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***Observational Study***

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

Alqahtani AS *et al.* Respiratory infections’ vaccines in GCC countries

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**Abstract**

***AIM***

To study the uptake, barriers and motivators of influenza, pneumococcal, meningococcal and pertussis vaccines among 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 Statistical Package for Social Sciences (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 ≥ 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 burden 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[1-4]. Annually, influenza causes a million deaths worldwide[5,6], and pneumonia, mostly caused by *Streptococcus pneumoniae*, is responsible for 1.6 million deaths globally[7]. 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[8]. In addition, there has been a resurgence of pertussis in the last several years and the disease causes about 200000 annual deaths globally[9]. 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 (KSA), Kuwait, Bahrain, Qatar, United Arab Emirate (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[10].

Influenza is a common disease in GCC countries[11,12], and therefore members of public especially children, elderly and people with chronic diseases are specially recommended to take the vaccine[13-17]. Despite these recommendations, the vaccination rate remains low[18-20]. 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[18,20], whereas, lack of awareness, uncertainty of the effectiveness of the vaccine, and fear of adverse effects are the most common barriers[21,22]. Additionally, some individuals are misinformed that seasonal influenza vaccines are not necessary since they are young[21]. 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[23]. Meningococcal disease is uniquely important in GCC countries, especially in relation to Hajj and Umrah pilgrimages[24]; consequently, the GCC countries endeavour to ensure vaccination (with ACWY vaccine) of all pilgrims to Hajj and Umrah[14,24-26]. In GCC countries, pneumococcal vaccine is recommended for individuals with pre-existing diseases (*e.g*., sickle cell disease) and elderly adults[27,28], 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[29,30]. 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 ≥ 16 years old, as described elsewhere[31]. 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[32-34] 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 air-borne 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 ± 8.3), 82% (1485/1812) were male and 24% (436/1812) reported having ≥ 1 chronic diseases. Over half of participants [53% (845/1812)] 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 ≥ 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% (61/300)] (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 ≤ 10 cigarettes per day) [adjusted odds ratio (aOR) 2.0, 95% confidence interval (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 rest 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, 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 receiving meningococcal vaccine while the rest 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% (129/436). 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 compared to 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[35], and even higher than the uptake among Saudi Arabian Hajj pilgrims (4%)[36]. However this uptake rate is much lower than the coverage rate among HCWs in GCC countries which ranges between 19% and 72%[18,20,21,37,38]. 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 rate. For instance, Abbas *et al*[39] 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 ≥ 19 years resident in the United States (43.2%)[40], France (26.4%), Germany (28.2%), and the United Kingdom (28.7%) in recent years[41]. 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[42,43]. Low vaccination uptake secondary to lack of awareness has been observed even among HCWs in some GCC countries[21].

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[19,21], and among general population in some Middle Eastern countries[43,44].

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[45]. 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*[39] 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*[41]*’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, in Saudi Arabia smoking prevalence ranges between 2.4% and 52.3%[46]. Smoking is a recognised key risk factor for many respiratory infections[47], 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 US adults, where smokers were found to be less likely to be vaccinated against influenza[48]. 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[23,49], 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)[50], these rates were higher than to what had been found in the United States a year after the implementation of this recommendation[51].

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[52,53].

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[54,55]. 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[56,57]. 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[58]. Therefore, motivating the clients for vaccination should be the physicians’ priority in order to achieve a satisfactory immunisation target rate. Chan *et al*[59] 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[60], 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*[61]. 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 could be ultimately brought under control[62].

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)[32-34,63]. Another limitation is that this study does not distinguish native citizens from expatriates who may be different in the accesses 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 ≥ 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.

