CITIZEN'S PERSPECTIVE ABOUT SIDE EFFECTS OF COVID-19 VACCINATION: A CASE STUDY OF DISTRICT SHAHEED BENAZIR ABAD, SINDH PROVINCE OF PAKISTAN

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ABSTRACT: *Coronavirus disease (COVID-19) is one of the biological hazards in the entire world. Different countries have developed a number of vaccines to control the spread of the virus. To date, millions of people have been vaccinated in Pakistan. However, a still large number of people did not get vaccinated due to different scaring news related to the side effects of vaccines. Therefore, in this study, we analyzed the side effects of different COVID-19 vaccines by responses of common people. A survey was conducted from June-2021 to January-2022 in District Shaheed Benazir Abad, Sindh Province of Pakistan. There were 1000 respondents in which n=400 refused to respond, and n=600 responded, including 535 males and 65 females. Out of a total of 600 respondents, there were 249 Sinovac vaccinated, 25 Sinopharm vaccinated, 5 CanSino Bio vaccinated, 271 Pfizer vaccinated, 43 AstraZeneca vaccinated and 7 PakVac vaccinated. The respondents were divided into five age groups viz 18-30 years old, 31-40 years old, 41-50 years old, 51-60 years old, and above 60 years old. The data were analyzed using excel, and a sigma plot was used to illustrate that data. The ArcMap 10.5 was used in the mapping study area and visualization of COVID-19 cases. The study revealed that were 58.66% had not any effect of vaccination, 13% felt fit, 9.16% observed symptoms of heat, 1.33% had breathing difficulty, 1.66% had a headache, 3.33%) had flu, 1.66% had a cough, 7.33% had a fever, 0.33% had pain in bones, 2.5% had pain in the body, 0.50% had a stomach, and 0.50% had a skin problem. It was found that all types of vaccines are equally effective in controlling the spread of the virus with temporary symptoms appearing after taking the vaccine dose. According to the responses, it was noticed that the temporary sign could be variable and depending on the vaccine type. Based on sample size, results showed that the Pfizer vaccine is effective and efficient, followed by Sinovac, AstraZeneca, and Sinopharm, respectively.*

Key words: COVID-19 vaccines; Side effects, Pfizer; Sinovac; AstraZeneca

1. INTRODUCTION

The COVID-19 pandemic has caused significant morbidity and mortality around the world, as well as major social, educational, and economic disruptions. There was an urgent global need to develop safe and effective vaccines that are widely and equitably available in all countries. Several companies have announced vaccines such as Sputnik V, Pfizer Biotech, AstraZeneca, Moderna, Sinovac, Sinopharm, and CanSino Bio for the COVID-19 pandemic that has caused extreme poverty and over a billion people losing their livelihoods around the world [1]. Globally, as of 27-28 February 2022, there have been 434,154,739 confirmed cases of COVID-19 and 5,944,342 deaths, a total of 10,585,766,316 vaccine doses have been administered [2]. In Pakistan confirmed cases are 1,510,221, deaths 30,196, recovered 1,442,938, fully vaccinated 98,809,724 and total doses administered 214,661,126 [3].

The research on the effects of the COVID-19 vaccine has been investigated in different countries. For Example, [4] conducted research in Thailand to investigate shoulder injury related to the Sinovac COVID-19 vaccine and reported that a 52-year-old Thai male felt shoulder pain after the Sinovac COVID-19 vaccination in his right shoulder. [5] Studied on side effects of Sinopharm COVID-19 vaccination in the United Arab Emirates and found that site pain and fatigue were the most common after the first and second doses. [6] conducted research in the United States to investigate detailed side effects of the BNT162b2 mRNA vaccine and reported that Pain, malaise, muscle pain, headache, chills, fever, arthralgia, nausea, muscle cramps, sweating, dizziness, facial red tide, brain fog, swelling, loss of appetite, decreased sleep, itching, tingling, diarrhea, stuffy nose are common. These effects usually disappear 2-3 days after injection [7].

However, there is a significant research gap related to the effects of COVID-19 vaccination in Pakistan. Due to fake or scary news in social media on the side effects of the vaccine, common people, particularly the illiterate, avoiding to vaccination. They are thinking that they could die or be sick after getting vaccinated. For example, a study in China found that more than 30% of the respondents did not want to get vaccinated and were worried about the side effects [8]. Others [9] Found that 16% expressed intense worries in the United Kingdom about unforeseen effects of the vaccine. [10] found more than 27% of respondents in Turkey were afraid of the side effects of the vaccine, and in the United States, more than 14% of respondents strongly agreed that the side effects of the vaccine are worse than COVID-19 itself [11]. The objectives of the present study were: (1) To investigate the response of common people on the effects of COVID-19 vaccination in District Shaheed Benazir Abad, Sindh Province Pakistan, and (2) to determine the efficiency and effects of different types of vaccines.

