١ **Effectiveness of COVID-19 Vaccines in Mahabad, Iran: A Cohort Study**

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٣ The COVID-19 pandemic has shown that infectious diseases can become serious crises,
٤ emphasizing the importance of vaccination as the best way to prevent such outbreaks. The aim of
٥ study was to examine how well COVID-19 vaccines work in the northwestern region of Iran, city
٦ of Mahabad.This retrospective cohort study compared 1077 vaccinated employees of the Mahabad
٧ city health department (exposed group) with 1338 unvaccinated employees from other departments
٨ (unexposed group). Demographic details, vaccination dates, types, and outcomes were extracted
٩ from the local health system. Data on cases came from the disease unit, while hospitalization was
١٠ retrieved from the Medical Care Monitoring Center (MCMC). Attributable fractions for the
١١ exposed group and relative risks with 95% confidence intervals were calculated for each vaccine
١٢ dose, stratified by sex, age group, and exposure level. Data analysis was conducted using
١٣ STATA16, with a p-value < 0.05 considered statistically significant.The overall efficacy of
١٤ COVID-19 vaccines in preventing the disease is 51%, with a 26% effectiveness in averting
١٥ hospitalization. Stratifying by vaccine type, AstraZeneca exhibits an 81% efficacy (95% CI: 0.61–
١٦ 0.91) in preventing infection, followed by Sputnik at 41% (95% CI: 0.086–0.62) and Sinopharm-
١٧ Baharat at 10% (95% CI: 0.50–0.46). Similarly, in preventing hospitalization, AstraZeneca
١٨ demonstrates a 79% efficacy (95% CI: 0.083–0.95), Sputnik at 29% (95% CI: 0.77–0.71), and
١٩ Sinopharm–Bharat at 44% (95% CI: 0.63–0.81). Notably, effectiveness in preventing both disease
٢٠ and hospitalization is higher in men than women. AstraZeneca vaccine emerges as the most
٢١ effective in preventing both disease and hospitalization, followed by Sputnik with optimal
٢٢ efficacy. Analyzing vaccine effectiveness across age groups reveals the lowest efficacy in
٢٣ individuals below 30 years old, while the highest efficacy is observed in the age group above 51
٢٤ years. Despite challenges in vaccine selection and timely administration in Iran, our findings
٢٥ demonstrate that three doses of COVID-19 vaccines achieve an effectiveness exceeding 75% for
٢٦ preventing hospitalization and death, underscoring the vital role of vaccination as a primary
٢٧ preventive measure against infectious disease outbreaks. This reinforces the importance of
٢٨ proactive preparation and investment in robust vaccination programs for optimal epidemic control.

٢٩ **Keywords:** COVID-19 Vaccines, Vaccine Efficacy, Risk Assessment, Risk Ratio , Iran

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٣١ 1. Introduction:

٣٢ In December 2019, cases of pneumonia caused by an unknown virus were reported associated

٣٣ with a seafood wholesale market in Wuhan City, Hubei Province, China. First, this disease was

٣٤ mentioned in China under the name of mysterious respiratory disease, and then this disease was

٣٥ named as Covid-19 by the World Health Organization (1). On January 30, 2020, the World

۳٦ Health Organization declared the COVID-19 pandemic a public health emergency of

۳۷ international concern (2). On March 11, 2020, this disease was declared a pandemic, so that its

۳۸ importance and prevalence can be determined even more (1 , 3). With the onset of the emerging

۳۹ disease of Covid-19 in late December 2019 in China and its rapid spread throughout the world,

٤۰ scientists began their research to develop a vaccine (4). The causative agent of Covid-19 is the

٤۱ SARS-CoV-2 coronavirus. The presence of spike protein on the surface of the SARS-CoV-2

٤۲ coronavirus is one of the most important structural features of this virus (5).The spike protein of

٤۳ SARS-CoV-2 directly binds to the ACE2 receptor on the surface of human alveolar epithelial

٤٤ cells of the host, which facilitates the entry and replication of the virus (6).

٤٥ The covid-19 disease has imposed a huge burden on the world, so that after about three years

٤٦ since the beginning of the covid-19 pandemic worldwide (until February 19, 2023), more than

٤۷ 670 million confirmed cases have been recorded and more than 6 million people have died. In

٤۸ the Islamic Republic of Iran, until February 19, 2023, the number of infected people was

٤۹ 7,500,000 and the number of deaths was 145,000 (7) Non-pharmacological interventions such as

٥۰ social distancing, mask use and contact tracing have been the mainstay of health policy strategies

٥۱ to reduce the spread of the virus and limit the demand for healthcare (8). To prevent Covid-19 as

٥۲ the emerging disease of the century and the most difficult health challenge, it is necessary to

٥۳ discover an effective vaccine (4). Vaccines are the most important tool to prevent infection and

٥٤ severe disease caused by SARS-Covid-19 (9). The process of vaccination and immunization of

٥٥ the people of the world against diseases is known as one of the greatest public health

٥٦ achievements. Immunization programs have resulted in significant reductions in mortality and

