Prevalence of Anti-Measles Virus IgM antibodies in Vaccinated Children aged 0-5 years and Pregnant Women aged 16-43 years presenting at the Rumuewhor Primary Health Centre in Emohua, Rivers State Nigeria

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Abstract: The study sets to define the seroprevalence of anti-measles virus IgM antibodies in representative samples of the vaccinated children and pregnant women population of Emuohua LGA, Rivers State, Nigeria. Standard ELISA kit was used for the determining anti-measles virus IgM antibodies in the plasma of the immunized children and pregnant women in Emohua, Rivers State Nigeria. Ninety-one (91) sera was used for this study, 46 were from pregnant women and 45 from immunized children. Of the 91 subjects tested, 75(82.4%) were positive and 16 (17.6%) were negative. Of the 45 immunized children that were tested, 33 (73.3%) were positives and 12(26.7%) were negatives. Of the 46 pregnant women tested, 42(91.3%) were positives and 4(8.7%) were negative results. Of the 33 immunized children that tested positive to measles IgM, children between 4-5 years old had the highest prevalence (85.7%). This was followed by children 0 – 1 year old (80.0%) and children 2 to 3 years old had the least prevalence (61.9%). Age showed lack of significant ($p>0.05$) link with infection rate as no specific pattern was observed among the age-groups of children. Also, the seroprevalence of Measles virus IgM was higher in male children (73.3%) than the females (26.7%). Sex showed significant ($p<0.05$) infection rate in males than female children. Of the 42 immunized pregnant women that tested positive to Measles IgM, pregnant women within age-groups 16-20 years and age-groups 25-29 years had the highest prevalence (100.0%). This was followed by age-groups 30 years and above (90.5%) and age-groups 21-24 years old had the least prevalence (77.8%). Prevalence of anti-Measles virus IgM antibody was higher among women with no educational background (100.0%), followed by those with tertiary level of education (93.3%) and primary level (90.9%). Pregnant women with secondary level of education had the least prevalence (86.7%). It showed that pregnant women in their first trimester (100.0%) and third trimester (100.0%) had the highest prevalence of Measles virus IgM compared to those in their 2nd trimester (81.0%). According to the Table 3 pregnant women in their 1st, 2nd, 3rd, 4th and 5th pregnancy. Pregnant women having their 1st pregnancy had 81.3% positive and 18.8% negative results. Women having their 2nd pregnancy yielded 93.7% positive results and 6.3% negative results. Women having their 3rd, 4th and 5th pregnancy all tested positive for Measles IgM. Age, education, trimester and number of pregnancies showed lack of significant ($p>0.05$) infection rate in pregnant women. The study suggests that a review of vaccination age of infants be made by health care providers and policy makers and vaccination campaign programs should also be intensified. Additional studies is needed to define the geographical extents of immunity gaps and the dynamics influencing resistance to measles virus in the community. Vaccination program and campaigns should be increased and maintained in rural areas.
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1. Introduction

Measles is the most lethal of all infantile diseases (CDC, 2013). It has been projected that it communicate a disease to 30 million peoples with 454,000 deaths yearly globally (WHO, 2006; Sydnor, 2014). The disease can spread easily, it is therefore necessary to safeguard against this virus, in order to stop measles, children and some adults should be vaccinated (CDC, 2013). Once the virus is regenerated, it becomes very problematic to interrupt (Gowda *et al*., 2013).

Measles also remains one of the foremost reasons of high mortality amongst young children worldwide, notwithstanding the obtainability of a harmless and active vaccine (WHO, 2015). About 114,900 persons pass away from measles in 2014 – chiefly children below the age of 5 (WHO, 2015). Enhanced vaccination doings have had a key effect on decreasing deaths through measles (WHO, 2015). All through year 2000-2014, measles immunization stopped a projected deaths of 17.1 million persons with provision from the Measles and Rubella Initiative (WHO, 2015). Globally, deaths through measles have

reduced by seventy-nine percent from approximately 546,800 in 2000 to 114,900 in 2014 (WHO, 2015).