2. MATERIALS AND METHODS

2.1 Study site

The District Shaheed Benazir Abad (SBA), previously known as Nawabshah, is one of the populous districts in the Sindh province of Pakistan. It is located in the central part of the Sindh province [12]. The district is sub-divided into four talukas, including Nawabshah, Sakrand, Qazi Ahmed (Doulatpur), and Daur. It covers about 4,502 km2. According to the census report of 2017 population of the SBA is 1,612,847. In which 51.6% are male, 48.3% female and 0.1% trans genders. About 69.6% live in rural areas, and 30.4% are urban population. There are 46.9% are literate, and 53.1% are illiterate [13]. The study area map is shown in Figure 1.

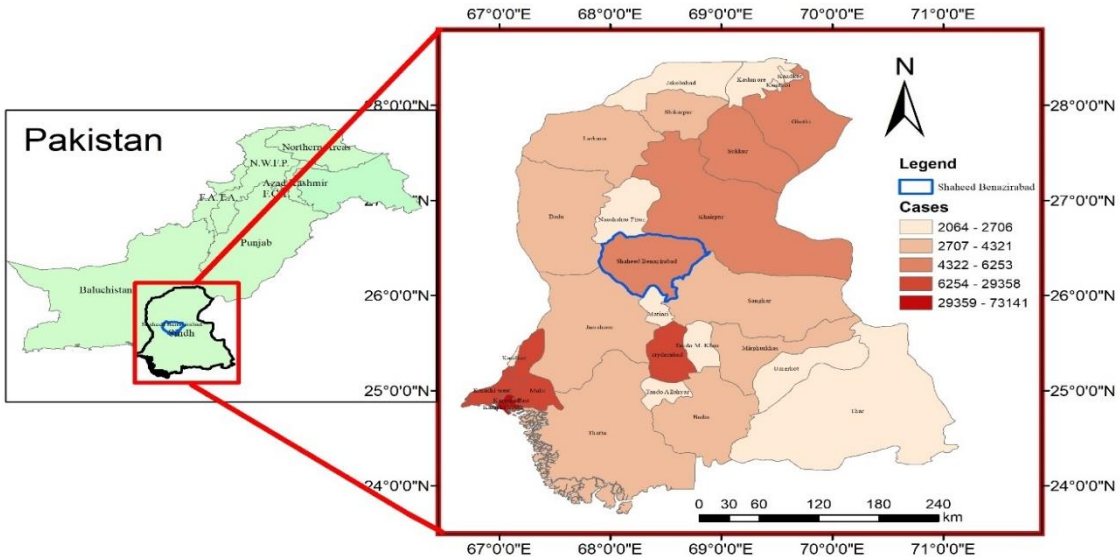

Figure 1. The location of the study area and map of the Sindh province of Pakistan show COVID-19 cases according to the latest update retrieved from the Health Department Government of Sindh Heath [14]

2.2 Data collection methods and analysis

A survey study was conducted from June-2021 to January-2022, using a questionnaire consisting of 13 options including nothing, feeling fit, feeling the heat, breathing difficulty, headache, flu, cough, fever, pain in bones, pain in the body, stomach problem, skin problem and other. There were 1000 respondents in which n=400 refused to respond, and n=600 responded, including 89.16% (535) male and 10.83 (65) female. From total 600 respondents, there were 41.50% (249) Sinovac vaccinated, 4.16% (25) Sinopharm vaccinated, 0.83% (5) CanSino Bío vaccinated, 45.16% (271) Pfizer vaccinated, 7.16% (43) AstraZeneca vaccinated and 1.16% (7) PakVac vaccinated (Figure 2). The respondents were divided into five age groups viz 55.16% (331) 18-30 years old, 12.33% (74) 31-40 years old, 20.50% (123) 41-50 years old, 8.50% (51) 51-60 years old and 3.5% (21) above 60 years old. The respondents were divided into different occupations including 29.66% (178) government servants, 2.83% (17) farmers, 2.66% (16) laborers, 1.16% (7) shopkeepers, 0.50% (3) private workers, 0.66% (4) landlords, 0.66% (4) businessmen, 0.16% (1) mechanic, 0.83% (5) drivers, 1.5% (9) private teachers, 0.16% (1) tailor, 0.33% (2) social workers, 48.33% (290) students, 8.5% (52) housewives, 0.16% (1) unemployed, 0.50% (3) retires, 1.16% (7) aged and 0.16% (1) disable. The data were collected from city hospital Sakrand, government boys' degree college Sakrand, high schools, and villages. After obtaining basic information such as name, gender, age group, vaccination registration number, vaccine name, dose, occupation, and address. We asked respondents what did you feel after the COVID-19 vaccination? The main section of the questionnaire is given in the supplementary file, and demographic data of study participants reporting receipt of COVID-19 vaccines are presented in table 1. The inclusion criteria were participants received a vaccine dose either single or double and the exclusion criteria were participants did not receive a vaccine dose. The collected data were analyzed using excel, and a sigma plot was used to visualize that data. The ArcMap 10.5 was used in the mapping study area and showed COVID-19 cases in the Sindh province of Pakistan.

