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Vaccination in Pregnancy: A Systematic Review of Maternal and Neonatal Outcomes

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Introduction. Vaccination during pregnancy is one of the most effective preventive interventions in maternal healthcare. Immunization protects pregnant individuals against vaccine-preventable infections while providing passive immunity to newborns. Current international guidelines recommend routine maternal vaccination against influenza, tetanus-diphtheria-pertussis (Tdap), COVID-19, and respiratory syncytial virus (RSV) in appropriate settings. Nevertheless, vaccine uptake remains suboptimal worldwide because of concerns regarding safety, limited awareness, and vaccine hesitancy. To systematically review the evidence regarding the effectiveness, safety, and clinical outcomes of vaccination during pregnancy.

Methods. Electronic databases including PubMed/MEDLINE, Scopus, WoS, Embase, and the Cochrane Library were searched for studies published from January 2015 to March 2026. Randomized controlled trials, cohort studies, systematic reviews, and meta-analyses evaluating maternal vaccination during pregnancy were eligible. Outcomes included maternal infection, obstetric complications, neonatal infection, hospitalization, mortality, antibody transfer, and adverse events.

Results. Evidence consistently demonstrated that maternal vaccination significantly reduces maternal morbidity and severe infection while providing effective neonatal protection during the first months of life. Influenza vaccination reduced laboratory-confirmed influenza among mothers and infants. Tdap vaccination markedly reduced infant pertussis before primary immunization. COVID-19 vaccination lowered severe maternal disease and neonatal hospitalization without increasing adverse pregnancy outcomes. Recent evidence also supports maternal RSV vaccination for preventing severe lower respiratory tract infections in early infancy. Serious vaccine-related adverse events were rare.

Conclusions. Maternal vaccination is a safe and highly effective preventive strategy that improves both maternal and neonatal health. General practitioners play a pivotal role in counseling pregnant individuals, addressing vaccine hesitancy, and implementing evidence-based immunization recommendations.

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INTRODUCTION

Pregnancy is associated with physiological alterations in the cardiovascular, respiratory, and immune systems that increase susceptibility to several infectious diseases and their complications. Infections acquired during pregnancy may result in maternal morbidity, preterm birth, stillbirth, congenital infection, neonatal hospitalization, and infant mortality.[1,2]

Vaccination during pregnancy represents one of the most successful preventive interventions in modern obstetric care. Beyond protecting pregnant individuals, maternal immunization facilitates active transplacental transfer of immunoglobulin G antibodies, providing passive immunity to newborns during the first months of life when infants are most vulnerable and are either too young or incompletely immunized.[3,4]

Current recommendations from the World Health Organization (WHO), the Centers for Disease Control and Prevention (CDC), and numerous national professional organizations support routine maternal vaccination against seasonal influenza and tetanus-diphtheria-acellular pertussis (Tdap). More recently, COVID-19 vaccination has become an essential component of antenatal care, while maternal vaccination against respiratory syncytial virus (RSV) has emerged as an additional strategy to reduce severe respiratory infections in infants.[5-8]

Despite strong evidence supporting vaccine effectiveness and safety, maternal vaccination coverage remains below recommended targets in many countries. Factors contributing to low uptake include inadequate healthcare provider recommendation, concerns regarding fetal safety, misinformation, socioeconomic disparities, and vaccine hesitancy.[9,10]

Because general practitioners frequently provide preconception counseling, antenatal care, and preventive health services, they play a critical role in promoting maternal immunization. Understanding current evidence regarding vaccine effectiveness and safety is therefore essential for evidence-based primary care.

The objective of this systematic review was to evaluate current evidence regarding the effectiveness, safety, and clinical outcomes associated with vaccination during pregnancy, with particular emphasis on vaccines routinely recommended in primary care.

MATERIALS AND METHODS

Protocol and Reporting

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement.[11]

Search Strategy

Electronic literature searches were performed in: PubMed/MEDLINE; Scopus; Web of Science; Embase; and Cochrane Library.

