

Determinants of COVID-19 Vaccine Uptake among Health care workers; Case study of Mogadishu Somalia

Abstract

Aims: Covid-19 disrupted the system and operations globally between 2020 and 2021 through exponential infections, disease and adverse negative economic impact. Due to the high risk of infection, health care workers are a high priority target group for vaccination against COVID-19. The main objective of this study was to assess the factors associated with COVID-19 vaccine uptake among health care workers in Mogadishu, Somalia. Specifically, the study sought to establish the proportion of vaccinated healthcare workers and to determine the socio-demographic and healthcare system factors associated with COVID-19 vaccine uptake among health care workers in Mogadishu, Somalia.

Methodology: Purposive sampling was used to select the six hospitals in Mogadishu while stratified random sampling was used to select a sample of 276 participants in the sampled hospitals. Structured questionnaires were employed in collecting data. Data was analyzed using descriptive statistics and logistic regression.

Results: The study established that 54.3% of the healthcare workers had taken the Covid-19 vaccine. The study found that the socio-demographic factors that increased the odds of uptake of the Covid-19 vaccine were job cadre with doctors (Odds=0.859, $p=0.007$), Nurses (Odds=1.175, $p=0.010$); area of work with ICU (Odds=0.614, $p=0.014$), Isolation Ward (Odds=2.825, $p=0.007$); Age 21-30 years (Odds=1.125, $p=0.002$), 31-40 years (Odds=1.106, $p=0.000$). The healthcare system factors associated with increased odds for covid-19 vaccine uptake were being in contact with patients with Covid-19 (Odds=0.948, $p=0.008$); Conducting weekly tests (Odds=0.786, $p=0.010$); previously testing positive for Covid-19 (Odds=0.752, $p=0.041$).

Conclusion: The study concludes that a significant number (45.7%) of healthcare workers in Mogadishu have not yet taken up the Covid-19 Vaccine for a number of reasons, this is worrying since these are the frontline workers in the fight of COVID 19 pandemic.

Recommendations: The study recommends that health promotion is necessary to enhance vaccine uptake among health workers particularly during such pandemics. Policymakers and administrators should establish clear guidelines and a supportive environment to enhance health promotion during pandemics.

Keywords: *Healthcare Workers, Socio-Economic Factors, Healthcare Systems, Vaccination, Covid-19*

1.1 Introduction

Coronavirus disease 2019 (Covid-19) pandemic that is caused by Severe Acute Respiratory Syndrome Coronavirus (SARS CoV-2) has led to high mortality and morbidity rates in the whole world. Coronaviruses belong to a family Coronaviridae, genus Beta-coronavirus and they

are enveloped single stranded RNA viruses. Coronaviruses have four structural proteins, namely; Nucleocapsid (N), membrane (M), spike (S), and envelope (E) proteins (Tsang *et al.*, 2020). The disease is highly contagious, however, the spread from human to human is through respiratory droplets during coughing or sneezing. Most of the studies done globally reported that the disease spread by aerosol penetration into the upper respiratory by inhaling droplets. The COVID-19 disease started in Wuhan China at the end of 2019 and the disease spread very fast throughout the entire world (Tsang *et al.*, 2020). In February 2020, the WHO declared Covid-19 a global pandemic (Ciotti *et al.*, 2020).

In the last two years (2019 to 2021), people have suffered under the Covid-19 pandemic, researchers have been working around the clock in order to prevent this disease from spreading further and to develop a cure as well. Towards the end of the year 2020, researchers developed several different Covid-19 vaccines. Currently (November, 2021), there are more than seven Covid-19 vaccines approved by WHO includes; Johnson and Johnson, AstraZeneca/Oxford, Sinopharm, Sinovac, Moderna, Pfizer/Bion Tech, and COVAXIN. These vaccines have been reported to be safe for most people aged 18 years and above (WHO, 2021c). The vaccines have been found not to be 100% preventive against the COVID-19 disease, however, they prevent against an individual developing severe COVID-19 disease (Nzaji *et al.*, 2020).

The risk of infections and deaths resulting from COVID -19, healthcare workers are majorly the frontline workers and therefore at a higher risk. COVID-19 vaccines remain the only effective method of preventing further infection and reduction of morbidity and mortality due to the disease. Therefore, health care workers are among the priority group of persons to receive COVID-19 vaccines (Papagiannis *et al.*, 2021). The Somalian government through the ministry of health had received three different types COVID-19 vaccines. These vaccines include COVAXIN, AstraZeneca/Oxford and Johnson and Johnson, that is, 2051300 doses, 823200 doses, and 638900 doses respectively. There is a case of reluctant to uptake of the vaccines by a number of health care workers in Somalia (WHO, 2021a).