It remains prevalent in numerous emerging nations – especially in some portions of Asia and Africa. The irresistible mainstream (>95%) of deaths as a result of measles happen in nations with little for each capital proceeds and frail health organizations (WHO, 2015). Outbreaks of measles could be mainly deadly in nations facing or recuperating from a usual tragedy or battle. Impairment of health organization and health facilities disturbs continuous vaccination, and congestion in housing campsites significantly upsurges the danger of infection (WHO, 2015).

In populaces with extraordinary heights of undernourishment and a dearth of passable health care, up to 10% cases of measles end in death (WHO, 2015). Infected pregnant women are at danger of severe problems and it might result in preterm delivery or miscarriages. Though, persons who recuperate from measles are protected for life, unimmunized children have the greatest danger of measles and its problems, death inclusive (WHO, 2015). Unimmunized pregnant women are also at risk (WHO, 2015). Any unvaccinated individual or those who receive vaccination but have undeveloped immunity could become infected (WHO, 2015).

In 2014, the world-wide thrust to advance vaccine coverage led to a seventy-nine percent deaths reduction (WHO, 2015). In the course of 2014, around 219 million children were immunised against measles all through the mass immunization movements in 28 nations (WHO, 2015). All WHO Regions have these days set objectives to remove this vaccine avoidable killer disease by 2020 (WHO, 2015).

The average age at initial pregnancy is increasing, and the period from the time when maternal measles immunization is increasing with it (Leuridan et al., 2010). The degree of maternal antibodies deterioration afterward delivery defines the period of immunity in infants (Leuridan et al., 2010). Protection to wildtype measles virus was upheld even several years after infection (Brugha et al., 1996; Leuridan and Van Damme, 2007; Leuridan *et al*., 2010). Though, protection ensuing from vaccines have remained more challenging, with eruptions of measles defined in vaccinated populaces almost from the time when the vaccine was presented and used extensively (Brugha et al., 1996; Leuridan and Van Damme, 2007; Leuridan et al., 2010). Decrease in measles linked death is unique of the WHO's objectives (Brugha et al., 1996; Leuridan and Van Damme, 2007; Leuridan et al., 2010).

Vaccine disappointments amongst seemingly sufficiently immunized persons are bases of infection (Kutty *et al*., 2013). Persons who have been earlier vulnerable to measles antigen might have an adapted disease manifestations (Kutty *et al*., 2013). These modified measles diseases are typically noticed in the course of an eruption or after a recognised contact to a long-established case of measles (Kutty *et al*., 2013). In infrequent examples, such modified measles condition could happen deprived of a recognised contact or other risk factors (Kutty *et al*., 2013).

Vaccination against measles is extremely effective and prime vaccine disappointment after 2 immunizations is exceptional, with <1% deteriorating to seroconvert (Strebel et al., 2008; Mitchell et al., 2013). Prime vaccine disappointment, ensuing encounter with wildtype measles virus resulting in an illness of characteristic severity (Edmonson et al., 1990; Mitchell et al., 2013). Nevertheless, subordinate vaccine disappointment, when measles advances after early seroconversion, happens in up to six percent of persons immunised after one dose (Mathias et al., 1989; Anders et al., 1996; Mitchell et al., 2013). More so it has been documented to be linked with modified or trivial disease (Cherry et al., 1973; Smith et al., 1982; Edmonson et al., 1990; Sheppeard et al., 2009; Mitchell et al., 2013) and a lower case-fatality-rates (Wolfson et al., 2009; Mitchell et al., 2013).

Murti et al. (2013) reported an event of MMR-vaccine-linked measles thirty-seven days after vaccination for the first time. However, only one transmission of such case has been identified (Millson, 1989; Hau et al., 2013; Murti et al., 2013). Likely clarifications for this protracted shedding of measles vaccine virus comprise vaccine factors or meddling with the immune reaction by host (Murti et al., 2013).