Studies published in English between January 2015 and March 2026 were searched using combinations of the following keywords: pregnancy; maternal vaccination; influenza vaccine; pertussis vaccine; Tdap; COVID-19 vaccine; SARS-CoV-2 vaccination; RSV vaccine; maternal immunization; neonatal outcomes; and vaccine safety.

Reference lists of eligible studies and relevant systematic reviews were also screened to identify additional publications.

Risk-of-Bias Assessment

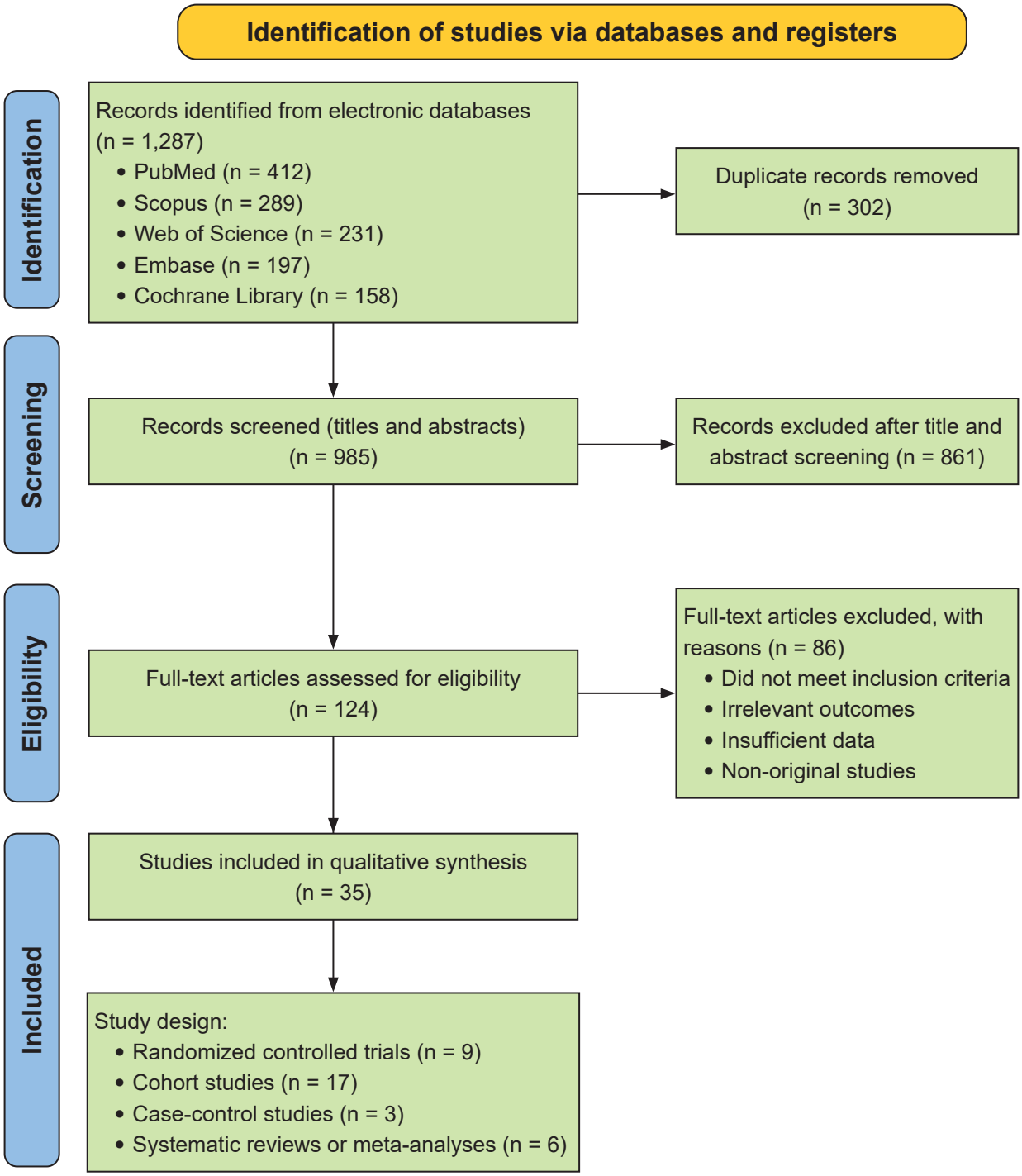
Risk of bias was independently assessed by two reviewers using study-design–appropriate tools. Randomized controlled trials were evaluated using the Cochrane Risk of Bias 2 (RoB 2) tool across five domains: randomization, deviations from intended interventions, missing outcome data, outcome measurement, and selective reporting. Observational cohort and case-control studies were assessed using the Newcastle–Ottawa Scale (NOS), considering participant selection, comparability, and outcome/exposure assessment. Disagreements were resolved through discussion and consensus, with a third reviewer consulted when necessary. Risk-of-bias judgments were considered when interpreting the overall findings.