There are various socio-demographic factors ranging from profession to marital status that are associated with the uptake of Covid-19 vaccine among the health-care workers. A study conducted in Abia State, Nigeria, revealed that age was established to be one of the factors that determine the Covid-19 vaccination hesitancy. It was reported that a larger proportion of younger health-care workers were likely to decline the uptake of COVID-19 vaccination as oppose to the older colleagues (Amuzie *et al.*, 2021). This finding was attributed to the fact that there is a perception that young people have lower risk among the Abia State health care workers (Amuzie *et al.*, 2021). Studies done in Jordan and Bangladesh showed that in both countries, the younger people were more likely to agree to take vaccines for Covid-19 if provided, with 39% of participants above 60 years old in Bangladesh declining the vaccine (Ali & Hossain, 2021; El-Elimat *et al.*, 2021).

Professionals were found to be an important factor in determining Covid-19 vaccination hesitancy in Nigeria among the health care workers from Abia State. The research determined that the clinical staff which comprises of doctors, nurses as well as other clinical health-care workers were likely to agree to a Covid-19 vaccination in comparison with the non-clinical staff members (Amuzie *et al.*, 2021). This finding on the difference on Covid-19 vaccine hesitancy based on categories of health workers was similar to the study finding where unlike other health professional cadres, medical doctors reported a lower vaccination reluctance (Biswas *et al.*, 2021).

Li et al. (2021) led a concentrate on health-care workers (HCWs) perspectives and related factors towards Covid-19 vaccination: a fast efficient survey. Two specialists screened the writing autonomously, and 13 examinations were remembered for the efficient survey. Immunization acknowledgment shifted broadly and went from 27% to 77%. Health-care workers had uplifting outlooks on the future Covid-19 antibodies, while vaccination reluctance was yet normal. Segment factors, for example, men, more established age and doctors were positive prescient variables. Ladies and attendants had more vaccination reluctance. Past flue vaccination and self-saw risk were facilitators. Worries for wellbeing, adequacy and viability and doubt of the public authority were hindrances.

Governments have come up with measures to try contain the disease. Different vaccine manufacturers around the world have been in the race of developing vaccines against COVID-19. Various studies have been done to assess the uptake of the COVID-19. While some studies have shown a higher vaccine acceptability, others have reported vaccine hesitancy. In Somalia, however, little has been recorded in relation to the uptake of COVID-19 vaccine among health care workers. In order to eradicate COVID-19 infection, there is need to increase vaccination of citizen and more specifically the health workers face the highest risk of contraction the virus. Therefore, the study assessed the factors associated with COVID-19 vaccine uptake among health care working who are working at selected hospitals in Mogadishu, Somalia. In particular, the study investigated the socio-demographic and healthcare system factors associated with Covid-19 vaccine uptake among Healthcare workers in Mogadishu. The findings from this study will be an important input to the relevant decision and policy makers in control of such diseases especially in regards to health service providers.

The theoretical model of the study was based on the socio-demographic and healthcare system factors and is shown in Figure 1.

