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Article

# Investigation of adverse effects following COVID-19 immunization: A comparison of six vaccines in Pakistan

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**Abstract: Aim:** This survey was created to find out the prevalence of immunized people and its objectives include evaluating how the general public responded to the six different COVID-19 vaccination and the range and severity of six COVID-19 vaccine adverse effects that participants self-reported. **Methodology:** A cross-sectional survey using questionnaires was carried out. The development and proper validation of a self-administered questionnaire were completed. SPSS version 23.0 was used to analyze data. For statistical evaluation, descriptive analysis was used to determine demographic frequency and percentage, other questions, and adverse effects. Analysis of associations between study variables was done using chi-square tests. Each participant gave verbal consent before the collection of data. The participants' confidentiality was protected. **Results:** A total of 493 participants were enrolled in the study, with 42.6% of them falling between the age range of 21 to 30 years. A total of 493 people had acquired vaccinations; of these, 25.96% had obtained Sinopharm, 22.31% had received Cansino Pakvac, 16.63% had acquired Pfizer, 12.57% had given Sinovac, 11.96% had obtained Moderna, and 10.54% had received AstraZeneca. These vaccines' most significant adverse effects included injection site pain, fever, headache, weariness, myalgia, joint pain, and chills. **Conclusion:** Even though after receiving the first dose of the vaccination, over 55% of those who received it reported musculoskeletal side effects, such as muscle aches and fatigue, we found that participants generally accepted the vaccination. After obtaining the second vaccine shot, it was observed that participants did not have as many adverse effects.

**Keywords:** COVID-19 vaccines; adverse effects; injection site pain; musculoskeletal effects

## 1. Introduction

SARS-CoV-2, an enveloped non-segmented positive-sense RNA virus, was publicly announced in Wuhan, China on 31 December 2019 [1,2]. Due to its rapid spread across the globe, leading to the range of illness severities, the WHO declared COVID-19 a pandemic on 11 March 2020 [3–6]. Various therapeutic regimens were introduced, but due to a lack of efficacy, vaccines have proven to be one of the most effective interventions for combating COVID-19 [7,8].

In December 2020, Pfizer–BioNTech, and Moderna were the first vaccines to get authorization for emergency use, and in phase III, clinical trials 95% efficacy was reported [9–11]. Lipid nanoparticle delivery systems or modified mRNA systems were used in these vaccines [12]. In terms of efficacy at a very low cost, RNA vaccines were manufactured rapidly and have a potent effect. As they are not produced with actual pathogens and the host DNA is not incorporated as in the case of other viral vaccines, they show better safety profile [13]. The localized side effects of both vaccines are vomiting, pain, nausea, fever, headache, muscle aches, and in rare cases anaphylactic

reactions [14]. On the other hand, Vero cells are used to make the Sinopharm whole virus vaccine which is inactivated. These cells create multiple copies of the SARS-CoV-2 virus, which are then deactivated with beta-propiolactone that binds to its genes. 79.34% efficacy has been shown by Phase III clinical trials conducted in Argentina, Bahrain, Egypt, Morocco, Pakistan, Peru, and the United Arab Emirates (UAE) and approved by WHO for emergency use [15]. The vaccine is required to be used in 2 doses at 3–4 weeks intervals. According to available data side effects like headache, fever, injection site pain, etc. [14]. CansinoBio is manufactured by the introduction of coronavirus genetic material into the human body cold virus is used which boosts the T cell response and helps combat the disease [16]. AstraZeneca is approved for the active immunization of people over the age of 18 against COVID-19, which is brought on by the SARS-CoV-2 virus. The most often reported adverse responses were pain, myalgia, weariness, malaise at the injection site as well as discomfort at the injection site [17].

Aim of the study is to find out the history of people who have been vaccinated with Covid 19 vaccination which includes vaccination before or after COVID-19 infection and to compare the prevalence of adverse effects of vaccines administered in twin cities of Pakistan i.e., Cansino Pakvac, Sinovac, Sinopharm, AstraZeneca, Moderna, and Pfizer BioNTech. This survey will shed light on the actual adverse effects that COVID-19 vaccination recipients have encountered and will also give people more confidence to acquire COVID-19 vaccinations.

## 2. Methodology

### 2.1. Study design

questionnaire-based cross-sectional survey was conducted. A self-administered questionnaire comprised was developed and duly validated. The questions were developed by obtaining information from various standard National and International guidelines standing at the time of the study, which included different questions, comprising sociodemographic characteristics, information about any Chronic disease, COVID-19 infection, and post-vaccination adverse effects in the population of twin cities (Islamabad/Rawalpindi) of Pakistan [18,19].

### 2.2. Sample source and time-frame

The questionnaire was first developed and thoroughly checked. A total of 493 responses were collected. The duration of the survey was six months from September 2021 to February 2022. It was assessed that it would take five minutes to complete the questionnaire; no incentives were offered to any respondents. The questionnaire was evaluated by 10–15 experts to guarantee face and content validity. Although it wasn't included in the final study, the expert's feedback was used to refine the questionnaire.

The study was conducted mainly for the people of twin cities, to determine the Covid-19 Infection, recovery period, side effects, and symptoms post-vaccination among them. So, the general population of Rawalpindi and Islamabad was included in the study. Patients excluded from the study who had severe illnesses.

### 2.3. Data collection

A structured questionnaire consisting of 12 questions was used and the responses were collected. 8 questions were multiple-choice type and 4 questions were in yes/no format. Data were collected from the general population of Islamabad and Rawalpindi. The structure of the questionnaire contains closed-ended questions, described. First of all, the demographic data of the participants were taken, seven questions collecting basic information on the characteristics of the participant (gender, age, education, chronic conditions, etc.). Of 12 questions 1 is in tabular form which includes the possible adverse effects related to the following vaccine types i.e. Cansino Pakvac, Sinovac, Sinopharm, AstraZeneca, Moderna, and Pfizer-BioNTech. The questions from 1 to 7 are related to COVID-19 infection, recovery period, willingness to vaccination, post-COVID vaccination symptoms, etc. The questions from 8 to 12 consist of the interval, duration, severity of symptoms, and any medication taken if symptoms appear. The study variables were participant age, gender, and vaccination before or after COVID-19 infection. The data were gathered using a non-probability, convenience sampling technique. We were able to gather enough data with the necessary variables.

### 2.4. Data analysis

Version 23.0 of the Statistical Package for Social Sciences (SPSS) was used to analyze the data. Descriptive analysis was employed for statistical evaluation, such as frequency and percentage of demographics, other inquiries, and adverse effects of various vaccines. Inferential statistics were used to analyze relationships between research variables. The Kolmogorov-Smirnov test was used to evaluate the nature of the data distribution and discovered that the data was not distributed normally. To assess the associations between the research variables, non-parametric tests were used. The chi-square test was used to draw comparison among categorical groups to assess whether the variables were associated. It was declared that the $P$-value $< 0.05$ was significant.

### 2.5. Ethical approval

The research was approved by The University of Lahore, Islamabad Campus (Ref # BEC/0507). Before data collection, verbal consent was taken from every participant. The confidentiality of the participants was ensured. Participation in this study was entirely voluntary and without compensation. Before data collection, the purpose of the survey was explained, and they were also informed that the completion and submission of the questionnaire would be taken upon their consent.

## 3. Results

### 3.1. Demographical features

There were 500 responses, 7 of whom were incomplete, resulting in a final sample size of 493. **Table 1** shows the demographical features of the study participants. Most study participants were 21–30 years old (42.6%), 31–40 years old (18.5%), 16.6% 15–20 years old, 11.6% 41–50 years old, 6.7% 51–60 years, and 4.1%

above 60 years. There was a female predominance with 58.6% females. According to educational status, most of them did middle (25.3%) followed by primary 23.9%, matriculation 14%, intermediate 11.4%, graduation 9.1%, post-graduation 1.8%, and 4.5% were illiterate. According to their health status, 88.55% had no chronic disease, 6.3% had hypertension, 1.9% had diabetes, 1.2% had heart disease, 0.2% had cancer, and 0.2% had obesity.

