



# Seasonal Influenza Vaccination Coverage among Egyptian Healthcare Workers in Fayoum University Hospitals: Influencing Attitude, Barriers, and Relation with COVID-19

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## ABSTRACT

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Attitude, Barriers, COVID-19, Healthcare Workers, Influenza Vaccine

**Background:** As the COVID-19 situation remains dynamic, there is a possibility of influenza and COVID-19 co-circulation. The World Health Organization has reevaluated the prioritization of influenza risk groups, including healthcare workers (HCWs). **Objective:** To assess the coverage of influenza vaccination among HCWs over four consecutive flu seasons and to examine the barriers, motivators, and attitudes toward influenza vaccination among HCWs during the 2022-2023 flu season. **Methods:** A cross-sectional study was carried out using a pre-prepared, self-administered questionnaire. The study surveyed 304 HCWs at Fayoum university Hospitals. **Results:** The rate of influenza vaccine uptake increased from 16.9% during 2019-2020 flu season to 40.8% in the last season. The attitude score was greater for those who received a flu vaccination last season than for those who did not ( $39.93 \pm 4.89$  vs.  $37.77 \pm 5.50$ ,  $p=0.001$ ). SARS-CoV2 infection during the pandemic was significantly associated with vaccine uptake during the last flu season (2022-2023). Most respondents indicated that the flu vaccine would protect them or their family (93.5%). While the main perceived barrier was that the flu vaccine was not mandatory (55.0%). Multiple logistic regression analysis recognized that having COVID-19 during the pandemic (AOR = 1.92, 95% CI: 1.07-3.47), and individuals who received the flu vaccine in 2021-2022 flu season (AOR = 6.53, 95% CI: 3.28 -12.98) to be significant predictors for the increased vaccine uptake during 2022-2023 flu season. **Conclusions:** Influenza vaccine coverage is suboptimal among HCWs due to inadequacy of knowledge and misperceptions and fears regarding vaccine efficacy and safety.

## INTRODUCTION

Influenza, as reported by the Centers for Disease Control and Prevention (CDC), causes up to 646,000 deaths each year.<sup>1</sup> Additionally, seasonal influenza is a major cause of absenteeism and disruption of health services during the colder months. This period is notoriously marked by increased demand for healthcare, which burdens the health system and decreases the quality of care.<sup>2</sup>

Globally, the influenza vaccination rate remains below the desired level at 33.2%, including among

healthcare workers (HCWs). This persists despite public health initiatives in many countries, health education programs, and recommendations from the World Health Organization (WHO).<sup>3-5</sup>

It is highly recommended by the World Health Organization (WHO).<sup>6</sup> and the Centers for Disease Control and Prevention (CDC).<sup>7</sup> that healthcare workers (HCWs) receive the influenza vaccination. Influenza vaccination provides direct protection to medical staff involved in patient care and

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management<sup>8</sup> by preventing nosocomial outbreaks,<sup>2</sup> and it offers potential indirect benefits, such as reducing the burden of additional respiratory illnesses among both individual patients and healthcare services.<sup>9</sup>

Currently, there are numerous hypotheses about the relationship between influenza vaccination and Coronavirus Disease 2019 (COVID-19). Influenza vaccination is particularly crucial given that both influenza and COVID-19 are contagious respiratory viral infections with short incubation periods, spread mainly by droplets, and may be clinically indistinguishable. Moreover, the consequences of co-infection are still unclear, and new strains of these viruses may emerge.<sup>10</sup> These infections are particularly life-threatening for high-risk populations, such as the elderly, individuals with chronic diseases, and those who are immunocompromised, potentially leading to severe morbidity and mortality.<sup>11</sup>

Influenza vaccination may be an effective measure for directly protecting against COVID-19 by reducing the severity and complications of respiratory illness in COVID-19 patients. It also lowers the risk of hospitalization, particularly in intensive care units.<sup>9</sup> Huang et al. observed that influenza vaccination might offer marginal protection against COVID-19 infection.<sup>12</sup> Additionally, a comprehensive systematic review and meta-analysis demonstrated that receiving the influenza vaccine is associated with a reduced risk of contracting COVID-19.<sup>13</sup> Furthermore, having had a COVID-19 infection during the outbreak was linked to a higher attitude score regarding influenza vaccination. This finding is consistent with a study by Scardina et al., which indicated that the pandemic context heightened the perceived importance of influenza vaccination among individuals.<sup>14</sup>

Hence, the present research aims to evaluate influenza vaccination coverage among Healthcare Workers (HCWs) at Fayoum University Hospital over four consecutive flu seasons, with a particular focus on the determinants during the most recent flu season (2022-2023). Additionally, this study seeks to gauge HCWs' attitudes towards influenza vaccination in the 2022-2023 flu season and explore its relationship with their actual vaccine uptake. Furthermore, our investigation aims to analyze how COVID-19 infection and vaccination may have influenced HCWs' attitudes and uptake of the influenza vaccine during the 2022-2023 flu season.

