Seroprevalence of Measles Specific IgG Antibody among Children in Adamawa State Nigeria

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Abstract: Measles account for nearly half of the 1.7 million annual deaths due to childhood vaccine-preventable diseases. Presence of measles specific IgG antibodies has been proven to correlate with protection (immunity) to natural measles infection. This study was therefore designed to determine the seroprevalence of measles specific IgG in relation to vaccination status, types of settlement and parents' occupation among children aged 0-14 years in Adamawa State. The research was carried out within the three senatorial districts of the State. Three hundred and sixty eight (368) serum samples collected from children were used to determine the prevalence using ELISA technique. Questionnaire was used to obtain demographic data of the children. The study revealed that 227 (61.6%) of the children had protective measles IgG antibody, while 141 (38.4%) had unprotective or no measles IgG antibody. Statistical analysis revealed that there was significant association between prevalence of measles specific IgG antibody and vaccination status against measles, types of settlement and parents' occupation (p-value < 0.05).
Key words: Demographic data, ELISA, IgG Antibody, Measles virus, Prevalence, Vaccination,

INTRODUCTION

Measles is considered an eradicable disease due to its single serotype, effective vaccine, lack of naturally occurring non-human reservoirs and high clinical expression of the disease. (World Health Organization [WHO], 2000) The high communicability of measles infection, its resemblance in the prodromal stage to other febrile rash diseases, and the occasional occurrence of asymptomatic and non-classical cases are seen as challenges which can be surmounted (WHO, 2000). In the late 1990s, the WHO established a time frame for measles elimination in the different global regions. The difficulties in reaching this goal have shifted the emphasis towards improving control in countries with the highest measles mortality (WHO, 2001).

Immunity against Measles can be achieved through vaccination and can also be produced in individuals who had the disease and successfully recovered or as passive immunity in neonate as a result of Maternal Measles Antibodies (MMAs) which may wane sometimes even before the age of receiving the first dose of the vaccine. This renders them vulnerable to infection by the measles virus (Center for Disease Control [CDC], 2015).

Although, measles immunization is widely regarded as one of the safest and most cost effective public health interventions, serological studies indicated that vaccine-induced immunity might be less protective and less durable than immunity conferred by natural measles infection (Mossong and Muller, 2013).

It is well documented that vaccinated individuals have lower levels of measles specific IgG than those with natural immunity (Damien, 1998; van den Hof, 1999). The decline of measles virus-antibodies is also faster in vaccinees than in children who recovered from the disease (Markowitz, 1990). Women with vaccine-induced immunity tend to have lower anti-measles virus antibody levels than women with naturally-acquired immunity, and their children may be susceptible to measles at an earlier age. Lower levels of measles antibodies in vaccinated individuals may result not only from the direct effects of vaccination but because successful vaccination programmes reduce measles virus transmission and thus boosting of immunity through exposure to wild-type measles virus (WHO, 2008).

The role of circulating wild-type measles virus for boosting immunity is not fully understood. It is therefore possible that waning of antibodies may be accelerated in the absence of re-exposure to Measles Virus. Although recent outbreak studies in developed countries suggest that vaccine efficacy is very high with 90–95% of exposed vaccinees being protected from measles infection

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(Markowitz 1990; Mossong and Muller 2000), this may change in the future, as the vaccinated population grows older. Antibody titres in vaccinated individuals are subject to substantial waning, which may not only result in typical measles, but also in susceptibility to a milder or subclinical form of infection (Aaby *et al.,* 1986; Edmonson *et al.,* 1990).

The epidemiological implications of vaccinees having lost their immunity, becoming susceptible to a milder form of measles and being able to transmit the virus have been investigated previously using a simple mathematical model (Mossong *et al.,* 1999).

Since presence or absence of measles specific IgG antibodies has been proven to correlate with protection and susceptibility to natural measles infection (Mossong and Muller, 2013), there is need to check the IgG antibody levels especially in children 0-14 years that are more vulnerable to the disease. Weldegebriel *et al,* (2011) reported that confirmed measles cases increased in Nigeria from 383 in 2006 to 2542 in 2007 and to 9510 in 2008. Of the confirmed cases in 2008, 717 (30%) occurred in children <2 years of age, 1145 (48%) in 2-4 years old, and 354 (14%) in 5-14 years of age. This showed significant percentage of children from 0-14 years being affected and therefore, they are more vulnerable to the disease.

