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Effectiveness of Covid-19 Vaccine in Pregnant Women: A Systematic Review

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Abstract

The newly developed COVID-19 vaccine has raised public concerns over its efficacy and safety as an approach to end COVID-19 pandemic. COVID-19 vaccination is well-established as the most promising preventive measures against COVID-19 infection in both general and vulnerable populations. This study aims to evaluate the effectiveness of COVID-19 vaccine in pregnant women as a subgroup of vulnerable population by analysing several important immunological parameters in pregnant women. Specifically, it investigates how effective the COVID-19 vaccine reduced the infection rate and affected mothers' antibody levels against SARS-CoV-2. Immunological parameters studied in this review are maternal antibody response against SARS-CoV-2 and the transplacental antibody transfer. To test the hypothesis that COVID-19 vaccine is effective in pregnant women, a systematic review was conducted on previous studies regarding COVID-19 vaccine and its outcomes in pregnancy. Results were narratively analysed. The results showed reduced COVID-19 infection rate, elevated maternal antibody titre against SARS-CoV-2 and positive transplacental anti-SARS-CoV-2 IgG antibody transfer in vaccinated pregnant women in comparison to unvaccinated pregnant women. These results suggest that COVID-19 vaccine is highly effective against COVID-19 infection in pregnant women. Furthermore, COVID-19 vaccine not only elicits sufficient maternal antibody response as an immunity for mothers against COVID-19 infection but also provides similar protection for infants via passive immunity via transplacental antibody transfer. In conclusion, vaccination against COVID-19 in pregnant women should be strongly encouraged due to its favourable outcomes and protection against COVID-19 disease.

Keywords

Vaccine, COVID-19, SARS-CoV, pregnant woman, maternal antibody, transplacental antibody.

Introduction

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus, which causes respiratory illnesses known as coronavirus diseases (COVID-19), has been plaguing people all over the world [1]. SARS-CoV-2 infects humans by binding its spike (S) protein to ACE2 receptors, which are found on the surface of lung cells [2]. The first signs of inflammation appear as soon as SARS-CoV-2 enters the host. Initial immune

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response draws T cells specific to the virus to the infected areas, where the virus is eliminated to prevent the infection from spreading throughout the host. For most people, this results in recovery. On the other hand, patients who are experiencing severe disease trigger an aberrant host immune response.

Pregnant women typically experience an immune response against SARS-CoV-2 similar to that of healthy individuals, with a small variation that could have an impact on the unborn child. For instance, it has been noted in multiple studies that maternal IgG against SARS-CoV-2 is present in both symptomatic and asymptomatic COVID-19 infected mothers, and that this antibody is passed into the foetus through the placenta [3]. Pregnant women infected with COVID-19 have higher levels of cytokines interleukin-8 (IL-8), IL-10, and IL-15. These cytokines are linked to inflammation and could point to a highly active inflammatory mechanism. Previous study has demonstrated a correlation between the severity of the disease and the cytokine levels in pregnant COVID-19 infected women [4].

Prominent pharmaceutical companies successfully developed COVID-19 vaccines in response to the pandemic [5]. Among the top pharmaceutical giants working on COVID-19 vaccines are Oxford/AstraZeneca, Moderna Therapeutics, and Pfizer/BioNTech. The use of various vaccine platforms is one obvious way in which these vaccines differ from one another. AstraZeneca uses a chimpanzee adenovirus-vectored vaccine, while Pfizer and Moderna use developed mRNA vaccine technology [6].

The infectious agent, vaccine factors (vaccine type, adjuvant, administration schedule, and others), and host factors (age, sex, immunological history, and others) are among many factors that influence the effectiveness of a vaccines [7]. Vulnerable populations are strongly encouraged to get a vaccine because of their increased susceptibility to infection [8]. Vulnerable populations in the context of public health are demographic groups that are more prone to contracting a particular illness or health issues, in this case, COVID-19 infection. Children, expectant mothers, elderly, and immunocompromised individuals are all included in this category [9]. Thus, it is essential that the vaccination be both safe and effective.