Lastly, we seek to elucidate the perceived facilitators and barriers to influenza vaccination reported by HCWs during the same flu season (2022-2023).

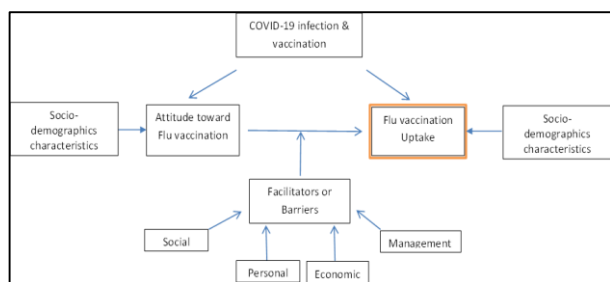
## METHODS

A cross-sectional study was conducted between March and May 2023. Participants in this study were HCWs employed at Fayoum University Hospitals. Fayoum University Hospitals consist of three teaching hospitals: Surgical, Internal Medicine, and Pediatrics. The staff includes 484 physicians, 1,586 nurses, 182 administrators, 32 workers, and 60 security employees. Using Epi Info 7, the sample size for this study was estimated. A minimal sample size of 289 was calculated based on a 50% expected proportion for flu vaccine uptake, a 95% confidence interval, and a 5% precision. Ultimately, 304 participants were selected from the lists of HCWs at the three hospitals using stratified sampling to ensure representation from each HCW subgroup.

**Study questionnaire:** Based on a literature review, a pre-prepared, self-administered Arabic questionnaire was developed.<sup>15, 16</sup> A conceptual framework was created to illustrate the study variables and their relationships (Figure 1). The questionnaire comprised four sections; (1) Socio-Demographic Factors: Age, sex, occupation, education level, income level, COVID-19 infection and vaccination history, and the presence of chronic illness. (2) Flu Vaccine Uptake: Details on the uptake of the flu vaccine. (3) Attitude Toward Flu Vaccination: Attitudes towards influenza vaccination during the 2022-2023 flu season. (4) Motives and Barriers: Motivations for and barriers to influenza vaccination during the 2022-2023 flu season. A pilot sample (n=30) was used to assess the clarity of the survey questions, leading to revisions of the survey form.

**Study variables:** The dependent variable was flu vaccination uptake, while attitude toward influenza vaccination was the independent variable. COVID-19 infection and vaccination, along with socio-demographic characteristics, were considered potential confounders. Barriers and facilitators to vaccination were regarded as mediating factors between attitude toward flu vaccination and vaccine uptake.

**Statistical analysis:** Statistical analysis was performed using IBM Statistical Packages for Social Sciences (SPSS) version 22 (Armonk, NY: IBM Corp.).



**Figure 1: Conceptual framework including the study variables**

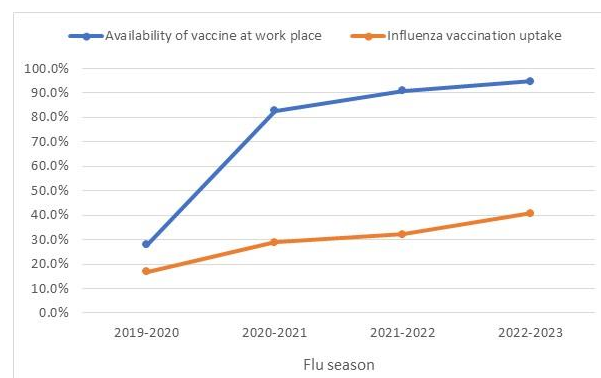
Categorical data were presented as numbers and percentages, with chi-square ( $\chi^2$ ) tests used for univariate analysis. Attitude scores were summarized as means and standard deviations (SD). Comparisons between two groups were conducted using the unpaired t-test, while comparisons among three or more groups were performed using one-way ANOVA. Odds ratios and 95% confidence intervals (CIs) were calculated to estimate the probability of flu vaccine coverage for different factors using multiple logistic regression. Factors significantly associated with flu vaccine uptake in the univariate analysis were included in the regression model. Statistical significance was set at  $P < 0.05$ .