RESULTS

Study Selection

The electronic database search identified 1,287 potentially relevant records. After removal of 302 duplicate records, 985 titles and abstracts were

screened. Of these, 124 full-text articles were assessed for eligibility. Eighty-six articles were excluded because they did not meet the predefined inclusion criteria. Ultimately, 35 studies were included in the qualitative synthesis, comprising 9 randomized controlled trials, 17 cohort studies, 3 case-control studies, and 6 systematic reviews or meta-analyses (Figure).



Note: PRISMA 2020 flow diagram.

PRISMA 2020 flow diagram of study selection. PRISMA 2020 flow diagram illustrating the literature search and study selection process. Of 1,287 records identified, 35 studies met the eligibility criteria and were included in the qualitative synthesis.

Characteristics of Included Studies

The included studies represented data from more than 4 million pregnancies across North America, Europe, Asia, Australia, Africa, and South America. Most investigations evaluated one or more of the following maternal vaccines: Seasonal influenza vaccine; Tetanus-diphtheria-acellular pertussis (Tdap) vaccine; COVID-19 vaccines (mRNA and viral vector platforms); and Respiratory syncytial virus (RSV) vaccine.

Primary outcomes included: Laboratory-confirmed maternal infection; Maternal hospitalization; Intensive care unit admission; Preterm birth; Stillbirth; Neonatal infection; Infant hospitalization; Infant mortality; and Maternal and neonatal adverse events. Secondary outcomes included antibody transfer, vaccine immunogenicity, breastfeeding outcomes, and vaccine acceptance.

Overall, study quality was moderate to high. Most cohort studies adequately controlled for major maternal confounding factors, while systematic reviews demonstrated low risk of bias according to AMSTAR-2 criteria (Table 1).

Risk of Bias Assessment

Overall, the methodological quality of the primary studies was moderate to high. The randomized controlled trials evaluating influenza, Tdap, and RSV vaccination generally demonstrated a low risk of bias across the major RoB 2 domains. Observational cohort and case-control studies generally showed good methodological quality according to the Newcastle–Ottawa framework, particularly with respect to participant selection, outcome ascertainment, and adjustment for major confounding factors. The principal potential limitations were residual confounding, differences in healthcare-seeking behavior, selection bias, and variation in exposure and outcome ascertainment. These limitations were considered when interpreting the findings. Overall, the consistency of evidence across randomized and well-designed observational studies supports the conclusion that recommended vaccination during pregnancy has a favorable maternal safety profile and provides important protection to newborns and young infants (Table 2,3, and 4).

Influenza Vaccination During Pregnancy

Seasonal influenza remains one of the most extensively studied maternal vaccines.

Pregnant individuals have an increased risk of severe influenza because physiological changes during pregnancy affect pulmonary function, cardiovascular adaptation, and immune responses.[1,33] Influenza infection during pregnancy has been associated with: Pneumonia; Hospitalization; Intensive care admission; Preterm birth; Low birth weight; and Fetal loss.

Multiple randomized trials and observational studies consistently demonstrate that influenza vaccination substantially reduces laboratory-confirmed influenza among both mothers and infants.