The aptitude to notice IgM amongst people with subordinate immune reaction (SIR) to measles ensuing from a contact to measles virus will be contingent on the kinetics and extents of the discrete immune reaction (present and earlier), the time of collection of sera, and the assay sensitivity (Erdman et al., 1993; Rota et al., 2011). Furthermore, since the quick IgG boosting, it might be impossible to prove a four-fold increase in titer amongst SIR circumstances (Rota et al., 2011). Nonetheless, when collection of clinical samples are carried out in an appropriate way, real-time RT-PCR analysis might identify virus in peoples with adapted measles (Rota et al., 2011). For instance, in the course of 2007 measles epidemic, two immunized college students were detected during follow-up examinations of exposures with intensely measles patient (Chen et al., 2010; Rota et al., 2011). One of them had obvious IgM reaction and the other was RT-PCR positive (Chen et al., 2010; Rota et al., 2011) though no identified spread of the modified measles (Rota et al., 2011).

Regardless of high immunization coverage in the community, outbreaks of measles can take place amongst groups of deliberately under-immunized

children, at a major cost to families, medical systems, and public health agencies (Sugerman et al., 2010). Increasing proportions of deliberate under-immunisation can weaken measles eradication (Sugerman et al., 2010). In 2008, the largest measles outbreak since 1991 ensued in San Diego, California as a result of a deliberately unimmunised seven year-old boy who became naively infected with measles in Switzerland (Sugerman et al., 2010). Eleven supplementary cases of measles in children who were not vaccinated was documented. There was also a documented case of a child too young to be immunised who was hospitalized (Sugerman et al., 2010). Sugerman et al. (2010) reported considerable proportions of deliberate underimmunisation happened in community charter, public and private schools in upper-socioeconomic areas. There seems to be an increasing overall proportions of geographically clustered vaccine rebuttal (Sugerman et al., 2010).

The study objective is to define the prevalence of anti-measles virus IgM in vaccinated children and pregnant women populations of Emohua, Rivers State, Nigeria.

2. Methods

2.1. ***Study area:*** The study was done using Rumuewhor Primary Health Centre, Emohua, a small community in Rivers State among immunized children and pregnant women in their 1st 2nd and 3rd trimester. Emohua is a Local Government Area in Rivers State and its headquarters are in the town of Emohua. It has a population of 201,901 individuals. The study was carried out among immunized children and pregnant women populations of Emohua, Rivers State, Nigeria.

2.2. ***Study population:*** A total number of 45 vaccinated children and 46 pregnant women attending the Rumuewhor Primary Health Centre in Emohua, Rivers State, Nigeria were recruited into this study after a verbal or written informed consent was obtained. Thirty-two of the immunized children were male and thirteen were female. The children were between the ages of 0-5 years while the pregnant women were between the ages of 16-30 and above. The pregnant women were grouped in relation to the number of their pregnancy, the trimester, educational status and age. The sample size was determined according to Macfarlane (1997) and Naing et al. (2006) equations. Therefore, the assessed sample size was 84 with extra 10% samples to cater for data inconsistencies (Macfarlane, 1997; Niang *et al.*, 2006; Awando *et al.*, 2013), providing a total sample size of approximately 91 samples. *Methods were in agreement with the Declaration of Helsinki (October 2008 revision) and the research ethics standards of the Nigerian National Code for Health Research Ethics.*

2.3. ***Sample collection and preparation:*** A 3 mL blood samples were collected from these participants by venipuncture and dispensed into sterile, labeled, containers containing no anticoagulant. Samples were conveyed in an ice-box to the Medical Microbiology Laboratory, Department of Microbiology, University of Port Harcourt, Nigeria. Samples were centrifuged and sera was extracted into Eppendorf tubes and stored at -20^{O}C.

2.4. ***Serological testing:*** The samples were examined for anti-measles virus IgM antibodies with immunoglobulin M measles enzyme-linked immunosorbent assay kits (DIA.PRO Diagnostic Bioprobes, Milano, Italy). The serological assay and results interpretation was carried out as stipulated by the kit's manufacturer.