## RESULTS

Among the 304 HCWs included in the study, nearly half (53.6% = 163/304) were female. Their ages ranged from 20 to 59 years, with a mean  $\pm$  SD of  $31.9 \pm 8.8$ . Approximately 54.9% (167/304) of the HCWs resided in urban areas. A significant majority, 63.2% (192/304), held a university degree. Nurses constituted 46.7% (142/304) of the participants. Most HCWs, specifically 90.5% (275/304), were non-smokers. Among the HCWs, 72% (219/304) were married. Additionally, the vast majority, 92.8% (282/304), had no chronic health conditions. Most participants, 58.9% (179/304), had work experience ranging from one to five years, and 72.4% (220/304) reported a monthly income in the range of 2000-5000 L.E (see Table 1 for details).

About one-quarter (27.9% = 79/283) of the HCWs reported that the flu vaccine was available at the workplace during the 2019–2020 flu season. This availability significantly increased after the COVID-19 pandemic, reaching 94.7% (288/304) in the 2022–2023 flu season (see Additional Table 1). However, the proportion of HCWs who actually received the influenza vaccine did not increase as dramatically, rising from 16.9% during the 2019–

2020 flu season to 40.8% in the 2022–2023 season (see Additional Table 1 and Figure 2). The vaccination rates during the COVID-19 pandemic seasons of 2020–2021 and 2021–2022 were 28.9% and 32.2%, respectively (see Additional Table 1).



**Figure 2: Relation between availability of influenza vaccine at work and vaccine uptake by the study participants during the different flu seasons**

Among the vaccinated HCWs, 66.7% (32/48) received the vaccine for free at their workplace in the 2019–2020 flu season. This proportion increased to 99.2% (123/124) in the 2022–2023 flu season (see Additional Table 1).

Influenza vaccine uptake during the last flu season (2022–2023) in relation to socio-demographic characteristics: Our findings revealed that influenza vaccination uptake during the 2022–2023 flu season was significantly higher among urban residents (46.7%,  $p = 0.020$ ), those with a monthly income greater than 5000 L.E (64.3%,  $p < 0.001$ ), studied participants with a postgraduate degree (64.5%,  $p < 0.001$ ), and physicians (59.4%,  $p < 0.001$ ) (see Table 2).

Attitude scores were calculated from 14 attitude questions, with a minimum score of 14 and a maximum score of 70. A higher score indicated a more positive attitude towards vaccination. The average attitude score among HCWs was  $38.65 \pm 5.35$ , with scores ranging from 24 to 54. Attitude scores were significantly higher among unmarried participants ( $p = 0.005$ ), those with a monthly income greater than 5000 L.E ( $p < 0.001$ ), HCWs with university and postgraduate degrees ( $p < 0.001$ ), physicians and nurses ( $p = 0.001$ ), and studied participants with more than five years of experience ( $p = 0.014$ ) (see Additional Table 2).

**Table 1: Sociodemographic characteristics of the study participants (n=304)**

	N	%
<b>Age</b>		
20-29	164	53.9
30-39	79	26.0
40-49	40	13.2
≥50	21	6.9
<b>Sex</b>		
Male	141	46.4
Female	163	53.6
<b>Residence</b>		
Urban	167	54.9
Rural	137	45.1
<b>Education</b>		
Illiterate	14	4.6
Read & write	6	2.0
Primary or preparatory	5	1.6
Secondary	56	18.4
University	192	63.2
Postgraduate	31	10.2
<b>Occupation</b>		
Physicians	69	22.7
Nurse	142	46.7
Administrators	31	10.2
Security employee	39	12.8
Workers	23	7.6
<b>Smoking</b>		
Smokers	29	9.5
Non-smokers	275	90.5
<b>Marital status</b>		
Married	219	72.0
Un married	85	28.0
<b>Having chronic diseases</b>		
Yes	21	6.9
No	282	92.8
<b>Experience duration</b>		
Less than one year	21	6.9
One to five years	179	58.9
More than five years	104	34.2
<b>Monthly income</b>		
1000-2000	70	23.0
2000-5000	220	72.4
>5000	14	4.6

HCWs who received the flu vaccine during the last season had a higher attitude score compared to those who did not receive the vaccine ( $39.93 \pm 4.89$  vs.  $37.77 \pm 5.50$ ,  $p = 0.001$ ).

