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Original Article

EVALUATION OF THE POTENTIAL ASSOCIATED FACTORS CONTRIBUTING TO VARIOUS SIDE EFFECTS OF COVID-19 VACCINES IN BANGLADESH

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ABSTRACT

Objective: Due to questions about the safety and possible side effects of COVID-19 vaccines, initially, most individuals with chronic comorbid conditions showed unwillingness to vaccination. Though COVID-19 vaccines were found safe in clinical trials, real-world results still need to be explored to generate and further analyze the safety and efficacy profile of these vaccines. Our study aimed to evaluate and associate the various side effects of COVID-19 vaccines at different covariate levels along with comorbid conditions.

Methods: This cross-sectional study aimed to evaluate the side effects of COVID-19 vaccines in Bangladesh using data collected from a sample of vaccinated individuals through a structured questionnaire. The data were analyzed using descriptive statistics, bivariate analysis with a chi-square test, and multiple logistic regression model to identify the frequency, severity, and duration of side effects, as well as the associations between side effects and potential predictors. Our study investigated the side effects of four prominent approved COVID-19 vaccines in Bangladesh.

Results: The findings revealed that Sinopharm was the most administered vaccine, accounting for 55% of the respondents. The majority of participants (38%) reported experiencing mild side effects, such as pain at the injection site, fatigue, and headache, while only 13% required hospitalization due to severe side effects. Significant associations were observed between vaccine type and variables such as gender, age group, concomitant health complications, prior COVID-19 history, physician's recommendation, and adverse consequences. Logistic regression analysis identified significant associations between the presence of side effects and variables such as concomitant health complications (OR=3.2 p-value: 0.011) and concomitant medications (OR=0.38, p-value: 0.039).

Conclusion: These results provide valuable insights to help guide vaccination strategies and ensure vaccine safety in Bangladesh. Further investigation into these aspects in larger and more diverse groups is necessary, taking longitudinal follow-up and the objective evaluation of side effects into consideration.

Keywords: Covid-19 vaccine, Vaccine's side effects, Comorbidity, Vaccine comparison, Public health

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INTRODUCTION

"Coronaviruses" refers to a group of viruses that are enveloped, single-stranded positive-sense RNA viruses having spike (crown-like) protein projections on the surface [1]. This group of viruses is capable of infecting immunocompetent humans with mild respiratory infections [2]. On 31st Dec 2019 in Wuhan China, patients reported pneumonia-like symptoms and the cause was a novel coronavirus named SARSoV-2 (severe acute respiratory syndrome coronavirus-2). On spreading all over the world, the World Health Organization (WHO) declared it a pandemic [3, 4]. According to a few studies and CDC (Centers for Disease Control and Prevention), clinical manifestations were reported as fever, dry cough, dyspnea, acute respiratory distress syndrome (ARDS), anosmia or hyposmia, loss of taste, myalgia, anorexia, fatigue, headache, gastrointestinal symptoms included diarrhea, abdominal pain, and vomiting/nausea [5, 6]. One of the reviews identified that extrapulmonary manifestations of COVID-19 affect urinary, cardiovascular, gastrointestinal, hematological, hematopoietic, neurological, and reproductive systems, underscoring the need for improved management and diagnosis [7]. The severity and prevalence of these symptoms vary according to geography, time frame, age, comorbidity type, and variation type [8–10]. As a treatment and preventive measure, many ways evolved to combat this disease, including traditional herbal medicines, plasma therapy, corticosteroids, antimalarials, antivirals, rheumatoid drugs, and interferon as immunomodulators. Ritonavir-boosted nirmatrelvir, molnupiravir, and certain anti-SARS-CoV-2 monoclonal antibodies including bebtelovimab [11].

