Afr. J. Med. med. Sci. (Sept., 2014) 43, Suppl. 73-78

Implication of vaccination on measles reduction and elimination in Nigeria

AB Onoja[1], KM Hamid[2], JA Adeniji[1,4] and MD Mukhtar[3]

Department of Virology, College of Medicine, University of Ibadan[1], School of Medical Laboratory Science, Usmanu Danfodiyo University Sokoto[2], Department of Biological Sciences, Bayero University Kano[3], World Health Organization Polio Reference Laboratory Ibadan, Nigeria[4].

Abstract

Background: Availability of a safe and effective vaccine encouraged the establishment of measles mortality reduction and elimination goals in six World Health Organization regions. In the WHO-AFRO region, they intend to eliminate measles by 2020. This initiative led to the successful elimination of measles in 2012 in the American region. This study mined data from independent investigations in two geographical regions in Nigeria, in order to observe the prospects of preventive measures against wild measles virus in a resource limited setting.

Materials and methods: Retrospective data from 757 children between the ages of 10 months and 13years were used. 500 were from children in Kano, Northwest Nigeria and 257 from children in Ibadan, Southwest Nigeria. Data analysis was done using SPSS 16.0.

Results: In all, 386 (75.4%) of the vaccinated children were protected while 121 (23.6%) were not protected. Among the unvaccinated children, 63 (25.7%) were protected while 135 (55.1%) were not protected (X^2=120.919, p=0.000). In Kano, 81% of the vaccinated children were protected while 18.4% were not protected. In Ibadan, 95% of the vaccinated children were protected (X^2=22.129, p=0.000).

Conclusion: The herd immunity in Kano and Ibadan in this study is not sufficient to reduce wild measles virus infection. But this finding is encouraging, because Kano has suffered several epidemics prior to the vaccination campaigns resulting from religious apathy which is the bane of vaccination efforts in Northern Nigeria. Therefore, with the right approach in Northern Nigeria, it is possible to sustain national and global immunization drive.

Keywords: *Measles, Vaccination, Immunization, Nigeria*

Correspondence: Dr. A.B. Onoja Department of Virology, College of Medicine, University of Ibadan. bernardonoja@yahoo.com

Résumé

Contexte: La disponibilité d'un vaccin sûr et efficace a encouragé l'entreprise des objectifs de réduction de la mortalité et l'élimination de la rougeole dans six régions de l'Organisation Mondiale de la Santé. Dans la région de l'OMS-AFRO, ils ont l'intention d'éliminer la rougeole d'ici 2020. Cette initiative a menée à la réussite de l'élimination de la rougeole en 2012 dans la région de l'Amérique. Cette étude extrait des données provenant de recherches indépendantes dans deux régions géographiques du Nigeria afin d'observer les perspectives de mesures de prévention contre le virus sauvage de la rougeole dans un cadre limité de ressources.

Matériels et méthodes: Les données rétrospectives de 757 enfants âgés de 10 mois et 13 années ont été utilisées. 500 des enfants étaient de Kano, Nord-ouest du Nigeria et 257 des enfants d'Ibadan, Sud-ouest du Nigeria. L'analyse des données a été effectuée en utilisant SPSS 16.0.

Résultats: En tout, 386 (75,4%) des enfants vaccinés étaient protégés tandis que 121 (23,6%) n'étaient pas protégés. Dans les enfants non vaccinés, 63 (25,7%) étaient protégés alors que 135 (55,1%) n'était pas protégés (X^2 = 120,919, p = 0,000). A Kano, 81% des enfants vaccinés étaient protégés alors que 18,4% n'étaient pas protégés. A Ibadan, 95% des vaccinés étaient protégés (X^2= 22,129, p = 0,000).

Conclusion: L'immunité de troupeau à la fois à Kano et à Ibadan est assez bonne pour réduire l'infection par le virus sauvage de la rougeole. Ce constat est encourageant, car Kano a subi plusieurs épidémies avant le début des campagnes de vaccination résultant de l'apathie religieuse qui est l'adversité des efforts de vaccination. Voici la preuve qu'avec bonne approche dans le nord du Nigeria, il est possible de maintenir un mouvement national et mondial de vaccination.

