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Original Article

Assessing the Post-Vaccination Impact of Different Brands of COVID-19 Vaccines in Bangladeshi Population

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Abstract:

The Covishield was the first vaccine introduced in Bangladesh to combat the global COVID-19 pandemic. Gradually, Bangladesh introduced Moderna, Sinopharm, and Pfizer-BioNTech vaccines to combat COVID-19. The goal of this study was to assess the short- and long-term adverse effects of these vaccinations on the Bangladeshi people. A cross-sectional study was undertaken on social media and in face-to-face interviews with vaccinees. The collected data were then analyzed to assess the effectiveness and adverse effects of the vaccine after administration. This study garnered a total of 502 responses; the majority of respondents were between 18 and 40 years old, and 74.7% were male. Before vaccination, 13.94% of respondents were infected with the SARS-CoV-2 virus. From the populations under survey, 210 (after the 1st dose) and 222 (after the 2nd dose) reported various side effects after taking the COVID-19 vaccine. Oxford-AstraZeneca, Sinopharm, and Pfizer-BioNTech showed relatively fewer post-vaccination complications. A total of 34.06% of those who received the COVID-19 vaccine reported experiencing localized symptoms, the most prevalent of which were swelling and pain at the injection site following immunization. To assess the effectiveness of these vaccines, 47 participants were infected with COVID-19 after vaccination, but only four were hospitalized. Within 7 days of treatment, 61.7% of infected patients were recovered. However, to assess the long-term effects of post-vaccination, data on 273 individuals was collected separately after one year following the initial vaccination, and most of the respondent's results were similar to the initial study.

Key words: COVID-19 vaccine, Chronic diseases, Vaccine effectiveness, Post-vaccination impact, Injection site pain/swelling, Bangladeshi population.

Introduction:

COVID-19 is caused by infection with the severe acute respiratory syndrome coronavirus 2, which has a helical symmetry in its nucleocapsid and a positive-sense single-stranded RNA genome[1]. It was declared a pandemic in early 2020 and is still ongoing[2]. As of 2 July 2023, over 767 million confirmed COVID-19 cases globally, with more than 6.9 million deaths have been reported globally[3]. COVID-19 symptoms can range from mild to severe, with varying impacts on individuals. Mild symptoms typically resemble common cold-like issues, including cough, sore throat, nasal congestion, low-grade fever (below 100.4°F or 38°C), fatigue, muscle or body aches, headache, loss of taste or smell, and mild gastrointestinal discomfort like nausea or diarrhea. These symptoms are generally manageable

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at home with rest and hydration. Moderate symptoms involve more persistent issues, such as a higher and more consistent fever (between 100.4°F and 102°F or 38°C and 39°C), a worsening cough, mild to moderate shortness of breath, chest pain, pronounced fatigue, increased muscle or body aches, and more significant gastrointestinal symptoms like moderate nausea or vomiting. Severe symptoms, however, are critical and require immediate medical attention. These include a high fever (above 102°F or 39°C), severe shortness of breath even at rest, intense and persistent chest pain or pressure, severe fatigue, confusion or disorientation, and bluish lips or face indicating oxygen deprivation. Severe gastrointestinal symptoms such as intense vomiting or diarrhea can also occur, leading to dehydration. It is crucial to seek medical advice if symptoms worsen or new severe symptoms develop, especially for individuals with underlying health conditions or compromised immune systems. Early intervention and medical evaluation can significantly impact the management and outcome of the disease[4-6]. Rapid transmission of COVID-19 has led to an overburden on public health, and the world economy, highlighting the need for a fast and effective method to prevent or treat these potentially deadly infections[7]. Treatments include antiviral medications (nucleotide analogs), antimalarial drugs (to avoid entrance and multiplication of virus cells), immunomodulators, and plasma-based therapy[8-13]. Despite different treatment options, no prospective medicines for COVID-19 are now accessible. Previous research showed that patients are frequently re-infected but have been declared clinically recovered[14]. Therefore, safe and effective preventive vaccines are urgently needed to control this pandemic.