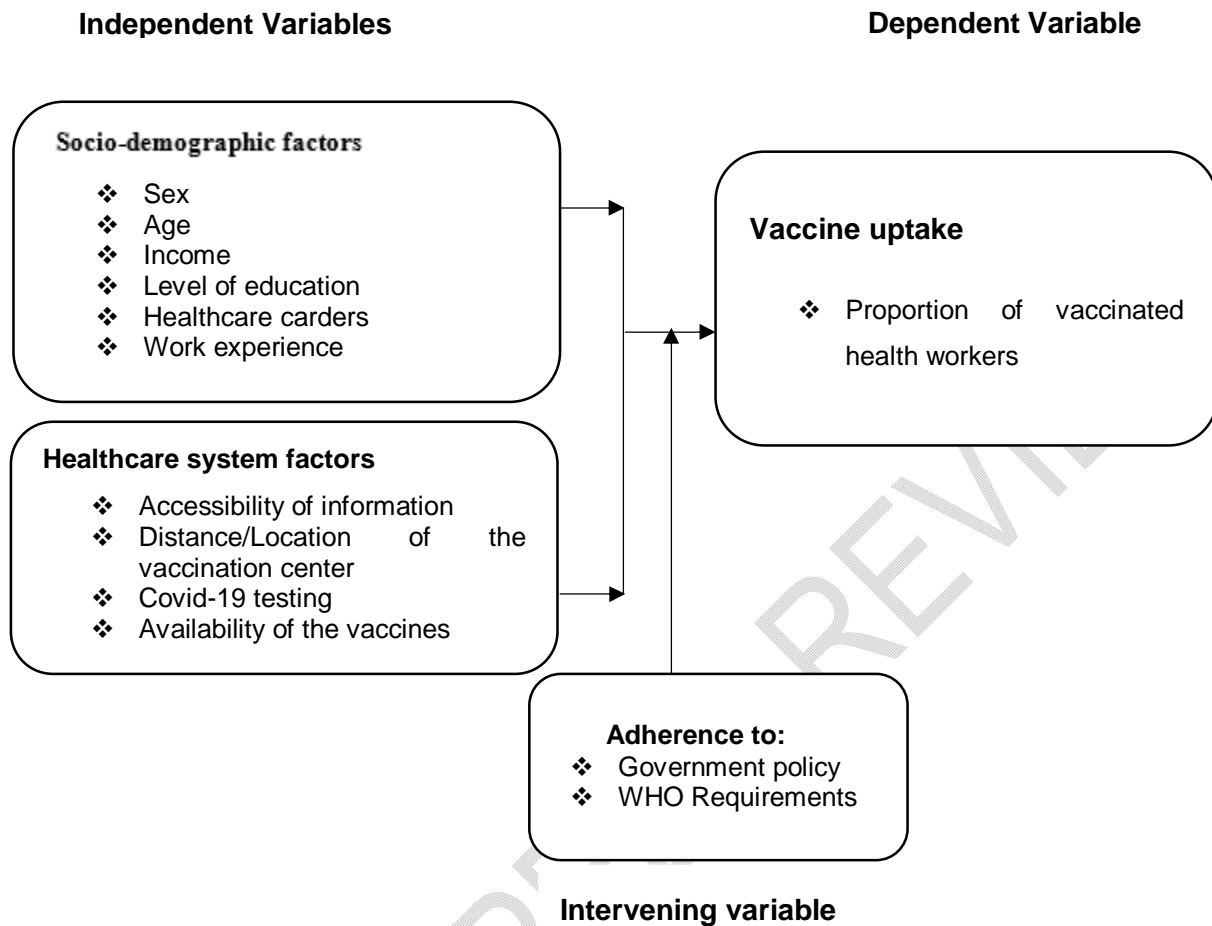


Figure 1: Conceptual Framework

In the study, socio-demographic factors were: sex; age modeled as 20-30 years, 31-40 years, 41-50 years and 51-60 years; Income levels gauged as below \$100, \$100 - \$200, \$200 - \$300, \$300-\$400 and Above \$500; education levels recognized as Certificate, Diploma, Bachelor's degree, Master's Degree and PHD; healthcare cadres which involved Doctor, Nurse, Lab-Technologists, Pharmacists and Midwives; work experience was modeled as less than a year, 2 to 4 years, 5 to 7 years and more than 8 years. Healthcare system factors involved accessibility of information on Covid-19 vaccines, the distance or location from the vaccination center, whether the respondents undertook Covid-19 tests, the frequency of doing so as well as the availability of the vaccines. As such, a combination of socio-demographic and healthcare system factors can affect the uptake of Covid-19 vaccines among healthcare system factors among hospitals in Mogadishu, Somalia.

2.1 Methodology

The research employed a cross-sectional descriptive research design and collected data based on the mixed method paradigm where both quantitative and qualitative data collection methods was employed to gather data from respondents by use of structured questionnaire and Key Informants Interviews. The study targeted all health care workers including; doctors, nurses, laboratory technician, Pharmacist and midwives who work at the selected hospitals including, Banadir

Hospital, De martini Hospital, SOS Hospital, Shafi Hospital, Daru Shifa Hospital and Somali Sudanese Hospital in Mogadishu, Somalia.

3.1 Results and Discussion

Out of 276 staff from the 6 hospitals involved in the study, 265 questionnaires were dully filled and returned as shown below. This represents a 96.01% response rate which is more than sufficient for statistical inference based on the assertions of Mugenda and Mugenda (2003) who states that a response rate of above 50% is adequate hence the response rate was well above the required rate.

3.2 Uptake of Covid-19 Vaccine

265 healthcare staff took part in the study. Of these, 144 were found to have taken the Vaccine while 121 did not as shown in Figure 2.

