

Perceptions and Concerns Regarding COVID-19 Vaccination in a Military Base Population

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ABSTRACT

Introduction:

Safe and effective vaccines against severe acute respiratory syndrome-associated coronavirus 2 are essential tools in the fight against the coronavirus disease 2019 (COVID-19) pandemic. However, hesitancy to vaccination is a major barrier to achieving herd immunity, particularly among a population working on a military base. To better understand the perceptions and concerns of these individuals, a voluntary survey was conducted.

Materials and Methods:

An interactive, online survey was constructed and disseminated to individuals associated with Wright-Patterson Air Force Base (WPAFB) in Dayton, OH. Survey participation was voluntary with responses collected over the initial weeks in which WPAFB began to distribute COVID-19 vaccines in a series of phases. Although initially designed to collect demographic data and identify reasons for potential vaccine hesitancy among WPAFB 88th Medical Group personnel, the study population was expanded to include all WPAFB-affiliated personnel at the direction of base leadership. The chi-squared test was used to examine the relationships between categorical variables, while multivariable logistic regression was used to assess age and occupation as independent risk factors for vaccine hesitancy.

Results:

A total of 816 individuals completed the survey, of whom 22.7% ($n = 185$) self-identified as vaccine hesitant (VH). The VH group had a lower mean age than the not vaccine hesitant (NVH) group (39.3 ± 14.2 vs. 45.9 ± 13.4 , $P < .001$). Respondents whose occupation was medical were more likely to be VH than their non-medical colleagues (49% vs. 18%, $P < .001$). The VH group was more concerned about short-term side effects (43% vs. 26%, $P < .001$), long-term side effects (82% vs. 50%, $P < 0.001$), vaccine effectiveness (23% vs. 5%, $P < .001$), vaccine making them feel sick (22% vs. 13%, $P = .002$), being infected with COVID-19 from the vaccine (10% vs. 5%, $P = 0.008$), and worry about misinformation/political agenda (43% vs. 31%, $P = 0.003$). Younger respondents and medical personnel were more likely to be concerned about long-term side effects and vaccine effectiveness, and the younger group was also more likely to be concerned about pregnancy/breastfeeding issues and worry about misinformation/political agenda. Age (younger vs. older, odds ratio 2.15) and occupation (medical vs. non-medical, odds ratio 3.74) were independent risk factors for vaccine hesitancy. The NVH group was more likely to recommend the COVID-19 vaccine to a friend or family member than the VH group (93% vs. 20%, $P < .001$) as were the older age group (79% vs. 67%, $P = .001$) and non-medical personnel (81% vs. 52%, $P < .001$).

Conclusions:

Younger age and medical occupation were independent risk factors for vaccine hesitancy and these individuals were less likely to recommend vaccination to a friend or family member. We also identified several key concerns related to vaccination hesitancy, in particular those related to short- and long-term side effects, and the spread of misinformation. Among military personnel, these findings carry important implications that may negatively impact mission readiness, a matter that merits further investigation. Our COVID-19 vaccination hesitancy findings can be used to guide targeted interventions at future vaccination campaigns in a military population.

INTRODUCTION

The discovery of coronavirus disease 2019 (COVID-19) and its subsequent pandemic has led to significant morbidity and mortality over the past years. At the time of this publication, there have been over 126 million documented cases of COVID-19 worldwide, and more than 2.7 million deaths.¹ The USA alone accounts for over 30 million COVID-19 cases (24%) and more than 548,000 deaths (20%).¹ In December 2020, the FDA issued Emergency Use Authorization for two vaccinations against COVID-19. Given an initial limited

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supply, the CDC established a phased prioritization system to optimize effective use of these vaccines.^{2,3} As vaccinations were introduced to medical personnel at Wright-Patterson Air Force Base (WPAFB) in Dayton, OH, initial informal surveys of the medical group found a surprisingly high prevalence of hesitancy to vaccination, despite this cohort being composed of predominantly frontline medical professionals who were involved in the direct care of patients infected with COVID-19. When the same survey was expanded to include non-medical personnel, retirees, and civilian contractors at WPAFB, the survey yielded similar results.

