

# World Journal of *Clinical Cases*

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## Observational Study

**Vaccinations against respiratory infections in Arabian Gulf countries: Barriers and motivators**

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**Data sharing statement:** Technical appendix, original data, and statistical code of manuscript are available from the corresponding author at [amani.alqahtani@health.nsw.gov.au](mailto:amani.alqahtani@health.nsw.gov.au).

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## Abstract

### AIM

To study the uptake, barriers and motivators of influenza, pneumococcal, meningococcal and pertussis vaccines among members of public in Arabian Gulf countries.

### METHODS

A cross-sectional survey among the Gulf Cooperation Council (GCC) countries' residents. Data collected electronically through a smartphone app. The survey variables aimed to investigate the respondents' awareness about vaccines against influenza, pneumococcal, meningococcal and pertussis infections. Collected data concerning the respondents' socio-demographic characteristics, their perception toward vaccine uptake and the factors that motivate or demotivate them from taking influenza vaccine. The data were analysed statistically using the SPSS v.23.0. Differences in the characteristics of users from different countries were quantified through bivariate analysis. Other important variables and controlling factors were studied using logistic regression.

### RESULTS

A total of 1812 respondents participated in the study. Their mean age was 27 years, 82% were male and 24% had  $\geq 1$  chronic diseases. The overall uptake of influenza vaccine was 17% (21% among "at risk" people) and ranged from 15% in Saudi Arabia to 24% in Qatar. Doctor's advice (23%) and a perception of having low body immunity (21%) were the main cited reasons for being vaccinated, whereas unawareness about the vaccine (43%) was the main barrier. The overall uptake of pneumococcal vaccine in the preceding three years was 22% (25% among "at risk" individuals) and ranged from 0% in Bahrain to 79% in Kuwait. The overall uptake of pertussis vaccine was 16% (31% among "vulnerable" people), and ranged from 7% in Saudi Arabia to 75% in Oman. The overall uptake of meningococcal vaccine was 20% (29% among the "at risk" people) and ranged from 3% in Oman to 50% in Bahrain.

### CONCLUSION

The vaccination uptake across GCC countries is suboptimal and varies widely across the countries. Further research is needed to unearth the reasons and formulate action plan.

**Key words:** Gulf Cooperation Council; Influenza; Meningococcal vaccine; Motivators and barriers; Pertussis vaccine; Pneumococcal vaccine; Respiratory infections

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**Core tip:** Like many other parts of the world, the uptake of the adult vaccinations against respiratory infections in Arabian Gulf countries remains unknown. This area hosts the world's largest annual mass gathering (Hajj pilgrimage) which increases the risk of global dissemination of infectious diseases, particularly, respiratory infections. The coverage rate of the vaccinations against respiratory infections among the public in gulf cooperation council countries was low when compared to that in developed countries. Physicians could play a significant role in enhancing vaccine uptake, and their advice was the principal motivator among our participants.

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## INTRODUCTION

Respiratory infections particularly influenza, pneumococcal, pertussis and meningococcal diseases are a major threat to humans and continue to take a heavy toll across the globe<sup>[1-4]</sup>. Annually, influenza causes a million deaths worldwide<sup>[5,6]</sup>, and pneumonia, mostly caused by *Streptococcus pneumoniae*, is responsible for 1.6 million deaths globally<sup>[7]</sup>. The incidence of meningococcal disease ranges from one per 100000 population in developed world settings to 1000 per 100000 population in the developing countries of the "meningitis belt" during the epidemic seasons with a high rates of case fatality, and long-term sequelae<sup>[8]</sup>. In addition, there has been a resurgence of pertussis in the last several years and the disease causes about 200000 annual deaths globally<sup>[9]</sup>. Vaccinations against influenza, pertussis, and pneumococcal and meningococcal diseases are available, but the vaccination uptake against these diseases remains unknown in many parts of the world including the countries of the Gulf Cooperation Council (GCC).

The GCC comprises of six Arabian countries: Kingdom of Saudi Arabia, Kuwait, Bahrain, Qatar, United Arab Emirates (UAE) and Oman. The GCC countries share a similar social and economic background, health issues, and essentially identical health system and policy. As the host of various mass gathering events (e.g., Hajj pilgrimage and international sport and business events), GCC region occupies a distinctive epidemiological position in the global map, and certain vaccines (e.g., quadrivalent meningococcal vaccine) are unique requirements for some of its residents<sup>[10]</sup>.

