COMPARATIVE ANALYSIS OF ADVERSE EFFECTS FOLLOWING BOOSTER DOSE BY DIFFERENT mRNA COVID-19 VACCINES AFTER TWO DOSES OF ADENOVIRAL VACCINATION IN HEALTH-CARE WORKERS

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ABSTRACT

Objective: This study explores the adverse effects to different messenger RNA (mRNA) vaccines (BNT162b2/Pfizer or mRNA-1273/Moderna) in health-care workers (HCWs) who received a third (booster) dose and were previously vaccinated twice with the adenoviral vector vaccine (ChAdOx1-S/Astra Zeneca).

Materials and methods: The data were collected based on surveys of 175 HCWs at the University Clinical Hospital (UCH) Mostar from October 2021 to March 2022. The participants filled out the initial general survey form immediately before the booster vaccination and a second survey form regarding adverse effects after the vaccination. Based on the administered vaccines, HCWs were divided into two groups – Pfizer and Moderna. Data organisation and statistical analysis were performed using Microsoft Excel and SPSS statistical software.

Results: Out of 175 participants, 132 (75.4%) had mild adverse effects post-vaccination, while no severe adverse effects were recorded. Adverse effects overall were significantly more frequent in participants vaccinated with the Moderna vaccine compared to the Pfizer vaccine (82.7%, $P < 0.001$) and were significantly more prevalent in women (82.5%, $P = 0.031$). Specifically, shoulder pain, chills, shivering, and fever were more frequently reported by participants vaccinated with the Moderna vaccine.

Conclusions: Both mRNA vaccines were considered safe to use, while the use of the Pfizer vaccine as a booster dose in a heterologous vaccination approach might have a lower incidence of adverse effects. Thus, the wide range of available vaccines is favourable during pandemic, and their dosages should be reconsidered primarily according to their immunological effectiveness in the future.

Keywords: COVID-19, COVID 19 Vaccines, booster vaccination, adverse effects, health-care workers.

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INTRODUCTION

Coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory coronavirus 2 (SARS-CoV-2), and it was first officially confirmed in December 2019 in Wuhan, China (1). The World Health Organisation (WHO) declared the COVID-19 pandemic on March 11, 2020, and it remains a threat to global health due to several variants still emerging and circulating (2). The incubation period of the disease ranges from 2 to 14 days, and common symptoms include fever, chills, sore throat, coughing, difficulty breathing, shortness of breath, and loss of smell or taste (3,4). More severe clinical manifestations are most often presented in the elderly, immunodeficient, persons with chronic diseases, and children with cardiovascular and respiratory diseases (5–7). Considering there is no adequate-targeted treatment, prevention of the disease through self-protection measures and vaccination is a key course of action in the fight against COVID-19 (8, 9). This is especially important for health-care workers (HCWs), who are at occupational risk and whose systemic vaccination and regular use of protective equipment could ensure a safer work environment for both themselves and the patients they treat (10).
Initially, vaccination with two doses of messenger RNA (mRNA) vaccine was considered sufficient to provide protection against symptomatic COVID-19 (9,11). However, as the pandemic progressed and new SARS-CoV-2 variants of concern (VOCs) predominated, it was shown that two doses were not sufficient to prevent symptomatic disease, its severe forms, and fatal outcomes, suggesting the use of a third (booster) dose (12). From 2021 onwards, the recommendation for the use of a booster dose remained in order to provide additional protection, especially for the elderly and immunodeficient patients (13). However, in Bosnia and Herzegovina (BiH), booster vaccination was initially recommended to everyone over the age of 18 (6 months post-primary vaccination or disease recovery).

A certain number of people experience mild adverse effects from COVID-19 vaccinations, which include pain and swelling at the injection site, headaches, fatigue, muscle and joint pain, and fever, while more serious adverse effects include thrombosis with immune thrombocytopenia, anaphylactic reactions, and Guillain-Barré syndrome (9,11,14). Despite the occurrence of adverse effects, which are mostly of a milder form, there is insufficient data on this topic in the population of BiH where various vaccines against COVID-19 were administered, depending on their availability at the time. In this study, we aimed to assess the frequency and severity of adverse effects to different mRNA vaccines among HCWs in order to determine a more suitable vaccination regimen.

PARTICIPANTS, STUDY DESIGN, AND METHODS

Study population

A total of 175 HCWs of University Clinical Hospital (UCH) Mostar who received a booster dose of mRNA vaccine after previously being fully vaccinated with the adenoviral vector (ChAdOx1-S/Astra Zeneca) vaccine were included in the study. The relevant sociodemographic

and clinical data were collected from survey forms between October 2021 and March 2022. The participants were divided into two groups based on the type of vaccine they received as a booster dose. Group 1 (Pfizer) included 42 HCWs who received the BNT162b2 vaccine, and Group 2 (Moderna) included 133 HCWs who received the mRNA-1273 vaccine. The participants' inclusion in the study was based on the time period, while the allocation into groups was based on the type of vaccine they selected. A notable difference in group sizes can be explained by the voluntary selection of vaccines by the HCWs and the vaccine availability that was not stable at the time.