There are increasing concerns regarding COVID-19 vaccination, mainly over public trust on its efficacy and safety. Additionally, among the first group to receive vaccinations, pregnant women and other vulnerable populations should be given special encouragement and priority [12]. The purpose of this review is to evaluate the effectiveness of vaccination in protecting vulnerable population from contracting COVID-19 disease. Furthermore, mounting data indicates that the COVID-19 vaccination is the most reliable and safe way to protect pregnant women and their unborn children from COVID-19 infection [13].

A systematic review conducted to assess the safety and efficacy of COVID-19 vaccines in pregnant women, focusing on immunological aspects such as infection rate, maternal antibody titre, and transplacental antibody transfer. This review aims to provide comprehensive evidence on the safety and effectiveness of vaccination as a scientifically proven method to combat COVID-19 infection.

Methods

Eligibility Criteria

Studies that were included in this systematic review met the following criteria: (1) use a case-control, case report or prospective cohort study design; (2) single studies that were published between March 2020 to March 2022; (3) study participants with the age range of 16 and above; (4) pregnant women as subjects; (5) the paper was written in English. Outcomes in this study included infection rate, transplacental antibody transfer and maternal antibody response. Studies encompassing review articles, irrelevant studies, non-human studies, and duplicates were excluded in this review.

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Search strategy and selection of literature

Comprehensive keyword searches were conducted on 11th April until 13th April 2022 to find articles published in databases (PubMed and ScienceDirect). This research is limited to studies involving humans reported in English. The following keywords were used: ''[effectiveness] AND [SARS-CoV-2) OR (Covid-19)] AND [(pregnant) OR (pregnancy)] AND [(vaccine) OR (vaccination)]". All studies retrieved from the electronic searches were exported into Mendeley reference manager to remove duplicates and perform screening. Excluded studies were described in the PRISMA flowchart.

Data Extraction

From the selected studies, the following information was extracted: first authors' names, year of publication, country of origin, study design, sample size, gestational age at first vaccination, sample size, age, sample collection, vaccine type, and outcomes (infection rate, maternal antibody titre and placental antibody transfer ratio).

Statistical Analysis

Due to key differences found in the comparisons performed in each study along with various outcome measures, meta-analysis of the included studies could not be performed. Alternatively, evidence is narratively synthesized.

Results

Literature search results

Literature research through PubMed and ScienceDirect databases have gathered 902 articles. After removing duplicates (n=7), the remaining 895 articles underwent preliminary screening. Of these, 373 articles were included that corresponded to immunology study whereas 522 articles were excluded (review paper, animal studies, irrelevant vaccine, and non-pregnant population). After title-based and abstract screening, 20 articles were selected for eligibility screening. However, 12 out of 20 were excluded based on irrelevant immunological outcomes. Finally, 8 studies were included in this systematic review.

Synthesis of Results

The findings from all included studies were centred around the same group of exposure, namely pregnant women and outcome variables which are COVID-19 infection rate, maternal antibody response and transplacental antibody transfer. Where applicable, significant findings such as *p*-value were reported.

Study Characteristics

A total of 8 observational studies, consisting of 7 prospective cohort and 1 retrospective cohort studies were included in this systematic review that assessed the relationship between Covid-19 vaccine and immunological outcomes in pregnant women. The earliest study was published in 2021 whereas the latest study was published in March 2022. In terms of origin of the studies, 3 studies were conducted in the United States, 3 in Israel, and 1 each in Scotland and Taiwan. One prospective cohort study is applicable for two outcomes, namely, maternal antibody transfer and transplacental antibody transfer [15]. General characteristics of prospective cohort and retrospective cohort study are presented in Table 1-3.

