Original Article

Assessment Of Immunization And Nutritional Status: A Comparative Study Of Children 12-59 Months Of Age In Rural And Urban Communities Of Sokoto State, Nigeria

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ABSTRACT

Immunization and optimal nutrition are critical for child survival, yet disparities persist between rural and urban communities in low-resource settings. This study assessed and compared immunization coverage and nutritional status among children aged 12-59 months in rural and urban areas of Sokoto state, Nigeria. A cross-sectional comparative study employed multi-stage sampling to select 260 children (130 rural, 130 urban) from households. Data on socio-demographics, immunization history (verified via cards), and anthropometry (weight, height/length) were collected using interviewer-administered questionnaires and standard tools. Immunization status was classified per Nigeria's National Programme on Immunization schedule; nutritional status was determined using WHO z-scores. Data were processed using IBM® SPSS version 25 and analysed using descriptive and inferential statistics. Full immunization coverage was 31.5% urban vs. 20.0% rural ($p<0.001$). Rural children had higher stunting (58.5% vs. 46.9%, OR=2.1), wasting (33.1% vs. 22.3%, OR=1.91, 95%CI:1.11-3.28), and underweight (60.0% vs. 52.3%, OR=1.83, 95%CI:1.25-2.68) rates. The factors that were found to be significantly associated with the immunization status of the children in both groups were the educational level of the mothers ($p< 0.001$), the occupation of the fathers, and the presence of an immunization card ($p< 0.001$). In urban areas, there was a statistically significant association between immunization status and stunting ($p= 0.003$), underweight ($p= 0.003$), and wasting ($p=0.029$). However, in rural areas, there was only a statistically significant association between immunization status and underweight ($p= 0.010$). Urban children exhibited superior immunization coverage and nutritional outcomes compared to rural peers, underscoring inequities driven by access barriers. Strengthening rural outreach, community nutrition programs, and surveillance is essential.

Keywords: Immunization status, Nutritional status, Under-five children.

INTRODUCTION

The future of any country is determined by the growing generation of the country. The health of the children of any country represents the health status of the people of that country. Since this growing generation is going to be the future productive citizens, they should be healthy enough to make use of the full potential of their productive age.

In Nigeria, vaccine preventable deaths accounted for about 40% of all under-five deaths, which was probably associated with the performance of routine immunization falling from 74% in 2010 to 52% in 2012 as assessed by the DPT3 coverage, a key performance indicator.[2] The Nigerian National Immunization Coverage in the multiple indicator cluster survey (MICS/NICS) 2016 report, showed that only 33% of children received all three doses of pentavalent vaccine, with varied suboptimal coverage rates in all the geopolitical regions.[3] Immunization survey results revealed that low coverage, missed opportunities and a high number of unimmunized children occur more in the northern part of the country than in the south. A comparison of third-dose pentavalent coverage trends reveals that the North-west zone has the lowest immunization coverage (14%), followed by the North East

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(25%) and the North Central (44%), while the southern zones have coverage ranging from 61% to 64%. It is therefore not surprising that under-five mortality rates are highest in the North West, followed by the North East and North Central zones, respectively.[3] According to the Nigeria Demographic and Health Survey (NDHS) 2018, vaccination status of children varied with residence (urban or rural) and geopolitical zones. The survey revealed that 44.4% of children aged 12-23 months were fully vaccinated in urban areas, compared to 22.7% in rural areas.[4]

Undernutrition is common among children under 5, particularly in the poorest regions of the world, such as sub-Saharan Africa and South Asia, where 1 in every 3 children is undernourished.[5] Undernutrition manifests in different ways as underweight, stunting, wasting and specific nutritional deficiencies of key vitamins and minerals that children need to grow and develop properly. Stunting, as defined by a recent report from the WHO, UNICEF and the World Bank, refers to a child who is too short for his or her age.[5] It is a result of chronic or recurrent undernutrition. A more acute form of undernutrition is wasting, which refers to a child who is too thin for his or her height. Wasting results from rapid weight loss or a failure to gain weight.[5]

An estimated 178 million children are stunted globally and an additional 19 million children have wasting. Notably, stunting is more prevalent than wasting as it is a result of chronic or recurrent undernutrition, shorter episodes of wasting, which themselves can be reversible, but over time lead to stunting, which is largely irreversible and has lifelong consequences. Many of these conditions are associated with concomitant micronutrient deficiencies and among them, vitamin A, iron, iodine and zinc deficiencies are the most prevalent in childhood.[7] There are disparities in the nutritional status of children under five in urban and rural communities of Nigeria, with the inhabitants of rural areas having a higher prevalence of stunting, underweight and wasting than those in the urban areas.[4]

The relationship between immunization and the prevention of undernutrition is well-established.[6] Childhood vaccination may protect children's nutritional status and lead to improved child growth in developing countries.[7] It has been recognized for decades and highlighted by the United Nations Children Fund (UNICEF) that infectious diseases contribute to child undernutrition.[8] An infectious disease can cause reduced dietary intake[8], increased nutrient loss and elevated nutrient requirements caused by an increase in metabolism, such as those due to fever. Because vaccination prevents infectious disease, it too may promote child growth and reduce the prevalence of both wasting and stunting.[9] This study aimed to assess and compare the immunization and nutritional status of children aged 12 to 59 months in urban and rural communities of Sokoto state, Nigeria.

