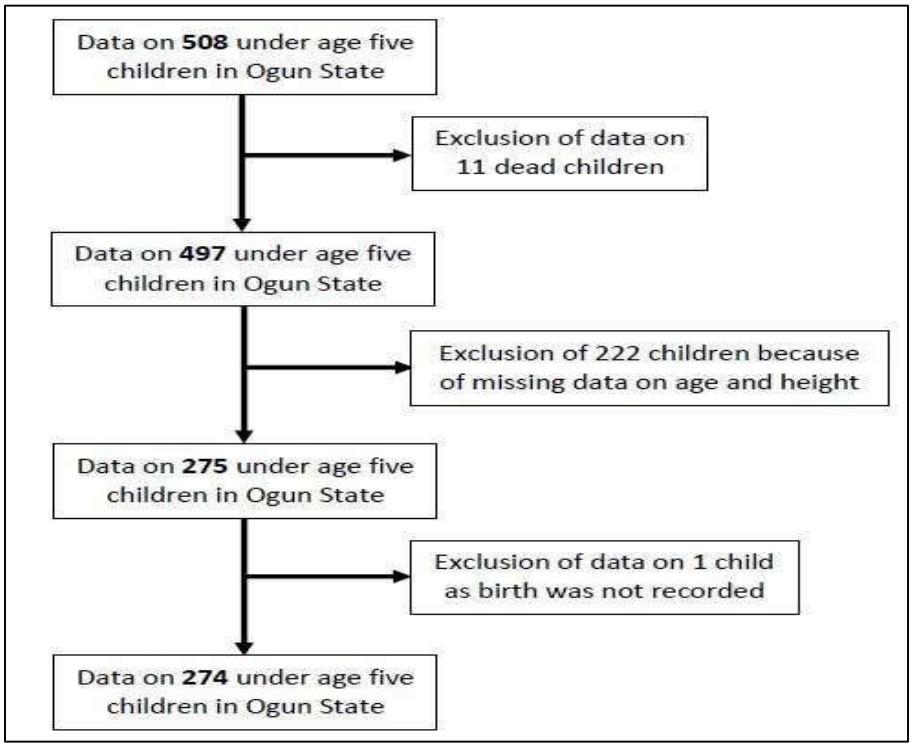

Table-1. Description and analysis coding plan of study variables

Variables	Description and categorization in 2018 NDHS	Analysis Coding
Outcome variable		
Stunting*	Height/Age standard deviation (New WHO): (continuous)	Coded as: 0=Not stunted 1=Stunted
Independent variables	Sex of child: (1= male, 2=female)	

Sex of child		Used same coding for analysis
Day of birth (child)	Day of birth: (continuous)	Used same value for analysis
Month of birth (child)	Month of birth: (continuous)	Used same value for analysis
Year of birth (child)	Year of birth: (continuous)	Used same value for analysis
Child‟s age in months*	Child‟s age in months:(continuous)	Coded as: 1=00-05 months 2=06-11 months 3=12-23 months 4=24-35 months 5=36-47 months 6=48-59 months
Child‟s height	Child‟s height in centimeters (1 decimal): (continuous)	Used same value for analysis
Height/Length measure (centimeters)	Height: Lying or standing: (1=lying, 2=standing)	Used same coding for analysis
Day child‟s height was measured	Date measured (day): (continuous)	Used same value for analysis
Date measured (month)	Date measured (month): (continuous)	Used same value for analysis
Date measured (year)	Date measured (year): (continuous)	Used same value for analysis
Residence type	Type of place of residence: (1=urban, 2=rural)	Used same coding for analysis
Household income	Wealth index for urban/rural: (1=Poorest, 2=Poorer, 3=Middle, 4=Richer, 5=Richest)	Recoded as 1=Low income 2=Middle income 3=High income
Child‟s weight (kilograms)	Child‟s weight in kilograms (1 decimal): (continuous)	Used same value for analysis
Mother‟s educational level	Highest educational level:	Used same coding for analysis

	(0=No education, 1=Primary, 2=Secondary. 3=Higher)	

*Variable calculated using WHO Anthro Survey Analyser

Table-2. Socio-demographic characteristics of children aged 0-59 months in Ogun State, Nigeria (n=274)