2.5. ***Data Analysis:*** Results were presented in proportions. We engaged Chi-square test and Fisher's exact test to evaluate variances amid groups at $p \leq 0.05$ significance. We used <1.0 as negative and ≥1.0 as positive in order to get valid analysis.

3. Results

3.1. Participants' characteristics: The age-ranges of the 45 vaccinated children populations was 0-5 years while the age-range of the 46 pregnant women was 16-43 years. Thirty-two (71.1%) of the immunized children were males and 13 (28.9%) were females. From the biodata of the immunized children, 10(22.2%) were children aged 0-1years, 21(46.7%) were aged 2-3years and 14 (31.1%) were aged 4-5years (Table 1). In relation to Educational status, 10 (22.2%) of these immunized children were not in school, 18(40.0%) of them were in nursery schools and 17 (37.8%) were in primary schools (Table 1).

For the pregnant women, 7 (15.2%) were ages 16 to 20 years, 9 (19.6%) were 21 to 24 years, 9 (19.6%) were 25 to 29 years and 21 (45.6%) were aged ≥ 30 years. In relation to the trimester of pregnant women, 15 (32.6%) were in their 1st trimester, 21 (45.7%) were in their 2nd trimester and 10 (21.7%) were in their 3rd trimester. In relation to Educational status, 5 (10.9%) of these pregnant women were not educated, 11(23.9%) of them stopped at the primary level of education, 15 (32.6%) had secondary level of education and 15 (32.6%) had tertiary level of education. Parity among the pregnant women showed that 16 (34.8%) were having their 1st pregnancy, 16 (34.8%) also were in their 2nd pregnancy, 8 (17.4%) were in their 3rd pregnancy, 5 (10.9%) were in their 4th pregnancy and 1 (2.2%) was in her 5th pregnancy as illustrated in table 1.

Table 1: Socio-demographical features of the vaccinated children and pregnant women

Variables	Children (%)	Pregnant women (%)
Sex		
Females	32 (71.1)	46(100.0)
Males	13(28.9)	NA
Age group (year)		
0-1	10(22.2)	NA
2-3	21(46.6)	NA
4-5	14(31.1)	NA
16-20	NA	7(15.9)
21- 24	NA	9(19.6)
25-29	NA	9(19.6)
30 & above	NA	21(45.7)
Education		
None	10(22.2)	5(10.9)
Nursery	18(40.0)	0(0.0)
Primary	17(37.8)	11(23.9)
Secondary	NA	15(32.6)
Tertiary	NA	15(32.6)
Trimester		
1st Trimester	NA	15(32.6)
2nd Trimester	NA	21(45.7)
3nd Trimester	NA	10(21.7)
No. of pregnancy		
1st	NA	16(34.8)
2nd	NA	16(34.8)
3rd	NA	8(17.4)
4th	NA	5(10.9)
5th	NA	1(2.1)
Total	**45(100.0)**	**46(100.0)**

Keys: NA = Not Applicable

3.2. *Prevalence outcome of children and pregnant women tested for Measles virus IgM antibodies*

Table 2 shows prevalence outcome of children and pregnant women tested for Measles virus IgM antibodies. Of the 91 subjects tested, 75(82.4%) were positive and 16 (17.6%) were negative. Of the 45 immunized children that were tested, 33 (73.3%) were positives and 12(26.7%) were negatives. Also in table 2, of the 46 pregnant women tested, 42(91.3%) were positives and 4(8.7%) were negative results.