Influenza is a common disease in GCC countries<sup>[11,12]</sup>, and therefore members of public especially children,

**Table 1** Vaccination uptake in Gulf Cooperation Council countries in published literature

Ref.	Study year	Country	Population	Sample size	Age in years	Vaccine	Vaccine uptake % (n/n)
Abbas <i>et al</i> <sup>[39]</sup>	2004-2005	Saudi Arabia	Workers of two major industries: A food processing and a chemical plant	2400	(20-60)	Influenza	62.4 (562/900) food processing industry and 55.6 (834/1500) chemical industry
Al-Tawfiq <i>et al</i> <sup>[38]</sup>	2007	Saudi Arabia	HCWs at Saudi Aramco Medical Services Organization	244	NR	Influenza	51 in the preceding year and 71.5 in the last 5 years
Shahbic <i>et al</i> <sup>[18]</sup>	2007	Qatar	HCWs at Hamad Medical Corporation in Doha	14292	NR	Influenza	19.4 (2773/14292)
Rehmani <i>et al</i> <sup>[20]</sup>	2009	Saudi Arabia	HCWs at King Abdul-Aziz National Guard Hospital	512	Mean 35.8 (22-64)	Influenza	34.4 (176/512)
Abu-Gharbieh <i>et al</i> <sup>[64]</sup>	2009	United Arab Emirates, Kuwait and Oman	HCWs at hospitals, polyclinics and medical centres	993	(25-45)	Influenza	42.5 (442/993)
Al-Khashan <i>et al</i> <sup>[35]</sup>	2009	Saudi Arabia	Military personnel of Central Military Region in Riyadh	2230	Mean 36.3	Influenza and meningococcal	17.8 (396/2230) and 51.7 (1153/2230) respectively
AlQuliti <i>et al</i> <sup>[65]</sup>	2012	Saudi Arabia	Emergency room HCWs at 4 hospitals in Al-Madinah	321	NR	Meningococcal	84.7 (272/321)
Garcell <i>et al</i> <sup>[37]</sup>	2011-2013	Qatar	HCWs at the Cuban Hospital	209 (2011-2012), and 325 (2012-2013)	NR	Influenza	61.9 (129/209) in 2011-2012 and 71.1 (231/325) in 2012-2013
Alshammari <i>et al</i> <sup>[21]</sup>	2012-2013	Saudi Arabia	HCWs at 6 major hospitals	242	NR	Influenza	38.8 (94/242)
Alhammadi <i>et al</i> <sup>[66]</sup>	2012-2013	Qatar	HCWs at a tertiary teaching institution in Doha	223	NR	Influenza	68.3 (152/223)
Alhammadi <i>et al</i> <sup>[22]</sup>	2013	Qatar	HCWs at a paediatric unit at Hamad Medical Corporation in Doha	230	NR	Influenza	67.7 (151/230)
Fakhrawi <i>et al</i> <sup>[67]</sup>	2015	Bahrain	Sickle cell patients attending primary health care centres	230	NR	Pneumococcal	62.2 (143/230)

HCW: Health care workers; NR: Not recorded.

elderly and people with chronic diseases are specially recommended to take the vaccine<sup>[13-17]</sup>. Despite these recommendations, the vaccination rate remains low<sup>[18-20]</sup>. Studies conducted to assess the influenza vaccine uptake among health care workers (HCWs) in GCC countries reveal that the decision to receive the vaccine is influenced by an individual's type of work, gender, vaccine awareness, need to protect those around and previous vaccination encounters<sup>[18,20]</sup>, whereas, lack of awareness, uncertainty of the effectiveness of the vaccine, and fear of adverse effects are the most common barriers<sup>[21,22]</sup>. Additionally, some individuals are misinformed that seasonal influenza vaccines are not necessary since they are young<sup>[21]</sup>. Similarly, for pneumococcal vaccine the barriers to the implementation of the vaccine arise from incomplete awareness of the benefit and safety of the vaccine as well as inadequate understanding of the seriousness of the disease among health professionals<sup>[23]</sup>. Meningococcal disease is uniquely important in GCC countries, especially in relation to Hajj and Umrah pilgrimages<sup>[24]</sup>; consequently, the GCC countries endeavour to ensure vaccination (with ACWY vaccine) of all pilgrims to Hajj and Umrah<sup>[14,24-26]</sup>. In GCC countries, pneumococcal vaccine is recommended for individuals with pre-existing diseases (*e.g.*, sickle cell

disease) and elderly adults<sup>[27,28]</sup>, and pertussis vaccine is generally advised for HCWs and pregnant women.