Nonetheless, vaccination is regarded as an effective preventive intervention to control the spreading of COVID-19 globally. After publishing the genome sequence of SARS-CoV-2 on 11 January 2020, vaccine development was initiated globally and the first vaccine started the first human clinical trial on 16th March 2020 [5, 9]. As SARS-CoV-2 bind with the host cell receptor ACE-2 (angiotensin-converting enzyme 2) through its spike (S) protein to enter the host cell, most vaccine targeted with neutralizing antibodies against S protein thus prevent binding with ACE-2 receptor and pathogenesis of virus [12]. The first approved vaccine was developed by Pfizer/BioNTech (Dec 2020) and accepted in 146 countries [13, 14]. While collecting the data for this study, in Bangladesh, it was observed that vaccines from AstraZeneca, Pfizer, Sinopharm, Moderna, and Sinovac were administered for 1st dose and 2nd dose whereas Janssen was administered only for 2nd dose [15]. It's crucial to recapture that each vaccine has some noticeable, typical side effects [16]. According to the CDC, after getting a Covid 19 vaccine, individuals may experience pain, redness, and swelling in the vaccinated area, tiredness, headache, muscle pain, chills, fever, nausea, etc. This symptom may intensify after the second dose. Some serious and rare adverse effects are mentioned as anaphylaxis, thrombosis, myocarditis, and pericarditis (CDC 2022) [17].

In clinical trials, Covid-19 vaccines were found safe; however, investigators did not get sufficient time to generate safety data and explore the dose optimization factors of these vaccines. Therefore, it is of huge significance to generate and analyze the safety and efficacy profile of these vaccines through real-world evidence [18–20].

In Bangladesh, the vaccine inauguration was held on 27th Jan 2021 and the vaccination program started on 7th Feb 2021 all over the country by prioritizing frontline workers and older people aged 40 y and above at the beginning. Due to the question of safety and possible side effects, most individuals with chronic disease showed

unwillingness at the beginning days of the vaccine campaign [21]. Almost 85.62% of the total population is vaccinated in Bangladesh and a total of 359,933,508 doses of vaccine have been given up to 18 June 2023. According to reports made by the WHO, 2,041,623 confirmed cases of COVID-19 infection and 29,457 fatalities have been reported in Bangladesh from 3 Jan 2020 to 21 Jun 2023 [22]. Therefore, our study is aimed to understand the potential associated factors affecting the changing pattern of side effects of different candidates of administered vaccines in Bangladesh and associate the occurrence of those side effects at different covariate levels with comorbid complications. This will be an insight to evaluate the emergence and severity of common and rare side effects after covid 19 vaccination in the Bangladeshi population.

MATERIALS AND METHODS

This cross-sectional study employed convenience sampling to collect data on COVID-19 vaccine side effects among individuals in Bangladesh. Data collection was conducted through an online survey (in Google Forms) and disseminated via social media platforms. The survey was designed to capture relevant information regarding the participants' demographic characteristics, vaccine type received, and reported side effects. The survey was conducted in the English language and included structured questions to ensure consistency in data collection. Participants of all ages and genders who had received at least one dose of the COVID-19 vaccine met the inclusion criteria of this study. However, those who were not immunized were not included in this study. The online survey link was shared on various social media platforms, allowing individuals who had received at least one dose of a COVID-19 vaccine to voluntarily participate and provide self-reported information on their vaccine's side effects. Participation in the study was anonymous and voluntary, and participants were assured of the confidentiality and privacy of their responses. We also took the consent of publishing the result of this research from the respondents. The data collection period spanned from 01-02-2023 to 01-03-2023. Ethical approval for this study was obtained from the Ethical Review Committee of the Department of Pharmacy, East West University (EWU-ERCDOP) on 29 January 2023 with the decision number "EWU-ERCDOP-00003". After finishing the deadline, we found 305 complete responses from the participants. Among them, those patients who have at least one of the diseases among mental illness, diabetes, kidney disease, liver disease, asthma, heart disease, thyroid disease, immunodeficiency disorder, cancer, rheumatoid arthritis, vitamin deficiency are considered to have concomitant health complications in this study. We also asked them whether they are taking medication even with the physician's recommendation. Our study investigated four prominent candidates of covid 19 vaccines available in Bangladesh (Moderna, Oxford-AstraZeneca, Pfizer, and Sinopharm). People got one out of these four candidates for vaccines randomly. Though the 4th round of covid 19 vaccination is ongoing here, none of the respondents of this research had 3rd or 4th doses of the vaccine. In this study, most of the respondents got the vaccines of Sinopharm and they took vaccines without any physician's recommendation. We also considered the severity of the side effects of vaccines on a scale (none, mild, moderate, severe, and very severe) according to a previously published research paper [23].