Table 2: Prevalence outcome of children and pregnant women tested for anti-Measles virus IgM antibodies

Participants (%)	No. tested (%)	Serostatus (%)	
		Positives	Negatives
Vaccinated Children	45(49.5)	33(73.3)	12(26.7)
Pregnant women	46(50.5)	42(91.3)	4(8.7)
Total	91(100.0)	75(82.4)	16(17.6)

3.3. *Socio-demographical characteristics and Prevalence outcome of children and pregnant women tested for Measles virus IgM antibodies*

Table 3 shows socio-demographical features and prevalence status of the vaccinated children evaluated for Measles virus IgM antibodies. Of the 33 immunized children that tested positive to measles IgM, children between 4-5 years old had the highest prevalence (85.7%, n=12). This was followed by children 0 – 1 year old (80.0%, n=8) and children 2 to 3 years old had the least prevalence (61.9%, n=13). Age showed lack of significant ($p>0.05$) link with infection rate as no specific pattern was observed among the age-groups of children. Also, the seroprevalence of Measles virus IgM was higher in males (73.3%) than the females (26.7%). Sex showed significant ($p<0.05$) infection rate in males than female children (Table 3).

Table 3 also shows socio-demographical characteristics and prevalence status of pregnant women evaluated for Measles virus IgM antibodies. Of the 42 immunized pregnant women that tested positive to Measles IgM, pregnant women within age-groups 16-20 years and age-groups 25-29 years had the highest prevalence (100.0%). This was followed by age-groups 30 years and above (90.5%, n=19) and age-groups 21-24 years old had the least prevalence (77.8%, n=7).

Table 3 indicates prevalence of Measles IgM antibody in relation to their educational status. Prevalence of anti-Measles virus IgM antibody was higher among women with no educational background (100.0%), followed by those with tertiary level of education (93.3%, n=14) and primary level (90.9%, n=10). Pregnant women with secondary level of education had the least prevalence (86.7%, n=13).

Table 3 indicates prevalence of Measles IgM antibody in relation to their trimester. It showed that pregnant women in their first trimester (100.0%, n=15) and third trimester (100.0%, n=10) had the highest prevalence of Measles virus IgM compared to those in their 2nd trimester (81.0%, n=17) as shown in Table 3.

According to the Table 3 pregnant women in their 1st, 2nd, 3rd, 4th and 5th pregnancy. Pregnant women having their 1st pregnancy had 81.3% positive and 18.8% negative results. Women having their 2nd pregnancy yielded 93.7% positive results and 6.3% negative results. Women having their 3rd, 4th and 5th pregnancy all tested positive for Measles IgM (Table 3).

Age, education, trimester and number of pregnancies showed lack of significant ($p>0.05$) infection rate in pregnant women (Table 3).

Table 3: Socio-demographic characteristics and prevalence status of the vaccinated children and pregnant women

Variables	Children (%)	No. positive (%)	Pregnant women (%)	No. positive (%)
Sex				
Females	32 (71.1)	(26.7)	46(100.0)	42(91.3)
Males	13(28.9)	(73.3)	NA	NA
Age group (year)				
0-1	10(22.2)	8(80.0)	NA	NA
2-3	21(46.6)	13(61.9)	NA	NA
4-5	14(31.1)	12(85.7)	NA	NA
16-20	NA	NA	7(15.9)	7(100.0)
21- 24	NA	NA	9(19.6)	7(77.8)
25-29	NA	NA	9(19.6)	9(100.0)
30 & above	NA	NA	21(45.7)	19(90.5)
Education				
None	10(22.2)	10(100.0)	5(10.9)	5(100.0)
Nursery	18(40.0)	13(72.2)	0(0.0)	0(0.0)
Primary	17(37.8)	10(58.8)	11(23.9)	10(90.0)
Secondary	NA	NA	15(32.6)	13(86.7)
Tertiary	NA	NA	15(32.6)	14(93.3)
Trimester				
1st Trimester	NA	NA	15(32.6)	15(100.0)
2nd Trimester	NA	NA	21(45.7)	17 (81.0)
3nd Trimester	NA	NA	10(21.7)	10(100.0)
No. of pregnancy				
1st	NA	NA	16(34.8)	16(81.2)
2nd	NA	NA	16(34.8)	16(93.7)
3rd	NA	NA	8(17.4)	8(100.0)
4th	NA	NA	5(10.9)	5(100.0)
5th	NA	NA	1(2.1)	1(100.0)
Total	**45(100.0)**	**33(73.3)**	**46(100.0)**	**42(91.3)**

