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Reliability of self-reported history in predicting immunity against measles, rubella, mumps, and varicella among health care workers

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Aim: To determine the immunity of health care workers (HCWs) against measles, rubella, mumps, and varicella infections, and to evaluate the reliability of self-reported history of the disease in predicting immunity.

Materials and methods: A self-reported questionnaire was used to obtain the history of the diseases and ELISA to screen specific IgG antibodies. The history of the diseases was compared with serological testing results.

Results: Eighty-one HCWs were included in the study. Immunity against measles was 97.5%, rubella 100%, mumps 72.8%, and varicella 96.3%. Positive predictive values of positive histories of the diseases were 100% for measles and rubella, 96.5% for varicella, and 77.4% for mumps. The negative predictive values of the negative/unknown histories were 3.9%, 0%, 3.8%, and 30.0% for measles, rubella, varicella, and mumps, respectively.

Conclusion: A positive history of the disease is reliable for predicting the immunity against measles, rubella, and varicella, and vaccination is not required for the HCWs with a positive history. In contrast, a negative/unknown history had no benefit in predicting susceptibility; thus, we consider that these HCWs must be vaccinated according to the serological testing results. For mumps, a decision for vaccination of HCWs can be made by combining the self-reported history and serological testing results.

Key words: Measles, rubella, mumps, varicella, seroprevalence, health care worker

Sağlık çalışanlarının kızamık, kızamıkçık, kabakulak ve suçiçeği geçirme öykülerinin immüniteyi tahmin etmedeki güvenilirliği

Amaç: Bu çalışmada sağlık çalışanlarının kızamık, kızamıkçık, kabakulak ve suçiçeğine karşı immünitelerinin belirlenmesi ve hastalığı geçirme öyküsünün immüniteyi tahmin etmedeki güvenilirliğinin değerlendirilmesi amaçlanmıştır.

Yöntem ve gereç: Sağlık çalışanlarının hastalığı geçirme öyküleri anket formlarına kaydedilmiştir, spesifik IgG antikorları ELISA yöntemi ile tespit edilmiştir. Hastalığı geçirme öyküleri serolojik test sonuçları ile karşılaştırılmıştır.

Bulgular: Seksen-bir sağlık çalışanı çalışmaya dahil edilmiştir. Çalışma grubunun % 97,5'inin kızamığa, % 100'ünün kızamıkçığa, % 72,8'inin kabakulağa ve % 96,3'ünün suçiçeğine karşı bağışık olduğu saptanmıştır. Hastalığı geçirme öyküsünün immüniteyi tahmin ettirme oranı kızamık ve kızamıkçık için % 100, suçiçeği için % 96,5, kabakulak için % 77,4 olarak bulunmuştur. Hastalığı geçirmeme veya geçirip geçirmediğini bilmeme öyküsünün immün olmamayı tahmin ettirme oranı kızamık, kızamıkçık, suçiçeği ve kabakulak için sırasıyla % 3,9, % 0, % 3,8 ve % 30,0 olarak saptanmıştır.

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Sonuç: Hastalığı geçirme hikayesinin kızamık, kızamıkçık ve suçiçeğine karşı immüniteyi tahmin ettirmede güvenilir olduğu ve hastalığı geçirme hikayesi olan sağlık personelini aşılamaya gerek olmadığı sonucuna varılmıştır. Aksine, hastalığı geçirmeme veya geçirip geçirmediğini bilmeme öyküsünün immun olmamayı tahmin ettirmede bir yararı olmadığı düşünülmüştür; bu nedenle hastalığı geçirmeme veya geçirip geçirmediğini bilmeme öyküsü olan sağlık personelinin serolojik test sonuçlarına göre aşılanmaları gerektiği sonucuna varılmıştır. Kabakulak için aşılama kararı, sağlık personelinin hastalığı geçirme öyküsü ve serolojik test sonucu beraber değerlendirilerek verilmelidir.

Anahtar sözcükler: Kızamık, kızamıkçık, kabakulak, suçiçeği, seroprevalans, sağlık çalışanı

Introduction

Measles, rubella, mumps, and varicella virus (MRMV) infections are typical childhood infections, and are preventable by vaccination (1). The Centers for Disease Control and Prevention guidelines report that birth before 1957 is generally considered acceptable evidence of immunity against measles, rubella (except women who could become pregnant) and mumps (2). When acquired during childhood, these are clinically mild infections. However, they can occur in susceptible adults, often causing serious morbidity and a loss of time at work (3). Measles can be severe among immunocompromised persons (4). During pregnancy, varicella can cause significant maternal, perinatal, and infant morbidity (5), and rubella can result in congenital rubella infection (1).