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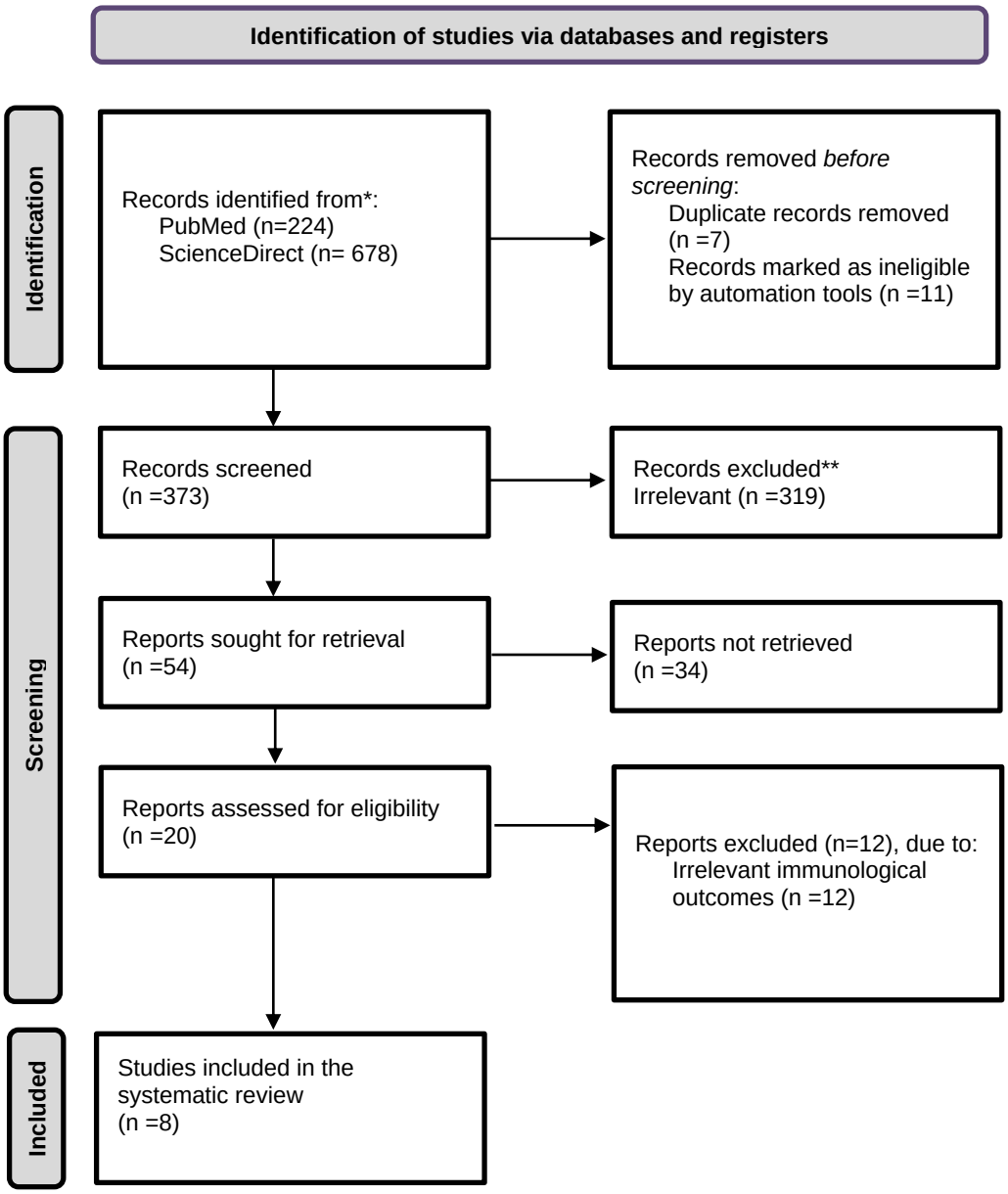

Figure 1: PRISMA flow diagram of literature selection process. The study selection process includes three main stages of identification, screening, and inclusion [14].

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Results of Individual Studies

Infection Rate

Three observational studies investigated the infection rate among vaccinated versus unvaccinated pregnant women (Table 4). In Theiler *et al,* 2021, there was significant reduction in the risk of future infection among vaccinated pregnant women (p=0.0004) [16]. In addition, vaccinated pregnant women who reported cases of infection during first trimester were infected prior to first vaccination. No significant reduction risk of infection observed within 10 days from vaccination (p=0.79), however, statistical significance of infection rate risk reduction was reached 11-27 days post-vaccination (p<0.001) and 28 days or more after vaccination (p<0.001) [17]. Hospital admission and critical care admission were significantly lower among vaccinated pregnant women, 5.1% and 0.2% respectively, in comparison to non-vaccinated pregnant women, 19.5% and 2.7% respectively [18].