**REFERENCES**

1 **Boianelli A**, Nguyen VK, Ebensen T, Schulze K, Wilk E, Sharma N, Stegemann-Koniszewski S, Bruder D, Toapanta FR, Guzmán CA, Meyer-Hermann M, Hernandez-Vargas EA. Modeling Influenza Virus Infection: A Roadmap for Influenza Research. *Viruses* 2015; **7**: 5274-5304 [PMID: 26473911 DOI: 10.3390/v7102875]

2 **Drijkoningen JJ**, Rohde GG. Pneumococcal infection in adults: burden of disease. *Clin Microbiol Infect* 2014; **20** Suppl 5: 45-51 [PMID: 24313448 DOI: 10.1111/1469-0691.12461]

3 **Harrison LH**, Trotter CL, Ramsay ME. Global epidemiology of meningococcal disease. *Vaccine* 2009; **27** Suppl 2: B51-B63 [PMID: 19477562 DOI: 10.1016/j.vaccine.2009.04.063]

4 **Hewlett EL**, Burns DL, Cotter PA, Harvill ET, Merkel TJ, Quinn CP, Stibitz ES. Pertussis pathogenesis--what we know and what we don't know. *J Infect Dis* 2014; **209**: 982-985 [PMID: 24626533 DOI: 10.1093/infdis/jit639]

5 **Fischer WA**, Gong M, Bhagwanjee S, Sevransky J. Global burden of influenza as a cause of cardiopulmonary morbidity and mortality. *Glob Heart* 2014; **9**: 325-336 [PMID: 25667184 DOI: 10.1016/j.gheart.2014.08.004]

6 **World Health Organization**. Vaccines against influenza WHO position paper – November 2012. *Wkly Epidemiol Rec* 2012; **87**: 461-476 [PMID: 23210147]

7 **Said MA**, Johnson HL, Nonyane BA, Deloria-Knoll M, O'Brien KL, Andreo F, Beovic B, Blanco S, Boersma WG, Boulware DR, Butler JC, Carratalà J, Chang FY, Charles PG, Diaz AA, Domínguez J, Ehara N, Endeman H, Falcó V, Falguera M, Fukushima K, Garcia-Vidal C, Genne D, Guchev IA, Gutierrez F, Hernes SS, Hoepelman AI, Hohenthal U, Johansson N, Kolek V, Kozlov RS, Lauderdale TL, Mareković I, Masiá M, Matta MA, Miró Ò, Murdoch DR, Nuermberger E, Paolini R, Perelló R, Snijders D, Plečko V, Sordé R, Strålin K, van der Eerden MM, Vila-Corcoles A, Watt JP. Estimating the burden of pneumococcal pneumonia among adults: a systematic review and meta-analysis of diagnostic techniques. *PLoS One* 2013; **8**: e60273 [PMID: 23565216 DOI: 10.1371/journal.pone.0060273]

8 **Pelton SI**. The Global Evolution of Meningococcal Epidemiology Following the Introduction of Meningococcal Vaccines. *J Adolesc Health* 2016; **59**: S3-S11 [PMID: 27449148 DOI: 10.1016/j.jadohealth.2016.04.012]

9 **Gaillard ME**, Bottero D, Moreno G, Rumbo M, Hozbor D. Strategies and new developments to control pertussis, an actual health problem. *Pathog Dis* 2015; **73**: ftv059 [PMID: 26260328 DOI: 10.1093/femspd/ftv059]

10 **Memish ZA**. Infection control in Saudi Arabia: meeting the challenge. *Am J Infect Control* 2002; **30**: 57-65 [PMID: 11852419 DOI: 10.1067/mic.2002.120905]

11 **Al-Awaidy S**, Hamid S, Al Obaidani I, Al Baqlani S, Al Busaidi S, Bawikar S, El-Shoubary W, Dueger EL, Said MM, Elamin E, Shah P, Talaat M. The Burden of Influenza-Associated Hospitalizations in Oman, January 2008-June 2013. *PLoS One* 2015; **10**: e0144186 [PMID: 26642055 DOI: 10.1371/journal.pone.0144186]

12 **Amer HM**, Alshaman MS, Farrag MA, Hamad ME, Alsaadi MM, Almajhdi FN. Epidemiology of 11 respiratory RNA viruses in a cohort of hospitalized children in Riyadh, Saudi Arabia. *J Med Virol* 2016; **88**: 1086-1091 [PMID: 26595650 DOI: 10.1002/jmv.24435]

13 **Kim DK**, Riley LE, Harriman KH, Hunter P, Bridges CB. Advisory Committee on Immunization Practices Recommended Immunization Schedule for Adults Aged 19 Years or Older - United States, 2017. *MMWR Morb Mortal Wkly Rep* 2017; **66**: 136-138 [PMID: 28182599 DOI: 10.15585/mmwr.mm6605e2]