HCWs who had contracted COVID-19 during the pandemic exhibited a significantly higher attitude score compared to those who remained uninfected ( $39.63 \pm 5.62$  vs.  $37.46 \pm 4.78$ ,  $p < 0.001$ ) (Additional Table 3). Moreover, having had COVID-19 was strongly associated with influenza vaccine uptake

during the 2022-2023 flu season ( $p < 0.001$ ) (Table 3). In contrast, COVID-19 vaccination status did not show a significant association with attitude scores ( $38.58 \pm 5.28$  for vaccinated vs.  $38.58 \pm 5.44$  for non-vaccinated,  $p = 0.823$ ) (Additional Table 3) or influenza vaccine uptake ( $p > 0.050$ ) (Table 3).

Most respondents reported the following as facilitators for receiving the flu vaccine: it would protect them or their family (93.5%), protect their colleagues or patients (88.7%), the vaccine was readily available (86.3%), the flu vaccine was offered at a low price or for free (82.3%), and it would reduce the risk of COVID-19 co-infection (58.9%) (Additional Table 4).

Among those who did not receive the flu vaccine, the main perceived barrier was that it was not mandatory (55.0%). Additionally, 51.7% of healthcare workers (HCWs) expressed concern over potential side effects, 47.8% stated they were not ill at the time of vaccination, 46.7% were too busy at work, 40.6% believed contracting influenza would provide natural immunity, and 40.0% considered influenza infection not severe (Additional Table 4). Multiple logistic regression analysis identified two statistically significant predictors for increased likelihood of flu vaccine uptake during the 2022-2023 season: having contracted COVID-19 during the pandemic (AOR = 1.923, 95% CI: 1.065-3.469,  $p = 0.030$ ) and receiving the flu vaccine during the 2021-2022 season (AOR = 6.528, 95% CI: 3.282-12.984,  $p < 0.001$ ) (Table 4).

## DISCUSSION

The WHO has re-evaluated the prioritization of influenza risk groups due to the ongoing COVID-19 pandemic and the potential for both viruses to circulate simultaneously.<sup>17-19</sup> This dual threat could place additional strain on healthcare systems and at-risk populations. To address this, the CDC and ACIP recommend annual influenza vaccination for all healthcare workers (HCWs) to reduce illness and mortality, along with COVID-19 vaccination for everyone aged six months and older, including HCWs.<sup>20-23</sup>

This study assessed influenza vaccination coverage among HCWs over four flu seasons, including one before and three after the COVID-19 pandemic. It also explored barriers, motivators, and attitudes toward vaccination during the 2022-2023 flu season.

**Table 2: Relation between influenza vaccine uptake during the last flu season (2022-2023) and sociodemographic characteristics of the HCWs**

	Influenza vaccine uptake (flu season 2022-2023)		P-value
	Yes (n=124)	No (n=180)	
Age			
20-29	64 (39.0%)	100 (61%)	0.857
30-39	35 (44.4%)	44 (55.7%)	
40-49	17 (42.5%)	23 (57.5%)	
≥50	8 (38.1%)	13 (61.9%)	
Sex			
Male	53 (37.6%)	88 (62.4%)	0.291
Female	71 (43.6%)	92 (56.4%)	
Residence			
Urban	78 (46.7%)	89 (53.3%)	0.020*
Rural	46 (33.6%)	91 (66.4%)	
Marital			
Married	85 (38.8%)	134 (61.2%)	0.706
Unmarried	31 (36.5%)	54 (63.5%)	
Smoking			
Smokers	9 (31.05)	20 (69.0%)	0.261
Non-smokers	115 (41.8%)	160 (58.2%)	
Experience duration			
Less than one year	8 (38.1%)	13 (61.9%)	0.625
One to five years	35 (45.5%)	42 (54.5%)	
More than five-year	81 (39.3%)	125 (60.7%)	
Income monthly			
1000-2000	13 (18.6%)	57 (81.4%)	<0.001*
2000-5000	102 (46.4%)	118 (53.65)	
>5000	9 (64.3%)	5 (35.7%)	
Education			
Less than secondary education	5 (20%)	20 (80%)	<0.001*
Secondary	10 (17.9%)	46 (82.1%)	
University	89 (46.4%)	103 (53.6%)	
Postgraduate	20 (64.5%)	11 (35.5%)	
Occupation			
Physicians	41 (59.4%)	28 (40.6%)	<0.001*
Nurse	62 (43.7%)	80 (56.3%)	
Administrators	10 (32.3%)	21 (67.7%)	
Security employee & workers	11(17.7%)	51(82.3%)	
Chronic illness			
Yes	9 (42.9%)	12 (57.1%)	0.842
No	115 (40.6%)	168 (59.4%)	