However, there have been limited studies assessing the coverage of influenza, pneumococcal, meningococcal and pertussis vaccines in GCC countries. Most of the available studies on the uptake of vaccines against these infections in GCC countries have been conducted among HCWs (Table 1). Essentially no study has assessed the uptake of these vaccines among the general population other than pilgrims<sup>[29,30]</sup>. In this regard, our study aims to evaluate their uptake among the members of the public in the GCC countries, explore the barriers to and facilitators of vaccination, and identify other factors that may affect uptake.

## MATERIALS AND METHODS

### *Study design and participant recruitment*

The study was a cross-sectional survey among the GCC countries' residents aged  $\geq 16$  years old, as described elsewhere<sup>[31]</sup>. The survey was conducted in Arabic but the data were collated and analysed in English. The data were collected electronically (online) through the "Gulf Indicators" (GI) smartphone app which was released in Apple App store in November 2014 for the

purpose of collecting research data for cross-sectional and cohort studies. The approach was successfully tested in a few studies<sup>[32-34]</sup> and was found to be reliable and capable of collecting valid and credible data. Some of the mechanisms the app uses to ensure credibility of data include a "built-in" location verification function that verifies that users hail from the GCC countries only. In addition, the app gives each user a unique device identifier to prevent redundancy of data or rather the submission of several forms by the same user, it also promotes anonymity of the respondent. Lastly, the app does not accept submission of incomplete forms thus ensures recording of all vital information.

This survey was published on the GI platform from September to December 2015. To start with, users voluntarily registered to the GI platform. After completing the consent form, the participant could then start answering the survey. The survey variables aimed to investigate the respondents' awareness about vaccines against influenza, pneumococcal, meningococcal and pertussis infections, and collected data concerning their socio-demographic characteristics, their perception toward vaccine uptake, their understanding of the risk of exposure to viruses transmitting airborne infections, and the factors that motivate or demotivate them from taking influenza vaccine.

### Sample size

If we assume that at least 50% of the public in GCC countries will have the right knowledge about airborne diseases and their vaccines, and considering an error margin of 10% to be acceptable for this survey, a minimum sample size of 480 was considered sufficient for this survey, but we aimed to recruit as many participants as possible within the survey period even after the minimum sample size was achieved.

### Statistical analysis

The data collected were analysed statistically using SPSS v.23.0 (SPSS, Inc., Chicago, IL, United States). Parameters such as the response rates and users' characteristics were analysed descriptively. Differences in the characteristics of users across the countries were quantified through bivariate analysis. Other important variables and controlling factors related to the research topic such as age, gender, country, chronic medical conditions, and educational level, were studied using logistic regression, using the backward Wald method.

### Ethics approval

This study was reviewed and approved by the Human Research Ethics Committee at King Saud University (Ethics Ref No: 4/2016), Riyadh, Saudi Arabia.

## RESULTS

### Demographics

Out of 2741 individuals who downloaded the application, 1812 (66%) completed the survey. Their mean age was

27.3 years (SD  $\pm$  8.3), 82% (1485/1812) were male and 24% (436/1812) reported having  $\geq$  1 chronic diseases. Over half of participants [53% (967/1812)] were smokers and 56% (1009/1812) had up to high school level of education (Table 2).

### Seasonal influenza vaccine

Overall, 17% (300/1812) received seasonal influenza vaccine during the year 2015, 74% (1345/1812) did not receive the vaccine, and 9% (167/1812) were unsure about vaccination status. The influenza vaccine uptake varied slightly across the countries ranging from 15% (163/1105) among residents of Saudi Arabia to 24% (22/93) among residents of Qatar (Table 2). The vaccine uptake among the "at risk" group (those who have chronic condition) was 21% (92/436): The uptake among people aged  $\geq$  65 years with no pre-existing disease was 20% (1/5), 50% (4/8) among those with pre-existing diseases and 21% (78/423) among those aged < 65 with chronic diseases.

Physicians' advice was the most cited reason [23% (68/300)] influencing the decision for vaccine uptake, followed by the perception of having low body immunity [21% (62/300)] (the other reasons are summarised in Table 3). In contrast, not being aware of the vaccine [43% (573/1345)] was the main cited reason for non-receipt of the vaccine (the other reasons are listed in Table 3).