The authors note these findings to be of particular importance among active duty military personnel, where refusal to vaccinate is likely to impact the ability of active duty military personnel to perform their duties and may negatively impact overall mission readiness. Furthermore, hesitancy to vaccination increases the overall risk of infection, which in turn sharply increases the odds that an individual may spread the virus to other members of his or her community who are not yet vaccinated or otherwise unable to receive the vaccine.⁴

Public skepticism toward vaccination has been an ongoing area of medical research for many decades, dating back to the first recorded attempt at vaccination.⁵ Before the COVID-19 pandemic, there was hesitancy to other vaccines, including polio,⁶ measles, mumps and rubella (MMR),⁷ and influenza.⁸ In some cases, vaccine hesitancy was directly linked to actions of the medical establishment. For example, public concern for the poliovirus vaccination increased dramatically after the Cutter Incident of 1955, in which multiple children developed paralysis after being unintentionally administered a vaccine that contained live virus because of a laboratory processing error and contamination of cell debris which resulted in inadequate inactivation of the virus.⁶ Years later, public trust in the safety of vaccination was again damaged when a 1998 publication erroneously suggested a link between MMR vaccination and the development of childhood autism.⁹ Although the article has since been retracted, vaccine hesitancy remains a growing concern in part because of these historical events.

The public health crisis of the pandemic has prioritized a need for preventive care, but perhaps more importantly the pandemic has highlighted a need for increased focus on understanding an emergency-use protocol, addressing attitudes toward vaccination, and increasing trust in medicine in an increasingly digital world. To better understand the implications associated with vaccine hesitancy among military base personnel, our survey was designed to gather information about current perceptions and concerns regarding COVID-19 vaccines. The objective of this study was to enhance efforts to educate and inform base personnel about vaccination for COVID-19. We hope to use our survey results to highlight areas of particular concern, generate constructive dialogues regarding vaccine hesitancy, and provide direction for future research on vaccination hesitancy.

METHODS

Survey Content

A locally developed questionnaire was administered between November 2020 and January 2021 using the SurveyMonkey.com proprietary software system. Respondents gave their age and occupation and then answered if they would accept a COVID-19 vaccine if offered. Next respondents replied to a list of concerns related to vaccination: short- and long-term side effects, misinformation on the vaccines, efficacy of the vaccine, pain associated with the administration of the vaccine, whether vaccination would make the individual feel sick or become infected with the virus, and pregnancy or breastfeeding issues. Respondents indicated as many concerns as applicable or none at all. Finally, respondents were asked if they would recommend the vaccine to a friend or family member.

The survey was accessed via HTML link or QR code, which was available immediately before the seminars that informed participants of COVID-19 vaccination and distribution plans at WPAFB. Surveys were completed in person or virtually. Participation was voluntary and anonymous.

Target Cohort

The questionnaire was initially made available only to health-care personnel affiliated with Wright Patterson Medical Center at WPAFB. However, at the request of base leadership, the survey was subsequently expanded to include any individual affiliated with WPAFB who attended the seminar (either in person or virtually). Participants were notified of the survey via email, social media, flyers on base, and through word of mouth. The study had no inclusion or exclusion criteria. Approximately 8,000 individuals had the opportunity to complete the survey. No completed or partially completed questionnaire was excluded from data analysis.

Statistical Analysis

Data were collected, compiled, and downloaded from SurveyMonkey (www.surveymonkey.com). Analyses were conducted using IBM SPSS Statistics 25.0 (IBM, Armonk, NY). Means and SDs are reported for age, while counts and percentages are reported for categorical variables. The independent samples Mann-Whitney test was used for the comparison on age. Mann-Whitney test was used rather than the *t*-test since age did not follow the normal distribution. The chi-squared test was used to examine relationships between two categorical variables. Multivariable logistic regression was used to assess age and occupation as independent risk factors for vaccine hesitancy. Inferences were made at the 0.05 level of significance with no corrections for multiple comparisons.