٥۷ prevalence of infectious diseases, including the eradication of polio worldwide (10).In order to

٥۸ succeed in reducing the prevalence and treatment of vaccine-preventable diseases, immunization

٥۹ programs should be combined with the national vaccination process and the vaccination

٦۰ coverage should reach over 70% (11). Nowadays, most of the vaccines are made based on the

٦۱ weakened infectious agent or messenger RNA, which can induce the cellular and humoral

٦۲ immune system to produce antibodies in order to reduce the possibility of death and severe

٦۳ complications in case of exposure to the infectious agent (4). The presence of the spike protein

٦٤ on the surface of the coronavirus is one of the most important structural features of this virus, so

٦٥ the spike protein can be a suitable target for the preparation of various types of vaccines against

٦٦ the Covid-19 disease, which has attracted the attention of many scientists (5).

٦٧   Until August 2021, more than 150 vaccines were being developed in different stages of research

٦٨   and clinical trials to deal with this pandemic. Most of these vaccines are made on the basis of

٦٩   weakened infectious agent or messenger RNA, which can induce the cellular and humoral

٧٠   immune system to produce antibodies in order to reduce the possibility of death and severe

٧١   complications in case of exposure to SARS-CoV-2 (4) .

٧٢   With the introduction of the first effective vaccine against Covid-19 by an American-German

٧٣   company called Pfizer BioNTech in December 2019, i.e. 11 months after the first case of

٧٤   infection with Covid-19 was recorded, scientists were able to stop the multi-year process of

٧٥   developing a new vaccine. pass in less than a year and the hopes to return to normal life become

٧٦   stronger (12). After that, other reputable companies in the world introduced vaccines, including

٧٧   Moderna, Johnson & Johnson, AstraZeneca-Oxford, Sputnik V, Quaxin, Novavax, Sinovac, and

٧٨   Sinopharm. Of course, all these vaccines had not received final approval from reputable

٧٩   organizations such as the World Health Organization and the Food and Drug Organization when

٨٠   they were used. In this regard, Iran has also made efforts to make and develop a vaccine. As of

٨١   January 11, 2023, 12.7 billion doses of the Covid-19 vaccine have been administered worldwide,

٨٢   with 67.9% of the world's population receiving at least one dose. While 4.19 million vaccines

٨٣   were administered daily at that time, according to official reports of national health agencies,

٨٤   only 22.3% of people in low-income countries had received at least the first vaccine by

٨٥   September 2022 (13). The major challenge for these vaccines is the diverse mutations of SARS-

٨٦   CoV-2, which lead to the creation of new species; But scientific efforts to develop and improve

٨٧   vaccines are still ongoing (4). Clinical controlled trials and clinical studies in real conditions

٨٨   from some countries have shown clear evidence of the effectiveness of the vaccines used (14).

٨٩   So far, many studies have been conducted on the effectiveness of different covid-19 vaccines in

٩٠   different countries, and they have provided different estimates of the effectiveness of vaccines

٩١   according to the difference in the real environmental conditions of the use of vaccines. There are

٩٢   new mutations and different strains globally; Therefore, understanding the effectiveness of

٩٣   different vaccines against different strains has become the main priority in the world (14-16).In

٩٤   Iran, universal vaccination to achieve collective safety and reduce the risk of transmission of

٩٥   infection, disease and its consequences was chosen and implemented as a suitable solution by the

٩٦   Ministry of Health, and since 21st of February 2019, nationwide vaccination with Sputnik

٩٧   vaccine made in Russia Due to the high chance of exposure to this virus, it was started on

⁹⁸ healthcare workers and in Mahabad city on March 10, 2019, vaccination of healthcare workers

⁹⁹ with Sputnik vaccine was started and continued with covaxin (Bharat), Sinopharm and

¹⁰⁰ AstraZeneca vaccines.The country of Iran has experienced eight waves of the corona epidemic

¹⁰¹ so far, and West Azarbaijan province and Mahabad city in this province have been one of the

¹⁰² main centers of this disease during several waves. Therefore, the present study was conducted

¹⁰³ using a retrospective cohort method with the aim of evaluating the effectiveness of different

¹⁰⁴ covid-19 vaccines in preventing covid-19 disease, hospitalization and covid-19-related death

¹⁰⁵ among employees working in the health department of Mahabad city.

2. Materials and Methods:

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¹⁰⁷ The current research is longitudinal retrospective cohort to evaluate the effectiveness of

¹⁰⁸ different vaccines used in employees working in different health and treatment departments

¹⁰⁹ of Mahabad city in preventing covid-19 disease, hospitalization and death due to covid-19

¹¹⁰ disease. Mahabad city located in Northwest of Iran in West Azarbaijan province (Fig1).

¹¹¹ **2.1 Sample size:** To determine the necessary sample size for this cohort study, we employed the

¹¹² power and sample size analysis tools within STATA 15. We aimed for a power of 90% to

¹¹³ detect a relative risk of 0.83 with an alpha level of 0.01. Based on these parameters, the

¹¹⁴ analysis yielded a final sample size of approximately 2100.

