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RESEARCH ARTICLE

Self-reported Side Effects After Vaccination Against COVID-19 in Honduras

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Abstract:

Background: A series of atypical pneumonia cases with severe course was identified in December 2019, in the community of Wuhan, in Hubei, China. The new disease was called COVID-19. The pandemic was declared by the World Health Organization in March 2020. Understanding SARS-CoV2 genomic allowed the scientific community to develop vaccine candidates against COVID-19. Over 41 scientific groups conducted clinical trials to prove vaccines efficiency, efficacy, and safety.

Method: A cross sectional retrospective study was performed in Honduras from July 21st, to December 1st, 2021. This study included the population who received at least one dose of any COVID-19 vaccine. The data were collected using an online survey using Google Forms and a QR code to make it easier for the participants to access the survey and to avoid collecting any personal data from the participants. The symptoms were self-reported. A total of 2108 participants were included in the study through the online survey.

Results: The average age of the participants was 34.6±11.1 years with higher frequency of people between 20-29 years age. Side effects were reported in 60.7% cases, after the first dose of COVID-19 vaccine or in cases where only one dose was required. Only 1916 received a second dose of COVID-19 vaccine and 38.9% of them showed side effects after that second dose. The most common side effect is pain at the injection site (49.7% and 30.7%). The most common systemic side effects are fever (34.8% and 17.5%), headache (33.5% and 19.1%) and myalgia (32.8% and 17.6%).

Conclusions: The side effects reported by the population after any vaccination against COVID-19 are mainly systemic effects like fever, myalgia and headache, while the most common local side effect is pain at the injection site. The rate of side effects were higher in females, and younger participants after both doses, the differences are statistically significant.

Keywords: Vaccines, COVID-19, Side effects

Introduction

In December 2019, a series of atypical pneumonia cases with severe course was identified in the community of Wuhan, in Hubei, China, which required mechanic ventilation. Bronchoalveolar lavage samples from these patients were analyzed and a new infectious agent very similar to the bat coronavirus was identified. [1] This cluster of cases had direct contact with the Huanan Seafood Market in Wuhan. The causative agent was identified and denominated as the new coronavirus. These cases were confirmed by the Chinese authorities as COVID-19. [2] RT-PCR method was used to detect these cases, which identifies the genomic sequence of the receptors linked to the S domain, present in Coronavirus.[3]

The coronavirus strains have caused two large-scale pandemics over the past two decades: SARS (severe acute respiratory syndrome) and MERS (middle east respiratory syndrome). The outbreak that started in Wuhan spread rapidly with numerous cases and deaths reported and spreading to more than 10 countries by January 2020. The typical symptoms presented in these patients include fever, dry cough, shortness of breath or dyspnea, headache, and pneumonia. The onset of symptoms can result in progressive respiratory failure leading to alveolar damage and death.3 Clinical evidence confirmed human-to-human transmission evidenced by family contact and health workers who went sick.[4] The World Health Organization on January 16, notified the existence of several cases within the Chinese territory and also in Japan, Thailand and Korea. The first deaths reported due to this syndrome was caused by a new infectious agent then called nCoV-2019 (new coronavirus of 2019). A very little was known about the impact of this new disease, its incubation period, the severity of the manifestations and the form of contagion. At that time human-to-human transmission was estimated to be limited since most cases were correlated with the epicenter, the city of Wuhan.[5] The actual number of cases is a controversial parameter, especially at the beginning of the epidemic. Beyond political transparency for reporting of cases or communication strategies, it is likely that there is a biasness in the information since the most severe cases are those that will seek medical attention hence will be reported. Mild or asymptomatic cases are probably underdiagnosed. This is an element that makes it difficult to control the disease and decrease the number of cases. It is known that not even asymptomatic patients can transmit the disease but those affected patients who are in the incubation period also transmit the virus. This could largely explain the exponential growth in number of cases.[6]

Coronaviruses are classified as: alpha, beta, gamma, and delta, the first two can cause infections in humans while gamma and delta coronaviruses usually cause infection in birds and occasionally in mammals. The novel coronavirus is the seventh coronavirus type capable of causing infection in humans. [7–9] Coronaviruses are single-stranded RNA viruses that are 26 to 32 kilobases in length. Its regular host includes various animals such as camels, cats, dogs, civets, and bats, among others. Its name derives from the appearance it shows when observed by electronic microscopy: as a solar corona. Historically, coronaviruses have been the cause of disease in humans, mainly mild infections generally associated with symptoms of the common cold, with the exception of severe acute respiratory syndrome (or SARS) that originated in Guangdong, China in 2002 and was responsible for more than 8000 infections and 774 deaths in 37 countries; the other exception was the middle east respiratory syndrome (or MERS), which was detected in Saudi Arabia in 2012, causing approximately 2,500 cases and 858 deaths. Viruses experience a high rate of mutations per year. Previously reported

cases suggest that there were few mutations, which meant a rapid transmission that did not allow time to experience too many mutations and their rapid identification. [4,8,9]

The structure of SARS-CoV2 is approximately 125 nanometers in size, composed of a single strand of RNA in the positive sense, composed of 26 to 32 kilobases. Its genomic strand contains the configuration of four structural proteins that make up the outer membrane of the virus: a spike glycoprotein or S (8 to 12 nanometers in length), envelope proteins or E, membrane protein or M and nucleocapsid or N, in addition to 16 other proteins such as hemagglutinin esterase, helicase and RNA polymerase. These proteins participate in the processes of transcription and replication. The coronavirus can bind to human cells through the spike protein through various receptors, such as angiotensin converting enzyme (ACE). The coronavirus enters the cell and the RNA strand is released into the cell cytoplasm. It uses the host's infrastructure for viral replication and after being assembled, they are released by exocytosis. The lipid membrane of the virus comes from the infected cell. This process is similar for all human coronaviruses. The genomic structure contains at least 6 open reading frames (ORFs). The first two thirds of the SARS CoV2 coronavirus genome codes for viral replication. It generates two large proteins at the beginning of infection. It is then fragmented into 16 proteins that participate in replication and transcription. The last third of the genome encodes the four structural proteins. [7,8,10]

The spike protein or S (150 kilodaltons) is responsible for binding to receptor cells. In addition to the heart, kidney and bladder, the main target is the angiotensin-converting enzyme 2 receptor in humans that is expressed in lung tissues in type 2 pneumocytes. The spike protein contains two subunits, one is responsible for binding to the angiotensin 2 receptor and the other is responsible for fusion between the virus and host membranes. This protein is different in SARS CoV (cause of SARS) and SARS CoV2 (cause of COVID-19). The later one contains 12 additional nucleotides that could increase the efficiency of the diffusion of SARS CoV2 compared to the rest of betacoronaviruses. The M protein, 25-30 kilodaltons, is a dimer that maintains the curvature of the viral membrane.