Vaccination is an effective way to lessen the burden of COVID-19, and the success rate is based on high acceptance of the existing vaccine. Despite the extensive research on the immunogenicity of COVID-19 vaccines since their introduction, concerns remain about their effectiveness against emerging variants, long-term immunity, and potential side effects. Since the introduction of COVID-19 vaccines, there has been intensive research on their immunogenicity[5,15-16]. As of December 31, 2023, 56% of the global population has been vaccinated with a complete primary series of a COVID-19 vaccine, and 28% of the global population has received at least one booster dose of a COVID-19 vaccine[4]. After COVID-19 vaccination, the immune system produces immunoglobulin G (IgG) which may neutralize SARS-CoV-2 by binding to the receptor binding domain (RBD) of the S1 subunit of the spike protein of SARS-CoV-2 in serum. Recent studies showed that antibody levels drop rapidly after vaccination[17]; moreover, protection against infection also drops overtime after the second dose of the vaccine[18]. Post-vaccination COVID-19 infection was confirmed through positive RT-PCR or antigen tests for SARS-CoV-2 following vaccination (CDC, 2021)[19].

The COVID-19 vaccination program in Bangladesh began on January 27, 2021, with the launch of the nationwide campaign. Initially, the country relied heavily on the Oxford-AstraZeneca vaccine, procured from India and through the COVAX initiative. However, due to supply disruptions, Bangladesh diversified its vaccine portfolio, incorporating Sinopharm and Sinovac from China, Pfizer-BioNTech, Moderna, and Johnson & Johnson vaccines. The program prioritized frontline health workers and vulnerable populations, eventually expanding to the general adult population and later to adolescents. The rollout saw a mix of mass vaccination centers, mobile clinics, and digital registration platforms to streamline the process. By the end of 2022, significant progress had been made, with millions receiving their first and second doses, and booster doses being administered to further enhance immunity. The program's success was marked by robust public health campaigns, international cooperation, and an adaptable strategy to overcome supply challenges and increase coverage across the country[20-21]. This study's main objectives included assessing the short- and long-term adverse reactions and efficacy of COVID-19 vaccines, along with investigating factors linked to their acceptance within the context of Bangladesh.

Materials and Methods:

This survey research on the COVID-19 vaccine's post-vaccination side effects and implications was conducted both online and offline, utilizing a retrospective and cross-sectional technique. The online questionnaire was then shared over social and electronic media (Facebook, Messenger, WhatsApp, LinkedIn, and Email), and the offline data was collected by face-to-face interview.

The current study targeted a random sample of individuals who had received at least one dose of the COVID-19 vaccine. A total of 502 respondents were included in this study from different areas of Bangladesh, such as Dhaka, Khulna, Jessore, Manikganj, Gazipur, and so on. However, data on 273 people was gathered a year after the initial vaccination to evaluate the long-term consequences of post-vaccination effects. The sample size has been estimated using the random and snowball sampling methods[22].

The instrument was developed by the researcher and was composed of six parts in the Questionnaire. They were the: Demographic Data Assessment Form; Background history analysis before vaccination; Vaccination Information; After effects of Vaccination (1st dose); After effects of Vaccination (2nd dose) and Post Vaccination Effects.

The initial study was conducted from 11 November 2021 to 30th November 2022. A response period of 24 weeks was designated to gather feedback from individuals who received the COVID-19 vaccine. The survey enlisted a sample of 502 individuals from diverse socioeconomic backgrounds who had received either one or two doses of the vaccine. Only responses that contained complete answers were included in the final analysis. To assess the long-term impacts of post-vaccination effects, data on 273 individuals were collected more than one year after the initial vaccination.

Statistical testing was conducted using version 20 of SPSS (SPSS Inc., Chicago, IL) and Excel (Microsoft Corporation, Redmond, WA). Sociodemographic parameters such as gender, age, place of living, education, comorbidities, side effects, and their severity were analyzed with descriptive statistics. Cross-tabulation and Pearson Chi-square test were done of different variables. Chi-square test for independence was done to assess which manufacturers of vaccines or the types of vaccines enhance the likelihood of safety and effectiveness. In all tests of relationship between two variables was deemed statistically significant if p value <0.5. The assessment included the presentation of cumulative and average data, with the results being expressed as percentages (%).