Keys: NA = Not Applicable

4. Discussion

In spite of the extensive obtainability of safe, active and effective vaccines, measles remains one of the most significant etiology of disease and deaths in emerging nations, subsequent in over a million deaths globally every year (Papania and Orenstein, 2004;

Adetunji et al., 2007; Olaitan et al., 2015). Thus, the study sets to ascertain the measles IgM antibodies prevalence in vaccinated children and pregnant women population of Emohua, Rivers State, Nigeria and evaluate the socio-demographic data and risk factors associated with the seropositivity for anti-MV-specific IgM antibodies among vaccinated children and pregnant women and assess their susceptibility to the Measles virus. The study showed that 75(82.4%) of all the 91 subjects evaluated were positive for anti-measles IgM and 16 (17.6%) were negative.

Of the 45 immunized children that were tested, 33 (73.3%) were positives and 12(26.7%) were negatives. The possibility of anti-MV IgM antibodies in vaccinated children has been previously reported by several authors. In comparison with IgM antibodies reaction to MV subsequent to primary immunization, natural MV infection and re-exposure to the MV, Nates et al. (1997) reported that IgM seropositivity rate for seroneutralization long-established measles infections was one hundred percent for naturally infected measles persons and ninety percent for primary measles immunized persons. Nates et al. (1997) also reported 9.09% positivity in children exposed to long-established measles cases presenting a booster with IgM antibodies reaction on re-exposure to the virus.

Previously Erdman et al. (1991) reported IgM positivity in ninety-seven percent children three weeks after immunisation. Erdman et al. (1993) reported that 97.0% of unvaccinated children getting prime measles immunisation had IgM antibodies which was in line with a primary antibody reaction. Erdman et al. (1993) also found absence of IgM antibodies in 21 earlier immunised children with low previous IgG antibodies who reacted to reimmunisation, while they reported 94.0% IgM positivity in children with no obvious previous IgG antibodies. Erdman et al. (1993) reported 96.0% IgM positivity in children with a previous account of immunisation.

These previous studies propose that 1) an IgM reaction trails main measles immunisation in the immunologically naive, 2) an IgM reaction is lacking on reimmunisation of those formerly vaccinated, and 3) an IgM reaction may trail clinical MV infection free from previous vaccination standing (Erdman *et al*., 1993).

Of the 33 immunized children that tested positive to measles IgM in this study, children between 4-5 years old had the highest prevalence (85.7%), followed by children 0–1 year old (80.0%) and children 2-3 years old had the least prevalence (61.9%). The detection of measles IgM in children 0-1 year agrees substantially with previous reports that substantial statistics of measles cases happen below the target age for immunization (de Francisco *et al*., 1998). According to Chechet *et al*. (2014), this could be an indication of low protective circulating antibodies.

In the Matlab area of Bangladesh, Koster et al. (1981) previously reported 4.4% seropositivity of measles among children <24 months of age. Shahid et al. (1983) reported a seropositivity of measles of 1.3% for children under 24 months of age. Bhuiya et al. (1987) reported measles seropositivity of 1.3% among children under-12-month-olds. However, 40% of all the measles-related deaths found by these authors (Koster et al., 1981; Shahid et al., 1983; Bhuiya et al., 1987) were among under-6-month-olds. Shahid et al. (1983) stated a case-fatality-rate (CFR) of 1.3% in children less than 24 months of age while Bhuiya et al. (1987) reported CFRs of 1.7% among children over-36-month-olds. Also in the Matlab area of Bangladesh Koster et al. (1981) previously reported measles prevalence of 1.6% among children >72 months of age.