The E-protein (8 to 12 kilodaltons) participates in the assembly and release process of the virus. Protein N participates in the encapsulation process of the virus. Hemagglutinin esterase is found only in some betacoronaviruses and its function is to bind sialic acid, which facilitates viral entry into cells and its spread through mucosal membranes. [8,11]

The virological studies showed that the newly identified strain of Wuhan coronavirus was similar to the sarbecoviruses that include SARS-CoV, the causative agent of the SARS pandemic in 2002 and 2003 and coronaviruses found in bats. It is estimated that this virus has been arisen from a recombination of the sarbecovirus group. The phylogenetic line is 82% related to the bat coronavirus SL-CoVZC45. This indicated that the virus could have been arisen from a combination of both strains. The surface proteins of this virus were similar to SARS coronavirus and the bat coronavirus. The protein of SARS-CoV2 is capable of binding to angiotensin converting enzyme receptors two, which would facilitate infection in humans and human-to-human transmission. The identification of multiple strains of the similar coronavirus in bats, supports the idea that these animals serve as natural hosts or reservoirs for these viruses. [1] The genetic analysis suggests coronavirus origin in the bat, however, it is suggested that some other animal acts as a host. The bats were hibernating at the time of the beginning of the outbreak and no bats were found in the market of shellfish from Wuhan where the first cases originated. Both the coronavirus causing SARS and MERS required an

intermediate host (the civet in SARS and the camel in MERS).[4] This coronavirus was classified in the betacoronavirus within the sarbecovirus subgroup. Its complete genomic sequence was released on January 12 of 2020. On January 30, the World Health Organization declared an international emergency due to the new disease. The name of the disease COVID-19 was designated on February 11 and after genetic analysis it was designated as SARS-CoV2. [10]

Understanding SARS-CoV2 genomic allowed the scientific community to develop several candidate vaccines against COVID-19. Over 41 scientific groups conducted clinical trials to prove vaccines efficiency, efficacy, and safety. Moderna and Pfizer-BioNTech developed a widely spread RNA vaccine against COVID-19, while Astra Zeneca and Oxford University, Gamaleya Research Institute and Johnson & Johnson and Beth Israel Deaconess Medical Center developed a viral vector vaccine based on adenovirus.[12]

The clinical trials revealed that the incidence of severe adverse reactions were low and the most common effects were pain at the injection site, headache and fatigue.[13]

The tolerability profile of the vaccines may depend on the vaccine type, age, body mass index, pre-existing immunity, and sex (higher response in females).[14]

As the pandemic developed, the scientific community started to research for possible vaccines. Nowadays there are 11 approved vaccines with a properly recommended dose.15 After the success of the development of effective vaccines the major concern was the safety on general population and the incidence of potentially serious side effects. According to the clinical trials, the overall incidence and prevalence of side effects is limited to general and minor side effects and those effects where mainly reported within 48 hours of the vaccination.[16]

Vast majority of the population accepts the vaccination and the lower acceptance rates are usually among the elderly population due concerns regarding side effects, lack of information, religious and cultural factors.[17]

By late June 2022, about 425,930 cases of COVID-19 and 10,903 deaths have been confirmed. About 14,369,912 doses of vaccines against COVID-19 have been administrated, including second dose and booster dose which represents about 53.07% of the population.[18] The purpose of this research was to identify the prevalence of side effects reported by the population in Honduras after the vaccination against COVID-19 corresponding to the first and second dose.

Materials and method

A cross sectional retrospective study performed in Honduras since July 21st, 2021, to December 1st, 2021. This study included the population of patients older than 13 years who received at least one dose of any COVID-19 vaccine.

An online survey using Google Forms were designed to collect the data. QR code was used to make it easier for the participants to access the survey and to avoid collecting any personal data from the participants. The online survey contained two checkpoints whether participants did not accept to participate or they accepted but did not receive any COVID-19 vaccine, the survey ended immediately. Also, the survey was only available to complete once registering with e-mail.

The questions asked in the survey were evaluated one by one by experts according to four main criteria sufficiency, clarity, coherence, and relevance. Each question was evaluated from 1 to 4 points. The evaluation by experts was compared

using Cohen´s kappa coefficient using SPPS version 25 for Windows obtaining .786 considered as reliable.

A total of 2138 participants accessed the survey form, 13 of them did not accept to participate and 17 of them did not receive any COVID-19 vaccine, hence 30 participants were discarded from the sample. A total of 2108 participants were included in the study through the online survey.

This research did not involve any risk for the participants because the study design is retrospective. Confidentiality was kept by avoiding any request of personal data, no names were included according to the Declaration of Helsinki. The the first question of the survey was regarding the consent of the participant. When any participant did not accept to provide information, the survey instantly ended.

The outcomes of the survey were analyzed using the software Statistical Package for the Social Sciences (SPSS) version 25 for Windows 10. The qualitative variables were analyzed with Chi square test while the quantitative variables were analyzed with t-student test, statistically significant difference was set at p value <0.05 and confidence interval of 95%.

Results

A total of 2108 participants out of 2138 were included in the study. The most frequent vaccine type was ChAdOx1-S by Astra Zeneca (n= 1191) representing 56.5%. The second most common vaccine was Moderna (n= 552) representing 26.2% and Pfizer-BioNTech vaccine (263) representing 12.5%. Other vaccine types registered were Johnson & Johnson (n=39, 1.9), Sputnik V (n=60, 2.8%), Sanofi (n=2, 0.1%) and SinoPharm (n=1, 0.047%).

The average age of the participants was 34.61±11.129 years with higher frequency of people between 20-29 years old (n= 734, 34.8%). Other demographic variables are summarized in table 1.

Table 1. Demographic variables of survey participants

Variable	n	%
Age		
<20 years	67	3.2
20- 29 years	734	34.8
30-39 years	710	33.7
40-49 years	374	17.7
50-59 years	163	7.7
60-69 years	44	2.1
70-79 years	8	0.4
≥80 years	8	0.4
Gender		
Female	1470	69.7
Male	638	30.3
Health workers		
Yes	155	7.4

Only 27.3% (n= 575) of the participants referred clinical background or are currently receiving medication for any disease, within these cases the most frequent illness was high blood pressure (n= 213, 10.1%). The frequency of the clinical background is explained in table 2.

Table 2. Frequency of diseases reported in the clinical background of the participants

Disease	n	%
Allergic rhinitis	25	1.2
Antiphospholipid antibody syndrome	4	0.2
Anxiety	4	0.2
Arthritis	6	0.3
Asthma	74	3.5
Cancer	10	0.5
Chronic kidney disease	2	0.1
Chronic venous insufficiency	7	0.3
Depression	3	0.1
Dermatitis	4	0.2
Diabetes	109	5.2
Epilepsy	3	0.1
Fibromyalgia	8	0.4
Gastritis	7	0.3
Gastroesophageal reflux disease	4	0.2
Heart disease	9	0.4
High blood pressure	213	10.1
HIV	3	0.1
Hyperthyroidism	4	0.2
Hypothyroidism	48	2.3
Lupus	8	0.4
Migraine	12	0.6
Obesity	13	0.6
Other autoimmune diseases*	5	0.2
Other diseases	20	0.9
Polycystic ovary syndrome	7	0.3
Rheumatoid arthritis	3	0.1
Unspecified allergies	5	0.2
Unspecified thyroid disease	12	0.6

*Vasculitis, psoriasis, polymyositis, multiple sclerosis, and unspecified autoimmune diseases.

Side effects were reported in 60.7% cases after the first dose of COVID-19 vaccine or in cases when only one dose was required. Only 1916 received a second dose of COVID-19 vaccine and 38.9% of them showed side effects. 30.9% of participants showed side effects after both doses. While in 30.9% cases revealed side effects only after the first dose, while 7.9% of the cases showed symptoms only after the second dose. In 30.2% of the cases no side effects were described after both doses (p= .000). The reported side effects are summarized in table 3.

