ORIGINAL

Immune response evaluation after Sputnik V vaccination in Sari healthcare population

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Abstract : Background and objective : Generally, protection against SARS-CoV-2 was assessed by the measurement of antibody titers against spike protein and receptor binding domain "RBD". Many global efforts lead to development of several vaccines based on various strategies. The aim of the present study was to evaluate the efficacy of Sputnik V vaccine among Sari healthcare staff population, Iran. Methods : Seventy-nine health professional staffs that were vaccinated with two doses of Sputnik V vaccine were selected. The Immune response against spike and RBD proteins was evaluated by ELISA assays 3-4 weeks after second dose of vaccine injection. Results : The results showed the antibody titers were raised after vaccination. Data analysis has also demonstrated that the efficacy of vaccine was not related to age, gender and previous infection of SARS-CoV-2. Conclusion : Sputnik V vaccine can lead to a protective response against COVID-19 infection in high percentage of the population. J. Med. Invest. 70 : 317-320, August, 2023

INTRODUCTION

The Severe Acute Respiratory Syndrome Coronavirus 2 "SARS-CoV-2" has been recently caused a human pandemic of coronavirus disease since 2019 "COVID-19" (1). Although most infected patients showed mild symptoms, around 10% had severe symptoms including dyspnea, high respiratory rate, and low blood oxygen saturation which can even lead to death because of respiratory or multiple organs failure (2). There is currently no specific treatment for the disease and thus the patients are treated with supportive care (1).

Among the coronaviruses structural proteins, the Spike (S) and the Nucleocapsid (N) proteins have been introduced as the main immunogens (3-5). Similar to other coronaviruses, the entrance of SARS-CoV-2 into host cells is mediated by the transmembrane spike (S) glycoprotein that forms prominent homotrimers protruding from the viral surface (4). The S protein is comprised of one : an S1 subunit, recognizes host cell receptors (and is divided into A, B, C, and D domains), and two : an S2 subunit that promotes fusion of the viral and cellular membranes to initiate the infection. The SARS-CoV-2 S domain B (so-called receptor-binding domain or RBD) binds to angiotensin-converting enzyme 2 (ACE2) that serves as an entry receptor. The molecular mechanism of RDB attachment to ACE2 have been recently unveiled and it is the main target of neutralizing Abs (nAbs) applied in therapeutic and vaccine design efforts (5). Commercial SARS-CoV-2 serological assays that detect antibodies specific to these viral proteins/domains have become now commercially available. Up to now, several vaccines have been introduced using various technologies such as mRNA, recombinant protein, adenoviral vector, and inactivated virus-based platforms but there is little evidence to determine what proportion of patients produce antibodies after vaccination and how long they can protect the recipients against a new infection. Therefore, the goal of the present was to evaluate the response of anti-Spike, anti-RBD, and Neutralizing antibodies after Sputnik V vaccination in Sari healthcare staffs population, Iran.

MATERIAL & METHODS

Patients and Controls

In this study seventy-nine people (Healthcare staffs form Mazandaran University of Medical Sciences) (49 males) that were vaccinated with the Sputnik V vaccine were selected to include the study. The participant's age was between 22-75 years. All participants have no underlying disease such as diabetes mellitus, chronic kidney disease "CKD", cardiovascular disease "CVD", malignancy or a history of pulmonary involvement such as tuberculosis, chronic obstructive pulmonary disease "COPD" The serum samples were taken 3-4 weeks after second dose of vaccination.

Participants were divided into four subgroup according to age (> 50, < 50), gender (male, female), previous infection of COVID-19 (infected and non-infected), and severity of disease (mild[1], moderate[2], severe[3]). Analysis was done to find the relationship between vaccine efficacy and age, gender, previous infection of COVID-19 and severity of the disease.

Laboratory measurements

The anti-spike IgG and anti-RBD IgG enzyme link immune sorbent assays "ELISA" (14002-Pishtazteb) were carried out to assess the immune response and the Neutralization test was performed by competitive ELISA (14002-Pishtazteb).

