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ORIGINAL ARTICLE

The Reported Side Effects of Corona Virus Vaccination among Oral Health Care Workers

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ABSTRACT

Vaccines function via a variety of methods to provide disease protection; nevertheless, the process of establishing immunity may create side effects. As a result, the goal of this research was to investigate the COVID–19 vaccination's acute side effects among oral health care professionals. In order to investigate the pictured objectives the research was conducted in a explorative manner. The data was collected from the oral health care workers using survey analysis to bring insights into the study objectives. Study followed by the descriptive and frequency analysis of the reported side effects in the selected population. The analytical procedures found that persons who have been vaccinated may display a variety of symptoms, and it is important to examine which vaccination is most cost-effective or has the fewest side effects for a certain age range. Classification should be based on these factors. There are many more aspects to consider when making vaccination decisions, including cost-effectiveness, minimal or zero adverse effects, and efforts to protect socioeconomically disadvantaged populations, as well as the urgent need to restore economic and social normality.

Keywords: Side effects of Covid-19, OHCW, Corona Virus Vaccine.

INTRODUCTION

Coronavirus (CoVs) belonging to the Coronaviridae family (Nidovirales order) primarily affect the human respiratory system (Malik et al., 2021). The Corona Virus emerged in the Wuhan Province of China in Dec 2019 and a Global Pandemic was proclaimed on 11 March 2020. The Virus has affected Over 111.7 million people globally with more than 2.4 million dead and over 63 million recovered (Arokiaraj, 2020). It left the world frozen in time as ordinary life came to a screeching halt for millions around the world, even those living in the most advanced countries in the world were unable to cope with the new status quo. For months everyone in the world was waiting for the first coronavirus vaccine. Enough herd immunity against SARS-CoV-2 infection was required to successfully limit the COVID-19 pandemic. Between 2011 and 2020, vaccinations against infectious diseases are predicted to save at least 23 million lives (Khan et al., 2020). A critical element of every vaccination's development is the discovery, measurement, and weighting of potential benefits and known and hypothetical safety risks. Among the questions raised during the development of COVID-19's vaccine is whether the immune responses elicited by the vaccination may aid in the acquisition of SARS-CoV-2 (Kundu & Bhowmik, 2020).

Vaccines have historically been an extremely effective method of combating epidemics (Wadman & You, 2017). The anti-vaccine movement that promotes vaccination hesitancy has shown to be a major public health risk and included to the global health hazards list (Rund et al., 2004). For example, the infectious measles outbreak in 2019 was fueled. Additionally, disinformation about antivaccine roll out quicker than knowledge about their beneficial equivalents (Pagotto et al., 2021). Numerous conspiracy theories were propagated over social media immediately following declaration of COVID-19 as a pandemic. For instance, there was two notable politicians voiced vaccination attitudes against COVID-19 to local populations and so encouraged vaccination hesitation. Another research provided an online heuristic map of containment vaccine COVID-19 showing a complex landscape with an unparalleled complexity of the vaccine (Madewell et al., 2020). The reasons for the refusal of vaccination differ depending on the area and the sociocultural context. COVID-19 has been demonstrated to be extremely contagious among people. It is difficult to identify SARS-potential CoV-2 carriers who can infect patients via asymptomatic carriers, creating sickness a perplexing public health ultimatum (Kundu & Bhowmik, 2020). As a result, research teams from several organizations and universities worldwide have performed vaccine development investigations. Among these, national COVID-19 research stands out for its breadth of coverage, encompassing practically every type of immunization. The development of COVID-19 vaccinations, on the other hand, has sparked substantial debate (Agarwal & Reed, 2021).

Many studies have shown that even vaccinated individuals may have major uncertainties and worries about vaccination (Mahase, 2021). Many experts feel that immunization programs are threatened by increased public skepticism over the safety and efficacy of vaccines (Phipps et al., 2020). Previous estimates show that less than 5% to 10% of people are strongly opposed to vaccination (Kahwa et al., 2020). However, a greater fraction may be classed as vaccine-reluctant. Another researcher hypothesized that value-based messaging draws people back to their fundamental morals and influences their opinions on issues such as vaccination(Shultz et al., 2020). Larson discusses the following elements: Certain risks associated with vaccinations, such as side effects, cause concern, reluctance, and vaccination refusal; individuals who believe their freedom is being trampled on are fought and occasionally coerced by government regulations. Sometimes those who don't trust government spread their doubts to pharmaceutical vaccinations that provide income and promote public investigation into the motives for vaccine production (Rund et al., 2004). Another researcher also discovered, while researching the anti-vaccine situation in Texas, that the anti-vaccine community believes vaccines are a government control tool that increases the wealth of large pharmaceutical companies at the expense of adverse consequences that may cause lifelong damage. Disinformation about the vaccine's benefits, medicinal composition, and adverse effects is one of the barriers to universal vaccination because it impairs individuals' comprehension and buy-in (Schwarzinger et al., 2021). Concerns regarding vaccine safety continue to play a significant role in the majority of situations of decreased vaccination uptake. Many studies show that public opinions towards vaccination have an important effect on the production and marketing of a vaccine (Menni et al., 2021).

