



An Outbreak of Measles in a University in Korea, 2014

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Measles has been declared eliminated from the Korea since 2006. In April 2014, a measles outbreak occurred at a University in Seoul. A total of 85 measles cases were identified. In order to estimate vaccine effectiveness of measles vaccine, we reviewed the vaccination records of the university students. The vaccine effectiveness of two doses of measles containing vaccine was 60.0% (95% CI, 38.2–74.1; $P < 0.05$). Transmission was interrupted after the introduction of outbreak-response immunization. The outbreak shows that pockets of under-immunity among college students may have facilitated the disease transmission despite the high 2-dose vaccination coverage in the community.

Keywords: Measles; MMR; Outbreak; College; University; Korea

Measles is a highly contagious disease that is now vaccine-preventable. Following a nationwide epidemic with 55,696 reported cases, the Korean government introduced the Five-Year Measles Elimination Program, which includes maintaining the coverage rate of 2-dose vaccination rate higher than 95% (1,2). After the implementation of the program, the number of annual measles cases dramatically declined to less than 1 per 1 million, and Korea became the first Western Pacific nation to declare that measles was eliminated in 2006 (3) and was verified to be measles-free along with Australia, Mongolia, Macau, and China in 2014 because overall incidence and surveillance indicators met the World Health Organization criteria for measles elimination (4).

During April–June 2014, a measles outbreak occurred at a University in Seoul, Korea. A total of 85 cases of measles were diagnosed among students and employees. To characterize the outbreak, the Seoul Center for Infectious Disease Control and the Korea Centers for Disease Control and Prevention (KCDC) conducted a field investigation, active surveillance, and review of the immunization records.

The university had approximately 14,000 undergraduate and graduate students and 3,000 faculty members. The university occupies around 200,000 m² campus area covered with multiple buildings and facilities. Through routine surveillance sys-

tem, the KCDC was informed of laboratory confirmed cases of measles on April 8, 2014. Subsequently, active surveillance was established and field epidemiologic study was initiated.

The definition of suspected measles case was individuals with following features: fever, and rash, and at least one of cough, coryza, or conjunctivitis. Suspected measles cases were identified through the school's health center. All suspected cases were quarantined and were interviewed using standardized questionnaire, and physical examinations were performed by trained physicians. Presence of symptoms (fever, rash, cough, coryza, or conjunctivitis), travel history, and days of illnesses were assessed.

We reviewed the measles vaccination records in the National Immunization Registry. Measles-specific antibody was tested at Seoul Metropolitan City Research Institute of Health and Environment and Division of Respiratory Viruses of KCDC by using a measles enzyme-linked immunosorbent assay (ELISA) for immunoglobulin M (IgM) and immunoglobulin G (IgG) (enzyme immunoassay [EIA]; Siemens Healthcare Diagnostics Inc., Erlangen, Germany). Primary care providers in the nearby area were informed about the outbreak and were asked to report any suspected cases.

The index case was an 18-year-old male with the documented two-dose immunization history, and had developed rash on April 8, 2014 (Fig. 1). On April 19–21, five secondary cases in the

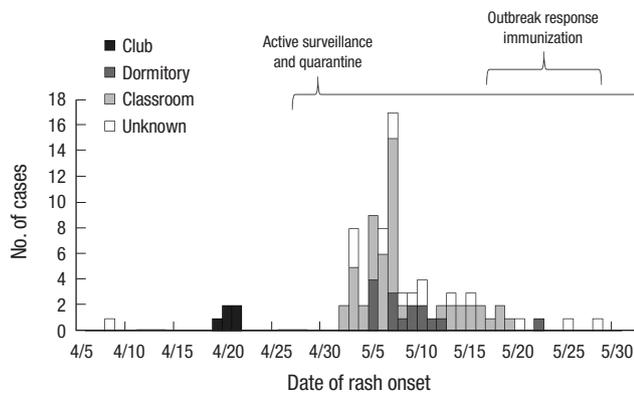


Fig. 1. Outbreak of measles on a university campus in Seoul, Korea, 2014. The different colors of the bars represent the places where the patients were exposed to measles virus.

same club had developed rash. On May 2, two cases with epidemiological linkage were notified, and the incident cases have increased until mid-May. The last case had symptom onset on May 28. A total of 85 cases were confirmed in the University. The median age was 20 years (range, 19 to 44 years), 67% ($n = 57$) cases were born during 1984–1993 (the recipients of measles and rubella [MR] vaccine catch-up campaign in 2001), and 61% ($n = 52$) were male. Five (5.9%) were foreign-nationals, 16 (18.8%) were living in dormitory, and 52 (61%) had documentation of immunization history.