14 **Al-Tawfiq JA**, Memish ZA. The Hajj: updated health hazards and current recommendations for 2012. *Euro Surveill* 2012; **17**: 20295 [PMID: 23078811]

15 **Zeitouni MO**, Al Barrak AM, Al-Moamary MS, Alharbi NS, Idrees MM, Al Shimemeri AA, Al-Hajjaj MS. The Saudi Thoracic Society guidelines for influenza vaccinations. *Ann Thorac Med* 2015; **10**: 223-230 [PMID: 26664559 DOI: 10.4103/1817-1737.167065]

16 **Al-Abri SS**, Al-Maashani S, Memish ZA, Beeching NJ. An audit of inpatient management of community-acquired pneumonia in Oman: a comparison with regional clinical guidelines. *J Infect Public Health* 2012; **5**: 250-256 [PMID: 22632599 DOI: 10.1016/j.jiph.2012.03.002]

17 **Lopez A**, Mariette X, Bachelez H, Belot A, Bonnotte B, Hachulla E, Lahfa M, Lortholary O, Loulergue P, Paul S, Roblin X, Sibilia J, Blum M, Danese S, Bonovas S, Peyrin-Biroulet L. Vaccination recommendations for the adult immunosuppressed patient: A systematic review and comprehensive field synopsis. *J Autoimmun* 2017; Epub ahead of print [PMID: 28381345 DOI: 10.1016/j.jaut.2017.03.011]

18 **Shahbic HE**, Said HA. Flu vaccine among health workers in Qatar. *Saudi Med J* 2010; **31**: 1157-1160 [PMID: 20953534]

19 **Alkuwari MG**, Aziz NA, Nazzal ZA, Al-Nuaimi SA. Pandemic influenza A/H1N1 vaccination uptake among health care workers in Qatar: motivators and barriers. *Vaccine* 2011; **29**: 2206-2211 [PMID: 21462430 DOI: 10.1016/j.vaccine.2010.08.093]

20 **Rehmani R**, Memon JI. Knowledge, attitudes and beliefs regarding influenza vaccination among healthcare workers in a Saudi hospital. *Vaccine* 2010; **28**: 4283-4287 [PMID: 20441803 DOI: 10.1016/j.vaccine.2010.04.031]

21 **Alshammari TM**, AlFehaid LS, AlFraih JK, Aljadhey HS. Health care professionals' awareness of, knowledge about and attitude to influenza vaccination. *Vaccine* 2014; **32**: 5957-5961 [PMID: 25218193 DOI: 10.1016/j.vaccine.2014.08.061]

22 **Alhammadi A**, Khalifa M, Abdulrahman H, Almuslemani E, Alhothi A, Janahi M. Attitudes and perceptions among the pediatric health care providers toward influenza vaccination in Qatar: A cross-sectional study. *Vaccine* 2015; **33**: 3821-3828 [PMID: 26144904 DOI: 10.1016/j.vaccine.2015.06.082]

23 **Feldman C**, Abdulkarim E, Alattar F, Al Lawati F, Al Khatib H, Al Maslamani M, Al Obaidani I, Al Salah M, Farghaly M, Husain EH, Mokadas E. Pneumococcal disease in the Arabian Gulf: recognizing the challenge and moving toward a solution. *J Infect Public Health* 2013; **6**: 401-409 [PMID: 23999349 DOI: 10.1016/j.jiph.2013.06.004]

24 **Memish ZA**, Shibl AM. Consensus building and recommendations based on the available epidemiology of meningococcal disease in Gulf Cooperation Council States. *Travel Med Infect Dis* 2011; **9**: 60-66 [PMID: 21345738 DOI: 10.1016/j.tmaid.2011.01.004]

25 **Shibl A**, Tufenkeji H, Khalil M, Memish Z. Consensus recommendation for meningococcal disease prevention for Hajj and Umra pilgrimage/travel medicine. *East Mediterr Health J* 2013; **19**: 389-392 [PMID: 23882966]