MATERIALS AND METHODS

Study area

This study was conducted in rural (Gwadabawa, Kware, Shagari and Wurno LGAs) and urban (Sokoto South) communities of Sokoto state, which is located in the extreme northwest of Nigeria. Sokoto South is one of the five urban LGAs in Sokoto state. It is composed of 11 geopolitical wards, has several health facilities (public and private) and schools located in it. Gwadabawa is one of the eighteen rural LGAs with its headquarters in the town of Gwadabawa on the A1 Highway. Located within the LGA are the School of Health Technology, many secondary and primary schools, a General Hospital, and one primary health care centre in each of the 11 geopolitical wards. Kware is another rural local government. Located within the headquarters are: the Neuropsychiatric hospital, the Comprehensive health centre, and at least one primary health centre in each of the 11 geopolitical wards. Shagari is another rural Local Government Area in Sokoto State, which has 10 geopolitical wards with a primary health centre in each ward and a general hospital located within the LGA headquarters. Wurno is also a rural LGA located in the Sokoto East Senatorial zone. It has 11 geopolitical wards, with each having a primary health centre.

Study Design

This was a comparative cross-sectional study design.

Sample Size Determination

Sample size estimation was done based on the formula for the study design to compare proportions in 2 independent groups.

The minimum sample size was determined using the formula.10

$$n = \frac{(Z_{1-\frac{\alpha}{2}} + Z_{\beta})^2 \ X \ (P_1 q_1 + p_2 q_2)}{(P_1 - P_2)^2}$$

130 subjects were recruited into the study per group.

Sampling Technique

A multistage sampling technique was used to select the study participants. Stratification of LGAs into urban(5) and rural(18) by the National Population Commission was adopted. One urban and 4 rural local government areas were selected by simple random sampling through balloting. From the selected Urban LGA, one (1) ward was selected by simple random sampling (balloting). While in each of the selected rural local government areas, one (1) ward was selected by simple random sampling (balloting), making 1 ward in the selected urban LGA and 4 wards from the selected rural LGAs. One settlement each was selected from the selected urban ward and rural wards using simple random sampling through balloting.

Data Collection Methods

Information about child immunizations was collected from immunization cards and the mother's verbal report, with the verification of the presence of a BCG scar. Mothers or caregivers were asked to show the children's health record cards, which contained individual immunization data. Where the card was available, the interviewer extracted the information on immunization and filled it into the checklist appropriately. Where there was no specific information on the card, the mother or caregiver was then asked to confirm or otherwise whether the child had received other vaccinations that were not recorded on the card. If there was no immunization card, or if the mother or caregiver was unable to show the card, the child's immunization information was based on their recall. In case of immunization failure, they were asked to give reasons for the failure. Each child selected for the study had anthropometric measurements taken for weight, height, mid-upper arm circumference and body mass index (BMI).

Statistical Analysis

Data analysis was done using IBM® SPSS version 25. Quantitative variables were summarized using the mean and standard deviation and categorical variables were summarized using frequencies and percentages. The Chi-square test and Fisher's exact were used to compare sociodemographic characteristics, immunization status and nutritional status in urban and rural groups.

Ethical consideration

Ethical approval for the study was sought and obtained from the Research and Ethics Committee of the Ministry of Health, Sokoto, Nigeria. A consent form was given to the literate respondents to read and sign and was read out in the native Hausa language to the respondents with no formal education to thumbprint.

RESULTS

Majority of the mothers in both groups were in the age group of 25-29 years. The difference in the distribution of the age groups was statistically significant (p= 0.008). Mothers in the urban area had a higher mean age compared to those in rural area, the difference was statistically significant (p= 0.004). The difference in tribe distribution was statistically significant (p<0.001) with Hausas being the majority in both groups (86.9% urban vs 83.1% rural). About one third of mothers in the urban group 45 (34.6%) compared to 3 (2.3%) in the rural group had completed their secondary education, while 109 (83.8%) had only Quranic education in the rural group compared to 58 (44.6%) in the urban group. The rural group had a higher proportion of unemployed mothers 80 (61.5%) compared to the urban group 48 (36.9%). There was a statistically significant difference in terms of the educational attainment and the occupation of the mothers of the children in both groups (p< 0.001).

Fathers who had completed tertiary education formed the highest proportion 56 (43.1%) in the urban group compared to the rural group where those with Quarnic only education 60 (46.2%) formed the highest proportion. Nearly half of the fathers 58 (44.6%) were civil servants in the urban area compared to only 17 (13.1%) in the rural area. There was a statistical significant difference in terms of the educational attainment and the occupation of the fathers of the children in both groups (p< 0.001). There was also a statistically significant difference (p<0.001) in the distribution of the respondents by social class with the majority of the respondents being in social class IV and V in Urban (48.5%) and rural group (49.2%) respectively [Table 1].

