Original Research Article

Vaccination Hesitancy and Zero-Dose Children in Borno State, Nigeria: Comparative Analysis of Urban Priority and Non-Priority LGAs and Their Implications for Immunization Coverage

ABSTRACT

Background

This study delves into the multifaceted landscape of childhood immunization within urban settings, focusing on vaccine refusal, non-compliance (including partial compliance or defaulter households), and their impacts on immunization coverage. The research, conducted as a case study in communities situated in both Zero-Dose priority LGAs (Local Government Areas) of Maiduguri Metropolitan Council (MMC) and Jere and non-priority LGAs of Konduga and Mafa in Borno State, aims to comprehensively understand the perspectives shaping immunization decisions.

Method

The method involves an extensive quantitative analysis of socio-demographic factors, electronic media ownership, and parental characteristics. Data were collected through household surveys collected from 173 participants, analyzing vaccination records, and assessing immunization coverage rates for period of twelve months. Statistical methods, including chi-square tests, are utilized to explore relationships between settlement types, parental levels of education, and vaccine-related behaviors.

Results

Results indicate significant associations between vaccine refusal, non-compliance, and specific socio-demographic factors. Parental education levels and the gender of the household head emerge as pivotal determinants impacting immunization status and vaccination card retention. Electronic media ownership, particularly radios and handsets, is identified as potential channels for targeted health communication strategies.

Conclusion

The findings underscore the need for tailored, context-specific interventions to enhance immunization coverage, awareness, and acceptance in urban settings. By addressing educational disparities, gender dynamics, and settlement-specific challenges, the study aims to contribute to the development of effective strategies in achieving comprehensive immunization coverage and mitigating the risks associated with vaccine refusal and non-compliance. Ultimately, this research provides valuable insights into the dynamics of childhood immunization, informing public health policies and interventions in the specified LGAs of Borno State.

Keywords: ***Vaccination hesitancy; Zero-dose; Immunization; Implication; Coverage***

INTRODUCTION

Vaccination against diseases if herd immunity is achieved confers protection to the population. Achieving herd immunity means vaccinating a certain percentage of the population. Achieving the desired coverage

for individual and community protection is challenged by several factors; supply or demand barriers. Vaccination is identified as one of the greatest public health inventions of all time. It has played a significant role in improving chances of human survival and marked a point at which humans and animals stood a chance against pathogens. The children age groups, especially those under 5 years, have been scientifically proven to be more susceptible to disease causing antigens. Globally, vaccine hesitancy and noncompliance have gained prominence as significant barriers to achieving comprehensive immunization coverage. The World Health Organization (WHO) recognizes vaccine hesitancy as one of the top ten threats to global health, emphasizing the need for tailored strategies to address this multifaceted challenge [1]. While immunization programs have made substantial progress, persistent pockets of vaccine refusal and non-compliance can compromise community immunity, leaving populations vulnerable to outbreaks of vaccine-preventable diseases [2].

However, vaccine refusal, non-compliance, and partial compliance among households pose significant challenges to achieving optimal immunization coverage. World Health Organization emphasizes the importance of addressing systemic barriers to immunization to reduce the prevalence of zero-dose children [3]. Zero-dose children, defined as those who have never received any routine vaccinations, represent a vulnerable population at higher risk of disease transmission. Identifying the factors contributing to the existence of zero-dose children is critical for designing targeted interventions to reach these underserved populations.

Urban areas present a unique set of challenges for immunization programs. The complexity of urban living, coupled with diverse cultural and socio-economic factors, can contribute to vaccine hesitancy and non-compliance. Accessibility issues, misinformation, and cultural beliefs specific to urban contexts may influence the decision-making processes within households regarding vaccination [4]. Understanding these urban-specific challenges is critical for tailoring interventions that resonate with the diverse population found in urban settings.

Borno State, situated in northeastern Nigeria, faces unique challenges due to a complex humanitarian context marked by conflict, displacement, and strained healthcare systems. Within this context, understanding the perspectives of vaccine refusal, non-compliance, and partial compliance in urban settings is critical. The study focuses on specific local government areas (LGAs) to provide a nuanced understanding of vaccine-related behaviors, differentiating between the zero-dose priority LGAs of Maiduguri Metropolitan Council (MMC) and Jere and the non-priority LGAs of Konduga and Mafa.

Maiduguri Metropolitan Council (MMC) and Jere have been identified as zero-dose priority LGAs, emphasizing the urgent need for targeted interventions to address the prevalence of children who have never received routine vaccinations. Misinformation about vaccine safety and efficacy in these areas contribute to unique challenges, influencing the perspectives and behaviors of households regarding immunization. It is worth noting that, factors such as access to healthcare services, insecurity, and disruptions to routine life may contribute to vaccine hesitancy and noncompliance. Understanding the

communities in MMC and Jere involves delving into the socio-cultural fabric, examining the impact of displacement on healthcare-seeking behaviors, and identifying the specific reasons behind vaccine refusal and non-compliance. It is crucial to contextualize these findings within the broader framework of the region's challenges to develop effective strategies for improving routine and supplementary immunization activities.

