

Brief Report

Screening for Measles Vaccination in Young Japanese Non-healthcare Workers Through Self-reported History

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Abstract: Screening for Measles Vaccination in Young Japanese Non-healthcare Workers Through Self-reported History: Chihiro NISHIURA, et al. Department of Safety and Health, Tokyo Gas Co., Ltd.—

Objectives: The aim of this study was to examine the efficacy of a self-administered questionnaire as a prescreening tool to determine the immune status against measles among non-healthcare workers. **Methods:** The study subjects were Japanese non-healthcare workers aged 19–30 yr employed at a gas company that underwent an annual health checkup in 2009. Their histories of measles infection, vaccination and possible contact with measles patients were collected through a self-administered questionnaire. The sensitivity and specificity of these self-reports were analyzed against a serum anti-measles IgG assay as a gold standard.

Results: Of the 509 respondents, 93.3% had immunity against measles. The sensitivity, specificity and positive predictive values for the self-report questionnaire were 14.1, 97.1 and 98.5% for infection history; 39.2, 73.5 and 95.4% for vaccination history; and 13.1, 85.3 and 92.5% for possible contact history, respectively. **Conclusions:** Self-reported histories poorly predicted immune status against measles in young Japanese non-healthcare workers. The results suggest that a universal serological screening is still the most effective method available to identify those who require measles vaccination.

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Key words: Adult, Japanese, Measles, Screening, Sensitivity and specificity, Vaccination

The World Health Organization recommends immunization against measles not only in children but also in susceptible adults in order to eliminate measles¹⁾. Susceptibility among adults is due to primary vaccine

failure, secondary vaccine failure or individuals being unvaccinated and unexposed to measles²⁾.

A considerable portion of young adults in some countries, including Japan, missed the opportunity to be vaccinated because 1) they did not belong to the age group targeted for vaccination²⁾, 2) their parents feared side effects or doubted the necessity of the vaccine and did not agree to vaccination³⁾ or 3) they could not reach a vaccination center because of reasons such as ill health or their parents being at work³⁾.

Susceptible young adults are at risk of contracting measles, leading to localized outbreaks. In fact, an outbreak in a population of young adults was recently reported at a Japanese workplace⁴⁾. In addition, young adults with measles are at higher risk of developing clinically severe disease and the associated complications as compared with children with the virus⁵⁾. Therefore, identification and vaccination of susceptible young adults is necessary to protect them, and the surrounding population, from a measles epidemic, particularly in heavily populated urban areas, where transmission of the measles virus is likely to be dense and prolonged²⁾.

Universal serological screening is a commonly used procedure to detect susceptible adults. Although serological screening is accurate, it is costly, invasive and not always feasible in community settings. Previous studies have attempted to seek inexpensive and noninvasive alternatives for screening, such as self-reporting concerning the history of measles infection^{6–11)}. However, to the best of our knowledge, all of the previous studies were conducted in healthcare settings. Moreover, few studies have been limited to young adults.

In this study, we compared the efficacy of a self-administered questionnaire about measles history against a serological gold standard. The purpose of the study was to determine whether the questionnaire was comparable in reliability to a serological assay

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and thus whether it could be used as a prescreening tool to identify immunized young adults in non-healthcare settings to rule them out from subsequent serological screening and vaccination.

Methods

Background of measles vaccination in Japan

In 1978, the Japanese Ministry of Health and Welfare introduced regulations concerning the 1-dose measles vaccination. The immunization rate was quite low, around 70%, in the early 1990s¹²⁾, and measles outbreaks occurred in both children and adults every year from 1999 to 2003 and in 2007 and 2008¹³⁾. To remedy the situation, in 2008, Japan implemented a measles vaccination schedule comprising 2 doses in childhood and supplemental immunization activities at the age of 13 or 18 yr.

Study samples

From April 2009 to March 2010, Japanese white-collar workers aged 19–30 yr (median, 25 yr) were voluntarily enrolled for an annual health checkup at a large gas company in the Tokyo metropolitan region. Of the 831 employees, 509 participated in the study, giving a response rate of 61%. All the participants were born after 1978. Sixty-six participants (13.0%) were born on or after the 2nd April 1990 and were subject to supplemental immunization activities in Japan.

Objective measures

The serum levels of a measles-specific IgG antibody were measured using a commercial enzyme immunoassay (EIA) kit (Denka Seiken Co., Ltd., Tokyo, Japan) at the time of the checkup. Positive immunity against measles was defined as an IgG antibody titer of 4 or more, in accordance with the manufacturer's instructions. Birth date and sex were determined from the administrative records obtained from the company.

Subjective measures

A self-administered questionnaire was distributed to all age-appropriate employees 1 month before the health checkup. Questionnaires from employees who consented to participate in the study were collected at the checkup. The questionnaire consisted of multiple-choice questions about the history of measles infection (infection history; yes, no or unknown), history of vaccination for measles (vaccination history; 2-dose, 1-dose, none or unknown) and history of possible contact with a measles-infected person (possible contact history; yes, no or unknown), which was phrased as “Has anyone close to you ever had measles?”

Statistical analysis

Confidence intervals were estimated by the exact binomial method. In the calculations for sensitivity, specificity, positive predictive value and negative predictive value, the gold standard was defined as a positive EIA test for serum measles-specific IgG. A positive result on the questionnaire was defined as a response of “yes” for infection history and possible contact history, “1-dose” or “2-dose” for a 1-dose or 2-dose vaccination history and “2-dose” for a 2-dose vaccination history. All other responses constituted a negative result. All statistical calculations were performed using Stata 11 (StataCorp, College Station, TX, USA) with the Stata DIAGT module¹⁴⁾.