26 **Ceyhan M**, Anis S, Htun-Myint L, Pawinski R, Soriano-Gabarró M, Vyse A. Meningococcal disease in the Middle East and North Africa: an important public health consideration that requires further attention. *Int J Infect Dis* 2012; **16**: e574-e582 [PMID: 22647750 DOI: 10.1016/j.ijid.2012.03.011]

27 **Memish ZA**, Arabi YM, Ahmed QA, Shibl AM, Niederman MS. Management and prevention strategies for community-acquired pneumonia in the Gulf Corporation Council. *J Chemother* 2007; **19** Suppl 1: 33-46 [PMID: 18073168]

28 **Alharbi NS**, Al-Barrak AM, Al-Moamary MS, Zeitouni MO, Idrees MM, Al-Ghobain MO, Al-Shimemeri AA, Al-Hajjaj MS. The Saudi Thoracic Society pneumococcal vaccination guidelines-2016. *Ann Thorac Med* 2016; **11**: 93-102 [PMID: 27168856 DOI: 10.4103/1817-1737.177470]

29 **Alfelali M**, Barasheed O, Tashani M, Azeem MI, El Bashir H, Memish ZA, Heron L, Khandaker G, Booy R, Rashid H. Changes in the prevalence of influenza-like illness and influenza vaccine uptake among Hajj pilgrims: A 10-year retrospective analysis of data. *Vaccine* 2015; **33**: 2562-2569 [PMID: 25887084 DOI: 10.1016/j.vaccine.2015.04.006]

30 **Alqahtani AS**, Rashid H, Heywood AE. Vaccinations against respiratory tract infections at Hajj. *Clin Microbiol Infect* 2015; **21**: 115-127 [PMID: 25682277 DOI: 10.1016/j.cmi.2014.11.026]

31 **Alqahtani AS**, Rashid H, Basyouni MH, Alhawassi TM, BinDhim NF. Public response to MERS-CoV in the Middle East: iPhone survey in six countries. *J Infect Public Health* 2017; Epub ahead of print [PMID: 28185821 DOI: 10.1016/j.jiph.2016.11.015]

32 **BinDhim NF**, Shaman AM, Trevena L, Basyouni MH, Pont LG, Alhawassi TM. Depression screening via a smartphone app: cross-country user characteristics and feasibility. *J Am Med Inform Assoc* 2015; **22**: 29-34 [PMID: 25326599 DOI: 10.1136/amiajnl-2014-002840]

33 **BinDhim NF**, Freeman B, Trevena L. Pro-smoking apps for smartphones: the latest vehicle for the tobacco industry? *Tob Control* 2014; **23**: e4 [PMID: 23091161 DOI: 10.1136/tobaccocontrol-2012-050598]

34 **BinDhim NF**, McGeechan K, Trevena L. Who Uses Smoking Cessation Apps? A Feasibility Study Across Three Countries via Smartphones. *JMIR Mhealth Uhealth* 2014; **2**: e4 [PMID: 25098439 DOI: 10.2196/mhealth.2841]

35 **Al-Khashan HI**, Selim MA, Mishriky AM, Binsaeed AA. Meningitis and seasonal influenza vaccination coverage among military personnel in central Saudi Arabia. *Saudi Med J* 2011; **32**: 159-165 [PMID: 21301763]

36 **Rashid H**, Shafi S, Haworth E, El Bashir H, Memish ZA, Sudhanva M, Smith M, Auburn H, Booy R. Viral respiratory infections at the Hajj: comparison between UK and Saudi pilgrims. *Clin Microbiol Infect* 2008; **14**: 569-574 [PMID: 18373688 DOI: 10.1111/j.1469-0691.2008.01987.x]

37 **Garcell HG**, Ramirez EC. Influenza immunization coverage for healthcare workers in a community hospital in Qatar (2011-2012 and 2012-2013 seasons). *J Infect Public Health* 2014; **7**: 70-72 [PMID: 24284023 DOI: 10.1016/j.jiph.2013.06.007]

38 **Al-Tawfiq JA**, Antony A, Abed MS. Attitudes towards influenza vaccination of multi-nationality health-care workers in Saudi Arabia. *Vaccine* 2009; **27**: 5538-5541 [PMID: 19651170 DOI: 10.1016/j.vaccine.2009.06.108]