Surveys

Two survey forms were filled out by the participants, one prior to vaccination and the other 7-14 days after the vaccination. The first form that HCWs filled out immediately before receiving the booster dose included questions regarding age, gender, profession, acute conditions, or fever 2 days prior, other vaccines administered 2 weeks prior, previous SARS-CoV-2 infection, previous life-threatening allergy reactions, allergy to ethanol, other allergies, pregnancy, and breastfeeding. After the booster dose, HCWs filled out the second form regarding adverse effects related to the vaccination. The questions included: type of vaccine, allergic reaction (local or systemic), and adverse effects (redness and swelling at the injection site, shoulder pain, chills, shivering, fever > 37.2ºC, rash, headache, nausea, fatigue, vomiting, and neurological disorders). Participants had the option to write additional adverse effects that were not listed in the questionnaire itself.

Statistical analysis

Collected data were processed using Microsoft Excel and IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY). Standard statistical methods were utilised (Chi-square test or Fisher's exact test), and all tests were two-tailed, where values of $P < 0.05$ were considered statistically significant. The results were presented as absolute numbers (n) and percentages (%) in the form of graphics or tables.

Ethical statement

The study was conducted in accordance with the ethical standards stated in the 1964 Declaration of Helsinki and its subsequent amendments. Since this study involved the analysis of standardised questionnaires, obtaining informed consent was not necessary, and any participant identifying information was excluded.

RESULTS

The study included 175 HCWs of UCH Mostar who previously received two doses of the ChAdOx1-S (Astra Zeneca) adenoviral vector vaccine and were additionally vaccinated with BNT162b2 (Pfizer) or mRNA-1273 (Moderna) vaccine. Of the total number of participants, 42 (24%) were vaccinated with the Pfizer vaccine, and 133 (76%) were vaccinated with the Moderna vaccine. The median age of all HCWs included in the study was 49 (25-65) years, and 89 (50.9%) were male. In the Pfizer group, the median age was 49 (25-64) years, and there were 23 females (54.8%), while in

the Moderna group, the median age was also 49 (26-65) years, and there were 70 males (52.6%). There was no statistical difference among participants between the two established groups regarding age and gender distribution (P = 0.403) (data not shown).

Table 1. *Adverse effects of participants regarding the type of vaccine administered*

	Group 1 (Pfizer) n (%)	**Group 2 (Moderna) n (%)**	***P* value**
Number of participants	**42**	**133**	
Shoulder pain	20 (47.6)	102 (76.7)	**<0.001**
Redness/swelling at the injection site	2 (4.8)	22 (16.5)	0.070*
Chills	3 (7.1)	33 (24.8)	**0.015***
Shivering	0 (0)	16 (12.0)	**0.013***
Fever > 37.2ºC	6 (14.3)	48 (36.1)	**0.007**
Rash	0 (0)	2 (1.5)	1.000*
Headache	5 (11.9)	34 (25.6)	0.063
Nausea	2 (4.8)	13 (9.8)	0.527*
Fatigue	10 (23.8)	49 (36.8)	0.119
Vomiting	0 (0)	1 (0.75)	1.000*
Neurological disorders	0 (0)	0 (0)	1.000*

*Fisher's exact test; Bold values represent statistical significance.