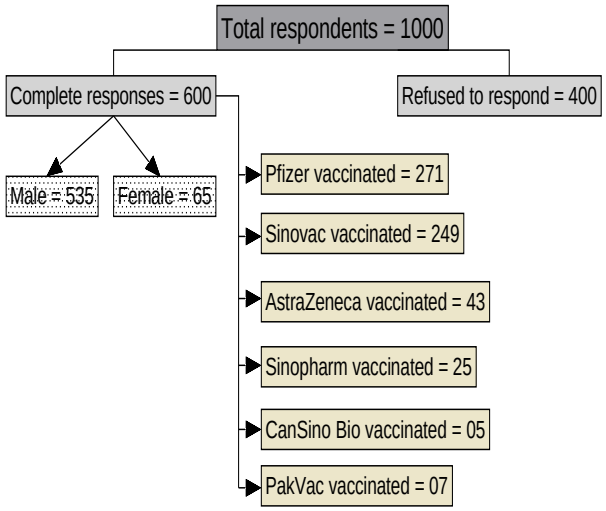

Figure 2. Flow chart of the study

3. RESULTS

Figure 3 shows the overall responses of respondents to COVID-19 vaccinations. Results showed that among the total 600 respondents, there were 58.66% (352) had not any effect of vaccination, 13% (78) felt fit, 9.16% (55) observed symptoms of heat, 1.33% (8) had breathing difficulty, 1.66% (10) had a headache, 3.33% (20) had flu, 1.66% (10) had a cough, 7.33% (44) had a fever, 0.33% (2) had pain in bones, 2.5% (15) had pain in the body, 0.50% (3) had stomach and 0.50% (3) had a skin problem.

Table 1. Demographic data of study participants reporting receipt of COVID-19 vaccines.

Occupation	Respondents	Percent
Government Servants	178	29.66
Farmers	17	2.83
Laborers	16	2.66
Students	290	48.33
Aged	7	1.16
Shopkeepers	7	1.16
Housewives	51	8.50
Disables	1	0.16
Private Job Holders	3	0.50
Landlords	4	0.66
Businessmen	4	0.66
Mechanics	1	0.16
Drivers	5	0.83
Unemployed	1	0.16
Private Teachers	9	1.50
Tailors	1	0.16
Retire	3	0.50
Social Workers	2	0.33
Vaccinations		
AstraZeneca	43	7.17
Sinovac	249	41.50
Sinopharm	25	4.17
CanSino BÍO	5	0.83
Pfizer	271	45.17
PakVac	7	1.16
Age Groups		
18-30	331	55.16
31-40	74	12.33
41-50	123	20.50
51-60	51	8.50
Above 60	21	3.50