Maternal Antibody Response

A study by Collier is the first study that evaluated COVID-19 antibody responses in both pregnant and non-pregnant women [15]. In pregnant women, the median RBD IgG titres in vaccinated and infected individuals were 27,601 and 1,321 respectively while the neutralizing antibody titres were 910 in vaccinated pregnant women and 148 in infected pregnant women [15]. In the non-pregnant population, the vaccinated individuals marked 37,839 for the median regional binding domain (RBD) immunoglobulin G (IgG) titres whereas infected individuals recorded 771. There was also a significance difference in the neutralizing antibody titres between vaccinated and infected non-pregnant populations which are 901 and 193, respectively (Table 5).

A study by Beharier et al., (2021) reported that IgG responses against S1, S2, RBD were elicited upon vaccination but not nucleocapsid protein [19]. However, IgG responses against all these proteins, S1, S2, RBD and N protein, were observed in the infected pregnant population. In their research, S1 IgG and RBD IgG levels seen in vaccinated pregnant women were relatively higher (p=0.0009 and p=0.0045, respectively) compared to PCR-positive pregnant women. In contrast, S2 IgG and N IgG were elevated in infected pregnant women (p=0.0016 and p<0.0001, respectively) in comparison to vaccinated pregnant women [19].

With regard to COVID-19 vaccine doses, Rottenstreich and colleagues showed that pregnant women who received two doses of COVID-19 vaccine had higher levels of anti-spike-protein IgG and anti-RBD-specific IgG antibodies in comparison to two women who only received one dose of COVID-19 vaccine [20]. The median concentration of anti-spike-protein IgG in two-dose group and two one-dose pair was 319 AU/mL whereas in one-dose pair was 50 and 52 AU/mL. As for the median anti-RBD-specific IgG concentration, the two-dose group was 11,150 AU/mL whereas the one-dose pair was 293 and 1, 137 AU/mL [20].

Transplacental Antibody Transfer

Three observational studies investigated transplacental antibody transfer. In the same study conducted by Collier et al. (2021) describes two types of antibodies were observed in cord blood which were antibody against SARS-CoV-2 RBD and neutralizing antibody [15]. The maternal blood RBD IgG level was 14953 AU while cord blood RBD IgG level was 19873 AU in vaccinated pregnant women. As for neutralizing antibody levels, maternal blood and cord blood recorded 1016 AU and 324 AU respectively. These levels in vaccinated pregnant women are notably higher than unvaccinated, infected maternal and infant which were 1 342 AU and 635 AU respectively for median RBD IgG titres. For neutralizing antibody levels in unvaccinated, infected pregnant women, the median antibody titres for maternal and cord blood were 151 AU and 164 AU respectively [15].

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Otero et al. (2022) observed majority of pregnant women (92%) recorded positive maternal IgG following vaccination with median of 16.54 AU/mL followed by positive infant IgG in 89% of infants born to vaccinated pregnant women with median infant IgG of 17.38 AU/mL [21]. In this study, maternal IgG levels of vaccinated pregnant women were relatively higher than unvaccinated pregnant women with SARS-CoV-2 infection, 16.54 AU/mL and 1.66 AU/mL respectively. This trend is also reflected on infant IgG in which infant IgG levels in the vaccinated population were also higher compared to those with natural infection, 17.6 AU/mL and 1.29 AU/mL respectively. Furthermore, vaccinated pregnant women also showed slightly higher IgM levels compared to those of natural infection, IgM 1.21 AU/mL and IgM 0.56 AU/mL, respectively. However, there is no difference of IgM levels observed in infants of both vaccinated and natural infection groups, 0.15 AU/mL and 0.15 AU/mL respectively [21].

Table 1: Characteristics of included studies for infection rate outcome.

