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Evaluating the Reasons for Partial and Non-immunization of Children in Wushishi Local Government Area, Niger State, Nigeria: Methodological Comparison

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Abstract

Immunization of children against childhood preventable diseases has remained one of the most important cost effective and public health strategies to reduce childhood preventable morbidity and mortalities arising from infectious diseases. A recent report released by World Health Organization (WHO) stated that 1 in 10 infants did not receive vaccination in 2016. Also, a survey conducted in Bida Emirate Area of Niger State Nigeria in 2015 found that full routine immunization coverage in this area was less than 30%. The aim of this study was to establish the full routine immunization status and the reasons for its partial and non-immunization of children in Wushishi Local Government Area using WHO recommended cluster survey method and contrast with Factor Analysis (FA) method to see if the same results were achieved. The findings showed that the full immunization status for this area was very low (36%) and the results of analysis of reasons for failure from both methods seem contradictory. However, it reflected that lack of proper information was strongest for both methods. The disparity obtained in the two methods might be a result of methodological issues. The health implication is that much is expected to be done in the area of enlightenment campaign of the need for immunization and the need to complete the required basic dose especially in the rural areas. *(Afr J Reprod Health 2018; 22[4]: 113-122).*

Keywords: Vaccination, Factor Analysis, Principal Component Analysis, In-complete immunization

Résumé

La vaccination des enfants contre les maladies évitables chez l'enfant reste l'une des stratégies les plus importantes en termes de coût et de santé publique pour réduire la morbidité et la mortalité évitables chez les enfants provenant de maladies infectieuses. Selon un récent rapport publié par l'Organisation mondiale de la santé (OMS), 1 nourrisson sur 10 n'a pas été vacciné en 2016. En outre, une enquête menée en 2015 dans la région de l'émirat de Bida dans l'État du Niger, au Nigéria, a révélé que la couverture vaccinale systématique dans cette région était inférieure à 30%. L'objectif de cette étude était d'établir le statut complet de la vaccination de routine et les raisons de son échec dans la région du gouvernement local de Wushishi en utilisant la méthode d'enquête en grappes recommandée par l'OMS et en la comparant à la méthode de l'analyse factorielle, pour voir si les mêmes résultats étaient obtenus. Les résultats ont montré que l'état de vaccination complet de cette région était très faible (36%) et les résultats de l'analyse des raisons de l'échec avec les deux méthodes étaient contradictoires. Cependant, cela reflète que le manque d'informations correctes était le plus important pour les deux méthodes. La disparité obtenue dans les deux méthodes pourrait être le résultat de problèmes méthodologiques. L'implication en matière de santé est que beaucoup de choses devraient être faites dans le domaine de la campagne d'illumination concernant la nécessité de la vaccination et la nécessité de compléter la dose de base requise, en particulier dans les milieux ruraux. *(Afr J Reprod Health 2018; 22[4]:113-122).*

Mots-clés: Vaccination/immunisation, analyse factorielle, état vaccinal, échec de la vaccination, Etat du Niger, Nigéria

Introduction

Immunization of children against childhood preventable diseases has remained one of the most important cost effective and public health strategies to reduce childhood preventable morbidity and mortalities arising from infectious diseases[1,2]. Globally, over three million deaths are recorded annually from vaccine preventable diseases, while more than two million deaths are delayed through immunization processes[2,3]. The implication is that there are more childhood mortality resulting from vaccine preventable diseases than is being prevented by vaccine[4]. The Expanded Programme on Immunization (EPI) which was established in 1974 through a World Health Assembly resolution (resolution WHA27.57) has the mandate to ensure that all children around the globe are immunized with life-saving vaccines following the success of the global smallpox eradication programme[5]. The first diseases targeted by the EPI were diphtheria, whooping cough, tetanus, measles, poliomyelitis and tuberculosis[5].