Mots-clés: *Rougeole, Vaccination, Immunisation, Pays en voie de développement*

Introduction

Despite the comprehensive measles-reduction strategy and partnership of World Health Organization (WHO) and United Nations International Children Emergency Fund (UNICEF) in supporting measles mortality reduction, certain countries continue to face recurrent epidemics with high disease burden [1]. In Africa, about 13million cases and 650,000 deaths occur annually with sub-Saharan Africa having the highest morbidity and mortality [2]. Measles is the fifth leading cause of childhood mortality in Nigeria [3] and the annual incidence rate is 18.2 per 100,000 children [4]. More worrisome is the case of importation of measles into the United States of America by a 15months old baby traveller who visited Nigeria between December 15, 2010 and January 29, 2011; from whom measles virus B3 genotype was isolated [5,6]. This came years after the Federal Government of Nigeria through the National Programme on Immunization (NPI) conducted an integrated catch-up measles campaign in 2005 and 2006 in the southern and northern states respectively [7] and a nationwide follow-up campaign in 2008 [8] in collaboration with local and state governments. However, two major outbreaks occurred in Sokoto and Kaduna, both states in Northwest Nigeria and another in Bauchi State - Northeast [9]. In Nigeria, vaccination coverage over the years varied from 35-70% from administrative figures [8]. The interplay of several factors affects immunization. These factors include break in cold-chain of measles vaccine due to long distance to vaccination centres, a history of measles, intercurrent infections and malnutrition. While it may not be possible to assess some of the factors due to logistics problems, it is possible to assess immune status and make deductions based on available demographic details. Furthermore, measles serosurveillance activities are important in monitoring child health as it serves as an early warning system for measles epidemics. This is because of the numerous factors like young age at time of infection, low socioeconomic status, overcrowding due to high population density, concomitant diarrhea, malnutrition (including Vitamin A deficiency), lack of access to health care and underlying immunodeficiency from a variety of sources which increase severity of measles in this part of the world [10]. Kano is in Kano State (Northwest Nigeria) and has the largest population in northern Nigeria with over 9.4 million people, while Ibadan is in Oyo State (Southwest Nigeria) and also highly populated with a population of over 5.5 million people [11]. This study mined data from independent investigations in two geographically different regions in Nigeria with a view to establishing herd immunity and appraising the prospects of preventive measures against wild measles virus.

Materials and methods

Study design/Study population.

Data was obtained from 757 children between the ages of 10months and 13 years, 500 were from children attending Murtala Mohammed Specialist Hospital Kano, Northwest Nigeria and 257 from Oni Memorial Children's Hospital and Adeoyo Maternity Hospital Ibadan, Southwest Nigeria. The hospitals were selected because they are pediatric referral centers in the respective States. Haemagglutination/Haemagglutinitation Inhibition (HA/HAI) antibody investigations as described by Onoja et al., [12] were carried out partly in the Microbiology unit of Mohammed Abdulahi Wase Specialist Hospital Kano and the Department of Virology, College of Medicine, University of Ibadan with the virus antigen prepared and supplied from the Department of Virology, University of Ibadan. The measles vaccine was prepared with Edmonston-Zagreb measles strain manufactured by Serum Institute of India Ltd, 212/2 Hadapsar, Pune 411026, India. The study was done in accordance with standard ethical practices following approval by the ethical committees of Kano State Hospital Management Board and Oyo State Ministry of Health. Parental assent was obtained before blood samples were collected from any child. Vaccination history was obtained from parental/guardian recall as most people did not bring their vaccination cards.

Statistical analysis

SPSS 16.0 was used to carry out an analysis on the association between variables using Chi square test.

Results

Of the 500 children in Kano, 332 (66.4%) were vaccinated while 168 (50.6%) were not. Also, of the 257 children in Ibadan - Oyo State, 180 (70%) were vaccinated while 77 (30%) were not. There was a significant association between those that were vaccinated and those that were protected in

Table 1: Distribution of age group and MV HI Ab titre among children in parts of Nigeria

	Titre	Age groups		
		<1yr	1-4yrs	>5yrs
Kano				
	10	13	42	14
	20	4	63	36
	40	4	77	43
	80	4	50	39
	160	-	36	53
	320	-	6	16
Ibadan				
	10	3	28	19
	20	4	47	10
	40	4	46	18
	80	1	32	24
	160	2	8	8
	320	-	3	-

Kano (p=0.000). In Ibadan all the people that were vaccinated were protected. Herd immunity against measles was 66.8% in Kano and 73.0% in Ibadan. When history of measles infection was compared with the level of immunity, there was a significant association between those who had measles infection and were protected in Kano (p=0.000) whereas there was perfect return of outcome in Ibadan because number with history of measles was small. In Kano, there were 71 malnourished children out of which 24 (33.8%) were protected and 47 (66.2%) were not protected, the number of malnourished children in Ibadan was not considered. There was no significant difference between the level of immunity among children in Kano and Ibadan (p=0.385). Antibody titre is not dependent on the locations studied (p=0.314). Also, there was no association between the antibody titres in Kano and Ibadan. There was no association between gender and immune status in Kano (p=0.1000) as well as Ibadan (p=0.574). In Kano, there were 392 (78.4%) children belonging to the low socioeconomic class and 108 (21.6%) in the middle socioeconomic status while in Ibadan 230 (89.5%) children belonged to the low socioeconomic class and 27 (10.5%) to the middle socioeconomic status. There was no significant difference in the socioeconomic status and level of immunity in both parts of Nigeria.