The highest proportion of children in both the urban 38 (29.2%) and rural 42 (32.3%) groups were in the age group 48-59months. There was no statistically significant difference in age (χ^2 = 0.927, p = 0.467). The mean ages in the urban and rural areas were 34.70 14.4 and 35.12 14.8months respectively (t=0.233, p= 0.816). A higher proportion of female children 73 (56.2%) compared to male children 57 (43.8%) was observed in urban group; while the sex distribution was equal in rural group (50% male vs 50% female). There was no statistically significant difference in the gender distribution in the groups (χ^2 = 0.988 p =0.384). A higher proportion of children in the rural group 106 (81.5%) were delivered at home compared to 69 (53.1%) in the urban group; and this was statistically significant (Fischer's exact, p<0.001) [Table 2].

Immunization coverage by card and mother recall. The highest coverage reported for children in urban and rural areas was for OPV0 at 78 (60.0%) and OPV1 at 78 (60.0%), respectively. Men A antigen coverage for urban and rural children was 41(32.0%) and 33 (25.8%), respectively and these were the lowest coverage values reported. About a third 41 (31.5%)) of the children in the urban group and 26 (20.0%) of the children in the rural group were fully immunized. Similarly, 48 (37.0%) of the children in the urban group, compared with 65 (50.0%) from the rural group, were partially immunized. About a third of the children in both groups were unimmunized, with 41 (31.5%) and 39 (30.0%) in the urban and rural groups, respectively. There was a statistically significant difference in the immunization status between the 2 groups. (χ^2= 5.966, p = 0.047) [Table 3].

A higher proportion 53 (40.8%) of the children in the urban areas received 1^{st} dose of Vitamin A compared with 42 (32.3%) of their rural counterparts (p=0.198). Fifty-four (41.5%) of the children in the urban area received 2^{nd} dose of Vitamin A compared with 49 (37.7%) of the children in the rural areas (p= 0.612). Only a smaller proportion of children 18 (13.8%) in urban and 14 (10.8%) rural, received all ten doses of Vitamin A (p=0.572) [Figure 1].

A higher proportion of the children in the urban areas 57 (76.0%) compared to 50 (68.5%) of the children in the rural areas have their immunization cards but this difference was not statistically significant (p= 0.360) [Figure 2].

Fewer children in the Urban area (52.3%) were underweight compared with those in the rural area (60%). The mean weights of children in the urban area (11.98 4.08kg) were more than those of the rural areas (11.92 3.16kg) (p= 0.900). A higher proportion of the children in the rural areas 76 (58.5%), compared to those in the urban areas 61 (46.9%) were stunted (p= 0.082). The mean heights in the urban and rural areas were 87.44 11.71cm and 86.34 11.58cm, respectively (p= 0.234). About a third of children in the rural areas 43 (33.1%), compared to about a fifth 29 (22.3%) of those in the urban areas, were wasted, but the difference was also not statistically significant (p= 0.234) [Table 4].

A higher proportion of the children in the rural areas 40 (30.6%), compared to 28 (21.7%) of the children in the urban areas, have acute malnutrition and the difference was significant (p= 0.024) [Figure 3].

The proportion of children with underweight in the urban communities was 15 (36.6%) among those who were fully immunized, compared to 63 (70.7%) among those who were not fully immunized. The differences in proportions were statistically significant, p =0.003. In rural communities, 9 (34.6%) of the children who were fully immunized were underweight compared to 59 (56.7%) of children who were not fully immunized. The difference was statistically significant (p=0.010). In urban communities, about 12 (29.3%) of the children who were fully immunized were stunted compared to 49 (55.1%) of children who were not fully immunized. The difference was statistically significant (p=0.001). The proportion of children with stunting in the rural communities was 12 (46.1%) among those who were fully immunized compared to 64 (61.5%) among those who were not fully immunized but the difference was not statistically significant (p=0.825). Only 13 (16.1%) of the children in the urban communities with full immunization status were wasted compared to 16 (31.2%) of those who were not fully immunized, the difference was statistically significant (p=0.029). The proportion of children with wasting in the rural communities was 8 (36.4%) among those who were fully immunized compared to 35 (38.9%) among those who were not fully immunized and the difference was not statistically significant (p=0.905) [Table 5].

In the urban areas, 12 (37.5%) of children in the age group 12 to 23months were fully immunized compared with 29 (29.6%) of those aged 24months and above (p= 0.511). Also, in rural areas, 8(28.6%) of children in the age group 12 to 23months were fully immunized compared with 18(17.6%) of those aged 24months and above (p=0.284). In the urban areas, 30 (42.9%) of the children whose mothers had formal education were fully immunized compared to 11(18.3%) of those whose mothers had nonformal education (p= 0.001). Similarly, 39 (34.8%) of those children whose fathers had formal education were fully immunized as compared to 2 (11.1%) of those whose fathers had nonformal education (p =0.044). Also, 27 (46.6%) of those whose fathers were employed in the formal sector were fully immunized as compared to those whose fathers were employed in the informal sector (farming=1(16.7%), trade/business = 13 (19.7%) (p =0.003). Also, 9(56.3%) of children in social classes I and II were fully immunized compared to those in social class III 19 (46.3%) and social classes IV and V 13(17.8%), p= 0.017. In the rural areas, 14 (77.8%) of the children whose mothers had formal education were fully immunized compared to 12 (10.7%) of those whose mothers had nonformal education (p< 0.001). Also, 27 (46.6%) of the children whose fathers were employed in the formal sector were fully immunized as compared to 2 (5.1%) and 13 (19.7%) of those whose fathers were employed in farming and business/trade, respectively. The differences in proportions were statistically significant, p=0.018 [Table 6].