MATERIALS AND METHODS

Ethical Consideration

Approval was obtained from Adamawa State Hospital Service Management Board (Ref. No. HSMB/S291 Vol.1/11), and Adamawa State Universal Basic Education Board (Ref. No. UBEB/SS/280/VOL.1). Also, informed consent approval was obtained from parents of the participating population before collecting samples.

Sampling Techniques and Sample Size Determination

Multistage sampling technique was used to draw the samples for this study. Cluster sampling was used to cluster the state into three based on senatorial zones of the state. Random sampling was used to select two Local Government Areas (L.G A) from each of the senatorial zones making six Local Government Areas. Hospitals, nursery, primary and junior secondary schools were randomly selected from each of the selected Local government Areas as sample Lise-Meitner-Straße 2. D-24145 Kiel (Germany) in accordance with the manufacturer's collection areas. Stratified sampling was used to select the children between 0-14 years based on the age group 0-4; 5-9; 10-14 for convenience. In order to obtain an appropriate sample size that will represent the total number of children aged 0-14 years in the state, and their respective number in the various Local Government selected for the study, the following formular was used.

$$n = \frac{Z^2 (P) (1-P)}{d^2}$$ (Naing *et al*.2006)

Where;

n = Sample size.

Z = Z statistic for a level of confidence (i.e. area under the standard normal distribution curve) which is 1.96 at 95% confidence level.

P = Expected prevalence in percentage express as decimal or in proportion of one.

d = Precision (in proportion of one) at 95% confidence level, precision is 5% and d is 0.05

For this study, P = 0.65, d=0.05, and Z=1.96.

Substituting these values in the formula above;

$$n = \frac{(1.96)^2(0.65) (1-0.65)}{(0.05)^2} \quad n = \quad 349.5$$

Going by the formular, at confidence level of 95%, a sample size of 349.5 is required for the study. However 368 samples were used.

Demographic Data of the Participants

Questionnaire method was employed to obtain demographic data of the participants.

The questionnaires were filled with the demographic data of the participants such as gender, age, history of measles infection, parents' occupation, type of settlement and history of vaccination. This was done prior to collection of samples.

Sample Collection

About 2 millilitres blood samples were collected from the participants by using venipuncture using sterile disposable syringe and needles. The blood samples were allowed to clot and then centrifuged at 2000 rpm for 5 minutes; the sera were harvested into clean sterile screw capped bottles with the proper label as described by WHO, (2000).

Sample Analysis

Sampled sera were assayed using measles IgG commercial ELISA kit manufactured by Demeditec Diagnostics GmbH.

instructions (Demeditec Diagnostic, 2018) and the standardised laboratory procedure to determine the measles IgG antibody qualitatively and quantitatively.

RESULTS

Prevalence of Measles Specific IgG Antibody Based on Vaccination Status

Table 1 showed measles antibody status of children based on their vaccination status. Statistically, there was significant association between vaccination and antibody status (P–value of 0.022). The highly protected cases were those that have been vaccinated.

Prevalence of Measles Specific IgG Antibody Based on Type of Settlement

As shown in table 2, the settlements were classified as Urban and Rural. Statistical analysis (Pearson Chi-square), showed that there is significant association between type of settlement and antibody status (P-value = 0.000) with those from urban settlement having more protective antibody than those from rural settlements.

Prevalence of Measles Specific IgG Antibody Based on Parents' Occupation

Table 3 showed the prevalence of measles IgG antibody based on the occupation of the parents of the participants were 91, 82, 44 and 10 children whose parents are civil servants, farmers, businessmen and others respectively were having protective antibody while 23, 38, 49 and 31 of them were respectively having no or unprotective antibody.

The result also showed that there is significant association between antibody status and parents occupation with children whose parents are civil servant having more protective antibody followed by these of farmers, then businessmen and then other occupations (P-value = 0.000).