Table 3. Side effects reported in the next 8 days after vaccination

Symptoms	First dose		Second dose	
	n	%	n	%
Abdominal pain	82	3.9	53	2.8
Adenopathy	5	0.2	2	0.1
Allergy	52	2.5	33	1.7
Anaphylaxis	6	0.3	4	0.2
Anosmia	1	0.04	-	-
Anxiety	1	0.04	2	0.1
Arthralgia	7	0.3	7	0.3
Blurry vision	61	2.9	34	1.8
Bruise on injection site	1	0.04	1	0.04
Chest pain	3	0.1	3	0.1
Chills	497	23.6	220	11.5
Cough	2	0.1	1	0.04
Dehydration	2	0.1	-	-
Diarrhea	22	1	11	0.6
Difficulty breathing	3	0.1	2	0.1
Dizziness	263	12.5	136	7.1
Dysgeusia	-	-	2	0.1
Dysphonia	1	0.04	-	-
Elevated liver transaminase levels	1	0.04	-	-
Fainting	12	0.6	12	0.6
Fever	734	34.8	335	17.5
Headache	707	33.5	365	19.1
High blood glucose	1	0.04	-	-
High blood pressure	-	-	3	0.1
Hypotension	1	0.04	2	0.1
Increase of appetite	4	0.2	2	0.1
Loss of appetite	4	0.2	3	0.1
Menstrual cycle alterations	3	0.1	6	0.3
Myalgia	692	32.8	337	17.6
Nausea	201	9.5	102	5.3
Pain behind the eye	1	0.04	-	-
Pain on injection site	1047	49.7	589	30.7
Paresthesia	1	0.04	2	0.1
Petechiae	2	0.1	-	-
Phlebitis	3	0.1	1	0.04
Rhinorrhea	4	0.2	6	0.3
Shivering	1	0.04	-	-
Swelling of arms and hand	1	0.04	-	-
Swelling of one side of the face	1	0.04	1	0.04

Tachycardia	3	0.1	5	0.2
Tenderness of injection site	110	5.2	59	3.0
Tiredness/sleepiness	94	4.5	62	3.2
Vomiting	5	0.2	2	0.1

The participants rated the severity of symptoms after each vaccination. After the first dose 18.5% (n=237) of the participants rated the severity as very mild, 36.2% (n=463) as mild, 37.8% (n=484) as moderate and 7.4% (n=95) as severe and 9.5% (n=122) of the participants who referred side effects after the vaccination needed medical attention due adverse reactions. After the second dose the severity rate was 24.5% (n=183) as very mild, 32.5% (n=243) as mild, 34.8% (n=260) and 8.2% (n=61) as severe. Only 8.6% (n=64) of the people who referred side effects needed medical help due adverse reaction after the second dose.

The average number of symptoms during the next 8 days after the first dose was 2.2±2.31 symptoms [2.11-2.32, CI 95%] and after the second dose the average was 1.26±2.01 symptoms [1.17-1.35, CI 95%]. The difference between the first and second dose is statistically significant (paired t- student test 16.230 p= .000).

The mean number of symptoms after the first dose in females was 2.42±2.36 symptoms [2.29-2.54, CI 95%] while in males the average was 1.75±2.004 [1.58-1.91, CI 95%], this difference is statistically significant (p=.000). The mean number of symptoms after the second dose in females was 1.33±2.071 symptoms [1.22-1.44, CI 95%] while in males the average was 1.08±1.844 [0.93-1.23, CI 95%], this difference is statistically significant (p=.012). The difference between vaccine types is shown in table 4. There is statistically significant difference between vaccine types for both doses accordingly (first dose ANOVA test p=.000, second dose ANOVA test p=.000). SinoPharm vaccine was not included in this analysis due to not enough participants who received this vaccine. Johnson & Johnson was not included on the analysis because vaccination only includes one dose, and the second dose is a booster shot using Pfizer-BionNTech applied 2 months after the first dose.

Table 4. Total amount of symptoms reported during the next 8 days after vaccination according to vaccine type

Vaccine	First dose		Second dose	
	Number of side effects	CI 95%	Number of side effects	CI 95%
Astra Zeneca	2.58±2.33	2.44-2.71	0.86±1.62	0.77-0.96
Moderna	1.96±2.44	1.77-2.16	2.24±2.51	2.03-2.46
Pfizer-BioNTech	1.09±1.62	0.88-1.31	1.02±1.72	0.79-1.25
Johnson & Johnson	1.58±2.06	0.27-2.90	-*	-*
Sputnik V	2.09±2.08	1.52-2.67	1.08±1.57	0.64-1.51
Sanofi	2.00±2.82	-23.41-27.41	2.50±3.53	-29.27-34.27

*Comparison cannot be performed as current vaccination with this vaccine is made only with one dose and the second dose is considered as booster shot using Pfizer-BioNTech in Honduras.

Patients without clinical background showed higher number of symptoms during the second dose compared to those who referred clinical background (p=.0.026) but there is no statistically significant difference when compared to the first dose (p=0.108). A higher average of side effects was reported in participants without high blood pressure in both doses compared to those with high blood

pressure (first dose p=0.000, second dose p=0.021). The same effect was observed in participants without diabetes who showed higher average of side effects than participants with diabetes (first dose p=.004 and second dose p=0.047). Participants with asthma showed higher average of side effects after the second dose than those without asthma (p=0.012) but no significant difference was observed after the first dose (p=0.100). People with migraine showed a higher average of side effects after the first dose when compared to those without migraine (p=0.015) but no statistically significant difference was observed after the second dose (p=0.115). There was no statistically significant difference in the average of side effects after both doses when considering other illness. The mean side effects are showed in table 5.

Table 5. Total amount of side effects reported according to the clinical background

Clinical background	First dose		Second dose	
	Number of side effects	CI 95%	Number of side effects	CI 95%
Any clinical background	2.07±2.274*	1.92-2.30	1.09±1.941*	0.93-1.26
No clinical background	2.25±2.324*	2.14-2.38	1.32±2.031*	1.21-1.43
High blood pressure	1.64±2.138*	1.39-1.99	0.94±1.826*	0.69-1.20
No high blood pressure	2.26±2.322*	2.17-2.38	1.29±2.026*	1.20-1.39
Diabetes	1.58±2.204*	1.15-2.05	0.87±1.704*	0.53-1.21
No diabetes	2.24±2.313*	2.15-2.236	1.28±2.022*	1.19-1.37
Asthma	2.64±2.402	2.16-3.32	1.86±2.510*	1.25-2.46
No asthma	2.19±2.307	2.09-2.30	1.24±1.985*	1.14-1.33
Migraine	3.25±2.927*	1.05-4.59	2.73±3.438	0.42-5.04
No migraine	2.20±2.307*	2.11-2.31	1.25±1.996	1.16-1.34

*Statistically significant difference.

There is statistically significant difference in the number of side effects according to age ranges. The average of side effects after the first dose in people younger than 40 years was 2.47 and the average of side effects in people 40 years old and older was 1.53 (p=0.000). The average side effects after the second dose in people younger than 40 years was 1.38 while in people older as 40 years the average was 0.96 (p=0.000). A higher amount of side effects is observed in younger people after both doses.

Certain side effects showed higher prevalence in females when compared to males, this difference is statistically significant. The prevalence of each side effect is shown in table 6.

Table 6. Prevalence of side effects after first and second dose in females and males.

Side effects	First dose		Second dose	
	Female	Male	Female	Male
Any side effect	63.5%*	54.2%*	40.6%*	34.8%*
Pain in injection site	53.5%*	40.9%*	32.2%*	27.4%*
Redness and tenderness	6.1%*	3.0%*	3.7%*	1.2%*
Fever	36.2%*	31.7%*	16.9%	18.9%
Chills	25.9%*	18.2%*	11.5%	11.4%
Headache	38.2%*	22.7%*	21.1%*	14.2%*
Blurry vision	3.1%	2.5%	1.7%	1.9%
Dizziness	14.4%*	8.0%*	7.5%	6.1%
Fainting	0.7%	0.2%	0.7%	0.5%
Nausea	11.7%*	4.5%*	6.4%*	2.8%*
Myalgia	34.3%*	29.5%*	18.4%	15.6%
Abdominal pain	4.2%	3.1%	3.2%	1.7%
Allergy	3.1%*	1.1%*	1.9%	1.4%
Anaphylaxis	0.4%	0%	0.2%	0.2%
Tiredness/sleepiness	4.5%	4.4%	3.4%	2.8%
Arthralgia	0.5%	0%	0.5%	0%
Diarrhea	1.1%	0.9%	0.5%	0.7%

*Statistically significant difference

The prevalence of side effects according to vaccine types was higher for people who received Astra Zeneca or Sputnik V after the first dose while the lowest prevalence was shown in people who received Johnson & Johnson vaccine. The prevalence of side effects after the first dose are shown in table 7.

Table 7. Comparison of prevalence of side effects after the first dose according to vaccine types.