\*Significant at  $p < 0.05$ 

The study included 304 participants, most of whom were young (53.9% aged 20-29), female (53.6%), and nurses (46.7%). Compared to a similar study in Egypt, this study had fewer physicians, whereas the Egyptian study reported nearly half of the

participants as physicians, with most being female and under 40 years old.<sup>24</sup>

In a study conducted in Egypt to assess influenza vaccine hesitancy among HCWs at a Maternal and Child Healthcare Center, the mean age of participants was 34.6 years, with 84.4% being female, 89.6% married, and 53.2% physicians. The mean years of experience among participants was 10.6 years, 18.2% had chronic diseases, and only 2.6% were smokers.<sup>25</sup>

A study in the UK examined knowledge, attitudes, and behavior towards influenza vaccination among HCWs during the COVID-19 pandemic, reporting that 63.1% of participants were female, with an average age of 41.7 years. The median work experience was 16.9 years, and 38.4% were married. Of the participants, 51.1% were doctors and 26.6% were nurses.<sup>26</sup>

Another study in China focused on influenza vaccination coverage among HCWs during the 2020/2021 and 2021/2022 influenza seasons. Clinicians comprised 60.3% of participants, while nurses accounted for 25.8%. Our findings partially align with the study by Ma et al. (2022), as we also observed a similar median age of 37 years and a median duration of 12 years of work experience among the surveyed healthcare workers.<sup>18</sup>

Based on the demographic characteristics of our study and other studies, we concluded that the most common participants in surveys involving HCWs were young individuals with relatively short experience, predominantly female, and often married. In several previous studies, the response rate of doctors was higher than that of nurses, which contrasts with our findings.<sup>18,24-26</sup>

In the present study, the proportion of studied participants receiving the influenza vaccine increased steadily over the years. The uptake rate was 16.9% in the 2019-2020 season and rose during the COVID-19 pandemic to 28.9% in 2020-2021, 32.2% in 2021-2022, and 40.8% in 2022-2023. Previous studies examining influenza vaccination adherence among Egyptian HCWs found an adherence rate of 30.7% during the 2019 season.<sup>24]</sup>, and 36.4% during the 2021 season.<sup>25</sup> Another Egyptian study reported a lower uptake rate of just 13% among HCWs.<sup>15</sup>

The influenza vaccine uptake observed in our study was similar to rates reported in Eastern Mediterranean regions, where uptake was estimated at 28.2%.<sup>27</sup> However, our uptake rates were lower

than those reported in China, where 43.7% of HCWs received the influenza vaccine during the 2020/2021 season and 35.4% during the 2021/2022 season.<sup>18</sup> In contrast, a survey conducted by the CDC found that 79.9% of healthcare personnel (HCP) in the US

received the influenza vaccine during the 2021-2022 season, and 75.9% during the 2020-2021 season.<sup>21</sup> These much higher rates compared to our findings could be due to factors such as the availability of free

**Table 3: Relation of COVID-19 disease and vaccination with influenza vaccine uptake during the flu seasons 2020-2021, 2021-2022 and 2022-2023**

			Having COVID-19 disease (during the pandemic time)		P-value	Receiving COVID-19 vaccination		P-value
			Yes	No		Yes (n=145)	No (n=159)	
			(n=167)	(n=137)				
<b>Influenza vaccine uptake during Flu seasons</b>	2020-2021**	Yes	49 (30.8%)	33 (26.6%)	0.439	-----	-----	-----
		No	110 (69.2%)	91 (73.4%)		-----	-----	-----
	2021-2022**	Yes	53 (34.2%)	38 (29.7%)	0.419	45 (34.4%)	46 (30.3%)	0.463
		No	102 (65.8%)	90 (70.3%)		86 (65.6%)	106 (69.7%)	
	2022-2023	Yes	83 (49.7%)	41 (29.9%)	<0.001*	57 (39.3%)	67 (42.1%)	0.689
		No	84 (50.3%)	96 (70.1%)		88 (60.7%)	92 (57.9%)	