39 **Abbas M**, Fiala L, Tawfiq L. Workplace influenza vaccination in two major industries in saudi arabia: a cost benefit analysis. *J Egypt Public Health Assoc* 2006; **81**: 59-73 [PMID: 17382084]

40 **Williams WW**, Lu PJ, O'Halloran A, Kim DK, Grohskopf LA, Pilishvili T, Skoff TH, Nelson NP, Harpaz R, Markowitz LE, Rodriguez-Lainz A, Bridges CB. Surveillance of Vaccination Coverage Among Adult Populations - United States, 2014. *MMWR Surveill Summ* 2016; **65**: 1-36 [PMID: 26844596 DOI: 10.15585/mmwr.ss6501a1]

41 **Endrich MM**, Blank PR, Szucs TD. Influenza vaccination uptake and socioeconomic determinants in 11 European countries. *Vaccine* 2009; **27**: 4018-4024 [PMID: 19389442 DOI: 10.1016/j.vaccine.2009.04.029]

42 **El Khoury G**, Salameh P. Influenza Vaccination: A Cross-Sectional Survey of Knowledge, Attitude and Practices among the Lebanese Adult Population. *Int J Environ Res Public Health* 2015; **12**: 15486-15497 [PMID: 26690189 DOI: 10.3390/ijerph121215000]

43 **Abu-Rish EY**, Elayeh ER, Mousa LA, Butanji YK, Albsoul-Younes AM. Knowledge, awareness and practices towards seasonal influenza and its vaccine: implications for future vaccination campaigns in Jordan. *Fam Pract* 2016; **33**: 690-697 [PMID: 27567011 DOI: 10.1093/fampra/cmw086]

44 **Assaf AM**, Hammad EA, Haddadin RN. Influenza Vaccination Coverage Rates, Knowledge, Attitudes, and Beliefs in Jordan: A Comprehensive Study. *Viral Immunol* 2016; **29**: 516-525 [PMID: 27509083 DOI: 10.1089/vim.2015.0135]

45 **Seale H**, Heywood AE, McLaws ML, Ward KF, Lowbridge CP, Van D, MacIntyre CR. Why do I need it? I am not at risk! Public perceptions towards the pandemic (H1N1) 2009 vaccine. *BMC Infect Dis* 2010; **10**: 99 [PMID: 20403201 DOI: 10.1186/1471-2334-10-99]

46 **Bassiony MM**. Smoking in Saudi Arabia. *Saudi Med J* 2009; **30**: 876-881 [PMID: 19617999]

47 **Jayes L**, Haslam PL, Gratziou CG, Powell P, Britton J, Vardavas C, Jimenez-Ruiz C, Leonardi-Bee J. SmokeHaz: Systematic Reviews and Meta-analyses of the Effects of Smoking on Respiratory Health. *Chest* 2016; **150**: 164-179 [PMID: 27102185 DOI: 10.1016/j.chest.2016.03.060]

48 **Takayama M**, Wetmore CM, Mokdad AH. Characteristics associated with the uptake of influenza vaccination among adults in the United States. *Prev Med* 2012; **54**: 358-362 [PMID: 22465670 DOI: 10.1016/j.ypmed.2012.03.008]

49 **Al-Tawfiq JA**, Memish ZA. Prevention of pneumococcal infections during mass gathering. *Hum Vaccin Immunother* 2016; **12**: 326-330 [PMID: 26176306 DOI: 10.1080/21645515.2015.1058456]

50 **Centers for Disease Control and Prevention (CDC)**; Advisory Committee on Immunization Practices. Updated recommendations for prevention of invasive pneumococcal disease among adults using the 23-valent pneumococcal polysaccharide vaccine (PPSV23). *MMWR Morb Mortal Wkly Rep* 2010; **59**: 1102-1106 [PMID: 20814406]

51 **Lu PJ**, Nuorti JP. Uptake of pneumococcal polysaccharide vaccination among working-age adults with underlying medical conditions, United States, 2009. *Am J Epidemiol* 2012; **175**: 827-837 [PMID: 22403807 DOI: 10.1093/aje/kwr376]