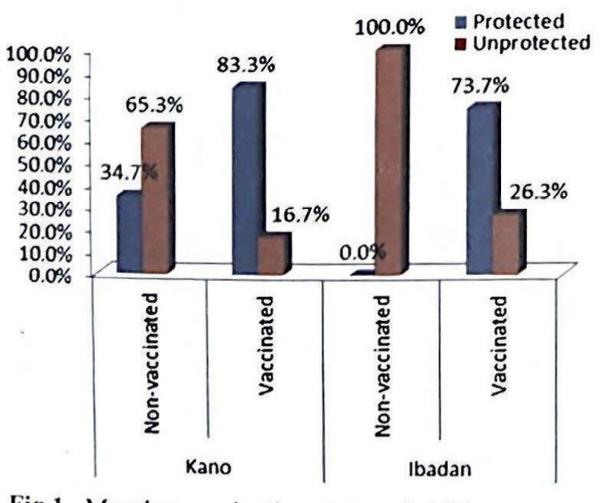

Fig 1. Measles vaccination status of children in Kano and Ibadan, Nigeria

Discussion

The vaccination level in Kano is in accordance with administrative figures reported by the WHO country office [8]. However, our findings in Ibadan show that the vaccination level is higher than the figures they reported. This relatively high vaccination in Ibadan can be attributed to the level of literacy among the populace and awareness created by the free use of mass media to effectively disseminate information concerning vaccination activities, without fear of intimidation. Such fears have hampered vaccination activities in the polio vaccination programme, with the killing of vaccinators in parts of Kano [20]. With a herd immunity of 66.8% in Kano and 73.0% in Ibadan, the level of protection is not sufficient to guard against the wild measles virus which requires a herd immunity of 84.7% and vaccination coverage of 92-95% [21].

Table 2: Distribution of age group and level of protection

Location	Protected	Unprotected	Total
Kano			
≤1yr	11 (55.0%)	9 (45.0%)	20 (100.0%)
1.1-4.9yrs	149 (61.9%)	24 (33.8%)	242 (100.0%)
>5yrs	174 (73.1%)	17 (45.9%)	238 (100.0%)
Ibadan			
=1yr	9(45.0%)	11(55.0%)	20 (100.0%)
1.1-4.9yrs	70 (49.6%)	71 (50.4%)	141 (100.0%)
≥5yrs	56 (58.3%)	40 (41.6%)	96 (100.0%)

These accounts in both locations give an idea of the immune status of children in Nigeria, more so that measles vaccination coverage is within administratively reported limits. The immune status remained at such low ebb that between the first and thirty-ninth week in 2013; 55,268 suspected measles cases with 335 deaths (CFR, 0.61%) were reported from 36 States and the Federal Capital Territory, almost seven times increase, compared with 8,610 cases with 106 deaths (CFR, 1.25%) from 36 States and FCT in the same period in 2012 [22]. The unvaccinated children (Fig 1) may have being missed or refused to be vaccinated due to sentiments or myths associated with vaccines. This is because negative statements about vaccination programmes have being made by some religious leaders in time past, they claimed some vaccines were laced with anti-fertility, cancerous agents and HIV by Western countries [23].

