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Original Article

Seroprevalence of influenza A H1N1 (swine) infection in the human population in a cantonment

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ABSTRACT

Background: Various serosurveys and studies were conducted globally on pandemic influenza. H1N1 virus reported so far provides ample evidence of differing perspectives, regarding its epidemiology especially with regard to prevalence, populations groups, and behaviour related to vaccine acceptance. A multigroup, cross-sectional survey among 658 healthy subjects was carried out, in Pune among students, health-care workers (HCWs), and soldiers to assess the seroprevalence of pandemic influenza H1N1 virus and its associated factors.

Methods: The total sample size, based on forecasted prevalence of 33%, worked out to be 640. We studied 658 subjects including 103 students, 201 HCWs, and 354 serving soldiers. The sample for each group was selected from the respective study population by simple random sampling using a random number table. Haemagglutination inhibition test was carried out at the National Institute of Virology.

Results: The overall seroprevalence of pandemic influenza H1N1 (2009) virus was found to be 46.5% (95% confidence interval 42.6–50.4) which was adjusted to 39.4% after excluding those vaccinated. The availability of vaccine for high-risk group such as HCWs did not find much favour with the HCWs who did not accept vaccine for various reasons. Whereas only one student was vaccinated, 21.4% of HCWs and 32.5% of soldiers were vaccinated.

Conclusion: Based on high seroprevalence of antibodies against H1N1 virus during pandemic, vaccination of general population is not recommended. However, high-risk groups and HCWs need to be protected with flu vaccine. There is a need to encourage HCWs for accepting vaccination.

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Introduction

The first influenza pandemic of the 21st century was declared with the emergence of a novel influenza A (H1N1) strain in Mexico and the USA in April 2009.¹ Influenza A pH1N1 2009 pandemic has resulted in more than 622,482 of laboratory-confirmed cases of pandemic influenza H1N1 2009 virus, including over 18,036 deaths in over 230 countries.² Presently, the “pandemic H1N1/09 virus” continues to circulate across the globe as a seasonal virus contributing to still about 42% of subtyped influenza A viruses.³ In January 2014, 23 cases were tested positive for H1N1 virus, and four deaths were reported in routine H1N1 surveillance, and in January 2015, 1864 cases were tested positive, and 169 deaths were reported. In January 2016, 460 were positive for H1N1 virus, and of these, 76 deaths were reported.⁴

Seroprevalence studies guide the health managers to take a decision on vaccine policy for future epidemics/pandemics. The present study was planned to fill the gap in the knowledge on the evolution and extent of the epidemic in a cantonment.

Material and methods

A cross-sectional descriptive population-based study was carried out among three groups of individuals residing in Pune Cantonment namely serving soldiers, school children and health-care workers (HCWs). Taking the forecasted prevalence of 33% population at the end of pandemic, the sample size for three groups of population was calculated as serving soldiers, 329 (say 350); school children, 81 (say 90) and HCWs, 184 (say 200). The total sample worked out to be 640. A total of 658 subjects including 201 HCWs, 354 soldiers and 103 students were studied. The sample for each group was selected from the respective study population by simple random sampling using the random number table. A different questionnaire for each group was developed. The validity of the questionnaire was assessed by experts in the field and also by content and construct validity. The reliability was assessed by calculating Cronbach's alpha for various domains using SPSS software, version 14.0. The values of Cronbach's alpha were 0.69 and 0.81 for domains of knowledge and practices, respectively. Informed consent was obtained from the study subjects, and approval from institutional ethics committee was obtained. Briefly, 5 ml of blood was collected, and serum was separated and stored in sterile cryovials which was transported to the testing laboratory at the National Institute of Virology, Pune, in storage boxes under cold chain. Haemagglutination inhibition test for detection of influenza A H1N1 (swine) anti-H1N1 IgG antibodies was carried out on each of the samples following protocols. A cutoff at titre 1:20 was kept for seropositivity. Quality assurance measures, such as training, supervision and appropriate feedback mechanisms, were integral part of each activity during the study. A database was created in MS Access, and appropriate descriptive and analytical statistics were applied using SPSS software, version 13.