52 **Clarke M**, Thomas N, Giles L, Marshall H. Community awareness and predictors of uptake of pertussis booster vaccine in South Australian adults. *Vaccine* 2015; **33**: 7337-7343 [PMID: 26514422 DOI: 10.1016/j.vaccine.2015.10.068]

53 **Halperin BA**, MacDougall D, MacKinnon-Cameron D, Li L, McNeil SA, Langley JM, Halperin SA. Universal tetanus, diphtheria, acellular pertussis (Tdap) vaccination of adults: What the Canadian public knows and wants to know. *Vaccine* 2015; **33**: 6840-6848 [PMID: 26392011 DOI: 10.1016/j.vaccine.2015.09.012]

54 **Hmamouchi I**, Winthrop K, Launay O, Dougados M. Low rate of influenza and pneumococcal vaccine coverage in rheumatoid arthritis: data from the international COMORA cohort. *Vaccine* 2015; **33**: 1446-1452 [PMID: 25659279 DOI: 10.1016/j.vaccine.2015.01.065]

55 **Palache A**. Seasonal influenza vaccine provision in 157 countries (2004-2009) and the potential influence of national public health policies. *Vaccine* 2011; **29**: 9459-9466 [PMID: 22024174 DOI: 10.1016/j.vaccine.2011.10.030]

56 **Nichol KL**, Mac Donald R, Hauge M. Factors associated with influenza and pneumococcal vaccination behavior among high-risk adults. *J Gen Intern Med* 1996; **11**: 673-677 [PMID: 9120653]

57 **Ridda I**, Macintyre CR, Lindley RI. A qualitative study to assess the perceived benefits and barriers to the pneumococcal vaccine in hospitalised older people. *Vaccine* 2009; **27**: 3775-3779 [PMID: 19464561 DOI: 10.1016/j.vaccine.2009.03.075]

58 **Bovier PA**, Chamot E, Bouvier Gallacchi M, Loutan L. Importance of patients' perceptions and general practitioners' recommendations in understanding missed opportunities for immunisations in Swiss adults. *Vaccine* 2001; **19**: 4760-4767 [PMID: 11535327 DOI: 10.1016/S0264-410X(01)00223-7]

59 **Chan SS**, Leung DY, Leung AY, Lam C, Hung I, Chu D, Chan CK, Johnston J, Liu SH, Liang R, Lam TH, Yuen KY. A nurse-delivered brief health education intervention to improve pneumococcal vaccination rate among older patients with chronic diseases: a cluster randomized controlled trial. *Int J Nurs Stud* 2015; **52**: 317-324 [PMID: 25012957 DOI: 10.1016/j.ijnurstu.2014.06.008]

60 **Pebody RG**, Hippisley-Cox J, Harcourt S, Pringle M, Painter M, Smith G. Uptake of pneumococcal polysaccharide vaccine in at-risk populations in England and Wales 1999-2005. *Epidemiol Infect* 2008; **136**: 360-369 [PMID: 17445314 DOI: 10.1017/S0950268807008436]

61 **Loubet P**, Kernéis S, Groh M, Loulergue P, Blanche P, Verger P, Launay O. Attitude, knowledge and factors associated with influenza and pneumococcal vaccine uptake in a large cohort of patients with secondary immune deficiency. *Vaccine* 2015; **33**: 3703-3708 [PMID: 26073016 DOI: 10.1016/j.vaccine.2015.06.012]

62 **al-Gahtani YM**, el Bushra HE, al-Qarawi SM, al-Zubaidi AA, Fontaine RE. Epidemiological investigation of an outbreak of meningococcal meningitis in Makkah (Mecca), Saudi Arabia, 1992. *Epidemiol Infect* 1995; **115**: 399-409 [PMID: 8557071]

63 **Trevena L**. There's an App for That: A Guide for Healthcare Practitioners and Researchers on Smartphone Technology. *Online J Public Health Inform* 2015; **7**: e218 [PMID: 26392848 DOI: 10.5210/ojphi.v7i2.5522]

64 **Abu-Gharbieh E**, Fahmy S, Rasool BA, Khan S. Influenza vaccination: healthcare workers attitude in three Middle East countries. *Int J Med Sci* 2010; **7**: 319-325 [PMID: 20922053]