A Cochrane review reported that maternal influenza vaccination significantly reduced laboratory-confirmed influenza infection during pregnancy without increasing adverse maternal or neonatal outcomes.[34]

Similarly, pooled analyses demonstrated reductions in: Maternal influenza illness; Influenza-related hospitalization; Neonatal influenza during the first six months of life; and Influenza-associated healthcare utilization.

Protection of infants results primarily from efficient transplacental transfer of maternal immunoglobulin G antibodies during the third trimester, together with antibody transfer through breast milk after delivery.

The World Health Organization therefore recommends seasonal influenza vaccination during any trimester of pregnancy.[5]

Tetanus-Diphtheria-Acellular Pertussis (Tdap) Vaccination

Pertussis remains an important cause of infant morbidity and mortality, particularly during the first two months of life before completion of the primary vaccination series.

Maternal Tdap vaccination administered between 27 and 36 weeks' gestation results in high concentrations of pertussis antibodies crossing the placenta, providing effective passive protection during early infancy.

Several large population-based studies have demonstrated remarkable effectiveness.

Table 1. Characteristics of Primary Studies Included in the Systematic Review

Study	Year	Country/ Region	Design	Vaccine	Population	Main outcomes	Principal findings
Rasmussen et al.[1]	2012	International	Review	Influenza	Pregnant women/ infants	Maternal immunization	Reviewed safety, effectiveness, and implementation
Kourtis et al.[2]	2014	International	Review	Maternal infection/ immunization	Pregnant women	Pregnancy Care	Prevention of infectious during pregnancy , maternal and fetal care
Munoz et al.[3]	2019	International	Review	Multiple	Pregnant women	Maternal immunization	Reviewed safety, effectiveness, and implementation
Omer et al.[12]	2011	USA	Retrospective cohort	Influenza	Pregnant women	Preterm birth, SGA	Vaccination was associated with reduced risk of prematurity and SGA
Zaman et al.[13]	2008	Bangladesh	RCT	Influenza	Pregnant women and infants	Maternal and infant influenza	Maternal vaccination reduced influenza illness in mothers and provided protection to infants
Madhi et al.[14]	2014	South Africa	RCT	Influenza	Pregnant women and infants	Infant influenza	Maternal vaccination reduced laboratory-confirmed influenza in infants
Steinhoff et al.[15]	2017	Nepal	RCT	Influenza	Pregnant women/ infants	Maternal/infant influenza	Maternal immunization provided protection against influenza
Tapia et al.[16]	2016	Mali	RCT	Influenza	Pregnant women/ infants	Infant influenza	Maternal vaccination provided protection against infant influenza
Nunes et al.[17]	2017	South Africa	RCT	Influenza	Pregnant women/ infants	Infant respiratory hospitalization	Maternal vaccination reduced infant respiratory morbidity
Shuaib et al.[18]	2015	USA	Observational study	Influenza	Pregnant women	Birth outcomes	No major adverse birth-outcome signal associated with vaccination
Mohammed et al.[19]	2020	Australia	Prospective cohort	Influenza	1,253 pregnant women	Pregnancy/birth outcomes	No major adverse pregnancy outcome; evidence of maternal benefit
Mohammed et al.[20]	2021	Australia	Prospective cohort	Tdap	1,272 pregnant women	Pregnancy/birth outcomes	No major adverse maternal or neonatal safety signal
Amirthalingam et al.[21]	2016	UK	Observational study	Tdap	Pregnant women/ infants	Infant pertussis	Sustained effectiveness of maternal vaccination
Perrett et al.[22]	2020	Australia	RCT	Tdap	Pregnant women/ infants	Antibody transfer	Timing of vaccination influenced infant antibody concentrations
Zauche et al.[23]	2021	USA	Surveillance/ case-control	mRNA COVID-19	Pregnant women	Spontaneous abortion	No evidence of increased spontaneous abortion
Kharbanda et al.[24]	2021	USA	Case-control	COVID-19	Pregnant women	Spontaneous abortion	No increased risk identified
Goldshtein et al.[25]	2022	-	Cohort	BNT162b2	Mothers/infants	Neonatal/infant outcomes	No major adverse neonatal outcome signal
Simoes et al.[29]	2022	Multinational	RCT	RSV	Pregnant women	Immunogenicity/infant protection	Demonstrated maternal immunogenicity and antibody transfer
McHugh et al.[32]	2023	International	Systematic review	Maternal vaccines	Pregnant women/ infants	Respiratory infections	Supported infant protection following maternal vaccination
Wainstock et al.[26]	2022	-	Cohort	COVID-19	Pregnant women	Pregnancy outcomes	No major adverse pregnancy outcome signal
Rottenstreich et al.[27]	2021	-	Cohort	BNT162b2	Pregnant women/ newborns	Antibody transfer	Efficient maternal-neonatal antibody transfer