In contrast, Konduga and Mafa, identified as non-priority LGAs, exhibit different dynamics in terms of vaccine-related behaviors. These areas may not be the immediate focus of zero-dose reduction initiatives, but understanding the factors contributing to vaccine hesitancy and non-compliance is equally vital for comprehensive public health strategies. In non-priority LGAs, the study will explore whether access to healthcare services plays a pivotal role, or if cultural and religious factors exert a more pronounced influence on vaccine-related decisions. By contrasting the perspectives and behaviors in non-priority LGAs with those in zero-dose priority LGAs, the research aims to focus on understanding some of the identified demand-side barriers; non-compliance, refusals and zero dose children and how their relationship in influencing low vaccine coverage in urban settings within Borno State.

METHODOLOGY

The methodology involves an extensive quantitative analysis of socio-demographic factors, electronic media ownership, and parental characteristics. Written informed consent was obtained from each participant. Data were collected through household surveys, analyzing vaccination records, and assessing immunization coverage rates. Confidentiality and anonymity of participants and data collected were strictly maintained throughout the study. The study also placed into consideration the cultural practices and beliefs of the LGAs where data was collected, ensuring ethical research standards and protection of rights and welfare of the participants.

The study used a stratified sampling method to ensure representation from diverse socio-economic and cultural backgrounds within the study areas. Data collection tool was designed to capture information on socio-cultural beliefs, accessibility issues, awareness levels, and experiences related to vaccine refusal and non-compliance.

Statistical methods, including chi-square tests were utilized to explore relationships between settlement types, parental education levels, and vaccine-related behaviors. The investigation encompasses Routine Immunization and Supplementary Immunization Activities (SIAs) to provide a holistic understanding of immunization coverage.

RESULTS

This is a field-based cross-sectional analytical study aimed at Vaccine refusal and non-compliance, including partial compliance (defaulter) households in Urban settings and Impacts on Immunization coverage (Routine Immunization and Supplementary Immunization Activities) and relation to Zero-dose

Children. The sample size of the study is 173 non-compliance households across 4 LGAs in Borno State, with 2 zero dose LGAs and 2 non-zero dose LGAs. The data was collected during fractional IPV (fIPV) and Measles Campaigns across the selected LGAs.

Table 1. Socio-demographic characteristics

Variable	Frequency	Percentage
LGA of intervention		
Jere	43	24.9
Konduga	48	27.7
Mafa	32	18.5
MMC	50	28.9
Settlement type		
Type I (Slum)	39	22.5
Type II (Squalor)	119	68.8
Type III (Squatter)	15	8.7
Education Status of child		
Primary	42	24.3
Islamic *Tsangaya*	40	23.1
Both	13	7.5
None	78	45.1
Education Status of Guardian		
Primary	29	16.8
Secondary	11	6.4
Tertiary	5	2.9
None	128	74.0
Distance from closest Health facility		
<1km	44	25.4
1-2km	62	35.8
3-4km	27	15.6
5-6km	6	3.5
>6km	34	19.7
Distance from closest School		
<1km	35	20.2
1-2km	69	39.9
3-4km	37	21.4
5-6km	8	4.6
>6km	24	13.9

Table 1 shows the socio-demographical characteristics of the study. a total of 50(28.9%) households/noncompliance children were recorded in MMC which was predominantly the highest number of non-compliance cases recorded in the study, 43(24.9%) recorded in Jere LGA, 48(27.7%) in Konduga and 32(18.5%) in cases recorded in Mafa LGA which was the least record non-compliance cases in the study. For the settlement type, 119(68.8) of the households recorded live in Type II (Squalor: a collection of poorly set buildings, not government approved) which forms the bulk of the data, 39(22.5%) lived in Type I (Slum) and 15(8/7%) lived in type III settlement (squatter) which is the lowest in the data recorded. The educational status of the children connotes 78(45.1%) have never attended any formal and informal education, 42(24.3%) and 40(23.1%) were recorded for both primary and Islamic *Tsangaya* respectively while only 13(7.5%) of the study sample have both Islamic and primary education. Parents/Guardians' educational status recorded 128(74.0%) have no formal or non-formal educational status which was the predominantly highest recorded with only 5(2.9%) having tertiary education. Six households (3.5%) indicated they would travel 5–6 km to reach the nearest health facilities, whereas 62 households (35.8%) reported that the distance to the closest facility was 1-2 km, the highest documented distance. Regarding the proximity to the nearest school, 69 individuals (39.9%) reported that it was within 1-2 km, 35 individuals (20.2%) said it was less than 1 km, and 8 individuals (4.6%) said it was 5–6 km away from their homes. Out of the total 173 households recorded, 152(88%) have a male head of household while 21(12%) have a female as head of household.