\*Significant at  $p < 0.05$  \*\* Twenty-one participants were excluded from total (experience was less than one year)

vaccines, insufficient information about the influenza vaccine, and a lower perception of the severity of influenza and the benefits of vaccination in our region.<sup>27</sup>

In our study, we observed a steady increase in influenza vaccination rates from 2019-2020 to 2022-2023. This contrasts with the decline in vaccine coverage among HCWs in China during the 2021/2022 influenza season compared to the previous season.<sup>18</sup> The decline in China may be attributed to the COVID-19 vaccination campaign, which began in 2020/2021, as routine immunization resources were redirected to COVID-19, making it more difficult to administer the influenza vaccine. Additionally, co-administration of the two vaccines is not permitted in China.<sup>18</sup> However, Schumacher and colleagues reported a positive impact of the COVID-19 pandemic on vaccination decisions, with a significant increase in overall vaccination coverage among HCWs.<sup>28</sup>

In our study, when analyzing influenza vaccine uptake in 2022-2023 across different socio-demographic characteristics, we found a significant positive association between vaccine uptake and HCWs with higher levels of education. Similarly, the CDC reported that during the 2021-2022 influenza season, HCWs with a master's, professional, or doctoral degree, as well as those with an associate or bachelor's degree, had higher vaccination coverage compared to those with some college education or less.<sup>21</sup> Higher education levels were identified as a

critical factor in getting vaccinated, consistent with our findings and those of Albanesi and colleagues.<sup>30</sup> In contrast, we did not find any relationship between influenza vaccine uptake and age in our study. However, a study conducted in Italy during the 2020-2021 season showed that younger healthcare workers had higher rates of influenza vaccination.<sup>30</sup> Additionally, we observed that a higher percentage of physicians were vaccinated compared to nurses, administrators, and housekeepers. This aligns with the CDC's findings, where influenza vaccination coverage was lower among nurses, physician assistants, other clinical personnel, non-clinical healthcare workers, assistants, and aides compared to physicians.<sup>21</sup> Resident physicians were found to have the highest vaccination rates in the study by Albanesi et al. (2022).<sup>30</sup>

In a study from Italy that investigated influenza vaccine uptake among healthcare and non-healthcare workers during the 2019/2020 and 2020/2021 seasons, overall uptake increased from 14.8% in 2019/2020 to 31.7% in 2020/2021. The study also found that male workers had higher vaccination rates than their female counterparts in both seasons.<sup>30</sup> In contrast, our study did not reveal any significant difference in influenza vaccine uptake between male and female HCWs.

There was an approximate 10 percentage point increase in the prevalence rate of influenza vaccination during the 2021-2022 season compared to the 2020-2021 season. Despite this increase, influenza vaccination requirements remained lower

than those for COVID-19 vaccination in most work settings.<sup>21</sup> In our study, a significant association was found between COVID-19 infection and influenza vaccine uptake during the 2022-2023 influenza season. This finding contrasts with a prospective cohort study of Spanish healthcare workers, which found that influenza vaccination did not significantly reduce the risk of COVID-19 infection.<sup>31</sup> Some studies have even suggested that receiving the

influenza vaccine might increase the risk of COVID-19 infection.

Nevertheless, a comprehensive analysis of studies investigating the relationship between seasonal influenza vaccination and the risk of COVID-19 infection found no significant increase in the risk of infection, severe illness, or death. In fact, some studies indicated inverse associations.<sup>32</sup> On the

**Table 4: Logistic regression model including factors associated with Flu vaccination in the last flu season (2022-2023)**