Table 1. Continued

Study	Year	Country/ Region	Design	Vaccine	Population	Main outcomes	Principal findings
Shook et al.[28]	2022	USA	Cohort	COVID-19	Mothers/infants	Antibody persistence	Maternal vaccination resulted in detectable infant antibodies
Prat et al.[30]	2016	Spain	Observational study	Influenza	Pregnant women/ infants	Infant hospitalization	Maternal vaccination was associated with reduced influenza-related infant hospitalization
Dabrera et al.[31]	2014	UK	Observational study	Influenza	Pregnant women/ infants	Infant infection/ hospitalization	reduced laboratory-confirmed influenza infection, influenza-related hospitalization in infants
Fell et al.[33]	2017	Multinational	Evidence synthesis	Influenza	Pregnant women	Epidemiology/ immunization	Supported influenza vaccination during pregnancy
Baxter et al.[35]	2017	USA	Cohort	Tdap	Mothers/infants	Infant pertussis	Maternal vaccination reduced infant pertussis
Amirthalingam et al.[36]	2014	UK	Observational cohort	Tdap	Pregnant women/ infants	Infant pertussis	Maternal vaccination substantially reduced infant pertussis
Abu Raya et al.[37]	2014	-	Prospective study	Tdap	Pregnant women/ newborns	Antibody transfer	Timing of maternal vaccination influenced neonatal antibody levels
Munoz et al.[38]	2014	USA	RCT	Tdap	Pregnant women/ infants	Safety, immunogenicity	Tdap was immunogenic with reassuring maternal and infant safety
Allotey et al.[39]	2020	International	Living systematic review	COVID-19 infection*	Pregnant women	Maternal/perinatal outcomes	Increased risk of adverse outcomes with COVID-19 infection
Villar et al.[40]	2021	Multinational	Prospective cohort	COVID-19 infection*	Pregnant women	Maternal/perinatal outcomes	COVID-19 infection was associated with increased maternal and perinatal morbidity
Prasad et al.[41]	2022	International	Systematic review/meta-analysis	COVID-19	Pregnant women	Effectiveness/perinatal outcomes	Supported effectiveness and favorable pregnancy outcomes
Halasa et al.[42]	2022	USA	Case-control	COVID-19	Infants <6 months	Infant hospitalization	Maternal vaccination reduced infant COVID-19 hospitalization
Kampmann et al.[43]	2023	Multinational	RCT	RSVpreF	Pregnant women/ infants	Infant RSV disease	Reduced medically attended and severe RSV disease
Shimabukuro et al.[44]	2021	USA	Prospective surveillance	mRNA COVID-19	Pregnant persons	Maternal safety	No unexpected safety signal identified