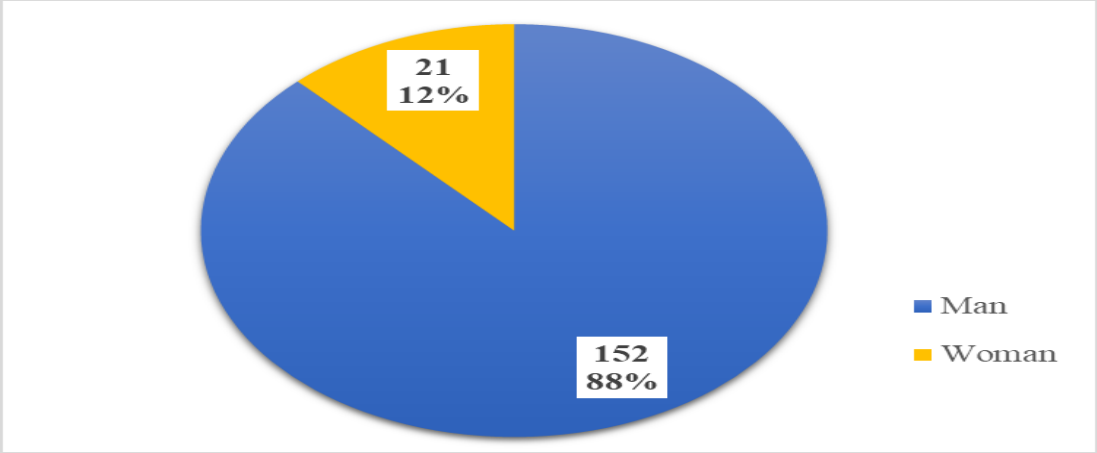

Figure 1: Distribution of head of household

Table 2 shows the electronic media owned in each of the households where 122(70.5%) of the households have owned a radio, 23(13.3%) have Television sets and 28(16.2%) have both television and radio in their households respectively. Households with handsets were 154(89.0%) while 19(11.0%) and no handsets in possession.

Table 2: Household Possession of Electronic Media

Variable	Frequency	Percentage
Type of electronic media owned		
Radio	122	70.5
Television	23	13.3
Both	28	16.2
Own handset		
Yes	154	89.0
No	19	11.0

Table 3 shows the biodata of the non-compliant children recorded in the study. The results shows that 93(53.8%) of the children were males which is slightly higher than that of females which is 80(46.2%) respectively. For the status if immunization of the children sampled for the study, 121(69.9%) were never immunized with any vaccine (Zero Dose children) which was predominantly higher than 52(30.1%) of the children which were partially immunized but later refused to complete vaccination. No fully immunized child was recorded from the non-compliance household sampled.

Table 3: Biodata of non-compliant children

Variable	Frequency	Percentage
Child's Gender		
Male	93	53.8
Female	80	46.2
Others	0	0.0
Immunization status		
Never immunized	121	69.9
Partially immunized	52	30.1
Fully immunized	0	0.0
Vaccination card availability		
Available	23	44.2
Lost	27	51.9
Never had	2	3.9
BCG Mark seen		
Not seen	130	75.1
Seen	43	24.9

Some socio-demographic characteristics were associated with Vaccine refusal, Noncompliance, including partial compliance (defaulter) households in Urban settings and Impacts on Immunization Coverage and

relation to Zero-dose Children using Chi-Square T-test to ascertain the level of significant relationships between the two. Table 4 below shows the relationship between settlement type and immunization status as a risk factor. There is no significant association between settlement type and immunization status as the p-value is greater than 0.05 (0.116), Therefore, it does not seem that the type of settlement has a statistically significant effect on whether children are fully or partially immunized. For settlement type and vaccination card availability, the association between the two is not statistically significant as the p-value is >0.05 (0.269). There is a strong statistically significant association between the type of settlement in which the data was collected and vaccine refusal in the past as the p-value is <0.05 (0.000), this is due to 116(73.9%) of the respondent refusing in the past are of type II settlement and contributing to the greater percentage of the refusals. For both awareness of vaccination campaigns and awareness of accessing vaccinations, the p-value is 0.000. This seems that the level of awareness of the vaccination campaign and awareness on accessing vaccination by parents/caregivers affects the compliance for vaccination across the settlements as 152(87.9%) of the sampled households responded to having no prior knowledge of the ongoing vaccination campaigns and 150(86.7%) are not aware on accessing vaccination. The result further reveals that there is a statistically significant association between the type of settlement and proximity of the clinic as an influence on vaccination acceptability by the parents/caregivers as the p-value is 0.031 which is less than the significant level of 0.05. The relationship between settlement type and Proximity of the clinic influences vaccination acceptability amongst the caregivers. Moreover, the settlement type affects the adequacy of information about the vaccination of a child as the statistical association shows a p-value <0.05 (0.041). There is more likelihood that those in urban LGAs have more adequate information about child vaccination as the data shows 79(45%) responded to having no adequate information about the vaccination status of the child.