**Table 1.** Demographical features (*n* = 493).

| Classification | Category | *n* (%) |
|---|---|---|
| **Age (yrs.)** | 15–20 yrs | 82 (16.6) |
| | 21–30 yrs | 210 (42.6) |
| | 31–40 yrs | 91 (18.5) |
| | 41–50 yrs | 57 (11.6) |
| | 51–60 yrs | 33 (6.7) |
| | >60 yrs | 20 (4.1) |
| **Gender** | Male | 204 (41.4) |
| | Female | 284 (58.6) |
| **Education** | Illiterate | 22 (4.5) |
| | Primary | 118 (23.9) |
| | Middle | 174 (25.3) |
| | Matriculation | 69 (14) |
| | Intermediate | 56 (11.4) |
| | Graduate | 45 (9.1) |
| | Post-Graduate | 9 (1.8) |
| **Chronic** | None | 437 (88.5) |
| **Conditions** | Cancer | 1 (0.2) |
| | Diabetes | 17 (1.9) |
| | Hypertension | 31 (6.3) |
| | Obesity | 1 (0.2) |
| | Heart Disease | 6 (1.2) |

## 3.2. Condition of participants before and after vaccination

Out of 493 participants, 17.8% had Covid-19 infection, 70.8% did not, and 11.4% were unaware of it. Recovery time for 12% of participants was 7–14 days, and for 5.9% it was 15–28 days. 100% of them received vaccinations. 3.9% were dissatisfied with the vaccination decision, 3.9% were unaware of it, and 92.3% were satisfied. The willingness to vaccinate was 90.7%. Vaccination rates were 70.8% before Covid-19 infection, 17.8% post-infection, and 11.4% unaware. The participants' adverse effects following vaccination have been further addressed. Participants reported experiencing negative effects at a rate of 19.5% immediately, 72% after an hour, 3.3% after six hours, 2.7% between seven and twelve hours, and 2.4% within twenty-four hours. Participants' adverse effects lasted for an average of one day, three days, and five days for 20%, 72%, and 8.4% of them, respectively. 38.7% of participants found general adverse effects, 40.5% mild, and 20.7% moderate, in order of the degree of such

effects. 12.4% of people reported taking medication, whereas 87.6% did not, and of the population that took the medication; 72.1% took Panadol, 22.9% took Brufen, 1.6% took Nuberol, and 3.3% took Duragesic (**Table 2**).

**Table 2.** Condition of Participants before and after vaccination.

| Questions | n (%) |
|---|---|
| **Did you suffer from a COVID-19 infection?** | |
| Don't know | 56 (11.4) |
| Total | 493 (100) |
| **Recovery Period** | |
| 7–14 days | 59 (12.0) |
| 15–28 days | 29 (5.9) |
| None | 405 (82.2) |
| Total | 493 (100) |
| **Did you get a vaccination?** | |
| Yes | 493 (100) |
| No | 0 (0) |
| Total | 493 |
| **Are you satisfied with the decision to vaccinate?** | |
| Yes | 455 (92.3) |
| No | 19 (3.9) |
| Don't know | 19 (3.9) |
| Total | 493 (100) |
| **Were you willing to vaccinate?** | |
| Yes | 447 (90.7) |
| No | 46 (9.3) |
| Total | 493 (100) |
| **Vaccinated before or after COVID-19 infection?** | |
| Before | 349 (70.8) |
| After | 88 (17.8) |
| Don't know | 56 (11.4) |
| Total | 493 (100) |
| **Interval of Adverse Effects in Participants Who Experienced Them** | |
| Immediate | 65 (19.5) |
| Within an hour | 240 (72) |
| After 6 hrs. | 11 (3.3) |
| 7–12hrs | 9 (2.7) |
| Within 24 hrs. | 8 (2.4) |
| Total | 333 (100) |
| **Duration of Adverse Effects in participants who experienced them** | |
| 1 day | 66 (20.0) |
| 3 days | 239 (72.0) |
| 5 days | 28 (8.4) |
| Total | 333 (100) |

**Table 2.** (*Continued*).

| Questions | n (%) |
|---|---|
| **The severity of the Adverse Effects in Participants Who Experienced Them** | |
| General | 129 (38.7) |
| Mild | 135 (40.5) |
| Moderate | 69 (20.7) |
| Total | 333 (100) |
| **Taken any medication and experienced adverse effects?** | |
| Yes | 61 (18.3) |
| No | 272 (81.7) |
| Total | 333 (100) |
| **Which medication did you in response to adverse effects?** | |
| Panadol | 44 (72.1) |
| Brufen | 14 (22.9) |
| Nuberol | 1 (1.6) |
| Duragesic | 2 (3.3) |
| Total | 61 (100) |

## 3.3. Population experienced COVID-19 Vaccine Adverse effects after administration of 1st and 2nd dose

Overall injection site pain after administration of 1st dose of Cansino Pakvac, Sinovac, Sinopharm, AstraZeneca, Moderna, and Pfizer BioNTech was 68.2%, 62.9%, 67.1%, 75%, 57.6%, and 73.2% respectively which was also the most prevalent adverse effect seen in them and the other adverse effects that are discussed in **Tables 3** and **4**.

**Table 3.** Covid-19 vaccines adverse effects after administration of 1st and 2nd dose.

| **Covid-19 Vaccines** | **Cansino Pakvac Single Dose** | | | **Sinovac 1st Dose** | | | **Sinopharm 1st Dose** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Adverse Effects** | **M N (%)** | **F N (%)** | **P N (%)** | **M** | **F N (%)** | **P N (%)** | **M N (%)** | **F N (%)** | **P N (%)** |
| Pain | 26 (54.2) | 49 (79.0) | **0.005** | 5 (29.4) | 34 (75.5) | **0.001** | 31 (55.4) | 56 (77.8) | **0.012** |
| Redness | 3 (6.3) | 4 (6.5) | >0.05 | 0 (0) | 5 (11.1) | >0.05 | 3 (5.4) | 5 (6.9) | >0.05 |
| Itching | 7 (14.6) | 11 (17.7) | >0.05 | 2 (11.8) | 2 (4.4) | >0.05 | 3 (5.4) | 4 (5.6) | >0.05 |
| Swelling | 2 (4.2) | 0 (0) | >0.05 | 1 (5.9) | 2 (4.4) | >0.05 | 1 (1.8) | 4 (5.6) | >0.05 |
| Tingling | 4 (8.3) | 6 (9.7) | >0.05 | 1 (5.9) | 2 (4.4) | >0.05 | 3 (5.4) | 4 (5.6) | >0.05 |
| Fatigue | 7 (14.6) | 13 (21.0) | >0.05 | 4 (23.5) | 3 (6.7) | >0.05 | 1 (1.8) | 10 (13.9) | **0.015** |
| Headache | 7 (14.6) | 13 (21.0) | >0.05 | 6 (35.3) | 13 (28.9) | >0.05 | 10 (18.0) | 30 (41.2) | **0.004** |
| Myalgia | 10 (20.8) | 8 (13.0) | >0.05 | 4 (23.5) | 32 (71.1) | **0.001** | 16 (28.5) | 58 (80.5) | **<0.0001** |
| Chills | 3 (6.3) | 5 (8.1) | >0.05 | 0 (0) | 6 (13.3) | >0.05 | 5 (8.9) | 10 (13.9) | >0.05 |
| Fever | 15 (31.3) | 22 (35.5) | >0.05 | 5 (29.4) | 7 (15.6) | >0.05 | 6 (10.7) | 20 (27.8) | **0.017** |
| Joint pain | 12 (25) | 6 (9.7) | **0.031** | 6 (35.3) | 13 (28.9) | >0.05 | 11 (19.6) | 27 (37.5) | **0.028** |
| Nausea | 2 (4.2) | 5 (8.1) | >0.05 | 2 (11.8) | 4 (8.9) | >0.05 | 3 (5.4) | 3 (4.2) | >0.05 |
| Vomiting | 0 (0) | 1 (1.6) | >0.05 | 0 (0) | 1 (2.2) | >0.05 | 1 (1.8) | 0 (0) | >0.05 |
| Diarrhea | 2 (4.2) | 2 (3.2) | >0.05 | 0 (0) | 1 (2.2) | >0.05 | 0 (0) | 1 (1.4) | >0.05 |
| Abdominal pain | 3 (6.3) | 2 (3.2) | >0.05 | 1 (5.9) | 3 (6.7) | >0.05 | 3 (5.4) | 4 (5.6) | >0.05 |

**Table 3.** (*Continued*).

| **Covid-19 Vaccines** | **Cansino Pakvac Single Dose** | | | **Sinovac 1st Dose** | | | **Sinopharm 1st Dose** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Adverse Effects** | **M N (%)** | **F N (%)** | **P N (%)** | **M** | **F N (%)** | **P N (%)** | **M N (%)** | **F N (%)** | **P N (%)** |
| Allergic rash | 2 (4.2) | 1 (1.6) | >0.05 | 0 (0) | 2 (2.2) | >0.05 | 2 (3.6) | 2 (2.8) | >0.05 |
| Swollen lymph nodes | 0 (0) | 5 (8.1) | >0.05 | 0 (0) | 2 (2.2) | >0.05 | 1 (1.8) | 4 (5.6) | >0.05 |
| Insomnia | 8 (7.3) | 7 (11.3) | >0.05 | 0 (0) | 5 (11.1) | >0.05 | 6 (10.7) | 7 (9.7) | >0.05 |
| Paralysis of injection site | - | - | - | 1 (5.9) | 2 (2.2) | >0.05 | 3 (5.4) | 3 (4.2) | >0.05 |