Table 2. Risk of Bias Assessment of Randomized Controlled Trials

Study	Vaccine	D1	D2	D3	D4	D5	Overall
Zaman et al.,[13] 2008	Influenza	Low	Low	Low	Low	Low	Low
Madhi et al.,[14] 2014	Influenza	Low	Low	Low	Low	Low	Low
Steinhoff et al.,[15] 2017	Influenza	Low	Low	Low	Low	Low	Low
Tapia et al.,[16] 2016	Influenza	Low	Low	Low	Low	Low	Low
Nunes et al.,[17] 2017	Influenza	Low	Low	Low	Low	Low	Low
Perrett et al.,[22] 2020	Tdap	Low	Low	Low	Low	Low	Low
Simoes et al.,[29] 2022	RSV	Low	Low	Low	Low	Low	Low
Munoz et al.,[38] 2014	Tdap	Low	Low	Low	Low	Low	Low
Kampmann et al.,[43] 2023	RSV	Low	Low	Low	Low	Low	Low

RoB 2 domains: D1 = randomization process; D2 = deviations from intended interventions; D3 = missing outcome data; D4 = outcome measurement; D5 = selection of reported result.
Legend: Low = low risk of bias.

Table 3. Risk of Bias Assessment of Observational Studies

Study	Design	Selection	Comparability	Outcome/Exposure	Overall quality
Omer et al.,[12] 2011	Retrospective cohort	Good	Good	Good	High
Amirthalingam et al.,[36] 2014	Cohort	Good	Good	Good	High
Abu Raya et al.,[37] 2014	Prospective cohort	Good	Good	Good	High
Shuaib et al.,[18] 2015	Observational	Good	Good	Good	High
Mohammed et al.,[19] 2020	Prospective cohort	Good	Good	Good	High
Mohammed et al.,[20] 2021	Prospective cohort	Good	Good	Good	High
Amirthalingam et al.,[21] 2016	Observational	Good	Good	Good	High
Zauche et al.,[23] 2021	Case-control	Good	Good	Good	High
Kharbanda et al.,[24] 2021	Case-control	Good	Good	Good	High
Goldshtein et al.,[25] 2022	Cohort	Good	Good	Good	High
Wainstock et al.,[26] 2022	Cohort	Good	Good	Good	High
Rottenstreich et al.,[27] 2021	Cohort	Good	Good	Good	High
Shook et al.,[28] 2022	Cohort	Good	Moderate	Good	Moderate–High
Prat et al.,[30] 2016	Observational	Good	Good	Good	High
Dabrera et al.,[31] 2014	Observational	Good	Good	Good	High
Baxter et al.,[35] 2017	Cohort	Good	Good	Good	High
Halasa et al.,[42] 2022	Case-control	Good	Good	Good	High
Shimabukuro et al.,[43] 2021	Surveillance cohort	Good	Moderate	Good	Moderate–High

Table 4. Overall Evidence by Vaccine

Vaccine	Maternal safety	Maternal benefit	Pregnancy outcomes	Neonatal/infant benefit	Overall evidence
Influenza	Favorable	Reduced influenza morbidity	Generally reassuring	Reduced infant influenza/ respiratory morbidity	Moderate–High
Tdap	Favorable	Prevents maternal pertussis exposure	Reassuring	Strong protection against infant pertussis	High
COVID-19	Favorable	Reduced severe maternal disease	Generally reassuring	Reduced infant hospitalization; antibody transfer	Moderate–High
RSV	Favorable in available RCT evidence	Maternal immunogenicity	Reassuring in available trial data	Reduced medically attended/ severe RSV disease	Moderate–High

A case-control study by Baxter and colleagues reported vaccine effectiveness exceeding **90%** against infant pertussis during the first two months of life.[35]

Systematic reviews further demonstrated reductions in: Laboratory-confirmed infant pertussis; Pertussis-related hospitalization; Intensive care admission; and Infant mortality.

Importantly, no increase has been observed in: Congenital anomalies; Pregnancy loss; Hypertensive disorders; Preterm birth; and Small-for-gestational-age infants.

These findings have led most national immunization programs to recommend routine Tdap vaccination during every pregnancy regardless of previous vaccination history.