[1]PCR positive without typical symptom
[2]PCR positive with taking medicine
[3]PCR positive with hospitalization

Statistical analysis

Data was analyzed using unpaired T and Mann-Whitney U tests. A two-sided p value of <0.05 was regarded as statistically significant.

RESULT

Seventy-nine healthcare staffs that received the two dose of the Sputnik V COVID-19 vaccine were selected. The median age of the participants was 51 years that 44.3% of them over 50 years old. 62% of the precipitants were males. 24% of participant had previous experience of SARS-CoV-2 infection that according to the severity of the disease were divided into 3 groups, 10.1% mild, 6.3% moderate, and 7.6% severe (Table 1). The mean Ab titers against spike and RBD were significantly high. These results demonstrated that the Sputnik V vaccine leads to a protective immunity against SARS-CoV-2.

The results of neutralizing antibody showed that administration of the Sputnik V vaccine caused production of neutralizing antibody in 88.6% of the participants. (Fig 1b, 2b, 3b, 3d). So neutralizing results in plasma from vaccinated individuals demonstrated that anti-RBD SARS-CoV-2 efficiently prohibited binding of the ACE2.

The anti-spike and anti-RBD levels were not significantly different between male and female participants. Moreover this significant difference was not also observed between cases with less and above 50 years old (Fig1, 2).

Likewise, the results showed that there is no correlation between previous history of disease and even severity of infection to SARS-CoV-2 with immune response after vaccination. (Fig 3)

Table 1. demographic parameters of participants receiving Sputnik V vaccine

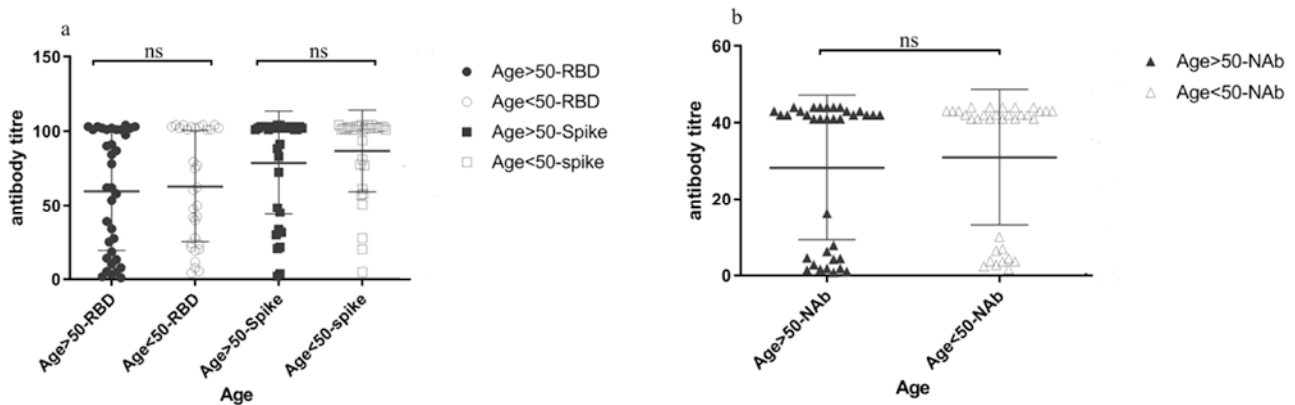| Characteristic	n	%
Age		
> 50	39	49.4
< 50	40	50.6
Gender		
Male	49	62.5
Female	30	37.5
History of COVID-19 infection		
Uninfected	60	76
Infected	19	24
· Mild	8	10
· Moderate	5	6.3
· Severe	6	7.6