**Table 4.** Covid-19 vaccines adverse effects after administration of 1st and 2nd dose.

| **Covid-19 Vaccines** | **AstraZeneca 1st Dose** | | | **Moderna 1st Dose** | | | **Pfizer BioNTech 1st Dose** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Adverse Effects** | **M N (%)** | **F N (%)** | ***P N* (%)** | **M N (%)** | **F N (%)** | ***P N* (%)** | **M N (%)** | **F N (%)** | ***P N* (%)** |
| Pain | 17 (70.8) | 22 (78.5) | >0.05 | 7 (30.4) | 27 (75.0) | **0.001** | 19 (52.7) | 41 (89.1) | **<0.0001** |
| Redness | 2 (8.3) | 2 (7.14) | >0.05 | 1 (4.3) | 3 (8.3) | >0.05 | 2 (5.6) | 3 (6.5) | >0.05 |
| Itching | 3 (12.5) | 1 (3.6) | >0.05 | 1 (4.3) | 2 (5.6) | >0.05 | 2 (5.6) | 2 (4.3) | >0.05 |
| Swelling | 0 (0) | 3 (10.7) | >0.05 | 1 (4.3) | 2 (5.6) | >0.05 | 0 (0) | 3 (6.5) | >0.05 |
| Tingling | 3 (12.5) | 1 (3.6) | >0.05 | 0 (0) | 2 (5.6) | >0.05 | 1 (2.8) | 3 (6.5) | >0.05 |
| Fatigue | 3 (12.5) | 2 (7.14) | >0.05 | 1 (4.3) | 5 (13.9) | >0.05 | 4 (11.1) | 4 (8.7) | >0.05 |
| Headache | 9 (37.5) | 5 (17.9) | >0.05 | 3 (13.0) | 16 (44.4) | **0.012** | 6 (16.7) | 20 (43.5) | **0.01** |
| Myalgia | 12 (50) | 19 (67.8) | >0.05 | 5 (21.7) | 29 (80.5) | **<0.0001** | 22 (61.1) | 28 (61.0) | >0.05 |
| Chills | 4 (16.7) | 2 (7.14) | >0.05 | 3 (13.0) | 3 (8.3) | >0.05 | 4 (11.1) | 2 (4.3) | >0.05 |
| Fever | 4 (16.7) | 6 (21.4) | >0.05 | 2 (8.7) | 13 (36.1) | **0.018** | 4 (11.1) | 17 (36.9) | **0.008** |
| Joint pain | 8 (33.3) | 5 (17.9) | >0.05 | 2 (8.7) | 16 (44.4) | **0.004** | 12 (33.3) | 11 (26.1) | >0.05 |
| Nausea | 3 (12.5) | 3 (10.7) | >0.05 | 5 (21.7) | 0 (0) | **0.003** | 3 (8.3) | 3 (6.5) | >0.05 |
| Vomiting | 0 (0) | 1 (3.6) | >0.05 | 1 (4.3) | 0 (0) | >0.05 | 0 (0) | 1 (2.2) | >0.05 |
| Diarrhea | 0 (0) | 1 (3.6) | >0.05 | 0 (0) | 1 (2.7) | >0.05 | 0 (0) | 1 (2.2) | >0.05 |
| Abdominal pain | 0 (0) | 3 (10.7) | >0.05 | 0 (0) | 4 (11.1) | >0.05 | 2 (5.6) | 2 (4.3) | >0.05 |
| Allergic rash | 2 (8.3) | 0 (0) | >0.05 | 2 (8.7) | 0 (0) | >0.05 | 0 (0) | 2 (4.3) | >0.05 |
| Swollen lymph nodes | 1 (4.2) | 1 (3.6) | >0.05 | 0 (0) | 2 (5.6) | >0.05 | 0 (0) | 2 (4.3) | >0.05 |
| Insomnia | 3 (12.5) | 2 (7.14) | >0.05 | 3 (13.0) | 2 (5.6) | >0.05 | 3 (8.3) | 4 (8.7) | >0.05 |
| Paralysis of injection site | 1 (4.2) | 2 (7.14) | >0.05 | 2 (8.7) | 1 (2.7) | >0.05 | 0 (0) | 3 (6.5) | >0.05 |

### 3.4. Association of 1st dose COVID-19 Vaccines ADRs with gender

The chi-square test revealed a statistically significant difference in the distribution of adverse effects after the 1st dose of the vaccination between gender in the case of the Cansino Pakvac vaccine, pain at the injection site ($p = 0.005$), and joint pain ($p = 0.031$), following the Sinovac vaccine, pain ($p = 0.001$), and myalgia ($p = 0.001$), after the Sinopharm vaccine, pain ($p = 0.012$), fatigue ($p = 0.015$), headache ($p = 0.004$), myalgia ($p < 0.0001$), fever ($p = 0.017$), and joint pain ($p = 0.028$), in the case of AstraZeneca no significant *p*-values were observed, after the Moderna vaccine pain ($p = 0.001$), headache ($p = 0.012$), myalgia ($p < 0.0001$), fever ($p = 0.01$), joint pain ($p = 0.004$), and nausea ($p = 0.003$), and in the matter of Pfizer BioNTech vaccine showing the values pain ($p = <0.0001$), headache ($p = 0.010$), and fever ($p = 0.008$) with most of these seen in female gender (**Tables 5** and **6**).

**Table 5.** Association of 1st dose COVID-19 Vaccines ADRs with gender.

| **Covid-19 Vaccines** | **Cansino Pakvac Single Dose** | | | **Sinovac 1st Dose** | | | **Sinopharm 1st Dose** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Adverse Effects** | **M N (%)** | **F N (%)** | ***P N (%)*** | **M *N (%)*** | **F N (%)** | ***P N* (%)** | **M N (%)** | **F N (%)** | ***P N* (%)** |
| Pain | 26 (54.2) | 49 (79.0) | **0.005** | 5 (29.4) | 34 (75.5) | **0.001** | 31 (55.4) | 56 (77.8) | **0.012** |
| Redness | 3 (6.3) | 4 (6.5) | >0.05 | 0 (0) | 5 (11.1) | >0.05 | 3 (5.4) | 5 (6.9) | >0.05 |
| Itching | 7 (14.6) | 11 (17.7) | >0.05 | 2 (11.8) | 2 (4.4) | >0.05 | 3 (5.4) | 4 (5.6) | >0.05 |
| Swelling | 2 (4.2) | 0 (0) | >0.05 | 1 (5.9) | 2 (4.4) | >0.05 | 1 (1.8) | 4 (5.6) | >0.05 |
| Tingling | 4 (8.3) | 6 (9.7) | >0.05 | 1 (5.9) | 2 (4.4) | >0.05 | 3 (5.4) | 4 (5.6) | >0.05 |
| Fatigue | 7 (14.6) | 13 (21.0) | >0.05 | 4 (23.5) | 3 (6.7) | >0.05 | 1 (1.8) | 10 (13.9) | **0.015** |
| Headache | 7 (14.6) | 13 (21.0) | >0.05 | 6 (35.3) | 13 (28.9) | >0.05 | 10 (18.0) | 30 (41.2) | **0.004** |
| Myalgia | 10 (20.8) | 8 (13.0) | >0.05 | 4 (23.5) | 32 (71.1) | **0.001** | 16 (28.5) | 58 (80.5) | **<0.0001** |
| Chills | 3 (6.3) | 5 (8.1) | >0.05 | 0 (0) | 6 (13.3) | >0.05 | 5 (8.9) | 10 (13.9) | >0.05 |
| Fever | 15 (31.3) | 22 (35.5) | >0.05 | 5 (29.4) | 7 (15.6) | >0.05 | 6 (10.7) | 20 (27.8) | **0.017** |
| Joint pain | 12 (25) | 6 (9.7) | **0.031** | 6 (35.3) | 13 (28.9) | >0.05 | 11 (19.6) | 27 (37.5) | **0.028** |
| Nausea | 2 (4.2) | 5 (8.1) | >0.05 | 2 (11.8) | 4 (8.9) | >0.05 | 3 (5.4) | 3 (4.2) | >0.05 |
| Vomiting | 0 (0) | 1 (1.6) | >0.05 | 0 (0) | 1 (2.2) | >0.05 | 1 (1.8) | 0 (0) | >0.05 |
| Diarrhea | 2 (4.2) | 2 (3.2) | >0.05 | 0 (0) | 1 (2.2) | >0.05 | 0 (0) | 1 (1.4) | >0.05 |
| Abdominal pain | 3 (6.3) | 2 (3.2) | >0.05 | 1 (5.9) | 3 (6.7) | >0.05 | 3 (5.4) | 4 (5.6) | >0.05 |
| Allergic rash | 2 (4.2) | 1 (1.6) | >0.05 | 0 (0) | 2 (2.2) | >0.05 | 2 (3.6) | 2 (2.8) | >0.05 |
| Swollen lymph nodes | 0 (0) | 5 (8.1) | >0.05 | 0 (0) | 2 (2.2) | >0.05 | 1 (1.8) | 4 (5.6) | >0.05 |
| Insomnia | 8 (7.3) | 7 (11.3) | >0.05 | 0 (0) | 5 (11.1) | >0.05 | 6 (10.7) | 7 (9.7) | >0.05 |
| Paralysis of injection site | - | - | - | 1 (5.9) | 2 (2.2) | >0.05 | 3 (5.4) | 3 (4.2) | >0.05 |