The first coronavirus was found in Pakistan on 26 February 2020 in Karachi, and 918,936 cases have been reported since then. We have had 20,736deaths and 839,322 recoveries spread all over the country. Whereas, around 1,513,144 individuals have been completely vaccinated. The COVID-19 pandemic is already well contained in Pakistan, a country of about 220 million people, and with the formal launch of coronavirus vaccinations on 2 February 2021, there is a greater likelihood that Bette's situation will improve. In addition to that, China, a long-standing partner of Pakistan, has aided Pakistan in its fight against Coronavirus by granting Islamabad access to 500,000 doses of Chinese Sinopharm vaccine. Similarly, the World Health Organization launched its COVAX initiative, a global plan for vaccine distribution, and recommended up to 17 million doses of the

Pakistani AstraZeneca vaccine in the first half of 2021(Riad et al., 2021).

Covid-19 vaccinations available in Pakistan:

The Chinese Sinopharm & Sinovac vaccine: Sinopharm said on 30 December 2020 that phase three immunization research found that it was 79 percent less effective than Pfizer and Moderna. However, 86 percent of the United Arab Emirates approved Sinopharm vaccines in January, according to early data from its phase-three trial. One of the individuals with a CNBG COVID-19 vaccine injected in the United Arab Emirates (UAE), including two of the country's highest-ranking ministries. Other countries to approve the Sinopharm vaccine are Bahrain, Jordan, the Philippines, Seychelles, Hungary, Morocco, Serbia and Pakistan (Riad et al., 2021). Serbia received one million units of COVID-19 vaccine from China in January, making it the first European country to do so. Hungary became the first EU country to approve China's COVID-19 Sinopharm in the same month (Alvarez et al., 2021). Furthermore, China has gifted Pakistan 500,000 doses of the Sinopharm vaccine which was approved by Pakistan and is used for the vaccination drive in the country that started on February 2, 2021 (Dutta et al., 2021).

Sinovac Corona Vac is another Chinese vaccine that is identical to Sinopharm and has a rate of efficacy of greater than 50%, as revealed by final phase tests in Brazil. Experts believe this is sufficient effectiveness because practically everyone who participated in the experiment in Brazil was a high-risk medical professional, and the vaccine's efficiency of 77.96 percent in mild case protection implies that the vaccination will minimize hospitalizations by 78 percent (Rüggeberg et al., 2007).

The Russian-developed Sputnik V vaccine: The Russian Ministry of Health produced and tested the Sputnik V vaccination. It is important to note that although the vaccine's phase 1 and phase 2 trial date has been published, the phase 3 data has not, so this efficacy rate cannot be verified. Russian scientists have not reported any side effects associated with the vaccine. The vaccine has mainly just been tested in Russia but has been approved in Argentin and 20 other countries. It also uses a modified version of the common cold virus to teach the immune system to fight COVID-19.

By December 2020, Belarus and Argentina will get vector-based immunization authorization for emergency usage. Hungary was the first EU country, along with the United Arab Emirates in the Gulf area, to register the shot for emergency usage. Also licensed for emergency usage are Algeria, the Palestinian Territories, Serbia and Mexico(Date, 2011). Iran approved the vaccine on 25 January 2021 by Foreign Minister Mohammed Javad Zarif saying Iran is hoping to purchase and co-produce the shot in the near future following the ban on government imports from the US and UK by Supreme Leader Ayatollah Ali Khamenei.

Russia was the first country to test and approve the Sputnik V immunization, and the list of countries that have been authorized today stands at 30: The United Kingdom of Bolivia, Belarus, Argentina, Bolivia, Bolivia, Serbia, Algeria, Palestine, Venezuela, Paraguay, Turkmenistan, Hungary, the United Arab Emirates, Iran, the Republic of Guinea, Tunisia, Armenia, Mexico, Nicaragua, the Republic of Bosnia and Herzegovina, Lebanon, Myanmar, Pakistan, Mongolia, Montenegro, Saint Vincent and the Grenadines, Uzbekistan, Gabon, San Marino, and Gheg (Dib et al., 2021).