We applied several statistical analyses to get insight into the data. Descriptive statistics are presented in table 1. To examine whether the different candidates of vaccines have an association with the different types of covariates, chi-square tests were conducted and represented in table 2. We also used a multiple logistic regression model to determine the contribution of the related variables to the occurrence of side effects.

RESULTS

Descriptive analysis

Table 1 presents the descriptive analysis of the data sample, including demographic factors and vaccine-related information. The study comprised participants from various age groups, with 54.1% being male. People aged between 11 to 20 participated the most (34.43%) in the study, while participation among those aged above 60 was relatively low (18.69%). Regarding BMI classification, 61.31% of participants were considered "Normal," while 30.82% fell into the "Overweight and Obese" category. Urban residents accounted for 62.3% of the sample. Notably, 52.46% of participants had concomitant health complications, and 48.52% were on concomitant medications.

Physician involvement in vaccination decisions was relatively high, with 68.2% of participants seeking a physician's opinion on medication. However, 71.8% did not consult a physician for treating the side effects of the COVID-19 vaccine. The majority (73.77%) had no prior history of being COVID-19 positive, and 65.9% had received at least a second dose of the vaccine. Among the vaccine types administered, Sinopharm was the most common (34.43%), followed by Pfizer (24.26%). After vaccination, most participants experienced side effects within one to three days (85.57%), but only 13.11% reported severe side effects leading to hospitalization. Notably, 51.15% reported adverse consequences of the COVID-19 vaccination on their previous health issues. Additionally, common side effects included headache, weariness, body and joint aches, chills, fever, chest pain, injection site redness, injection site swelling, shortness of breath, and diarrhea.

Bivariate analysis

Table 2 provides insights into the relationship between various covariates and the vaccine type used for COVID-19 vaccination. The corresponding p-values from chi-square tests indicate the statistical significance of the associations observed.

Table 1: Descriptive analysis of the sample

Variable name	Category	Frequency	Percentage
Gender	Female	140	45.9
	Male	165	54.1
Age Group	11-20	105	34.43
	21-30	51	16.72
	31-40	34	11.15
	41-50	22	7.21
	51-60	36	11.8
	60+	57	18.69
BMI	Normal	187	61.31
	Underweight	24	7.87
	Overweight and Obese	94	30.82
Area of Residence	Rural	115	37.70
	Urban	190	62.30
Concomitant health complications	No	145	47.54
	Yes	160	52.46
Concomitant medications	No	157	51.48
	Yes	148	48.52
Physician's opinion on medication	No	97	31.80
	Yes	208	68.20

Variable name	Category	Frequency	Percentage
Prior history of being COVID-19 positive	No	225	73.77
	Yes	80	26.23
Vaccine dose taken	Second Dose	201	65.90
	First Dose	104	34.10
Vaccine type	Moderna	61	20.00
	Oxford-AstraZeneca	65	21.31
	Pfizer	74	24.26
	Sinopharm	105	34.43
Physician's recommendation on vaccination	No	206	67.54
	Yes	99	32.46
Side effects initiation	One to Three Days	261	85.57
	7 D	27	8.85
	More than 7 D	17	5.57
Side effects continuance	One day	102	33.44
	Three days	84	27.54
	Five days	52	17.05
	More than Five days	67	21.97
Coronavirus infection, after vaccination	No	278	91.15
	Yes	27	8.85
Self-medication to relieve side effects	No	201	65.90
	Yes	104	34.10
Physician consultation to treat side effects of the COVID-19 vaccine	No	219	71.80
	Yes	86	28.20
Side effects severity	None	46	15.08
	Mild	117	38.36
	Moderate	66	21.64
	Severe	49	16.07
	Very Severe	27	8.85
Hospitalization due to side effects severity after vaccination	No	265	86.89
	Yes	40	13.11
The adverse consequence of COVID-19 vaccination on previous health issues	No	149	48.85
	Yes	156	51.15
Types of side effects after 1st dose:	Headache	91	12.21
	Fatigue	68	9.13
	Injection site pain	236	31.68
	Body and joint pain	88	11.81
	Chills	45	6.04
	Fever	45	6.04
	Chest Pain	11	1.48
	Injection site redness	48	6.44
	Injection site swelling	68	9.13
	Shortness of breathing	25	3.36
	Diarrhea	20	2.68
Types of side effects after 2nd dose	Headache	90	13.60
	Fatigue	47	7.10
	Injection site pain	194	29.31
	Body and joint pain	81	12.24
	Chills	36	5.44
	Fever	52	7.85
	Chest Pain	8	1.21
	Injection site redness	53	8.01
	Injection site swelling	68	10.27
	Shortness of breathing	20	3.02
	Diarrhea	13	1.96