	Adjusted Odds Ratio (aOR)	95% CI for aOR	P-value
<b>Residence</b>			
Rural	R		
Urban	1.414	0.797 2.509	0.237
<b>Income</b>			
1000-2000	R		
2000-5000	2.689	0.714 10.126	0.144
>5000	2.786	0.429 18.082	0.283
<b>Education</b>			
Less than secondary education	R		
Secondary	0.578	0.140 2.381	0.447
University	2.580	0.548 12.155	0.231
Postgraduate	2.413	0.381 15.27	0.349
<b>Occupation</b>			
Security employer & workers	R		
Physicians	1.570	0.268 9.174	0.617
Nurse	1.453	0.281 7.519	0.656
Administrators	2.545	0.421 15.385	0.309
<b>Attitude score</b>	1.032	0.977 1.091	0.257
<b>Having COVID-19 during the pandemic</b>			
No	R		
Yes	1.923	1.065 3.469	<b>0.030*</b>
<b>Influenza vaccination during flu season 2021-2022</b>			
No	R		
Yes	<b>6.528</b>	<b>3.282 12.984</b>	<b>&lt;0.001*</b>
<b>Influenza vaccination during flu season 2020-2021</b>			
No	R		
Yes	1.432	0.716 2.861	0.31
<b>Influenza vaccination during flu season 2019-2020</b>			
No	R		
Yes	1.174	0.517 2.665	0.701

\*Significant at  $p < 0.05$ ; CI: confidence interval; r: reference category

contrary, the seasonal influenza vaccine appears to offer protective benefits against COVID-19 infection but does not reduce the severity of the disease.<sup>33</sup> Conlon et al. identified a probable link between influenza vaccination and a lower incidence of COVID-19 infection among American participants.<sup>34</sup> Additionally, Italian researchers found that receiving

the influenza vaccine was associated with a reduced risk of contracting COVID-19 infection.<sup>35</sup>

Likewise, a study conducted in Turkey by Erismis et al. indicated that influenza vaccination might confer a modest level of protection against susceptibility to COVID-19 infection.<sup>36</sup> Similarly, Noale et al. investigated the relationship between influenza and pneumococcal vaccines and COVID-19 infection and

found that both anti-pneumococcal and, to a lesser degree, influenza vaccinations were associated with a decreased risk of COVID-19 infection.<sup>37</sup> Huang et al. also observed that influenza vaccination might provide marginal protection against COVID-19 infection.<sup>12</sup> Furthermore, a comprehensive systematic review and meta-analysis demonstrated that receiving the influenza vaccine was linked to a reduced risk of contracting COVID-19 infection.<sup>13</sup>

At Fayoum University Hospitals, as part of infection and prevention control policies, the influenza vaccine is available for all HCWs free of charge, though it is not mandatory. In our study, non-vaccinated HCWs reported several barriers to influenza vaccination, with the most significant being the non-mandatory nature of the vaccine, concerns about vaccine side effects, limited time for vaccination, never having been ill during the vaccination schedule, and the belief that the vaccine is not protective against the flu. A previous study conducted in Egypt found similar reasons for HCWs not getting vaccinated, including perceptions of vaccine ineffectiveness, concerns about complications and adverse events, and vaccine expenses.<sup>24</sup> Another study from Saudi Arabia also reported similar barriers, such as perceived lack of vaccine effectiveness, feeling healthy, and concerns about vaccine side effects,<sup>38</sup> which aligns with our findings. This is consistent with a study by Alshammari et al., where vaccine safety concerns were identified as the main barrier.<sup>39</sup>

However, unlike our study, many other studies have indicated that the unavailability of the vaccine is a major factor contributing to low vaccination coverage.<sup>40-42</sup> For instance, in a study conducted in China, HCWs who were not vaccinated during the 2021/2022 influenza season cited being too busy at work as a primary reason, which is similar to one of the barriers reported in our study. Other reasons included the perception that influenza infection was not severe, reluctance to pay for vaccination, inconvenient vaccination locations, and fear of adverse reactions.<sup>18</sup>

In our study, the most important reasons for receiving the influenza vaccine were related to safety and personal factors, such as protecting oneself, family members, colleagues, and patients, as well as being aware of the risk of infection at work and other occupational exposures. These findings are consistent with previous studies from Egypt<sup>15,24,25</sup>

Oman,<sup>43</sup> Italy,<sup>44</sup> and a systematic review reporting similar motivations globally.<sup>45</sup>