Results

The subjects in the study belonged to relatively younger population with a mean of 24.3 years due to inclusion of students and young soldiers.

Health-care workers

In a total of 201 HCWs, the mean age of the group was 30.79 years. All three categories (doctors, nurses and paramedics) had similar proportions who were vaccinated with an overall vaccination rate of 21.4% to HCWs (Table 1). Different factors were examined for their association with seropositivity, but none of the factors showed significant difference (Table 2). Seropositivity was 30.3% among HCWs with no significant difference among the three categories.

Students

A total of 103 students were included in the study. Risk profile of students for getting the infection from any known case in their family, friends and school was studied. On examining selected factors for their association with seropositivity, none of the variables were found to be significantly associated with serostatus (Table 3).

Serving soldiers

The study subjects were young working population with the mean age of 23.18 years. Their knowledge on mode of spread and how it does not spread was examined (Fig. 1). On studying attitude of these soldiers (Table 4) towards acceptance of vaccine, it was seen that out of 239 (67.5%) who were not vaccinated, 129 would like to get vaccinated while 110 did not wish to be vaccinated. Amongst these 110 subjects who did not wish to get vaccinated, reasons for not taking vaccine were analyzed (Fig. 2). However, no such vaccination was mandated for any category including soldiers and it was purely voluntary to take vaccine or not. The cross tabulation between the study participant at risk of Influenza Pandemic pH1N1 2009 and presence of antibodies to Pandemic H1N1 2009 virus in serum shows that no significant statistical relationship exists (Table 5).

Table 1 – Vaccination status and category of HCWs.

Category	Vaccination status		Total
	Vaccinated, n (%)	Not vaccinated, n (%)	
Doctors	11 (22.9)	37 (77.1)	48
Nurses	5 (20.0)	20 (80.0)	25
Paramedic	27 (21.1)	101 (78.9)	128
Total	43 (21.4)	158 (78.6)	201
Chi-square, 0.10; p value, 0.95. HCWs, health-care workers.			

Table 2 – Association of selected factors with serostatus in HCWs (n = 201).

	Factors	Serostatus		Chi-square	p value	Significant/not significant
		Negative n (%)	Positive n (%)			
1	Category of HCW					
	Doctors	35 (72.9)	13 (27.1)	1.37	0.50	Not significant
	Nurses	15 (60.0)	10 (40.0)			
	Paramedics	90 (70.3)	38 (29.7)			
2	Sex of HCWs			2.65	0.10	Not significant
	Female	21 (58.3)	15 (41.7)			
	Male	119 (72.1)	46 (27.9)			
3	Directly involved in patient care					
	Yes	66 (71.7)	26 (28.3)	0.35	0.55	Not significant
	No	74 (67.9)	35 (32.1)			
4	History of flu symptoms in last one year (Yates correction used)			0.06	0.97	Not significant
	No	101 (69.2)	45 (30.8)			
	Yes	34 (70.8)	14 (29.2)			
	Do not know	5 (71.4)	2 (28.6)			
5	History of close contact with a known case of H1N1			2.30	0.51	Not significant
	No	102 (72.9)	38 (27.1)			
	Yes	19 (61.3)	12 (38.7)			
	Do not know	16 (64.0)	9 (36.0)			
	No response	3 (60.0)	2 (40.0)			

HCW, health-care workers.

Table 3 – Association of selected factors with serostatus in students.

	Factors	Serostatus		Chi-square	p value	Significant/not significant
		Negative (n)	Positive (n)			
1	Do you think you are at risk of H1N1?					
	No	66	35	Not applicable	Not applicable	Not significant
	Yes	1	0			
	Do not know	1	0			
2	Any known case of swine flu at home or school?			0.85	0.35	Not significant
	No	62	29			
	Yes	6	6			
3	Any known case in close friends?					
	No	67	35	Not applicable	Not applicable	Not significant
	Yes	01	0

Fig. 1 – Distribution of study participants in % (soldiers) as per the knowledge of modes of spread.