Side effects after first dose	Astra Zeneca	Moderna	Pfizer-BioNTech	Johnson & Johnson	Sputnik V
Any side effect*	67.8%	56.0%	41.1%	38.5%	65.0%
Pain in injection site*	52.7%	51.8%	35.4%	23.1%	50.0%
Redness and tenderness	5.2%	6.9%	3.0%	2.6%	0.0%
Fever*	43.2%	28.1%	11.8%	28.2%	38.3%
Chills*	29.0%	19.2%	6.1%	25.6%	31.7%
Headache*	39.9%	29.5%	15.6%	17.9%	33.3%
Blurry vision	3.3%	2.5%	2.7%	0%	1.7%
Dizziness*	14.8%	11.4%	6.8%	5.1%	6.7%
Fainting	0.8%	0.8%	0.4%	0%	0%
Nausea*	11.8%	7.2%	3.4%	15.4%	8.3%
Myalgia*	41.1%	25.5%	12.9%	20.5%	31.7%
Abdominal pain	4.3%	4.3%	2.3%	0%	1.7%
Allergy	2.2%	3.4%	2.3%	0%	1.7%
Anaphylaxis	0.3%	0.4%	0.4%	0%	0%
Tiredness/sleepiness*	4.5%	3.4%	5.3%	0%	10.0%

Arthralgia	0.5%	0.2%	0%	0%	0%
Diarrhea	1%	1.1%	1.1%	0%	1.7%

*Statistically significant difference

The prevalence of side effects in people who received second dose of Astra Zeneca was lower than the rest of vaccine types while people who received Moderna vaccine showed higher prevalence of side effects. The prevalence of individual vaccine side effects after the second dose is shown in table 8.

Table 8. Comparison of prevalence of side effects after the second dose according to vaccine types.

Side effects after second dose	Astra Zeneca	Moderna	Pfizer-BioNTech	Sputnik V
Any side effect*	32.0%	55.5%	34.4%	43.4%
Pain in injection site*	23.2%	48.9%	27.2%	28.3%
Redness and tenderness*	1.4%	7.5%	1.3%	0%
Fever*	10.0%	36.0%	12.9%	15.1%
Chills*	5.8%	24.3%	9.4%	15.1%
Headache*	14.6%	32.0%	12.9%	15.1%
Blurry vision	1.4%	2.9%	1.8%	0%
Dizziness*	5.0%	13.5%	4.0%	3.8%
Fainting	0.4%	1.3%	0.4%	0%
Nausea*	3.9%	9.4%	4.0%	1.9%
Myalgia*	11.9%	29.7%	18.3%	18.9%
Abdominal pain*	1.3%	6.7%	1.3%	1.9%
Allergy*	0.9%	3.7%	1.3%	1.9%
Anaphylaxis	0.1%	0.4%	0.4%	0%
Tiredness/sleepiness*	3.3%	3.7%	2.2%	0%
Arthralgia	0.2%	0.5%	0.4%	1.7%
Diarrhea	0.5%	1.0%	0%	0%

*Statistically significant difference

The severity of the side effects in females and males did not exhibit statistically significant difference as shown in table 9.

Table 9.1. Severity of side effects after vaccination in females and males

Severity side of effects		Female	Male
First dose	Very mild	18.3%	19.1%
	Mild	36.2%	36.1%
	Moderate	37.7%	38.2%
	Severe	7.7%	6.6%
Second dose	Very mild	24.4%	24.9%
	Mild	33.9%	28.9%
	Moderate	34.2%	36.3%
	Severe	7.5%	10.0%

The severity score of different vaccines after the first dose determined by the participants showed significant difference (table 10). Johnson & Johnson vaccine was not included in the comparison because it includes only one dose.

Table 9.2. Severity of side effects according to vaccine type

Severity of side effects		Astra Zeneca	Moderna	Pfizer-BioNTech	Johnson & Johnson	Sputnik V
First dose*	Very mild	16.0%	21.0%	25.9%	13.3%	30.8%
	Mild	35.2%	36.9%	40.7%	40.0%	38.5%
	Moderate	39.8%	35.6%	31.5%	46.7%	30.8%
	Severe	9.0%	6.5%	1.9%	0%	0%
Second dose*	Very mild	31.8%	14.9%	22.1%	-	39.1%
	Mild	40.0%	24.2%	31.2%	-	26.1%
	Moderate	25.1%	46.4%	36.4%	-	34.8%
	Severe	3.1%	14.5%	10.4%	-	0%

*Statistically significant difference

Discussion

A total of 60.7% cases revealed side effects after the first dose of any COVID-19 vaccine. Previous studies have shown diverse outcomes regarding the total amount of side effects specially when comparing simultaneously several vaccine types. Menni et al.[19] showed that 71.9% of the participants who received Astra Zeneca vaccines referred at least one side effect, however when compared to the participants who received Pfizer-BioNTech vaccine, only 12.3% referred at least one side effect after the first dose. Other researchers referred different amounts of side effects after the first dose of COVID-19 vaccines, Azimi et al.[20] reported 93.5% of prevalence of at least one side effect after Astra Zeneca vaccine, while Andrzejczak-Grządko, Czudy and Donderska[21] have found that 96.5% reported at least one side effect after the first dose of Astra Zeneca while only 29.4% reported side effects after the first dose of Pfizer-BioNTech vaccine. In our study, the most common used vaccine was Astra Zeneca, the average number of participants reported at least one side effect. This outcome is in line with the findings of previous studies that revealed the prevalence of side effects in population who received this vaccine type.

After the second dose, 30.9% cases revealed at least one side effect. Menni et al.[19] found that 22% of the participants had adverse reactions after the second dose of Pfizer-BioNTech vaccine. Anderson et al.[22] in the clinical trial for the Moderna vaccine showed that up to 75% of the participants who received doses of 25 µg in population aged between 25 and 56 years and 30% of the population older than 71 years reported side effects after the second dose. Andrzejczak-Grządko, Czudy and Donderska21 found that 54.8% of participants who showed side effects after the second dose of Pfizer-BioNTech vaccine. According to Baden et al.[23] 88.6% of the subjects had at least one side effect after the second dose of Moderna vaccine. Meanwhile, Efrati et al.[24] reported that 55.9% of the subjects had at least one symptom after the second dose of Pfizer-BioNTech vaccine. The lower prevalence of side effects after the second dose may be due the high number of

participants who received Astra Zeneca vaccine. Studies revealed significantly minimum side effects after the second dose when compared to the first. Similar outcomes were reported by Casas, Català and Muñoz-Santos[14] while carrying out clinical trials. The comparison of the side effects is shown in table 10.

Table 10. Comparison of side effects reported in the next 8 days after vaccination