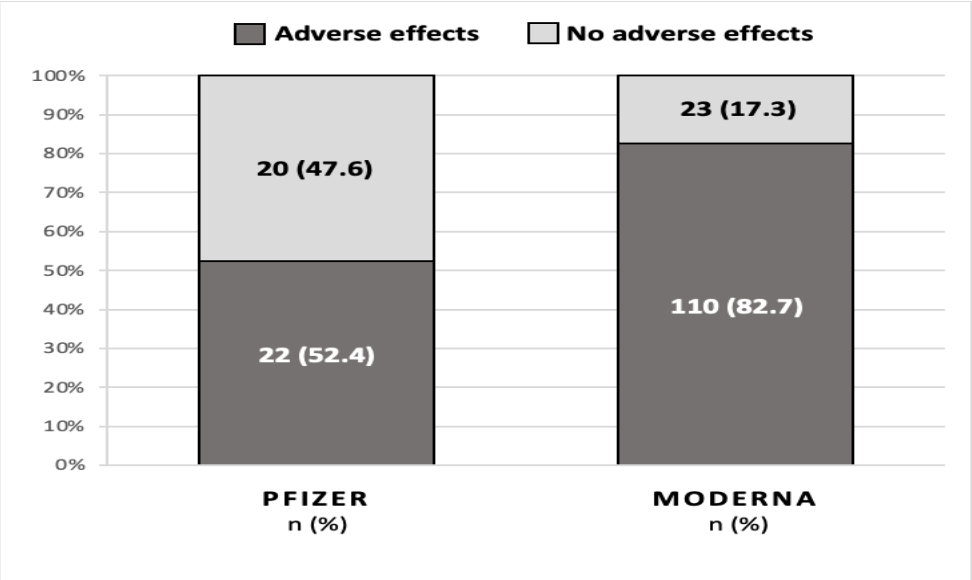

Figure 1. *Comparison of total adverse effects reported after different vaccines*

Adverse effects to mRNA vaccines were reported by 132 participants (75.4%). Of those, 22 out of 42 (52.4%) participants from the Pfizer group reported adverse

effects, while 110 out of 133 (82.7%) participants reported adverse effects to the Moderna vaccine, which was statistically significant ($P < 0.001$) (**Figure 1**). Our results indicate a significantly higher occurrence of certain adverse effects in participants who were vaccinated with the Moderna vaccine. These included shoulder pain (102/133, 76.7%, $P < 0.001$), chills (33/133, 24.8%, $P = 0.015$), shivering (16/133, 12%, $P = 0.013$), and fever (48/133, 36.1%, $P = 0.007$) (**Table 1**).

Table 2. *Adverse effects of participants regarding gender*

	Female n (%)	**Male n (%)**	***P* value**
Number of participants	**86**	**89**	
Total adverse effects reported	71 (82.5)	61 (68.5)	**0.031**
Shoulder pain	66 (76.7)	56 (62.9)	**0.046**
Redness/swelling at the injection site	15 (17.4)	9 (10.1)	0.158
Chills	23 (26.7)	13 (14.6)	**0.047**
Shivering	9 (10.5)	7 (7.9)	0.550
Fever > 37.2ºC	34 (39.5)	20 (22.5)	**0.014**
Rash	1 (1.2)	1 (1.1)	1.000*
Headache	25 (29.1)	14 (15.7)	**0.034**
Nausea	12 (13.9)	3 (3.4)	**0.014***
Fatigue	35 (40.7)	24 (27.0)	0.054
Vomiting	0 (0)	1 (1.1)	1.000*
Neurological disorders	0 (0)	0 (0)	1.000*

*Fisher's exact test; Bold values represent statistical significance.

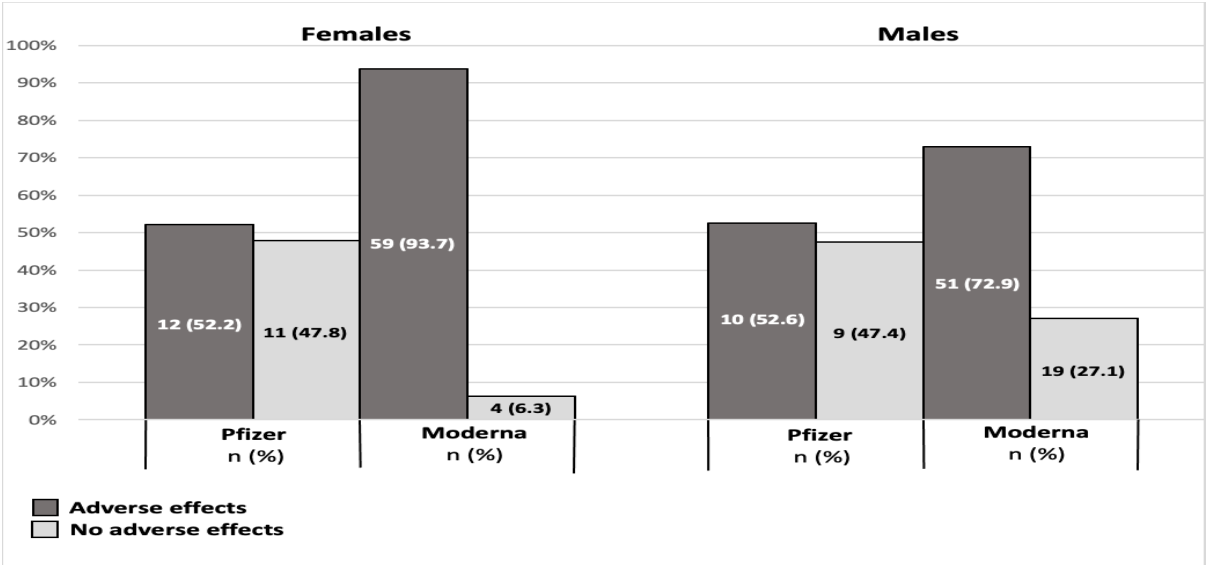

Figure 2. *Comparison of total adverse effects reported in regard to gender and vaccine type*