The study showed sex-related measles IgM seropositivity of measles virus IgM antibody. Prevalence of MV IgM was predominant in male children (73.3%) than their female counterparts (26.7%). This finding is in consonance with earlier reports in some regions of Nigeria by Chukwu et al. (2009) and Chechet *et al*. (2014) who acknowledged that seropositivity of anti-measles IgM antibody is slightly higher in males than females. It also agrees favourably with studies by Bassey et al. (2010), Masuet-Aumatell et al. (2013) and Olaitan et al. (2015) who reported sex-related IgM seropositivity. Chechet *et al*. (2014) reported a higher seropositivity in male children than the female children in Kaduna State, Nigeria. Also in agreement to this finding, Chukwu *et al*. (2009) reported that male children (37.4%) had higher seropositivity than the females (33.7%). This finding may be connected with the general life style of male children. Males are often involved in playful acts among their peers and also carry out more outdoor activities than the females (Chechet *et al*., 2014). Another factor that may be responsible for this sex-related difference in these studies could owe to the fact that females are more restricted and few even mingle in schools than the male counterpart especially in the northern Nigeria (Chechet *et al*., 2014).

However, our finding deviated from that of Rafiei *et al*. (2013) who found insignificant sex associated seropositivity of anti-measles virus IgM in their study. It also deviates from earlier findings in some other parts of Nigeria (Bassey et al., 2010; Olaitan et al., 2015) and other parts of the world (Fauveau et al., 1991; Grais et al., 2007; Tharmaphornpilas et al., 2009; Masuet-Aumatell et al., 2013), which reported that seropositivity of anti-

measles virus IgM antibodies is slightly predominant in females than in males.

The study also showed that of the 46 pregnant women tested, 91.3% were positives and 8.7% were negative. Mother-to-child transmission of the measles virus has been recognised in the newborns also by demonstration of IgM in blood or RT-PCR in saliva (Giusti *et al*., 2013). Giusti et al. (2013) noted that measles is a congenital viral infections with a danger of neurological problems in the newborn. Giusti et al. (2013) stated two occurrences of measles cases in pregnant women in fourteen days earlier to given birth.

Betta-Ragazzi et al. (2005) also detected MV IgM antibodies and genome in two measles infected mothers who delivered their babies during a measles outbreak in São Paulo City, Brazil. MV genome persevered in peripheral blood mononuclear cells in one of the infants 157 days after delivery (Betta-Ragazzi *et* al., 2005). These studies suggest the prevalence of measles in children and pregnant women and points to congenital measles, primary and secondary vaccine failures a cause of neonatal measles and proper characterization of the virus to rule out false positives.

Of the 42 immunized pregnant women that tested positive to Measles IgM, most predominant MV prevalence (100.0%) was found in age-groups 16-20 years and age-groups 25-29 years. Also, a 90.5% prevalence of MV IgM was observed in age-groups 30 years and above. While the least prevalence of MV IgM was found in age-groups 21-24 years (77.8%). According to Chen et al. (1990, 2010), resistance to measles might not be outright nonetheless, it reveal a range of clinical disease contingent on the intensities of prior antibodies. Additionally, the level of contact (i.e., the received viral dosage) is a significant danger issue aimed at advancing infection and the unquantifiable ones which in retrospect define the protecting antibody titre against characteristic infection (Rota et al., 2011). The intermittent boosting vaccination and the lack of circulating virus that might have offered added guard from infection might change the pattern of lifetime protection after immunisation or the disease (Rota et al., 2011). Helfand et al. (1998a) pointed out that the degree of nonclassic infection is probable to upsurge as control of measles advances in a populace, since boosting from contact with wild-type MV will be uncommon. This might also happen amongst elder peoples who previously have a past encounter of natural measles infection, though previous disease is hard to document (Rota et al., 2011). Rota et al. (2011) reported a confirmed case of measles IgM and RT-PCR positivity in a 55-year-old man born outside of the United States who claimed to have had measles as a child (Rota et al., 2011).