Table 4: Chi-Square test between type of settlement and other risk factors associated with vaccine refusal

Variable	Settlement type			
	Type I Freq.(%)	Type II Freq.(%)	Type III Freq.(%)	P-value
Immunization status				
Never immunized	26(21.5)	81(66.9)	14(11.6)	0.116
Partially immunized	13(25.0)	38(73.1)	1(1.9)	
Vaccination card availability				
Available	8(34.8)	14(60.9)	1(4.3)	0.269
Lost	5(18.5)	22(81.5)	0(0.0)	
Never had	0(0.0)	2(100)	0(0.0)	
Vaccine refusal in the past				
Yes	29(18.5)	116(73.9)	12(7.6)	0.000
No	10(62.5)	3(18.8)	3(18.8)	
Awareness on vaccination campaigns				
Yes	36(22.5)	108(71.1)	8(5.3)	0.000
No	3(14.3)	11(52.4)	7(33.3)	
Awareness on accessing vaccination				
Yes	34(22.7)	110(73.3)	6(4.0)	0.000
No	5(21.7)	9(39.1)	9(39.1)	
Proximity of clinic influences vaccination acceptability				
Yes	14(36.8)	23(60.5)	1(2.6)	0.031
No	25(18.5)	96(71.1)	14(10.4)	
Adequate information about vaccination of child				
Yes	27(28.7)	62(66.0)	5(5.3)	0.041
No	12(15.2)	57(72.2)	10(12.7)	

Table 5 below shows the relationship between Parent/Guardian educational level and risk factors associated with vaccine refusal. The p-value is less than 0.05 (0.001), indicating a statistically significant correlation between the level of education of the parent or guardian and the immunization status of the child. This suggests that the level of education of the parent or guardian influences the child's

immunization status, either fully or partially. Parent/Guardian educational level and vaccination card availability the association between the two is statistically significant as the p-value is <0.05 (0.012). This indicates that parent/guardian vaccination card retention is influenced by their educational attainment. The study also shows that, because the p-value is >0.05, there is no statistically significant relationship between the Parent/educational Guardian's background and history of refusing vaccinations (0.333). Moreover, as table 5 below illustrates, all of the p-values were greater than 0.05, indicating that there was no statistically significant correlation found in the other risk factors connected to the parents' or guardians' educational level in the study.

Table 5: Chi-Square test between Parent/Guardians' educational level and other risk factors associated with vaccine refusal

Variable	Parent/Guardian educational level				
	None Freq.(%)	Primary Freq.(%)	Secondary Freq.(%)	Tertiary Freq.(%)	P-value
Immunization status					
Never immunized	98(81.0)	12(9.9)	9(7.4)	2(1.7)	0.001
Partially immunized	30(57.7)	17(32.7)	2(3.8)	3(5.8)	
Vaccination card availability					
Available	13(56.5)	7(30.4)	2(8.7)	1(4.3)	0.012
Lost	15(55.6)	10(37.0)	0(0.0)	2(7.4)	
Never had	2(100.0)	0(0.0)	0.(0.0)	0(0.0)	
Vaccine refusal in the past					
Yes	114(72.6)	28(17.8)	11(7.0)	4(2.5)	0.333
No	14(87.5)	1(6.3)	0.(0.0)	1(6.3)	
Awareness on vaccination campaigns					
Yes	108(71.1)	28(18.4)	11(7.2)	5(3.3)	0.126
No	20(95.2)	1(4.8)	0(0.0)	0(0.0)	
Awareness on accessing vaccination					
Yes	106(70.7)	28(18.7)	11(7.3)	5(3.3)	0.087
No	22(95.7)	1(4.3)	0(0.0)	0.(0.0)	
Proximity of clinic influences vaccination acceptability					
Yes	33(86.8)	5(13.2)	0(0.0)	0(0.0)	0.113
No	95(70.4)	24(17.8)	11(8.1)	5(3.7)	
Adequate information about vaccination of child					
Yes	67(71.3)	18(19.1)	8(8.5)	1(1.1)	0.189
No	61(77.2)	11(13.9)	3(3.8)	4(5.1)	

The household head was further compared with the risk factors associated with vaccination refusal and non-compliance, to test the significant association on the risk factors. There is a statistical significance between either man or woman being the head of the household and immunization status as the p-value is <0.05 (0.007), the data further reveals that out of the 21 households who have female household head, all

the 20 (95.2%) were never immunized with any vaccine compared to 101(66.5%) of the household with men as household head were never immunized with any vaccine (zero dose). For card retention, the study further reveals that there is a statistically significant association when compared with the household head with a p-value of 0.058. This signifies that the household head being a man or woman has an impact on card retention in the household as the data shows that 22(95.7%) of the respondents who have cards have male household heads. The relationship between head of household and vaccine refusal in the past shows a statistically significant as the p-value is less than 0.05. The data further reveals that 141(89.8) households who refused vaccination in the past have men as head of household while 166(10.2%) have women as household head. Furthermore, as shown in Table 6 below, the other risk factors associated with the head of household were not statistically significant as the p-values were greater than 0.05.

