International Journal of Infectious Diseases 49 (2016) 189–195

Contents lists available at ScienceDirect

International Journal of Infectious Diseases

journal homepage: www.elsevier.com/locate/ijid

Measles immunity among pregnant women aged 15–44 years in Namibia, 2008 and 2010☆

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ARTICLE INFO

Article history:
Received 19 January 2016
Received in revised form 16 May 2016
Accepted 18 May 2016

Corresponding Editor: Eskild Petersen, Aarhus, Denmark.

Keywords:
Measles
Seroprevalence
Namibia
Pregnant women
Population immunity

SUMMARY

Background: Namibia experienced a large measles outbreak starting in 2009, with 38% of reported cases in adults, including women of reproductive age. Population immunity was assessed among pregnant women to determine whether immunization activities were needed in adults to achieve measles elimination in Namibia.

Methods: A total of 1708 and 2040 specimens sampled from Namibian pregnant women aged 15–44 years who were included in the 2008 and 2010 National HIV Sentinel Survey, respectively, were tested for measles immunoglobulin G antibody. The proportion of women seropositive overall and by 5-year age strata was determined, and factors associated with seropositivity were analyzed by logistic regression, including age, facility type, gravidity, HIV status, and urban/rural setting. Seropositivity in 2008 versus 2010 was compared.

Results: In both analysis years, measles seropositivity was lower in 15–19-year-olds (77%) and 20–24-year-olds (85–87%) and higher in 25–44-year-olds (90–94%) (2008, $p < 0.001$; 2010, $p < 0.001$). Overall measles seropositivity did not differ between 2008 (87%) and 2010 (87%) ($p = 0.7$). HIV status did not affect seropositivity.

Conclusions: Late in a large measles outbreak, 13% of pregnant women in Namibia, and almost one in four 15–19-year-old pregnant women, remained susceptible to measles. In Namibia, immunization campaigns with measles-containing vaccine should be considered for adults.

1. Introduction

Globally, the number of reported measles cases decreased by 73% from 2000 to 2014.[1] In the World Health Organization (WHO) African Region, estimated measles deaths decreased during this period by 86%; nonetheless, outbreaks continued to occur in this region and accounted for 73 914 cases and an estimated 48 000 deaths in 2014, representing 42% of the global measles mortality burden.[1]

In the pre-vaccine era, measles was primarily an illness affecting children, and infection in young adults and during pregnancy was uncommon, estimated to occur in 6 per 100 000 pregnancies.[2,3] However, as measles vaccine coverage increased in countries, the chance of measles virus exposure in childhood decreased substantially and the age at onset of disease shifted to include young adults and women of reproductive age.[4–6] During 2009–2010, measles outbreaks in a number of African countries demonstrated this shift in measles epidemiology, characterized by cases occurring among older children and young adults.[4]

DOI of original article: http://dx.doi.org/10.1016/j.ijid.2016.05.009
☆ The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.
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http://dx.doi.org/10.1016/j.ijid.2016.05.020

Namibia, a country in southwestern Africa, has an estimated population of 2.1 million.[7] In 2014, Namibia had an HIV prevalence among adults aged 15–49 years of 16.0%, one of the highest in the world,[8] and high compared with other countries in the Sub-Saharan Africa region.[9] Routine measles vaccination at 9 months of age began in 1983, before independence from South Africa.[10] WHO and United Nations Children's Fund estimates of coverage among 12–23-month-olds with the first dose of measles-containing vaccine in Namibia decreased from 76% in 1989 to 58% in 2001, ranged from 63% to 76% during 2002–2012, and increased to 83% in 2014.[10] In addition to vaccination through routine immunization services, periodic measles supplementary immunization activities (SIAs) have been conducted every 3 years, starting in 1997, following the WHO-recommended strategy for measles mortality reduction, with reported administrative coverage of 90–104%.[11,12]

From August 2, 2009 through February 2, 2011, a large measles outbreak occurred in Namibia, with 3256 laboratory-confirmed or epidemiologically linked cases.[11,13] A distinguishing feature of this outbreak was that 38% of reported cases occurred among adults aged ≥15 years, including women of reproductive age. Measles cases in pregnant women in Namibia during this outbreak resulted in adverse maternal, fetal, and neonatal outcomes, including neonatal and maternal death.[14] In response to the outbreak, outbreak response immunization (ORI) targeting children aged 6–59 months, regardless of previous measles vaccination, was conducted in seven districts in 2009–2010.[13] ORI targeting all persons aged ≥6 months was implemented in February 2010 in Opuwo district, where the highest number of measles cases was reported during the outbreak,[13,15] and ORI targeting persons aged 6 months to 35 years was conducted in three districts during May–June 2010.