Reference, study design & country of origin	Gestational age at first vaccine & Sample collection	Sample size of Pregnant Women		Age, *y* Mean ± SD or Median (IQR) (Pregnant Women)		Vaccine type
		Vaccinated (N)	Not Vaccinated (N)	Vaccinated (N)	Not Vaccinated (N)	
Theiler 2021[16] Cohort USA	-32 weeks (Median /IQR 13.9-40.6 weeks) -Electronic medical record from Mayo Clinic	140	1652	31.8 years	30 years	Pfizer-BioNTech and Moderna
Goldshtein 2021[17] Retrospective Cohort Israel	-NR - The Maccabi Healthcare Services database	7 530	7 530	31.1±5.01 years	31.5±4.85 years	Pfizer-BioNTech
Stock 2022[18] Cohort Scotland	-2+0 weeks -COVID-19 in Pregnancy in Scotland (COPS) database	18 399	126 149	31 years	31 years	Pfizer-BioNTech, Moderna and Oxford-AstraZeneca

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Table 2: Characteristics of included studies for maternal antibody response outcome.

Reference, study design & country of origin	Gestational age at first vaccine & sample collection	Sample size of Pregnant Women		Age, *y* Mean ± SD or Median (IQR) (Pregnant Women)		Vaccine type
		Vaccinated (N)	Not Vaccinated (N)	Vaccinated (N)	Not Vaccinated (N)	
Collier 2021[15] Cohort study USA	< 14 weeks: 5 14-28 week: 15 ≥ 28 weeks: 10 - SARS-CoV-2 RBD in serum and milk were assessed by ELISA. Neutralizing antibody activity was assessed by Luciferase Assay System.	30	22	35 (32-36) years	31 (28-36) years	Pfizer-BioNTech and Moderna
Behariar 2021[19] Cohort study Israel	Mean 34.5 ±week 7.5ks - Maternal blood samples IgG and IgM titers were measured using Milliplex MAP SARS-CoV-2 Antigen Panel (for S1, S2, RBD and N).	92	66	31.7±5.8 years	31.6±5.8 years	Pfizer-BioNTech
Rottenstreich 2021[20] Cohort study Israel	33 days - Assessment of maternal antibody and cord blood antibody using chemiluminescent microparticle immunoassay (CMIA).	20	0	32 (28-37) years	NR	Pfizer-BioNTech

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Table 3: Characteristics of included studies for transplacental antibody transfer outcome.

Reference, study design & country of origin	Gestational age at first vaccine & sample collection	Sample size of Pregnant Women		Age, y Mean ± SD or Median (IQR) (Pregnant Women)		Vaccine type
		Vaccinated (N)	Not Vaccinated (N)	Vaccinated (N)	Not Vaccinated (N)	
Collier 2021[15] Cohort study USA	< 14 weeks: 5 14-28 week: 15 ≥ 28 weeks: 10 SARS-CoV-2 RBD in serum and milk (ELISA). Neutralizing antibody activity (Luciferase Assay System).	30	22	35 (32-36) years	31 (28-36) years	Pfizer-BioNTech and Moderna
Otero 2022[21] Cohort study USA	NR - SARS-CoV-2 IgM and IgG were measured in maternal and infant plasma using the SARS-CoV-2 IgG and IgM antibody test kit.	99	252	34.1 years	31.5 years	Pfizer-BioNTech and Moderna
Shen 2022[22] Cohort study Taiwan	28.45 (±2.64) weeks - Neutralizing antibody and S1 receptor binding domain (RBD) IgG antibody level in maternal and cord blood were measured.	29	0	33.21 (±3.89) IQR (35-31) years	0	Moderna

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Table 4: Infection rate outcomes of individual studies.