Results:

The primary focus of this survey study was to examine a diverse range of populations residing in various regions of Bangladesh, both urban and rural. In total, there were 502 participants, of whom 74.7% were male and 25.3% were female (only 3.1% were pregnant during vaccination), actively answering all the constructive questions. The participant's educational qualifications were also assessed, and 69.9% of them were found to have completed higher secondary education or higher. The participants were categorized into six different age groups: below 18 years, 18–30 years, 31–40 years, 41–50 years, 51–60 years, and above 60 years. The results from Table I show that the majority of vaccine recipients belong to the age groups of 18–30 years and 31–40 years, corresponding to 69.1%. The respondent's distribution was 52.8%, 34.1%, and 3.1% from urban, suburban, and rural areas, respectively. Here, 38.5% of participants were job holders and 33% were students (Table I).

Table I: Distribution of population according to demographic variables (n = 502).

Variable	Category	Frequency (Percentage)
Gender	Male	375 (74.7%)
	Female	127 (25.3%)
Age Group	Below 18 years	53 (10.6%)
	18 - 30 years	209 (41.6%)
	31 - 40 years	138 (27.5%)
	41-50 years	80 (15.9%)
	51-60 years	15 (3.0%)
	Above 60 years	7 (1.4%)
Educational Level	Less than high school	33 (6.6%)
	High school or equivalent	118 (23.5%)
	Higher secondary	107 (21.3%)
	Bachelor's degree	162 (32.3%)
	Postgraduate studies	82 (16.3%)
Place of living	Urban (A city like Capital or District)	265 (52.8%)
	Suburban (Sub-district)	171 (34.1%)
	Rural (A village)	66 (13.1%)
Employment Status	Govt. Job	50 (10.0%)
	Private Job	143 (28.5%)
	Retired Person	5 (1.0%)
	Student	168 (33.5%)
	Agriculture	26 (5.2%)
	Business	54 (10.8%)
	None	56 (11.2%)

Most of the respondents have taken Sinopharm (174/502), Pfizer-BioNTech (132/502), and Oxford-AstraZeneca (116/502) vaccines. Of the 502 respondents 174/502 (34.66%) had received the Sinopharm vaccine, of which 4.60% reported moderate to severe symptoms (Figure 1). More than 26 percent (26.29) of participants took Pfizer-BioNTech vaccine as 1st dose and only 9.84% reported moderate to severe symptoms. Among all participants, 23.10% were administered the Oxford-AstraZeneca vaccine whereas 13 (2.59%) faced moderate to severe symptoms (Figure 1A). Thirty-seven (9.39%%) (out of 394) participants reported moderate to severe symptoms after taking the vaccine of all manufacturers as 2nd dose which was negligible (Figure 1B).

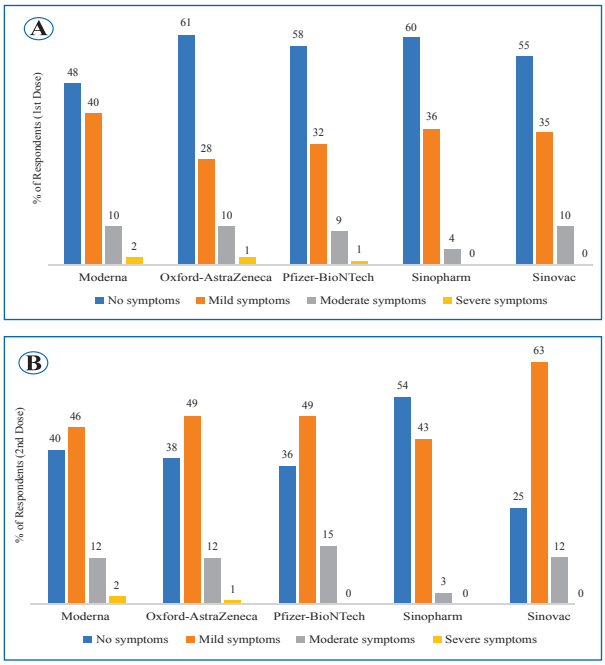

Figure 1: Manufacturer-wise post-vaccination symptoms of COVID-19 Vaccines. Figure 1A represents the 1st dose, and Figure 1B represents the 2nd dose.

The Pearson chi-square test was conducted to examine the relationship between the vaccine manufacturers and the symptoms after vaccination, and the association was statistically significant (P <0.001).

Among the survey participants, 7.6% had chronic conditions like hypertension, diabetes, asthma, and cardiovascular disease. About 12% of the individuals had obesity, and only 1.4% had asthma. Furthermore, several participants identified osteoporosis, renal diseases, hypothyroidism, and fatty liver as pre-existing medical conditions. Relation of side effects with pre-existing chronic disease is shown in Figure 2.