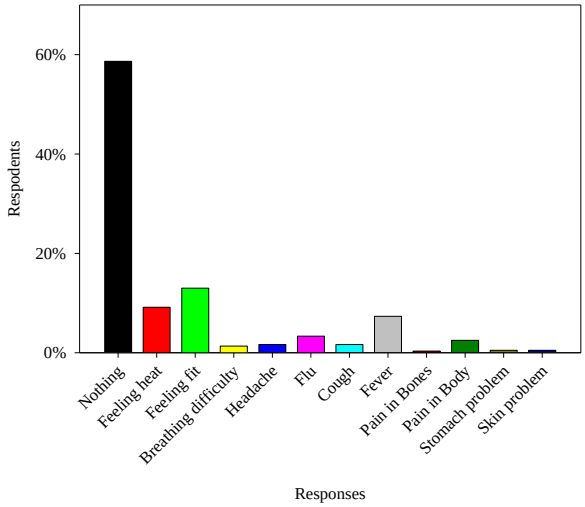

Figure 3. Overall responses of respondents to COVID-19 vaccinations

Figure 4 below shows the response of respondents to different types of vaccines. In terms of vaccine, among 249 Sinovac-vaccinated, 60.24% (150) had not any effect of vaccination, 13.65% (24) feel fit, 7.22% (18) observed symptom of heat, 3.21% (8) had breathing difficulty, 2% (5) had headache, 1.61% (4) had flu, 1.61% (4) had cough, 7.63% (19) had fever, 0.4% (1) had pain in bones, 1.2% (3) had pain in body and 1.2% (3) had skin problem (Figure 4a); among 271 Pfizer-vaccinated, 62.36% (169) had not any effect of vaccination, 10.33% (28) feel fit, 9.96% (27) observed symptom of heat, 4.43% (12) had flu, 1.85% (5) had cough, 6.54% (18) had fever and 4.43% (12) had pain in body (Figure 4b); among 43 AstraZeneca-vaccinated, 48.84% (21) had not any effect of vaccination, 6% (13.95) feel fit, 16.28% (7) observed symptom of heat, 4.65% (2) had flu, 2.33% (1) had cough, 9.30% (4) had fever and 4.65% (2) had stomach (Figure 4c); among 25 Sinopharm-vaccinated, 28% (7) had not any effect of vaccination, 28% (7) feel fit, 12% (3) observed symptom of heat, 20% (5) had headache, 4% (1) had flu, 4% (1) had fever and 4% (1) had pain in bones (Figure 4d); among 5 CanSino Bío-vaccinated, 80% (4) had not any effect of vaccination and 20% (1) feel fit (Figure 4e); among 7 PakVac-vaccinated, 14.29% (1) had no any effect of vaccination, 28.56% (2) feel fit, 14.29% (1) had flu, 28.56% (2) had fever and 14.29% (1) had stomach (Figure 4f).