In urban areas, 41 (34.5%) of children whose mothers attended antenatal care were fully immunized, compared to 0 (0.0%) of those whose mothers did not attend antenatal care (p=0.017). About half, 32 (50.8%), of children whose mothers attended postnatal care were fully immunized, compared to 9 (13.6%) of children whose mothers did not participate in postnatal care. The differences in proportions were statistically significant, p < 0.001. A high proportion, 27 (45.0%), of children born at a hospital or clinic were fully immunized, compared to 14 (20.0%) of children born at home (p=0.003). The majority of children with immunization cards, 30 (52.6%), were fully immunized compared to 11 (15.1%) of those without immunization cards (p < 0.001). In rural areas, 25 (21.0%) of children whose mothers attended antenatal care were fully immunized, compared to 1 (9.1%) whose mothers did not attend antenatal care (p=0.693). Similarly, 17 (27.0%) of children whose mothers attended postnatal care were fully immunized, compared to 9 (13.4%) of those whose mothers did not attend postnatal care (p=0.078). A high proportion of children with immunization cards, 23 (46.0%), were fully immunized compared to 3 (3.8%) of children without immunization cards (p < 0.001) [Table 7].

In the urban areas, 19 (59.4) of the children in the age group 12 to 23months were stunted, wasted and underweight as compared to 53 (52.0) of those in the age group 24 – 59, (p=1.000). Similarly, a high proportion of the children whose fathers were civil servants 37 (63.8%) and traders 39 (59.1%) were stunted, wasted and underweight as compared to the children of farmers 2 (33.3%) respectively (p=0.345). In the rural areas, 14 (50.0%) of the children in the age group 12 – 23months were stunted, wasted and underweight compared to 53 (52.0%) of those in the age group 24 – 59months, p=1.000. Also, civil servants had the highest proportion of children 12 (70.6%) with stunted, wasted and underweight, p=0.191 [Table 8].

In the urban areas, 47 (60.2%) of children with poor dietary diversity were stunted, wasted and underweight compared to 21 (40.4%) of those with good dietary diversity, p=0.211. In the rural areas, about half of children with poor dietary diversity 47 (51.1%) were stunted, wasted and underweight compared to those with good dietary diversity 18 (47.4%), p= 0.581 [Table 9].

Table 1: Sociodemographic characteristics of the respondents

Variables	Urban (n=130) n (%)	Rural (n=130) n (%)	Test-statistics p-value
Age group of mothers (years)			
15-19	2 (1.5)	10 (7.7)	
20 – 24	13 (10.0)	22 (16.9)	
25 – 29	63 (48.5)	44 (33.8)	
30 – 34	27 (20.8)	28 (21.6)	χ^2= 11.059
≥ 35	25 (19.2)	26 (20.0)	**p=0.025**
Mean ± SD (years)	32.99 ± 7.598	30.11 ± 8.348	t=2.914 **p=0.004**
Religion			
Islam	125 (96.2)	130 (100)	Fischer's exact
Christianity	5 (3.8)	0	**p=0.029**
Tribe			
Hausa	113 (86.9)	108 (83.1)	
Fulani	9 (6.9)	7 (5.4)	
Yoruba	5 (3.8)	1 (0.8)	Fischer's exact
Igbo	3 (2.3)	0	**p<0.001**
Other	0	14 (10.8)	
Number of children			
1 – 4	65 (50.0)	79 (60.8)	χ^2= 3.051
≥ 5	65 (50.0)	51 (39.2)	p= 0.105
Mothers' education level			
None	2 (1.5)	3 (2.3)	
Quranic only	58 (44.6)	109 (83.8)	
Primary	9 (6.9)	14 (10.8)	Fischer's exact
Secondary	45 (34.6)	3 (2.3)	**p<0.001**
Tertiary	16 (12.3)	1 (0.8)	
Fathers' education level			
None	0 (0.0)	0	
Quranic only	16 (12.3)	60 (46.1)	
Primary	2 (1.5)	7 (5.4)	Fischer's exact
Secondary	56 (43.1)	46 (35.4)	**p<0.001**
Tertiary	56 (43.1)	17 (13.1)	
Occupation of mother			
Unemployed	48 (36.9)	80 (61.5)	
Farming	0 (00.0)	0 (0.0)	Fischer's exact
Trade/business	77 (59.2)	48 (36.9)	**p<0.001**
Civil servant	5 (3.9)	2 (1.5)	
Occupation of father			
Unemployed	0 (0.0)	0	
Farming	6 (4.6)	39 (30.0)	χ^2 =47.070
Trade/business	66 (50.8)	74 (56.9)	**p< 0.001**
Civil servant	58 (44.6)	17 (13.1)	
Social class of parent			
SC I	2 (1.5)	0	
SC II	14 (10.8)	1 (0.8)	
SC III	41 (31.5)	7 (5.4)	Fischer's exact
SC IV	63 (48.5)	58 (44.6)	**p<0.001**
SC V	10 (7.7)	64 (49.2)	