Adverse effects to mRNA vaccination were reported by 71 out of 86 (82.5%) women who participated in the study, compared to 61 out of 89 (68.5%) men, which was also statistically significant ($P = 0.031$). In the Pfizer group, 12 out of 23 (52.2%) women and 10 out of 19 (52.6%) men experienced adverse effects (P = 0.976). However, in the Moderna group, a significantly higher proportion of women (59/63, 93.7%) compared to men (51/70, 72.9%) reported adverse effects (P = 0.001) (**Figure 2**). When comparing individual adverse effects reported between genders, women experienced shoulder pain (66/86, 76.7%, $P = 0.046$), chills (23/86, 26.7%, $P = 0.047$), fever (34/86, 39.5%, $P = 0.014$), headache (25/86, 29.1%, $P = 0.034$), and nausea (12/86, 13.9%, $P = 0.014$) more frequently than men (**Table 2**). When we further stratified participants based on gender and analysed individual adverse effects, we found no influence of gender on the occurrence of adverse effects between the Pfizer and Moderna groups of participants (**Supplementary Table 1**).

Supplementary Table 1. *Adverse effects of participants regarding gender and the type of vaccine administered*

		Group 1 (Pfizer) n(%)	Group 2 (Moderna) n(%)	*P* value
Number of participants		**42**	**133**	
Shoulder pain	Male	9 (21.4)	47 (35.3)	0.929
	Female	11 (26.2)	55 (41.4)	
	Total	20 (47.6)	102 (76.7)	**<0.001**
Redness/swelling at the injection site	Male	0 (0)	9 (6.7)	0.510*
	Female	2 (4.8)	13 (9.8)	
	Total	2 (4.8)	22 (16.5)	0.070*
Chills	Male	0 (0)	13 (9.8)	0.288*
	Female	3 (7.1)	20 (15.0)	
	Total	3 (7.1)	33 (24.8)	**0.015***
Shivering	Male	0 (0)	7 (5.3)	1.000*
	Female	0 (0)	9 (6.7)	
	Total	0 (0)	16 (12.0)	**0.013***
Fever > 37.2ºC	Male	0 (0)	20 (15.0)	0.074*
	Female	6 (14.3)	28 (21.1)	
	Total	6 (14.3)	48 (36.1)	**0.007**
Rash	Male	0 (0)	1 (0.75)	1.000*
	Female	0 (0)	1 (0.75)	
	Total	0 (0)	2 (1.5)	1.000*
Headache	Male	0 (0)	14 (10.6)	0.139*
	Female	5 (11.9)	20 (15.0)	
	Total	5 (11.9)	34 (25.6)	0.063
Nausea	Male	0 (0)	3 (2.3)	1.000*
	Female	2 (4.8)	10 (7.5)	
	Total	2 (4.8)	13 (9.8)	0.527*
Fatigue	Male	3 (7.1)	21 (15.7)	0.505*
	Female	7 (16.7)	28 (21.1)	
	Total	10 (23.8)	49 (36.8)	0.119
Vomiting	Male	0 (0)	1 (0.75)	1.000*
	Female	0 (0)	0 (0)	
	Total	0 (0)	1 (0.75)	1.000*
Neurological disorders	Male	0 (0)	0 (0)	1.000*
	Female	0 (0)	0 (0)	
	Total	0 (0)	0 (0)	1.000*

*Fisher's exact test; Bold values represent statistical significance.

From other adverse effects, two participants reported leg pain, one in the Pfizer and one in the Moderna group. No participants reported acute conditions,

fever, other vaccinations, allergies to ethanol, and pregnancy prior to booster vaccination, while one participant was breastfeeding during our study period. Two HCWs reported previous life-threatening allergic reactions, but no such reactions were reported after COVID-19 vaccine administration.