Table 2: Distribution of different candidates of vaccines at different covariate levels

Variable name	Category	Vaccine type (%)				P value
		Moderna	Oxford-Astra Zeneca	Pfizer	Sinopharm	
Gender	Female	15	24	18	43	0.002
	Male	24	19	30	27	
Age Group	11-20	22	9	28	0	<0.001
	21-30	20	20	29	31	
	31-40	29	9	30	32	
	41-50	14	18	27	41	
	51-60	19	31	17	33	
	60+	14	49	12	25	
BMI	Normal	20	22	27	31	0.167
	Underweight	17	5	30	48	
	Overweight and Obese	20	25	17	38	
Area of Residence	Rural	19	27	19	35	0.183

Variable name	Category	Vaccine type (%)				P value
		Moderna	Oxford-Astra Zeneca	Pfizer	Sinopharm	
	Urban	21	18	27	34	
Concomitant health complications	No	22	34	18	26	0.009
	Yes	18	10	30	42	
Concomitant medications	No	23	32	17	28	0.003
	Yes	17	10	32	41	
Physician's opinion on medication	No	21	11	29	39	0.031
	Yes	20	26	22	32	
Prior history of being COVID-19 positive	No	17	21	22	40	0.012
	Yes	26	23	31	20	
Vaccine dose taken	Both Dose	18	13	43	26	<0.001
	First Dose	21	26	14	39	
Physician's recommendation on vaccination	No	19	18	21	42	<0.001
	Yes	22	27	31	20	
Side effects initiation	One to Three Days	19	21	22	38	0.590
	7 D	30	19	33	18	
	More than 7 D	18	29	47	6	
Side effects continuance	One day	6	13	25	56	0.041
	Three days	24	26	23	27	
	Five days	21	21	35	23	
	More than Five days	36	28	17	19	
Coronavirus infection, after vaccination	No	18	22	25	35	0.139
	Yes	37	15	19	29	
Self-medication to relieve side effects	No	17	22	21	40	0.050
	Yes	25	19	30	26	
Physician consultation to treat side effects of the COVID-19 vaccine	No	18	20	22	40	0.009
	Yes	26	26	29	19	
Side effects severity	None	15	11	24	50	0.001
	Mild	10	15	30	45	
	Moderate	27	24	26	23	
	Severe	33	37	8	22	
	Very Severe	30	30	25	15	
Hospitalization due to side effects severity, after vaccination	No	19	21	25	35	0.739
	Yes	25	23	24	28	
The adverse consequence of COVID-19 vaccination on previous health issues	No	27	35	13	25	0.006
	Yes	18	17	28	37	
Types of side effects after 1st dose	Headache	30	27	19	24	0.031
	Fatigue	25	29	25	21	
	Injection site pain	20	18	25	37	
	Body and joint pain	33	28	17	22	
	Chills	32	26	31	11	
	Fever	29	24	23	24	
	Chest Pain	25	50	0	25	
	Injection site redness	10	30	35	25	
	Injection site swelling	25	25	29	21	
	Shortness of breathing	33	22	23	22	
	Diarrhea	29	29	28	14	
Types of side effects after 2nd dose	Headache	31	24	21	24	0.102
	Fatigue	27	27	23	23	
	Injection site pain	21	20	22	37	
	Body and joint pain	32	24	22	22	
	Chills	35	29	30	6	
	Fever	25	21	29	25	
	Chest Pain	25	25	50	0	
	Injection site redness	24	20	36	20	
	Injection site swelling	32	23	26	19	
	Shortness of breathing	33	22	12	33	
	Diarrhea	20	60	1	19	