RESULTS

Table I shows that 816 individuals completed the survey. The vaccine hesitant (VH) group had a lower mean age than the not vaccine hesitant (NVH) group (39.3 ± 14.2 vs. 45.9 ± 13.4 ,

TABLE I. Comparison of Respondents Who Are Vaccine Hesitant and Those Not Vaccine Hesitant on Age and Occupation

	Vaccine hesitant <i>n</i> = 185	Not vaccine hesitant <i>n</i> = 631	<i>P</i>
Age ^a years: mean ± SD	39.3 ± 14.2	45.9 ± 13.4	<.001 ^c
Age group <i>n</i> (%)			<.001 ^d
30 years or younger	70 (38)	113 (62)	
31 years or older	115 (18)	515 (82)	
Occupation ^b <i>n</i> (%)			<.001 ^d
Medical	59 (49)	61 (51)	
Non-medical	124 (18)	570 (82)	

Sample sizes: ^aVaccine hesitant, *n* = 185. Vaccine not hesitant, *n* = 628.

^bVaccine hesitant, *n* = 184.

^cMann-Whitney test.

^dChi-squared test.

P < .001). Similarly, when age was categorized as younger (30 years or younger) or older (31 years or older), younger respondents were more likely to be VH (38% vs. 18%, *P* < .001). Respondents whose occupation was medical were more likely to be VH than their non-medical colleagues (49% vs. 18%, *P* < .001).

Table II compares the VH and NVH groups on concerns related to vaccination. The VH group was more concerned about short-term side effects (43% vs. 26%, *P* < .001), long-term side effects (82% vs. 50%, *P* < .001), vaccine effectiveness (23% vs. 5%, *P* < .001), vaccine making them feel sick (22% vs. 13%, *P* = .002), being infected with COVID-19 from the vaccine (10% vs. 5%, *P* = .008), and worry about misinformation/political agenda (43% vs. 31%, *P* = .003). The VH group was more likely to have concerns not specified in the questionnaire (33% vs. 11%, *P* < .001), while the NVH group was more likely to have no concerns (31% vs. 4%, *P* < .001).

Table III compares younger respondents (30 years or less) to older respondents (31 years or more). The younger group was more concerned about long-term side effects (66% vs. 55%, *P* = .014), vaccine effectiveness (15% vs. 8%, *P* = .003), pregnancy and breastfeeding issues (4% vs. 1%, *P* = .005), and worry about misinformation/political agenda (40% vs. 32%, *P* = .029).

Table III also compares medical respondents to non-medical respondents. The 120 medical personnel included eight physicians, two nurse practitioners or advanced practice nurses, 16 nurses, 42 medical technicians, and 52 other medical personnel. The medical group was more concerned about long-term side effects (66% vs. 56%, *P* = .049) and vaccine effectiveness (14% vs. 8%, *P* = .036).

When entered into the multivariable logistic regression equation to predict vaccine hesitancy, both age (younger vs. older) and occupation (medical vs. non-medical) were independent risk factors for vaccine hesitancy (age: odds ratio = 2.15 with 95% CI = 1.47 to 3.15; occupation: odds

TABLE II. Comparison of Respondents Who Are Vaccine Hesitant and Those Not Vaccine Hesitant on Vaccination Concerns

Concern <i>n</i> (%)	Vaccine hesitant <i>n</i> = 185	Not vaccine hesitant <i>n</i> = 631	<i>P</i> ^a
Short-term side effects	80 (43)	162 (26)	<.001
Long-term side effects	152 (82)	318 (50)	<.001
Vaccine not effective	43 (23)	32 (5)	<.001
Vaccine will make me feel sick	41 (22)	81 (13)	.002
Infection with COVID-19 from the vaccine	18 (10)	29 (5)	.008
Afraid the vaccine will hurt	5 (3)	7 (1)	.22
Pregnancy or breastfeeding issues	3 (2)	11 (2)	1.00
Worry about misinformation/political agenda	79 (43)	195 (31)	.003
Other concerns	61 (33)	72 (11)	<.001
No concerns	8 (4)	198 (31)	<.001

^aChi-squared test.

ratio = 3.74 with 95% CI = 2.46 to 5.69). Consequently, being younger and being medical personnel were independent risk factors for vaccine hesitancy.