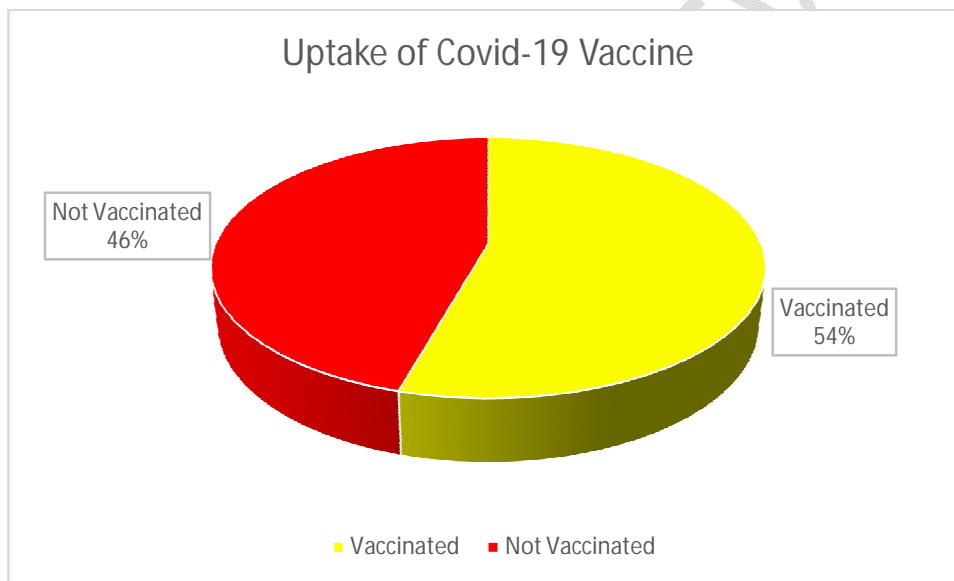


Figure 2: Uptake of Covid-19 Vaccine among Healthcare Workers in Mogadishu

Based on the table above, 54.3% of the respondents had taken the Covid-19 Vaccine while 45.7% had not taken it yet. These findings are similar to those of Shah (2020) who investigated the mindfulness and immunization designs among healthcare workers in Kenya and Uganda and found the proportion of immunization to be about 50% respectively. The similarity might be because Somalia, Kenya and Uganda are all in the East African Region and as such may share similar socio-economic practices and beliefs.

One key informant KII2 stated that, “.....*We made it mandatory for the staff to take the vaccine because we were the biggest center dealing with Covid-19 cases....*” (KII 2). Another Interviewed Informant (KII 5) stated that... “*There was no obligations and Are there was no programs designed but everyone who is interested we used to give them that time....*” (KII 5).

3.3 Bivariate Analysis

The independence tests assess whether an association exists between the two variables by comparing the observed pattern of responses in the cells to the pattern that would be expected if the variables were truly independent of each other. Chi-square test was conducted for the categorical variables to determine their association with Covid-19 vaccine uptake among the healthcare workers

Table 1: Chi square Outputs

Risk Factors	Chi-Square	df	Asymp. Sig.
Gender	6.333a	1	0.012
Job Cadre	6.115a	4	0.191
Work Area	21.732a	8	0.010
Age	17.371a	3	0.001
Work Experience	21.836a	3	0.000
Education	5.819a	4	0.268
Income	22.317a	4	0.000
Chronic Diseases	0.813a	1	0.367
Contact with Infected Patients	17.044a	1	0.000
Testing at the Facility	0.000a	1	0.999
Test Status	30.678a	1	0.000
Frequency of Test	6.634a	3	0.157
Cost of Test	15.694a	3	0.001
Covid Positive	13.052	1	0.000
Proximity to Vaccination Center	9.387a	3	0.025
Vaccine Expensive	8.133a	4	0.088
Accessibility of Vaccine	15.060a	4	0.005
Vaccines cause diseases	9.031a	1	0.003
Vaccine Side Effects	6.455a	1	0.011
Family Members Covid Positive	3.566a	1	0.059
People with Chronic Diseases	1.286a	1	0.257

The Chi-square results indicated that Gender, the department of work in the hospital, Age, income and the number of years of experience in their respective were the socio-economic factors associated with covid-19 vaccination among healthcare workers. The healthcare system factors associated with covid-19 vaccination were contact with infected patients, test status, cost of tests, history of testing positive and side effects.

3.4 Socio-Demographic Factors Associated with Covid-19 Vaccine Uptake among Healthcare Workers

The socio-demographic factors that were used to predict the uptake of covid-19 vaccine among the healthcare workers were gender, job cadres, hospital area, age, work experience, education level, income and presence or absence of chronic disease.

Table 2: Multivariate Logistic Model for Socio-Demographic Factors Associated with Covid-19 Vaccine Uptake among Healthcare Workers