**Table 6.** Association of 1st dose COVID-19 Vaccines ADRs with gender.

| **Covid-19 Vaccines** | **AstraZeneca 1st Dose** | | | **Moderna 1st Dose** | | | **Pfizer BioNTech 1st Dose** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Adverse Effects** | **M N (%)** | **F N (%)** | ***P N* (%)** | **M N (%)** | **F N (%)** | ***P N* (%)** | **M N (%)** | **F N (%)** | ***P N* (%)** |
| Pain | 17 (70.8) | 22 (78.5) | >0.05 | 7 (30.4) | 27 (75.0) | **0.001** | 19 (52.7) | 41 (89.1) | **<0.0001** |
| Redness | 2 (8.3) | 2 (7.14) | >0.05 | 1 (4.3) | 3 (8.3) | >0.05 | 2 (5.6) | 3 (6.5) | >0.05 |
| Itching | 3 (12.5) | 1 (3.6) | >0.05 | 1 (4.3) | 2 (5.6) | >0.05 | 2 (5.6) | 2 (4.3) | >0.05 |
| Swelling | 0 (0) | 3 (10.7) | >0.05 | 1 (4.3) | 2 (5.6) | >0.05 | 0 (0) | 3 (6.5) | >0.05 |
| Tingling | 3 (12.5) | 1 (3.6) | >0.05 | 0 (0) | 2 (5.6) | >0.05 | 1 (2.8) | 3 (6.5) | >0.05 |
| Fatigue | 3 (12.5) | 2 (7.14) | >0.05 | 1 (4.3) | 5 (13.9) | >0.05 | 4 (11.1) | 4 (8.7) | >0.05 |
| Headache | 9 (37.5) | 5 (17.9) | >0.05 | 3 (13.0) | 16 (44.4) | **0.012** | 6 (16.7) | 20 (43.5) | **0.01** |
| Myalgia | 12 (50) | 19 (67.8) | >0.05 | 5 (21.7) | 29 (80.5) | **<0.0001** | 22 (61.1) | 28 (61.0) | >0.05 |
| Chills | 4 (16.7) | 2 (7.14) | >0.05 | 3 (13.0) | 3 (8.3) | >0.05 | 4 (11.1) | 2 (4.3) | >0.05 |
| Fever | 4 (16.7) | 6 (21.4) | >0.05 | 2 (8.7) | 13 (36.1) | **0.018** | 4 (11.1) | 17 (36.9) | **0.008** |
| Joint pain | 8 (33.3) | 5 (17.9) | >0.05 | 2 (8.7) | 16 (44.4) | **0.004** | 12 (33.3) | 11 (26.1) | >0.05 |
| Nausea | 3 (12.5) | 3 (10.7) | >0.05 | 5 (21.7) | 0 (0) | **0.003** | 3 (8.3) | 3 (6.5) | >0.05 |
| Vomiting | 0 (0) | 1 (3.6) | >0.05 | 1 (4.3) | 0 (0) | >0.05 | 0 (0) | 1 (2.2) | >0.05 |
| Diarrhea | 0 (0) | 1 (3.6) | >0.05 | 0 (0) | 1 (2.7) | >0.05 | 0 (0) | 1 (2.2) | >0.05 |
| Abdominal pain | 0 (0) | 3 (10.7) | >0.05 | 0 (0) | 4 (11.1) | >0.05 | 2 (5.6) | 2 (4.3) | >0.05 |
| Allergic rash | 2 (8.3) | 0 (0) | >0.05 | 2 (8.7) | 0 (0) | >0.05 | 0 (0) | 2 (4.3) | >0.05 |
| Swollen lymph nodes | 1 (4.2) | 1 (3.6) | >0.05 | 0 (0) | 2 (5.6) | >0.05 | 0 (0) | 2 (4.3) | >0.05 |
| Insomnia | 3 (12.5) | 2 (7.14) | >0.05 | 3 (13.0) | 2 (5.6) | >0.05 | 3 (8.3) | 4 (8.7) | >0.05 |
| Paralysis of injection site | 1 (4.2) | 2 (7.14) | >0.05 | 2 (8.7) | 1 (2.7) | >0.05 | 0 (0) | 3 (6.5) | >0.05 |

### 3.5. Association of 2nd dose COVID-19 Vaccines ADRs with gender

The chi-square test in the case of 2nd dose showed that the distribution of adverse effects was statistically significant in the matter of the Sinovac vaccine, pain ($p$ = 0.001), and myalgia ($p$ < 0.0001), Sinopharm vaccine, pain ($p$ = 0.004), redness ($p$ = 0.045), fatigue ($p$ = 0.011), headache ($p$ = 0.005), myalgia ($p$ < 0.0001), fever ($p$ = 0.005), joint pain ($p$ = 0.031) and allergic rash ($p$ = 0.044), AstraZeneca no significant values, Moderna vaccine, pain ($p$ < 0.0001) and myalgia ($p$ < 0.0001), and Pfizer BioNTech vaccine, pain ($p$ = < 0.0001), itching ($p$ = 0.041), headache ($p$ = 0.013) and fever ($p$ = 0.027) with most of these seen in female gender (**Tables 7** and **8**).

**Table 7.** Association of 2nd dose COVID-19 Vaccines ADRs with gender.

| **Covid-19 Vaccines** | **Sinovac 2nd Dose** | | | **Sinopharm 2nd Dose** | | |
|---|---|---|---|---|---|---|
| **Adverse Effects** | **M N (%)** | **F N (%)** | ***P N* (%)** | **M N (%)** | **F N (%)** | ***P N* (%)** |
| Pain | 4 (23.5) | 31 (68.9) | **0.001** | 17 (30.3) | 40 (55.6) | **0.004** |
| Redness | 0 (0) | 2 (4.4) | >0.05 | 5 (8.9) | 1 (1.4) | **0.045** |
| Itching | 2 (11.8) | 1 (2.2) | >0.05 | 5 (8.9) | 3 (4.2) | >0.05 |
| Swelling | 2 (11.8) | 1 (2.2) | >0.05 | 2 (3.6) | 1 (1.4) | >0.05 |
| Tingling | 1 (5.9) | 1 (2.2) | >0.05 | 0 (0) | 3 (4.2) | >0.05 |
| Fatigue | 3 (17.6) | 2 (4.4) | >0.05 | 2 (1.8) | 13 (18.1) | **0.011** |
| Headache | 3 (17.6) | 7 (15.6) | >0.05 | 5 (8.9) | 21 (29.2) | **0.005** |
| Myalgia | 1 (5.9) | 29 (64.4) | **<0.0001** | 12 (21.4) | 51 (70.8) | **<0.0001** |
| Chills | 1 (5.9) | 2 (2.2) | >0.05 | 7 (12.5) | 9 (12.5) | >0.05 |
| Fever | 2 (11.8) | 6 (13.3) | >0.05 | 5 (8.9) | 21 (29.2) | **0.005** |
| Joint pain | 7 (41.2) | 7 (15.6) | >0.05 | 8 (14.3) | 22 (30.5) | **0.031** |
| Nausea | 3 (17.6) | 3 (6.7) | >0.05 | 4 (7.1) | 5 (6.9) | >0.05 |
| Vomiting | 0 (0) | 1 (2.2) | >0.05 | 0 (0) | 4 (5.6) | >0.05 |
| Diarrhea | 0 (0) | 1 (2.2) | >0.05 | 2 (3.6) | 2 (2.8) | >0.05 |
| Abdominal pain | 2 (11.8) | 2 (4.4) | >0.05 | 2 (3.6) | 5 (6.9) | >0.05 |
| Allergic rash | 0 (0) | 2 (2.2) | >0.05 | 0 (0) | 5 (6.9) | **0.044** |
| Swollen lymph nodes | 0 (0) | 2 (2.2) | >0.05 | 4 (7.1) | 1 (1.4) | >0.05 |
| Insomnia | 1 (5.9) | 4 (8.9) | >0.05 | 6 (10.7) | 8 (11.1) | >0.05 |
| Paralysis of injection site | 0 (0) | 2 (4.4) | >0.05 | 1 (1.8) | 4 (5.6) | >0.05 |