Table 6: Chi-Square test of relationship between head of household and risk factors associated with vaccine refusal.

Variable	Head of household		
	Man Freq.(%)	Woman Freq.(%)	P-value
Immunization status			
Never immunized	101(83.5)	20(16.5)	0.007
Partially immunized	51(98.1)	1(1.9)	
Vaccination card availability			
Available	22.(95.7)	1(4.3)	0.058
Lost	27(100.0)	0(0.0)	
Never had	2(100.0)	0(0.0)	
Vaccine refusal in the past			
Yes	141(89.8)	16(10.2)	0.014
No	11(68.8)	5(31.3)	
Awareness on vaccination campaigns			
Yes	134(88.2)	18(11.8)	0.748
No	18(85.7)	3(14.3)	
Awareness on accessing vaccination			
Yes	133(88.7)	17(11.3)	0.407
No	19(82.6)	4(17.4)	
Proximity of clinic influences vaccination acceptability			
Yes	35(92.1)	3(7.9)	0.364
No	117(86.7)	18(13.3)	
Adequate information about vaccination of child			
Yes	83(88.3)	11(11.7)	0.848
No	69(87.3)	10(12.7)	

DISCUSSION

Non-compliance Distribution across LGAs

The study indicates that the highest number of noncompliance cases was recorded in MMC (28.9%), followed by Jere LGA (24.9%), Konduga (27.7%), and Mafa LGA (18.5%). This distribution reflects variations in noncompliance across different Local Government Areas (LGAs) in the study area aligning

with previous study which revealed that,trends in noncompliance and refusals vary across regions as some areas experience a surge in vaccine hesitancy, others may exhibit resilient immunization behaviors [5].

Settlement Types and Non-compliance

The research findings indicate that the majority of noncompliance cases were found in Type II settlements (Squalor), constituting 68.8% of the data. This aligns with existing knowledge that socio-economic conditions and living environments can influence health-related behaviors. Suffice it to say however, the finding is in tandem with another study which asserts that populations facing economic disparities may encounter barriers to accessing vaccination services, contributing to vaccine-preventable disease outbreaks [6].

Educational Status of Children

The research findings indicate that 45.1% of children had never attended any formal or informal education. This finding underscores the importance of education in shaping healthy behaviors. To support this (Dubé et al., 2013), assert thatthese concerns can be addressed through targeted education campaigns, sharing evidence-based information, and dispelling myths which can positively shift attitudes towards recognizing vaccines as safe and essential.

Parents/Guardians' Educational Status

The research findings indicate a significant proportion (74.0%) of parents/guardians had no formal or non-formal educational status. This aligns with existing literature suggesting a link between parental education and vaccination choices.One significant study reported a positive correlation between higher levels of parental education and an increased likelihood of adhering to recommended vaccination schedules [7]. The study, which analyzed data from a nationally representative sample, concluded that parents with higher education levels tend to be more informed about the benefits of vaccinations, possess a better understanding of the scientific evidence supporting immunization, and are more likely to comply with vaccination guidelines.

Furthermore, a comprehensive review of existing literature on parental attitudes toward vaccinations was conducted by another team of researchers, and recorded that parents with lower levels of education often exhibit higher levels of vaccine hesitancy or refusal [8]. This hesitancy may stem from a lack of access to credible information, lower health literacy, and susceptibility to misinformation regarding vaccine safety and efficacy.

Distance to Health Facilities and Schools

The findings indicate varying distances to health facilities and schools. For instance, 35.8% reported that the distance to the closest health facility was 1-2 km, while 39.9% reported that the nearest school was

within 1-2 km. These findings emphasize the role of accessibility in healthcare utilization and education as opined by study which noted that noncompliance and refusals may be exacerbated when healthcare facilities are distant or inadequately equipped, leading to a higher prevalence of zero-dose children [6].

Household Head Gender

The research findings indicate that the majority of households (88%) have a male head. Gender dynamics can influence health-related decision-making. One of the recent studies supports the notion that household gender dynamics play a crucial role in health decision-making. It also noted that in patriarchal family structures, where a male is the household head, there may be specific gender norms and power dynamics that impact health-related choices. This can result in differential access to healthcare resources, with potential consequences for the overall health and well-being of household members [9].

Moreover, a study conducted a year ago found that in households with a male head, there might be disparities in healthcare utilization patterns, the author therefore highlighted that decision-making authority often rests with the male head, affecting the allocation of resources, including those related to healthcare [10]. This imbalance in decision-making power may influence health-seeking behaviors and access to essential health services.

In a different context, research by Atia and colleagues (2023) emphasized the importance of considering gender dynamics in health interventions. They argued that acknowledging the influence of the male head in households is crucial for designing effective health programs, as it can impact the acceptance and implementation of health initiatives [11].

