

Seroprevalence of measles, mumps, rubella, and varicella among physicians and nurses in Jordan

Faris Ghalib BAKRI^{1,2,*}, Zakaria Mohammad ABDELRAHIM², Alaqahira Samih ALKALBANI², Ghada Mohammad KHRAIS¹, Deena Shamroukh SHAMROUKH³, Ferial Ahmad HAYAJNEH⁴, Azmi MAHAFZA³

¹Division of Infectious Diseases, Jordan University Hospital, University of Jordan, Amman, Jordan

²Infection Control Office, Jordan University Hospital, University of Jordan, Amman, Jordan

³Department of Microbiology, Jordan University Hospital, University of Jordan, Amman, Jordan

⁴Faculty of Nursing, University of Jordan, Amman, Jordan

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Background/aim: Measles, mumps, rubella, and varicella can affect susceptible healthcare workers who might subsequently spread the infection to susceptible patients and workers. Here, we aim to determine the seroprevalence of these infections among physicians and nurses and to compare the history of varicella with the results of varicella antibodies among study participants.

Materials and methods: Two randomly selected groups, one group of physicians and one of nurses, from a university hospital in Jordan were interviewed and their serum IgG antibodies were measured.

Results: The physicians and nurses group had 252 and 241 participants, respectively. The physicians group had significantly more males and younger participants. The percentage of individuals in the physician and nurse groups with positive antibodies to measles was 75.4% and 75.1%, respectively; mumps, 88.5% and 94.2%; rubella, 89.3% and 87.1%; and varicella, 92.1% and 92.5%. Immunity was similar between the 2 groups except for mumps, where significantly more nurses were immune. The positive and negative predictive values for the history of varicella to predict immunity in all participants were 95% and 13.5%, respectively.

Conclusion: A small but important proportion of our healthcare workers are still susceptible to measles, mumps, rubella, and varicella. In addition, the recall history to varicella showed suboptimal ability to predict immunity.

Key words: Measles, mumps, rubella, varicella, healthcare workers, Jordan

1. Introduction

Measles, mumps, rubella, and varicella remain potential risks for transmission in healthcare settings. A healthcare worker (HCW) who lacks immunity is at high risk for contracting the disease, for complications, and for transmitting the infection to susceptible patients (1–8).

In Jordan, no data exist on the susceptibility rates among HCWs for measles, mumps, rubella, or varicella. Furthermore, to our knowledge, vaccination programs for these infections are not implemented in most Jordanian hospitals. Here, we aim first to determine the seroprevalence of these infections in 2 groups of HCWs: 1 group of physicians and 1 group of nurses working in a large university hospital in Jordan. Second, we aim to compare the history of varicella with varicella antibodies among the study participants. Our data would help in estimating the risks posed to HCWs by these infections and in developing vaccination policies in our area.

2. Methods and materials

The study was conducted at the Jordan University Hospital (Amman, Jordan), which is a large teaching and tertiary hospital with 540 bed capacity. It serves both children and adults with a working staff of 542 physicians and 775 nurses. The hospital has no vaccination program for HCWs for any of the tested infections.

The study was approved by the hospital's institutional review board. We aimed to select 1 group of physicians and 1 group of nurses. A sample size of around 250 participants in each group of physicians and nurses was recommended, assuming seroprevalence for the tested infections of 80%, significance level of 0.05, and accuracy of 5 percentage points. Systematic sampling was used to select participants; a list for staff names for each group was generated and sorted according to alphabetical order. Selection was conducted by including every second name in the physician list and every third name in the nurse list.

* Correspondence: fbakri@ju.edu.jo

In case of refusal or unavailability, the next name in the list was selected. Investigators interviewed the participants and collected blood samples.

Collected sera were frozen and later tested using a commercial enzyme-linked immunosorbent assay. Blood was tested for IgG antibodies to measles, mumps, varicella zoster virus (IBL International, Germany), and rubella (Biorad, France) according to the manufacturer's instructions. Equivocal results were considered negative (9). Participants were informed about their results and those who had seronegative results were advised to take the appropriate vaccines.