Furthermore, in our study, HCWs who received the influenza vaccine had higher attitude scores compared to non-vaccinated HCWs. This is consistent with previous reports indicating that prior influenza vaccination among HCWs is associated with a more positive attitude towards the vaccine.<sup>14,46,47</sup> Additionally, having had a COVID-19 infection during the outbreak was associated with a higher attitude score, aligning with Scardina et al.'s study, which found that the pandemic context increased the perceived importance of influenza vaccination.<sup>14</sup> This suggests that the pandemic may have heightened HCWs' perception of the importance of influenza vaccination, likely due to the risk of co-circulation of influenza and COVID-19 during the flu season, as discussed in the literature.<sup>48</sup> The logistic regression model analyzing factors associated with influenza vaccination in the 2022-2023 season revealed that having COVID-19 during the pandemic was associated with increased uptake of the influenza vaccine. Experiencing COVID-19 may have encouraged influenza vaccine uptake by raising awareness of respiratory viruses, increasing the desire to avoid co-infection, highlighting the similarity in symptoms, fostering greater trust in vaccination, enhancing public health messaging, and a sense of societal responsibility. These factors combined can lead individuals who have experienced COVID-19 to be more proactive in protecting themselves and others by getting vaccinated against influenza.

Another factor associated with improved uptake of influenza vaccination was receiving the influenza vaccine during the previous flu season (2021-2022). Individuals who received the vaccine in one season and subsequently experienced a milder or flu-free season with fewer flu-related illnesses are more likely to attribute their good health to the vaccine. This positive personal experience can increase confidence in the vaccine and motivate individuals to continue getting vaccinated in the future, serving as a real-world example of the vaccine's effectiveness.

However, there are limitations to consider in this study. Influenza vaccination status relied on self-reporting by respondents, which may be influenced by social desirability bias and recall bias. Additionally, the sample size was insufficient in some subgroups, resulting in coverage estimates



that did not meet the criteria for reporting proportions.<sup>21</sup>

Several factors, such as healthcare infrastructure c health programs, shape the accessibility and public coverage of the influenza vaccine. The Egyptian Ministry of Health offers seasonal influenza vaccines at no cost, prioritizing risk groups. These healthcare workers and high vaccines are distributed via are directorates health and various medical facilities nationwide to ensure they reach the people who need them the most. At Fayoum University hospitals, the influenza vaccine is administered to staff every October.<sup>15</sup>

## CONCLUSIONS

Influenza vaccine coverage is suboptimal among HCWs in Egypt. Low vaccination rates are due to various factors, including inadequate knowledge, misperceptions, and fears regarding vaccine efficacy and safety. These findings should inform and improve future promotion campaigns to address the identified barriers. Participants in this study generally had positive attitudes towards the influenza vaccine, providing an opportunity to enhance vaccine coverage through tailored health education campaigns and organizational strategies. Implementing a combination of these strategies can help overcome the barriers that limit vaccination compliance.

Based on the previous study findings, we recommend tailored health education campaigns that address specific misconceptions and concerns about the influenza vaccine, increase vaccine accessibility, provision of evidence-based information to counteract the belief that the vaccine is ineffective or unnecessary, provision of incentives to encourage HCWs to get vaccinated, use of strategies to overcome vaccine hesitancy, including positive personal experiences, engaging trusted leaders and influencers within the healthcare setting to advocate for vaccination, and involvement of HCWs in the development and implementation of vaccination programs to ensure that their perspectives and needs are considered. By addressing these recommendations, healthcare organizations can work towards improving influenza vaccination coverage among HCWs and enhancing overall public health.

## Ethical Approval

The Research Ethics Committee, Faculty of Medicine, Fayoum University, Egypt, has approved

the study protocol (session 101; Code: R379). A written informed consent was obtained from all participants. Sufficient measures have been implemented to ensure the confidentiality of data throughout the entire process of data collection, storage, analysis, and sharing. All study procedures were following the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its amendments.

**Conflict of interest:** All authors report no conflict of interest relevant to this article.

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**Author contribution:** MM: Developed the concept of the study and shared in statistical analysis, WYA: contributed to statistical data analysis. EMH: The corresponding author to the journal. AE: Data collection. All authors contributed in design the study questionnaire, writing the draft of the manuscript, critical revision of the manuscript, and approved its final version.

**Availability of data and materials:** The datasets utilized and/or examined in the present study can be obtained from the corresponding author upon a reasonable request.

**Abbreviations:** CDC = Centers for Disease and Prevention, HCWs = Healthcare workers, WHO = World health organization, COVID-19 = Coronavirus disease 2019, ACIP = The Advisory Committee on Immunization Practices

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