Household Possession of Electronic Media

The study provides insights into the electronic media ownership within households, revealing that 122 (70.5%) of the households own a radio, 23 (13.3%) have television sets, and 28 (16.2%) possess both television and radio. Moreover, the majority of households, numbering 154 (89.0%), own handsets, while 19 (11.0%) do not have any handsets.

This electronic media ownership distribution aligns with previous research on media accessibility and its impact on health-related behaviors. There is an emphasis on the importance of radio ownership in disseminating health information in resource-limited settings [12]. The widespread ownership of radios in the households, as indicated in Table 2, suggests a potential avenue for health communication strategies, especially for interventions requiring broad dissemination.

Furthermore, the presence of television sets in 13.3% of households may be considered in the context of health education campaigns. Oliveira-Cruz and his team highlighted the effectiveness of using television as a medium for health promotion, particularly in urban settings [13]. The data from Table 2 suggests that utilizing television for health communication could be a viable option in reaching a subset of households.

The high prevalence of handset ownership in 89.0% of households is noteworthy. Mobile phones have been recognized as powerful tools for health communication and intervention delivery. With a significant proportion of households having access to handsets, there is potential for leveraging mobile technology in disseminating health-related information, reminders, and interventions.Mobile technologies, including text messages and apps, have shown promise in providing immunization reminders and educational content directly to households. These interventions have the potential to overcome barriers related to awareness and appointment adherence [14].

Bio-data of Non-Compliant Children

The research findings present the bio-data of non-compliant children in the study, indicating that 93 (53.8%) of the children were males, slightly outnumbering females at 80 (46.2%). In terms of immunization status, 121 (69.9%) of the children were never immunized (Zero Dose children), a significantly higher proportion compared to 52 (30.1%) who were partially immunized but later refused to complete the vaccination schedule. Notably, no fully immunized child was recorded among the non-compliant households sampled.

These findings align with existing literature on gender differentials in vaccination coverage and the consequences of incomplete immunization. Research by Ansell et al.[15] emphasizes the gender disparities in health-seeking behaviors and healthcare utilization among children. The slightly higher proportion of non-compliant males in Table 3 may warrant targeted interventions to address potential gender-specific barriers to immunization.

Moreover, the prevalence of Zero Dose children, as highlighted in Table 3, underscores the urgent need for interventions aimed at improving initial vaccine uptake. The implications of delayed or missed doses in vaccine schedules, has noted the heightened risk of vaccine-preventable diseases among incompletely immunized children [6].

The absence of fully immunized children in the non-compliant households, as noted in Table 3, emphasizes the critical gap in achieving comprehensive immunization coverage within this population. Completing the recommended vaccine schedule for optimal protection against vaccine-preventable diseases is very critical and should be given required attention [16]. The absence of fully immunized children in the non-compliant group signals a need for targeted interventions to address barriers to completing the vaccination series.

Chi-square Test between Parent/Guardians' Educational Level and Other Risk Factors Associated with Vaccine Refusal

The findings of the study provide an analysis of the relationship between the educational level of parents or guardians and various risk factors associated with vaccine refusal. The results demonstrate a

statistically significant correlation between the level of education of the parent or guardian and the immunization status of the child (p-value = 0.001). This implies that the educational background of the parent or guardian plays a significant role in influencing the child's immunization status, whether fully or partially.

In addition, the association between parent/guardian educational level and vaccination card availability is also found to be statistically significant (p-value = 0.012). This suggests that the retention of vaccination cards by parents or guardians is influenced by their educational attainment.

However, no statistically significant relationship is observed between the parent/guardian's educational background and the history of refusing vaccinations (p-value = 0.333). This indicates that, in this study, the educational level of parents or guardians does not appear to have a significant impact on their history of refusing vaccinations for their children.

It's noteworthy that for the other risk factors associated with parents' or guardians' educational level, all p-values are greater than 0.05, indicating no statistically significant correlations in those aspects in this study.

These findings align with a similar study, highlighting the influence of parental education on health-related decision-making, including vaccination choices for children [17]. The statistically significant associations underscore the importance of considering the educational background of parents or guardians in developing targeted interventions to improve immunization rates and vaccination-related behaviors.

Chi-square Test between Type of Settlement and Other Risk Factors Associated with Vaccine Refusal

The analysis of socio-demographic characteristics associated with vaccine refusal, noncompliance, and impacts on immunization coverage in urban settings is presented in Table 4. Chi-square and T-test were employed to assess significant relationships between these variables.

For settlement type and immunization status, the results indicate that there is no significant association between the type of settlement and immunization status (p-value = 0.116). This suggests that the type of settlement does not have a statistically significant effect on whether children are fully or partially immunized.

Similarly, for settlement type and vaccination card availability, the association is not statistically significant (p-value = 0.269), implying that the type of settlement does not significantly influence the availability of vaccination cards among households.

In contrast, a strong statistically significant association is observed between settlement type and vaccine refusal in the past (p-value = 0.000). This is highlighted by the fact that 116 (73.9%) of the respondents

who refused vaccination in the past are from type II settlements, contributing to a higher percentage of refusals in that settlement type.