First author, year & country	Age range	Infection rate N (%)		*p* Value	Confounding Factors Adjusted
		Intervention	**Comparison**		
Theiler 2021[16] USA	16-55 years	**Vaccinated** None: 138 (99%) Trimester 1: 0 (0%) Trimester 2: 2 (1%) Trimester 3: 0 (0%)	**Non-vaccinated** None: 1652 (89%) Trimester 1: 26 (1%) Trimester 2: 84 (5%) Trimester 3: 100 (5%)	0.0004	- Age - Health status
		Vaccinated vs Non-vaccinated: 2 (1.4%) vs 210 (11.3%), p=0.0004			
Goldshtein 2021[17] Israel	≥ 18 years	**Vaccinated** Cumulative infection: 108 ≤10 days: 70 (0.93%) 11-27 days: 38 (0.51%) ≥28 days: 10 (0.21%)	**Non-vaccinated** Cumulative infection: 202 ≤ 10 days: 73 (0.97%) 11-27 days: 83 (1.12%) ≥28 days: 46 (0.96%)	0.79 <0.001 <0.001	-Age -Gestational age -Residential area -Population subgroup -Parity -Influenza immunization status
Stock 2022[18] Scotland	18-44 years	**Vaccinated** 550 (11.1%) Hospital admission: 28 (5.1%) Critical care admission: 1 (0.2%)	**Non-vaccinated** 3 833 (77.4%) Hospital admission: 745 (19.5%) Critical care admission: 102 (2.7%)		Age Clinical risk Demographic

In addition, one observational study evaluated the transplacental antibody transfer between two-dose group and one-dose group of vaccinated mothers [22]. Based on their observation, the median percentage of neutralizing antibodies inhibition against SARS-CoV-2 in maternal blood was significantly higher in mothers vaccinated with two doses in comparison to those vaccinated with one dose, 97.46% and 40.32% respectively. The same trend was also reflected on the neonatal sera in which the median percentage of neutralizing antibodies inhibition against SARS-CoV-2 in cord blood was significantly higher in two-dose vaccinated group compared to one-dose vaccinated group, 97.37% and 43.33% respectively (p=0.0031). The cord to maternal ratio of SARS-CoV-2 neutralizing antibodies was slightly higher in one-dose group compared to two-dose group, 1.07 and 0.99 respectively. This study also observed that every mother-neonatal pair in two-dose group vaccination was positive for SARS-CoV-2 S1 receptor binding domain (RBD) IgG antibodies with positive correlation between maternal sera and cord blood concentration (p<0.0001) [22].

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Table 5: Maternal SARS-CoV-2 antibody titre outcomes of individual studies.

First author, year & country	Maternal SARS-CoV-2 antibody titre		p Value	Confounding Factors Adjusted
	Intervention	Comparison		
Collier 2021[15] USA	Vaccinated RBD IgG (median): 27 601 AU Neutralizing AB (median): 910 AU	Non-vaccinated, infected RBD IgG (median): 1 321 AU Neutralizing AB (median): 148 AU		Age (28-36 years) Health status Race
Beharier 2021[19] Israel	Vaccinated vs. PCR-positive S1 IgG: Higher in vaccination RBD IgG: Higher in vaccination S2 IgG: Higher in PCR positive Nucleocapsid IgG: Higher in PCR positive		 p= 0.0009 p= 0.0045 p= 0.0016 p<0.0001	Age (≥ 18 years) Health status
Rottenstreich 2021[20] Israel	Two dose group Maternal anti-S IgG (median): 319 AU/mL Maternal anti RBD IgG (median): 11,150 AU/mL	One dose group Maternal anti-S IgG (2 women): 50 AU/mL & 52 AU/mL Maternal anti RBD IgG (2 women): 293 AU/mL & 1,137 AU/mL		Age (>18 years) Health status

Discussion

The systematic review aims to summarise the published epidemiological data from observational studies that investigate the outcomes of COVID-19 vaccine in pregnant women. To the best of knowledge, this is among the early systematic review that has gathered the evidence linked to the immunological outcomes. Immunological outcomes gathered in this review are COVID-19 infection rate, maternal antibody response and transplacental antibody transfer with vaccinated pregnant women. Vaccinated and unvaccinated pregnant women were assessed as the exposure variables whereas COVID-19 infection rate, maternal antibody titer and transplacental antibody transfer as the outcome variables. In this review, it is found that COVID-19 vaccine is significantly associated with the immunological outcomes of pregnant mothers. COVID-19 vaccine significantly reduces the COVID-19 infection rate among pregnant women. Furthermore, there is a positive association between COVID-19 vaccine, maternal antibody response and transplacental antibody transfer.