χ^2-Pearson's Chi square test; *t*- Independent *t* test

Table 1: Sociodemographic characteristics of children

Variables	Urban (n=130) n (%)	Rural (n=130) n (%)	Test-statistics p-value
Child's age group (months)			
12-23	32 (24.6)	28 (21.5)	
24-35	30 (23.1)	30 (23.1)	χ^2= 0.927
36-47	30 (23.1)	30 (23.1)	p=0.467
48-59	38 (29.2)	42 (32.3)	
Mean ± SD (months)	34.70 ± 14.4	35.12 ± 14.8	t= 0.233 p=0.816
Sex			
Male	57 (43.8)	65 (50.0)	χ^2= 0.988
Female	73 (56.2)	65 (50.0)	p=0.384
Place of delivery			
Home	69 (53.1)	106 (81.5)	
Hospital	56 (43.1)	24 (18.5)	Fischer's exact
Clinic/dispensary	4 (3.1)	0 (0.0)	**p<0.001**
TBAs house	1 (0.8)	0 (0.0)	
Birth order			
1- 2	30 (23.0)	50 (38.5)	χ^2= 8.388
3 – 4	37 (28.5)	36 (27.7)	**p=0.016**
≥ 5	63 (48.5)	44 (33.8)	

χ^2-Pearson's Chi -square test, *t*- Independent *t* test

Table 3: Immunization status of the children by cards and mothers' recall

Vaccine	Urban (n=130) n (%)	Rural (n=130) n (%)	Test-statistics χ^2	p-value
BCG	66 (51.2)	60 (46.5)	0.558	0.455
HBVo	69 (53.1)	66 (51.2)	0.095	0.804
OPV				
0	78 (60.0)	74 (56.9)	0.253	0.706
1	76 (58.5)	78 (60.0)	0.064	0.900
2	69 (53.1)	72 (55.4)	0.139	0.803
3	61 (46.9)	67 (52.3)	0.758	0.455
Penta				
1	67 (51.5)	57 (44.2)	1.403	0.264
2	58 (44.6)	47 (36.4)	1.798	0.206
3	51 (39.2)	45 (34.9)	0.758	0.455
PCV				
1	65 (50.0)	56 (43.1)	1.403	0.264
2	58 (44.6)	47 (36.2)	1.933	0.164
3	51 (39.2)	44 (34.4)	0.654	0.441
IPV	43 (33.1)	40 (31.0)	0.160	0.790
Measles	54 (41.5)	56 (43.1)	0.63	0.900
Yellow fever	48 (37.2)	48 (36.9)	0.002	1.000
Men A	41 (32.0)	33 (25.8)	1.217	0.335
Immunization status				
Fully immunized	41 (31.5)	26 (20.0)		
Partially immunized	48 (37.0)	65 (50.0)	5.966	**0.047**
Un-immunized	41 (31.5)	39 (30.0)		

χ^2-Pearson's Chi square test BCG - Bacillus Calmette-Guerin HBV-hepatitis B vaccine OPV - oral polio vaccine PCV- pneumococcal conjugate vaccine IPV - inactivated polio vaccine, Men A - Meningitis A conjugate vaccine

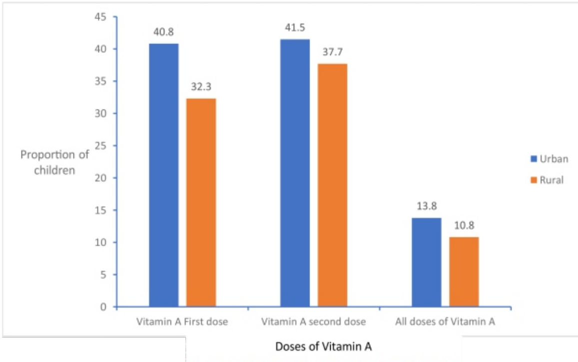

Figure 1: Vitamin A supplement status of the children

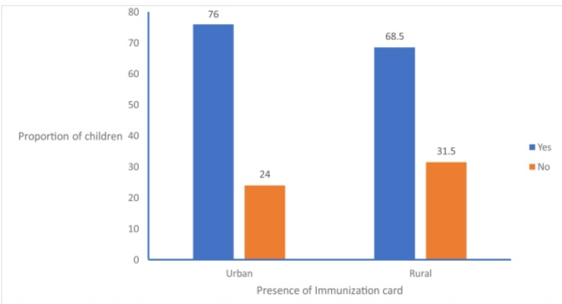

Figure 2: Immunization card seen

Table 4: Prevalence of underweight, stunting and wasting a mong children

Variables	Urban (n=130) n (%)	Rural (n=130) n (%)	Test-statistics p-value
Weight for age			
Normal	62 (47.7)	52 (40.0)	χ^2= 1.562
Underweight	68 (52.3)	78 (60.0)	p=0.130
Mean ± SD in kg	11.98 ± 4.08	11.92 ± 3.16	t= 0.125 p= 0.900
Height for age			
Normal	69 (53.1)	54 (41.5)	χ^2= 3.472
Stunting	61(46.9)	76 (58.5)	P=0.082
Mean ± SD in cm	87.44 ± 11.71	86.34 ± 11.58	t= 0.760 p= 0.448
Weight for height			
Normal	79 (60.8)	69 (53.1)	χ^2= 2.997
Wasting	29 (22.3)	43 (33.1)	p=0.234
Overweight/obesity	22 (16.9)	18 (13.8)	
Both underweight, stunted and wasted			
Yes	52 (40)	63 (48.5)	χ^2= 1.887
No	78 (60)	67 (51.5)	p= 0.212