Side effect	Results		Comparison		Vaccine
	First dose	Second dose	First dose	Second dose	
Abdominal pain	3.9%	2.8%	0.89% after both doses		Astra Zeneca[25]
			2.03%	6.69%	Pfizer-BioNTech[26]
Lymphadenopathy	0.2%	0.1%	0.3%		Pfizer-BioNTech[13]
			0.8%		Pfizer-BioNTech[27]
			Uncommon		Pfizer-BioNTech[28]
			7.5%		Pfizer-BioNTech[29]
Allergic reactions	2.5%	1.7%	1.7%		Astra Zeneca[19]
			0.7%		Pfizer-BioNTech[19]
Anaphylaxis	0.3%	0.2%	10-49 for each 100,000		Any vaccine[30]
Arthralgia	0.3%	0.3%	26%	45%	Moderna[23]
			30% of patients younger than 70 and only 13% in patients older than 71		Moderna[22]
			>50%		Any vaccine[31]
			3.2%	7%	Pfizer-BioNtech[19]
			11.5%	-	Astra Zeneca[19]
Bruise on injection site	0.04%	0.04%	<5%		Astra Zeneca[32]
			0.9%	0.5%	Pfizer-BioNtech[19]
			2.4%	-	Astra Zeneca[19]
Chills	23.6%	11.5%	2.5	6.4%	Pfizer-BioNtech[19]
			14.7%	-	Astra Zeneca[19]
			>30%		Pfizer-BioNtech[33]
			31.9%		Pfizer-BioNtech[34]
Cough	0.1%	0.04%	<4%		CoronaVac[35]
			2-4%		CoronaVac[36]
Diarrhea	1%	0.6%	11.8%	-	Astra Zeneca[20]
			0.6%	-	Astra Zeneca or Pfizer-BioNTech[21]
			<4%		CoronaVac[35]
			1.4%	0.6%	Pfizer-BioNTech[24]
			1%		CoronaVac[36]
Dizziness	12.5%	7.1%	Uncommon		Astra Zeneca or Pfizer-BioNTech[21]
			8.2%		Astra Zeneca or Pfizer-BioNTech[37]
Elevated liver transaminase levels	0.04%	-	10% after 6 weeks in patients with solid tumors		Pfizer-BioNTech[38]
Fainting	0.6%	0.6%	Uncommon		Astra Zeneca or Pfizer-BioNTech[21]
Fever	34.8%	17.5%	14.2%		Pfizer-BioNTech [34]
			22%	21.7%	Pfizer-BioNtech[39]
			66.3%		Astra Zeneca[20]
			56.6%		Astra Zeneca[21]
Headache	33.5%	19.1%	46.5%		Astra Zeneca[20]
			42%	46%	Pfizer-BioNtech[39]
			34.3%		Pfizer-BioNtech[29]
			24.2%		Astra Zeneca or Pfizer-BioNTech [37]
			56.4%		Astra Zeneca or Pfizer-BioNTech[21]

Side effect	Results		Comparison		Vaccine
	First dose	Second dose	First dose	Second dose	
			15.8%	33.9%	Pfizer-BioNTech[21]
			28%	60%	Moderna[23]
			36%		Astra Zeneca[40]
			14%		Pfizer-BioNTech[40]
			30%		Moderna[40]
			44%		Astra Zeneca or Pfizer-BioNTech[41]
High blood glucose	0.04%	-	0.001%		Johnson & Johnson[42]
Loss of appetite	0.2%	0.1%	Uncommon		AstraZeneca, Pfizer-BioNTech, Moderna, Sputnik, SinoVac or Johnson & Johnson[43]
			1.7%		Astra Zeneca[20]
Menstrual cycle alterations	0.1%	0.3%	50-60%		Astra Zeneca, Pfizer-BioNTech, Moderna or Johnson & Johnson[44]
Myalgia	32.8%	17.6%	36.7%		Pfizer-BioNTech or Astra Zeneca[37]
			23%	54%	Moderna[23]
			10%		Astra Zeneca[40]
			7%		Pfizer-BioNTech[40]
			9%		Moderna[40]
			33.2%		Johnson & Johnson[45]
			2.3%	5%	Pfizer-BioNTech[19]
			7%	-	Astra Zeneca[19]
			42%	-	Astra Zeneca[25]
Nausea	9.5%	5.3%	12%	13.2%	Pfizer-BioNTech[39]
			13%	-	Astra Zeneca[20]
			2.7%	-	Astra Zeneca[21]
			0.7%		Pfizer-BioNTech[46]
			21.3%		Moderna[46]
			5.7%		Astra Zeneca[46]
			0.7%		Sputnik V[46]
			15.5%		Johnson & Johnson[46]
Pain on injection site	49.7%	30.7%	84.7%		Pfizer-BioNTech[34]
			88%	89.8%	Pfizer-BioNTech[39]
			58.8%	-	Astra Zeneca[20]
			52.6%		Astra Zeneca[21]
			63.3%	57.1%	Pfizer-BioNTech[21]
			40%		Astra Zeneca[40]
			35%		Pfizer-BioNTech[40]
			70%		Moderna[40]
			51.4%	55.9%	Pfizer-BioNTech[24]
Paresthesia	0.04%	0.1%	0.06%		Pfizer-BioNTech[47]
			1/43,252		Pfizer-BioNTech[13]
Petechial rash	0.1%	-	1/21,997		Sputnik V[48]
			1-10%		Moderna[49]
			1-10%		Sputnik V[49]
			1-10%		CoronaVac[49]
Rhinorrhea	0.2%	0.3%	Uncommon		Sputnik V[43]
Shivering	0.04%	-	2.5%	6.4%	Pfizer-BioNTech[19]
			14.7%	-	Astra Zeneca[19]
Tenderness of injection site	5.2%	3.0%	57.2%	50.9%	Pfizer-BioNTech[19]
			49.3%	-	Astra Zeneca[19]
			57.89%		Astra Zeneca[25]
			<25%		Astra Zeneca[32]
Tiredness/ Sleepiness/ fatigue	4.5%	3.2%	60%	62.2%	Pfizer-BioNTech[39]
			66.3%	-	Astra Zeneca[20]
			8.4%	14.4%	Pfizer-BioNTech[19]
			21.1%	-	Astra Zeneca[19]

Side effect	Results		Comparison		Vaccine
	First dose	Second dose	First dose	Second dose	
			40%	70%	Moderna[23]
			<40%		Astra Zeneca[40]
			<45%		Moderna[40]
			<20%		Pfizer-BioNTech[40]
Vomiting	0.2%	0.1%	10%	15%	Moderna[23]
			1.4%		Astra Zeneca[21]
			Uncommon		Pfizer-BioNTech[21]
			1.4%	1.7%	Pfizer-BioNTech[24]
			0.36%	1.67%	Pfizer-BioNTech[26]

Arthralgia was an uncommon in our finding while in previous studies this symptom was very common. This difference may be due to the differences in questionnaire of the survey because each participant should describe their own symptoms.

Similarly, the prevalence of blurred vision, difficulty in breathing, and chest pain is not previously described in other studies. There are no specific incidence of the incidence of these symptoms, however they are referred in the summary of characteristics associated with the COVID-19 vaccines as a possible sign of thromboembolism or thrombocytopenia,48 however further studies are needed to understand the causes of these symptoms in the studied population.

Cases of phlebitis were described in 0.1% of the participants after the first dose and 0.04% after the second dose. The current investigations do not show this symptom as an adverse reaction; however, this finding may be the continuity of thromboembolic events. Thrombophlebitis after the vaccination with Astra Zeneca vaccine is already reported in 2022 by Winston and Munien.[50] Thromboembolic events are not common and the statistics showed this side effect in 1.7/100,000 of the participants who received Moderna42 and 12/54.19 million of the participants who received Pfizer-BioNTech,33 39/925,380 also with the Pfizer-BioNTech[47] vaccine and 1.4% in participants who received the Astra Zeneca vaccine.

Rhinorrhea and tachycardia are both uncommon findings in the population who received any COVID-19 vaccine. These symptoms and also vomiting can be a manifestation of allergic reactions as described by Sampath et al.[51]

There is significant difference of side effects according to age ranges. The average of side effects after the first dose in people younger than 40 years was higher (2.47), while the average of side effects in people 40 years or above was 1.53 (p=0.000). The average side effects after the second dose in people older than 40 years was 0.96 and in people younger as 40 was 1.38 (p=.000). A higher amount of side effects is observed in younger people after both doses. This findings have been also reported by Riad et al.39 who described an average of 4.50±2.596 side effects in healthcare workers aged 43 years or younger and 3.87 ±2.599 side effects in participants older than 43 years (p= 0.001). However, Azimi et al.[20] reported no significant difference between the number of general side effects and the age of the participants, although our findings did not show statistically significant differences (p= 0.472). Despite these finding, the researchers reported significant difference among the prevalence of myalgia and fever, those symptoms were more common in participants younger than 40 years (fever 70.5% vs 60.7%, p= 0.004 and myalgia 73.6% vs 61.3%, p= 0.009). Polack et al.[13] also described a higher frequency of reported systemic effects in younger patients, 71% of the patients older than 55 years described pain after the first dose and 66% after the second dose while in younger patients the frequency was higher, 83% reported pain after the first dose

and 78% after the second dose. Headache and fatigue were also more frequent in younger patients, the prevalence of these symptoms was 59% and 52% after the first and second dose in younger patients and 51% and 39% in older patients

Certain side effects, such as pain at the injection site, redness and tenderness, fever, headache nausea and myalgia showed higher prevalence in females compared to males, this difference is statistically significant. Borobia et al.[41] described similar findings, where local and systemic side effects were more commonly reported by females. Hoffmann et al.[33] also described a higher frequency of side effects in women (72% did not showed local side effects and 85% did not showed systemic effects) when compared to men (78% did not showed local side effects and 90% did not showed systemic effects). The researchers also described younger age in the female participants who referred side effects. A higher prevalence of symptoms related to the vaccination among women has been described by Saeed et al.[52] describing that only 17% and 11.6% of the women did not showed any side effect after the first and second dose of Sinopharm vaccine. The comparison between side effects according to the vaccine type are shown by each vaccine in tables 11-15.