Uptake Of Covid-19 Vaccine among Health workers	Odds Ratio	Std. Err.	z	P> z 	[95% Conf. Interval]
Gender					
Male	0.483	0.409	1.115	0.291	0.691 3.436
Job Cadre					
Doctor	0.859	-0.718	0.500	0.007	0.24 4.071
Nurse	1.175	-0.562	-8.060	0.010	0.536 6.544
Lab-Technologist	0.016	1.198	0.000	0.994	0.095 10.368
Pharmacist	0.023	1.66	1.377	0.241	0.006 3.691
Hospital Area					
ICU	0.614	-1.446	2.480	0.014	0.056 17.987
ER	-0.745	1.432	0.026	0.872	0.076 20.822
OT	0.548	1.341	0.488	0.485	0.184 35.373
Isolation Ward	2.825	-0.389	-0.440	0.007	0.007 2.981
General Ward	-0.154	1.386	0.159	0.690	0.115 26.259
OPD	-0.122	1.207	0.021	0.224	0.112 12.696
IPD	-1.614	1.403	0.346	0.556	0.028 6.845
Delivery/Labor	-0.007	1.359	0.001	0.975	0.067 13.737
Age					
20-30 years	1.125	1.091	288.212	0.002	13004886 9.36
31-40 years	1.006	1.058	304.45	0.000	13172174 8.358
41-50 years	0.832	0.000	3.656	0.054	4.634038 426.038
Work Experience					
Two to four years	1.029	1.089	0.422	0.516	0.24 17.167
Five to Seven years	0.926	1.096	0.005	0.944	0.108 7.937
Eight to ten years	0.691	1.335	0.077	0.781	0.05 9.44
Highest Education Level					
High School	1.261	2.331	0.01	0.921	0.013 121.506
Diploma	0.431	1.707	0.244	0.622	0.015 12.219
Bachelor Degree	-0.893	1.583	0.005	0.043	0.04 19.867
Master's Degree	-0.685	1.667	0.052	0.82	0.026 17.974
Monthly Income					

Below \$100	0.916	0.763	9.042	0.003	2.223	44.238
\$100 - \$200	0.829	0.788	2.903	0.088	0.817	17.936
\$200 - \$300	1.909	0.598	1.168	0.286	0.591	6.169
\$300 - \$400	1.447	0.591	0.39	0.532	0.454	4.606

The results indicated that doctors had 0.859 more odds of taking up Covid-19 vaccines among healthcare workers as compared to midwives (P=0.007). Nurses had a 1.175 more odds of taking up the Covid-19 vaccine in comparison to midwives at the hospitals in Mogadishu (P=0.010). Healthcare workers in ICU had 0.614 more odds to take the vaccine compared to those working at the pharmacy (P=0.014) while healthcare workers at the Isolation ward had 2.825 more odds to take the Covid-19 vaccine compared to those at the pharmacy (P=0.007). These findings were in line with Biswas *et al.* (2021) who established that medical doctors typically displayed a lower vaccination reluctance in comparison with other job cadres.

Healthcare workers between the ages of 20 and 30 had 1.125 times more odds to take up the vaccine compared to those aged between 51 to 60 years (P=0.002<0.05). In addition, the workers aged between 31 and 40 years had 1.006 times more odds to take up the vaccine in comparison to their counterparts aged between 51 and 60 years old (P=0.000< 0.05). Finally, healthcare workers with Bachelor degrees had 0.893 less odds to take the vaccine compare to their counterparts with PhDs (P=0.043<0.05) while the healthcare workers earning less than \$100 a month had 0.916 more odds to take up the vaccine (P=0.003<0.05).

This backs the findings by Ali and Hossain (2021) as well as El-Elimat *et al.* (2021) who established that younger people were more likely to agree to take vaccines for Covid-19 if provided. However, the results dispute those of Amuzie *et al.* (2021) who established that younger healthcare workers were less likely to take up the Covid-19 vaccine in comparison to their older counterparts. The study also backs those of Samo *et al.* (2022) who found that when contrasted with more youthful, the vaccinations reluctance and refusal was higher in more established individuals age >30 years ($\chi^2 = 7.45$, $p = 0.02$).

3.5 Healthcare System Factors Associated with Covid-19 Vaccine Uptake among Healthcare Workers

The healthcare system factors that were used to predict the uptake of covid-19 vaccine among healthcare workers in Mogadishu Somalia were contact with Covid-19 patients, frequency of testing for COvid-19, whether they had been tested for Covid-19 before, Cost of Covid-19 test, side effects, existence of chronic diseases or whether ay family member had suffered form Covid-19.

Table 3: Multivariate Logistic Model for Healthcare System Factors and Uptake of Covid-19 Vaccine

Uptake of Covid-19 Vaccine among Healthcare Workers	Odds Ratio	Std. Err.	z	P> z	[95%Conf. Interval]	
Contact with Covid-19 patients						
Yes	0.948	0.344	0.150	0.008	0.465 1.931	