χ^2-Pearson's Chi -square test, *t*- Independent *t* test

Table 5: Relationship between immunization status and nutritional status (stunting, wasting and underweight)

Immunization status	Urban Weight -for-age n (%) Normal	Urban Weight -for-age n (%) underweight	Test statistics and p -value	Rural Weight -for-age n (%) Normal	Rural Weight -for-age n (%) Underweight	Test statistics and p- value
Fully Immunized						
Yes	26 (63.4)	15 (36.6)	χ^2= 7.924	17 (65.4)	9 (34.6)	χ^2= 6.634
No	26 (29.2)	63 (70.7)	**p= 0.003**	45 (43.3)	59 (56.7)	**p= 0.010**
	Height -for-age n (%) Normal	**Stunted**		**Height -for-age n (%) Normal**	**Stunted**	
Fully Immunized						
Yes	29 (70.8)	12 (29.2)	χ^2=6.500	14 (53.9)	12 (46.1)	χ^2=1.127
No	40 (44.9)	49 (55.1)	**p=0.001**	40 (38.4)	64 (61.5)	p=0.825
	Weight -for-height n (%) normal	**wasted**		**Weight -for-height n (%) normal**	**wasted**	
Fully Immunized	**n=108**			**n=112**		
Yes	26 (83.9)	13 (16.1)	χ^2=7.149 **p=0.029**	14 (63.6)	8 (36.4)	χ^2=0.142 P=0.905
No	53 (68.8)	16 (31.2)		55 (61 .1)	35 (38.9)	

χ^2= Pearson's chi -square

Table 7: Relationship between maternal health care utilization and immunization status of children

Variables	Urban Fully Immunized n (%) Yes	Urban Fully Immunized n (%) No	Test statistics and p -value	Rural Fully Immunized n (%) Yes	Rural Fully Immunized n (%) No	Test statistics and p- value
Mother attended ANC						
Yes	41 (34.5)	78 (65.5)	Fisher's exact	25 (21.0)	94 (79.0)	Fisher's exact
No	0	11 (100)	**p=0.017**	1 (9.1)	10 (90.9)	P=0.693
Mother attended PNC						
Yes	32 (50.8)	32 (49.2)	χ^2=19.899 **p<0.001**	17 (27.0)	46 (73.0)	χ^2=3.727 p=0 .078
No	9 (13.6)	57 (86.4)		9 (13.4)	58 (86.6)	
Mother received TT Immunization						
Yes	38 (37.7)	59 (60.8)	χ^2= 10.213	22 (21.0)	83 (79.0)	χ^2= 0.310
No	3 (9.1)	30 (90.9)	**p= 0.001**	4 (1 6.0)	21 (84.0)	p= 0.782
Place of delivery						
Home	14 (20.0)	56 (80.0)	χ^2= 9.352 **p= 0.003**	21 (19.8)	85 (80.2)	Fisher's exact p=1.000
Hospital/clinic	27 (45.0)	33 (55.0)		5 (20.8)	19 (79.2)	
Presence of immunization card						
Yes	30 (52.6)	27 (47.4)	χ^2= 20.917 **p< 0.001**	23 (46.0)	27 (54.0)	χ^2= 34.328 **p<0.001**
No	11 (15.1)	62 (84.9)		3 (3.8)	77 (96.3)	

χ^2= Pearson's chi -square, ANC - Antenatal Care, PNC -Postnatal Care, TT -Tetanus Toxoid

Table 8: Relationship between sociodemographic variables of the re spondents and stunting, wasting and underweight