¹¹⁵ We included 1077 employees working in the health and treatment department of Mahabad city in

¹¹⁶ the study between April 22, 1400 until the end of August 1400.To conduct the study, after

¹¹⁷ approving the plan in the ethics committee of Urmia University of Medical Sciences and

¹¹⁸ receiving approval code

¹¹⁹). Then the coordination for data collection and the necessary coordination with the officials of

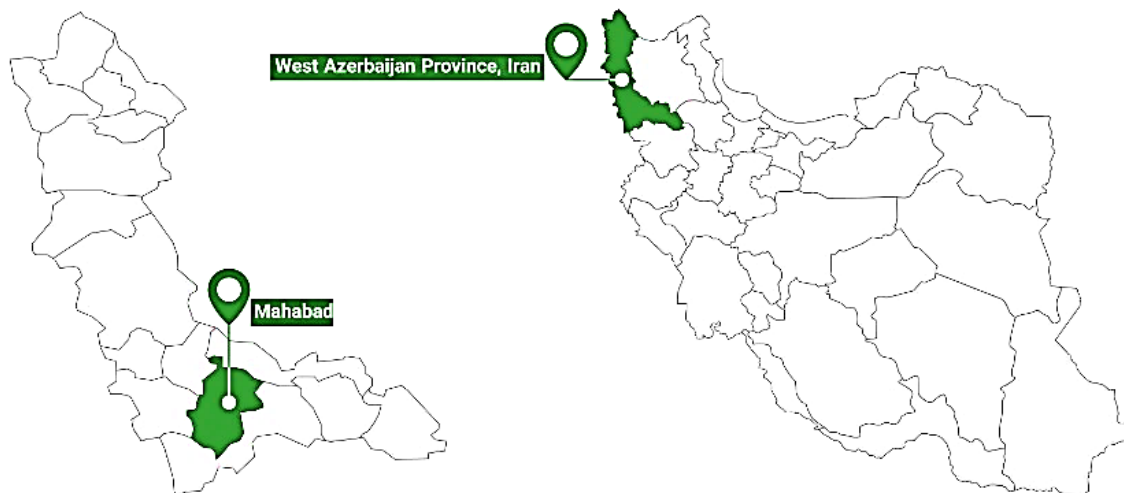¹²⁰ the health and treatment network of Mahabad city for data collection were done.

Figure 1: Geographical location of Mahabad City in West Azarbaijan Province in Iran

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۱۲٤ The exposure group (as the group receiving the vaccine) included employees working in the

۱۲٥ health and treatment department of Mahabad city who received the Covid-19 vaccine from April

۱۲٦ 22, 1400 to the end of August 1400. In this study, people were defined as exposed (vaccinated)

۱۲۷ who received at least two doses of the same type of vaccine. The control group was selected

۱۲۸ from the population of employees working in petrochemicals, education and banks in Mahabad

۱۲۹ city who have no history of receiving vaccines between April 22, 1400 and the end of August

۱۳۰ 1400.

۱۳۱ The entry criteria for the exposure group is to be employed in the health and treatment sector of

۱۳۲ Mahabad city, for health workers and for the control group, to be employed in the health and

۱۳۳ treatment, petrochemical, education and banking sectors of Mahabad city.

۱۳٤ 2.2 Exclusion criteria included the following people:

۱۳٥ 1. People who had a history of being infected with Covid-19, hospitalization or death before the

۱۳٦ start of vaccination or 14 days before receiving the second dose, their test result was positive.

۱۳۷ 2. People who did not receive the second dose of the vaccine.

۱۳۸ 3. People who were not vaccinated with two doses of the same vaccine.

١٣٩ 4. People were vaccinated with uncommon vaccines in the country.

١٤٠ After selecting the exposure group and the control group, in order to prepare the necessary

١٤١ information for the exposure group (vaccine recipient), an Excel file including national code

١٤٢ data, age, sex, occupation, type of vaccine, date of receiving the first dose, date of receiving the

١٤٣ second dose from the SIB system of the health center and The data related to infection include

١٤٤ the date of infection, the time interval of infection after receiving the vaccine, the outcom of

١٤٥ infection (Covid-19 disease, hospitalization and death) from the database of positive cases of the

١٤٦ city disease unit, hospitalization data from the medical records department of the hospital, and

١٤٧ data on death cases. was extracted from the environmental health unit due to access to all

١٤٨ deceased cases. To prepare the data of the control group after receiving the national code of the

١٤٩ employees from the relevant department, the data including the national code, age, gender,

١٥٠ occupation from the apple system and the data related to the disease from the database of the

١٥١ positive cases of the disease unit of the city health center headquarters, the data related to the

١٥٢ hospitalization status was extracted from the medical records department of the hospital and the

١٥٣ data of the deceased cases from the environmental health unit due to access to all the deceased

١٥٤ cases.

١٥٥ The reason for choosing the bank employees was because they were among the group that had a

١٥٦ high level of exposure to the virus, like the medical staff, and a large number of them got

١٥٧ infected with the Covid-19.Teachers were among the occupations of the society whose statistical

١٥٨ population was large for comparison and were exposed to the virus of Covid-19 in various ways.

