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(Review Article)

# Risk of Bell's Palsy after COVID-19 vaccination

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## Abstract

At the close of 2019, a global health crisis known as COVID-19, or coronavirus (2019-nCoV), broke out. Vaccination is used as a means of prevention. The COVID-19 vaccines may be categorized into four groups: viral vector, entire virus, subunit protein, and nucleic vaccines. Upon evaluating the advantages of vaccinations, it becomes evident that there are adverse side effects that may develop. Bell's palsy is regarded as a significant adverse reaction after immunization. This observational essay aims to consolidate knowledge about the SARS-CoV-2 infection and its association with the risk of Bell's palsy after COVID-19 vaccination.

**Keywords:** COVID-19; Bell's Palsy; Vaccination; Human and health

## 1. Introduction

Three years ago, the World Health Organization (WHO) received reports of pneumonia with an unexplained cause in Wuhan, China. The focal point of concern in China was identified as the SARS-CoV-2 virus, which is responsible for causing severe acute respiratory syndrome, as was proven in January 2020.

This virus has the potential to spread quickly and can be transmitted from one person to another. Several preventative measures have stopped its spread. Breaking the transmission cycle via early discovery, self-isolation, and vital protection is crucial. Vaccination against COVID-19 is one way to avoid it (1).

Vaccines save between two and three million deaths from infectious illnesses each year, proving that the benefits exceed the hazards (2). Due to the greater number of individuals exposed to the vaccine in the post-approval era compared to clinical trials, there are few responses to the vaccination, despite the fact that it often results in mild symptoms that are seldom reported (3)(4). Thus, in order to reduce the risk of harm, negative effects need to be recognized and addressed as soon as feasible (5). Bell's palsy is a neurological condition that can occur as a side effect of receiving the COVID-19 vaccination (6).

## 2. Discussion

### 2.1. Coronavirus Disease-2019

The current strain of coronavirus is responsible for the disease referred to as COVID-19, or Corona Virus Condition 2019. The first designation for this illness was the "2019 novel coronavirus," often referred to as "2019-nCoV." The abbreviation COVID-19 (7) is formed by combining the letters "CO" (coronavirus) and "D" (disease). The SARS-CoV-2 virus, along with other double-stranded RNA viruses, has this particular attribute. The lipid envelope that surrounds the approximately 30 kb-long genome contains membrane glycoproteins called S proteins (8) (9). The virus uses spike-

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like structures to bind to the receptor on the host cell and gain entry into it (9) (10)(11). The references used are Millet & Whittaker (2015), Walls et al. (2020), and Wang et al. (2020). The S protein governs the virus's ability to cause cancer. Besides the viral S protein, the SARS-CoV-2 virus has a membrane (M), envelope (E), and nucleocapsid (N) as well (8) (12).

SARS-CoV- 2 variations are categorised into two groups: variants of concern (VOCs) and variants of interest (VOIs). The VOCs include omicron (B.1.1.529), beta (B.1.351), alpha (B.1.1.7), gamma (P.1), mu (B.1.621), and delta (B.1.617.2). Some examples of Variants of Interest (VOIs) are the mu variant (B.1.621) and the lambda variant (C.37). Alagheband Bahrami et al. (2022) assert that these alterations assist the virus in evading certain immune reactions (13).

### 2.2. COVID-19 Vaccines

When a person receives a vaccine, they will develop active, specific immunity against certain illnesses because vaccines include antigens, which are chemicals that may trigger the body's immune system to manufacture antibodies as a type of resistance (14).

Vaccines are classified into four categories per Sharma et al.: nucleic, entire virus, protein subunit, and viral vector vaccines. Vaccines against viruses derived from several genera have been altered to function as vectors and subsequently interact with immune cells to aid in the recognition and evasion of dangerous viruses. Upon injection, the body's immune cells identify foreign antigens and initiate an immunological response, which involves the production of antibodies by B cells and the destruction of infected cells by T cells. There are two forms of whole viruses: inactivated and live. The genetic material of the virus is destroyed during inactivation by radiation, heat, and chemicals. In the meantime, the body employs a weaker version of the virus in the live-attenuated vaccination. Subunit of Protein Certain portions of virus-like pieces, antigens, protein segments, or polysaccharides—all of which are incapable of infecting the body—are used in vaccines. Vaccines containing nucleic acids transfer genetic material from viral antigens into host cells. The mRNA is translated into protein after being transcribed in the nucleus from the DNA vaccine and transported to the cytoplasm. Delivery of the mRNA to the host cell's cytoplasm is necessary for translation into the target protein (14).