Covid-19 Testing at Health Facility

Yes	1.788	0.626	1.660	0.097	0.901	3.551
Tested for Covid-19						
Yes	1.232	0.464	13.149	0.000	0.075	0.462
Frequency of Covid-19 Testing	0.493	0.247	-1.410	0.159	0.185	1.318
Once	0.577	0.270	-1.180	0.239	0.231	1.442
Weekly	0.786	0.376	0.040	0.010	0.467	2.080
After Two Weeks	0.493	0.247	-1.410	0.159	0.185	1.318
Cost of COVID-19 test						
Free	0.363	0.285	-1.290	0.197	0.078	1.693
\$10 -\$20	0.905	0.537	-0.170	0.866	0.283	2.895
\$ 30 - \$40	1.573	0.971	0.730	0.046	0.469	5.275
Covid-19 Positive						
Yes	0.752	-0.260	0.820	0.041	0.382	1.481
Proximity to Vaccination Centre						
Close-by	0.063	1.33	5.16	0.023	0.004	0.661
Fairly Close	1.402	0.487	10.970	0.033	0.709	2.770
Fairly Far	0.943	1.409	2.681	0.102	0.306	1.576
Vaccines Cause Disease						
Yes	0.704	0.283	0.870	0.038	0.320	1.547
Vaccine Side Effect						
Yes	0.918	1.011	0.117	0.733	0.195	10.248
Family Positive for Covid-19						
Yes	3.217	0.62	0.001	0.974	0.291	3.302
Chronic Disease						
Yes	1.22	0.803	2.116	0.146	0.666	15.526

The results indicated that that workers who had been in contact with patients with Covid-19 had 0.948 more odds to take the vaccine when compared to those who had not ($P=0.008<0.05$). In addition, healthcare workers who conducted covid-19 tests weekly had 0.786 more odds to be vaccinated compared to those who did so monthly ($P=0.010<0.05$). The HCWs who had tested positive for Covid-19 at some point in the past had 0.752 more odds to be vaccinated against the virus when compared to those who had not ($P=0.041 < 0.05$). Finally, the healthcare workers in Mogadishu who lived fairly close to vaccination centres had 1.402 more odds to get the vaccine in comparison to their counterparts who lived far away ($P=0.033 < 0.05$). The findings are in line with the study by Elizondo-Alzola *et al.* (2021) who established that vaccine hesitancy among pediatric medical caretakers was down to the perception of the vaccines and medical side effects affiliated to it. This is also in line with Fakonti *et al.* (2021) who highlighted tales and paranoid fears as a factor causing Covid19 immunization reluctance

4.1 Conclusions

Based on the findings, the study concludes that 45.7% of healthcare workers in Mogadishu have not yet taken up the Covid-19 Vaccine for a number of reasons. This is a significant proportion that is a cause for concern given the role that healthcare workers play in the provision of healthcare and the frequency of contact with patients suffering from Covid-19. As regards the socio-demographic factors associated with the uptake of Covid-19 vaccine among the healthcare workers, the study determined that gender, area of work, age, work experience and income levels were associated with Covid-19 vaccine uptake. Finally, the study found that contact with infected patients, the existence of Covid-19 testing at the healthcare centers, cost of tests and whether or not the healthcare workers had previously tested positive for Covid-19 were associated with the uptake of the Covid-19 vaccine in Mogadishu. The Study recommends that Health promotion is necessary to enhance vaccine uptake among health workers particularly during such pandemics. Policymakers and administrators should establish clear guidelines and a supportive environment to enhance health promotion during pandemics.

7.1 Consent

All authors declare that ‘written informed consent was obtained from the participants (or other approved parties) for publication of this article and accompanying images. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal

References

- Abdullah, S. M. (2019). Similiarity Artikel: Social Cognitive Theory: A Bandura Thought Review published in 1982-2012. *Journal Psikodimensia*, 18(1), 85-100.
- Ahmed, M. A., Colebunders, R., Gele, A. A., Farah, A. A., Osman, S., Guled, I. A.,... & Siewe Fodjo, J. N. (2021). COVID-19 vaccine acceptability and adherence to preventive measures in Somalia: results of an online survey. *Vaccines*, 9(6), 543.
- Ali, M., & Hossain, A. (2021). Original research: What is the extent of COVID-19 vaccine hesitancy in Bangladesh? A cross-sectional rapid national survey. *BMJ Open*, 11(8). <https://doi.org/10.1136/BMJOPEN-2021-050303>
- Amuzie, C. I., Odini, F., Kalu, K. U., Izuka, M., Nwamoh, U., Emma-Ukaegbu, U., & Onyike, G. (2021). COVID-19 vaccine hesitancy among health care workers and its socio-demographic determinants in Abia State, Southeastern Nigeria: a cross-sectional study.