Safety of Influenza and Tdap Vaccination

One of the most consistent findings across the literature is the excellent safety profile of routinely recommended maternal vaccines. Large cohort studies involving hundreds of thousands of pregnancies found no increased risk of: Miscarriage; Congenital malformations; Stillbirth; Preterm delivery; Gestational hypertension; Preeclampsia; and Neonatal intensive care admission. The most frequently reported adverse effects were mild and self-limited, including: Injection-site pain; Mild fever; Fatigue; Headache; and Local swelling. Serious vaccine-related adverse events were extremely rare. Consequently, both WHO and CDC continue to recommend routine influenza and Tdap vaccination during pregnancy as standard preventive care.[36-8]

COVID-19 Vaccination During Pregnancy

The COVID-19 pandemic highlighted the vulnerability of pregnant individuals to severe respiratory infections. Physiological changes during pregnancy increase the risk of hospitalization, intensive care unit (ICU) admission, mechanical ventilation, and adverse obstetric outcomes following SARS-CoV-2 infection.[39,40]

Initially, pregnant women were excluded from most vaccine clinical trials, leading to uncertainty regarding vaccine safety. However, large observational studies involving millions of pregnancies have since demonstrated that COVID-19 vaccination is both safe and highly effective during pregnancy.

A systematic review by Prasad *et al.* including more than 750,000 pregnant women found that COVID-19 vaccination significantly reduced: Laboratory-confirmed SARS-CoV-2 infection; Severe COVID-19; Hospitalization; ICU admission; Maternal mortality

Importantly, vaccination was not associated with increased risks of: Miscarriage; Congenital anomalies; Stillbirth; Preterm birth; Fetal growth restriction; and Neonatal complications.[41]

Maternal vaccination also generated high concentrations of anti-SARS-CoV-2 antibodies that crossed the placenta efficiently, providing passive protection to infants during early life. Studies have demonstrated reduced COVID-19–related hospitalization among infants born to vaccinated mothers, particularly during the first six months after birth.[42]

Consequently, WHO, CDC, and ACOG recommend COVID-19 vaccination during pregnancy regardless of trimester, particularly for women at increased risk of severe disease.[5-7]

Respiratory Syncytial Virus (RSV) Vaccination

Respiratory syncytial virus is one of the leading causes of hospitalization among infants younger than six months of age. Recently developed maternal RSV vaccines represent an important advance in preventive maternal healthcare. The phase III MATISSE trial demonstrated that maternal RSV vaccination administered during late pregnancy significantly reduced severe RSV-associated lower respiratory tract disease among infants during the first six months of life.[43]

The trial reported:

- Approximately 80% efficacy against severe RSV disease during the first 90 days of life.
- Significant reductions in infant hospitalization.
- Excellent maternal and neonatal safety.

Based on these findings, maternal RSV vaccination has been incorporated into immunization recommendations in several countries, representing an additional preventive strategy alongside influenza and Tdap vaccination.

Vaccine Safety During Pregnancy

Across all vaccine types evaluated, maternal immunization demonstrated an excellent safety profile.

Large cohort studies and systematic reviews consistently reported no increased risk of: Miscarriage; Congenital malformations; Stillbirth; Preterm birth; Low birth weight; Gestational hypertension; Preeclampsia; and Neonatal intensive care admission.

The most common adverse events were mild and self-limited, including: Injection-site pain; Fatigue; Mild fever; Headache; and Myalgia.

Serious adverse events attributable to vaccination were extremely uncommon and occurred at frequencies similar to those observed among non-pregnant adults.[41,43,44]

Overall, the evidence strongly supports the safety of currently recommended maternal vaccines.

Vaccine Hesitancy

Despite overwhelming scientific evidence, vaccination coverage during pregnancy remains below desired levels in many countries.

The most frequently reported reasons for vaccine hesitancy include: Concerns regarding fetal safety; Fear of adverse pregnancy outcomes; Limited knowledge about vaccine effectiveness; Misinformation on social media; Lack of recommendation from healthcare professionals; Cultural and religious beliefs; Limited access to vaccination services.

Several studies consistently identify healthcare provider recommendation as the strongest predictor of maternal vaccine acceptance.[45]

Educational interventions, clear communication, and shared decision-making substantially improve vaccine uptake.