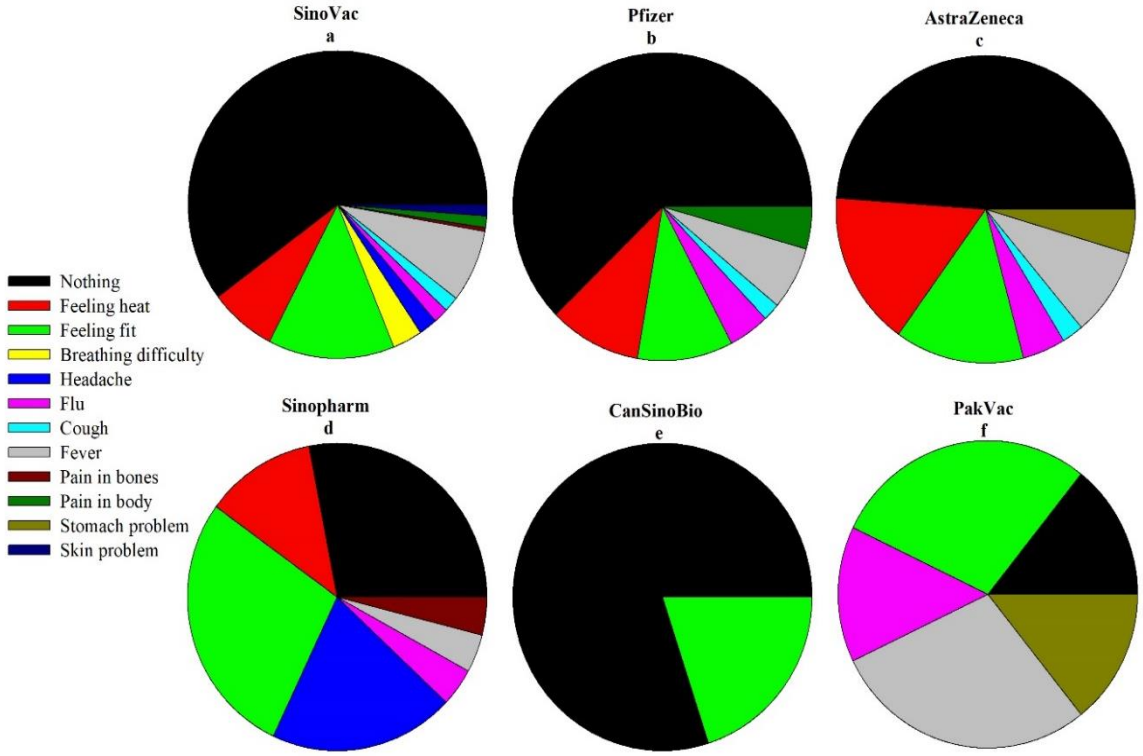

Figure 4. Responses of respondents to different types of COVID-19 vaccines

Figure 5 shows the responses of respondents to COVID-19 vaccinations according to different age groups. In terms of age groups, among 331 18-30 years-vaccinated, 60.73% (201) had not any effect of vaccination, 10.88% (36) feel fit, 9.97% (33) observed symptom of heat, 0.60% (2) had breathing difficulty, 0.60% (2) had headache, 3.63% (12) had flu, 1.81% (6) had cough, 7.55% (25) had fever, 0.30% (1) had pain in bones, 3.63% (12) had pain in body and 0.30% (1) had stomach problem (Figure 5a); among 74 31-40 years-vaccinated, 56.76% (42) had not any effect of vaccination, 12.16% (9) feel fit, 8.11% (6) observed symptom of heat, 2.7% (2) had breathing difficulty, 2.7% (2) had headache, 6.76% (5) had flu, 8.11% (6) had fever, 1.35% (1) had pain in bones and 1.35% (1) had skin problem (Figure 5b); among 123 41-50 years-vaccinated, 56.91% (70) had not any effect of vaccination, 19.51% (24) feel fit, 8.13% (10) observed symptom of heat, 3.25% (4) had breathing difficulty, 3.25% (4) had headache, 0.81% (1) had flu, 1.63% (2) had cough, 4.07% (5) had fever, 0.81% (1) had pain in body, 0.81% (1) had stomach problem and 0.81% (1) had skin problem (Figure 5c); among 51 51-60 years-vaccinated, 56.86% (29) had not any effect of vaccination, 15.69% (8) feel fit, 3.92% (2) observed symptom of heat, 1.96% (1) had headache, 3.92% (2) had flu, 11.66% (6) had fever, 1.96% (1) had pain in body, 1.96% (1) had stomach problem and 1.96% (1) had skin problem (Figure 5d); among 21 above 60 years-vaccinated, 52.38% (11) had not any effect of vaccination, 4.76% (1) feel fit, 19.04% (4) observed symptom of heat, 9.52% (2) had cough, 9.52% (2) had fever and 4.76% (1) had pain in body (Figure 5e).

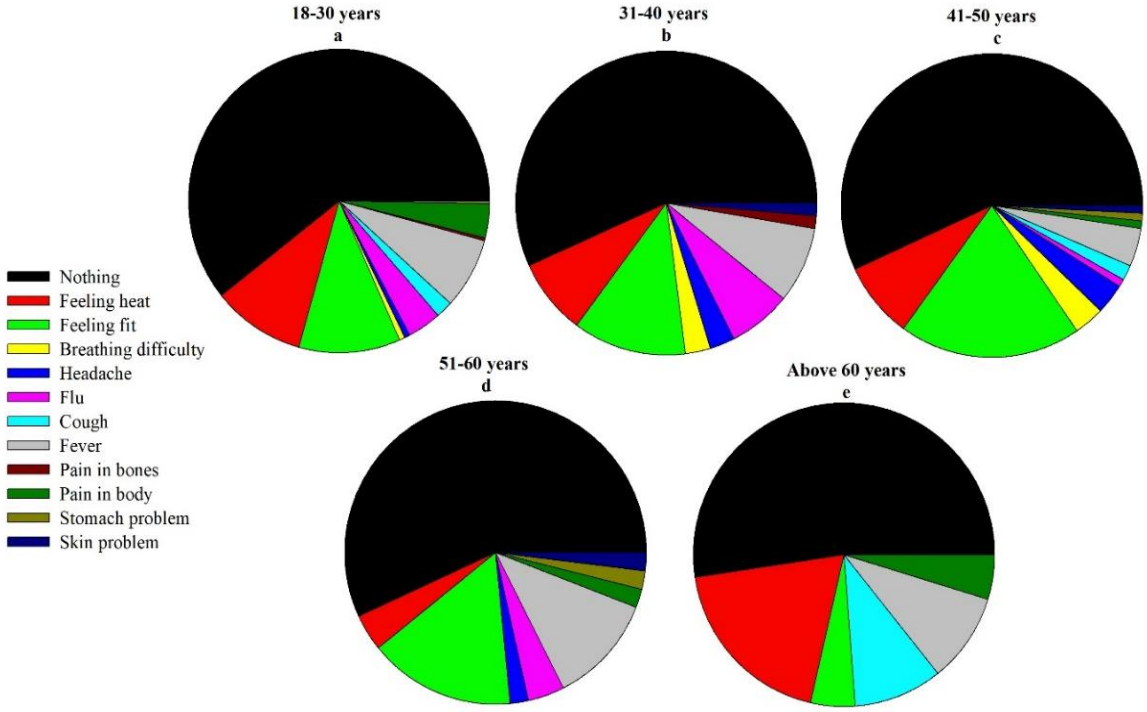

Figure 5 Responses of respondents to COVID-19 vaccinations according to different age groups

4. DISCUSSION

Generally, COVID-19 vaccines are effective in controlling the spread of the coronavirus and its variants [15, 16]. However, researchers have demonstrated that after vaccination, adverse reactions can occur, which are divided into systemic and local effects. Systemic side effects include headache, fever, fatigue, chills, nausea, diarrhea, unusual myalgia, and unusual joint pain, while local side effects include pain, redness, swelling, heat, itching, pain, and bruising [17]. Most effects are usually resolved within 1–3 days post-vaccination [18].