**Table 8.** Association of 2nd dose COVID-19 Vaccines ADRs with gender.

| **Covid-19 Vaccines** | **AstraZeneca 2nd Dose** | | | **Moderna 2nd Dose** | | | **Pfizer BioNTech 2nd Dose** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Adverse Effects** | **M N (%)** | **F N (%)** | **P N (%)** | **M N (%)** | **F N (%)** | **P N (%)** | **M N (%)** | **F N (%)** | **P N (%)** |
| Pain | 12 (50.0) | 18 (64.3) | >0.05 | 3 (13.0) | 25 (69.4) | **<0.0001** | 13 (36.1) | 35 (76.1) | **<0.0001** |
| Redness | 0 (0) | 1 (3.6) | >0.05 | 0 (0) | 2 (5.6) | >0.05 | 1 (2.8) | 2 (4.3) | >0.05 |
| Itching | 3 (12.5) | 0 (0) | >0.05 | 1 (4.3) | 1 (2.7) | >0.05 | 0 (0) | 5 (10.8) | **0.041** |
| Swelling | 2 (8.3) | 0 (0) | >0.05 | 2 (8.7) | 1 (2.7) | >0.05 | 0 (0) | 3 (6.5) | >0.05 |
| Tingling | 1 (4.2) | 0 (0) | >0.05 | 0 (0) | 1 (2.7) | >0.05 | 1 (2.8) | 2 (4.3) | >0.05 |
| Fatigue | 4 (16.7) | 2 (7.14) | >0.05 | 2 (8.7) | 3 (8.3) | >0.05 | 4 (11.1) | 5 (10.8) | >0.05 |
| Headache | 3 (12.5) | 9 (32.1) | >0.05 | 4 (17.4) | 6 (16.7) | >0.05 | 4 (11.1) | 16 (34.8) | **0.013** |
| Myalgia | 16 (66.7) | 21 (75) | >0.05 | 4 (17.4) | 18 (50.0) | **<0.0001** | 16 (44.4) | 21 (45.7) | >0.05 |

**Table 8.** (*Continued*).

| **Covid-19 Vaccines** | **AstraZeneca 2nd Dose** | | | **Moderna 2nd Dose** | | | **Pfizer BioNTech 2nd Dose** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Adverse Effects** | **M N (%)** | **F N (%)** | **P N (%)** | **M N (%)** | **F N (%)** | **P N (%)** | **M N (%)** | **F N (%)** | **P N (%)** |
| Chills | 4 (16.7) | 3 (10.7) | >0.05 | 2 (8.7) | 2 (5.6) | >0.05 | 1 (2.8) | 6 (3.0) | >0.05 |
| Fever | 4 (16.7) | 9 (32.1) | >0.05 | 5 (8.5) | 4 (11.1) | >0.05 | 6 (16.7) | 18 (39.1) | **0.027** |
| Joint pain | 5 (20.8) | 8 (28.8) | >0.05 | 6 (10.1) | 8 (22.2) | >0.05 | 11 (30.6) | 10 (21.7) | >0.05 |
| Nausea | 3 (12.5) | 2 (7.14) | >0.05 | 4 (17.4) | 2 (5.6) | >0.05 | 3 (8.3) | 3 (6.5) | >0.05 |
| Vomiting | 0 (0) | 1 (3.6) | >0.05 | 0 (0) | 1 (2.7) | >0.05 | 0 (0) | 1 (2.2) | >0.05 |
| Diarrhea | 0 (0) | 1 (3.6) | >0.05 | 0 (0) | 1 (2.7) | >0.05 | 0 (0) | 2 (4.3) | >0.05 |
| Abdominal pain | 2 (8.3) | 2 (7.14) | >0.05 | 1 (4.3) | 2 (5.6) | >0.05 | 0 (0) | 4 (8.7) | >0.05 |
| Allergic rash | 0 (0) | 1 (3.6) | >0.05 | 0 (0) | 1 (2.7) | >0.05 | 0 (0) | 2 (4.3) | >0.05 |
| Swollen lymph nodes | 0 (0) | 2 (7.14) | >0.05 | 1 (4.3) | 1 (2.7) | >0.05 | 1 (2.8) | 1 (2.2) | >0.05 |
| Insomnia | 2 (8.3) | 3 (10.7) | >0.05 | 3 (5.1) | 2 (5.6) | >0.05 | 1 (2.8) | 4 (8.7) | >0.05 |
| Paralysis of injection site | 0 (0) | 2 (7.14) | >0.05 | 0 (0) | 2 (5.6) | >0.05 | 1 (2.8) | 1 (2.2) | >0.05 |

### 3.6. Association of 1st dose Covid-19 Vaccines ADRs with age group 1 (40 years and below) & group 2 (41 years and above)

The association between participant age groups after 1st dose of vaccination elaborates the following prominent values in the following cases that are the Cansino Pakvac vaccine, swelling ($p = 0.018$), fatigue ($p = 0.009$), chills ($p = 0.010$), fever ($p = 0.031$), and vomiting ($p = 0.012$), the Sinovac vaccine, myalgia ($p = 0.037$), and abdominal pain ($p = 0.041$) and, the prominent adverse effects were seen in the age group 41 years and above, the Sinopharm vaccine, pain ($p = 0.001$), headache ($p = 0.001$), myalgia ($p < 0.0001$), fever ($p = 0.034$), joint pain ($p = 0.002$), and nausea ($p = 0.010$), the AstraZeneca vaccine, pain ($p = 0.008$), and the Moderna vaccine pain ($p < 0.0001$), headache ($p = 0.004$), myalgia ($p = 0.012$), fever ($p = 0.020$), and joint pain ($p = 0.032$), and significant negative impacts were observed in people under the age of 40 (**Tables 9** and **10**).

**Table 9.** Association of 1st dose Covid-19 Vaccines ADRs with age group 1(40 years and below) & group 2 (41 years and above).

| **Covid-19 Vaccines** | **Cansino Pakvac Single Dose** | | | **Sinovac 1st Dose** | | |
|---|---|---|---|---|---|---|
| **Adverse Effects** | **Group 1 N (%)** | **Group 2 N (%)** | ***P N* (%)** | **Group 1 N (%)** | **Group 2 N (%)** | ***P N* (%)** |
| Pain | 51 (65.4) | 24 (75.0) | >0.05 | 24 (63.1) | 15 (62.5) | >0.05 |
| Redness | 7 (9.0) | 0 (0) | >0.05 | 3 (7.9) | 2 (8.3) | >0.05 |
| Itching | 12 (15.4) | 6 (18.8) | >0.05 | 2 (5.3) | 2 (8.3) | >0.05 |
| Swelling | 0 (0) | 2 (6.3) | **0.018** | 2 (5.3) | 1 (1.2) | >0.05 |
| Tingling | 6 (7.7) | 4 (12.5) | >0.05 | 2 (5.3) | 1 (1.2) | >0.05 |
| Fatigue | 10 (12.8) | 10 (31.3) | **0.009** | 3 (7.9) | 4 (16.7) | >0.05 |
| Headache | 13 (16.7) | 7 (21.9) | >0.05 | 14 (36.8) | 5 (20.8) | >0.05 |
| Myalgia | 15 (19.2) | 3 (9.4) | >0.05 | 20 (52.6) | 16 (66.7) | **0.037** |
| Chills | 4 (5.1) | 4 (12.5) | **0.01** | 4 (10.5) | 2 (8.3) | >0.05 |
| Fever | 19 (24.3) | 18 (56.25) | **0.031** | 7 (18.4) | 5 (20.8) | >0.05 |
| Joint pain | 10 (12.8) | 8 (25.0) | >0.05 | 10 (26.3) | 9 (37.5) | >0.05 |