DISCUSSION

In this study carried out in UCH Mostar from October 2021 to March 2022, we analysed adverse effects after administration of a booster dose of mRNA COVID-19 vaccines. The study included 175 HCWs who received two doses of adenoviral vector vaccine, and then a booster dose of either the Pfizer or Moderna mRNA vaccine, whose gender and age distribution across the two established groups were quite uniform. Adverse effects after vaccination were reported by 75.4% of all participants, and the results indicated a significantly higher occurrence of adverse effects after vaccination with the Moderna vaccine. The influence of gender on the occurrence of adverse effects was also evident from the results, which showed that women experienced adverse effects more frequently. Our results showed the higher occurrence of adverse effects in women only in the Moderna group, while there was no correlation between gender and the occurrence of adverse effects after Pfizer vaccine administration. Out of all the adverse effects observed, participants from the Moderna group reported a significantly higher frequency of shoulder pain, chills, shivers, and fever as compared to the Pfizer group. On the other hand, women reported more cases of shoulder pain, chills, fever, headache, and nausea compared to men, and no significant difference was observed when further comparing individual adverse effects by gender between the Pfizer and Moderna groups. It is important to point out that none of the participants of this study reported the occurrence of severe adverse effects after being vaccinated either with booster mRNA vaccines or primary adenoviral vaccines.

The more frequent occurrence of mild adverse effects to mRNA vaccines has been documented (10,14), while our results showed a significant increase in the frequency of such reactions after the administration of the Moderna vaccine. This is in accordance with other studies that found post-Moderna vaccination adverse effects to be more frequent compared to the Pfizer vaccine, while noting that the Moderna vaccine is easier to transport and store since it is less sensitive to temperature (15,16). The reason for the higher occurrence of adverse effects across our study population may be the Moderna vaccine dosage of 50 µg at the time, which was the same as the dosage used in the primary vaccination against COVID-19. Previous reports of adverse effects to the full dose of the administered Moderna vaccine were significantly more frequent compared to the half dose, while the immunological effects remained unchanged (17,18). Meanwhile, the use of a booster dose of 25 µg was recommended for the Moderna vaccine, given the almost identical effectiveness compared to the full 50 µg dose (19).

Our results point towards more frequent adverse effects to the mRNA vaccine in women, which is in accordance

with previous studies (20–22). This was evident among our Moderna group participants, indicating that it was not the case for mRNA vaccines in general. Again, this may be the result of the higher dosage of the Moderna vaccine and the fact that women are more likely to report their symptoms (23). Besides that, historically, females and males have shown different reactions to vaccines, and it seems that women's immune system is more reactive (24,25). This only became more prominent during the pandemic, with mass vaccinations taking place globally. Considering the hormonal and physiological variations between men and women which may influence their immune response (26), it may be advisable to reconsider the vaccination dosage for women in the future.

Frequently reported adverse effects after vaccination were both systemic (fever, chills, fatigue, and headache) and local (redness or swelling at the injection site and shoulder pain), and were again reported more frequently by women. Among all the study participants, not a single case of severe allergic reaction or anaphylaxis was recorded. The results of other studies based on online surveys indicate the possibility of the occurrence of such severe adverse effects to mRNA vaccines in 0.2-2% of the population (15,27), and show that their occurrence is quite rare for all the other COVID-19 vaccines as well (28). The reason for no reports of such reactions in our study may be the relatively small number of participants and the fact that they were interviewed on site by health professionals at the vaccination centre. On the other hand, all the participants in this study were properly vaccinated with two doses of the ChAdOx1-S vaccine, which expresses the S (spike) protein as an immunogen and elicits a substantial cellular response after the second dose (29). Pro-inflammatory cytokines secretion can be induced by S protein alone (30), while higher existing immunity can influence the local and systemic inflammatory impact of cytokines upon subsequent dosing (31). Therefore, milder adverse effects could be attributed to better immunological acceptability across our study population. Also, the question arises as to whether the high incidence of adverse reactions to the Moderna vaccine is in correlation with prior SARS-CoV-2 infection. It has been suggested that previous COVID-19 recovery was associated with higher odds of reporting adverse effects (15). However, 79 out of 175 (45.1%) participants in our study have previously recovered from COVID-19, and this data did not influence the overall results, as there was no significance in regard to the vaccine type (P = 0.468), gender (P = 0.115), and total adverse effects reported (P = 0.884) (data not shown).

Considering the wide range of participants' ages and their different roles within the health-care system, our results can be translated to the population of BiH and can indicate COVID-19 vaccine safety in regard to their quality and availability during the pandemic. Our findings are in accordance with other studies that demonstrate low mRNA vaccine severe adverse effects and overall safety, which would be acceptable for people in the indication groups for booster vaccination (32). Since the time of our study, as SARS-CoV-2 evolved, vaccine formulations and

policies have also been updated. Bivalent mRNA vaccines were developed in late 2022 as a response to the emergence of the Omicron (B.1.1.529) variant, and they targeted both the original and new SARS-CoV-2 strains (33). As of late 2023, the updated (2023-2024 formula) mRNA COVID-19 vaccines by Pfizer-BioNTech and Moderna that are aimed at the XBB.1.5 Omicron subvariant have been created and are recommended for everyone 6 months and older (34). The wide range of available vaccines and their continuous variant-targeted development leave room for medical experts to prescribe the best vaccination regimen against SARS-CoV-2 and potentially hold the answer to controlling future pandemics.