Regarding awareness of vaccination campaigns and awareness of accessing vaccinations, both associations show a statistically significant relationship with p-values of 0.000. This suggests that the level of awareness of vaccination campaigns and the awareness of accessing vaccinations by parents/caregivers significantly affect compliance for vaccination across different settlements.

Furthermore, the analysis reveals a statistically significant association between settlement type and the proximity of the clinic as an influence on vaccination acceptability by parents/caregivers (p-value = 0.031). This implies that the location of clinics in relation to settlement type has an impact on the acceptability of vaccination among caregivers.

Finally, settlement type is found to influence the adequacy of information about child vaccination, with a statistically significant association (p-value = 0.041). The data suggests that those in urban LGAs are more likely to have more adequate information about child vaccination, as 79 (45%) respondents reported having no adequate information about the vaccination status of their children.

Chi-square Test between Parent/Guardians' Educational Level and Other Risk Factors Associated with Vaccine Refusal

The findings of the study provide an analysis of the relationship between the educational level of parents or guardians and various risk factors associated with vaccine refusal. The results demonstrate a statistically significant correlation between the level of education of the parent or guardian and the immunization status of the child (p-value = 0.001). This implies that the educational background of the parent or guardian plays a significant role in influencing the child's immunization status, whether fully or partially.

In addition, the association between parent/guardian educational level and vaccination card availability is also found to be statistically significant (p-value = 0.012). This suggests that the retention of vaccination cards by parents or guardians is influenced by their educational attainment.

However, no statistically significant relationship is observed between the parent/guardian's educational background and the history of refusing vaccinations (p-value = 0.333). This indicates that, in this study, the educational level of parents or guardians does not appear to have a significant impact on their history of refusing vaccinations for their children.

It's noteworthy that for the other risk factors associated with parents' or guardians' educational level, all p-values are greater than 0.05, indicating no statistically significant correlations in those aspects in this study.

These findings align with that of Kickbusch, highlighting the influence of parental education on health-related decision-making, including vaccination choices for children [17]. The statistically significant associations underscore the importance of considering the educational background of parents or guardians in developing targeted interventions to improve immunization rates and vaccination-related behaviors.

Chi-Square Test of Relationship between Head of Household and Risk Factors Associated with Vaccine Refusal

The research findings provide an analysis of the relationship between the gender of the household head and various risk factors associated with vaccination refusal and non-compliance. The results demonstrate statistical significance between either a man or a woman being the head of the household and the immunization status of the child (p-value = 0.007). Further exploration of the data reveals that out of the 21 households with female household heads, all 20 (95.2%) were never immunized with any vaccine, compared to 101 (66.5%) of households with male household heads being never immunized (zero dose).

For card retention, the study reveals a statistically significant association with the gender of the household head, with a p-value of 0.058. This suggests that whether the household head is a man, or a woman has an impact on card retention in the household. The data indicates that 22 (95.7%) of the respondents who have vaccination cards have male household heads.

The relationship between the gender of the household head and vaccine refusal in the past is also statistically significant, with a p-value less than 0.05. The data further reveals that 141 (89.8%) households who refused vaccination in the past have men as the head of the household, while 166 (10.2%) have women as household heads.

However, for the other risk factors associated with the gender of the household head, as shown in Table 6, the p-values were greater than 0.05, indicating no statistically significant correlations in those aspects in this study.

These findings align with that of Mumtaz and Salway, which recognizes the influence of the household head's gender on health-related decision-making, including vaccination choices for children [18]. The statistically significant associations emphasize the importance of considering the gender of the household head in designing targeted interventions to address vaccine refusal and non-compliance.

CONCLUSION

This study delved into various facets of childhood immunization, examining routine immunization, Supplemental Immunization Activities (SIAs), and the interconnected relationships between them. The analysis of socio-demographic factors, electronic media ownership, and parental characteristics provided valuable insights into the dynamics influencing vaccination choices and compliance in urban settings. Notably, the prevalence of vaccine refusal and non-compliance was associated with distinct socio-

demographic factors, emphasizing the importance of tailoring interventions to specific population characteristics. The educational level of parents or guardians emerged as a significant factor, impacting immunization status and vaccination card retention. Furthermore, the gender of the household head played a crucial role, revealing statistically significant associations with immunization status, card retention, and vaccine refusal in the past. Electronic media ownership, particularly the widespread access to radios and handsets, highlighted potential channels for targeted health communication strategies. However, the study also illuminated areas of concern, such as the high proportion of Zero Dose children and the impact of settlement type on vaccine-related behaviors.

The findings underscore the need for nuanced, context-specific approaches to enhance immunization coverage, awareness, and acceptance. Tailored interventions addressing educational disparities, gender dynamics, and settlement-specific challenges could contribute to improved vaccination outcomes. Additionally, leveraging electronic media platforms for targeted health communication campaigns holds promise in enhancing awareness and addressing misinformation. As we navigate the complex landscape of childhood immunization, understanding the multifaceted influences on vaccination decisions is paramount. This study contributes valuable insights that can inform public health policies and interventions, fostering more effective strategies to achieve comprehensive immunization coverage and mitigate the risks associated with vaccine refusal and non-compliance in urban settings.