Ethical approval

During the checkups, all participants provided written consent for generic use of the health checkup data for research purposes, and the company's health authority approved the use of this data for the present study. All data were analyzed after anonymization.

Results

The total number of subjects with immunity was 475 (93.3%). The results of the questionnaire are presented in Table 1. Positive responses for 1-dose or 2-dose vaccination history were low (38.3%), despite the fact that vaccinations were mandatory in Japan at that time.

Table 2 lists the sensitivity, specificity and predictive values of the prescreening questionnaire for predicting immunity. The question on infection history revealed the highest specificity (97.1%), although the high specificity was accompanied by a large number of false-negative results. Another question about possible contact history had little significance for detecting subjects with protective immunity. The positive predictive value for infection history was the highest value in the questions, although the estimated confidence intervals largely overlapped. All the questions had very low sensitivity, indicating that it was difficult to detect immune subjects on the basis of self-reported history alone.

Discussion

In this study, the presence of IgG could be due to vaccination, disease or both. Several studies have previously assessed the efficacy of screening using self-reporting for determining measles immunity among young adults^{8–11)}. Although the sensitivity and specificity of a screening test is theoretically independent of prevalence, the tests could still be susceptible to the characteristics of the study populations, which means that simple comparisons across studies can be problematic. In a previous study with a population

Table 1. Results of the seroprevalence data and self-reported history of measles collected from subjects (n=509)

	No. of subjects (%)	No. of subjects positive for measles- specific IgG (%)
Total	509 (100)	475 (93.3)
Age		
19–20	119 (23.4)	109 (91.6)
21–25	160 (31.4)	147 (91.9)
26–30	230 (45.2)	219 (95.2)
Sex		
Men	447 (87.8)	415 (92.8)
Women	62 (12.2)	60 (96.8)
Possible contact history		
Yes	67 (13.2)	62 (92.5)
No	199 (39.1)	188 (94.5)
Unknown	243 (47.7)	225 (92.6)
Infection history		
Yes	68 (13.3)	67 (98.5)
No	262 (51.5)	243 (92.8)
Unknown	179 (35.2)	165 (92.2)
Vaccination history		
1-dose	143 (28.1)	136 (95.1)
2-dose	52 (10.2)	50 (96.2)
None	32 (6.3)	31 (96.9)
Unknown	282 (55.4)	258 (91.5)

Table 2. Findings from a self-administered prescreening questionnaire for measles vaccination among young Japanese non-healthcare workers (n=509)

	Sensitivity (%) (95% CI)	Specificity (%) (95% CI)	PPV (%) (95% CI)	NPV (%) (95% CI)
Infection history	14.1 (11.1, 17.6)	97.1 (84.7, 99.9)	98.5 (92.1, 100)	7.5 (5.2, 10.3)
2-dose vaccination history	10.5 (7.9, 13.6)	94.1 (80.3, 99.3)	96.2 (86.8, 99.5)	7.0 (4.8, 9.7)
1-dose or 2-dose vaccination history	39.2 (34.7, 43.7)	73.5 (55.6, 87.1)	95.4 (91.4, 97.9)	8.0 (5.2, 11.5)
Possible contact history	13.1 (10.2, 16.4)	85.3 (68.9, 95.0)	92.5 (83.4, 97.5)	6.6 (4.4, 9.3)

CI, confidence interval; PPV, positive predictive value; NPV, negative predictive value.

similar to our study (Japanese medical students), seroprevalence, sensitivity, specificity and positive predictive value for infection history were 90.2, 22.8, 86.8 and 94.3%, respectively¹⁰. Our results show higher specificity than those obtained in this study involving medical students.

One of the possible reasons for the high specificity for infection history observed in our study may be attributed to the prescreening method. In the study with medical students mentioned above¹⁰, questionnaires were administered and immediately collected during a class. In our study, there was a 1-month period between the administration and collection of the questionnaires, during which time the subjects could consult their parents or refer to their medical records and maternity passbook for their history. In this report, we found that there were fewer “unknown”

(35.2%) responses for infection history than observed in the study of medical students (57.5%)¹⁰, suggesting that not only the content of the questionnaire but also the method of administration might affect the performance of the prescreening tool. In addition, workers in a large-scale company may take their health status more serious than students, which may lead to fewer “unknown” responses. Since the question of infection history is not targeted at subclinical infection but at clinical infection, recall of infection history by subjects and/or their parents was likely to be specific, which may result in high specificity for infection history.

The value of specificity for vaccination history was small, presumably due to primary and secondary vaccine failure, especially in the case of the 1-dose measles vaccination. Low sensitivity and specificity

for possible contact history would be due to both the ambiguous range of “close to you” in the question and difficulty in confirming that the others actually had measles.

Since for most previous studies the use of a self-reported history yielded less favorable outcomes than in our study, further research is needed to clarify which methods and subgroups are most suitable for prescreening through self-reported history. However, with the level of sensitivity obtained in this study, the use of a universal serological screening method should remain the first choice for screening of young adults eligible for measles vaccination.

The strength of our study lies in the relatively large sample size and the narrow age range, which provides a better control against unknown confounders related to age compared with other studies employing mixed samples of a wider age range. A major limitation of our study is the possible lack of generalizability because the data came from only one company, although the age-specific seroprevalence of measles and the responses concerning the history of measles vaccination in our study sample showed results similar to those obtained in a Japanese national survey conducted in the same year¹⁵⁾.

In conclusion, the use of data obtained from a self-reported questionnaire on an individual's history of measles as a prescreening tool has limited efficacy among young adults in non-healthcare settings. Therefore, we recommend using a universal serological screening method as the first choice for efficient screening for measles vaccination.

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