This study has several limitations. A relatively small number of participants might have resulted in difficulty obtaining significant relations from the data. On the other hand, there is a notable difference in sample sizes between our two established groups. Observing a larger group of HCWs and having them separated into two groups of comparable sizes might provide more reliable results regarding our study points.

CONCLUSIONS

The data presented in our study point towards the overall safety of mRNA vaccines, despite the mild adverse effects. The administration of the Pfizer vaccine during the COVID-19 pandemic might have ensured a safer vaccination regimen in regard to the lower frequency of adverse effects. A wide range of available vaccines is favourable in order to provide a personalised and secure immunisation, while the higher occurrence of adverse effects among females may point towards reconsidering the vaccine dosage.

REFERENCES

1. Hui DS, I Azhar E, Madani TA, Ntoumi F, Kock R, Dar O, et al. The continuing 2019-nCoV epidemic threat of novel coronaviruses to global health - The latest 2019 novel coronavirus outbreak in Wuhan, China. Int J Infect Dis. 2020;91:264–6. doi: 10.1016/j.ijid.2020.01.009.
2. CDC. SARS-CoV-2 Variant Classifications and Definitions [Internet]. Atlanta: Centers for Disease Control and Prevention; [updated 2023 Sep 1; cited 2024 Feb 14]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/variants/variant-classifications.html
3. WHO. Coronavirus disease (COVID-19) [Internet]. Geneva: World Health Organization; c2021 [updated 2023 Aug 9; cited 2024 Feb 28]. Available from: https://www.who.int/news-room/fact-sheets/detail/coronavirus-disease-(covid-19)
4. Cherry G, Rocke J, Chu M, Liu J, Lechner M, Lund VJ, et al. Loss of smell and taste: a new marker of COVID-19? Tracking reduced sense of smell during the coronavirus pandemic using search trends. Expert Rev Anti Infect Ther. 2020;18(11):1165–70. doi: 10.1080/14787210.2020.1792289.
5. Evans RA, Dube S, Lu Y, Yates M, Arnetorp S, Barnes E, et al. Impact of COVID-19 on immunocompromised populations during the Omicron era: insights from the observational population-based INFORM study. Lancet Reg Health - Eur. 2023;35:100747. doi: 10.1016/j.lanepe.2023.100747.

6. Singhal S, Kumar P, Singh S, Saha S, Dey AB. Clinical features and outcomes of COVID-19 in older adults: a systematic review and meta-analysis. BMC Geriatr. 2021;21(1):321. doi: 10.1186/s12877-021-02261-3.
7. Woodruff RC, Campbell AP, Taylor CA, Chai SJ, Kawasaki B, Meek J, et al. Risk Factors for Severe COVID-19 in Children. Pediatrics. 2022;149(1):e2021053418. doi: 10.1542/peds.2021-053418.
8. Arapović J, Skočibušić S. The first two months of the COVID-19 pandemic in Bosnia and Herzegovina: Single-center experience. Biomol Biomed. 2020;20(3):396–400. doi: 10.17305/bjbms.2020.4838.
9. Polack FP, Thomas SJ, Kitchin N, Absalon J, Gurtman A, Lockhart S, et al. Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine. N Engl J Med. 2020;383(27):2603–15. doi: 10.1056/NEJMoa2034577.
10. Laura L, Dalmatin-Dragišić M, Martinović K, Tutiš B, Herceg I, Arapović M, et al. Does pre-existing immunity determine the course of SARS-CoV-2 infection in health-care workers? Single-center experience. Infection. 2023;51(2):323–30. doi: 10.1007/s15010-022-01859-y.
11. Falsey AR, Sobieszczyk ME, Hirsch I, Sproule S, Robb ML, Corey L, et al. Phase 3 Safety and Efficacy of AZD1222 (ChAdOx1 nCoV-19) Covid-19 Vaccine. N Engl J Med. 2021;385(25):2348–60. doi: 10.1056/NEJMoa2105290.
12. Hall V, Foulkes S, Insalata F, Kirwan P, Saei A, Atti A, et al. Protection against SARS-CoV-2 after Covid-19 Vaccination and Previous Infection. N Engl J Med. 2022;386(13):1207–20. doi: 10.1056/NEJMoa2118691.
13. Mbaeyi S, Oliver SE, Collins JP, Godfrey M, Goswami ND, Hadler SC, et al. The Advisory Committee on Immunization Practices' Interim Recommendations for Additional Primary and Booster Doses of COVID-19 Vaccines — United States, 2021. MMWR Morb Mortal Wkly Rep. 2021;70(44):1545-1552. doi: 10.15585/mmwr.mm7044e2.
14. Baden LR, El Sahly HM, Essink B, Kotloff K, Frey S, Novak R, et al. Efficacy and Safety of the mRNA-1273 SARS-CoV-2 Vaccine. N Engl J Med. 2021;384(5):403–16. doi: 10.1056/NEJMoa2035389.
15. Beatty AL, Peyser ND, Butcher XE, Cocohoba JM, Lin F, Olgin JE, et al. Analysis of COVID-19 Vaccine Type and Adverse Effects Following Vaccination. JAMA Netw Open. 2021;4(12):e2140364. doi: 10.1001/jamanetworkopen.2021.40364.
16. 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):1663–9. doi: 10.26355/eurrev_202102_24877.
17. Anderson EJ, Rouphael NG, Widge AT, Jackson LA, Roberts PC, Makhene M, et al. Safety and Immunogenicity of SARS-CoV-2 mRNA-1273 Vaccine in Older Adults. N Engl J Med. 2020;383(25):2427–38. doi: 10.1056/NEJMoa2028436.
18. Jackson LA, Anderson EJ, Rouphael NG, Roberts PC, Makhene M, Coler RN, et al. An mRNA Vaccine against SARS-CoV-2 — Preliminary Report. N Engl J Med. 2020;383(20):1920–31. doi: 10.1056/NEJMoa2022483.