In Nigeria, the initial immunization schedule of the Expanded Programme on Immunization prescribed five visits to receive one dose of Bacille Calmette Guerin (BCG), four doses of oral polio vaccine, three doses of diphtheria, pertussis and tetanus vaccine, and one dose of measles vaccine[6]. However, in 2004, the country included hepatitis B and yellow fever vaccines in its schedule, recommending the receipt of three doses of hepatitis B at birth, at six weeks of age, and at 14 weeks of age, while yellow fever should be given at nine months of age, along with measles vaccine[7]. In 2012, Nigeria began the phased replacement of the diphtheria, pertussis, and tetanus (DPT) vaccine with the pentavalent vaccine, which contains more antigens (DPT, *Haemophilus influenzae* type B, and hepatitis B)[8] and became operational in Niger State since 2013[4]. So, a child is classified as fully immunized if he/she has taken all the required basic doses of antigens at the required time, as partially immunized if he/she has only taken some and missed some and not immunized if he/she was never administered with any.

The Expanded Program on Immunization (EPI) aims at delivering the primary immunization series to at least 90% of infants at national level and at least 80% coverage sub-regional level earlier by year 2010 and later by 2015[9] and this has been further re-enacted to be achieved by 2020[10]. In recent national representative survey conducted in Nigeria in 2013 reported Full Routine Immunization Status (FRIS) at 25%[8]. Also, independent sub-national survey conducted in Bida Emirate Area of Niger State revealed that FRIS is at 30%[4]. However, a rate of 95% immunization coverage is necessary for the sustained control of vaccine preventable diseases[11]. Inadequate levels of immunization against childhood diseases remain a significant public health problem in resource-poor areas of the globe[12].

There had been variations in reasons for routine immunization failure reported in several places. WHO/UNICEF reported reasons concerning Nigeria to include: ignorance, religion, culture, rumours and shortage of vaccines[13]. Others reported most important reasons to include concerns about immunization safety and long distances to vaccination centres[14], unaware of the need of immunization and lack of faith in immunization[15]. However, the most important reasons in scale of preference for incomplete vaccination in Nigeria are not well established due to methodological approach. The World Health Organization had recommended percentage score analysis of one most important reason for not fully or no immunization of children[16]. This study however assumes that factors that may be responsible for a mother/care giver not to take a child for full immunization could be more than just one (a combination of many reasons). It is against this backdrop that this study seeks to evaluate the reasons for full immunization failure in Wushishi Local Government Areas of Niger State, Nigeria using factor analysis approach with the view of

ascertaining whether the same results could be attained with World Health Organization (WHO) cluster survey recommended approach.

Methods

Survey instrument

An interviewer-administered questionnaire was used to obtain data. Section A required the characteristics of mothers/caregiver and baby and Section B included reasons for non-vaccination as contained in a validated WHO immunization coverage cluster survey instrument[16]. Most of the questions on the survey instrument were close-ended. In addition, information about the child's vaccination status was obtained from the vaccination card (where available) or by maternal history (power to recall) and transferred to the survey instrument. A mother was eligible if she had a child aged between 12-24 months. A total of 215 respondents were interviewed.

Sample size determination

The sample size computation as contained in the WHO immunization cluster survey manual [WHO Cluster Survey][16] was used. The expected coverage for the area was 30% obtained in a similar area survey in 2015[4], a precision of ±10% and a design effect of 2 as recommended by WHO[16]. This gave a minimum sample size of 162. With the cluster of 6, a minimum of 27 respondents per cluster was required and this was rounded up to target 30 per cluster. However, 215 respondents were eventually captured and analysed.