The African Union's Africa Vaccine Acquisition Task Team, founded on 19 February 2021, is pleased to report that the African Union has accepted a Russian Federation offer of 300 million Sputnik vaccines to achieve the 60% target immunization rate. It provides a financing package to any Member State that wishes to preserve this immunization. In addition to that, Chughtai Lab in Pakistan has officially announced that they are expecting the arrival of the Sputnik V vaccine, making Pakistan one of the first countries to commercialize & market shots privately.

The Oxford-AstraZeneca vaccine: This coronavirus vaccine was made at Oxford University and was tested by AstraZeneca, a large British-Swedish pharmaceutical company. So far, this vaccine has an efficacy rate of 62% and has gone through three full phases of testing. No one who has received the vaccine has become ill because of it. It has been tested, approved, and permitted by the European Medicines Agency in the United Kingdom, Brazil, and South Africa for adults over the age of 18 (Muecksch et al., 2021). Although it is currently unknown how long its protection will last as more studies have to be conducted. This vaccine is produced using genetically modified strains of the common cold virus. These cells cannot cause disease, but they do prepare the body to fight viruses if they do occur (Waismel-Manor et al., 2020).

In August 2020, AstraZeneca will initiate phase 3 investigations in Brazil, South Africa, and the United States. These experiments were halted in September after a volunteer researcher developed a rare spinal inflammatory sickness called transverse myelitis. A week later, the trials began in Brazil and the United Kingdom. In early February, company officials announced that phase 3 clinical trial results showed that their vaccine was 82 percent effective after 12 weeks. Additionally, they stated that the vaccination was successful in reducing serious sickness, hospitalization, and death. They also noted that the vaccine achieved up to 67 percent efficacy in preventing disease transmission (Woko et al., 2020).

A few days later, South African officials postponed their plans to inoculate frontline healthcare workers, when clinical testing revealed that the AstraZeneca vaccine was ineffective in preventing mild to moderate COVID-19 illnesses in the current nation (Muecksch et al., 2021) In mid-February, the World Health Organization secured an emergency use license for the distribution of AstraZeneca vaccine around the world via its COVAX initiative, a worldwide initiative for coronavirus immunization of people in low- and middle-income countries. It aims to provide at least two billion free vaccine doses by the end of 2021, covering 20% of the world's most vulnerable people in over 90 countries, with Pakistan receiving one of 17 million AstraZeneca vaccine doses in the first half of 2022 (Agarwal & Reed, 2021).

CanSino Biologics: The last vaccination on this list is a Chinese antiviral vaccine developed by CanSino Biologics, Inc. and the Beijing Institute of Biotechnology. In Pakistan, this vaccine is now in phase 3 and has not yet been authorized. The government-funded National Institutes of Health (NIH) and AJM, CanSino's local representative, are heading the ad5 nCoV project. The inquiry will take place at prestigious medical research institutes in Karachi, Islamabad, and Lahore. Pakistan is entitled to 20 million doses of the vaccine following the conclusion of successful trials and favorable findings (Yamey et al., 2020).

China (In June 2020) authorized the military vaccination in early and mid-stage tests. Mexico, Saudi Arabia, and Russia are also doing late-stage trials. CanSino indicated that it is now in discussions with Brazilian and Chilean authorities to initiate Phase 3 vaccine research (Hafiz et al., 2020).

COVID-19 Vaccine Side Effects:

The Coronavirus Vaccines have been tested and proven to be safe, However, small side effects are possible and normally last only a few days. The most frequently reported Covid's side effects cover the following:

- Injection site pain
- Lymph nodes in the vaccinated arm swell painfully
- Frustration
- Migraine
- Distressed muscles or joints
- Nausea and spelling
- Frost or fever.

A side effect is not always a bad sign: the body may develop immunity to the infection (Menni et al., 2021; Schwarzinger et al., 2021).