When examining the Gender variable, a statistically significant association ($p = 0.002$) with Vaccine Type was found. Sinopharm was more frequently used among females, while Pfizer was the predominant choice among males. Age Group also showed a significant association ($p<0.001$) with Vaccine Type. Participants above 60 y old predominantly received the Oxford-AstraZeneca vaccine, while those in the 11-20 age group primarily received Pfizer or Sinopharm vaccines. Significant associations were also observed between Vaccine Type and variables such as concomitant health complications ($p = 0.009$), concomitant medications ($p = 0.003$), prior history of being COVID-19 positive ($p = 0.012$), physician's recommendation on vaccination ($p<0.001$), and adverse consequences of COVID-19 vaccination on previous health issues ($p = 0.006$). BMI and Area of Residence did not show statistically significant associations with Vaccine Type.

The findings suggest that factors such as Gender, Age Group, concomitant health complications, prior COVID-19 history, physician's recommendation, and adverse consequences influenced the selection of specific vaccine types.

Side effects distribution

Fig. 1 presents the distribution of side effects at different dose levels for COVID-19 vaccination. The fig.. Compares the percentage of individuals experiencing various types of side

effects after receiving the first and second doses. Among the reported side effects, headache was observed in 26% of individuals after the first dose, slightly increasing to 30% after the second dose. Fatigue was reported by 26% after the first dose but decreased to 22% after the second dose. Injection site pain was the most reported side effect, experienced by 65% of individuals after the first dose and 57% after the second dose. Furthermore, in a previous study, it was discovered that the majority of healthcare workers (HCWs) rightly recognized side effects such as pain (96.15%), fever (65.48%), allergic reactions (48.04%), and paralysis (8.15%); even at this point, HCWs agreed that vaccine is required to effectively combat this deadly pandemic [24]. Other side effects, such as body and joint pain, chills, fever, chest pain, injection site redness, injection site swelling, shortness of breath, and diarrhea, showed variations between the two doses.

Logistic regression analysis

Table 3 presents the odds ratios, standard errors, and p-values resulting from a multiple logistic regression analysis examining the association between various independent variables and the presence of side effects after COVID-19 vaccination.

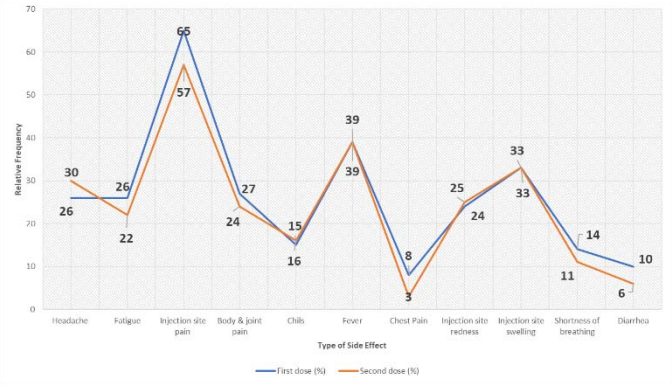

Fig. 1: Distribution of side effects at different dose levels

Table 3: Multiple logistic regression model for the occurrence of side effects, at different covariate levels