19. Chu L, McPhee R, Huang W, Bennett H, Pajon R, Nestorova B, et al. A preliminary report of a randomized controlled phase 2 trial of the safety and immunogenicity of mRNA-1273 SARS-CoV-2 vaccine. Vaccine. 2021;39(20):2791–9. doi: 10.1016/j.vaccine.2021.02.007.
20. Mori M, Yokoyama A, Shichida A, Sasuga K, Maekawa T, Moriyama T. Impact of sex and age on vaccine-related side effects and their progression after booster mRNA COVID-19 vaccine. Sci Rep. 2023;13(1):19328. doi: 10.1038/s41598-023-46823-4.
21. Green MS, Peer V, Magid A, Hagani N, Anis E, Nitzan D. Gender Differences in Adverse Events Following the Pfizer-BioNTech COVID-19 Vaccine. Vaccines. 2022;10(2):233. doi: 10.3390/vaccines10020233.
22. Kitagawa H, Kaiki Y, Sugiyama A, Nagashima S, Kurisu A, Nomura T, et al. Adverse reactions to the BNT162b2 and mRNA-1273 mRNA COVID-19 vaccines in Japan. J Infect Chemother. 2022;28(4):576–81. doi: 10.1016/j.jiac.2021.12.034.
23. Kroenke K, Spitzer RL. Gender Differences in the Reporting of Physical and Somatoform Symptoms. Psychosom Med. 1998;60(2):150–5. doi: 10.1097/00006842-199803000-00006.
24. Jensen A, Stromme M, Moyassari S, Chadha AS, Tartaglia MC, Szoeke C, et al. COVID-19 vaccines: Considering sex differences in efficacy and safety. Contemp Clin Trials. 2022;115:106700. doi: 10.1016/j.cct.2022.106700.
25. Potluri T, Fink AL, Sylvia KE, Dhakal S, Vermillion MS, Vom Steeg L, et al. Age-associated changes in the impact of sex steroids on influenza vaccine responses in males and females. NPJ Vaccines. 2019;4:29. doi: 10.1038/s41541-019-0124-6.
26. Al-Qazaz HK, Al-Obaidy LM, Attash HM. COVID-19 vaccination, do women suffer from more side effects than men? A retrospective cross-sectional study. Pharm Pract. 2022;20(2):2678. doi: 10.18549/PharmPract.2022.2.2678.
27. Mathioudakis AG, Ghrew M, Ustianowski A, Ahmad S, Borrow R, Papavasileiou LP, et al. Self-Reported Real-World Safety and Reactogenicity of COVID-19 Vaccines: A Vaccine Recipient Survey. Life Basel Switz. 2021;11(3):249. doi: 10.3390/life11030249.
28. Fiolet T, Kherabi Y, MacDonald CJ, Ghosn J, Peiffer-Smadja N. Comparing COVID-19 vaccines for their characteristics, efficacy and effectiveness against SARS-CoV-2 and variants of concern: a narrative review. Clin Microbiol Infect. 2022;28(2):202–21. doi: 0.1016/j.cmi.2021.10.005.
29. Lee TH, Nam M, Seo JD, Kim H, Kim HR, Hur M, et al. Evaluation of Cellular Responses to ChAdOx1-nCoV-19 and BNT162b2 Vaccinations. Ann Lab Med. 2023;43(3):290–4. doi: 10.3343/alm.2023.43.3.290.
30. Giannotta G, Murrone A, Giannotta N. COVID-19 mRNA Vaccines: The Molecular Basis of Some Adverse Events. Vaccines. 2023;11(4):747. doi: 10.3390/vaccines11040747.
31. Menni C, Klaser K, May A, Polidori L, Capdevila J, Louca P, 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):939–49. doi: 10.1016/S1473-3099(21)00224-3.