**Table 9.** (*Continued*).

| **Covid-19 Vaccines** | **Cansino Pakvac Single Dose** | | | **Sinovac 1st Dose** | | |
|---|---|---|---|---|---|---|
| **Adverse Effects** | **Group 1 N (%)** | **Group 2 N (%)** | ***P N* (%)** | **Group 1 N (%)** | **Group 2 N (%)** | ***P N* (%)** |
| Nausea | 5 (6.4) | 2 (6.3) | >0.05 | 4 (10.5) | 2 (8.3) | >0.05 |
| Vomiting | 0 (0) | 1 (3.1) | **0.012** | 1 (2.6) | 0 (0) | >0.05 |
| Diarrhea | 1 (1.3) | 3 (9.4) | >0.05 | 0 (0) | 1 (4.2) | >0.05 |
| Abdominal pain | 2 (2.6) | 3 (9.4) | >0.05 | 1 (2.6) | 3 (12.5) | **0.041** |
| Allergic rash | 2 (2.6) | 1 (3.1) | >0.05 | 2 (5.3) | 0 (0) | >0.05 |
| Swollen lymph nodes | 3 (3.8) | 2 (6.3) | >0.05 | 1 (2.6) | 1 (4.2) | >0.05 |
| Insomnia | 11 (14.1) | 4 (12.5) | >0.05 | 4 (10.5) | 1 (4.2) | >0.05 |
| Paralysis of injection site | - | - | - | 2 (5.3) | 1 (4.2) | >0.05 |

**Table 10.** Association of 1st dose Covid-19 Vaccines ADRs with age group 1(40 years and below) & group 2 (41 years and above).

| **Covid-19 Vaccines** | **Sinopharm 1st Dose** | | | **AstraZeneca 1st Dose** | | | **Moderna 1st Dose** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Adverse Effects** | **Group 1 N (%)** | **Group 2 N (%)** | ***P N* (%)** | **Group 1 N (%)** | **Group 2 N (%)** | ***P N* (%)** | **Group 1 N (%)** | **Group 2 N (%)** | ***P N* (%)** |
| Pain | 73 (74.5) | 13 (43.3) | **0.001** | 36 (80.0) | 3 (42.8) | **0.008** | 30 (73.1) | 4 (22.2) | **<0.0001** |
| Redness | 7 (7.1) | 1 (3.3) | >0.05 | 4 (8.9) | 0 (0) | >0.05 | 3 (7.3) | 1 (5.5) | >0.05 |
| Itching | 7 (7.1) | 0 (0) | >0.05 | 4 (8.9) | 0 (0) | >0.05 | 3 (7.3) | 0 (0) | >0.05 |
| Swelling | 3 (3.0) | 2 (6.7) | >0.05 | 3 (6.6) | 0 (0) | >0.05 | 3 (7.3) | 0 (0) | >0.05 |
| Tingling | 5 (5.1) | 2 (6.7) | >0.05 | 4 (8.9) | 0 (0) | >0.05 | 1 (2.4) | 1 (5.5) | >0.05 |
| Fatigue | 10 (10.2) | 1 (3.3) | >0.05 | 5 (11.1) | 0 (0) | >0.05 | 4 (9.8) | 2 (11.1) | >0.05 |
| Headache | 38 (38.8) | 2 (6.7) | **0.001** | 10 (22.2) | 4 (57.1) | >0.05 | 18 (43.9) | 1 (5.5) | **0.004** |
| Myalgia | 67 (68.4) | 7 (23.3) | **<0.0001** | 27 (60.0) | 4 (57.1) | >0.05 | 28 (68.3) | 6 (33.3) | **0.012** |
| Chills | 11 (11.1) | 4 (13.3) | >0.05 | 6 (13.3) | 0 (0) | >0.05 | 5 (12.2) | 1 (5.5) | >0.05 |
| Fever | 24 (24.5) | 2 (6.7) | **0.034** | 8 (17.8) | 2 (28.6) | >0.05 | 14 (34.1) | 1 (5.5) | **0.02** |
| Joint pain | 36 (36.7) | 2 (6.7) | **0.002** | 12 (26.7) | 1 (14.3) | >0.05 | 16 (39.0) | 2 (11.1) | **0.032** |
| Nausea | 2 (2.0) | 4 (13.3) | **0.01** | 6 (13.3) | 0 (0) | >0.05 | 3 (7.3) | 2 (11.1) | >0.05 |
| Vomiting | 1 (1.0) | 0 (0) | >0.05 | 1 (2.2) | 0 (0) | >0.05 | 1 (2.4) | 0 (0) | >0.05 |
| Diarrhea | 1 (1.0) | 0 (0) | >0.05 | 1 (2.2) | 0 (0) | >0.05 | 1 (2.4) | 0 (0) | >0.05 |
| Abdominal pain | 5 (5.1) | 2 (6.7) | >0.05 | 3 (6.7) | 0 (0) | >0.05 | 3 (7.3) | 1 (5.5) | >0.05 |
| Allergic rash | 3 (3.1) | 1 (3.3) | >0.05 | 2 (4.4) | 0 (0) | >0.05 | 1 (2.4) | 1 (5.5) | >0.05 |
| Swollen lymph nodes | 4 (4.1) | 1 (3.3) | >0.05 | 2 (4.4) | 0 (0) | >0.05 | 2 (4.9) | 0 (0) | >0.05 |
| Insomnia | 11 (11.2) | 2 (6.7) | >0.05 | 3 (6.7) | 0 (0) | >0.05 | 4 (9.8) | 1 (5.5) | >0.05 |
| Paralysis of injection site | 4 (4.1) | 2 (6.7) | >0.05 | 3 (6.7) | 0 (0) | >0.05 | 2 (4.9) | 1 (5.5) | >0.05 |

### 3.7. Association of 2nd dose Covid-19 Vaccines ADRs with age group 1 (40 years and below) & group 2 (41 years and above)

The chi-square test between participant age groups after the 2nd dose of vaccination elaborates the subsequent significant values, in the case of the Sinovac vaccine no significant values were observed, the Sinopharm vaccine, pain ($p = 0.002$), headache ($p = 0.034$), myalgia ($p < 0.0001$), fever ($p = 0.034$), and joint pain ($p = 0.047$), the AstraZeneca vaccine, abdominal pain ($p = 0.014$) and the Moderna vaccine, pain ($p = 0.002$), and myalgia ($p = 0.004$) and the age group 40 years and younger

experienced the most noticeable negative consequences as shown in **Tables 11** and **12**.

**Table 11.** Association of 2nd dose Covid-19 Vaccines ADRs with age group 1(40 years and below) & group 2 (41 years and above).

| **Covid-19 Vaccines** | **Sinovac 2nd Dose** | | | **Sinopharm 2nd Dose** | | |
|---|---|---|---|---|---|---|
| **Adverse Effects** | **Group 1 N (%)** | **Group 2** | ***P N* (%)** | **Group 1 N (%)** | **Group 2 N (%)** | ***P N* (%)** |
| Pain | 23 (60.5) | 12 (50.0) | >0.05 | 51 (52.0) | 6 (20.0) | **0.002** |
| Redness | 1 (2.6) | 1 (4.2) | >0.05 | 6 (6.1) | 0 (0) | >0.05 |
| Itching | 2 (5.2) | 1 (4.2) | >0.05 | 7 (7.1) | 1 (3.3) | >0.05 |
| Swelling | 2 (5.2) | 1 (4.2) | >0.05 | 3 (3.1) | 0 (0) | >0.05 |
| Tingling | 1 (2.6) | 1 (4.2) | >0.05 | 2 (2.0) | 1 (3.3) | >0.05 |
| Fatigue | 3 (7.9) | 2 (8.3) | >0.05 | 14 (14.3) | 1 (3.3) | >0.05 |
| Headache | 6 (15.8) | 4 (16.7) | >0.05 | 24 (24.4) | 2 (6.7) | **0.034** |
| Myalgia | 18 (47.4) | 12 (50) | >0.05 | 58 (59.2) | 5 (16.7) | **<0.0001** |
| Chills | 2 (5.2) | 1 (4.2) | >0.05 | 10 (10.1) | 6 (20.0) | >0.05 |
| Fever | 4 (10.5) | 4 (16.7) | >0.05 | 24 (24.5) | 2 (6.7) | **0.034** |
| Joint pain | 10 (26.3) | 4 (16.7) | >0.05 | 27 (27.5) | 3 (10.0) | **0.047** |
| Nausea | 3 (7.9) | 3 (12.5) | >0.05 | 6 (6.1) | 3 (10.0) | >0.05 |
| Vomiting | 0 (0) | 1 (4.2) | >0.05 | 4 (4.1) | 0 (0) | >0.05 |
| Diarrhea | 1 (2.6) | 0 (0) | >0.05 | 3 (3.1) | 1 (3.3) | >0.05 |
| Abdominal pain | 2 (5.3) | 2 (8.3) | >0.05 | 7 (7.1) | 0 (0) | >0.05 |
| Allergic rash | 1 (2.6) | 1 (4.2) | >0.05 | 4 (4.1) | 1 (3.3) | >0.05 |
| Swollen lymph nodes | 2 (5.3) | 0 (0) | >0.05 | 3 (3.1) | 2 (6.7) | >0.05 |
| Insomnia | 4 (10.5) | 1 (4.2) | >0.05 | 9 (9.2) | 5 (16.7) | >0.05 |
| Paralysis of injection site | 0 (0) | 2 (8.3) | >0.05 | 4 (4.1) | 1 (3.3) | >0.05 |