Variables	Urban Nutritional status n (%) Normal	Urban Stunting, wasting and underweig ht	Test statistics and p value	Rural Nutritional status n (%) Normal	Rural Stunting, wasting and underweight	Test statistics and p- value
Age groups (months)						
12-23	13 (40.6)	19 (59.4)	χ^2= 0.007	14 (50.0)	14 (50.0)	χ^2= 0.034
24-59	39 (39.8)	59(60.2)	p= 1.000	49 (48.0)	53 (52.0)	p= 1.000
Sex						
Male	17 (29.8)	40 (70.2)	χ^2=4.379	34 (52.3)	31 (47.7)	χ^2=0.770
Female	35 (47.9)	38 (52.1)	p=0.047	29 (44.6)	36 (55.4)	p=0.483
Tribe						
Hausa	42 (37.2)	71 (62.8)		52 (48.1)	56 (51.9)	Fisher's exact
Fulani	6 (66.7)	3 (33.3)	Fisher's	3 (42.9)	4 (57.1)	p=0.790
Yoruba	2 (40.0)	3 (60.0)	exact	0 (0.0)	1 (100.0)	
Igbo	2 (66.7)	1 (33.3)	p=0.270	0 (0.0)	0 (0.0)	
Others	0	0		8 (57.1)	6 (42.9)	
Religion						
Islam	49 (39.2)	76 (60.8)	Fisher's exact	52 (40.0)	78 (60.0)	N/A
Christianity	3 (60.0)	2 (40.0)	p= 0.388	0	0	
Occupation of mother						
Employed	20 (41.7)	28 (58.3)	χ^2= 0.088	41 (51.9)	38 (48.1)	χ^2=0.953
Unemployed	32 (39.0)	50 (61.0)	p= 0.853	22 (43.3)	29 (56.9)	p=0.372
Education of mother						
Nonformal	21 (35.0)	39 (65.0)	χ^2= 1.161	53 (47.3)	59 (52.7)	χ^2= 0.421
Formal	31 (44.3)	39 (55.7)	P=0.369	10 (55.6)	8 (44.4)	p= 0.614
Education of father						
Nonformal	10 (62.5)	6 (37.5)	χ^2=3.849	31 (51.7)	29 (48.3)	χ^2= 0.459
Formal	42 (36.8)	72 (63.2)	p= 0.060	32 (45.7)	38 (54.3)	p= 0.598
Occupation of father						
Farming	4 (66.7)	2 (33.3)	Fisher's	22 (56.4)	17 (43.6)	χ^2=3.458
Civil servant	21 (36.2)	37 (63.8)	exact	5 (29.4)	12 (70.6)	p= 0.191
Trade/business	27 (40.9)	39 (59.1)	p= 0.345	36 (48.6)	38 (51.4)	
Social class of parent						
Upper (SCI & II)	7 (43.8)	9 (56.3)		1 (100)	0	
Middle (SCIII)	19 (46.3)	22 (53.7)	χ^2= 1.365	2 (28.6)	5 (71.4)	Fisher's
Lower (SCIV & V)	26 (35.6)	47 (64.4)	p=0.505	60 (49.2)	62 (50.8)	exact p= 0.352

χ^2= Pearson's chi -square

Table 9: Relations hip between exclusive breastfeeding, dietary diversity, birth order, number of children and stunting, wasting and underweight

Variables	Urban Nutritional status n (%) Normal	Urban Stunting, wasting and underweight	Test statistics and p-value	Rural Nutritional status n (%) Normal	Rural Stunting, wasting and underweight	Test statistics and p - value
Exclusively breastfeed						
Yes	9 (39.1)	14 (60.9)	χ^2=0.009	8 (57.1)	6 (42.9)	χ^2=0.197
No	43 (40.2)	64 (59.8)	p=1.000	57 (49.1)	59 (50.9)	P=0.437
Dietary diversity						
Good	31 (59.6)	21 (40.4)	χ^2=1.855	20 (52.6)	18 (47.4)	χ^2=0.223
Poor	31 (39.8)	47 (60.2)	P=0.211	45 (48.9)	47 (51.1)	p=0.217
Birth order						
1-4	24 (35.8)	43 (64.2)	χ^2= 1.006	40 (46.5)	46 (53.5)	χ^2=0.387
≥ 5	28 (44.4)	35 (55.6)	p= 0.372	23 (52.3)	21 (46.7)	p=0.581
Number of children						
1-4	23 (35.4)	42 (64.6)	χ^2= 1.154	37 (46.8)	42 (53.2)	χ^2=0.213
≥5	29 (44.6)	36 (55.4)	p= 0.371	26 (51.0)	25 (49.0)	p=0.720

χ^2= Pearson's chi -squar e

DISCUSSION

In this study, children between 48-59 months of age formed the highest proportion in both urban and rural areas, and this is similar to the findings from studies done in Imo and Bangladesh.[11-13] A different trend was seen in a study done in Benin, Oyo and Ghana.[14-16] The reason for this difference could be that the latter studies focused only on children aged 12 to 23 months compared to this study, which included children aged 12 to 59 months.

The majority of the mothers in both groups were in the age group of 25-29 years, which was similar to findings of studies carried out in Nasarawa, Oyo, Imo, Ethiopia and Iran,[12,16-19] in which most of the respondents fell within this age group. However, this is in contrast to a study in Ondo State, Nigeria, as well as in Mozambique and India [20-22] where the majority of mothers were in the age group 20 to

24 years. The difference obtained could be due to differences in study settings.

Childhood immunization status was confirmed using the child's health card and the mother's/caregiver's recall. About one-third of the children in the urban areas were fully immunized compared to one-fifth in the rural areas. These findings are similar to the report of NDHS 2018 that found vaccination differs by place of residence, with urban children more likely to receive all vaccinations than rural children (44% versus 23%).[23] In addition to the NDHS 2018 report, different studies have documented higher immunization coverage in urban areas compared with rural areas.[3, 19, 24, 25, 26] Reasons could be attributed to the lack of awareness of the need for immunization services, which is higher among mothers in rural areas in comparison to those in urban areas. Another explanation for the higher proportion of fully immunized children in urban areas than in rural areas is that mothers in urban areas were better educated and thus should have better health-seeking behavior. However, the findings of a study done in Bayelsa contrasts these findings, where children living in rural areas were fully immunized compared to those living in urban areas.27

It was observed in this study that in both urban and rural areas, immunization rates were very low compared to the acceptable target set by the NPI of 80%. These results have important public health implications for the eradication of vaccine-preventable diseases in the country. Suboptimal immunization coverage results in low herd immunity with continued circulation of vaccine preventable diseases and increased morbidity and mortality from these diseases in the communities. Herd immunity is improved by immunizing eligible children in the community, and this subsequently results in a lower incidence of vaccine preventable diseases. This has been demonstrated in countries with greater than 90% coverage in which the mortality and morbidity resulting from these diseases have been significantly reduced and, in some cases, totally absent.1