In multivariate analysis, light smokers (defined as smoking  $\leq$  10 cigarettes per day) [adjusted odds ratio (aOR) = 2.0, 95%CI: 1.4-2.8,  $P < 0.01$ ], medium smokers (defined as smoking between 11-20 cigarettes per day) (aOR = 2.2, 95%CI: 1.6-3.1,  $P < 0.01$ ) and heavy smokers (smoking more than 20 cigarettes per day) (aOR = 1.8, 95%CI: 1.0-3.0,  $P < 0.04$ ) were more likely to be vaccinated compared to not smokers. Moreover, those who had malignancy (aOR = 3.1, 95%CI: 1.3-7.2,  $P = 0.01$ ) and those who suffered from immunosuppressive conditions (aOR = 5.1, 95%CI: 2.0-13.0,  $P < 0.01$ ) were more likely to receive influenza vaccine compared to individuals who did not suffer from these conditions (Table 4).

### Pneumococcal vaccine

Overall, 22% (397/1812) of the participants reported receiving pneumococcal vaccine in the three years prior to the survey and the remaining 78% (1415/1812) reported not receiving the vaccine. The uptake rate varied widely across the countries, ranging from 0% (0/98) in Bahrain to 79% (201/253) in Kuwait. The overall uptake rate among the "at risk" individuals was 25% (109/436), the uptake rate among participants with bronchial asthma, those with other lung diseases, heart diseases and diabetes was respectively, 35% (52/150), 52% (12/23), 32% (7/22) and 20% (31/152).

In multivariate analysis, males (aOR = 1.9, 95%CI: 1.2-2.9,  $P < 0.01$ ), heavy smokers (smoking more than 30 cigarettes per day) (aOR = 4.6, 95%CI: 2.6-8.0,  $P < 0.01$ ) and postgraduate degree holders (aOR = 2.1,

**Table 2** Demographic characteristics of surveyed participants, and their vaccination uptake

	<i>n</i> (%)	Influenza vaccine <i>n</i> (%)	Pneumococcal vaccine <i>n</i> (%)	Pertussis vaccine <i>n</i> (%)	Meningococcal vaccine <i>n</i> (%)
Overall		300 (17)	397 (22)	296 (16)	363 (20)
Age (yr)					
16-36	1578 (87)	243 (15)	342 (23)	250 (16)	330 (21)
37-55	218 (12)	50 (23)	50 (23)	46 (21)	28 (13)
≥ 56	18 (1)	7 (39)	5 (28)	0 (0)	5 (28)
Gender					
Male	1485 (82)	261 (18)	336 (23)	273 (18)	299 (20)
Female	327 (18)	39 (12)	61 (19)	23 (7)	64 (20)
Countries					
KSA	1105 (61)	163 (15)	74 (7)	82 (7)	302 (18)
Kuwait	253 (14)	42 (17)	201 (79)	87 (34)	19 (7)
UAE	203 (11)	45 (22)	43 (21)	35 (17)	76 (37)
Bahrain	98 (6)	18 (18)	0 (0)	20 (20)	49 (50)
Qatar	93 (5)	22 (24)	69 (74)	27 (29)	14 (15)
Oman	60 (3)	10 (17)	10 (17)	45 (75)	2 (3)
Education					
≤ High school certificate	803 (44)	128 (16)	193 (24)	133 (17)	172 (21)
> High school certificate	1009 (56)	172 (17)	204 (20)	163 (16)	191 (19)
Employments statuses					
No	237 (13)	23 (10)	51 (22)	26 (11)	60 (25)
Yes	1575 (87)	277 (16)	346 (22)	270 (17)	303 (19)
Government employee	530 (34)	80 (15)	114 (22)	96 (18)	110 (21)
Student	432 (27)	45 (10)	108 (25)	114 (26)	62 (14)
Private sector employee	415 (26)	104 (25)	89 (21)	44 (11)	66 (16)
Business	123 (8)	32 (26)	35 (29)	15 (12)	35 (29)
Home maker	46 (3)	12 (26)	0 (0)	0 (0)	2 (4)
Retired	29 (2)	4 (14)	0 (0)	1 (3)	28 (97)
Smoking status					
No	845 (47)	95 (11)	165 (20)	105 (12)	166 (20)
Yes/per day	967 (53)	205 (21)	232 (24)	191 (20)	197 (20)
≤ 10 cigarettes	273 (28)	55 (20)	41 (15)	50 (18)	67 (25)
11-20 cigarettes	452 (47)	106 (24)	119 (26)	87 (19)	82 (18)
21-30 cigarettes	131 (14)	21 (16)	27 (21)	19 (15)	26 (20)
> 30 cigarettes	111 (11)	23 (21)	45 (41)	35 (32)	22 (20)
Chronic diseases					
No	1376 (76)	208 (15)	288 (21)	163 (12)	236 (17)
Yes <sup>1</sup>	436 (24)	92 (21)	109 (25)	133 (31)	127 (29)
Diabetes	152 (35)	32 (21)	31 (20)	42 (28)	58 (38)
Bronchial asthma	150 (34)	29 (19)	52 (35)	45 (30)	37 (25)
Hypertension	54 (12)	13 (24)	4 (7)	15 (28)	22 (41)
Hypercholesterolemia	34 (8)	6 (18)	9 (27)	10 (29)	12 (35)
Immunosuppressive	37 (8)	14 (38)	13 (35)	15 (41)	14 (38)
Malignancy	27 (6)	9 (33)	5 (16)	10 (37)	5 (19)
Other lung diseases	23 (5)	4 (17)	12 (50)	10 (44)	8 (35)
Heart diseases	22 (5)	6 (27)	7 (32)	9 (41)	10 (46)
Chronic kidney disease	10 (2)	2 (20)	3 (30)	7 (70)	2 (20)
Other	78 (18)	14 (18)	22 (28)	28 (36)	9 (12)