Characteristics		Total (N)	Percentage (%)
Individual-level factors			
Child"s sex			
	Males	130	47
	Females	144	53
Child"s age group			
	00-05 months	27	10
	06-11 months	30	11
	12-23 months	62	23
	24-35 months	47	17
	36-47 months	43	16
	48-59 months	65	24
Maternal/household factors			
Type of residence			
	Urban	116	42
	Rural	158	58
Mother"s highest educational level			
	No education	38	14
	Primary	72	26
	Secondary	133	49
	Higher	31	11
Household income			
	Low income	16	6
	Middle income	48	18
	High income	210	77

Table-3. Prevalence of stunting in in children aged 0-59 months in Ogun State, Nigeria (n=274)

Variable	N	%	Mean Z-score [95% CI]
Stunting ┼			
-2SD and above (Normal/Not stunted)	210	77	-0.72 [-0.85, -0.59]
Below -2SD (Moderately stunted)	45	16	-2.48 [-2.57, -2.39]
Below -3SD (Severely stunted)	19	**7**	-3.73 [-3.99, -3.46]

† Identified using Height-for-age Z-score. Z-scores were generated by imputing age and height of children into WHO Anthro Survey Analyser (software).

Table-4. Stunting prevalence in children aged 0-59 months in Ogun State according to selected variables (n=274)

Characteristics	Not stunted	Moderately stunted	Severely stunted	Chi-square value #	p-value
	N (%)				
Sex of child					
Male	93 (72)	24 (18)	13 (10)	3.077	0.079
Female	117 (81)	21 (15)	6 (4)		
Age group (months)	26 (96)	1 (4)	0 (0)		
00-05	28 (93)	2 (7)	0 (0)		
06-11	48 (77)	12 (19)	2 (3)	11.094	0.001**
12-23	36 (77)	6 (13)	5 (11)		
24-35	23 (53)	15 (35)	5 (12)		
36-47	49 (75)	9 (14)	7 (11)		
48-59					
Type of residence	93 (80)	18 (16)	5 (4)	1.079	0.299
Urban	117 (74)	27 (17)	14 (9)		
Rural					
Household income	11 (69)	4 (25)	1(6)		
	34 (71)	9 (19)	5 (10)	1.773	0.183
Low income	165 (79)	32 (15)	13 (6)		
Middle income					
High income	27 (71)	6 (16)	5 (13)		
Maternal education	53 (74)	13 (18)	6 (8)	3.091	0.079
	102 (77)	24 (18)	7 (5)		
No education	28 (90)	2 (7)	1 (3)		
Primary					
Secondary					
Higher					

This value represents the linear-by-linear association (Asymptotic Significance: 2-sided) for maternal education, household income and age, because these variables are ordinal, whereas a continuity correction (Asymptotic Significance: 2-sided) value was obtained for sex and type of place of residence because both variables are dichotomous (binary). ** Significant at p-value <0.05

Table-5. Simple univariate logistic regression analysis

Independent variable categories	Crude OR	95% CI	p-value
Sex (female) §			
Sex (male)	1.72	0.98 - 3.03	0.059
Age in months (00-05) §	1.00		

	Age in months (06-11)	1.86	0.16 - 21.72	0.622
	Age in months (12-23)	7.58	0.94 - 60.95	0.057
	Age in months (24-35)	7.94	0.97 - 65.42	0.054
	Age in months (36-47)	22.61	2.81 - 181.93	0.003
	Age in months (48-59)	8.49	1.07 - 67.65	0.043
Type of residence (urban) §		1.00		
	Type of residence (rural)	1.42	0.79 - 2.53	0.238
Mother‟s highest education (higher) §		1.00		
	Mother‟s highest education (secondary)	2.84	0.81 - 9.97	0.104
	Mother‟s highest education (primary)	3.35	0.91 - 12.29	0.069
	Mother‟s highest education (none)	3.80	0.96 - 15.14	0.058
Household income (high) §		1.00		
	Household income (low)	1.67	0.55 - 5.04	0.366
	Household income (middle)	1.51	0.75 - 3.05	0.252

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