The immunization coverages in this study in both urban and rural areas are higher compared with the reports of MICS/NICS 2016-2017, NDHS 2018, Raji et al. 2019, who documented lower immunization coverages of 2.2, 4.5 and 7.6% in Sokoto State, respectively.[3, 23, 28] The low level of immunization coverage among children in urban and rural areas of Sokoto could be linked to the low literacy level of the mothers, as about one-third of the mothers in urban and only 2.3% in rural areas completed secondary education. Another reason could be due to vaccine hesitancy and refusal to accept vaccines for children, which has been an age-old challenge to immunization success in the northern part of the country. A significant proportion of children received no immunization in urban (31.5%) and rural (30.0%) areas, despite the availability of immunization services in urban (100%) and rural (99.1%) communities.

The main reason observed for non-immunization was their husbands being against it, which was 34.5% and 37.7% respectively, in urban and rural communities. Other reasons include being unaware of the need for immunization (7.3 and 37.8%), and their religion being against it (30.9 and 11.3%) in urban and rural areas, respectively. Most women in the study area were financially dependent on their husbands, and in most cases, decisions on how to run the family and health issues are made by the husband. These findings are similar to other studies.[29,30]

The result of this study revealed that undernutrition is a major challenge in the communities going by the prevalence of stunting [urban; (46.9%), rural (58.5%)], underweight [urban; (52.3%), rural (60.0%)] and wasting [urban; (22.3%), rural (33.1%)], which are much higher in the rural areas. A higher prevalence of stunting, wasting and underweight was observed in the rural areas compared to urban areas. These findings are comparable to the NDHS, 2018 report and studies conducted in Ondo and Lagos that reported a higher prevalence of stunting, wasting and underweight in rural areas compared to urban areas.23, 20, 31 The higher prevalence of undernutrition in rural areas might be a reflection of the low socioeconomic status and literacy level in these communities. The better nutritional status of urban children is probably due to the cumulative effect of more favourable socioeconomic conditions, which in turn lead to better caring practices for children and their mothers. Another reason could be due to gaps in favour of urban areas found in the level of proximate determinants of child nutritional status, especially women's education and immunization status of the children. The prevalence observed in this study is higher than the national prevalence reported for stunting [urban (26.5%) and rural (45.8%)], wasting [urban (5.4), rural (8.4%)] underweight [urban (15.5), rural (28.7%)] in the Nigeria Demographic and Health Survey of 2018, respectively.23 The findings from studies conducted in Kaduna, Enugu, Ghana, and India showed a lower prevalence of stunting, wasting and underweight when compared with this study.[21,22,32,33]

The unprecedented global social, economic and health crisis triggered by the COVID-19 pandemic posed grave risks to the nutritional status of young children in developing countries, including Nigeria.[31] The higher prevalence of undernutrition (especially wasting and underweight) observed in this study compared to other previous studies could be due to steep declines in household incomes, changes in the availability and affordability of nutritious foods, and interruptions to health, nutrition, and social protection services caused by the COVID-19 pandemic. The prevalence of stunting in urban areas in this study is similar to 44.9% in Kano, 46.0% in Edo and 43.3% in the rural area of Lagos.[31, 34, 35] The prevalence of stunting in rural areas is similar to the average prevalence (58.5%) in the Northwestern states reported by NDHS, 2018 and 58.8% documented in the study on nutritional status and its correlates among under five in India.[23, 32] In this study, stunting, underweight and wasting were high in both urban and rural groups. The impact of undernutrition on children could have intergenerational consequences for child growth and development, and life-long impacts on education, chronic disease risks and overall human capital formation.[36] Also, undernourished children are at an increased risk of morbidity and mortality from infectious diseases in the community. The majority of the children in the rural and urban areas had poor dietary diversity. This is similar to the findings of studies carried out in Benue and Lagos states of Nigeria.[31,37] Children need to be fed a wider variety of foods since an increase in individual dietary diversity score shows a corresponding increase in nutrient intake. Improving food variety may also reflect a high likelihood of meeting daily energy and nutrient requirements, which leads to improved nutrition in children under five years.[1]

Conclusion

The study found that immunization coverage was low in the urban and rural groups, but a significantly higher proportion of the children in urban areas were fully immunized compared to children in rural. There was a high prevalence of stunting, wasting and underweight among children in both urban and rural groups, with a higher proportion of children in the rural group having stunting, wasting and underweight compared to children from the urban group. Children who were fully immunized had a better nutritional status than those who were partially immunized or unimmunized in both urban and rural areas. In urban areas, there was a statistically significant association between immunization status and stunting, underweight, wasting and vitamin A deficiency. However, in rural areas, there was only a statistically significant association between immunization status and underweight.

Recommendation

Community health workers should educate parents about the importance of taking advantage of childhood immunization services, including vitamin A supplementation and ensuring children eat foods from all food groups. State and local governments, through agricultural and health departments, should encourage food diversification at the community level, micronutrient supplementation, and fortification of common foods.

No conflict of interest

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