The present study exhibited that among total respondents, a large number of people had no effect from the vaccine. Secondly, maximum people showed a feeling fit response. Thirdly, people complained about symptoms of feeling the heat, and fourthly, the maximum number of people complained about having a fever the next day after getting the vaccine dose. People also complained that to catch a cold, had a cough, headaches, breathing difficulty, pain in bones, pain in the body, stomach problems, and skin problems during the first week of vaccination. Our results are consistent with many other studies [6], [19]–[22] conducted research in the United States and found that vaccine recipients had symptoms during the early phase of post-vaccination; [23] studied responses of people to COVID-19 vaccination in Saudi Arabia and reported 90% had fatigue, and 85% had pain at injections area, [24] conducted research in Germany and found long term adverse effects of the COVID-19 vaccine is fever 19%, [25] studied in Jordan and found 10% of participants suffered from severe side effects, 39% of participants had moderate side effects, and 21% of participants had mild side effects of COVID-19 vaccines, and [26] also found advantage and disadvantages of COVID-19 vaccines.

In our study, a large number of respondents belonged to Pfizer and Sinovac vaccine because of early availability, preference of people, and worldwide acceptability to travel. Among different types of vaccines with consideration of sample size, the maximum respondents of Pfizer vaccinated people felt nothing and fit after vaccination, followed by Sinovac vaccinated. Thirdly, the maximum number of people immunized by Sinopharm showed feeling nothing and fit responses. Fifthly, the PakVac vaccinated people showed feeling nothing and fit responses. The CanSino Bio vaccinated were only 5 respondents in which 4 showed nothing response and 1 found feeling fit. Similar results were found by [8], [27], [28]. Following adverse effects, the results showed that both Sinovac and Sinopharm vaccinated people had headache problems compared to those who received Pfizer, AstraZeneca, CanSino Bio, and PakVac doses. In contrast, only breathing difficulty was found among those people who got the Sinovac dose. Except for Casino bio, flu and fever symptoms were found in all types of vaccines. In-depth, the result showed that Sinovac, Pfizer, and AstraZeneca vaccines caused cough, and AstraZeneca and PakVac recipients felt stomach problems. In addition, respondents of some vaccines complained about pain in bones, body, and skin problems. Following positive effects in terms of feeling fit or feeling nothing responses, the order of vaccines is Pfizer>Sinovac>AstraZeneca>Sinopharm based on sample size. These results agree with the findings of [29] reported neurological adverse effects in COVID-19 vaccines, others [30] found symptoms of fatigue, body pain, headache, muscle pain, fever, and gastrointestinal side effects, and elsewhere [18], they found that at least one side effect reported from 88% participants.

Regarding age factor, results showed that the majority of all age groups people had nothing and feeling fit effects, following feeling heat symptoms and fever symptoms. Interestingly, it is a fact that the immune system of older people is relatively weaker compared to younger ones [31], but people between 18 to 50 years old complained that they felt breathing difficulty after getting a vaccine dose compared to overage. Also, people belonging to the above 60 years old age group did not complain about flu. The reason could be that overage people took serious to coronavirus and cared compared to youngsters because during the early alarm of the Coronavirus, the WHO advised that older people have maximum chances to be affected, so they should take care [32, 33]. Following positive effect in terms of feeling fit or feeling nothing responses after getting vaccine dose, the order of age groups is 41-50 years>51-60 years>31-40 years>18-30 years>above 60 years, based on sample size.

5. CONCLUSION

The study was carried out to investigate the side effects of COVID-19 vaccination. It was found that all types of vaccines are equally effective in controlling the spread of the virus with temporary symptoms appearing after taking the vaccine dose. According to the responses, it was noticed that the temporary sign could be depending on the vaccine type. Our study, in general aspect, showed that there were 58.66% had not any effect of vaccination, 13% felt fit, 9.16% observed symptoms of heat, 1.33% had breathing difficulty, 1.66% had a headache, 3.33%) had flu, 1.66% had a cough, 7.33% had a fever, 0.33% had pain in bones, 2.5% had pain in the body, 0.50% had a stomach, and 0.50% had a skin problem. Considering the efficiency of vaccine types, the order of vaccines is Pfizer>Sinovac>AstraZeneca>Sinopharm, and according to the order of age groups is 41-50 years>51-60 years>31-40 years>18-30 years>above 60 years, based on sample size.