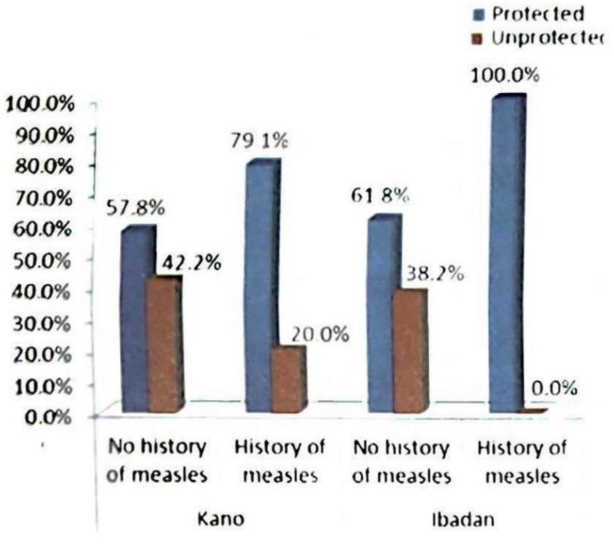

Fig 2: Immune status of children according to history of measles infection

In Kano, there was a significant association between those who had measles infection and were protected (Fig 2). This is expected as measles confers lifelong immunity and second attack of measles is unknown [10]. There was no association between gender and immune status in Kano and Ibadan (Fig 3). This finding is similar to a study carried out on gender differences in the reactogenecity of Measles–Mumps-Rubella vaccine in Israel in which no association was found between antibody titres in either gender [24]. The level of protection in children under 5yrs of age in Kano and Ibadan (Table 2) is a critical indicator for consideration in child health because of the fourth millennium development goal (MDGs) which intends to reduce child mortality by 2015. The implication is that the health care delivery system in Nigeria is still weak. This has also being elucidated in the 2003-2008 demographic health survey in which under five childhood mortality was 157 deaths per 1,000 live births [25]. Also, the Federal Ministry of Health reported that the age group of children mostly affected by measles was between 9 - 59 months in which over 37,000 measles cases were confirmed [22]. In 2000, measles was responsible for 22% deaths in children <5years of age and 17% deaths in children aged 5-14 years in Ethiopia [26]. Also, at least 1,200 measles-related deaths were recorded in Afghanistan and the case-fatality rate was 8-13% [27]. Case-fatality rates for people hospitalized with measles in some countries increased during years of economic depression [28]. It is our opinion that because of economic recession, there is the likelihood of many affected countries to reduce health funding which in turn will compromise the health status of children, lower the herd immunity and increase the incidence of measles. Malnutrition is a problem facing people in developing nations as shown in this study. The 66.2% malnourished children that were not protected in Kano underscore the need to strive and eradicate poverty and hunger. In malnourished children, it has been found that multiple aspects of the immune system are impaired which affects the general well-being of the child [29].

It has being shown that vaccinated children in households of lower socioeconomic status had a markedly higher chance of surviving to age 39 months than did unvaccinated children in households of lower socioeconomic status [30]. However, there was no significant difference in the level of immunity and the socioeconomic status (low and middle) of children in both parts of Nigeria. Since we had few children belonging to the middle socioeconomic class and none in the high class, we may not be able to make the clear distinction between low socioeconomic status and the others.

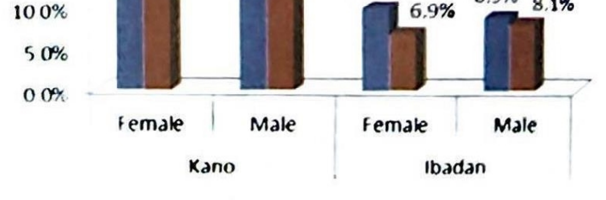

Fig 3: Immune status of children according to gender

However, a separate study found that unvaccinated children of low socioeconomic status were 2.5 times more likely than children of high socioeconomic status to die of measles. And that in vaccinated populations, children of low socioeconomic status had a 50% chance of dying compared to children of high socioeconomic status [31].

Collectively, there is still a significant population of unimmunized children in Nigeria. However, it is possible to attain the measles elimination goal by 2020 if attention is given to this vulnerable group. Immunization efforts should be strengthened to protect the vaccinators and ensure cold chain is always maintained so as to administer vaccines to children in the best condition. Malnutrition in underage children should be addressed to reduce child mortality and enhance measles antibody production.

Funding: None

Conflict of Interest: None `

Acknowledgment
The data analysis and manuscript writing was supported by the Medical Education Partnership Initiative in Nigeria (MEPIN) project funded by Fogarty International Centre, the Office of AIDS Research, and the National Human Genome Research Institute of the National Institute of Health, the Health Resources and Services Administration (HRSA) and the Office of the U.S. Global AIDS Coordinator under Award Number R24TW008878. The content is solely the responsibility of the authors and does not represent the views of the funding organizations.