<sup>1</sup>One or more chronic conditions. KSA: Kingdom of Saudi Arabia; UAE: United Arab Emirates.

95%CI: 1.1-3.9,  $P = 0.02$ ) were more likely to receive the vaccine. Additionally, residents of Kuwait (aOR = 20.4, 95%CI: 9.3-44.5,  $P < 0.01$ ) and Qatar (aOR = 16.8, 95%CI: 7.1-39.5,  $P < 0.01$ ) were more likely to take the vaccine, while Saudi Arabian residents (aOR = 0.3, 95%CI: 0.2-0.7,  $P < 0.01$ ) were least likely to receive the vaccine (Table 4).

### **Pertussis vaccine**

Overall, only 16% (296/1812) respondents reported receiving pertussis vaccine, the remaining 84% (1516/1812) denied taking the vaccine. The coverage varied very widely across the countries ranging from 7%

(82/1105) among Saudi participants to 75% (45/60) among Omani participants. The uptake of pertussis vaccine among "at risk" people was 31% (133/436).

Multivariate analysis showed that being male (aOR = 4.8, 95%CI: 2.8-8.2,  $P < 0.01$ ), heavy smoker (aOR = 4.5, 95%CI: 2.6-7.7,  $P < 0.01$ ) and having a chronic disease (aOR = 4.8, 95%CI: 3.5-6.6,  $P < 0.01$ ), especially chronic kidney disease (aOR = 6.3, 95%CI: 1.5-26.9,  $P < 0.01$ ) significantly increased the likelihood of being vaccinated against pertussis (Table 4).

### **Meningococcal vaccine**

Overall, only 20% (363/1812) of respondents reported



**Table 3** Motivators and barriers of taking influenza vaccine among the participants

Motivators' <i>n</i> (%) <sup>1</sup>	Barriers' <i>n</i> (%) <sup>1</sup>
Doctor's advice 68 (23)	Unawareness about the vaccine 573 (38)
Perception of low body immunity 62 (21)	Relying on body immunity (healthy lifestyle) 500 (33)
Believing the vaccine to be effective in preventing influenza 61 (20)	Perception of having good immunity 299 (20)
As a workplace requirement 40 (13)	Cost of the vaccine 292 (19)
	Not worried to get flu 168 (11)
	Fear of vaccine side effects 77 (5)
	Believing that the vaccine is not effective in preventing influenza 72 (5)

<sup>1</sup>Some participants cited more than one reason.

receiving meningococcal vaccine while the remaining 80% (1449/1812) denied receiving it. The vaccination uptake varied greatly across the countries ranging from 3% (2/60) among Omani participants to 50% (49/98) among Bahraini participants. The uptake among "at risk" individuals was 29% (127/436). In multivariate analysis, presence of cardiovascular disease (aOR = 3.4, 95%CI: 1.3-9.0,  $P < 0.01$ ) and diabetes (aOR = 2.7, 95%CI: 1.8-4.0,  $P < 0.01$ ), and being a resident of Bahrain (aOR = 12.1, 95%CI: 6.5-22.4,  $P < 0.01$ ), UAE (aOR = 8.0, 95%CI: 4.7-13.7,  $P < 0.01$ ), and Saudi Arabia (aOR = 3.2, 95%CI: 2.0-5.1,  $P < 0.01$ ) significantly increased the likelihood of receiving meningococcal vaccine.