LIST OF ABBREVIATIONS

COVID-19: Coronavirus disease 2019; PakVac: Pakistani Vaccine; WHO: World Health Organization; EMA: European Medicines Agency

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REFERENCES

[1] Ophinni, Y., Hasibuan, A. S., Widhani, A., Maria, S., Koesnoe, S., Yunihastuti, E., & Djauzi, S., COVID-19 vaccines: "Current status and implication for use in Indonesia. "*Acta Medica Indonesiana*, **52**(4), 388(2020)

[2] Coronavirus, "WHO Coronavirus (COVID-19) Dashboard | WHO Coronavirus (COVID-19) Dashboard with Vaccination Data," https://covid19.who.int/ (accessed Mar. 01, 2022),

[3] Pakistan, "COVID-19 Health Advisory Platform by Ministry of National Health Services Regulations and Coordination," https://covid.gov.pk/ (accessed Mar. 01, 2022).

[4] Chuaychoosakoon, C., Parinyakhup, W., Tanutit, P., Maliwankul, K., & Klabklay, P., "Shoulder injury related to Sinovac COVID-19 vaccine: a case report. "*Annals of Medicine and Surgery*, **68**, 102622(2021)

[5] Saeed, B. Q., Al-Shahrabi, R., Alhaj, S. S., Alkokhardi, Z. M., & Adrees, A. O., "Side effects and perceptions following Sinopharm COVID-19 vaccination. "*International Journal of Infectious Diseases*, **111**, 219-226(2021)

[6] Kadali, R. A., Janagama, R., Peruru, S., & Malayala, S. V., "Side effects of BNT162b2 mRNA COVID-19 vaccine: A randomized, cross-sectional study with detailed self-reported symptoms from healthcare workers. "*International Journal of Infectious Diseases*, **106**, 376-381(2021)

[7] Jenkins, M., Rupp, D., & Goebel, L. J., "Post-influenza vaccine subdeltoid bursitis. "*Cureus*, **12**(10) (2020)

[8] Leng, A., Maitland, E., Wang, S., Nicholas, S., Liu, R., & Wang, J., "Individual preferences for COVID-19 vaccination in China. "*Vaccine*, **39**(2), 247-254(2021)

[9] Paul, E., Steptoe, A., & Fancourt, D., "Attitudes towards vaccines and intention to vaccinate against COVID-19: Implications for public health communications. "*The Lancet Regional Health-Europe*, **1**, 100012(2021)

[10] Akarsu, B., Canbay Özdemir, D., Ayhan Baser, D., Aksoy, H., Fidancı, İ., & Cankurtaran, M., "While studies on COVID-19 vaccine is ongoing, the public's thoughts and attitudes to the future COVID-19 vaccine. "*International journal of clinical practice*, **75**(4), e13891(2021)

[11] Pogue, K., Jensen, J. L., Stancil, C. K., Ferguson, D. G., Hughes, S. J., Mello, E. J., & Poole, B. D., "Influences on attitudes regarding potential COVID-19 vaccination in the United States. "*Vaccines*, **8(**4), 582(2020)

[12] S. B. District, *district wise census results census 2017*. www.pbscensus.gov.pk, (2017), http://www.pbscensus.gov.pk/sites/default/files/DISTRICT_WISE_CENSUS_RESULTS_CENSUS_2017.pdf (Accessed: Oct. 24, 2021).

[13] Pakistan_District, "Shaheed Benazir Abad (District, Pakistan) - Population Statistics, Charts, Map and Location," (2017), https://www.citypopulation.de/en/pakistan/distr/admin/815__shaheed_benazir_abad/ (accessed Oct. 24, 2021).

[14] S. Health, "Districtwise Statistics COVID 19 | Health Department of Sindh," (2021). https://sindhhealth.gov.pk/Districtwise-Statistics-COVID-19 (accessed Mar. 01, 2022).