### 2.3. Bell’s Palsy

The attribution of the discovery of Bell's palsy (BP) is credited to Sir Charles Bell, a Scottish anatomist. Zhang et al. (2020) found a strong association between acute mononeuropathy and paralysis, particularly affecting the facial nerve. Bell's palsy is defined as the rapid progression of peripheral paralysis of the seventh cranial nerve, affecting just one side of the face (15). According to one theory, vaccination antigens that mimic the body's own molecules or activate dormant T cells can trigger an autoimmune response that results in Bell's palsy (16). Bell's palsy constitutes the majority, ranging from sixty to seventy-five percent, of reported cases. It afflicts an annual population of seventy to ninety thousand individuals, including both males and females (17).

Empirical evidence from randomized clinical trials has shown the impact of COVID-19 immunization on the peripheral nervous system. Some of these adverse consequences include Bell's palsy, Guillain-Barré syndrome (GBS), and neuralgic amyotrophy. On the sixth day after the first administration, certain cranial neuropathies, such as facial palsy, were seen as a consequence of receiving the Pfizer-BioNTech COVID-19 vaccine.

The Oxford-AstraZeneca COVID-19 vaccine experiment identified six instances of facial nerve palsy. The vaccination group consisted of three participants (12,021 individuals), whereas the placebo group had three participants (11,724 individuals) (6).

### 2.4. Possible Mechanism Bell's Palsy After Covid-19 Vaccination

The COVID-19 vaccine is categorized into four distinct kinds of formulations: entire virus, nucleic acid, protein component, and viral vector. The whole virus may be classified into two types: live-attenuated and inactivated. The inactivated version is used to make the Sinovac and Sinopharm variants of the COVID-19 vaccine. The subunit protein is responsible for generating the Novovax iteration of the COVID-19 vaccine. The viral vector generates the AstraZeneca strain of the COVID-19 vaccine. Within nucleic acid, there exists a specific form of mRNA vaccination that generates two distinct COVID-19 vaccines, namely the Moderna and Pfizer varieties. The mRNA vaccine is formulated with lipids to make it easier for nanoparticle parts to get into the cytoplasm during endocytosis. Ribosomes play a crucial role in converting the mRNA into the spike protein of SARS-CoV-2, which is responsible for the virus's ability to infect host cells. This protein stimulates antigen-presenting cells to produce the major histocompatibility complex class II (MHC II).

Antigen-presenting cells stimulate the activation of T helper cells, namely those expressing the CD4+ marker. T-helper cells generate both Th-2 and Th-1 cells. Th-1 cells will initiate the release of tumor necrosis factor-alpha (TNFα) also interleukin-1 (IL-1). Th-2 cells will induce the production of interleukin-6 (IL-6), interleukin-1 (IL-1), and tumor necrosis factor-alpha (TNFα). All three factors will contribute to the elevation of cytokines, resulting in the rupture of the myelin sheath.

The N. facialis is a cranial nerve in the central nervous system (CNS) that has nerve roots extending into the internal acoustic meatus. A branch of the N. facialis gives nerves to the lacrimal gland and nasal glands. Another branch, the N. strapedius, gives nerves to the M. strapedius and branches on the chroma tympani. The N. auricularis posterior, on the other hand, gives nerves to the auricular and M. temporalis. Finally, there are five branches that end in facial muscles: the buccal, mandibular, temporal, zygomatic, and cervical. Compression of the facial nerve happens when there is swelling in the stylomastoid foramen. Bell's palsy occurs as a consequence of the pressure exerted on the facial nerve, leading to muscular weakness in the affected area.

In the group that received the mRNA vaccination, the chance of having Bell's Palsy was considerably higher than in the subgroup that received the saline placebo. Nevertheless, the observed disparity could have been more substantial within the virus-vector vaccination grouping. After analyzing observational studies, it was found that there was no significant difference in the likelihood of experiencing high blood pressure after receiving an mRNA vaccine for SARS-CoV-2 compared to those who did not receive the vaccine. Various mechanisms have been proposed to elucidate the fundamental pathophysiology of BP. There is speculation that vaccination antigens, which can activate T cells by imitating human cell surface molecules, can trigger an autoimmune response (18). SARS-CoV-2 vaccinations do not include adjuvants that can enhance the immune response. On the other hand, mRNA vaccines can attach to cell membranes, which are usually resistant and activate an immune response (19), that can lead to an increase in blood pressure similar to what has been seen in situations of interferon therapy (20) (21).

## 3. Conclusion

The conclusion is that someone who has been vaccinated against COVID-19 does have a risk of developing Bell's palsy. The types of vaccines that show the risk of getting this are the mRNA vaccine in the form of the Pfizer-BioNTech COVID-19 vaccine and the viral vector vaccine in the form of the Oxford-AstraZeneca COVID-19 vaccine.

## Compliance with ethical standards

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### *Disclosure of Conflict of interest*

We declare that there was no major conflict of this article.

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