Variable	Category	Odds ratio	Standard error	P-value
Intercept		40.49	0.89	<0.001
Gender	Female	R		
	Male	0.78	0.31	0.433
Age Group	11-20	R		
	21-30	0.89	0.41	0.767
	31-40	1.57	0.5	0.365
	41-50	0.68	0.54	0.470
	51-60	1.24	0.5	0.662
	60+	2.68	0.5	0.050
BMI	Normal	R		
	Underweight	1.11	0.52	0.840
	Overweight	0.95	0.33	0.866
Area of Residence	Rural	R		
	Urban	0.71	0.33	0.298
Concomitant health complications	No	R		
	Yes	3.2	0.46	0.011
Concomitant medications	No	R		
	Yes	0.38	0.47	0.039
Physician's opinion on medication	No	R		
	Yes	0.51	0.36	0.059
Prior history of being	No	R		
COVID-19 positive	Yes	0.53	0.38	0.094
Vaccine dose taken	First Dose	R		
	Both Doses	1.56	0.31	0.158
Vaccine type	Moderna	R		
	Oxford-AstraZeneca (Covishield)	0.53	0.48	0.195
	Pfizer	0.45	0.47	0.089
	Sinopharm	0.27	0.42	0.002
Physician's recommendation	No	R		
on vaccination	Yes	1.74	0.34	0.102
Coronavirus infection, after vaccination	No	R		
	Yes	0.81	0.58	0.709
Self-medication to relieve side effects	No	R		
	Yes	0.41	0.33	0.006
Physician consultation to treat	No	R		
side effects of the COVID-19 vaccine	Yes	0.98	0.38	0.956
Hospitalization due to	No	R		
side effects severity after vaccination	Yes	0.62	0.51	0.356
Adverse consequences of COVID-19	No	R		
vaccination on previous health issues	Yes	0.38	0.42	0.022

The model indicates a strong association between the presence of side effects and the other independent variables, as indicated by a significant intercept term ($p<0.001$).

Among the independent variables, significant associations with side effects after COVID-19 vaccination were identified for Concomitant health complications and self-medication, with odds ratios of 3.19 (p = 0.011) and 0.40 (p = 0.006), respectively. These findings suggest that individuals with pre-existing health complications were more likely to experience side effects, while those who self-medicated were less likely to report adverse reactions. Moreover, the type of vaccine administered also showed a noteworthy association with side effects. Participants who received the Sinopharm vaccine had 0.27 times lower odds (p = 0.002) of experiencing side effects compared to those who received the Moderna vaccine. However, no statistically significant associations with side effects were found for other variables, including Gender, Age Group, BMI, Area of Residence, Physician's recommendation, Prior history of being COVID-19 positive, Vaccine dose taken, Coronavirus infection after vaccination, Physician consultation, and Hospitalization due to side effects severity.

The multiple logistic regression analysis reveals significant associations between certain independent variables and the presence of side effects after COVID-19 vaccination, providing valuable insights for healthcare professionals and policymakers.

Model fit assessment

The AIC value of 374.06 for the model indicates a reasonable goodness of fit, capturing a substantial portion of the underlying relationship between the independent variables and the presence of side effects. Additionally, the sensitivity of 0.797 presented in fig. 2 suggests that the model correctly identifies 79.7% of the cases in which side effects are present, indicating a good ability to detect individuals' likeliness to experience side effects after vaccination.