١٥٩ 2.3 The leveling of job groups based on exposure was done as follows:

١٦٠ **Exposure level 1** (people at high risk): Doctors and nurses in the corona department, laboratory

١٦١ workers, midwives in the delivery department, paramedics, and in the control group, bank

١٦٢ employees and level 1 health workers who received the vaccine in the specified time frame. They

١٦٣ have not received a vaccine.

١٦٤ **Exposure level two** (people at moderate risk): Doctors and nurses from other departments,

١٦٥ health workers, health midwives, emergency experts, radiology experts, operating room experts

١٦٦ and attendants, and in the control group, teachers and level two employees. Those who have not

١٦٧ received the vaccine within the specified time period.

١٦٨   **Exposure level 3** (people at low risk): Employees of administrative and health headquarters and

١٦٩   hospitals, guards and transport workers, in the control group, petrochemical workers and level 3

١٧٠   health workers who received the vaccine in the specified time frame. have not received.

١٧١   In this study, the risk of infection, relative risk and effectiveness of vaccines in general (all

١٧٢   vaccines) and by type of vaccine (Astrazenka, Sputnik, Sinopharm-Bharat) were calculated on

١٧٣   health workers. Age and gender were controlled as confounders using stratification technique in

١٧٤   the data analysis.

١٧٥ 2.4 The sources of the data:

١٧٦   1. SIB system (integrated health system) which can be used to extract demographic information

١٧٧   (age, sex), type of vaccine, date of receiving the first and second dose, etc. Vaccine, underlying

١٧٨   disease used.

١٧٩   2. Excel of the positive cases of the disease unit of Mahabad city to identify the positive cases

١٨٠   based on age, gender, occupation, underlying disease.

١٨١   3. The MCMC system of the hospital was used to extract the information of people hospitalized

١٨٢   due to the disease of covid-19 and the outcome of the disease, discharge or death.

١٨٣   4. In order to get the information of the people who died due to the covid-19 disease, Excel of

١٨٤   death cases of the diseases and environmental health unit of Mahabad city was used.

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١٨٦ 2.5 Vaccine effectiveness: It indicates how many percent of those who were supposed to be infected

١٨٧   will not be infected if the vaccine is injected. To calculate the effectiveness of the vaccine, the

١٨٨   attributable risk formula was used in the exposure group, which is written as follows:

١٨٩   Vaccine Efficacy = (Risk of Disease in Unvaccinated Group - Risk of Disease in Vaccinated

١٩٠   Group) /Risk of Disease in Unvaccinated Group

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١٩٢   Wilson's formula was used to calculate the confidence interval, which is obtained as follows:

١٩٣   Attributable Fraction $AF = (Pe - Pu) \cdot Pe$

١٩٤   95% Confidence Interval $CI = AF \pm (Z\alpha.2 * SE)$

Standard Error $SE = \sqrt{(Pe \cdot Ne) \cdot (1 - Pe \cdot Ne)}$

١٩٦   Analyzes were performed in Stata-16 software and a significance level of 0.05 was considered

3. Results:

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١٩٨   Table 1 shows the distribution of disease frequency, death, exposure level, hospitalization,
١٩٩   sex, type of vaccine, underlying disease, age and follow-up period in the exposed group
٢٠٠   (vaccine group) and the control group (non-vaccine group). This table shows that the rate of
٢٠١   disease in the control group is higher than the exposure group (10.6<5.1). The occurrence of
٢٠٢   death in the exposure and control groups is zero. The people in the medium exposure level
٢٠٣   have the largest number in the control group and the highest number in the high exposure
٢٠٤   level in the exposure group. Hospitalization in the control group is more than the exposure
٢٠٥   group (2%<1.5%). In the control group, males are the most frequent with 54.8% and in the
٢٠٦   exposure group, females are the most frequent with 53.9%. Sputnik vaccine recipients have
٢٠٧   the highest number and Bharat recipients have the lowest number in the exposure group. The
٢٠٨   median age in both the exposure and control groups is 36 years. The follow-up period in the
٢٠٩   control group is longer than the exposure group (30.79<18.43).

٢١٠   Table 1: frequency distribution by type of exposure

	Groups	Control Unvacinated		Exposed Vaccinated		P_value
		N	%	N	%	
Covid_19	Not infected	1196	89.4	1022	94.9	<0.001
	Infected	142	10.6	55	5.1	
Death	No	1338	100	1077	100	0.007
	Yes	0	0	0	0	
Exposure level	High	442	33	637	59.1	<0.001
	Moderate	586	43.8	359	3.33	
	Low	310	23.2	81	7.5	
Hospitalization	No	1311	98	1061	98.5	0.32
	Yes	27	2	16	1.5	
Sex	Female	605	54.2	580	53.9	<0.001
	Male	733	54.8	497	46.1	
Type of Vaccine	No_recived	1338	100	0	0	<0.001
	Sputnik	0	0	413	38.3	
	AstraZeneca	0	0	404	37.5	
	Sinopharm	0	0	135	12.5	
	Baharat	0	0	125	11.5	
Underlying Disease	No	1316	98.4	1062	98.6	0.16
	yes	22	1.6	15	1.4	
Age (Mean±Sd)		36.83	7.74	36.86	9.97	<0.001
Follow up Time (Mean±Sd)		150.96	30.79	158.57	18.43	<0.001