- Araújo, T. M. D., Souza, F. D. O., & Pinho, P. D. S. (2019). Vaccination and associated factors among health workers. *Cadernos de saude publica*, 35.
- Asma, S., Akan, H., Uysal, Y., Poçan, A. G., Sucaklı, M. H., Yengil, E., ... & Kut, A. (2016). Factors effecting influenza vaccination uptake among health care workers: a multi-center cross-sectional study. *BMC infectious diseases*, 16(1), 1-9.
- Badahdah, A. M., Alfelali, M., Alqahtani, A. S., Alsharif, S., Barasheed, O., Rashid, H., & Hajj Research Team. (2018). Mandatory meningococcal vaccine, and other recommended immunisations: Uptake, barriers, and facilitators among health care workers and trainees at Hajj. *World journal of clinical cases*, 6(16), 1128.
- Bandura, A. (1998). Health promotion from the perspective of social cognitive theory. *Psychology and health*, 13(4), 623-649.
- Bandura, A. (2002). Social cognitive theory in cultural context. *Applied psychology*, 51(2), 269-290.
- Bhattacharjee S, Dotto C. (202). First draft case study: Understanding the impact of polio vaccine disinformation in Pakistan. United States: First Draft. 2020
- Biswas, N., Mustapha, T., Khubchandani, J., & Price, J. H. (2021). The Nature and Extent of COVID-19 Vaccination Hesitancy in Health care Workers. *Journal of Community Health*, 46(6), 1. <https://doi.org/10.1007/S10900-021-00984-3>
- Charron, J., Gautier, A., & Jestin, C. (2020). Influence of information sources on vaccine hesitancy and practices. *Medecine et maladies infectieuses*, 50(8), 727-733.
- Ciotti, M., Ciccozzi, M., Terrinoni, A., Jiang, W. C., Wang, C. Bin, & Bernardini, S. (2020). The COVID-19 pandemic. <https://doi.org/10.1080/10408363.2020.1783198>, 365–388.
<https://doi.org/10.1080/10408363.2020.1783198>
- Coronavirus disease (COVID-19): (2021). Use of Emergency Use Listing procedure for vaccines against COVID-19 [Internet]. Who.int. 2021 [cited 8 June 2021].

<https://www.who.int/news-room/q-a-detail/coronavirus-disease-use-of-emergency-use-listing-procedure-for-vaccines-against-COVID-19> .

COVID-19 Vaccines (2021). Advice [Internet]. Who.int. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/COVID-19-vaccines/advice>

El-Elimat, T., AbuAlSamen, M. M., Almomani, B. A., Al-Sawalha, N. A., & Alali, F. Q. (2021). Acceptance and attitudes toward COVID-19 vaccines: A cross-sectional study from Jordan. *PLOS ONE*, *16*(4), e0250555. <https://doi.org/10.1371/JOURNAL.PONE.0250555>

Elizondo-Alzola, U., G. Carrasco, M., Pinós, L., Picchio, C. A., Rius, C., & Diez, E. (2021). Vaccine hesitancy among paediatric nurses: Prevalence and associated factors. *PLoS one*, *16*(5), e0251735.

Fakonti, G., Kyprianidou, M., Toumbis, G., & Giannakou, K. (2021). Attitudes and acceptance of COVID-19 vaccination among nurses and midwives in Cyprus: a cross-sectional survey. *Frontiers in public health*, *9*, 481.

Haridi, H. K., Salman, K. A., Basaif, E. A., & Al-Skaibi, D. K. (2017). Influenza vaccine uptake, determinants, motivators, and barriers of the vaccine receipt among health care workers in a tertiary care hospital in Saudi Arabia. *Journal of Hospital Infection*, *96*(3), 268-275.

Hossain, M. B., Alam, M. Z., Islam, M. S., Sultan, S., Faysal, M. M., Rima, S., ... & Mamun, A. A. (2021). Health belief model, theory of planned behavior, or psychological antecedents: What predicts COVID-19 vaccine hesitancy better among the Bangladeshi adults?. *Frontiers in public health*, *9*, 711066.

Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., Gu, X., Cheng, Z., Yu, T., Xia, J., Wei, Y., Wu, W., Xie, X., Yin, W., Li, H., Liu, M., ... Cao, B. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet*, *395*(10223), 497–506. [https://doi.org/10.1016/S0140-6736\(20\)30183-5](https://doi.org/10.1016/S0140-6736(20)30183-5)

Islam M, Kamal A, Kabir A, Southern D, Khan S, Hasan S et al. COVID-19 vaccine rumors and conspiracy theories: The need for cognitive vaccination against misinformation to improve vaccine adherence. *PLoS ONE*. 2021; *16*(5):e0251605. <https://doi.org/10.1371/journal.pone.0251605> PMID: 33979412