Precautions for Covid-19 Vaccine: If you plan to get a coronavirus vaccine in the near future, make sure you have not received any other kind of vaccine 14 days before or after. Any coronavirus vaccine that requires two shots may not provide proper protection until at least a few days after your second shot. Make sure to inform your healthcare provider of any allergies you have before getting the shot (Klinger et al., 2020). You must also remain on the premises for monitoring once you receive the shot in order to make sure you do not have any adverse reactions to the vaccine (Khan et al., 2020). If you receive the coronavirus immunization, you may develop COVID-19-related signs and symptoms. COVID-19 is frequently associated with the following signs and symptoms:

- Dry Cough
- Headache
- Shortness of breath or difficulty breathing
- Fatigue or Tiredness
- Loss of taste or smell

Other symptoms may include:

- Chills
- Sore throat
- Chest pain
- Fever
- Muscle aches
- Runny nose
- Pink eye (conjunctivitis)

The symptoms of COVID-19 vary from moderate to severe and individuals exhibit diverse symptoms. This is dependent on numerous factors such as immunity, underlying health, and age. Certain individuals may exhibit no symptoms at all yet nonetheless carry the COVID-19 virus (Menni et al., 2021; Riad et al., 2021; Schwarzinger et al., 2021).COVID-19 vaccine acceptance varies significantly by country. To this aim This country-specific study's objective is to the public involvement paradigm for COVID-19 immunization in order to develop effective preparedness strategies for China's pandemic reduction. The current study explores trending topics linked with COVID-19 vaccines on Weibo, eliciting popular opinion and COVID-19 vaccine propensity, such as costs of vaccines and aftereffect.

METHODOLOGY

Study Design and Sampling: The acceptability of general public for the COVID-19 immunisation campaign in this developing nation was evaluated using a cross-sectional approach. On the basis of the last survey's Google forms, an English questionnaire was prepared for OHCWs. It was considered that no any personal information was gathered during the study. The feedback form was distributed via media links and direct means, and our affiliated vaccination centers in major cities. The technique of snowball sampling was implemented to disseminate the survey questionnaire in general public.

Between February 14, 2021 and May 20, 2021, data was acquired. Prior to the study's final application, all individuals with age group greater then 18 years, who were considerable and sane were declared eligible to contribute. Permission was obtained on the basis of informed consent. The final analysis eliminated the questionnaires that were not completed.

Study Variables and Measures: Descriptive and demographic information was displayed on the start of survey questionnaire. It included information on age, sex, ethnic origin, kind of work, education, kind of symptoms showed, chronic conditions, and pre-COVID19 contagion (if any). The respondents were informed about the vaccine's brand name and effectiveness in order to assess the vaccine's acceptance (CanSino Biologics, and other those are operative in preventing suggestive cases).

The responders were asked "yes" or "no" if they accepted the vaccine. Age was classified into five categories (18-30, 31-40, 41-50, 51–60, and >61 years); vaccination was also classified into single doses, double injections, and others. Schooling and specialisation were classified as medicine, surgery, diagnostics, or other.

Statistical analysis: The Social Sciences Statistics Package (SPSS) 26 (IBM, Armonk, NY, US) was utilised for the analysis of the data and logistical regression was undertaken to discover OHCWs determinants of COVID-19 vaccine acceptability. Reliability was determined using univariate analysis and multivariable analysis was used for estimating the adjusted odds. Statistical significance p-value less than 0.05 was determined. The scale below was utilised for the analysis.

Table 1: scale for data clarification

intensity of symptoms						
	None					Intense
Scale	0	1	2	3	4	5

RESULTS

After analysis the results were implemented as the demographics, descriptive statistics and classification wise differences as given below in details.

Demographics: Demographics of the study variables are given in the table 1.1 which shows 41 respondents for Sinopharm while 72 number of respondents for the Sinovac. The age, gender and doses frequency analysis are given below in the table 2 that can be seen.

Table 2: Frequency Distribution

		Count	Table N %
Vaccine Domain	Sinpharm	41	36.3%
	SinoVac	72	63.7%
Gender	Male	53	46.9%
	Female	60	53.1%
Age Group	25-35	23	20.4%
	36-45	47	41.6%
	46-55	43	38.1%
	55 Above	0	0.0%
Doses	Single Shot	29	25.7%
	Double Shot	84	74.3%

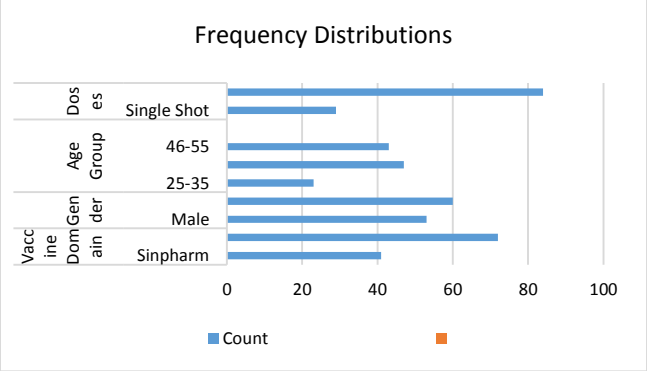

Figure 1: The graphical distribution of the respondents' frequencies.