Finally, **Table IV** shows that the NVH group was more likely to recommend the COVID-19 vaccine to a friend or family member than the VH group (93% vs. 20%, *P* < .001) as were the older age group (79% vs. 67%, *P* = .001) and non-medical personnel (81% vs. 52%, *P* < .001).

DISCUSSION

In a setting where COVID-19 vaccination is not mandatory, we found that the majority of individuals working at a military would accept the COVID-19 vaccination if offered; however, nearly one-quarter of our respondents would not. Vaccine hesitancy among all of our respondents and among individuals aged 30 years or younger was comparable to studies with civilian populations.¹⁰ In our study, 30 years of age or younger was chosen as the cutoff for the younger age group upon review of data obtained from the DoD 2019 Demographics Profile of the Military Community, which reported the average age of current active duty U.S. Air Force (USAF) enlisted personnel to be ~27.7 years of age; the total average age of current USAF personnel as of 2019, including both officers and enlisted personnel, was reported as 28.9 years of age.

TABLE III. Comparison on Vaccination Concerns by Age and Occupation

Concern <i>n</i> (%)	30 years or younger <i>n</i> = 183	31 years or older <i>n</i> = 630	<i>P</i> ^a	Medical occupation <i>n</i> = 120	Non-medical occupation <i>n</i> = 694	<i>P</i> ^a
Short-term side effects	51 (28)	190 (30)	.55	33 (28)	209 (30)	.56
Long-term side effects	120 (66)	349 (55)	.014	79 (66)	390 (56)	.049
Vaccine not effective	27 (15)	48 (8)	.003	17 (14)	57 (8)	.036
Vaccine make me feel sick	27 (15)	95 (15)	.91	23 (19)	99 (14)	.17
Infection with COVID-19 from the vaccine	14 (8)	33 (5)	.22	7 (6)	40 (6)	.98
Afraid the vaccine will hurt	5 (3)	7 (1)	.21	1 (1)	11 (2)	.83
Pregnancy or breastfeeding issues	8 (4)	6 (1)	.005	5 (4)	9 (1)	.06
Worry about misinformation/political agenda	74 (40)	200 (32)	.029	47 (39)	226 (33)	.16
Other concerns	27 (15)	106 (17)	.51	15 (13)	117 (17)	.23
No concerns	39 (21)	166 (26)	.17	30 (25)	176 (25)	.93

^aChi-squared test.

TABLE IV. Recommendation for COVID-19 Vaccination to Friend or Family Member

	Recommend COVID-19 vaccination	Not recommend COVID-19 vaccination	<i>P</i> ^a
HESITANCY			<.001
Vaccine hesitant	36 (20)	144 (80)	
Not vaccine hesitant	579 (93)	46 (7)	
AGE			.001
Younger age (30 years or younger)	122 (67)	59 (33)	
Older age (31 years or older)	490 (79)	131 (21)	
OCCUPATION			<.001
Medical occupation	62 (52)	58 (48)	
Non-medical occupation	553 (81)	130 (19)	

^aChi-squared test.

Additionally, our results suggest that within the military population there exists an age-related association with vaccine hesitancy, which has been demonstrated in civilian population studies as well.^{10,11} The cause for this is likely multifactorial; multiple prior investigations have suggested that factors such as lower socioeconomic status,¹² poor health literacy,¹³ concerns regarding vaccine safety,¹⁴ and younger age¹⁴ are

all possible contributors to vaccine hesitancy. Younger age is associated with lower mortality rate in individuals with COVID-19 infection¹⁵; the lower prevalence of significant morbidity and mortality related to COVID-19 among this population may also make the risks of vaccination, although minor, seem to outweigh its benefit.