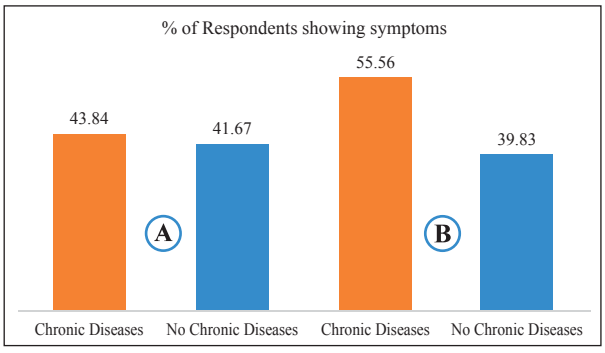

Figure 2: Effects of chronic diseases on side-effects of COVID-19 vaccines. (A) After 1st dose and (B) After 2nd dose.

Of the 502 respondents, 210 (41.83%) (after the first dose) and 222 (56.35%) (after the second dose) reported post-vaccination side effects. Only 1.3% of respondents reported severe side effects that persisted longer than one week. Seventy-five participants (14.94%) reported moderate symptoms, while 352 (70.12%) (first and second doses) reported mild or less severe symptoms (Table II). Most participants reported having no symptoms.

Table II: Symptoms during or after receiving the first (n=502) and second (n=394) dose of vaccination.

Type of symptoms	Number of respondents (%)	Number of respondents (%)
No symptoms at all	292 (58.17)	172 (43.65)
Yes, mild symptoms	167 (33.27)	185 (46.95)
Yes, moderate symptoms	40 (7.97)	35 (8.88)
Yes, severe symptoms	3 (0.60)	2 (0.51)

Only four (8.51%) of the 47 patients who developed COVID-19 after vaccination required hospitalization. About 61.7% of affected patients recovered within 7 days of treatment (Table III and Figure 3). The majority of participants (90.64%, 455/502) reported that they didn't get affected after vaccination.

Table III: Distribution of population according to post-vaccination infection and level of treatment status (n=502)

Post-vaccination Infection	Number (%)	Treatment of infected persons	Number (%)
No	455 (90.64%)	Did not seek medical care	1 (2.13%)
After 1st dose	11 (2.19%)	Received medical care but was not hospitalized	42 (89.36%)
After 2nd dose	36 (7.17%)	Was hospitalized	4 (8.51%)

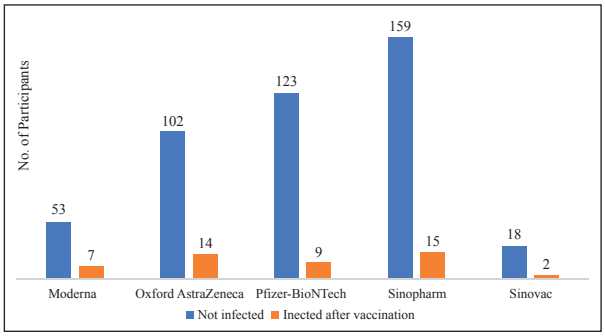

Figure 3: Manufacturer wise no. of infected people after vaccination.

Among 273 random participants, only 17 (6.23%) reported that they had noticed long-term side effects after vaccination, and the side effects were abdominal pain, fever, breathing difficulties, and asthma. However, it is quite difficult to say that the side effects reported by respondents were only caused by the COVID-19 vaccine, as we have no clinical data. Only three (1.10%) participants had antibody testing results, and all results were positive. Most of the respondents reported that they had not experienced any long-term side effects.

Discussion

In this survey study, we aimed to analyze the impact of post-vaccination on different brands of COVID-19 vaccines. The vaccination program started in Bangladesh on 25 June 2021. Due to concerns related to vaccine adverse events and effectiveness, most of the population was unwilling to receive vaccines[23]. Our study focused on summarizing all the reported adverse effects and post-vaccination effects. According to this study's demographic data, it was determined that educated respondents were more aware of the possible fatal nature of the disease and that most vaccine recipients held a degree beyond a high school diploma. About 52.8% of vaccine recipients in our study resided in urban locations. Eighty five percent of the population was between the ages of 18 and 50, while 10.6% of the population was younger than 18. In 21.12% of the participants, chronic disease and obesity were the predominant comorbidities, accounting for 7.6% and 12%, respectively.