Seroprevalence was calculated for each group of physicians and nurses and for the combined 2 groups. For analysis, we used the chi-square test for proportion data and the Mann–Whitney U test for nonparametric data. Results were considered statistically significant if the 2-tailed P-value was <0.05. Statistical analysis was done with SPSS 16. Seroprevalence and the predictive value of history of varicella infection were calculated as previously described (8,10).

3. Results

The study was performed between March 2011 and March 2012. Sixty-two HCWs (27 physicians and 35 nurses) refused to participate and 5 HCWs were found to have resigned. We excluded 7 blood samples because names on the blood samples were missing. Out of 1972 tests, 156 (8%) gave an equivocal result. Equivocal results accounted for 59.8% of the negative samples.

Table 1. Characteristics and seroprevalence of both study groups.

	Physicians n = 252 n (%)	Nurses n = 241 n (%)	P ^a
Males (%)	170 (67.5%)	67 (27.8%)	0.000*
Age, years			
<30	185 (73.4%)	125 (51.9%)	0.000*
30–39	53 (21.0%)	65 (27.0%)	
40–49	8 (3.2%)	46 (19.1%)	
>50	6 (2.4%)	5 (2.1%)	
Mean ± SD	28.8 ± 6.3	31.4 ± 7.9	
Median	27	29	
Range	22–67	22–57	
Measles Immune	190 (75.4%)	181 (75.1%)	0.940
Mumps Immune	223 (88.5%)	227 (94.2%)	0.025*
Rubella Immune	225 (89.3%)	210 (87.1%)	0.459
Varicella Immune	232 (92.1%)	223 (92.5%)	0.846

*Significant P-value; ^aChi-square test.

3.1. Characteristics of study participants

The total number of participants was 493 (252 physicians and 241 nurses). All participants were Jordanian. Overall mean age was 30 years (SD: ±7.3; range: 22–67). The physician group had significantly more males and younger participants than the nurse group (Table 1).

3.2. Seroprevalence and associated factors

The total number of participants with antibodies to measles was 371 (75.3%), mumps 450 (91.3%), rubella 435 (88.2%), and varicella 455 (92.3%) (Table 1). Immunity to tested diseases was similar between the physician and nurse groups except for mumps, where significantly more nurses were immune (P = 0.025) (Table 1). A total of 5 participants were born before 1957 (4 male physicians and 1 male nurse), and all had protective antibodies to all tested diseases. Of all participants, 184 (97 physicians, 87 nurses; 37%) had no immunity to at least 1 of the 3 infections – measles, mumps, or rubella – for which a single combined vaccine formulation is available, and 202 (105 physicians, 97 nurses) participants (40%) had no immunity to at least 1 of the 4 tested infections.

Testing for associations between immunity and age or sex showed that, in the physician group, immunity to measles significantly increased with age, whereas in the nurse group, immunity to both measles and mumps significantly increased with age and females were more likely to be immune to measles (Table 2). In addition, after separating the participants according to birthdate before or after the year 1982 (the year in which the measles vaccine was introduced into the national vaccination program),

those who were born before 1982 were significantly more immune to measles than those who were born after 1982. In the physician group, seropositivity was 42/45 (93.3%) and 148/207 (71.5%) for those born before and after 1982, respectively (P = 0.002); in the nurse group, seropositivity was 95/102 (93.1%) and 87/140 (62.1%) for those born before and after 1982, respectively (P = 0.000) (Table 3). Regarding rubella, 23 out of 213 (11%) of female HCWs at childbearing age (≤ 39 years) had no immunity (Table 4).