Ethical Approval:

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

Consent

As per international standards or university standards, Participants' written consent has been collected and preserved by the author(s).

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

REFERENCES

1. World Health Organization. (2019). Ten threats to global health in 2019. Retrieved from [https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019]

2. Oyo-Ita, A., Wiysonge, C. S., Oringanje, C., Nwachukwu, C. E., Oduwole, O., Meremikwu, M. M., & Garner, P. (2016). Interventions for improving coverage of childhood immunisation in low-income and middle-income countries. Cochrane Database of Systematic Reviews, 7.
3. World Health Organization. (2020). Immunization coverage is improving, but 1 in 5 children is still missing out on vital vaccines. Retrieved from [https://www.who.int/news-room/detail/15-07-2020-immunization-coverage-is-improving-but-1-in-5-children-is-still-missing-out-on-vital-vaccines]
4. Abuya, T., Njuki, R., Warren, C. E., Okal, J., Obare, F., Kanya, L., ... & Bellows, B. (2016). A policy analysis of the implementation of a reproductive health vouchers program in Kenya. BMC Public Health, 16(1), 9.
5. Dubé, E., Gagnon, D., Ouakki, M., Bettinger, J. A., Guay, M., Halperin, S., ... & De Serres, G. (2014). Understanding vaccine hesitancy in Canada: Results of a consultation study by the Canadian Immunization Research Network. PloS ONE, 9(6), e100989.
6. Wiysonge, C. S., Uthman, O. A., Ndumbe, P. M., & Hussey, G. D. (2012). Individual and contextual factors associated with low childhood immunisation coverage in sub-Saharan Africa: a multilevel analysis. *PloS one*, *7*(5), e37905.
7. Smith, K. P., & Smith, K. R. (2018). Socioeconomic status and childhood leukemia incidence in affluent communities. Sociological Science, 5, 322-335.
8. Larson, H. J., Jarrett, C., Schulz, W. S., Chaudhuri, M., Zhou, Y., & Dube, E. (2014). Measuring vaccine hesitancy: The development of a survey tool. Vaccine, 32(34), 4165–4175. doi: 10.1016/j.vaccine.2014.06.014
9. Sara, Chace, Dwyer., Sanyukta, Mathur., Karen, Kirk., C., Dadi., Leanne, Dougherty. (2022). "When you live in good health with your husband, then your children are in good health …." A qualitative exploration of how households make healthcare decisions in Maradi and Zinder Regions, Niger. BMC Public Health, doi: 10.1186/s12889-022-13683-y
10. Chidi, Slessor, Mbah., Uche, C., Isiugo-Abanihe., Ezebunwa, E., Nwokocha. (2023). Influence of Household Decisions on the Socio-Economic and Fertility Behaviour of Women in Rural Nigeria. *Journal of International Cooperation and Development*, doi: 10.36941/jicd-2023-0014
11. Atia, Hossain., Gaylan, Peyari, Tarannum, Dana. (2023). Perception About Household Decision-Making Process on Obtaining Maternal Health Services Among the Employed Women of Dhaka City. Social sciences review (Dhaka), doi: 10.3329/ssr.v38i2.6446
12. Levermore, R., & Power, T. (2017). Radio and development in Africa: A concept paper. *Journal of Contemporary African Studies*, 35(3), 415–433.
13. Oliveira-Cruz, V., Hanson, K., & Mills, A. (2016). Approaches to overcoming constraints to effective health service delivery: A review of the evidence. *Journal of International Development*, 18(1), 41–51.
14. Bangure, D., Chirundu, D., Gombe, N. T., Marufu, T., Mandozana, G., Tshimanga, M., ... & Apollo, T. M. (2017). Effectiveness of short message services reminder on childhood immunization programme in Kadoma, Zimbabwe – A randomized controlled trial, 2013. BMC Public Health, 17(1), 1–9.
15. Ansell, N., Fonseca, M., & Hajdu, F. (2018). Gender and immunization: Challenges and strategies in vaccination programming. Global Public Health, 13(10), 1232–1242
16. Orenstein, W. A., Hinman, A., Nkowane, B., & Olive, J. M. (2011). Reassessment of the benefits and risks of immunization. Vaccine, 29(Suppl 4), D38–D46.
17. Kickbusch, I., Pelikan, J. M., Apfel, F., & Tsouros, A. D. (2013). Health literacy: The solid facts. World Health Organization (WHO) Regional Office for Europe.
18. Mumtaz, Z., & Salway, S. (2009). 'I never go anywhere': Extricating the links between women's mobility and uptake of reproductive health services in Pakistan. Social Science & Medicine, 68(11), 2066–2073.