۲۱۲ Table 2 shows that out of 2415 participants in the study, 1077 people received vaccine as
۲۱۳ exposure group and 1338 people did not receive vaccine as control group. The highest number of
۲۱٤ vaccine recipients is related to Sputnik vaccine with 414 people and the lowest is related to
۲۱٥ Bharat vaccine with 125 people. The rate of infection with covid-19 in the control group is
۲۱٦ 10.6%, and also among the people receiving the vaccine, the highest rate of infection is related to
۲۱۷ the recipients of Sino pharm vaccine and the lowest is related to AstraZeneca. The highest
۲۱۸ percentage of hospitalization is in Bharat vaccine. The most type of vaccine injected in women
۲۱۹ was related to Sino pharm vaccine with 66.7% and in men related to Sputnik vaccine with
۲۲۰ 50.8%. The rate of underlying disease is higher in those who have received sin pharm vaccine.

۲۲۱ Table 2: frequency distribution based on the type of vaccine received

	Groups	Sputnik 413		AstraZeneca 404		Sinopharm 135		Baharat 125		P_value
		N	%	N	%	N	%	N	%	
Covid_19	Not infected	378	93.7	396	98	124	91.9	115	92	<0.001
	infected	26	6.3	8	2	11	8.1	10	8	
Death	No	413	100	404	100	135	100	125	100	0.12
	yes	0	0	0	0	0	0	0	0	
Hospitalization	No	406	98.3	402	99.5	131	97	122	97.6	0.23
	yes	7	1.7	2	0.5	4	3	3	2.4	
Sex	Female	203	49.2	223	55.2	90	66.7	64	51.2	<0.001
	Male	210	50.8	181	44.8	45	33.3	61	48.8	
Underlying Disease	No	405	98.1	402	99.5	132	97.8	123	98.4	0.42
	Yes	8	1.9	2	0.5	3	2.2	2	1.6	
Age (Mean±Sd)		38.5	10.9	35.4	8.8	34.8	10.1	38.1	8.7	<0.001
Follow up Time (Mean±Sd)		158.8	16.3	159.7	16.5	155.7	25.3	156.6	21.4	<0.001

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۲۲۳ Table 3 shows the effectiveness of the vaccine in preventing the disease of covid-19 by dose in
۲۲٤ both sexes, that the relative risk is higher in the second dose and the relative risk in general is
۲۲٥ 0.48% in both sexes. The effectiveness of the vaccine is 0.51% with a confidence interval (0.34-
۲۲٦ 0.64) and the effectiveness of the second dose is higher than the first dose in general.

۲۲۷ Table 3: frequency distribution based on the type of vaccine received

Vaccine Dose	Groups	Positive	Negative	Relative Risk (95% CI)	Effectiveness (95% CI)	P_Value

		positive	Negative	Relative Risk	effectiveness	P_Value
First Dose	Vaccinated	13	1064	0.39 (0.28_0.55)	0.25 (-0.65_0.65)	0.45
	Control	12	1326			
Second Dose	Vaccinated	42	1035	1.34 (0.64_2.93)	0.60 (0.44_0.71)	<0.001
	Control	131	1207			
Total	Vaccinated	55	1022	0.48 (0.35_0.65)	0.51 (0.34_0.64)	<0.001
	control	141	1197			

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229 Table 4 shows the effectiveness of vaccines in preventing hospitalization due to the covid-19
230 disease according to male and female gender. The effectiveness of the vaccine in preventing
231 hospitalization is higher in males than in females. The effectiveness in men is 0.61 with a
232 confidence interval (0.32-0.85) and 0.30 in women. The effectiveness of the vaccine in
233 preventing hospitalization in both sexes is low and 0.26.
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235 Table 4: Effectiveness of vaccines in preventing hospitalization due to covid-19 disease
236 according to male and female gender
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Sex	vaccine	positive	Negative	Relative Risk	effectiveness	P_Value
Male	Vaccinated	5	492	0.38 (0.149_1.05)	0.61 (0.32_0.85)	0.05
	Control	19	714			
Female	Vaccinated	11	569	1.43 (0.58_3.54)	0.30 (-0.70_0.71)	0.43
	Control	8	597			
Total	Vaccinated	16	1061	0.73 (0.39_1.35)	0.26 (-0.35_0.60)	0.32
	Control	27	1311			

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239 Table 5 shows the effectiveness of the vaccine in preventing the infection of Covid-19 by age
240 groups. In this table, the overall effectiveness in all vaccine cases is 0.81% in the age group over
241 51 years with a confidence interval (0.93-0.43) and the relative risk in the age group under 30
242 years is higher than all age groups. They have the lowest effectiveness.
243