3.3. Recall history of varicella

Recall history of varicella and the results of the serological testing for each group of physicians and nurses are shown in Table 5. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the recall history in predicting immunity by serological testing for the physicians group were 85.7% [156/(26 + 156)], 42.8% [6/(6 + 8)], 95.1% [156/164], and 18.7% [6/32], respectively, while for the nurse group they were 68.3%,

50%, 94.8%, and 10.5% (Table 6). When participants with an unknown history of varicella were included in the group with a negative history of varicella infection, the sensitivity and specificity became 67.2% and 60%, respectively, for physicians and 49.3% and 66.7% for nurses (Table 6).

4. Discussion

Here, the seroprevalence for measles was 75.4%, 75.1%, and 75.3% for the physicians, nurses, and the combined groups, respectively; mumps, 88.5%, 94.2%, and 91.3%; rubella, 89.3%, 87.1%, and 88.2%; and varicella, 92.1%, 92.5%, and 92.3%. Available seroprevalence studies from neighboring areas are scarce and show a range from 87% to 91% for measles (11–13), 92%–93% for mumps (12,13), 90%–98% for rubella (11–13), and 71%–98.5% for varicella (11–18). Therefore, our results, except for measles, are within the regional range. However, such results in healthcare workers might be unsatisfactory, since these

Table 2. Seropositivity according to sex and age in the physician and nurse groups.

		Physicians		Nurses	
		Seropositivity (%)	P	Seropositivity (%)	P
Measles	Males	127/170 (74.7)	0.714 ^a	44/67 (65.7)	0.036 ^{*a}
	Females	63/82 (76.8)		137/174 (78.7)	
	Age, median (IQR) years		0.000 ^{*b}		0.000 ^{*b}
	Immune	28.0 (25.0–30.0)		32.0 (26.0–40.0)	
	Susceptible	26.0 (24.0–28.0)		25.0 (23.0–28.8)	
Mumps	Males	151/170 (88.8)		63/67 (94.0)	
	Females	72/82 (87.8)	0.812 ^a	164/174 (94.3)	1.000 ^a
	Age, median (IQR) years				
	Immune	27.0 (25.0–30.0)	0.842 ^b	30.0 (25.0–38.0)	0.002 ^b
	Susceptible	27.0 (26.0–29.0)		24.0 (23.0–27.0)	
Rubella	Males	151/170 (88.8)	0.733 ^a	60/67 (89.6)	0.487 ^a
	Females	74/82 (90.2)		150/174 (86.2)	
	Age, median (IQR) years		0.236 ^b		0.698 ^b
	Immune	27.0 (25.0–30.0)		29.0 (24.0–38.0)	
	Susceptible	27.0 (24.0–30.0)		32.0 (25.0–40.0)	
Varicella	Males	156/170 (91.8)	0.801 ^a	62/67 (92.5)	0.998 ^a
	Females	76/82 (92.7)		161/174 (92.5)	
	Age, median (IQR) years		0.253 ^b		0.691 ^b
	Immune	27.0 (25.0–30.0)		29.0 (24.0–38.0)	
	Susceptible	26.0 (25.0–28.5)		28.0 (24.8–40.5)	

IQR: interquartile range. * Significant P-value. ^aChi-square test. ^bMann–Whitney U test.

Table 3. Seropositivity to measles in participants born before and after 1982.

	Physicians		Nurses	
	Seropositivity	P-value	Seropositivity	P-value
Born before 1982	42/45 (93.3%)	0.002* ^a	95/102 (93.1%)	0.000* ^a
Born after 1982	148/207 (71.5%)		87/140 (62.1%)	

*Significant P-value. ^aChi-square test.

Table 4. Rubella seronegativity according to the age groups in female HCWs.

Age group in years	Seronegativity in females (%)		
	Physicians	Nurses	Total
<30	8/66 (12.1%)	9/87 (9.2%)	17/153 (10.5%)
30–39	0/16 (0%)	7/43 (15.9%)	7/59 (11.7%)
40–49	0/0 (0%)	7/41 (17.1%)	7/41 (17.1%)
>50	0/0 (0%)	1/3 (33.3%)	1/3 (33.3%)
Total	8/82 (9.8%)	24/174 (13.1%)	32/256 (12.1%)

Table 5. Results for serological testing and recall history of varicella.