In Turkey, vaccination against measles is routine, but rubella and mumps vaccines have been included in the routine immunization program since 2006 as a measles-mumps-rubella vaccine. The goal of the immunization program of our Health Ministry is to achieve and to maintain an immunization rate of at least 95% in the whole country (6). Vaccination against varicella is not currently a routine application in our country. Because of their contact with patients or infective material from patients, health-care workers (HCWs) are at occupational risk for these vaccine-preventable infections (7,8). The nosocomial transmission of these infections has been documented in many studies (9-12). Maintenance of immunity is, therefore, an essential part of prevention and infection control programs for HCWs. Active immunization is strongly recommended against MRMV viruses because of the special risks for HCWs (8). The aim of this study was to determine the immunity of HCWs against MRMV infections, and to evaluate whether self-reported history of the disease or vaccination is predictive of immunity against these infections.

Materials and methods

A self-reported questionnaire was administered to all HCWs included in the study to record their histories of the infection, and vaccination against MRMV viruses. Responses were recorded as "yes", "no", and "don't know". A commercialized enzyme immunoassay (ELISA) method (Radim SpA, Italy) was used to determine the presence of anti-measles, anti-rubella, anti-mumps, and anti-varicella antibodies in serum samples. The assay was performed according to the manufacturer's instructions. Anti-rubella IgG antibodies were measured by quantitative assay; titers < 15 IU/mL were considered non-reactive, 15-30 IU/mL equivocal, and > 30 IU/mL reactive. Anti-measles, anti-mumps, and anti-varicella IgG antibodies were measured by qualitative assay; titers 0-0.9 were considered non-reactive, 0.9-1.1 equivocal, and > 1.1 reactive for each one of them. All equivocal titers were retested. If the retesting result was equivocal again, it was considered non-reactive. The histories of the diseases were compared to the serological testing results to determine the positive and negative predictive values for immunity.

Data were analyzed using SPSS version 13.0. Statistical analyses were performed by chi-square test. The history of disease was evaluated as a diagnostic test and sensitivity, specificity, and positive and negative predictive values were calculated for each infection. The following definitions were used:

Positive predictive value (PPV) = Probability of immunity among HCWs with a positive history

Negative predictive value (NPV) = Probability of susceptibility among HCWs with a negative/unknown history

Sensitivity = Probability of a positive history among immune HCWs

Specificity = Probability of a negative/unknown history among susceptible HCWs

Results

A total of 81 HCWs were included in the study. Forty-four of them were male (54%) and 37 female (46%). Their ages ranged from 20 to 57 years; the mean age was 34.44 ± 8.07 years. Twenty-six HCWs (32.1%) were working in surgical clinics, 28 (34.6%) in medical clinics, 16 (19.8%) in intensive care units, and 11 (13.5%) in other departments. None of the participants were vaccinated against rubella, mumps, or varicella. Eighty-eight percent of them recorded that they were vaccinated against measles within the childhood immunization program, and 12% recorded that they were not vaccinated or did not know whether they were vaccinated or not. Thus, histories of vaccination were not taken into consideration to evaluate the immunity.

Of the study population, 97.5% were serologically immune to measles, 100% to rubella, 72.8% to mumps, and 96.3% to varicella. The seroprevalence of antibodies against mumps (72.8%) was lower than the others, but there were no differences statistically ($P > 0.05$).

Positive predictive values of a positive history for measles and rubella were 100% for each, whereas they were 96.5%, and 77.4% for varicella and mumps, respectively. The negative predictive values of a negative or unknown history of the disease were 3.9%, 0%, 3.8%, and 30.0% for measles, rubella, varicella, and mumps, respectively (Table).

Table. Comparison of the histories of the diseases with antibody testing results.

History of disease		**Antibody testing**			
		Positive	Negative	Total	
Measles history	Positive	30	0	30	**Sensitivity** (30/79): 37.9% **Specificity** (2/2): 100% **PPV** (30/30): 100% **NPV** (2/51): 3.9%
	Negative/unknown	49	2	51	
	Total	79	2	81	
Rubella history	Positive	18	0	18	**Sensitivity** (18/81): 22.2% **Specificity** (0/0): 100% **PPV** (18/18): 100% **NPV** (0/63): 0%
	Negative/unknown	63	0	63	
	Total	81	0	81	
Mumps history	Positive	24	7	31	**Sensitivity** (24/59): 40.6% **Specificity** (15/22): 68.1% **PPV** (24/31): 77.4% **NPV** (15/50): 30.0%
	Negative/unknown	35	15	50	
	Total	59	22	81	
Varicella history	Positive	28	1	29	**Sensitivity** (28/78): 35.8% **Specificity** (2/3): 66.6% **PPV** (28/29): 96.5% **NPV** (2/52): 3.8%
	Negative/unknown	50	2	52	
	Total	78	3	81	

