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ORIGINAL ARTICLE

# Seroepidemiology for measles among elementary school children in Northern Taiwan



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Received 30 April 2014; received in revised form 21 August 2014; accepted 23 August 2014

Available online 31 October 2014

## KEYWORDS

measles;  
schoolchildren;  
seroepidemiology

**Background:** Despite the high vaccination coverage in Taiwan, sporadic cases or small cluster of measles still occur every year. Nevertheless, few studies provided information about the serostatus for measles in recent years. This cross-sectional survey aimed to establish the seroepidemiologic data of measles among elementary school children in New Taipei City, Taiwan during 2012–2013.

**Methods:** A multistage stratified sampling design using 14 variables was employed to obtain samples. All selected schoolchildren were bled for the serologic tests of measles by both chemiluminescence immunoassay (CLIA) and enzyme immunoassay (EIA).

**Results:** A total of 856 schoolchildren from 14 schools were recruited in this study. Among these individuals, the overall seropositive rates for measles were 82.24% and 92.17% by the Liaison and NovaLisa assays, respectively. For schoolchildren in each grade, the seropositive rates were > 90% for Grade 1, and then decreased gradually to 70–80% for Grade 6 ( $p < 0.001$  for both methods). A decay of measles-specific immunoglobulin G titers was also observed with the maximum drop between Grade 1 and Grade 2 (declining trend of  $p < 0.001$  for both).

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**Conclusion:** Although the seropositive rate of measles was > 90% for Grade 1, the rate for Grade 6 was only in the range of 70–80%, which may be a challenge to prevent outbreaks of measles in the future and should be monitored meticulously.

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## Introduction

Measles is an acute viral disease which is highly infectious in nature. It brings about a large body of illnesses, including fever, rash, conjunctivitis, diarrhea, pneumonia, encephalitis, and even death. In Taiwan, measles occurred epidemically with a 2-year cyclic fluctuation in the pre-vaccination era.<sup>1</sup> To diminish the burden of this disease, the Taiwanese government has been making a great effort by the use of measles-containing vaccines over the past 3 decades.

In Taiwan, the live attenuated measles vaccine (Schwarz strain) was first licensed for use in 1968 and a nationwide mass vaccination program with a two-dose schedule for children aged 9 months and 15 months was started in 1978. In January 1988, the immunization program was switched to a single dose of vaccine at 12 months of age, but was soon changed back to a two-dose schedule administered at 9 months and 15 months of age in May 1988, because of an outbreak of measles.<sup>2</sup> This strategy was continuously employed until 1991. Since 1992, the second dose of measles vaccine at 15 months of age was substituted with a measles, mumps, and rubella (MMR) vaccine on account of the policy for the elimination of measles, congenital rubella syndrome, poliomyelitis, and neonatal tetanus. Furthermore, a catch-up campaign with one dose of MMR vaccination targeting school students aged 7–13 years was conducted from 1992 to 1994. Since 2001, giving the second dose of MMR vaccine when first attending primary school was started. Another catch-up campaign was carried out for children aged 8–13 years from 2001 to 2004 due to outbreaks.<sup>3</sup> Since 2006, the first dose of measles vaccine was ceased, and a schedule of two doses of MMR vaccine was adopted: one at 12–15 months of age and the other at elementary school entry. However, the schedule for the first MMR vaccine was changed to 12 months of age in April 2009 in response to a reappearance of measles resulting from imported cases during the period of November 2008 to February 2009.<sup>4,5</sup> The second dose of MMR vaccine was switched to be given to children aged 5–6 years before they entered primary school, in September 2012.

According to data from the Taiwan Centers for Disease Control, the coverage rate for the first dose of measles vaccine reached 97.31% by 2012. However, domestic cases as well as imported cases of measles were still identified in low numbers every year in Taiwan. Seroepidemiologic data were very beneficial in understanding the epidemiology of infectious disease and determining the control strategy. Although seroprevalence for measles in Taiwan was previously well documented, the childhood serostatus was no longer well understood as measles became a sporadic

disease, especially in the past 3 years. Therefore, we carried out this survey to investigate the immunity status against measles in elementary school students in Northern Taiwan. The survey will be the pilot study of an ongoing nationwide study, and will be provided as the reference for a national immunization program.

## Materials and methods

### Ethics statement

The study proposal was reviewed and approved by the Institutional Review Board at Chang Gung Memorial Hospital, Taoyuan, Taiwan in 2012. Informed consents were obtained from all participants as well as their guardians. All informed consents were in the written form.

### Study populations and selection of participants

A cross-sectional survey of measles-specific immunoglobulin (Ig)G antibody in the population of elementary schoolchildren in New Taipei City was conducted from September 2012 to June 2013. New Taipei City comprises 29 administrative districts and is the second largest special municipality in Northern Taiwan. A total of 225,234 pupils resided in this city, which accounted for 16.5% of all primary school children in Taiwan in 2012. A multistage stratified method with probability proportional to size sampling was employed to obtain samples. The 29 administrative districts of New Taipei City were classified into five strata based on 14 variables, which included four demographic variables [population density (persons/km<sup>2</sup>), proportion of population aged > 65 years, < 15 years, and < 6 years], four socio-educational variables (number of physicians, nursing staff, low-income households, and near-poor households/10,000 people), and six medical facilities' variables (nursing staff/10,000 people, medical personnel/10,000 people, all staff in health centers/10,000 people, number of colleges or universities/10,000 people, proportion of agriculture population, and proportion of population with a college degree or above). From each stratum, elementary schools were selected as the primary sampling unit, and then classes were selected as the second sampling unit. One class was drawn from each grade in a sampled school, that is, a total of six classes were drawn from each sampled school. Students were selected at the final stage of the sampling scheme. Selected students were bled for the serologic tests of measles. All participants were manifestly healthy without acute illness as blood drawing. Past medical histories were obtained by a questionnaire from

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