Sampling techniques

The Local Government Area (LGA) was divided into eight major villages comprising 11 wards. Three major villages were selected to include two major villages hosting the two major health centres [(General Hospital and Comprehensive Health Centre (operated by a tertiary healthcare provider, Federal Medical Centre)] and another major village. These selected villages had a total of 6 wards. These formed the clusters. In each of the selected clusters therefore, all the identified villages were considered as sample units. The administration of instrument commences at the residence of the Village Head and subsequently moved to the nearest house on the right and so on. A mother with a baby between 12 and 24 months, and do not belong to the same household with another eligible mother was interviewed. If there were more than one mother eligible from the same household, the one with the youngest baby was considered[16]. At the event where there was a deficiency in the total needed for the cluster, the nearest village was considered and so on till the required respondents were found [16]. The data were collected by 6 trained enumerators made up of 3 females and 3 males which were grouped into 3 and included 2 data entry clerks. One supervisor was in-charge of the survey. This survey was conducted between October 30 and November 3, 2017.

Methods of data analysis

Two levels of analysis methods were carried out: at the first level, percentage frequency distribution method was used to describe the characteristics of mother and child as well as the most important reason for non-immunization of the child. At the second level, Factor Analysis (FA)-a multivariate analysis was used to establish contributory factors for partial or non-immunization of the child. All variables which were considered simultaneously were as contained in WHO cluster survey manual[16].

To determine the suitability of use of Factor Analysis (FA) for the data, the uniformity of sample was tested by examining the distribution of variables in a loading plot, contrasting the value observed against those expected in a normal distribution which was verified by Kaiser-Meyer-Olkin (KMO) measurement of adequacy[17]. A KMO

Table 1: Percentage Frequency Distribution of Immunization Status, and Background Factors

Variables	Numbers (%)
Immunization Status	
Fully Immunized	75 (34.9)
Partially Immunized	103 (47.9)
Not Immunized	37 (17.2)
Total	215 (100)
Background Factors	
Religion	
Islam	204 (94.9)
Christianity	11 (5.1)
Total	215 (100)
Education Status	
University	22 (10.2)
Secondary	32 (14.9)
Primary	26 (12.1)
None	135 (62.8)
Total	215 (100)
Occupation status	
Farmer	24 (11.2)
Trader	105 (48.8)
Civil Servant	10 (4.7)
Others	76(35,3)
Total	215 (100)
Number of Children	
One	26 (12.1)
Two	36 (16.7)
Three	34 (15.8)
Above 3	119 (55.3)
Total	215 (100)
Place of Delivery	
Hospital	73 (33.9)
Home	141 (65.6)
Others	1 (0.5)
Total	215 (100)
Gender of Child	
Female	105 (48.8)
Male	215 (100)

value of 0.90 – 1.00 is considered marvelous, 0.80 – 0.89 meritorious, 0.70 – 0.79 middling, 0.60 – 0.69 mediocre, and 0.50 – 0.59 miserable[17]. However, a KMO value of more than 0.50 was considered acceptable[17]. In addition, Bartlett test of homogeneity of variance (sphericity) was considered significant at $p<0.05$. Also, Principal Component Analysis (PCA) was used for the extraction of factors using Kaiser Criterion of Eigen value greater than 1.0.

The first factor extracted was the one that accounts for the maximum possible variance in the dataset. The second component explains the largest possible share of the remaining variance independently such that the components are not correlated with one another[17,18]. The scree plot (Eigen plot) was also plotted to help decide how many components would be appropriate. SPSS software package version 22.0 was used for the computation[19].

Results

Table 1 displayed the immunization status of children in Wushishi Local Government Area of Niger State and distribution of background variables. Only about 36% of children between the ages of 12 – 24 months were fully immunized with the basic immunization antigens, 47% were only partially immunized, while 17% were not immunized at all.

The background variable revealed that 95% of the participants were Muslims, more than two-third are illiterates, 55% had more than three children and 66% delivered at home.

The analysis of the most important reasons for not fully immunizing a child using WHO recommendation (with grouping)[16], is shown in Table 2.

The three most important reasons were ‘unaware of the need for immunization’ (27%) from ‘lack of information category’ followed by ‘vaccine not available’ (10%) from ‘obstacle category’, and ‘no faith in immunization’ from ‘lack of motivation category’ (2.9%).