Attack rate was significantly lower in the cohort born before 1993 compared to the cohort born after 1994 (0.3 vs. 1.3; $P < 0.05$) (Table 1). Difference in attack rate between Korean and foreign nationalities were not significant. A total of 1.6% of those living in dormitory were affected, whereas 0.5% of those not living in dormitory were affected. The estimated vaccine effectiveness of two doses of measles containing vaccine (measles, mumps, and rubella [MMR] or MR) was 60.0% (95% CI, 38.2–74.1; $P < 0.05$) (Table 2).

From May 15 to 25, the outbreak response immunization was conducted on 1,691 students and employees of the University who had no documentation of 2 doses of measles containing vaccine immunization. During the outbreak period, measles transmission was confirmed in 2 high schools and 1 junior high school and community, causing a total of 480 reported cases and 143 confirmed cases. The outbreak has prompted heightened monitoring that include active surveillance and implementation of disease awareness campaign. A total of 2,592 students and faculty members among 3,195 candidates without previous vaccination history (coverage rate of 81.2%) were vaccinated during the campaign.

Nonetheless, the measles outbreak continues to occur, despite satisfying the core criteria of the elimination of the disease. As the population immunity is sustained at a higher level, a rightward shift in age of measles infection has been reported in other occasions (5,6). In Korea, the outbreaks of measles have af-

Table 1. Attack rate of measles according to the demographic characteristics during the outbreak on a university campus, Korea, 2014

Variables	No. of confirmed cases/total population	Attack rate, %
Birth cohort		
Before 1993	30/10,252	0.3
After 1994*	55/4,298	1.3
Nationality		
Korean-national	80/14,550	0.6
Foreign-national	5/921	0.5
Residence		
Dormitory*	16/1,016	1.6
Non-dormitory	69/14,455	0.5

*Significantly higher incidence; $P < 0.05$.

Table 2. Vaccine effectiveness of two doses of measles containing vaccine during the outbreak on a university campus, Korea, 2014

Variables	Confirmed measles	No disease	Attack rate, %
Documentation of MCV2			
None*	33	3,017	1.1
Present†	52	11,448	0.5

*Significantly higher incidence; $P < 0.05$. †MCV2, two doses of measles containing vaccine; vaccine effectiveness calculated as $1 - \text{risk ratio} = 60.0\%$ (95% CI, 38.2–74.1; $P < 0.05$); note that 2,213 employees were excluded from the vaccine effectiveness analysis.

ected in various group setting. In 2010, a measles outbreak has occurred in a junior high school involving 127 suspected cases of measles resulting in 14.7% of attack rate (7). Most of the affected cases were aged from 13 to 15 years. An outbreak occurred in 2011 in Gyeongnam Province has shown that non-immune including infants less than 1 years of age may have played role in transmission in nosocomial and community settings (8). The 2014 outbreak in Korea has resulted in a total of 220 cases confirmed as measles until mid-2014, with 10 imported cases identified (4). The average age was 11.6 years (range, 3 months to 47 years) with a peak in young adults aged 19–29 years. The recent increase of cases in adolescents and young adults indicate the need for a vigilant monitoring in this population in Korea.

The present outbreak shows that pockets of under-immunity among young adult population may have contributed to the measles transmission. It is crucial to maintain a two-dose vaccination strategy with high coverage rates in this group for the sustained elimination of measles. Further study to investigate the cause of vaccine failures despite high 2-doses vaccination coverage should be warranted in the near future. This is the first report of measles outbreak in university setting in Korea, which highlights the importance of prompt reporting of suspected measles cases among young adults. In 2014, sporadic cases of measles that are potentially related to the current outbreak had been reported in other universities. Transmission to the community, high school, and junior high school in related to this outbreak was documented. We recommend to monitor the vaccination coverage in students entering the universities, and

heighten the level of surveillance in settings where young adults group together.

DISCLOSURE

The authors have no potential conflicts of interest to disclose.

AUTHOR CONTRIBUTION

Conceptualization: Choe YJ, Park YJ, Park O, Oh MD, Lee JK. Data curation: Choe YJ, Park YJ, Kim JW, Eom HE. Investigation: Park YJ, Eom HE, Park O. Writing - original draft: Choe YJ, Park YJ, Kim JH, Eom HE, Park O, Oh MD, Lee JK.

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