## DISCUSSION

To the best of our knowledge, this is the first study measuring the uptake of influenza, pertussis, pneumococcal and meningococcal vaccines among the public in the GCC countries. This study shows that the rate of vaccination against diseases that transmit via respiratory tract among people of GCC countries is suboptimal even among the high-risk individuals, and the vaccination rate varies according to the type of vaccine and the country of residence of the participants. Generally, having an "at risk" condition was associated with a higher vaccination rate among the members of public in GCC countries compared to that in normal individuals. Additionally, smokers were more likely to receive the vaccines than non-smokers.

The overall uptake of influenza vaccine was suboptimal, as we found that only 17% (300/1812) of the participants had the vaccine. Our findings are comparable to the rate (17.8%) found among Saudi military personnel in Riyadh in 2009<sup>[35]</sup>, and even higher than the uptake among Saudi Arabian Hajj pilgrims (4%)<sup>[36]</sup>. However this uptake rate is much lower than the coverage rate among HCWs in GCC countries which ranges between 19% and 72%<sup>[18,20,21,37,38]</sup>. More stringent vaccination requirement for the workers applied in health care settings in some GCC countries explain higher uptake among HCWs. Similar requirement exists in other workplace settings leading to increased vaccination

**Table 4** Significant predictors associated with vaccines uptake

Predictors	Adjusted OR	95%CI	<i>P</i> value
Influenza vaccine			
Smoking (< 10 sig)	1.95	1.35-2.83	< 0.01
Smoking (11-20 sig)	2.23	1.63-3.05	< 0.01
Smoking (> 20 sig)	1.75	1.04-2.96	0.04
Other respiratory disease	0.15	0.04-0.61	< 0.01
Cancer	3.05	1.29-7.21	0.01
Immune disease	5.08	1.98-13.03	< 0.01
Pneumococcal vaccine			
Male	1.90	1.23-2.93	< 0.01
Bachelor degree	0.64	0.45-0.90	0.01
Postgraduate	2.11	1.14-3.90	0.02
Smoking (> 30 sig)	4.60	2.64-7.99	< 0.01
KSA	0.31	0.15-0.66	< 0.01
Qatar	16.77	7.11-39.54	< 0.01
Kuwait	20.4	9.34-44.52	< 0.01
Meningococcal vaccine			
Postgraduate degree	2.24	1.38-3.62	< 0.01
Diabetes	2.67	1.80-3.95	< 0.01
Asthma	1.78	1.17-2.70	< 0.01
Cardiovascular disease	3.43	1.30-9.01	< 0.01
Age (16-36)	0.45	0.29-0.70	< 0.01
Age (37-55)	0.26	0.14-0.47	< 0.01
KSA	3.15	1.96-5.08	< 0.01
UAE	8.01	4.68-13.71	< 0.01
Bahrain	12.09	6.52-22.43	< 0.01
Pertussis vaccine			
Having chronic disease	4.81	3.49-6.62	< 0.01
Male	4.82	2.82-8.24	< 0.01
Smoking (11-20 sig)	1.89	1.30-2.75	< 0.01
Smoking (> 30 sig)	4.50	2.64-7.69	< 0.01
KSA	0.01	0.01-0.02	< 0.01
Qatar	0.05	0.02-0.12	< 0.01
UAE	0.02	0.01-0.05	< 0.01
Bahrain	0.03	0.01-0.07	< 0.01
Kuwait	0.08	0.04-0.16	< 0.01

KSA: Kingdom of Saudi Arabia; UAE: United Arab Emirate.

rate. For instance, Abbas *et al.*<sup>[39]</sup> recorded that influenza vaccine uptake rate among the employees of two different industries in Saudi Arabia ranged from 56% to 62% in 2004-2005 (Table 1).