- Leigh, J. P., Moss, S. J., White, T. M., Picchio, C. A., Rabin, K. H., Ratzan, S. C., ... & Lazarus, J. V. (2022). Factors affecting COVID-19 vaccine hesitancy among health care providers in 23 countries. *Vaccine*.
- Li, M., Luo, Y., Watson, R., Zheng, Y., Ren, J., Tang, J., & Chen, Y. (2021). Health care workers'(HCWs) attitudes and related factors towards COVID-19 vaccination: A rapid systematic review. *Postgraduate medical journal*.
- Nzaji, M. K., Ngombe, L. K., Mwamba, G. N., Ndala, D. B. B., Miema, J. M., Lungoyo, C. L., Mwimba, B. L., Bene, A. C. M., & Musenga, E. M. (2020). Acceptability of Vaccination Against COVID-19 Among Health care Workers in the Democratic Republic of the Congo. *Pragmatic and Observational Research*, 11, 103. <https://doi.org/10.2147/POR.S271096>
- O'Reilly, F. W., Cran, G. W., & Stevens, A. B. (2005). Factors affecting influenza vaccine uptake among health care workers. *Occupational Medicine*, 55(6), 474-479.
- Papagiannis, D., Rachiotis, G., Malli, F., Papathanasiou, I. V., Kotsiou, O., Fradelos, E. C., Giannakopoulos, K., & Gourgoulialis, K. I. (2021). Acceptability of COVID-19 Vaccination among Greek Health Professionals. *Vaccines*, 9(3), 1–7. <https://doi.org/10.3390/VACCINES9030200>
- Samo, A. A., Sayed, R. B., Valecha, J., Baig, N. M., & Laghari, Z. A. (2022). Demographic factors associated with acceptance, hesitancy, and refusal of COVID-19 vaccine among residents of Sukkur during lockdown: A cross sectional study from Pakistan. *Human Vaccines & Immunotherapeutics*, 18(1), 2026137.
- Schunk, D. H. (2012). Social cognitive theory.
- Short, M. B., Marek, R. J., Knight, C. F., & Kusters, I. S. (2022). Understanding factors associated with intent to receive the COVID-19 vaccine. *Families, Systems, & Health*, 40(2).
- Tsang, H. F., Wing, L., Chan, C., Chi, W., Cho, S., Chi, A., Yu, S., Kay, A., Yim, Y., Kit, A., Chan, C., Po, L., Ng, W., Kwan, Y., Wong, E., Pei, X. M., Jing, M., Li, W., Sze-Chuen, & ... Wong, S.-C. C. (2020). An update on COVID-19 pandemic: the epidemiology, pathogenesis, prevention and treatment strategies.

<https://doi.org/10.1080/14787210.2021.1863146>, 19(7), 877–888.
<https://doi.org/10.1080/14787210.2021.1863146>

- Tuckerman, J. L., Collins, J. E., & Marshall, H. S. (2015). Factors affecting uptake of recommended immunizations among health care workers in South Australia. *Human vaccines & immunotherapeutics*, 11(3), 704-712.
- Wagner, A. L., Masters, N. B., Domek, G. J., Mathew, J. L., Sun, X., Asturias, E. J., Ren, J., Huang, Z., Contreras-Roldan, I. L., Gebremeskel, B., & Boulton, M. L. (2019). Comparisons of Vaccine Hesitancy across Five Low- and Middle-Income Countries. *Vaccines*, 7(4). <https://doi.org/10.3390/VACCINES7040155>
- Wang, J., Jing, R., Lai, X., Zhang, H., Lyu, Y., Knoll, M. D., & Fang, H. (2020). Acceptance of COVID-19 Vaccination during the COVID-19 Pandemic in China. *Vaccines*, 8(3), 1–14. <https://doi.org/10.3390/VACCINES8030482>
- WHO. (2021a). *Africa COVID-19 dashboard - Vaccine Procurement & Vaccine administration*. <https://app.powerbi.com/view?r=eyJrIjoiY2ViYzIyZjItYzhkMi00ZWVkbkLTgyM2ItZTk1ZTJmODRjMTkxIiwidCI6ImY2MTBjMGI3LWJkMjQtNGIzOS04MTBiLTNkYzI4MGFmYjU5MCI6ImMiOj9>
- WHO. (2021b). *Coronavirus (COVID-19) | WHO | Regional Office for Africa*. <https://www.afro.who.int/health-topics/coronavirus-COVID-19>
- WHO. (2021c). *COVID-19 Vaccines Advice*. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/COVID-19 -vaccines/advice>
- WHO. (2021d). *WHO Coronavirus (COVID-19) Dashboard | WHO Coronavirus (COVID-19) Dashboard With Vaccination Data*. <https://Covid19.who.int>
- Wong, M. C. S., Wong, E. L. Y., Huang, J., Cheung, A. W. L., Law, K., Chong, M. K. C., Ng, R. W. Y., Lai, C. K. C., Boon, S. S., Lau, J. T. F., Chen, Z., & Chan, P. K. S. (2021). Acceptance of the COVID-19 vaccine based on the health belief model: A population-based survey in Hong Kong. *Vaccine*, 39(7), 1148–1156. <https://doi.org/10.1016/J.VACCINE.2020.12.083>