**Table 12.** Association of 2nd dose Covid-19 Vaccines ADRs with age group 1(40 years and below) & group 2 (41 years and above).

| **Covid-19 Vaccines** | **AstraZeneca 2nd Dose** | | | **Moderna 2nd Dose** | | |
|---|---|---|---|---|---|---|
| **Adverse Effects** | **Group 1 N (%)** | **Group 2 N (%)** | **P N (%)** | **Group 1 N (%)** | **Group 2 N (%)** | **P N (%)** |
| Pain | 27 (60) | 3 (42.9) | >0.05 | 25 (61.0) | 3 (16.7) | **0.002** |
| Redness | 1 (2.2) | 0 (0) | >0.05 | 1 (2.4) | 1 (5.5) | >0.05 |
| Itching | 2 (4.4) | 1 (14.3) | >0.05 | 1 (2.4) | 1 (5.5) | >0.05 |
| Swelling | 2 (4.4) | 0 (0) | >0.05 | 2 (4.9) | 1 (5.5) | >0.05 |
| Tingling | 1 (2.2) | 0 (0) | >0.05 | 1 (2.4) | 0 (0) | >0.05 |
| Fatigue | 5 (11.1) | 1 (14.3) | >0.05 | 3 (7.3) | 2 (11.1) | >0.05 |
| Headache | 10 (22.2) | 2 (28.6) | >0.05 | 7 (17) | 3 (16.7) | >0.05 |
| Myalgia | 32 (71.1) | 5 (71.4) | >0.05 | 26 (63.4) | 4 (22.2) | **0.004** |
| Chills | 7 (15.6) | 0 (0) | >0.05 | 4 (9.8) | 0 (0) | >0.05 |
| Fever | 11 (24.4) | 2 (28.6) | >0.05 | 8 (20.5) | 1 (5.5) | >0.05 |
| Joint pain | 1 (2.2) | 3 (6.7) | >0.05 | 7 (17) | 7 (38.9) | >0.05 |
| Nausea | 1 (2.2) | 1 (14.3) | >0.05 | 4 (9.8) | 2 (11.1) | >0.05 |
| Vomiting | 3 (6.7) | 0 (0) | >0.05 | 0 (0) | 1 (5.5) | >0.05 |

**Table 12.** (*Continued*).

| **Covid-19 Vaccines** | **AstraZeneca 2nd Dose** | | | **Moderna 2nd Dose** | | |
|---|---|---|---|---|---|---|
| **Adverse Effects** | **Group 1 N (%)** | **Group 2 N (%)** | **P N (%)** | **Group 1 N (%)** | **Group 2 N (%)** | **P N (%)** |
| Diarrhea | 1 (2.2) | 0 (0) | >0.05 | 1 (2.4) | 0 (0) | >0.05 |
| Abdominal pain | 3 (6.7) | 1 (14.3) | **0.014** | 2 (4.9) | 1 (5.5) | >0.05 |
| Allergic rash | 1 (2.2) | 0 (0) | >0.05 | 0 (0) | 1 (5.5) | >0.05 |
| Swollen lymph nodes | 2 (4.4) | 0 (0) | >0.05 | 2 (4.9) | 0 (0) | >0.05 |
| Insomnia | 5 (11.1) | 0 (0) | >0.05 | 4 (9.8) | 1 (5.5) | >0.05 |
| Paralysis of injection site | 2 (4.4) | 0 (0) | >0.05 | 1 (2.4) | 1 (5.5) | >0.05 |

### 3.8. Association of Participants who were Vaccinated before or after the COVID-19 infection with adverse effects of the Cansino Pakvac Vaccine

The significance of participant's adverse effects and were vaccinated before or after the Covid-19 infection shows the following significant values in the case of vaccines are the Cansino Pakvac vaccine, pain ($p$ = 0.007), redness ($p$ = 0.005), and myalgia ($p$ = 0.011), the Sinovac vaccine, redness ($p$ = 0.010), swelling ($p$ = 0.006), and chills ($p$ = 0.030), the Sinopharm vaccine, pain ($p$ = 0.043), headache ($p$ < 0.0001), and myalgia ($p$ < 0.0001), the AstraZeneca vaccine showed no significant p-values, the Moderna vaccine, pain ($p$ < 0.004), myalgia ($p$ = 0.032), and paralysis of injection site ($p$ = 0.020) and the Pfizer BioNTech vaccine, pain ($p$ = 0.039), and fatigue ($p$ = 0.040). The participants who received the vaccines after acquiring COVID-19 infection experienced the most adverse effects (**Tables 13** and **14**).

**Table 13.** Association of Covid-19 Vaccines ADRs with vaccination before or after COVID-19 infection.

| **Covid-19 Vaccines** | **Cansino Pakvac** | | | **Sinovac** | | | **Sinopharm** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Adverse Effects** | **Before N(%)** | **After N(%)** | **P N(%)** | **Before N(%)** | **After N(%)** | **P N(%)** | **Before N(%)** | **After N(%)** | **P N(%)** |
| Pain | 57 (68.7) | 15 (88.2) | **0.007** | 30 (63.8) | 5 (83.3) | >0.05 | 48 (60.8) | 25 (86.2) | **0.043** |
| Redness | 2 (2.4) | 4 (23.5) | **0.005** | 2 (4.3) | 0 (0) | **0.01** | 6 (7.6) | 1 (3.4) | >0.05 |
| Itching | 13 (15.7) | 4 (23.5) | >0.05 | 4 (8.5) | 0 (0) | >0.05 | 3 (3.8) | 3 (10.3) | >0.05 |
| Swelling | 2 (2.4) | 0 (0) | >0.05 | 0 (0) | 1 (16.7) | **0.006** | 1 (1.3) | 3 (10.3) | >0.05 |
| Tingling | 9 (10.8) | 0 (0) | >0.05 | 2 (4.3) | 0 (0) | >0.05 | 6 (7.6) | 0 (0) | >0.05 |
| Fatigue | 16 (19.3) | 2 (11.8) | >0.05 | 5 (10.6) | 0 (0) | >0.05 | 7 (9.0) | 3 (10.3) | >0.05 |
| Headache | 18 (18.0) | 1 (5.9) | >0.05 | 15 (31.9) | 2 (33.3) | >0.05 | 15 (19.0) | 22 (75.8) | **<0.0001** |
| Myalgia | 10 (12.0) | 7 (41.1) | **0.011** | 26 (55.3) | 5 (83.3) | >0.05 | 38 (48.1) | 28 (96.5) | **<0.0001** |
| Chills | 6 (7.2) | 2 (11.8) | >0.05 | 2 (4.3) | 2 (33.3) | **0.03** | 10 (12.7) | 4 (13.8) | >0.05 |
| Fever | 29 (35.0) | 7 (41.1) | >0.05 | 7 (14.9) | 2 (33.3) | >0.05 | 15 (19.0) | 7 (24.1) | >0.05 |
| Joint pain | 14 (16.9) | 3 (17.6) | >0.05 | 14 (29.8) | 1 (16.7) | >0.05 | 22 (27.8) | 11 (37.9) | >0.05 |
| Nausea | 7 (8.4) | 0 (0) | >0.05 | 5 (10.6) | 0 (0) | >0.05 | 3 (3.8) | 1 (3.4) | >0.05 |
| Vomiting | 1 (1.2) | 0 (0) | >0.05 | 1 (2.1) | 0 (0) | >0.05 | 1 (1.3) | 0 (0) | >0.05 |
| Diarrhea | 4 (4.8) | 0 (0) | >0.05 | 0 (0) | 0 (0) | 0.05 | 0 (0) | 1 (3.4) | >0.05 |
| Abdominal pain | 4 (4.8) | 1 (5.9) | >0.05 | 3 (6.4) | 0 (0) | >0.05 | 5 (6.3) | 2 (0) | >0.05 |
| Allergic rash | 3 (3.6) | 0 (0) | >0.05 | 1 (2.1) | 0 (0) | >0.05 | 4 (5.1) | 0 (0) | >0.05 |
| Swollen lymph nodes | 5 (6.0) | 0 (0) | >0.05 | 2 (4.3) | 0 (0) | >0.05 | 4 (5.1) | 0 (0) | >0.05 |
| Insomnia | 11 (13.3) | 3 (17.6) | >0.05 | 5 (10.6) | 0 (0) | >0.05 | 7 (9.0) | 3 (10.3) | >0.05 |
| Paralysis of injection site | - | - | - | 2 (4.3) | 0 (0) | >0.05 | 4 (5.1) | 1 (3.4) | >0.05 |