Factor Analysis was applied to establish the reasons that may play simultaneous role in lack of full immunization status. First, the results of Kaiser-Meyer-Olkin (KMO) and Bartlett’s test of sphericity were computed. KMO of 0.898 suggested that the sample size used was large enough for FA. Also, Bartlett’s test of sphericity had approximate Chi-square value of 2065.54 at 136 degrees of freedom was highly significant

Table 2: Percentage Frequency of Most Important Reason for Immunization Failure in Wushishi LGA, Niger State, Nigeria

	Variables	Numbers (%)
	Unaware of need for immunization	38 (27.1)
LACK OF	Unaware of need to return for other doses of immunization	25 (17.9)
INFORMATION	Place and/or time of immunization unknown	3 (21)
	Fear of side effects	11 (7.9)
	Contraindication	1 (0.7)
LACK OF	Postpone until another time	3 (2.1)
MOTIVATION	Have no faith in immunization	4 (2.9)
	Place of immunization too far	10 (7.1)
	Inconvenient time of immunization	2 (1.4)
OBSTACLES	Vaccinator absent	1 (0.7)
	Vaccine not available	14 (10)
	Mother too busy	12 (8.6)
	Family problem/Mother ill	12 (8.6)
	Child sick not brought for immunization	4 (2.9)
	Total	140 (100)

Table 3: Total Variance Explained by the Extracted Components in the Observed Variation

Component	Initial Eigen values			Extraction Sums of Squared Loadings	
	Total	% of Variance	Cumulative %	Total	% of Variance
1	8.688	51.108	51.108	8.688	51.108
2	1.789	10.521	61.628	1.789	10.521
3	1.291	7.592	69.220	1.291	7.592
4	.966	5.680	74.900		
6	.860	5.059	79.959		
7	.797	4.685	84.644		
8	.562	3.306	87.950		
9	.382	2.249	90.199		
10	.352	2.072	92.271		
11	.303	1.781	94.053		
12	.251	1.478	95.531		
13	.188	1.107	96.638		
14	.166	.979	97.617		
15	.159	.935	98.552		
16	.114	.673	99.225		
17	.087	.511	99.736		
18	.045	.264	100.000		

($p<0.000$) leading to the rejection of the non-homogeneity of variance.

The extraction method was done through PCA and Table 3 revealed that the first three component factors had an Eigen value >1.0 (i.e., 8.688, 1.789 & 1.291 for components 1, 2, & 3 respectively) accounting for over 69% of the observed variation in the pattern of reasons for failure to immunize children in Wushishi Local Government Area of Niger State. So, these components were extracted. Furthermore, the scree plot in Fig 1 shows a neat L-shape indicating a parallel line to horizontal at Eigen value equals 1.0 indicating that the three components 1, 2 & 3 were appropriate for extraction. Table 4 revealed that the first component accounted for more than 51% with

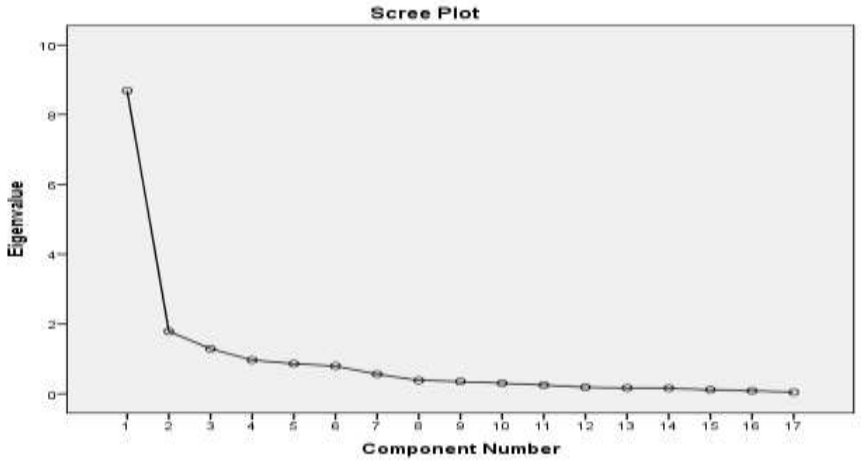

Figure 1: Scree plot describing the number of components extracted

Table 4: Component Matrix of Reasons for Incomplete/Non-Immunization of Children in Wushishi LGA, Niger State, Nigeria