244 Table 5: Effectiveness of covid-19 vaccines in preventing infection by age groups
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Age group	Groups	positive	Negative	Relative Risk	effectiveness	P_Value
Under 30 years	Vaccinated	16	345	0.84 (0.46_1.43)	0.15 (-0.66_0.56)	0.63
	Control	16	290			
31_40 years	Vaccinated	18	312	0.59 (0.35_1.00)	0.40 (-0.008_0.60)	0.46
	Control	55	548			
41_50 years	Vaccinated	17	244	0.40 (0.24_0.67)	0.59 (-0.33_0.75)	<0.001
	Control	60	311			
	Vaccinated	4	121	0.18	0.81	<0.001

Over 51 years old	Control	10	48	(0.06_0.56)	(0.43_0.93)

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4. Discussion:

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In addition to proving the effectiveness of the vaccine in clinical trials, demonstrating the
effectiveness of the vaccine in real-world environments plays an essential role in strategic
planning and control of infectious diseases in society. In this study, the effectiveness of
different covid-19 vaccines among the health workers of Mahabad city as a group who had
received the vaccine was investigated with the employees of other departments who did not
receive the vaccine in a 19-week follow-up period.

The most vaccine recipients were related to Sputnik vaccine made in Russia with 413 people
and the least 125 people were related to India's Bharat vaccine, the reason for this can be due
to the conditions of embargo and importation of vaccines from different countries and
distribution restrictions. The health workers of the whole country did not enter the country
anymore, and Sinopharm and AstraZeneca vaccines and vaccines made by Iranian scientists
such as Co Iran Barkat, Spycogen, etc. were used.

The frequency distribution of covid-19 disease and gender relationship showed that the rate
of covid-19 infection and hospitalization in men is more than women (<2.6). Also, the
percentage of people who had an underlying disease is more affected by covid-19 compared
to other people. The effectiveness of the vaccine based on the level of exposure in general
showed that level one exposure was the most effective and level three was the least effective.
The effectiveness of AstraZeneca, Sputnik, and Sinopharm-Bharat vaccines in preventing
covid-19 disease after receiving two doses of the vaccine is 0.81, 0.41 and 0.10%,
respectively, which indicates the high effectiveness of AstraZeneca vaccine and the
effectiveness of Sputnik vaccine. In preventing the disease in those who have injected the
vaccine, the half of the AstraZeneca vaccine is 0.41% and the effectiveness of the Sinopharm
and Bharat vaccines is low. Also, checking the effectiveness of the vaccine in preventing
hospitalization in both sexes after receiving both doses in AstraZeneca, Sputnik and
Sinopharm-Bharat vaccines is 0.79%, 0.29% and 0.44% respectively, and here the
effectiveness of AstraZeneca vaccine is high. have been.The effectiveness of AstraZeneca,
Sputnik, Sinopharm-Bharat vaccines in preventing the disease after receiving both doses is
higher in males than in females. The effectiveness of AstraZeneca and Sputnik vaccines in
preventing hospitalization after receiving both doses is greater in males than in females; But
in Sinopharm-Bharat, it is more in women. The study of Lee and his colleagues in
Guangzhou, China, in the investigation of the effectiveness of the Sinopharm vaccine,
showed that the effectiveness is more in women than in men (17).

In the current study, the effectiveness of Sputnik vaccine in preventing covid-19 disease is
0.41 and in preventing hospitalization is 0.29. Gunzans et al showed that the effectiveness of
Sputnik vaccine for the prevention of Covid-19 is 78.9, for the prevention of hospitalization
is 87.6, and for the prevention of mortality is 84.7 (13). Alirezamirahmad and his colleagues
at Shiraz University of Medical Sciences showed the effectiveness of the Sputnik vaccine in
preventing the infection of the Covid-19 disease by 74.8 and in preventing hospitalization by

67.5 (6). The study of Abtin Heydarzadeh and his colleagues stated the maximum effectiveness of the Sputnik vaccine in preventing hospitalization of 0.93 (18).

Examining the effectiveness of vaccines by age groups in preventing disease in the general state after receiving both doses, it is the highest and 81% in the age group above 51 years and the lowest is 15% in the age group below 30 years. The results of the investigation of the effectiveness of the vaccine in the prevention of infection by the type of vaccine in different age subgroups after receiving both doses showed that the AstraZeneca vaccine in the age group of 41-50 years, Sputnik and Sinopharm-Bharat in the age group over 51 years are the most effective. Have had .The lowest effectiveness in AstraZeneca vaccine is in the age group of 31-40 years, but in Sputnik and Sinopharm-Bharat in the age group below 30 years. In the study of Mirahmadizad (6) and his colleagues in the study of the effectiveness of different vaccines for Covid-19 in Shiraz University of Medical Sciences, it was shown that a large decrease in the attenuation rate (95%) was observed in all age groups except 18 to 44 and 64 and above. Examining the effectiveness by different levels of exposure in general in both genders showed that we had the most effectiveness in preventing infection at exposure level 1 and in preventing hospitalization at exposure level 2.