**Table 14.** Association of Covid-19 Vaccines ADRs with vaccination before or after COVID-19 infection.

| **Covid-19 Vaccines** | **AstraZeneca** | | | **Moderna** | | | **Pfizer BioNTech** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Adverse Effects** | **Before N(%)** | **After N(%)** | **P N(%)** | **Before N(%)** | **After N(%)** | **P N(%)** | **Before N(%)** | **After N(%)** | **P N(%)** |
| Pain | 28 (75.6) | 7 (77.8) | >0.05 | 25 (59.5) | 9 (81.8) | **0.004** | 43 (70.5) | 15 (93.8) | **0.039** |
| Redness | 3 (8.1) | 1 (11.1) | >0.05 | 2 (4.8) | 2 (18.2) | >0.05 | 3 (4.9) | 2 (12.5) | >0.05 |
| Itching | 3 (8.1) | 1 (11.1) | >0.05 | 3 (7.1) | 0 (0) | >0.05 | 1 (1.6) | 2 (12.5) | >0.05 |
| Swelling | 1 (2.7) | 1 (11.1) | >0.05 | 2 (4.8) | 1 (9.1) | >0.05 | 2 (3.3) | 1 (6.3) | >0.05 |
| Tingling | 4 (10.8) | 0 (0) | >0.05 | 1 (2.4) | 1 (9.1) | >0.05 | 2 (3.3) | 2 (12.5) | >0.05 |
| Fatigue | 4 (10.8) | 1 (11.1) | >0.05 | 4 (9.5) | 2 (18.2) | >0.05 | 3 (4.92) | 4 (25.0) | **0.04** |
| Headache | 9 (24.3) | 2 (22.2) | >0.05 | 13 (31.0) | 6 (54.5) | >0.05 | 19 (31.1) | 4 (25.0) | >0.05 |
| Myalgia | 21 (56.8) | 7 (77.8) | >0.05 | 22 (52.4) | 10 (91.0) | **0.032** | 37 (60.6) | 9 (56.3) | >0.05 |
| Chills | 4 (10.8) | 1 (11.1) | >0.05 | 6 (14.3) | 0 (0) | >0.05 | 5 (8.2) | 1 (6.3) | >0.05 |
| Fever | 7 (19.0) | 2 (22.2) | >0.05 | 11 (26.2) | 4 (36.4) | >0.05 | 13 (21.3) | 5 (31.3) | >0.05 |
| Joint pain | 7 (19.0) | 4 (44.4) | >0.05 | 11 (26.2) | 6 (54.5) | >0.05 | 17 (27.9) | 6 (37.5) | >0.05 |
| Nausea | 3 (8.1) | 1 (11.1) | >0.05 | 4 (9.5) | 0 (0) | >0.05 | 5 (8.2) | 0 (0) | >0.05 |
| Vomiting | 1 (2.7) | 0 (0) | >0.05 | 1 (2.4) | 0 (0) | >0.05 | 1 (1.6) | 0 (0) | >0.05 |
| Diarrhea | 0 (0) | 1 (11.1) | >0.05 | 0 (0) | 1 (9.1) | >0.05 | 0 (1.6) | 1 (6.3) | >0.05 |
| Abdominal pain | 1 (2.7) | 2 (22.2) | >0.05 | 2 (4.8) | 1 (9.1) | >0.05 | 2 (3.3) | 2 (12.5) | >0.05 |
| Allergic rash | 2 (5.4) | 0 (0) | >0.05 | 1 (2.4) | 0 (0) | >0.05 | 2 (3.3) | 0 (0) | >0.05 |
| Swollen lymph nodes | 2 (5.4) | 0 (0) | >0.05 | 1 (2.4) | 1 (9.1) | >0.05 | 2 (3.3) | 0 (0) | >0.05 |
| Insomnia | 5 (13.5) | 0 (0) | >0.05 | 4 (9.5) | 1 (9.1) | >0.05 | 6 (9.8) | 1 (6.3) | >0.05 |
| Paralysis of injection site | 1 (2.7) | 2 (22.2) | >0.05 | 0 (0) | 2 (18.2) | **0.02** | 2 (3.3) | 1 (6.3) | >0.05 |

## 4. Discussion

Lockdowns, contact tracing, quarantine, isolation, and social segregation are just a few of the preventive measures that have been put in place in response to the COVID-19 pandemic, a potentially fatal worldwide health disaster. Due to varied difficulties, these procedures were however, used in different ways around the world and had differing degrees of success in preventing the spread of illness. These discoveries compelled the world's health authorities to shift their attention to developing and using reliable vaccinations [2].

Our study looked into the frequency of adverse events (AEs) that the population of twin cities of Pakistan encountered after receiving the widely used COVID-19 vaccines employing a cross-sectional population questionnaire-based study during the study period.

Vaccination choice satisfaction was higher among women (women = 270, males = 183; $p$ = 0.004). Knowing the benefits of vaccination increased self-vaccination motivation in people with greater education ($p$ = 0.001).

In our study, prominent adverse effects that were seen after vaccination were pain at the injection site, myalgia, fever, joint pain, headache, fatigue, and chills which were in line with most of the studies conducted on post-vaccination symptoms [17,20,21].

Our study revealved that the percentage of at least one adverse effect that appeared in participants following the six vaccines administered in Pakistan is shown in ascending order that is AstraZeneca (75%), Pfizer BioNTech (73.2%), Cansino Pakvac (68.2%), Sinopharm (67.1%), Sinovac (62.9%), and Moderna (57.6%). This

outcome is comparable to a study performed in Mexico in 2022 [22].

The Pfizer-BioNTech, AstraZeneca, and Moderna vaccines all had at least one negative side effect. However, those who received the Sinopharm and Sinovac vaccines saw fewer adverse effects. The results suggest that mRNA-based vaccinations had more severe side effects than conventional vaccines. This result is close to research done on Mexican people in 2022 [22].

The relationship between gender and adverse effects showed that the most prominent adverse effects were seen in the female gender in the case of Cansino Pakvac, Sinovac, Sinopharm, AstraZeneca, Moderna, and Pfizer vaccines selected in this study. These results are comparable to the COVID-19 vaccination symptoms study carried out in India in 2021 [23].

The relationship between age groups (i.e., 40 and below and 41yrs and above) and adverse effects showed a varied response that is after receiving these vaccines (Cansino Pakvac, and Sinovac vaccines) adverse events are more prominent in the age group 41yrs and above and after the doses of Sinopharm, AstraZeneca, Pfizer BioNTech, and Moderna vaccines more adverse events were seen in age group 40yrs and below. These findings are comparable to earlier investigations that were done among Zambian, Indian and Mexican population [18,19,24].

The association with the adverse effects of vaccines with acquiring vaccination before or after COVID-19 infection showed that following 1st and 2nd doses of the vaccines (Cansino Pakvac, Sinovac, Sinopharm, Pfizer BioNTech, and Moderna) showed prominent adverse effects in individuals who were vaccinated after Covid-19 infection. The adverse reactions recorded following the first dose of the vaccination among patients who had previously acquired COVID-19 may be caused by antibody-dependent enhancement (ADE) [20].

The current study has some limitations as data was collected from twin cities of Pakistan so study results cannot represent the whole Pakistani Population. Furthermore, results lack authenticity and accuracy as adverse effects were not properly observed by paramedical staff rather, they were reported by the participants.

### Managerial insights

According to the results, it’s observed that RNA vaccines had more adverse effects as compared to Sinopharm. So, it suggested that the population who are going to be vaccinated after COVID-19 infection must not be administered with AstraZeneca, Moderna, and Pfizer BioNTech. Another interpretation can be drawn from results that Patients older than 40 years can face ADRs from RNA vaccines.

## 5. Conclusion

Although after receiving their first dose of vaccination, more than 55% of those who received it reported musculoskeletal side effects including muscle discomfort and fatigue, we found that participants generally accepted the immunization. We did not observe such a high proportion of negative side effects after the second immunization dosage. The majority of the symptoms were transient, and moderate, and didn’t need to be hospitalized. This finding may contribute to addressing a growing public health issue (vaccine hesitancy) that has been encouraged by false information about the

safety of vaccines. Given that gender and age groups are not evenly distributed, the results of this study should be regarded with caution in terms of external validity.

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