Table 4 – Attitude of study participants towards disease and vaccination.

Attitude	Yes	No	Don't Know
Perception of Pandemic Influenza as a serious disease	313 (88.4%)	1 (0.3%)	40 (11.3%)
Got vaccinated against Pandemic Influenza	115 (32.5%)	239 (67.5%)	–
If No, would you like to take vaccine for Pandemic Influenza	129 (54.0%)	110 (46.0%)	–

Fig. 2 – Distribution of study participants (soldiers) as per the reason for not taking vaccine among those who did not want to get vaccinated (n = 110).

Seroprevalence

Overall unadjusted seroprevalence among a total study population of 658 subjects was found to be 46.5% (95% confidence interval [CI] 42.6–50.4) with the highest positivity among serving soldiers (59.3%) followed by students and least positivity to antibodies to H1N1 virus was seen among HCWs (Table 6). Adjusted seroprevalence among study population was found to be 39.4% (95% CI 37.9–40.9), after excluding 21.4% of HCWs and 34.4% of soldiers who were vaccinated. The difference in unadjusted and adjusted seroprevalence was seen only among serving soldiers.

Discussion

The overall age in our study comprised relatively younger population with a mean age of 24.3 years. Various studies have been conducted in different parts of the world with a wide range of age groups to find seroprevalence in different age groups varying from <5 years to >60 years.^{5–16}

Overall seroprevalence rates in this study was 46.5% and when adjusted after excluding vaccinated subjects was found to be 39.4% (95% CI 37.9–40.9). Similar findings have been reported in a study from Mexico from transmission risk groups wherein they found that seroprevalence for students was 37.3%; for teachers, 33.9%; for older adults, 36.5% and for the general population, 33.0%; however, it was only 23.6% for HCWs.⁹

While comparing data for non-high-risk population represented by serving soldiers, in contrast to our findings of 51.0% (adjusted) seropositivity, some studies showed lesser seropositivity in different settings and groups ranging from 6% to 35.6%.^{6–12} In a study on the prepandemic and postpandemic pH1N1, seroprevalence were 12.8% and 28.3%, respectively, with an estimated overall infection rate of 15.6%.⁷ In another study, seroprevalence during the first 2 weeks of detection of pH1N1/2009v in Reunion Island was 29.8% in people under 20 years of age, 35.6% in adults (20–59 years) and 73.3% in the elderly (≥60 years) ($P < 0.0001$).⁸ In a study from Mexico, seroprevalence of the general population was found to be 33.0%.⁹ In a study among the Chinese population, weighted seroprevalence of pH1N1 virus was 21.5%.¹⁰ In a study from Sri Lanka, the overall community seroprevalence was 26.7%.¹¹ In a study from Canada, the overall seropositivity ranged from 10% to 19% after the first wave and 22%–31% by the end of the 2009/10 influenza season.¹² The overall seroprevalence of pH1N1 virus was found to be 29.9% in a study from Taiwan.¹⁵ In comparison to this study findings, study from Iran found that 1503 (58.91%) samples were positive for antibody against 2009 H1N1 virus.¹³ In a review article by Broberg et al.¹⁶, seroprevalence studies found 5%–60% of populations across different continents and age groups were found to have antibodies against the pH1N1 2009 virus. When comparing data of HCWs on seroprevalence, it was seen that in a study from Mexico, the seroprevalence was recorded as 23.6% which is slightly lower and comparable to our 26.1% seroprevalence among HCWs after adjusting for vaccination.⁹

Among the study participants, about two-third of HCWs, 18.6% of soldiers, and only one of 103 students thought that

Table 5 – Association of factors with seroprevalence status among soldiers.