CATEGORIES	Reasons	Components		
		1	2	3
LACK OF IMFORMATION	Unaware of the need for immunization	.105	.481	-.592
	Unaware of need to return for other doses of immunization	.951	-.007	-.175
	Place and/or time of immunization unknown	.868	.078	-.054
	Fear of side effects	.918	.127	-.051
	Contraindication	.114	.557	.171
	Postpone	.878	-.205	.040
LACK OF MOTIVATION	Lack of faith in immunization	.891	.075	-.095
	Rumour	.815	.129	.097
	Place of immunization too far	.806	.171	-.079
	Inconvenient time	.884	-.137	-.009
	Vaccinator absent	.890	-.124	-.042
OBSTACLES	Vaccine not available	.868	-.084	-.023
	Mother too busy	.246	.404	-.355
	Illness of mother	.754	-.370	.077
	Child ill not brought	.095	.670	.510
	Child brought but ill and not immunized	.460	.574	.191
	Long waiting time	.323	-.112	.647

reasons cutting across the three classifications of reasons. The second and third components are similar across the reasons though at varied degree of loading and with no reasons from lack of motivation classification. On component 1, variable 'unaware of need to return for 2nd or 3rd doses of the immunization' had the highest loading of 0.951 from 'lack of information category'. Also, component 2 was loaded heavily on 'child ill not brought for immunization' with 0.670 from 'obstacles category' followed by 'contraindication' from 'lack information category' and component 3 was loaded heavily on 'long waiting time' with 0.647 from 'obstacle category'.

Discussion

This study was designed to investigate two methodological approaches [(WHO percentage score of the most important reason and Principal Component Analysis (PCA) of Factor Analysis (FA)] in evaluating the reasons for partial and non-immunization of children aged 12 – 24 months using data collected from Wushishi Local Government Area, Niger State Nigeria. The 36% immunization status achieved for this area was an improvement over the level of the status (30%) found in a research conducted in 2015 in Bida Emirate Area (BEA), Niger State[4]. It is also within the neighbourhood result for the current routine immunization status in a study conducted for Northern part of Nigeria[20], but too low compared to WHO target as at 2015 of 80% full immunization coverage for sub-region[9,10]. The results obtained using WHO recommended approach identified 3 most important reasons with one selected from each of the 3 categories of reasons to include 'unaware of the need for immunization' from 'lack of information category'; followed by 'vaccines not available' from 'obstacle category' and 'lack of faith in immunization' from 'lack of motivation category'. On the other hand, PCA extracted 3 pattern of components that accounted for 69% of the total variance of reasons for partial or non-immunization of children. The 1st component which was highly characterised by 13 of the reasons (loading >0.3 was used as recommended)[21,22], however loaded heavily (0.954) on 'unaware of the need to return for 2 and 3 doses' from 'lack of information category' followed by 'vaccinators not available'(0.890) in 'obstacles category' and 'lack of faith' in 'lack of motivation category'. The 2nd component loaded highest on 'child ill and not brought' and followed by 'contraindication' from 'obstacles' and 'lack of information', respectively. On the other hand, the 3rd component was highest on 'long waiting time at the clinic' from the 'obstacle category'.