The studies included in this systematic review were retrieved according to PRISMA guidelines. PRISMA statement provides help to authors, journal peer reviewers and editors in reporting a wide array of systematic reviews in order to assess the benefits and harms of a particular healthcare intervention. PRISMA paves the way for authors to ensure utter transparency and complete reporting of systematic reviews and meta-analyses [23]. Furthermore, PRISMA emphasises the reporting of reviews that evaluate

the effects of intervention that is used as a basis for reporting systematic reviews with different objectives such as evaluating etiology, prevalence, diagnosis or prognosis [14].

Among all 8 articles, 3 of them explained the COVID-19 infection rate among vaccinated and unvaccinated pregnant women with a slightly different approach. Another 3 articles discussed the maternal antibody response outcome. 2 articles reported on RBD-IgG levels against SARS-CoV-2 among vaccinated pregnant women and unvaccinated, naturally infected pregnant women whereas 1 article discussed the similar outcome among two-dose group and one-dose group of vaccinated pregnant women. 1 article that discussed maternal antibody response outcome also discussed the transplacental antibody transfer outcome [15]. Lastly, 3 articles studied on the transplacental antibody transfer with 2 of them discussed the outcome between vaccinated pregnant women and unvaccinated, naturally infected pregnant women whereas 1 article discussed the outcome among two-dose group and one-dose group. Collier et al (2021) and Otero et al (2022) findings reported on RBD-IgG levels against SARS-CoV-2 of mothers and infants in vaccinated and unvaccinated, infected population [15, 21] whereas Shen et al (2022) reported on the percentage of inhibition of maternal and infant neutralizing antibodies against SAR-CoV-2 in two-dose vaccinated pregnant women and one-dose vaccinated pregnant women [22].

The key differences among the articles included in this study for infection rate outcome is the approach of measuring COVID-19 infection rate in vaccinated pregnant women. Theiler et al. (2021) measured infection rate among pregnant mothers by evaluating the rate of infection as the pregnancy progressed, ranging from trimester 1, trimester 2 and trimester 3 [16]. Meanwhile, Goldshtein et al. (2021) approached the infection rate outcome by investigating the rate of COVID-19 infection from the day of vaccination, particularly, 10 days and less from vaccination, 11 to 27 days from vaccination and 28 days or more from vaccination [17]. On the other hand, Stock et al., (2022) evaluated COVID-19 infection rate of pregnant mothers through hospital admission and critical care which relatively indicated the severity of the COVID-19 infection [18].

COVID-19 vaccination has been protective against maternal COVID-19 infection throughout pregnancy without any adverse outcomes to the mothers nor adverse birth outcomes [16]. According to the Australian Government Department of Health, the first dose of COVID-19 vaccine may provide partial protection against COVID-19 as soon as 12 days post-vaccination, however, this protection may be short-lived [24]. In contrast, stronger protection (immunity) against COVID-19 may be elicited 7-14 days after the final vaccine dose which aligns with the Goldshtein et al. (2021) findings in which the infection rate significantly reduced 11 days after vaccination [17]. Apart from that, COVID-19 vaccine has proven to prevent severe infection in pregnant women which corresponds to Stock et al. (2022) study that showed lower hospital admission in vaccinated population [18]. When individuals receive the COVID-19 vaccine, their immune response is heightened, leading to a higher level of protection against COVID-19 infection. This protection helps to limit the progression of the disease, resulting in milder or less severe infections that do not require hospitalization [25]. The first dose of the vaccine may provide some level of protection as early as 12 days after vaccination. However, it is important to note that this initial protection may not be long-lasting. Therefore, it is crucial to complete the full course of vaccination to ensure the best possible protection against COVID-19 [26,27].

Based on the current findings, there is multiple evidence that point to the effectiveness of COVID-19 vaccine on maternal antibody response. Development of maternal antibody response against SARS-CoV-2 is reported following vaccination, hence, proving the expected immunological outcome of vaccination. Notable difference of maternal antibody responses between vaccination and natural infection lies on the

rate of antibody response development. Rapid development of antibody response is seen in the vaccinated population whereas gradual development is seen in the naturally infected population [19].