PPV: Positive Predictive Value, NPV: Negative Predictive Value

Discussion

Immunity against measles was found to be 97.5% in our study. This value was higher than the 83.1% and 86% found in some studies (7,13), and was similar to the 98.6% and 98.5% found in other studies (14,15). Murray et al. reported in their study that historical information had no benefit in predicting immunity against measles (13). However, Trevisan et al. reported that a self-reported history of disease had a good PPV (94.7%) for a positive test for anti-measles antibodies (7). Our results show that self-reported history of measles was highly predictive of positive testing for anti-measles antibodies (PPV: 100%); all HCWs with a positive history were serologically immune to measles. The negative or unknown history of the disease was not predictive of susceptibility; of the 49 HCWs with a negative or unknown history, only 2 were found to be negative for anti-measles antibodies (NPV: 3.9%).

All of the HCWs tested (100%) were found to be immune to rubella. Some of the studies reported similar high prevalence rates (98.3%, 95.5%) (7, 14), but some of them reported low prevalence rates against rubella compared to our results (90.4%, 88.3%) (13,15). Trevisan and Celikbas reported in their studies that high PPVs such as 98.2% and 92%, respectively, were found in a positive history of the disease (7,14). In our study, all HCWs with a positive history of rubella infection were found positive for anti-rubella antibodies (PPV: 100%), and none of the HCWs with a negative or unknown history were found serologically negative, all of them were positive (NPV: 0%). Therefore, a positive history of the disease was found to be highly predictive of immunity, but a negative or unknown history was not found to be predictive of susceptibility for rubella.

The seroprevalence of antibodies against mumps was 72.8% in our study. In different studies, seroprevalence rates of anti-mumps antibodies were reported as 79.9%, 85.8%, and 92.2%, respectively (7,14,15). Trevisan and Celikbas reported in their studies that a PPV of a positive history for mumps was 92% (7,14). In our study, PPV was found to be low when compared to these values (77.4%); of the 31 HCWs who reported a positive history of mumps, 24 were found positive and 7 were found to be negative for anti-mumps antibodies. The NPV of a negative or unknown history of mumps was 30%; of the 50 HCWs who reported a negative or unknown history, only 15 were serologically negative. We concluded that positive and negative histories of the disease were not predictive of immunity against mumps.

Among tested HCWs, 96.3% had immunity to varicella. High seroprevalence rates were reported similar to our results in some studies (98%, 98%, 97.2%) (3,14,15) and low prevalence rates were reported in some other studies compared with our rates (84%, 84%, 81.4%) (13,16,17). In our study, a positive history of the disease was reliable for predicting the immunity against varicella. Only one HCW with a positive history was serologically non-reactive, and the PPV was found to be 96.5%. Similar to our result, Holmes, Celikbas and Trevisan reported in their studies that a self-reported history of varicella infection was a highly accurate indicator of immunity to the pathogen, including a positive predictive value of 100%, 100%, and 98.3%, respectively (3,7,14). A negative or unknown history of the disease was not reliable (NPV: 3.8%) in our study; of the 52 HCWs with a negative or unknown history, only 2 HCWs were serologically non-reactive, the remaining 50 were reactive for anti-varicella antibodies. Diez-Domingo et al. reported that a negative history was poorly predictive of susceptibility, similar to our result (16). On the other hand, Almuneef et al. reported that a positive or negative history of varicella was an unreliable indicator of susceptibility for varicella (17).

In the other studies, Oliveira et al. found that historical information was ineffective in predicting immune status to measles, rubella, mumps, and varicella infections (18). However, Ferson et al. suggested combining historical and serological screening to determine the immunity in their study (19).

In conclusion, for measles, rubella, and varicella, high positive predictive values were detected in HCWs with a positive history. We concluded that a positive history of the disease is reliable for predicting the immunity against these infections, and that vaccination is not required for these HCWs with a positive history. In contrast, a negative or unknown history had no benefit in predicting susceptibility; thus, we concluded that HCWs with a negative or unknown history for these infections must be

vaccinated according to the serological testing results. For mumps, the decision for vaccination of HCWs can be made after the evaluation of both self-reported history, and serological testing results. We recommend all seronegative HCWs be vaccinated against these infections.

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