A study was conducted in France on the effectiveness of the vaccines used in that country (Pfizer, AstraZeneca, etc.) versus hospitalization. In their study, the effectiveness of AstraZeneca reached more than 90% after two doses (19).A Canadian study on the effectiveness of vaccines used in that country (Pfizer, AstraZeneca, etc.) against symptomatic covid-19 disease and severe disease outcomes (hospitalization and death) showed a high efficacy (91%) after the first dose. AstraZeneca exists against it. In French and Canadian studies, the effectiveness of the AstraZeneca vaccine in preventing infection and hospitalization is high (9). In a study conducted in Shiraz (Iran) on the effectiveness of vaccines used in preventing infection, hospitalization and death, the results of this study showed that two doses of Sinopharm, AstraZeneca, Sputnik V and CO_ Iran Barkat are effective in reducing hospitalization. AstraZeneca's results were similar to our study, but Sputnik's results were higher than our findings.Also, the effectiveness obtained for the Sinopharm vaccine in our study is not consistent with the Shiraz University study, which may be due to the small size of our sample and the use of health workers as the vaccinated group, who are a high-risk group compared to the general population. In the study of Shiraz University, a large amount of general population was studied (6).In the study of Gilan University (18), which investigated the effectiveness of the vaccine on temporary and permanent hospitalization and death on hospitalized patients, the results of the study showed that the maximum effectiveness of the Sinopharm vaccine in preventing temporary hospitalization was 95%, permanent hospitalization was 85%, and death. 56%, the maximum effectiveness of the AstraZeneca vaccine in preventing hospitalization was 98% and 92% death, and the maximum effectiveness of the Co_ Iran Barkat vaccine in preventing hospitalization was 95% and 89%, the results of the study on the AstraZeneca vaccine are similar to our study; But the results of Sinopharm vaccine are different and more than our study.In the conditions of vaccine shortage for our country, which is related to many factors (i.e. delay in supply, sanctions), this study and two other studies (Shiraz and Gilan University of Medical Sciences) have shown that the implementation of an extensive vaccination

٣٣٠ program even for vaccines such as Sputnik V and Bharat For which there is limited
٣٣١ information on their effectiveness and impact, they have a significant impact on reducing
٣٣٢ covid-19 disease and on covid-19-related hospital admissions and deaths. Another study in
٣٣٣ the biggest hospital in West Azarbaijan province showed that the side effect of Sputnik
٣٣٤ vaccine was not persistent (20). This information is relevant to health and encourages health
٣٣٥ authorities to quickly achieve a critical mass of vaccinated population to control the disease
٣٣٦ across the country. Differences in population characteristics, study design, study timeline,
٣٣٧ type of vaccines, and effectiveness calculation method, as well as the presence of
٣٣٨ effectiveness adjustment, health system capacities, etc., can strongly affect studies.Hence,
٣٣٩ efficacy values should be interpreted subjectively.

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٣٤١ **Authors' Contribution**

٣٤٢ Study concept and design: M H ,Sh S & N P. Gathering and coding the data: N P.
٣٤٣ Analysis and interpretation of data: M H ,Sh S & N P. Drafting
٣٤٤ of the manuscript: N P & M H. Revision of the manuscript: N P & M H
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٣٤٦ **Ethics**
٣٤٧ The study was conducted after receiving approval from
٣٤٨ the Ethics Committee of Urmia University of Medical Sciences
٣٤٩ **Conflict of Interest**
٣٥٠ The authors declare that they have no conflict of interest.
٣٥١ **Funding**
٣٥٧ **Data Availability**
٣٥٨ The data that support the findings of this study are
٣٥٩ available on request from the corresponding author.
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٣٦٢ # 5. References:
٣٦٣ 1.   Wu D, Wu T, Liu Q, Yang Z. The SARS-CoV-2 outbreak: What we know. Int J Infect
٣٦٤   Dis. 2020;94:44-8.
٣٦٥ 2.   Sohrabi C, Alsafi Z, O'neill N, Khan M, Kerwan A, Al-Jabir A, et al. World Health
٣٦٦   Organization declares global emergency: A review of the 2019 novel coronavirus
٣٦٧   (COVID-19). Int J Surg. 2020;76:71-6.
٣٦٨ 3.   Maghded HS, Ghafoor KZ, Sadiq AS, Curran K, Rawat DB, Rabie K, editors. A novel
٣٦٩   AI-enabled framework to diagnose coronavirus COVID-19 using smartphone
٣٧٠   embedded sensors: design study.IRI. 2020 Aug 11 (pp. 180-187). IEEE.

٣٧١
٣٧٢
٣٧٣
4. Farahani AJ, Fallah SA, Khashei Z, Heidarzadeh F, Sadeghi F, Masoudi P, et al. Available effective vaccines in preventing COVID-19: a narrative review. J Marine Med. 2021;3:153-62.

٣٧٤
٣٧٥
5. Gao Q, Bao L, Mao H, Wang L, Xu K, Yang M, et al. Development of an inactivated vaccine candidate for SARS-CoV-2. Science. 2020;369(6499):77-81.