Other research revealed comparable demographic disparities in vaccine acceptance. Rural residents, Blacks, and Republicans were most vaccine-hesitant in a December 2020 de Beaumont Foundation survey[24]. Black and Hispanic vaccination hesitancy decreased between October 2020 and March 2021, according to this research, and vaccine confidence varies by demography. Their investigation confirmed that vaccination reluctance differs by race, ethnicity, education, and location[24].

This study revealed that the prevalence of chronic disease increases post-vaccination side effects. The Pfizer and Moderna mRNA-based vaccines have drawn the most attention about vaccination adverse effects due to their quick development and manufacture[25-26]. Similar to other vaccinations, these side effects are occasionally due to local allergic reactions with a delayed onset. However, the predominant complaint in the great majority of cases is a confluence of fever, headache, myalgia, and general malaise, influencing 60% of patients following their second vaccination dose. The majority of the symptoms are probably just related to the excessive synthesis of type I interferon (IFN-I)[27]. Seventy participants who had previously been infected with COVID-19 nonetheless received the vaccination. Localized symptoms including pain and edema at the injection site, fever, joint pain, and fatigue were common side effects, according to the CDC, a COVID-19 response team[27]. In this study, after the first or second dose of the COVID-19 vaccine, pain at the injection site, fever, dizziness, headache, and decreased appetite were common complications that occurred at an early stage of post-vaccination. A majority of the participants experienced post-vaccine side effects, thereby implying the proper function of their immune systems[28]. In recent scholarly research, the usual side effects following vaccination primarily included localized symptoms such as pain, redness, or swelling at the injection site, as well as systemic manifestations including muscle and joint discomfort, fatigue and lethargy, dizziness, fever, and headache[29-30]. Adverse reactions such as allergies and dermatological manifestations may manifest after the administration of vaccines[29,31].

Almost 41.09% of the participants (after the 1st dose) and 56.3% of the participants (after the 2nd dose) experienced these localized symptoms, whereas Oxford-AstraZeneca, Sinopharm, and Pfizer-BioNTech showed relatively less post-vaccination symptoms.

Sinopharm and Oxford-AstraZeneca's adverse effects were more severe after the first dosage than they were after the second, however, the BioNTech Pfizer vaccine's side effects were more severe after the second dose than they were after the first[32]. The Oxford-AstraZeneca vaccine demonstrated a higher level of efficacy compared to the Sinopharm BBIBP vaccine. Furthermore, the administration of a single dose of the Oxford-AstraZeneca vaccine elicited an immune response comparable to that induced by two doses of the Sinopharm BBIBP vaccine[32].

More than 34% of the respondents reported pain at the injection site and >16% reported fever, respectively, right after the vaccination. The majority of participants reported no symptoms. Forty-seven participants were affected by COVID-19 after vaccination; 11 participants were affected before taking the second dose, but only four were hospitalized among the 47. Consequently, our summary of the COVID-19 vaccine's associated adversereactions and post-infection data will be useful in reducing confusion regarding vaccination. The data assures that the vaccines used in Bangladesh are safe

and effective, even though they were developed rapidly and with limited clinical data.

Another study report shows that, according to the severity of post-vaccination side effects in mild or severe cases, all three vaccinations were safe[33]. After administering 1736 doses to the public in the first month of the immunization program, Pfizer, BioNTech, and Sinopharm COVID-19 vaccines had positive post-authorization safety profiles[33].

Conclusion:

Since its emergence in Wuhan, China, in late 2019, the COVID-19 pandemic has had a profound impact on the world. This study investigated the effectiveness and short-term adverse effects of COVID-19 vaccines in Bangladesh. The majority of participants reported injection-site swelling and pain, as well as fever and headaches. Furthermore, considering the side effects, only a few people had to visit a doctor or be admitted to the hospital. A small number of participants were affected covid-19 after vaccination and most of them were relieved without hospitalization. To determine the effectiveness of available vaccines in controlling and preventing SARS-CoV-2 infection in Bangladesh, it is necessary to conduct extensive follow-up research. Furthermore, prospective studies and associated pharmacovigilance and clinical studies should be conducted to investigate the long-term effects of these vaccine adverse effects. This study has key limitations. Non-random sampling may introduce selection bias, underrepresenting less engaged or offline individuals. The small sample size also limits statistical power and generalizability. Future research should include larger, more diverse populations for greater reliability.

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