	Factors	Serostatus		Chi-square	p value	Significant/not significant
		Positive (n) %	Negative (n) %			
1	Do you think you are at risk of H1N1?					
	Yes	34 (51.5%)	32 (48.5%)	2.04	0.15	Not significant
	No	176 (61.1%)	112 (38.9%)			
2	Duty at places with high risk of exposure to influenza A pH1N1 2009			0.01	0.91	Not significant
	Yes	112 (59.6%)	76 (40.4%)			
	No	98 (59.0%)	68 (41.0%)			

Table 6 – Seroprevalence of antibodies against pandemic influenza A H1N1 virus among study population.

Category of subjects	Unadjusted seroprevalence						Adjusted seroprevalence (after excluding those vaccinated)						Difference in unadjusted and adjusted seroprevalence Two-tailed Z-test
	Positive			Negative			Positive			Negative			
	n	%	95% CI	n	%	95% CI	n	%	95% CI	n	%	95% CI	
HCWs	61	30.3	24.4–37.2	140	69.6	62.9–75.8	44	26.1	21.5–30.5	124	73.9	69.4–78.4	P > 0.05, not significant
Students	35	33.9	25.1–44.0	68	66.1	55.9–74.8	35	33.9	25.1–44.0	68	66.1	55.9–74.8	Not required
Serving soldiers	210	59.3	54.1–64.4	144	40.7	35.5–45.8	122	51	48.1–53.9	117	49	46.1–51.9	P > 0.05, not significant
Total	306	46.50	42.6–50.4	352	53.50	49.6–57.3	201	39.4	37.9–40.9	309	60.6	59.1–62.1	
CI, confidence interval; HCW, health-care workers.													

CI, confidence interval; HCW, health-care workers.

they were at risk of influenza pandemic pH1N1 2009 virus, while in the study conducted in Turkey, it was found that 25.1% of the study group perceived their personal risk of contracting influenza as high.¹⁷ The study participants had comparable knowledge on disease as compared to other studies.^{18–20}

In the present study, 207 (58.4%) participants gave correct reply to the symptoms of pandemic influenza, much lower than other studies where 83.5% and 79.1% of participants identified correctly the symptoms of infected victims.^{21,22} In a study from Saudi Arabia, among young adults aged 18–24 years, most participants reported accurate information about the mode of transmission, but 43% stated that sexual contact was a mode of transmission.²³ All study subjects were aware that it is transmitted through droplet infection in the study among HCWs in Delhi.²⁴ In the present study, 226 (63.8%) participants said that there is a vaccine available against pandemic influenza which is higher than the studies from Saudi Arabia (47%) and Kenya (55%), respectively.^{23,25}

In a study among HCWs in Delhi, it was found that the practice of wearing mask during duty hours was observed among 82.6% of doctors and 85% of nurses.²⁴ In the study from Saudi Arabia, the use of a facemask in crowded areas was reported by 56.2% of study participants.²³ In our study, 246 (69.5%) of the participants (Soldiers) said they wash their hands more often than before. In comparison, a study from Udaipur, Rajasthan reports 54.6% of general population washed their hands with soap and water more often than usual.²²

In the present study, 115 (32.5%) of the subset of sample from serving soldiers got vaccinated. In a study among students from Vellore, it was found that only 12.7% had been vaccinated.²⁶ In a study among HCWs from Turkey, vast majority of study participants (92.8%) indicated that they would not be vaccinated due to vaccine safety and side effects.¹⁷

Conclusion

Overall seroprevalence among total study population of 658 subjects was found to be 46.5% (95% CI of 42.6–50.4) adjusted to 39.4% (95% CI 37.9–40.9) after excluding vaccinated subjects. A reasonably high level of natural immunity against H1N1 virus among the healthy young soldiers, HCWs and students clearly demonstrates that vaccination against H1N1 is not required at present in our country for the low-risk population.

Conflicts of interest

The authors have none to declare.

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