Table 11. Comparison of side effects of Astra Zeneca vaccine

Astra Zeneca	Side effects after first dose	Side effects after second dose	Comparison
Any side effect	67.8%	32.0%	71.9%[19]
Pain in injection site	52.7%	23.2%	58.8%[20] 52.6%[21]
Redness and tenderness	5.2%	1.4%	49.3% tenderness 4.2% redness[19]
Fever	43.2%	10.0%	66.3%[20] 56.6%[21]
Chills	29.0%	5.8%	14.7%[19,46]
Headache	39.9%	14.6%	56.4%[21] 46.5%[20] 36%[40] 24.2%[37]
Dizziness	14.8%	5.0%	Uncommon[21] 8.2%[37]
Nausea	11.8%	3.9%	13%[20] 5.7%[46] 2.7%[21]
Myalgia	41.1%	11.9%	42%[25] 36.7%[37] 10%[40] 7%[19]
Abdominal pain	4.3%	1.3%	0.89%[25]
Allergy	2.2%	0.9%	1.7%[19]
Tiredness/sleepiness/ fatigue	4.5%	3.3%	66.3%[20] <40%[40] 21.1%[19]
Arthralgia	0.5%	0.2%	11.5%[19]
Diarrhea	1%	1%	2.2%[19]

Table 12. Comparison of side effects of Pfizer-BioNTech vaccine

Pfizer-BioNTech	Side effects after first dose	Side effects after second dose	Comparison	
			First dose	Second dose
At least one side effect	41.1%	34.4%	13.5-% 28.8%[26]	54.60%[26]
Pain in injection site	35.4%	27.2%	51.4% -88%[24,39]	62.7%-89.8%[24,39]
Fever	11.8%	12.9%	6.6%-20%[21,27]	15.59-28%[21,26]
Redness and tenderness	3.7%	3.0%	Redness 3.8%-31%[19,41] Tenderness 57.2%[19]	Redness 7.2%-23%[19,39] Tenderness 50.9%[19]
Chills	6.1%	9.4%	6.6%-20.3%[21,24]	6.4%-32.2%[19,21]
Blurry Vision	1.7%	2.7%	No data available	No data available
Headache	15.6%	12.9%	7.8%- 59%[13,19]	33.9%-52%[13,21]
Fainting	0.7%	0.4%	No data available	No data available
Dizziness	7.5%	6.8%	No data available	No data available
Abdominal Pain	2.3%	1.3%	2.03%[26]	6.69%[26]
Nausea	3.4%	4.0%	3.38%-4.1%[24,26]	1.1%-10.53%[24,26]
Myalgia	18.4%	12.9%	19.80%-43%[26,41]	40.30%[26]
Allergic reactions	2.3%	1.3%	0.7%-4.1%[19,24]	1.1%-3.7%[19,24]
Anaphylaxis	0.4%	0.4%	4.7 and 5.0 cases per million doses[53]	
Tiredness/sleepiness	5.3%	2.2%	15%-60%[39,40]	62.2%[39]
Arthralgia	0%	0.4%	2.7%- 10.76%[24,26]	1.7%-30.55%[24,26]
Diarrhea	1.1%	0%	1.4%-2.08%[24,26]	0.6%-6.69%[24,26]

Table 13. Comparison of side effects of Moderna vaccine

Moderna	Side effects after first dose	Side effects after second dose	Comparison	
			First dose	Second dose
Any side effect	56.0%	55.5%	75%[22]	
Pain in injection site	51.8%	48.9%	70%[40]	
Fever	28.1%	36.0%	91.6%[46]	
Chills	19.2%	24.3%	48.3%[46]	
Headache	29.5%	32.0%	28%	60%[23]
Nausea	7.2%	9.4%	21.3%[46]	
Myalgia	25.5%	29.7%	23%	54%[23]
Allergy	3.4%	3.7%	1:45,000 developed serious allergic reactions including anaphylaxis[54]	
Anaphylaxis	0.4%	0.4%		
Tiredness/sleepiness	3.4%	3.7%	40%	70%[23]
Arthralgia	0.2%	0.5%	26%	45%[23]

Table 14. Comparison of side effects of Johnson & Johnson vaccine

Johnson & Johnson	Side effects after first dose	Comparison[46]
Pain in injection site	23.1%	58.6%
Fever	28.2%	12.8%
Chills	25.6%	7%
Headache	17.9%	44.4%
Nausea	15.4%	15.5%
Myalgia	20.5%	39.1%
Anaphylaxis	0%	No data available

Tiredness/sleepiness/ fatigue	0%	43.8%

Table 15. Comparison of side effects of Sputnik V vaccine

Sputnik V	Side effects after first dose	Side effects after second dose	Comparison[46]
Pain in injection site	50.0%	28.3%	5%
Fever	38.3%	15.1%	2.2%
Chills	31.7%	15.1%	0.4%
Headache	33.3%	15.1%	2.9%
Nausea	8.3%	1.9%	0.7%
Myalgia	31.7%	18.9%	0.9%
Anaphylaxis	0%	0%	No data available
Tiredness/sleepiness	10.0%	0%	2.5%

Other side effects in patients who received Pfizer-BioNTech vaccine described in other studies include vomiting (0.36%), and insomnia (4.52%)26. Other uncommon side effects such as elevated liver transaminases (up to 10%) and cervical or axillary lymphadenopathy were reported in cancer patients with solid tumors.[38] Serious side effects had a prevalence of 0.12%.26 Contrary to these findings, the studied population showed only 0.4% of cases referred to anaphylaxis.

The allergic reactions were not specified by the patients in this study. Meanwhile Galván Casas et al.[14] reported morbilliform eruptions, urticarial eruptions, maculopapular eruptions, lichen planus, erythema multiforme, and reactivations of herpes zoster. Frenck et al.[27] in his study reported two cases of appendicitis. Other uncommon described findings are paroxysmal ventricular arrhythmia,13 myocarditis (160 cases in males and 22 females),53 Bell´s Palsy (8 cases per 100,000 participants),47 cerebral venous thrombosis (5.63% per million participants) and pericarditis (37 cases, 40.5% of them after the first dose and 59.5% after the second dose).

The prevalence of side effects was higher in people who received Astra Zeneca vaccine while after the second dose, the prevalence of side effects in people who received Astra Zeneca was lower than the rest of vaccine types and the participants who received Moderna vaccine showed higher prevalence of side effects. These differences are statistically significant. Al Ghafri et al.[55] also reported higher prevalence of side effects after vaccination with Astra Zeneca vaccine in comparison to Pfizer-BioNTech after the first dose (53% vs 38.6%, p=.001). Adam et al.[37] revealed higher prevalence of side effects after the vaccination with Astra Zeneca in comparison to Pfizer-BioNTech regardless of the number of doses (74.3% vs 62.6%, p= .022). Meo et al.[56] also reported higher prevalence rates of side effects in population who received the Moderna vaccine in comparison to Pfizer BioNTech.