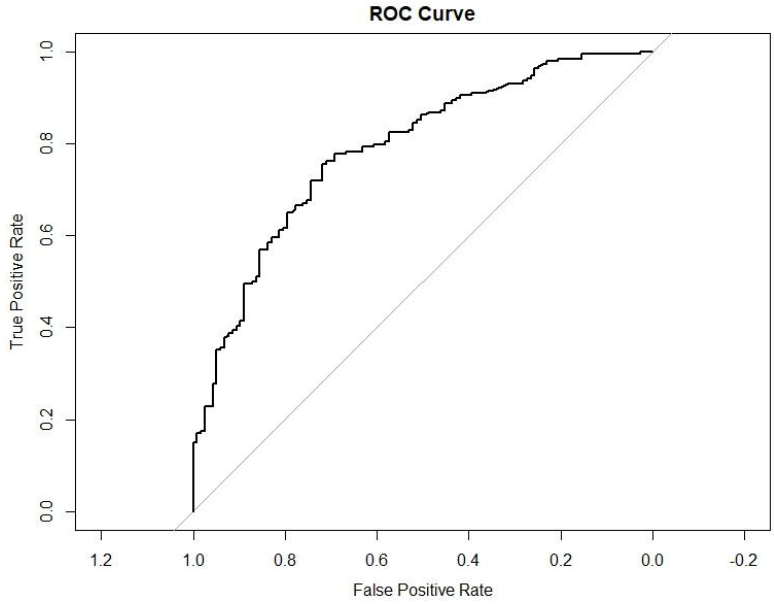

Fig. 2: ROC curve for multiple logistic regression model

Overall, the results provide valuable information on the distribution of side effects and factors influencing vaccine preference among different subgroups. To reduce side effects and enhance overall vaccination outcomes, these insights can help determine targeted vaccination tactics and strategies.

DISCUSSION

The findings of this study indicate that the distribution of vaccines among individuals in Bangladesh influenced certain demographic characteristics. It became apparent that the distribution of vaccines was discriminatory depending on the participants' gender, with females predominantly receiving the Sinopharm vaccine while males receiving mostly Pfizer. The age group also played a significant role, with older individuals (above 60) more likely to receive the Oxford-AstraZeneca vaccine, while the younger aged group (11-20) received Pfizer or Sinopharm vaccines. Previous research found that individuals with a non-overweight status had a higher risk of presenting fever ≥ 38 °C, vomiting, diarrhea, and chills after receiving the COVID-19 vaccine compared to those who were overweight, although most reported side effects were not significantly associated with weight status, and individual differences were determined by sex and age [25]. These findings highlight the importance of considering demographic factors in understanding the efficacy and safety of vaccines and also tailoring vaccination strategies.

Concurrent health complications had a significant association with the type of immunization received. Participants without complications were more inclined to receive Moderna or Oxford-AstraZeneca vaccines, while those with health complications leaned towards Pfizer or Sinopharm. Similarly, the use of concurrent medication by the participants was associated with a higher likelihood of opting for Pfizer or Sinopharm vaccinations. These findings suggest that individuals with underlying health conditions may have considered specific vaccine types based on their perceived efficacy or safety profiles. Moreover, a study revealed that the majority of respondents in Malaysia registered for and received COVID-19 vaccinations, but a small proportion expressed concerns about vaccine safety, and approximately three-quarters of vaccinated individuals experienced vaccine-related side effects, with pain at the injection site and tiredness being the most commonly reported; the prevalence and types of side effects varied based on age, gender, and the type of vaccine received [26]. Another observational study investigated the adverse effects of COVID-19 vaccines in 1,878 adult recipients and found that the major reported adverse effects were pain at the injection site, fatigue, drowsiness, and headache, with a higher prevalence among recipients of mRNA Pfizer-BioNTech vaccine compared to recipients of inactivated Sinopharm vaccine, while severe adverse effects were rare, and 95% of reported adverse effects were mild, requiring no or home-based treatment. Additionally, individuals less than 55 y of age, female gender, with a history of one or more comorbid conditions, those who received the mRNA Pfizer-BioNTech vaccine, and those with a history of COVID-19 infections were more likely to develop adverse effects post-COVID-19 vaccination compared to others [27].

The occurrence and severity of side effects varied among the different vaccine types. The Sinopharm vaccine was associated with a lower likelihood of experiencing side effects compared to the