	History of varicella	Varicella IgG negative (%)	Varicella IgG positive (%)	Total
Physicians	Positive	8 (4.8%)	156 (96.1%)	164
	Negative	6 (18.7%)	26 (81.2%)	32
	Unknown	6 (10.7%)	50 (89.2%)	56
Nurses	Positive	6 (5.1%)	110 (94.8%)	116
	Negative	6 (10.5%)	51 (89.4%)	57
	Unknown	6 (8.8%)	62 (91.1%)	68

Table 6. The validity of recall history for detecting varicella immunity.

	Physicians	Nurses	Physicians and nurses
Sensitivity	85.7%	68.3%	77.5%
Specificity	42.8%	50.0%	46.2%
PPV	95.1%	94.8%	95.0%
NPV	18.7%	10.5%	13.5%
Sensitivity (neg + u)	67.2%	49.3%	58.5%
Specificity (neg + u)	60.0%	66.7%	63.2%

Sensitivity (neg + u): sensitivity when people with unknown histories were added to those with a negative history. Specificity (neg + u): specificity when people with unknown histories were added to those with a negative history.

infections are highly transmissible and require very high population-level immunity (19). There was no significant difference in immunity between the physician and nurse groups except for mumps, where more nurses (94.2%) than physicians (88.5%) ($P = 0.025$) were immune, which could be due to the older age of participating nurses.

The finding that immunity to measles and mumps increases with age has been previously reported and was attributed to the possible low uptake of vaccine and the low exposure among the young age group (7,20–23). This explanation is further supported herein by finding significantly more immunity in participants born before the introduction of the measles vaccine in 1982 than in those born later. In addition, our finding that all 5 participants born before 1957 were immune to the tested infections is consistent with the Centers for Disease Control and Prevention definition, which states that persons born before 1957 are considered to have acceptable presumptive evidence of immunity to measles, rubella, and mumps (9).

In this study, the overall immunity rate to rubella was 88% (Table 1) and that for women of childbearing age was 89% (Table 3). These results are in accordance with 2 earlier community studies in Jordan: the first found that the overall immunity to rubella was 81% for women aged 15–35 years (24). The second found that the immunity for women from 15 to 49 years was 91%, but that for women aged 15–19 years, it dropped to 83% (25). These findings are significant because the incidence of congenital rubella in a given population depends on the number of susceptible individuals, the circulation of virus in the community, and the use of the rubella vaccine (26).

Our results also indicate that the PPV of the recalled history of varicella (95% for the overall participants) is

not high enough to safely consider those with a positive varicella history to be immune, since 14 of the 280 participants (5%) with a positive history of varicella were found to be seronegative. Moreover, the NPV of the recalled history of varicella (13.5% for all participants) was poor, meaning that a negative history of varicella was able to correctly identify only a few susceptible participants. For all participants, a negative or unknown history against varicella was able to detect 63% of seronegative participants, whereas 37% of seronegative participants were not detected by history. Therefore, to avoid missing seronegative HCWs, we recommend that all HCWs in our institution be tested for immunity against varicella and those who test seronegative should receive the varicella vaccine.

Our study is mainly limited by being conducted at a single healthcare facility. However, since our hospital serves a wide range of Jordan's population and the employees are all Jordanian, we think that our results are applicable to and representative of HCWs throughout the country.

In conclusion, among our population of HCWs, rates of immunity to measles are low, while those to mumps, rubella, and varicella are relatively high but still unsatisfactory. This highlights the need to establish policies to ensure protective immunity through testing, followed by vaccination of seronegative staff. Recall history of varicella poorly detected immunity to varicella, suggesting that the best approach to ensure acceptable levels of immunity to varicella is to test all HCWs for this virus and vaccinate those who are seronegative.

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