However, the uptake of influenza vaccine in this study was lower than what was found among adults aged  $\geq 19$  years resident in the United States (43.2%)<sup>[40]</sup>, France (26.4%), Germany (28.2%), and the United Kingdom (28.7%) in recent years<sup>[41]</sup>. Such a discrepancy may have stemmed from the lack of awareness about influenza vaccine which is common among the Gulf people as is evidenced by this study, and is consistent with the studies conducted in other Middle Eastern countries<sup>[42,43]</sup>. Low vaccination uptake secondary to lack of awareness has been observed even among HCWs in some GCC countries<sup>[21]</sup>.

An interesting finding of this study is that other factors such as the fear of the vaccine side effects and the belief that vaccine is not effective were relatively less common among the surveyed participants (5% each), while in other studies these were common reasons for non-receipt of vaccine among HCWs in GCC countries<sup>[19,21]</sup>, and among general population in some

Middle Eastern countries<sup>[43,44]</sup>.

Conversely, HCWs, especially physicians, were found to play a significant role in enhancing vaccination rate among the public as physicians' advice was found to be the main motivator for vaccine uptake among our participants. In a study conducted in Australia on public perceptions towards pandemic influenza vaccine a higher rate of compliance for physician recommended vaccination was observed compared to government recommendation<sup>[45]</sup>. Furthermore, other main uptake motivators among our participants were perception of low body immunity (21%) and believing the vaccine to be effective (20%). Finally, 13% of participants received the vaccine only because it was required in their workplace which is unsurprising given the higher uptake reported by Abbas *et al.*<sup>[39]</sup> among industry employees in Saudi Arabia.

This study shows that compared to other vaccines, the uptake rate of influenza vaccine varied only minimally ranging from 15% to 24%. This can be explained by the uniform recommendation regarding influenza vaccine across the GCC countries. We found that the uptake of influenza vaccine among "at risk" individuals was higher than among healthy people (21% vs 15%) which is consistent with the recent campaigns in the GCC countries which mostly focus on improving the uptake among "at risk" group.

An interesting finding in this study is that there was no difference in the influenza vaccine uptake between participants with varying educational levels, however, this finding was consistent with Endrich *et al.*<sup>[41]</sup>'s study who demonstrated that educational level had no significant effect on the influenza vaccination coverage rate among public in most of the European countries. On the contrary, the employed people had a higher uptake of influenza vaccine: Multiple factors can explain this finding including vaccination as a workplace requirement.

Smoking is a common habit among public in GCC countries; *e.g.*, in Saudi Arabia smoking prevalence ranges between 2.4% and 52.3%<sup>[46]</sup>. Smoking is a recognised key risk factor for many respiratory infections<sup>[47]</sup>, which may explain why smokers in our study were twice as likely to be vaccinated against influenza compared to non-smokers, but that was in contrast to the finding of a study conducted among United States adults, where smokers were found to be less likely to be vaccinated against influenza<sup>[48]</sup>. There might be cultural factors for this difference, which is unclear at this stage.

Pneumococcal vaccine is recommended in most of the GCC countries for adults more than 50 years of age or less than 50 with underlying health problems including smoking<sup>[23,49]</sup>, despite that, except for the participants from Kuwait and Qatar, the uptake rate in this study was suboptimal. However, the coverage rate among "at risk" individuals in our study was higher than that among general population especially, among participants with bronchial asthma (35%)

and smokers (24%), the group to be included in the latest recommendation by the United States Advisory Committee on Immunization Practices (ACIP)<sup>[50]</sup>, these rates were higher than to what had been found in the United States a year after the implementation of this recommendation<sup>[51]</sup>.

In our study, we found that the coverage rate of meningococcal vaccine was generally low but was relatively higher among "at risk" individuals compared to those who were "not at risk" (29% vs 17%) and that was expected as the recommendations were generally limited to certain individuals such as travellers to Hajj and Umrah pilgrimages, residents of Makkah and Madinah, and individuals with certain medical conditions. For the pertussis vaccine, the coverage rates in GCC countries varied very widely, from 7% in Saudi Arabia to 75% in Oman. A low uptake rate can be explained by not having a consistent pertussis vaccine recommendation for adults, except for certain groups in some countries such as HCWs and pregnant women. The surprisingly higher uptake reported among participants from Oman needs further research to validate, and if confirmed, to explore reasons for this better coverage. The results of studies from Australia and Canada revealed a coverage rate of pertussis vaccine among adults to be around 10%, despite the recommendation of Tdap for those who are likely to come in contact with children, and for pregnant women<sup>[52,53]</sup>.