Riad et al.39 also described the prevalence of side effects after the first and second dose of the Pfizer-BioNTech vaccine, showing higher rates of side effects after the second dose. The difference was statistically significant for the prevalence of fever, headache, myalgia, fatigue, and pain in the injection site.

Baden et al.[23] also reported higher prevalence of side effects after the second dose of the Moderna vaccine in comparison to the first dose.

The self-reported symptoms can be considered as a limitation to the study of side effects because it is possible that some conditions cannot be recognized by the participants and therefore not reported in the survey. The side effects of COVID-19 vaccines require active surveillance in the post-authorization phase to be able

to assess properly the vaccination regulations in the country. An active method to properly identify the side effects and diagnose potentially dangerous outcomes such as anaphylaxis, thrombosis or myocarditis is the need of time in Honduras.

Conclusions

The side effects reported by the population after any type of vaccination against COVID-19 are mainly systemic like fever, myalgia, and headache, while the most common local side effect is pain in the injection site. The rate of side effects are higher in females and in younger participants. After the first dose of any vaccine, the Astra Zeneca vaccine shows higher rates of side effects, however there is a statistically significant decrease in side effects of Astra Zeneca vaccine after the second dose.

Recommendations

Further investigations are highly recommended, specially to properly identify the prevalence of potentially dangerous side effects such as anaphylaxis. An active method of detection and reporting of side effects after the vaccination against COVID-19 is required. As the vaccination regulations in the country now include a booster dose, further investigations are required to identify if there is any change in the prevalence of side effects, especially in the population that received any vaccine type that is different to the booster shot.

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References

1.Wu F, Zhao S, Yu B, et al. A new coronavirus associated with human respiratory disease in China. Nature. 2020;579(7798):265-269. doi:10.1038/s41586-020-2008-3

2.Li Q, Guan X, Wu P, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. N Engl J Med. 2020;382(13):1199-1207. doi:10.1056/NEJMoa2001316

3.Zhou P, Yang X Lou, Wang XG, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature. 2020;579(7798):270-273. doi:10.1038/s41586-020-2012-7

4.Lu R, Zhao X, Li J, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet. 2020;395(10224):565-574. doi:10.1016/S0140-6736(20)30251-8

5.Organización Panamericana de la Salud, Organización Mundial de la Salud. Actualización Epidemiológica.; 2020.

6.Trilla A. Un mundo, una salud: la epidemia por el nuevo coronavirus COVID-19. Med Clin (Barc). 2020;154(5):175-177. doi:10.1016/j.medcli.2020.05.015

7.Palacios Cruz M, Santos E, Velázquez Cervantes MA, León Juárez M. COVID-19, una emergencia de salud pública mundial. Rev Clínica Española. 2020;(January). doi:10.1016/j.rce.2020.03.001

8.Pastrian-Soto G. Bases Genéticas y Moleculares del COVID-19 (SARS-CoV-2). Mecanismos de Patogénesis y de Respuesta Inmune. Int J Odontostomatol. 2020;14(3):331-337. doi:10.4067/s0718-381x2020000300331

9.Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med. 2020;382(8):727-733. doi:10.1056/NEJMoa2001017
10.Aragón-Nogales R, Vargas-Almanza I, Miranda-Novales MG, Miranda-Novales MG. COVID-19 por SARS-CoV-2: La nueva emergencia de salud. Rev Mex Pediatr. 2020;86(6):213-218. doi:10.35366/91871
11.Rabaan AA, Al-ahmed SH, Haque S, et al. SARS-CoV-2, SARS-CoV, and MERS-CoV: a comparative overview. Le Infez Med. 2020;(2):174-184.
12.Li Y Der, Chi WY, Su JH, Ferrall L, Hung CF, Wu TC. Coronavirus vaccine development: from SARS and MERS to COVID-19. J Biomed Sci. 2020;27(1):1-23. doi:10.1186/s12929-020-00695-2
13.Polack FP, Thomas SJ, Kitchin N, et al. Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine. N Engl J Med. 2020;383(27):2603-2615. doi:10.1056/nejmoa2034577
14.Galván-Casas C, Català A, Muñoz-Santos C. SARS-CoV-2 Vaccines and the Skin. Actas Dermo-Sifiliográficas (English Ed. 2021;112(9):828-836. doi:10.1016/j.adengl.2021.07.028
15.WHO. Status of COVID-19 Vaccines within WHO EUL / PQ evaluation process.; 2022.
16.Castells MC, Phillips EJ. Maintaining Safety with SARS-CoV-2 Vaccines. N Engl J Med. 2021;384(7):643-649. doi:10.1056/nejmra2035343
17.Syed Alwi SAR, Rafidah E, Zurraini A, Juslina O, Brohi IB, Lukas S. A survey on COVID-19 vaccine acceptance and concern among Malaysians. BMC Public Health. 2021;21(1):1-12. doi:10.1186/s12889-021-11071-6
18.World Health Organization. WHO Coronavirus Disease (COVID-19) Dashboard. Dashboard.
19.Menni C, Klaser K, May A, et al. Vaccine side-effects and SARS-CoV-2 infection after vaccination in users of the COVID Symptom Study app in the UK: a prospective observational study. Lancet Infect Dis. 2021;21(7):939-949. doi:10.1016/S1473-3099(21)00224-3
20.Azimi M, Dehzad WM, Atiq MA, Bahain B, Asady A. Adverse Effects of the COVID-19 Vaccine Reported by Lecturers and Staff of Kabul University of Medical Sciences, Kabul, Afghanistan. Infect Drug Resist. 2021;Volume 14:4077-4083. doi:10.2147/IDR.S332354
21.Andrzejczak-Grządko S, Czudy Z, Donderska M. Side effects after COVID-19 vaccinations among residents of Poland. Eur Rev Med Pharmacol Sci. 2021;25:4418-4421. doi:10.26355/eurrev_202106_26153
22.Anderson EJ, Rouphael NG, Widge AT, et al. Safety and Immunogenicity of SARS-CoV-2 mRNA-1273 Vaccine in Older Adults. N Engl J Med. 2020;383(25):2427-2438. doi:10.1056/nejmoa2028436
23.Baden LR, El Sahly HM, Essink B, et al. Efficacy and Safety of the mRNA-1273 SARS-CoV-2 Vaccine. N Engl J Med. 2021;384(5):403-416. doi:10.1056/nejmoa2035389
24.Efrati S, Catalogna M, Abu Hamad R, et al. Safety and humoral responses to BNT162b2 mRNA vaccination of SARS-CoV-2 previously infected and naive populations. Sci Rep. 2021;11(1):1-7. doi:10.1038/s41598-021-96129-6
25.Solomon Y, Eshete T, Mekasha B, Assefa W. Covid-19 vaccine: Side effects after the first dose of the oxford astrazeneca vaccine among health professionals in low-income country: Ethiopia. J Multidiscip Healthc. 2021;14:2577-2585. doi:10.2147/JMDH.S331140
26.Pani A, Cento V, Vismara C, et al. Results of the RENAISSANCE Study: REsponse to BNT162b2 COVID-19 vacciNe—short- And long-term Immune responSe evAluatioN in health Care workErs. Mayo Clin Proc. 2021;96(12):2966-2979. doi:10.1016/j.mayocp.2021.08.013
27.Frenck RW, Klein NP, Kitchin N, et al. Safety, Immunogenicity, and Efficacy of the BNT162b2 Covid-19 Vaccine in Adolescents. N Engl J Med. 2021;385(3):239-250. doi:10.1056/nejmoa2107456
28.Caminati M, Guarnieri G, Batani V, et al. Covid-19 vaccination in patients with severe asthma on biologic treatment: Safety, tolerability, and impact on disease control. Vaccines. 2021;9(8). doi:10.3390/vaccines9080853
29.Riad A, Hocková B, Kantorová L, et al. Side effects of mrna-based covid-19 vaccine: Nationwide phase iv study among healthcare workers in Slovakia. Pharmaceuticals. 2021;14(9):1-24. doi:10.3390/ph14090873
30.Li X, Ostropolets A, Makadia R, et al. Characterising the background incidence rates of adverse events of special interest for covid-19 vaccines in eight countries: Multinational network cohort study. BMJ. 2021;373. doi:10.1136/bmj.n1435
31.Cai C, Peng Y, Shen E, et al. A comprehensive analysis of the efficacy and safety of COVID-19 vaccines. Mol Ther. 2021;29(9):2794-2805. doi:10.1016/j.ymthe.2021.08.001
32.Madhi SA, Koen AL, Izu A, et al. Safety and immunogenicity of the ChAdOx1 nCoV-19 (AZD1222) vaccine against SARS-CoV-2 in people living with and without HIV in South Africa: an interim analysis of a randomised, double-blind, placebo-controlled, phase 1B/2A trial. Lancet HIV. 2021;8(9):e568-e580. doi:10.1016/S2352-3018(21)00157-0
33.Hoffmann MA, Wieler HJ, Enders P, Buchholz HG, Plachter B. Age- and sex-graded data evaluation of vaccination reactions after initial injection of the BNT162b2 mRNA vaccine in a local vaccination center in Germany. Vaccines. 2021;9(8):1-10. doi:10.3390/vaccines9080911
34.Klimek L, Jutel M, Akdis CA, et al. ARIA-EAACI statement on severe allergic reactions to COVID-19 vaccines – An EAACI-ARIA Position Paper. Allergy Eur J Allergy Clin Immunol. 2021;76(6):1624-1628. doi:10.1111/all.14726