٣٧٦
٣٧٧
٣٧٨
٣٧٩
6. Mirahmadizadeh A, Heiran A, Bagheri Lankarani K, Serati M, Habibi M, Eilami O, et al., editors. Effectiveness of coronavirus disease 2019 vaccines in preventing infection, hospital admission, and death: a historical cohort study using Iranian registration data during vaccination program. OFID; 2022: Oxford University Press US.

٣٨٠
٣٨١
7. WHO Coronavirus (COVID-19) Dashboard. [cited 2023 Feb 19]. Available from:https:..covid19.who.int..

٣٨٢
٣٨٣
8. Jara A, Undurraga EA, González C, Paredes F, Fontecilla T, Jara G, et al. Effectiveness of an inactivated SARS-CoV-2 vaccine in Chile. N Engl J Med. 2021;385(10):875-84.

٣٨٤
٣٨٥
٣٨٦
9. Nasreen S, Chung H, He S, Brown KA, Gubbay JB, Buchan SA, et al. Effectiveness of COVID-19 vaccines against symptomatic SARS-CoV-2 infection and severe outcomes with variants of concern in Ontario. Nat Microbiol. 2022;7(3):379-85.

٣٨٧
٣٨٨
٣٨٩
10. Ittefaq M, Baines A, Abwao M, Shah SFA, Ramzan T. Does Pakistan still have polio cases?: Exploring discussions on polio and polio vaccine in online news comments in Pakistan. Vaccine. 2021;39(3):480-6.

٣٩٠
٣٩١
٣٩٢
11. Wong L, Wong P, AbuBakar S. Vaccine hesitancy and the resurgence of vaccine preventable diseases: the way forward for Malaysia, a Southeast Asian country. Hum Vaccin Immunother. 2020;16(7):1511-20.

٣٩٣
٣٩٤
٣٩٥
٣٩٦
12. Oliver SE, Gargano JW, Marin M, Wallace M, Curran KG, Chamberland M, et al. The advisory committee on immunization practices' interim recommendation for use of Pfizer-BioNTech COVID-19 vaccine—United States, December 2020. MMWR. 2020;69(50):1922.

٣٩٧
٣٩٨
13. Wu D, Wu T, Liu Q, Yang Z. The SARS-CoV-2 outbreak: What we know. Int J Infect Dis. 2020;94:44-8.

٣٩٩
٤٠٠
٤٠١
٤٠٢
٤٠٣
14. Mirahmadizadeh A, Heiran A, Bagheri Lankarani K, Serati M, Habibi M, Eilami O, et al., editors. Effectiveness of coronavirus disease 2019 vaccines in preventing infection, hospital admission, and death: a historical cohort study using Iranian registration data during vaccination program. OFID; 2022: Oxford University Press US.

٤٠٤
٤٠٥
٤٠٦
٤٠٧
15. Silva-Valencia J, Soto-Becerra P, Escobar-Agreda S, Fernandez-Navarro M, Moscoso-Porras M, Solari L, et al. Effectiveness of the BBIBP-CorV vaccine in preventing infection and death in health care workers in Peru 2021. Travel Med Infect Dis. 2023;53:102565.

٤٠٨
٤٠٩
٤١٠
٤١١
16. Li XN, Huang Y, Wang W, Jing QL, Zhang CH, Qin PZ, et al. Effectiveness of inactivated SARS-CoV-2 vaccines against the Delta variant infection in Guangzhou: a test-negative case-control real-world study. Emerg Microbes Infect. 2021;10(1):1751-9.

٤١٢   17.   González S, Olszevicki S, Salazar M, Calabria A, Regairaz L, Marín L, et al.
٤١٣   Effectiveness of the first component of Gam-COVID-Vac (Sputnik V) on reduction
٤١٤   of SARS-CoV-2 confirmed infections, hospitalisations and mortality in patients aged
٤١٥   60-79: a retrospective cohort study in Argentina. EClinicalMedicine.
٤١٦   2021;40:101126.
٤١٧   18.   Heidarzadeh A, Moridani MA, Khoshmanesh S, Kazemi S, Hajiaghabozorgi M,
٤١٨   Karami M. Effectiveness of COVID-19 vaccines on hospitalization and death in
٤١٩   Guilan, Iran: a test-negative case-control study. IJID. 2023;128:212-22.
٤٢٠   19.   Nguyen LBL, Bauer R, Lesieur Z, Galtier F, Duval X, Vanhems P, et al. Vaccine
٤٢١   effectiveness against COVID-19 hospitalization in adults in France: A test negative
٤٢٢   case control study. Infect Dis. 2022;52(1):40-3.
٤٢٣   20.   Varghaei A, Heidari M, Daneshyar C, Nouri A, Mikaeilvand A. Side Effects of
٤٢٤   Sputnik V Vaccine in the Medical Staff of Dedicated COVID-19 Hospital. Iranian
٤٢٥   Journal of Medical Sciences. 2023 Apr 24.

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