Moderna vaccine. This finding may be attributed to differences in vaccine formulation, mechanisms of action, or individual immune responses. It is worth noting that most side effects reported were mild, and hospitalization due to side effects was rare. Similar outcomes were observed in a cross-sectional study conducted in a government COVID vaccination center in India where the majority of participants expressed satisfaction with the vaccination program [28]. In another online cohort study including 19,586 adults who received a COVID-19 vaccination, the factors most strongly associated with adverse effects were full vaccination dose, brand of vaccine, younger age, female sex, and having had COVID-19 before vaccination. Allergic reaction or anaphylaxis was reported in 0.3% of participants after partial vaccination and 0.2% of participants after full vaccination. These findings suggest that some individuals experience more adverse effects after COVID-19 vaccination, but serious adverse effects are rare [29]. The majority of individuals who experienced side effects managed those through self-medication, indicating the importance of patient education and counseling on managing vaccine-related side effects. A cross-sectional investigation in Jordan discovered that the majority of vaccinated individuals experienced side effects after receiving the first dose of any of the administered vaccines (AstraZeneca, Pfizer, Sinopharm), with the AstraZeneca vaccine showing a higher proportion of side effects, but the side effects were not severe and should not impede Jordan's successful pandemic control [30]. However, in the prospect of this study, the association of the different severity levels of side effects can be further investigated with the covariates for more conclusive results, using samples that are more broadly representative of Bangladesh in a longitudinal way.

Understanding the factors influencing vaccine selection and the occurrence of side effects is crucial for healthcare professionals and policymakers. The findings of this study can inform targeted vaccination strategies and interventions to mitigate side effects. For instance, individuals with concomitant health complications may require additional support and monitoring during the vaccination process. Furthermore, healthcare providers can play a vital role in providing better guidance and addressing concerns related to vaccine side effects, as a considerable proportion of participants did not consult a physician for managing side effects. Further research could involve longitudinal designs to track side effects over an extended period and investigate potential long-term effects. Additionally, conducting randomized controlled trials or comparative studies could provide a more rigorous assessment of the association between vaccine types and side effects. Moreover, future studies could delve deeper into specific subgroups, such as individuals with specific health conditions or those receiving multiple vaccine doses, to better understand the impact of these factors on vaccine side effects. Exploring the underlying mechanisms or biological factors that contribute to different side effects could also be an important avenue for future investigation.

LIMITATIONS OF STUDY

There are a few drawbacks to the current investigation. One of the limitations of this study is the use of convenience sampling, which may introduce selection bias and limit the generalizability of the findings. Future studies should consider using more representative sampling methods, such as random sampling and representative samples with larger sample sizes to increase the statistical power and allow for more robust analyses.

Another limitation is the reliance on self-reported data, which may be subject to recall bias or misinterpretation. Additionally, self-reported information on vaccine types, side effects, and health conditions may not always be accurate or complete. Future studies could incorporate objective measures or medical records to validate the self-reported data. Despite these drawbacks, this study provides valuable preliminary insights into the side effects of COVID-19 vaccines in Bangladesh and offers a vital foundation for further research in this field.

CONCLUSION

This cross-sectional study aimed to investigate the side effects of COVID-19 vaccines among individuals in Bangladesh and explore the association between vaccine types and various demographic and health-related factors. This study provides valuable insights regarding the occurrence of adverse reactions after COVID-19 vaccination, thus implicating the need to establish the safety profile of COVID-19 vaccines in Bangladesh. The findings highlight the need for more comprehensive and representative studies to explore the side effects of COVID-19 vaccines in Bangladesh.

To sum up, this study highlights the influence of demographic factors, concomitant health complications, COVID-19 vaccine types on the emergence of side effects after vaccination in Bangladesh. The findings underscore the importance of tailored vaccination strategies, patient education, and healthcare provider involvement to address concerns and optimize the vaccination experience. Further research is warranted to explore these factors in larger and more diverse populations, considering longitudinal follow-up and objective assessment of side effects. The knowledge gained from such studies can inform public health interventions, vaccination strategies, and the development of policies to ensure the safety and efficacy of COVID-19 vaccination programs in Bangladesh.

ETHICAL DECLARATION

The study was approved by the Ethical Review Committee of the Department of Pharmacy of East West University on 29 January 2023 with the decision number “EWU-ERCDOP-00003”. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

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AUTHORS CONTRIBUTIONS

Concept: ST, RG, SR, SI, NMK, Design: ST, RG, SR, SI, NMK, Supervising: ST, RG, Data collection and entry: RG, SR, Analysis and interpretation: SI, NMK, Search: ST, Writing: ST, NMK, Critical review: ST, RG, NMK.

CONFLICT OF INTERESTS

The authors declare that they do not have any conflict of interest.

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