[15] Jęśkowiak, I., Wiatrak, B., Grosman-Dziewiszek, P., & Szeląg, A., "The incidence and severity of post-vaccination reactions after vaccination against COVID-19. "*Vaccines*, **9**(5), 502(2021)

[16] Nguyen, M., "The Psychological Benefits of COVID-19 Vaccination. "*Advances in Public Health*, (2021)

[17] Menni, C., Klaser, K., May, A., Polidori, L., Capdevila, J., Louca, P., ... & Spector, T. D., "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. "*The Lancet Infectious Diseases*, **21**(7), 939-949(2021)

[18] Klugar, M., Riad, A., Mekhemar, M., Conrad, J., Buchbender, M., Howaldt, H. P., & Attia, S., "Side effects of mRNA-based and viral vector-based COVID-19 vaccines among German healthcare workers. "*Biology*, **10**(8), 752(2021)

[19] Yoda, T., & Katsuyama, H., Willingness to receive "COVID-19 vaccination in Japan. "*Vaccines*, **9**(1), 48(2021)

[20] Craig, B. M., "United States COVID-19 vaccination preferences (CVP): 2020 hindsight. "*The Patient-Patient-Centered Outcomes Research*, **14**(3), 309-318(2021)

[21] Khubchandani, J., Sharma, S., Price, J. H., Wiblishauser, M. J., Sharma, M., & Webb, F. J. (2021). "COVID-19 vaccination hesitancy in the United States: a rapid national assessment. "*Journal of Community Health*, **46**(2), 270-277

[22] Meo, S. A., Bukhari, I. A., Akram, J., Meo, A. S., & Klonoff, D. C., "COVID-19 vaccines: comparison of biological, pharmacological characteristics and adverse effects of Pfizer/BioNTech and Moderna Vaccines. "*Eur Rev Med Pharmacol Sci*, 1663-1669(2021)

[23] Alhazmi, A., Alamer, E., Daws, D., Hakami, M., Darraj, M., Abdelwahab, S., & Algaissi, A., "Evaluation of side effects associated with COVID-19 vaccines in Saudi Arabia. *Vaccines*, **9**(6), 674(2021)

[24] Klüver, H., Hartmann, F., Humphreys, M., Geissler, F., & Giesecke, J., "Incentives can spur COVID-19 vaccination uptake. "*Proceedings of the National Academy of Sciences*, **118**(36) (2021)

[25] Hatmal, M. M. M., Al-Hatamleh, M. A., Olaimat, A. N., Hatmal, M., Alhaj-Qasem, D. M., Olaimat, T. M., & Mohamud, R., "Side effects and perceptions following COVID-19 vaccination in Jordan: a randomized, cross-sectional study implementing machine learning for predicting severity of side effects. "*Vaccines*, **9**(6), 556(2021)

[26] Goss, A. L., Samudralwar, R. D., Das, R. R., & Nath, A., "ANA investigates: neurological complications of COVID-19 vaccines. "*Annals of neurology*, **89**(5), 856(2021)

[27] Kaplan, R. M., & Milstein, A., "Influence of a COVID-19 vaccine's effectiveness and safety profile on vaccination acceptance. "*Proceedings of the National Academy of Sciences*, **118**(10) (2021).

[28] Bogdanov, G., Bogdanov, I., Kazandjieva, J., & Tsankov, N., "Cutaneous adverse effects of the available COVID-19 vaccines. "*Clinics in dermatology*, **39**(3), 523-531(2021)

[29] Lu, L., Xiong, W., Mu, J., Zhang, Q., Zhang, H., Zou, L., ... & Zhou, D., "The potential neurological effect of the COVID-19 vaccines: a review. "*Acta Neurologica Scandinavica*, **144**(1), 3-12(2021)

[30] Al Khames Aga, Q. A., Alkhaffaf, W. H., Hatem, T. H., Nassir, K. F., Batineh, Y., Dahham, A. T., ... & Traqchi, M., "Safety of COVID-19 vaccines. "*Journal of medical virology*, **93**(12), 6588-6594(2021)

[31] Delbarre, E., Jacobsen, B. M., Reiner, A. H., Sørensen, A. L., Küntziger, T., & Collas, P., "Chromatin environment of histone variant H3. 3 revealed by quantitative imaging and genome-scale chromatin and DNA immunoprecipitation. "*Molecular biology of the cell*, **21**(11), 1872-1884(2010)

[32] Abu-Hammad, O., Alduraidi, H., Abu-Hammad, S., Alnazzawi, A., Babkair, H., Abu-Hammad, A., & Dar-Odeh, N., "Side effects reported by Jordanian healthcare workers who received COVID-19 vaccines. "*Vaccines*, **9**(6), 577(2021)

[33] Reinhardt, A., & Rossmann, C., "Age-related framing effects: Why vaccination against COVID-19 should be promoted differently in younger and older adults. "*Journal of Experimental Psychology: Applied*. (2021)