Nevertheless, unfortunately findings from other studies show that public health recommendations alone are not enough to increase the vaccination rate and that several other factors need to be addressed to achieve the target level of immunisation coverage<sup>[54,55]</sup>. One of the most important factors is physicians' recommendation in both primary health care and hospital settings, since this is a uniform finding across the studies<sup>[56,57]</sup>. In a qualitative sense, the significance of physicians' recommendations comes from two opposing directions. Firstly, it is found to be associated with increased uptake, and secondly, from the other direction, its absence represents the most important barrier<sup>[58]</sup>. Therefore, motivating the clients for vaccination should be the physicians' priority in order to achieve a satisfactory immunisation target rate. Chan *et al.*<sup>[59]</sup> demonstrated that a computerised reminder system telling the physicians about any patient having an indication for preventive care such as vaccinations to be an effective technique in increasing the vaccine uptake rate but it remains to be seen if such a strategy would be effective in the context of GCC countries.

Another important factor that can improve the uptake rate is focused public educational campaigns<sup>[60]</sup>, which provides the public with the knowledge of the importance of vaccination and its availability. Also, the public can be given detailed information about the disease against which the vaccine offers protection including discussions on how it can be prevented or at least its severity can be lessened by obtaining the vaccine on time as affirmed by Loubet *et al.*<sup>[61]</sup>.

Previously, many adult vaccination campaigns have been conducted in GCC countries particularly for influenza, pneumococcal and meningococcal vaccines but there are no published studies assessing the effectiveness of these campaigns, except for the meningococcal vaccination campaign in 1992 that followed a meningococcal outbreak in Makkah which was ultimately brought under control<sup>[62]</sup>.

This study is susceptible to recall bias as data were collected through a self-reported survey. Furthermore, the use of smartphone applications is less common in elderly people who represent an important part of the "at risk" population. This impacts the generalizability of the result. Despite these limitations, this is the first study measuring the uptake rate of seasonal influenza, pneumococcal, meningococcal and pertussis vaccines among members of public in the GCC countries. Another strength is that the application used in our study was tested and validated previously in more than one setting including in GCC countries and among travellers to GCC countries (*e.g.*, Hajj pilgrims)<sup>[32-34,63]</sup>. Conversely this study does not distinguish native citizens from expatriates who may be different in having access to preventive health care.

Although GCC countries had implemented recommendations for seasonal influenza, pneumococcal and meningococcal vaccines which were very much in line with the ACIP recommendations, the uptake rates according to our study was low compared to that in developed countries. This highlights the need for further research and implementation of tailored programmes for increasing awareness about vaccine-preventable diseases among adults in GCC countries. A number of measures such as setting up of vaccination clinics in public hospitals and vaccination cards for adults, reminder systems for both the public and HCWs, and regular program evaluation may need to be considered to achieve a satisfactory vaccination rate.

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## COMMENTS

### Background

The Gulf Cooperation Council (GCC) countries recommend vaccinations against influenza, pertussis, pneumococcal and meningococcal diseases for their residents but there is paucity of comparative data on the uptake of these vaccines across the countries.

### Research frontiers

This highlights the need for further research and implementation of tailored programmes for increasing awareness about vaccine-preventable diseases among adults in GCC countries.

### Innovations and breakthroughs

There have been limited studies assessing the coverage of influenza, pneumococcal, meningococcal and pertussis vaccines in GCC countries. This

study addresses those knowledge gaps.

## Applications

This study demonstrates that the uptake of vaccinations against respiratory infections among residents of GCC countries was suboptimal, even among the highly susceptible people, and varied widely across the countries. These findings inform public health policy.

## Terminology

GCC countries: GCC stands for Gulf Cooperation Council. It is a regional intergovernmental political and economic union consisting of six Arab states of the Arabian Gulf. The GCC countries are: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates; Hajj: Hajj is the Islamic pilgrimage to Mecca, Saudi Arabia which annually attracts about three million people from across the world; "At risk" group: Individuals who are aged  $\geq 65$  years and/or have chronic medical conditions such as diabetes, and bronchial asthma; "Not at risk" group: Individuals who do not have "at risk" conditions listed above, *i.e.*, individuals aged  $< 65$  years and do not have pre-existing medical conditions that predispose them to certain infections.

## Peer-review

This is a good and well written report regarding survey of vaccination uptake in Arabian Gulf countries. The result of this study would be good reference in this field.

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