32. Hause AM, Baggs J, Marquez P, Abara WE, Baumblatt J, Blanc PG, et al. Safety Monitoring of COVID-19 mRNA Vaccine Second Booster Doses Among Adults Aged ≥50 Years — United States, March 29, 2022–July 10, 2022. MMWR Morb Mortal Wkly Rep. 2022;71(30):971–6. doi: 10.15585/mmwr.mm7130a4
33. Tan CY, Chiew CJ, Pang D, Lee VJ, Ong B, Wang LF, et al. Effectiveness of bivalent mRNA vaccines against medically attended symptomatic SARS-CoV-2 infection and COVID-19-related hospital admission among SARS-CoV-2-naive and previously infected individuals: a retrospective cohort study. Lancet Infect Dis. 2023;23(12):1343–8. doi: 10.1016/S1473-3099(23)00373-0.
34. Regan JJ, Moulia DL, Link-Gelles R, Godfrey M, Mak J, Najdowski M, et al. Use of Updated COVID-19 Vaccines 2023-2024 Formula for Persons Aged ≥6 Months: Recommendations of the Advisory Committee on Immunization Practices — United States, September 2023. MMWR Morb Mortal Wkly Rep. 2023;72:1140-1146. Erratum in: Morb Mortal Wkly Rep. 2023;72(49):1335.

Laura L, Vučijak M, Arapović M, Arapović J. COMPARATIVE ANALYSIS OF ADVERSE EFFECTS FOLLOWING BOOSTER DOSE BY DIFFERENT mRNA COVID-19 VACCINES AFTER TWO DOSES OF ADENOVIRAL VACCINATION IN HEALTH-CARE WORKERS. Zdravstveni glasnik. 2024;10(2):8-21.

USPOREDNA ANALIZA NEŽELJENIH UČINAKA DOCJEPE RAZLIČITIM mRNA COVID-19 CJEPIVIMA NAKON DVIJE DOZE ADENOVIRUSNOG VEKTORSKOG CJEPIVA KOD ZDRAVSTVENIH DJELATNIKA

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SAŽETAK

Cilj: Ova studija istražuje neželjene učinke različitih glasničkih RNA (mRNA) cjepiva (BNT162b2/Pfizer ili mRNA-1273/Moderna) kod zdravstvenih djelatnika koji su primili treću (booster) dozu, a prethodno su dva puta cijepljeni adenovirusnim vektorskim cjepivom (ChAdOx1-S/Astra Zeneca).

Materijali i metode: Podatci su prikupljeni na temelju anketiranja 175 zdravstvenih djelatnika Sveučilišne kliničke bolnice (SKB) Mostar od listopada 2021. do ožujka 2022. Sudionici su ispunili početni opći anketni obrazac neposredno prije docjepljivanja te drugi anketni obrazac u vezi s nuspojavama nakon cijepljenja. Na temelju cjepiva, ispitanici su podijeljeni u dvije skupine – Pfizer i Moderna. Organizacija podataka i njihova statistička obrada su provedeni pomoću softvera Microsoft Excel i SPSS.

Rezultati: Od 175 sudionika, njih 132 (75,4%) je imalo blage nuspojave nakon docjepe, dok teže nuspojave nisu zabilježene. Ukupno gledano, nuspojave su bile značajno češće kod sudionika koji su primili cjepivo Moderna u usporedbi s onima koji su primili cjepivo Pfizer (82,7%, $P < 0,001$) te su bile značajno češće kod žena (82,5%, $P = 0,031$). Točnije, bolove u ramenu, zimicu, drhtavicu i vrućicu su češće prijavljivali sudionici cijepljeni Modernom.

Zaključci: U ovom radu je pokazano da su oba mRNA cjepiva sigurna za upotrebu, dok je upotreba Pfizer cjepiva za docjepu u heterolognom pristupu cijepljenju rezultirala manjom učestalošću neželjenih efekata. Širok raspon dostupnih cjepiva je povoljan u vremenima pandemije, a njihove doze bi u budućnosti trebalo preispitati prvenstveno prema njihovoj imunološkoj učinkovitosti.

Ključne riječi: COVID-19, cjepiva protiv COVID-19, docjepljivanje, štetni učinci, zdravstveni djelatnici.

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