65 **AlQuliti KW**, Tajaddin WA, Habeeb HA, As-Saedi ES,Sheerah SA, Al-Ayoubi RM, Bukhary ZA. Meningococcal immunization among emergency room health care workers in Almadinah Almunawwarah, Saudi Arabia. *Journal of Taibah University Medical Sciences* 2015; **10**: 175-80 [DOI: 10.1016/j.jtumed.2015.01.013]

66 **Alhammadi A**, Abdlrahman H, Khalifa M, Almuslemani E, Alhothi A, Janahi M. PO-0174 Attitudes Of Paediatric Health Care Workers Towards Influenza Vaccination In Qatar. *Arch Dis Child* 2014; **99**: A1–A620 [DOI: 10.1136/archdischild-2014-307384.837]

67 **Gatrad AR**, Shafi S, Memish ZA, Sheikh A. Hajj and the risk of influenza. *BMJ* 2006; **333**: 1182-1183 [PMID: 17158361 DOI: 10.1136/bmj.39052.628958.BE]

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|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 *et al*[39] | 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 *et al*[38] | 2007 | Saudi Arabia | HCWs at Saudi Aramco Medical Services Organization | 244 | NR | Influenza | 51 (124/244) in the preceding year and 71.5 (175/344) in the last 5 years |
| Shahbic *et al*[18] | 2007 | Qatar | HCWs at Hamad Medical  Corporation in Doha | 14292 | NR | Influenza | 19.4 (2773/14292) |
| Rehmani *et al*[20] | 2009 | Saudi Arabia | HCWs at King Abdul-Aziz National Guard Hospital | 512 | Mean 35.8 (22 - 64) | Influenza | 34.4 (176/512) |
| Abu-Gharbieh *et al*[64] | 2009 | United Arab Emirates, Kuwait and Oman | HCWs at hospitals, polyclinics and medical centres | 993 | (25 - 45) | Influenza | 42.5 (442/993) |
| Al-Khashan *et al*[35] | 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 *et al*[65] | 2012 | Saudi Arabia | Emergency room HCWs at 3 hospitals in Al-Madinah | 321 | NR | Meningococcal | 84.7 (272/321) |
| Garcell *et al*[37] | 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 *et al*[21] | 2012 - 2013 | Saudi Arabia | HCWs at 6 major hospitals | 242 | NR | Influenza | 38.8 (94/242) |
| Alhammadi *et al*[66] | 2012 - 2013 | Qatar | HCWs at a tertiary teaching institution in Doha | 223 | NR | Influenza | 68.3 (152/223) |
| Alhammadi *et al*[22] | 2013 | Qatar | HCWs at a paediatric unit at Hamad Medical Corporation in Doha | 230 | NR | Influenza | 67.7 (151/230) |
| Fakhrawi *et al*[67] | 2015 | Bahrain | Sickle cell patients attending primary health care centres | 230 | NR | Pneumococcal | 62.2 (143/230) |

HCW: Health care workers; NR: Not recorded.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 2 Demographic characteristics of surveyed participants, and their vaccination uptake | | | | | |
|  | **N (%)** | **Influenza vaccine *n* (%)** | **Pneumococcal vaccine** ***n* (%)** | **Pertussis vaccine** ***n* (%)** | **Meningococcal vaccine *n* (%)** |
| Overall | | 300 (17) | 397 (22) | 296 (16) | 363 (20) |
| Age | | | | | |
| 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 yr | 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 statues | | | | | |
| 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) |
| Yes1 | 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) |

1One or more chronic conditions’. KSA: Kingdom of Saudi Arabia; UAE: United Arab Emirates.

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

|  |  |
| --- | --- |
| Motivators’ *n* (%)1 | Barriers’ *n* (%)1 |
| Doctor’s advice 68 (23)  Perception of low body immunity 62 (21)  Believing the vaccine to be effective in preventing influenza 61 (20)  As a workplace requirement 40 (13) | Unawareness about the vaccine 573 (38)  Relying on body immunity (healthy lifestyle) 500 (33)  Perception of having good immunity 299 (20)  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) |

1Some participants cited more than one reason.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 4 Significant predictors associated with vaccines uptake | | | |
| Predictors | **Adjusted odds ratio** | **95%CI** | ***P* 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 | 20.40 | 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.