Table 1: Prevalence of Measles IgG Antibody Based on Vaccination Status

	Vaccinated children		Unvaccinated children	
Age group	Protective (%)	No/ Unprotective (%)	Protective (%)	No/Unprotective (%)
0-4	47(79.6)	12(20.4)	50(59.5)	34(40.5)
5-9	57(63.3)	33(36.7)	9(33.3)	18(66.7)
10-14	41(59.4)	28(40.6)	23(59.0)	16(41.0)
Total	**145(66.5)**	**73(33.5)**	**82(54.7)**	**68(45.3)**

(Pearson Chi-square = 5.2768, P-value = 0.022)

Table 2: Prevalence of Measles IgG Antibody Based on Type of Settlement

	Type of settlement		
Antibody status	Urban	Rural	Total
Protective	138	89	227
No/unprotective	56	85	141
Total	194	174	368

(Pearson Chi-square =15.5005, P-value = 0.000)

Table 3: Prevalence of Measles IgG Antibody Based on Parents' Occupation

Antibody status	Parents' occupation				
	Civil service	Farming	Business	Others	Total
Protective	91	82	44	10	227
Non-protective	23	38	49	31	141
Total	114	120	93	41	368

(Pearson Chi-square = 50.3729, P-value = 0.000).

DISCUSSION

Result of the study indicated that majority of the children had protective (positive) antibody against measles and among the unvaccinated, majority were protected. This may probably be due to clinical measles infection as well as passive immunity acquired from mother, which is enough to confer immunity against measles for some time especially in the age group 0-4 years.

Black and Yannet (1960) had earlier reported protective efficacy of antibodies to infants from passively acquired maternal antibodies even though the study conducted by Ahmadu *et al.,* (2013) shows that this type of immunity decline to unprotective level before nine mouth. The vaccinated that have unprotective antibody titre are those without history of clinical measles infection. This study showed that there is significant association between prevalence of measles antibody and vaccination status (P-value < 0.05).

Prevalence based on type of settlement of the participant indicated that those from urban areas were more protected than those from rural areas. This may be due to poor facilities, bad roads lack of Hospitals and electricity and lack of awareness in the rural areas which may in turn impede the delivery of vaccination and also affect the potency of the vaccine. These problems are less likely to be seen in most urban areas. This is in line with the work of Baba *et al*., (2007) that showed high degree of primary vaccine failure (76%) with very low (12%) rate of seroconversion and the failure was attributed to sub potency of the vaccines, improper handling of the vaccines during vaccination, storage of the vaccines etc. It was observed in his study that health workers in different Immunization centers improperly handled vaccines during vaccination. For instance most frozen ice packs used for keeping the vaccine at the beginning of a day's vaccination exercise were not changed even when they became hot later in the course of vaccination. In addition, it was observed most often that, the vaccine diluent was not stored at the same temperature as the vaccine before reconstitution. Such malpractices are mostly seen in rural areas and could adversely affect the potency of the vaccine. Therefore adequate monitoring of vaccination exercise in each vaccination centre should be enforced.

This study also indicated that children whose parents are civil servants are more protected than others. This may be due to the level of literacy of the parents as most civil servants are educated and therefore know the importance of immunization.

In comparison with the above findings, Janal *et al.* (2011) had conducted a serological survey of measles immunity among 479 elementary school children. Their finding confirms durable immunity and low rate of vaccine failure following live attenuated measles vaccination. Also a community–based survey to determine the prevalence of measles haemagglutinin-inhibiting (HI) antibodies among children in Santa Cruz Bolivia was conducted by Bartoloni *et al*. (2004) reported that measles vaccine coverage in the children was 77% and 1439 (87%) had detectable HI antibody, but a high proportion had antibody levels below 200miu (30-40%).They associated measles seronegativity with not being vaccinated against measles, negative history of measles disease and young age. Of the 212 children without detectable measles antibody, 123 (58%) had a positive history of vaccination or measles disease, they noted that historical information was not sufficiently reliable to identify susceptible. These findings are in line with the finding of this study. However, different antibody detection methods were used and there is disparity pertaining protective titres which depends on methods and detection kits used.

CONCLUSION

The study revealed that 66.5% of the vaccinated children had protective antibody titre (>10 U/ml) while 33.5% had either no or undetectable antibody (low levels antibody titre i.e ≤10 U/ml) which will not confer protection against measles according to the ELISA kit used. The study also revealed that at 95% confidence level, there is a significant relationship between prevalence of measles IgG antibody and vaccination status, type of settlement and parents' occupation.

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