Descriptive statistics: Descriptive Statistics are investigated of the study variables and are reported into the table 3 below. The tables show the mean, minimum and maximum values given to the responses along with the standard deviations.

Table 3: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Vaccine Domain	113	1.00	2.00	1.6372	.48296
Gender	113	1.00	2.00	1.5310	.50126
Age Group	113	1.00	3.00	2.1770	.74678
Doses	113	1.00	2.00	1.7434	.43872
Valid N (listwise)	113				

Reliability of scale values: Reliability and factor analysis is investigated for the scale responses, the Cronbach's Alpha values are investigated for n=12 which shows 0.952 values suggesting that the data is reliable to further use into further analysis. The standard values of Cronbach's Alpha are 0.7 or above.

Table 4: Reliability Analysis

Reliability Statistics	
Cronbach's Alpha	N of Items
.952	12

Normality and factor analysis: Along with reliability, adequacy tests are conducted using the Kaiser-Mayer-Olkin method, with a result of 0.935, despite the KMO standard value is 0.7 or above. The KMO results clearly suggest that data are normally distributed and may be used to do more study. The findings of the KMO are summarised in Table 5

Table 5: KMO Analysis

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.935
Bartlett's Test of Sphericity	Approx. Chi-Square	1106.760
	df	66
	Sig.	.000

Factor Loadings of the scale components are given in the table 1.5 which meats the given standard of the factor loading values (<0.7)

Table 6: Component Loadings

Component Matrix	
	Component
	1
Fever	.823
Dry Cough	.820
Fatigue/Tiredness	.771
Loss of taste/smell	.731
Breathing Shortness	.863
Muscle Aches	.762
Chills	.806
Sore Throat	.854
Runny Nose	.848
Headache	.800
Chest Pain	.783
Pink Eyes (conjunctivitis)	.855
Extraction Method: Principal Component Analysis.	
a. 1 components extracted.	

Age group differences: To know the age wise difference in the intensity of the symptoms, one Way ANOVA is performed, as we have 4 age groups as given is the table1.1, the groups differences are investigated as can be seen in the results matrix of the ANOVA in the table 1.6. It is clear from the statistics that higher the age of the respondents more they are vulnerable to represents the intense symptoms.

Table 7: Mean Difference Per Age Group

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
FEVER	Between Groups	11.799	2	5.900	2.449	.091
	Within Groups	264.980	110	2.409		
	Total	276.779	112			
DRY COUGH	Between Groups	13.079	2	6.539	3.823	.025
	Within Groups	188.143	110	1.710		
	Total	201.221	112			
FATIGUE/TIREDNESS	Between Groups	9.564	2	4.782	2.538	.084
	Within Groups	207.215	110	1.884		
	Total	216.779	112			
LOSS OF TASTE/SMELL	Between Groups	7.332	2	3.666	2.479	.089
	Within Groups	162.686	110	1.479		
	Total	170.018	112			
BREATHING SHORTNESS	Between Groups	24.487	2	12.243	5.417	.006
	Within Groups	248.611	110	2.260		
	Total	273.097	112			
MUSCLE ACHES	Between Groups	20.048	2	10.024	4.695	.011
	Within Groups	234.837	110	2.135		
	Total	254.885	112			
CHILLS	Between Groups	29.795	2	14.897	9.446	.000
	Within Groups	173.480	110	1.577		
	Total	203.274	112			
SORE THROAT	Between Groups	30.049	2	15.024	8.459	.000
	Within Groups	195.385	110	1.776		
	Total	225.434	112			
RUNNY NOSE	Between Groups	21.935	2	10.968	5.585	.005
	Within Groups	215.994	110	1.964		
	Total	237.929	112			
HEADACHE	Between Groups	27.554	2	13.777	8.162	.000
	Within Groups	185.667	110	1.688		
	Total	213.221	112			
CHEST PAIN	Between Groups	27.168	2	13.584	7.964	.001
	Within Groups	187.611	110	1.706		
	Total	214.779	112			
PINK EYES (CONJUNCTIVITIS)	Between Groups	42.180	2	21.090	10.358	.000
	Within Groups	223.962	110	2.036		
	Total	266.142	112			

Doses wise difference in symptoms (t-test): Secondly, the dose wise difference in the intensity of the symptoms is evaluated using independent sample t-test to know whether the intensity of the symptoms is higher in first or second shot of the vaccination.