References

1. Grais RF, Durby C, Gerstl S, Guthmann JP, Djibo A, Coker J, et al. Unacceptably high mortality related to measles epidemics in Niger, Nigeria and Chad. PLOS medicine 2007;4:122-129.
2. Muller CP, Hanses F, Troung A, Ammerhan WO, Ikusika W, Adu F. Molecular epidemiology of Nigerian and Ghanaian measles virus isolates reveals a genotype circulating widely in western and central Africa. J of Gen Virol 1999;80:871-877.
3. World Health Organization 2006. Mortality country fact sheet on Nigeria.
4. World Health Organization 2011. Reported measles cases and incidence rates by WHO member states 2010 and 2011.
5. Centre for Disease Control. Measles Imported by returning US travelers aged 6-23months, 2001-2011. MMWR 2011;60:397-400
6. Massachusetts Department of Public Health (MDPH). Clinical measles advisory by the Commonwealth of Massachusetts executive office of health and human services, Dept. of Public Health Division of Epidemiology and Immunization 2011;1-2
7. World Health Organization. Manual for the laboratory diagnosis of measles and rubella virus infection. 2nd Ed 2007.WHO/V&B/00.16p10-13
8. Goitem GW, Gasasira A, Harvey P, Masresha B, Goodson JL, Pate AM, *et al.* Measles resurgence following a nationwide measles vaccination campaign in Nigeria 2005-2008. J. Infect. Disease 2011;204:226-231.
9. DREF, 2007. Nigeria: Measles by the International Federation's Disaster Relief Emergency Fund 2007; 1-4 http://www.ifrc.org/do
10. White DO and Fenner FJ. Measles. In: Medical Virology 4th Edition. Academic Press California USA.1994. 461-464.
11. National Bureau of Statistics 2006. Federal Republic of Nigeria Official gazette FGP 71/52007/2500(0124). www.nigerianstat.gov.ng/pop2006.pdf
12. Onoja A.B. and Adeniji A.J. Kinetics of measlesantibody by Haemagglutination Inhibition Assay in children in south-west and north-central Nigerian State. Int Journal of Infect Dis 2013;17(7):552-555
13. Norrby E. and Gollmar Y. Appearance and persistence of antibodies against different virus components after regular measles infections. Infection and Immunity 1972;6:240-247
14. World Health Organization. Manual for virological investigation of poliomyelitis and measles.1990 Expanded Programme on Immmunization EPI/POLIO/90
15. Rota JS, Hummel KB, Rota PA, Bellini WJ. Genetic variability of the glycoprotein genes of current wild-type measles isolates. Virology 1992;188:135-142
16. Dayan GH, Rota J, Bellini W, Red SB. Measles: In Manual for the surveillance of vaccine preventable diseases 4th Ed 2008;56-98
17. Gershon AA, Krugman S. Measles virus. In:E.H. Lennette and N.J. Schmidt Eds, Diagnostic procedures for viral, rickettsial and chlamydial infections. American Public Health Association, Washington D.C. 1979; p665-693
18. Norrby E. and Gollmar Y. Identification of measles virus-specific hemolysis-inhibiting

antibodies separate from haemagglutination inhibiting antibodies. Infection and Immunity 1975;11:231-239

19. Orvell C. Identification of paramyxovirus-specific hemolysis inhibiting antibodies separate from haemagglutinating-inhibiting and neuraminidase-inhibiting antibodies. ActaPathologica et Microbiologica Scandinavia Section B 1976;84:441-450
20. Musa A. Resistance to polio immunization information in Kano Nigeria. A thesis in School of Library and Information Management Emporia State University 2013. http://hdl.handle.net/123456789/3289.
21. Anderson RM. The concept of herd immunity and the design of community-based immunization programmes. Vaccine 1992;10:928-935.
22. Federal Ministry of Health. Weekly Epidemiological Report-Nigeria 2013;3(39):1-11.
23. Jegede A.S. What led to the Nigerian boycott of the polio vaccination campaign? PLoSMed2007;4:e73
24. Shohat T, Green MS, Nakar O, Balli A, Dudevani P, Cohen A and Shohat M. Gender differences in the reactogenicity of Measles-Mumps-Rubella vaccine. Israel Medical Association Journal 2000;2(3):192-195
25. Nigeria Demographic and Health Survey 2008: p1-3.
26. Salama P, Assefa F, Talley L, Spiegel P, van Der Veen A, Gotway CA. Malnutrition, measles, mortality, and the humanitarian response during a famine in Ethiopia. JAMA 2001;286:563-571.
27. Ahmad K. Measles epidemics weeps through Afghanistan. Lancet 2000; 355:1439. 234.
28. Boughton CR. Morbilli in Sydney: A review of 3601 cases with consideration of morbidity, mortality, and measles encephalitis. Med J Aust 1964;58:859-865.
29. Perry RT and Halsey NA. The clinical significance of measles: A review. J of Infect Dis 2004;189: 4-16.
30. Holt EA, Boulos R, Halsey NA, Boulos LM, Boulos C. Childhood survival in Haiti: protective effect of measles vaccination. Pediatrics 1990;85:188-194.
31. Koenig MA, Bishai D, Khan MA. Health interventions and health equity: the example of measles vaccination in Bangladesh. Popul Dev Rev 2001;27:283-302.