Figure 1. Humoral immune response in 79 healthcare staffs after (vaccination) receiving the sputnik V vaccine. a) anti-RBD, anti-spike titer in based on two age group, b) Nab based on two age group.
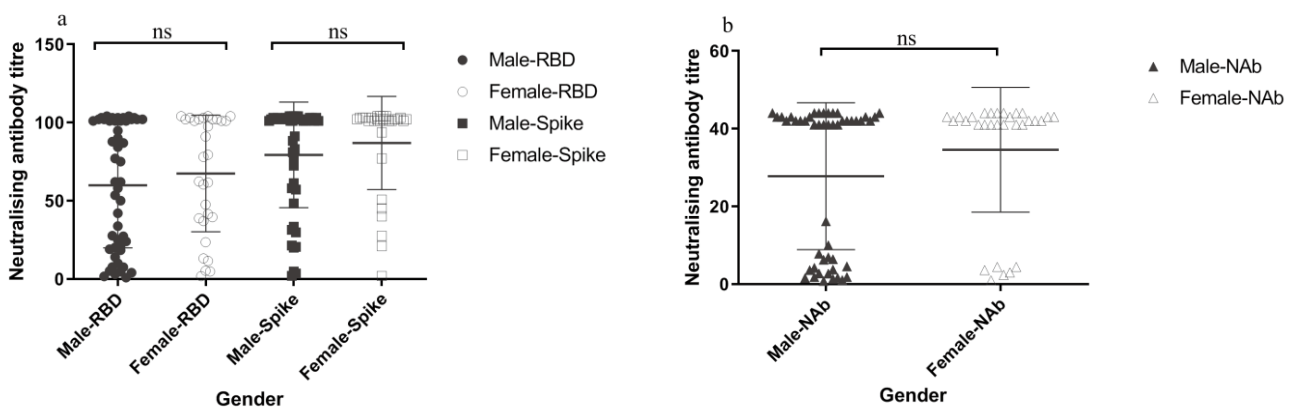

Figure 2. Humoral immune response in 79 healthcare staffs after receiving the sputnik V vaccine. a) anti-RBD, anti-spike in male and female, b) Nab in male and female.
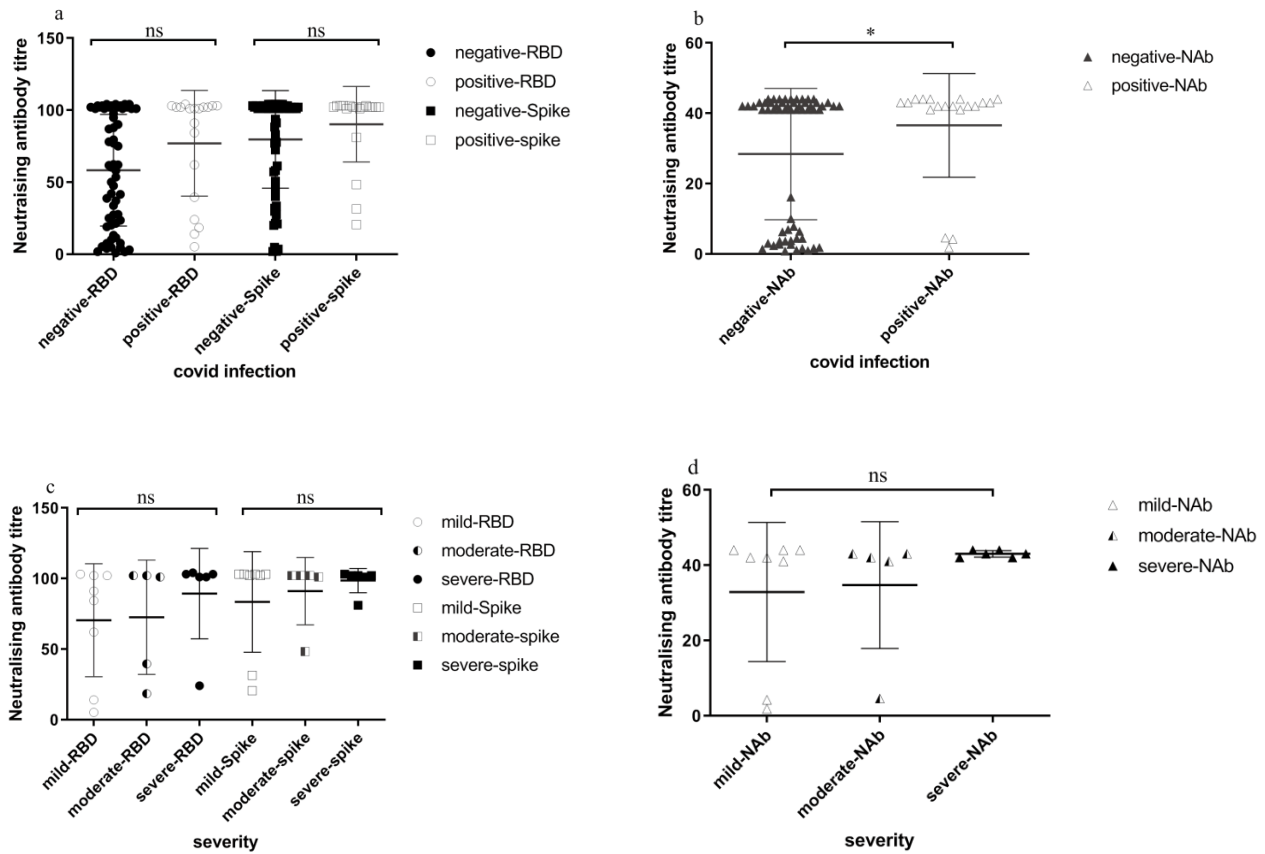
Figure 3.   Humoral immune response in 79 healthcare staffs after receiving the sputnik V vaccine. a) anti-RBD in anti-spike in infected and non-infected participants, b) Nab in infected and non-infected participants, c) anti-RBD, anti-spike in participants with previous infection of COVID-19 based on severity of disease, d) Nab in participants with previous infection of COVID-19 based on severity of disease.