To estimate measles population immunity in Namibian pregnant women before and late in the measles outbreak and to examine factors associated with seroprevalence (including HIV status), stored serum samples from the 2008 and 2010 national HIV surveys among pregnant women aged 15–44 years old were tested. It was reasoned that assessing the level of measles immunity in pregnant women in Namibia would provide substantial new knowledge towards understanding the level of susceptibility and the potential burden of disease in this population and would help guide immunization program activities needed in Namibia to achieve measles elimination.

2. Methods

2.1. National HIV Sentinel Survey

In 2008 and 2010, the Namibia Ministry of Health and Social Services (MoHSS) conducted a nationwide sentinel survey to estimate HIV prevalence in pregnant women aged 15–49 years. The survey was designed in accordance with the WHO standardized methodology for HIV prevalence surveys using convenient consecutive sampling of women attending antenatal clinic (ANC) service sites selected based on geographic representation from all regions and health districts, urban and rural clinics, areas with different population densities and sizes, and women of different socioeconomic status.[16,17] All pregnant women aged 15–49 years were included in the survey if they attended an ANC for the first time during their current pregnancy, were not referred from another health facility, and agreed to a routine blood draw.

The 2008 survey enrolled 8174 women from all 34 districts, 35 main hospital sites, and 89 satellite health centers and clinics; 8024 (98.2%) enrollees had specimens collected during March 17 to July 31, 2008.[17] The 2010 survey enrolled 7983 pregnant women from all 34 districts, 35 main hospitals, and 93 satellite health centers and clinics; 7888 (98.8%) enrollees had specimens collected during March 22 to September 6, 2010.[16] Most confirmed measles cases in the 2009–2011 outbreak occurred before the start of the 2010 survey (2519 of the 3256 confirmed cases, or 77%).[13] In both surveys, unlinked, de-identified specimens were tested for HIV antibodies; all de-identified data fields were retained electronically (unique identification, district abbreviation and site number, facility type, date of ANC visit, woman's age, gravidity, town of residence, antiretroviral therapy participation, and counseling for prevention of maternal to child transmission). Specimens were stored at 4–8 °C at the Namibia Institute of Pathology (NIP) in Windhoek.

2.2. Laboratory testing

Laboratory testing to detect measles-specific immunoglobulin G (IgG) antibody was performed at the NIP in 2012, using an enzyme immunoassay (EIA) (Enzygnost, Siemens, Germany); the manufacturer's recommended standard operating procedures were followed. The manufacturer assigns specimens with corrected optical density (OD) values >0.2 as positive, specimens with values of 0.1–0.2 as equivocal, and specimens with values <0.1 as negative. However, these classifications are designed for testing individuals and not population studies.[18] Using the quantitative evaluation recommended by the manufacturer, sample assays in the equivocal range resulted in titers ranging from 149 to 342 mIU/ml, which are higher than the accepted protective antibody concentration of 120 mIU/ml.[19,20] As a result, specimens with OD ≥0.1 were considered to be positive, which is consistent with previous studies suggesting the antibody levels in the equivocal range are protective against measles.[18,21,22] Positive, equivocal, and negative specimens are reported separately, but analyses were conducted using a combined grouping of positives and equivocals compared to negative specimens. Specimens that tested equivocal were retested as per the manufacturer's instructions, and if the result was confirmed, samples were classified as equivocal, otherwise as positive or negative.

To monitor the performance of the EIA assay, an in-house positive control for measles IgG was included on every EIA plate in addition to the controls supplied by the manufacturer. A 5% random sample of specimens was tested at the Centers for Disease Control and Prevention (CDC) in Atlanta, USA, for quality assurance; testing was found to be highly concordant with that at NIP (data not shown).

2.3. Sample size calculations

To estimate measles antibody seroprevalence within each 5-year age group with a desired precision of ±5%, it was determined to be necessary to test 428 specimens in each age group, assuming a seroprevalence of 50%, probability of achieving the desired precision of 0.95, and 10% loss due to specimens not found or inadequate for testing. The number of specimens in the 45–49 years age stratum was too few to result in meaningful estimates and these samples were excluded. The number of specimens in the 40–44 years age stratum was fewer than the target, so all specimens were sampled. To control for the distribution of HIV-infected women within each age group, the target sample size was allocated to the HIV-positive and HIV-negative groups based on the observed distribution in the ANC sentinel survey.[16,17]

2.4. Statistical analyses

A seroprevalence estimate and 95% confidence interval (CI) using the Wilson score method were calculated for each 5-year age group in each analysis year and within the following subpopulations: urban/rural setting, HIV status, gravidity, facility type (hospital, health center, or clinic), and health district. For each