The following matrix (Table 8) illustrates the increased severity of fatigue, dry cough loss of taste/smell, fever shortness of breath, chills, muscle aches, sore throat, headaches, runny nose, chest pain, and pink oyster (conjunctivitis) following the second vaccine injection with a significance level less than or equal to 0,05. The results of which can be seen below in the table 8.

Table 8: Independent Sample t-test

STATISTICS MATRIX						
	Doses	N	Mean	Std. Deviation	Sig.	t
FEVER	Single Shot	29	1.069	0.45756	0	-10.573
	Double Shot	84	3.6071	1.26127		-15.694
DRY COUGH	Single Shot	29	2.1034	0.97632	0.045	-6.81
	Double Shot	84	3.7619	1.17831		-7.462
FATIGUE/TIREDNESS	Single Shot	29	1.6207	1.01467	0.312	-7.982
	Double Shot	84	3.5357	1.14541		-8.47
LOSS OF TASTE/SMELL	Single Shot	29	1.4828	0.73779	0.277	-8.251
	Double Shot	84	3.2143	1.04214		-9.725
BREATHING SHORTNESS	Single Shot	29	1.5517	1.02072	0.209	-8.274
	Double Shot	84	3.75	1.29759		-9.292
MUSCLE ACHES	Single Shot	29	1.6552	1.04457	0.119	-4.571
	Double Shot	84	3.0238	1.48872		-5.41
CHILLS	Single Shot	29	1.5517	0.82748	0.055	-4.258
	Double Shot	84	2.7024	1.36902		-5.369
SORE THROAT	Single Shot	29	1.6552	0.76885	0.005	-6.585
	Double Shot	84	3.369	1.32428		-8.437
RUNNY NOSE	Single Shot	29	1.8276	0.75918	0	-6.316
	Double Shot	84	3.5357	1.38361		-8.27
HEADACHE	Single Shot	29	1.3103	0.54139	0.003	-7.48
	Double Shot	84	3.131	1.26852		-10.643
CHEST PAIN	Single Shot	29	1.8621	0.9901	0.035	-5.551
	Double Shot	84	3.3333	1.30184		-6.333
PINK EYES (CONJUNCTIVITIS)	Single Shot	29	1.2414	0.95076	0.023	-5.982
	Double Shot	84	2.9762	1.45599		-7.304

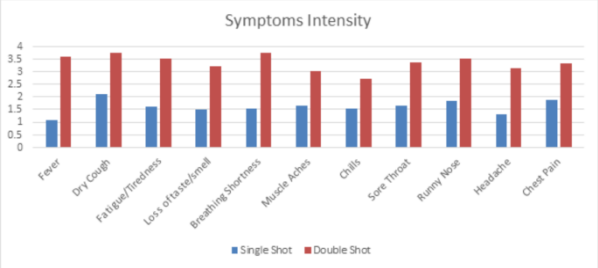

Figure 2: Mean Difference of Intensity of symptoms per Shot

CONCLUSION

Impact of corona virus vaccines and the process of vaccination in the Region of Pakistan is based on indication of vaccine efficacy, and while adoption to the vaccine is higher among people of older ages than others is cleared in surveys which are conducted in Pakistan, clear government communication is necessary. In order to make sure of the success of effective vaccination strategy that leverages the government is the vaccinated experience as a trusted source of medical information. Immunization, on the other hand, would be less cost effective if the vaccine could only be purchased at an amount for low budget or if its efficacy was as low as 35%. Additionally, even if a multiyear mass vaccination effort is economically efficient, it may divert scarce resources away from other critical health services. Additionally, as there are different symptoms those are shown by the people vaccinated in the due course, it is also to consider that, which vaccine is suitable for which age group and hence classification should be based on either cost effectiveness of the vaccine dosage or reduced side effects of the applied vaccines to individuals. Vaccination choices should also include factors other than cost-effectiveness, such as the minimum side-effects or zero side-effects and associated measures against socioeconomic marginalized groups, as well as the compelling need to restore economic and social normalcy. Analysts of this kind should be supported by macroeconomic research and data on larger societal effects within a well-defined decision agenda to appropriately guide policy decisions (e.g., health technology assessment).

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