DISCUSSION

Since the beginning of the COVID-19 pandemic, many attempts have been made to develop a vaccine to control the pandemic (6). Several vaccines with different platforms such as nucleic acid, viral-vectored vaccines and inactivated virus have been developed based on inhibition of viral cellular entry mechanism (7).

In order to choose appropriate vaccine, Evaluation of the efficacy of these vaccines in different populations is critical. Furthermore, studying the efficacy of vaccine can help researchers to identify the limitations of these current platforms such as reduction of vaccine effectiveness in elderly population, vaccine-associated side effects, and decrease of vaccines efficacy encountering new variants of coronavirus (8). Therefore, accelerating development of new comprehensive vaccine technology is necessary (9).

Due to insufficient information about immune response against COVID-19 after vaccination in different population with different genetics backgrounds around the world, several studies are required to provide definitive consequences.

Healthcare staffs are highly exposed to risk of the COVID-19 infection in comparison of other people. Additionally, they can be carriers of COVID-19. In this study we evaluated induced protective immune response results of the Sputnik V vaccine in healthcare staffs of Sari, Iran.

The present study may indicate the efficacy of the vaccine based on measurements of antibody against spike and RBD.

One of the most important concerns about vaccine efficacy is reducing the effectiveness of vaccines among the old individuals. Several studies have demonstrated that the vaccine efficacy is associated with age (7). In this study, antibody response was evaluated in both groups of participants (< 50 and > 50 years old) and there were no significant differences between the groups.

The immune system and its orchestrated response is affected by a multitude of endogenous and exogenous factors (10). One of the most frequent differences described in the immune response is its vigor and activity in females compared to males. Our present knowledge on sex differences in the immune response are mainly included the hormonal and genetic effects that have been proposed as explanatory mechanisms. Sexual hormones, mostly estrogen, and also progesterone and testosterone affect immune cells quantitatively and qualitatively. Relevant researches have indicated the impact of hormones on cytokine production by different effector cells, as well as their impact on immunoglobulin production by B lymphocytes and activity of granulocytes and NK cells. Importantly, these sex-based immunological differences contribute to variations in the incidence of autoimmune diseases, malignancies, susceptibility to infectious diseases, and responses to vaccines in males and females (10, 11). Unlike other studies, in the present study subgroup analysis by gender demonstrated that there were no statistical differences in immune responses toward COVID-19 between male and females. This may be due to the small sample size.

Although our study showed effectiveness of Sputnik V vaccine against COVID-19, there are several limitations in this research including lack of appropriative baseline, insufficient number of

participants, and uninvestigated antibody titer after first dose of vaccine injection. However, further studies with higher sample size are recommended to evaluate the efficiency of Sputnik V and other vaccines in different populations.

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