According to the Centers for Disease Control and Prevention (CDC), there is a strong correlation between the increased concentration of anti-SARS-CoV-2-RBD specific IgG in maternal blood following vaccination and increased neutralizing antibody titers [28]. This indicates that the production of specific IgG antibodies in response to the vaccine is associated with higher levels of neutralizing antibodies, which play a crucial role in preventing the advancement of COVID-19 and reducing the severity of the infection. Several studies have examined the relationship between anti-SARS-CoV-2-RBD IgG levels and neutralizing antibodies. For example, a study by Takheaw et al., 2022 found that there is a positive correlation between the levels of anti-RBD IgG and neutralizing antibodies in vaccinated individuals [29]. Similarly, another study demonstrated a correlation between high levels of anti-RBD IgG and neutralizing antibodies against different variants of SARS-CoV-2 [30]. These findings highlight the importance of measuring anti-SARS-CoV-2-RBD IgG levels as an indicator of the immune response to vaccination. The presence of antibodies suggests a robust humoral response and provides evidence of the vaccine's effectiveness in generating neutralizing antibodies. This information is valuable in assessing the protective immune response and the potential for preventing severe disease.

It is worth noting that the correlation between anti-SARS-CoV-2-RBD IgG levels and neutralizing antibodies may vary depending on factors such as the specific vaccine used, the timing of antibody measurement, and the individual's immune response [31]. Further study is needed to fully understand the relationship between these factors and the effectiveness of COVID-19 vaccines [32]. In summary, studies have shown a strong correlation between the concentration of anti-SARS-CoV-2-RBD specific IgG in maternal blood following vaccination and increased neutralizing antibody titers [31,32]. This indicates that the production of specific IgG antibodies in response to the vaccine is associated with higher levels of neutralizing antibodies, which play a crucial role in preventing the advancement of COVID-19 and reducing the severity of the infection.

According to studies, there is a positive and direct association between maternal IgG antibody against SARS-CoV-2 and infant IgG antibody post-vaccination. This indicates that COVID-19 vaccines elicit sufficient maternal antibodies against COVID-19, which can provide immune protection against SARS-CoV-2 for infants through passive immunity. Maternal immunoglobulin G (IgG) transfer across the placenta during pregnancy is facilitated by an active neonatal Fc receptor (FcRn). FcRn binds to maternal IgG in a pH-dependent process and transports IgG across placental tissue layers through transcytosis. Finally, FcRn releases bound IgG into the fetal blood circulation at physiological pH since antibodies are pH sensitive [32].

These findings highlight the importance of maternal vaccination in providing protective antibodies to infants. Maternal IgG antibodies generated following vaccination or natural infection could cross the placenta, thereby conferring the protective immunity to infants. Transplacental transfer of maternal antibodies plays a crucial role in protecting infants from SARS-CoV-2 infection and its associated complications [33].

In summary, the positive association between maternal IgG antibody against SARS-CoV-2 and infant IgG antibody post-vaccination demonstrates the effectiveness of COVID-19 vaccines in eliciting maternal antibodies. These antibodies can be transferred to infants through the placenta, providing them with passive immunity against SARS-CoV-2. The process of transplacental antibody transfer is mediated by FcRn, which facilitates the transport of maternal IgG across the placenta [34]. This knowledge underscores the importance of maternal vaccination in protecting both mother and infant from COVID-19 infection.

Conclusions

Based on current data, COVID-19 vaccines have been proven to be significantly effective in pregnant women. Studies have shown that COVID-19 vaccines reduce the infection rate among pregnant women and vaccinated pregnant mothers have recorded lower cases of COVID-19 compared to unvaccinated pregnant women. Furthermore, maternal antibody titre against SARS-CoV-2 is significantly higher in vaccinated pregnant mothers compared to naturally infected pregnant women. This indicates that COVID-19 vaccines elicit a stronger antibody response against SARS-CoV-2 compared to natural infection. This trend is also reflected in their babies, where fetal antibody titre against SARS-CoV-2 is significantly elevated and remains detectable at 6 months of age in those born to vaccinated mothers, proving positive transplacental antibody transfer. Consequently, more observational studies need to be carried out to draw a clearer conclusion supported by detailed epidemiological data.

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Conflict of Interest Disclosure

None to declare

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