From this study, the two methods identified the following as leading reasons: unaware of the need for immunization; unaware of the need to return for 2nd and 3rd doses; vaccines not available; child ill and not brought; long waiting time at the clinic; vaccinators not available; lack of faith in vaccination and contraindication. Though the two methodological approaches differ slightly in the results obtained, however there are two striking remarks:

Firstly, the leading factors found using the two methods were 'unaware of the need for immunization' identified by WHO recommended approach and 'unaware of the need to return for follow-up doses' as expressed by those with the pattern of component 1 of FA. The implication of this is that 'lack of information category' is the most important reason for partial and non-immunization of children in WLGA. However, this is not unconnected with high rate of those who delivered at home (65.6% of the respondents). This very high percentage of participants that delivered at home can be attributed to poor antenatal care utilization as noted in a recent research conducted for this area[23] and in turn also reflects poor literacy status of women of child bearing age[23]. This argument is consistent with the results obtained in Lucknow area in India[16], reflecting the level of literacy among mothers in the area.

Secondly, considering the 3 categories of reasons, the commonest reasons that cut across the WHO recommended approach and the 3 component patterns identified by FA were from obstacle category. These include vaccines not available; vaccinators not available; child ill and not brought and long waiting time.

Global Health Implications

The implication for the results obtained from these two approaches point to the fact that lack of proper information to mothers/care givers on the importance of immunization of children is strongest. As such, much is expected to be done in

enlightenment campaign of the need for immunization and the need to complete the required basic dose especially in the rural areas. It also implies that health advocacy program by health workers in this area is very low and more efforts in this direction by operators.

Recommendations

In view of the findings from this research, we recommend the following:

- There should be more comprehensive enlightenment campaign on the importance of immunization of children via health talks that should include families, religious and community leaders
- There should be erection of bill boards on immunization in strategic places around the localities with inscriptions translated in local dialects.
- There must be the specific education of the mother/care giver of the need to complete the doses, this should also focus on explaining the expected side effects and what to do when they occur, correct the notion of false contraindication thereby encouraging mothers/care givers to follow the schedule
- Health care providers must ensure prompt and quality service delivery to reduce long waiting time of mothers
- Village Heads and Religious Leaders should be involved in mobilizing their followers of the need to immunize their children
- Apart from house to house visitations currently adopted in most places to remind mothers to come for immunization, the use of Short Messaging Services (SMS) should be explored.
- Effort should be made by institutions responsible for the distribution of vaccines to ensure availability.
- Education of females should be encouraged
- Large scale follow-up study should be conducted to determine the reasons for the variation in the results obtained in using the two methods and perhaps to be done separately for those who are partially immunized and not immunized at all.

Ethical Approval

The study was approved by Research and Publication Ethics Committee of Niger State Polytechnic. Also, informed consents were obtained from all the women who participated in the survey and permission to administer the instrument in each locality visited was obtained from the local administrative authorities.

Conclusion

This paper has reported very low full routine immunization status with almost three-quarter of the children either partially or not immunized at all in Wushishi Local Government Area of Niger State, Nigeria. There was also a slight variation in the result of analysis of the reasons for incomplete or lack of immunization. Arising from WHO standard of evaluation the three most important reasons for partial or non-immunization of children were ‘unaware of the need of immunization’ followed by ‘vaccines not available on day of appointment’ and ‘lack of faith in immunization’. However, further probing for additional reasons that simultaneously impacted on partial and non-immunization using Principal Component Factor Analysis, revealed three most important reasons as ‘unaware of need to return for other does’, followed by ‘child ill and not brought for immunization’ and ‘long waiting time’. This variation found in the results may be attributed to methodological differences supporting the postulation that reasons for partial and non-immunization are not mutually exclusive, but

multiple responses which factor analysis can effectively handle.

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Conflict of Interest

The authors declare no conflict of interest.

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Author Contributions

Conceptualization, PEO, MAM, AM and DNO; methodology, PEO and MAM; data collection and curation, PEO, MAM, AM and DNO; software/Analysis, PEO, MAM, AM writing—original draft preparation, PEO and DNO; writing—review and editing, PEO and MAM. All authors have read and approved the final manuscript.

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