Respondents from the medical field were also less likely to accept the COVID-19 vaccine compared to their non-medical colleagues. Vaccine hesitancy among medical professionals is alarming, since this group experiences COVID-19 in their work environment and is familiar with the associated morbidity and mortality. Our VH results for medical personnel are consistent with those reported in civilian settings.^{16,17} COVID-19 vaccine uptake among healthcare workers has been suboptimal with respect to achieving herd immunity.¹⁸ Regarding COVID-19 vaccination specifically, Roy and Kumar identified COVID-19 concerns related to side effects and transparency of data as common reasons for vaccine refusal among healthcare personnel.¹⁹ Conversely, although our study had only eight physician respondents, all indicated that they would accept vaccination and would recommend vaccination to friends and family members. This VH discrepancy between physician and non-physician personnel merits further investigation.

Safe, effective novel mRNA vaccines against COVID-19 were developed reliably and rapidly, and the subsequent scalability of the manufacturing process may lead to the arrival of a new era for preventive medicine. However, the rapidity of these achievements has led some to not trust the science and be

reluctant to be vaccinated. With the implementation of these vaccines, herd immunity to protect against future infection has played a critically important role in controlling the COVID-19 pandemic.^{19,20} Although prior studies have recommended a vaccination rate of 70%-85% to achieve effective herd immunity, more recent publications suggest that herd immunity could be effective at vaccination rates as low as 60%-67%.^{1,19,20} Furthermore, favorable outcomes with regard to mortality, morbidity, and healthcare cost among individuals who have achieved immunity through vaccination vs. natural immunity after infection have been reported.²¹ Despite these reports, perceptions among military base personnel varied. Among individuals who were not likely to accept vaccination if offered, the chief concerns were related to side effects (both long and short term), misinformation, and discomfort associated with the vaccine. Additionally, a notable portion of individuals expressed concerns that receiving the vaccine could also inoculate them with the COVID-19 virus. One possible explanation for these concerns may stem from the abundance of information that has now been made available to the general public, by both news outlets and social media. Unfortunately, not all information sources are thoroughly vetted for accuracy, leading to the publication of misleading or outright false information regarding vaccination. This information has been broadly applied to opinions regarding COVID-19 vaccination and to vaccines in general, which may severely impair future public health measures aimed at primary prevention if left unaddressed when vaccination misinformation intersects with the power of today's social media. The implication is that widespread vaccine hesitancy among these populations at WPAFB has the potential to significantly negatively impact mission readiness at the installation level. Thus, ongoing surveillance of this population is paramount to mission success.

Our study had limitations. First, the survey took place at a single USAF military base. Consequently, generalizability to other military bases and civilian settings should be done with caution; nonetheless, our sample was likely similar to many other military and general civilian population environments. Second, since only about 10% from a pool of ~8,000 possible respondents completed the voluntary questionnaire, participant selection bias may have occurred. That is, we may have underreported (or overreported) the true population level of vaccine hesitancy. However, having over 800 respondents does offer some reassurance in the study's validity. Finally, the survey was constructed locally and did not undergo formal test instrument validation, although the questionnaire was carefully vetted and the findings had no apparent ambiguous interpretations.

CONCLUSION

A survey of active duty USAF personnel and others affiliated with WPAFB found a notable level of COVID-19 vaccine hesitancy, with both younger respondents and medical personnel more likely to be reluctant to receive vaccination. Key

concerns related to vaccination hesitancy were short- and long-term side effects and the impact of easily-accessed and readily available misinformation. These findings, especially if consistent across military installations, are concerning as there exists a high potential to directly negatively impact military readiness. Moreover, there was a large discrepancy among physician and non-physician medical personnel intent to become vaccinated that warrants further investigation. The survey data obtained imply that any future investigations directed towards vaccine hesitancy would benefit most from addressing vaccine safety and side effects, while striving to minimize or debunk sources of misinformation. This data collected regarding vaccination for COVID-19 is also likely to serve as a useful application for future vaccine efforts in a military population.

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CONFLICT OF INTEREST STATEMENT

None declared.

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