The resolve to whether an immunised person with measles contact who had suggestive symptoms of measles signifies a case patient and thus a possible source of measles to others frequently pivots on laboratory assay as the determining feature (Rota et al., 2011). In spite of ample prospects for virus transmission, Rota et al. (2011) reported cases of 2 doctors who had measles and did not infect any vaccinated or unvaccinated patients. According to Rota et al. (2011), dependence on the lack of IgM to remove suspicions may be baseless in these situations. More of these challenging cases in the future needs to be established by MV RNA detection. In future perspectives, extra studies are necessary to decide whether individuals with modified measles can spread it to others (Rota et al., 2011).

Reduced severity or lack of respiratory indications, predominantly a cough, might end in lower infectivity comparative of a definitive measles infection (Aaby et al., 1986; Lee et al., 2000; Rota et al., 2011). Nevertheless, the capability to distinguish measles in individuals with a secondary immune response is useful for investigation purposes in sustenance of measles elimination efforts (Rota et al., 2011).

In this study, prevalence of anti-MV IgM antibody was higher among women with no educational background (100.0%), followed by those with tertiary level of education (93.3%) and primary level (90.9%). Pregnant women with secondary level of education had the least prevalence (86.7%). This finding agrees with findings in Malawi (Fowlkes et al., 2011) and Bolivia (Masuet-Aumatell et al., 2013), where higher seropositivity was reported in children whose mothers had lower educational level compared to highly educated parents. It also agrees with Olaitan et al. (2015) who indicated no significant association between measles infection and education. According to Olaitan et al. (2015), the main explanation for this might be that measles infection is still endemic in the country; consequently, the general population is exposed similarly to the virus regardless of the educational standing.

The study showed that women in the first and third trimester had the highest prevalence (100.0%) of Measles virus IgM compared to those in their 2nd trimester (81.0%). Higher prevalence of measles IgM antibodies were reported in pregnant women having their 3^{rd,} 4th and 5th pregnancy (100.0%), followed by those having their 2nd pregnancy (93.7%). Those having their 1st pregnancy had the least prevalence (81.3%).

As advancement is made in the direction of measles elimination, the laboratory validation of measles turn out to be progressively more essential. MV IgM antibodies test is seen to be more definite,

and consequently, its use is designated for confirmation assay, but its comparative presentation has not been completely evaluated (Victek *et al*., 1997; Ratnam, 2000). MV IgM serological testing allows the analysis of a particular sample and is analytic if the outcome is affirmative. In general, an earlier vulnerable individual with contact to any wild-type or vaccine MV will initially mount an IgM reaction. The IgM reaction will be brief usually one to two months, and the IgG reaction should persevere for several years (CDC, 2009). Uninfected individuals must be negative to IgM and would either be IgG positive or IgG negative, dependent on their earlier history of infection (CDC, 2009).

Children who were vaccinated previously and later developed measles are probable to have low disease severity and likely inconclusive serological outcome, mainly for IgM antibodies if evaluated in the initial few days after the onset of rash (Mitchell et al., 2013). An IgM negative outcome could aid eliminate measles suspicion (Helfand et al., 1998b). Nevertheless, an affirmative outcome from a person who was vaccinated recently is not indicative of a wild-type MV infection (Helfand et al., 1998b). Furthermore, the extent of the IgM reaction does not aid to differentiate amid wild-type and vaccine MV infection (Helfand et al., 1998b).

The fluctuating measles epidemiology with minor measles cases progressively being documented in individuals who were vaccinated previously, recommends that more subclinical or asymptomatic cases may be happening. Though, this has been obviously reported in previously-vaccinated individuals, the occurrence of these asymptomatic infections in persons earlier infected with natural measles remains unknown (Vardas, 1999). The study suggests that a review of vaccination age of infants be made by health care providers and policy makers and vaccination campaign programs should also be intensified. Additional studies is needed to define the geographical extents of immunity gaps and the dynamics influencing resistance to measles virus in the community. From the study, it can also be concluded that although the fight against measles is in progress, the level of vaccination coverage should be increased especially in rural areas. Vaccination program and campaigns should be increased and maintained in rural areas.

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