35.Zhang Y, Zeng G, Pan H, et al. Safety, tolerability, and immunogenicity of an inactivated SARS-CoV-2 vaccine in healthy adults aged 18–59 years: a randomised, double-blind, placebo-controlled, phase 1/2 clinical trial. Lancet Infect Dis. 2021;21(2):181-192. doi:10.1016/S1473-3099(20)30843-4

36.Han B, Song Y, Li C, et al. Safety, tolerability, and immunogenicity of an inactivated SARS-CoV-2 vaccine (CoronaVac) in healthy children and adolescents: a double-blind, randomised, controlled, phase 1/2 clinical trial. Lancet Infect Dis. 2021;21(12):1645-1653. doi:10.1016/S1473-3099(21)00319-4

37.Adam M, Gameraddin M, Alelyani M, et al. Evaluation of post-vaccination symptoms of two common COVID-19 vaccines used in Abha, Aseer region, Kingdom of Saudi Arabia. Patient Prefer Adherence. 2021;15:1963-1970. doi:10.2147/PPA.S330689

38.Waldhorn I, Holland R, Goshen-Lago T, et al. Six-month efficacy and toxicity profile of bnt162b2 vaccine in cancer patients with solid tumors. Cancer Discov. 2021;11(10):2430-2435. doi:10.1158/2159-8290.CD-21-1072

39.Riad A, Pokorná A, Attia S, Klugarová J, Koščík M, Klugar M. Prevalence of covid-19 vaccine side effects among healthcare workers in the Czech Republic. J Clin Med. 2021;10(7). doi:10.3390/jcm10071428

40.Boekel L, Kummer LY, van Dam KPJ, et al. Adverse events after first COVID-19 vaccination in patients with autoimmune diseases. Lancet Rheumatol. 2021;3(8):e542-e545. doi:10.1016/S2665-9913(21)00181-8

41.Borobia AM, Carcas AJ, Pérez-Olmeda M, et al. Immunogenicity and reactogenicity of BNT162b2 booster in ChAdOx1-S-primed participants (CombiVacS): a multicentre, open-label, randomised, controlled, phase 2 trial. Lancet. 2021;398(10295):121-130. doi:10.1016/S0140-6736(21)01420-3

42.Takuva S, Takalani A, Garrett N, et al. Thromboembolic Events in the South African Ad26.COV2.S Vaccine Study. N Engl J Med. 2021;385(6):570-571. doi:10.1056/nejmc2107920

43.Veloza-Romero AJ, Díaz-Corredor DM, Rodríguez-Guevara Camila. Eficacia Y Seguridad De Las Vacunas En Desarrollo Contra La Covid-19. Published online 2020:26-27. www.iets.org.co

44.Laganà AS, Veronesi G, Ghezzi F, et al. Evaluation of menstrual irregularities after COVID-19 vaccination: Results of the MECOVAC survey. Open Med. 2022;17(1):475-484. doi:10.1515/med-2022-0452

45.Sadoff J, Gray G, Vandebosch A, et al. Safety and Efficacy of Single-Dose Ad26.COV2.S Vaccine against Covid-19. N Engl J Med. 2021;384(23):2187-2201. doi:10.1056/nejmoa2101544

46.Pascual-Iglesias A, Canton J, Ortega-Prieto AM, Jimenez-Guardeño JM, Regla-Nava JA. An Overview of Vaccines against SARS-CoV-2 in the COVID-19 Pandemic Era. Pathogens. 2021;10(8):1030. doi:10.3390/pathogens10081030

47.Barda N, Dagan N, Ben-Shlomo Y, et al. Safety of the BNT162b2 mRNA Covid-19 Vaccine in a Nationwide Setting. N Engl J Med. 2021;385(12):1078-1090. doi:10.1056/nejmoa2110475

48.Bogdanov G, Bogdanov I, Kazandjieva J, Tsankov N. Cutaneous adverse effects of the available COVID-19 vaccines. Clin Dermatol. 2021;39(3):523-531. doi:10.1016/j.clindermatol.2021.04.001

49.Niebel D, Novak N, Wilhelmi J, et al. Cutaneous adverse reactions to covid-19 vaccines: Insights from an immuno-dermatological perspective. Vaccines. 2021;9(9). doi:10.3390/vaccines9090944

50.Winston J, Munien K. Superficial Thrombophlebitis of the Penis following AstraZeneca ChAdOx1-S Vaccination: A Rare Venous Thromboembolic Complication. Eur J Case Reports Intern Med. Published online 2022:1-2. doi:10.12890/2022_003258

51.Sampath V, Rabinowitz G, Shah M, et al. Vaccines and allergic reactions: The past, the current COVID-19 pandemic, and future perspectives. Allergy Eur J Allergy Clin Immunol. 2021;76(6):1640-1660. doi:10.1111/all.14840

52.Saeed BQ, Al-Shahrabi R, Alhaj SS, Alkokhardi ZM, Adrees AO. Side effects and perceptions following Sinopharm COVID-19 vaccination. Int J Infect Dis. 2021;111(January):219-226. doi:10.1016/j.ijid.2021.08.013

53.Dooling K, Gargano JW, Moulia D, et al. Use of Pfizer-BioNTech COVID-19 Vaccine in Persons Aged ≥16 Years: Recommendations of the Advisory Committee on Immunization Practices — United States, September 2021. MMWR Morb Mortal Wkly Rep. 2021;70(38):1344-1348. doi:10.15585/mmwr.mm7038e2

54.Worm M, Ring J, Klimek L, et al. Anaphylaxie-Risiko bei der COVID-19-Impfung: Empfehlungen für das praktische Management. MMW - Fortschritte der Medizin. 2021;163(1):48-51. doi:10.1007/s15006-021-9530-6

55.Al Ghafri TS, Al Balushi L, Al Balushi Z, et al. Reporting at Least One Adverse Effect Post-COVID-19 Vaccination From Primary Health Care in Muscat. Cureus. 2021;13(8). doi:10.7759/cureus.17055

56.Meo SA, Bukhari IA, Akram J, Meo AS, Klonoff DC. COVID-19 vaccines: comparison of biological, pharmacological characteristics and adverse effects of Pfizer/BioNTech and Moderna Vaccines. Eur Rev Med Pharmacol Sci. 2021;25(3):1663-1669.