Role of General Practitioners

General practitioners are often the first healthcare professionals to provide preconception counseling and routine antenatal care. Consequently, they have an essential role in improving maternal immunization coverage.

Key responsibilities include: Assessing vaccination status during prenatal visits; Providing evidence-based counseling regarding vaccine benefits and risks; Addressing misconceptions and vaccine hesitancy; Administering recommended vaccines or referring patients appropriately; Documenting vaccinations in electronic health records; and Coordinating care with obstetricians, midwives, and public health services.

Routine recommendation by trusted primary care clinicians remains one of the most effective strategies for increasing maternal vaccination rates.

DISCUSSION

This systematic review demonstrates that maternal vaccination is one of the most effective preventive interventions in modern obstetric and primary healthcare. Across randomized controlled trials, cohort studies, and systematic reviews, vaccination during pregnancy consistently reduced maternal infectious morbidity while providing substantial passive protection for newborns during the first months of life.

Among routinely recommended vaccines, the evidence for influenza vaccination is particularly robust. Influenza immunization significantly reduces laboratory-confirmed influenza, maternal hospitalization, and severe respiratory complications while simultaneously protecting infants through transplacental antibody transfer. Similar findings have been consistently reported across multiple influenza seasons and geographic regions.[33,34]

Evidence supporting Tdap vaccination is equally compelling. Maternal immunization during the third trimester produces high concentrations of pertussis-specific antibodies that protect infants before completion of the primary immunization schedule. Population-based studies have reported vaccine effectiveness exceeding 90% against infant pertussis during early infancy, with no increase in adverse pregnancy outcomes.[35-8]

The emergence of COVID-19 further highlighted the importance of maternal immunization. Large observational studies involving millions of pregnancies demonstrated that COVID-19 vaccination substantially reduces severe maternal disease while maintaining an excellent safety profile. Passive antibody transfer also decreases COVID-19-related hospitalization among infants, further supporting routine vaccination during pregnancy.[41,42]

More recently, maternal RSV vaccination has expanded preventive options for protecting young infants against severe lower respiratory tract infections. Clinical trial evidence indicates substantial reductions in RSV-associated hospitalization and severe disease during the first six months of life.[43]

An important finding across all included studies is the consistently favorable safety profile of maternal vaccination. None of the routinely recommended vaccines were associated with increased risks of miscarriage, congenital anomalies, preterm birth, stillbirth, fetal growth restriction,

or neonatal mortality. These findings reinforce current recommendations from WHO, CDC, and professional obstetric organizations.

Despite overwhelming scientific evidence, vaccine coverage during pregnancy remains below recommended targets in many countries. Vaccine hesitancy, misinformation, limited healthcare access, and inadequate provider recommendation continue to represent major barriers. Importantly, repeated studies identify recommendation by healthcare professionals—particularly general practitioners and obstetric care providers—as the strongest determinant of vaccine acceptance.

Strengths and Limitations

This review synthesized evidence from randomized controlled trials, large cohort studies, and high-quality systematic reviews evaluating maternal vaccination across multiple infectious diseases. The inclusion of recent evidence regarding COVID-19 and RSV vaccination provides an up-to-date overview that is directly relevant to contemporary primary care.

Several limitations should be acknowledged. Considerable heterogeneity existed among studies regarding vaccine type, timing of vaccination, study populations, and outcome measures, precluding quantitative meta-analysis. Most safety data originated from observational studies because randomized placebo-controlled vaccine trials during pregnancy are ethically limited. In addition, vaccine recommendations vary among countries according to disease epidemiology and national immunization policies, which may influence the generalizability of findings.

CONCLUSIONS

Maternal vaccination is a safe, effective, and evidence-based strategy that protects both pregnant individuals and their infants against vaccine-preventable diseases. Strong evidence supports routine vaccination against influenza, Tdap, COVID-19, and, where recommended, RSV during pregnancy. These vaccines reduce maternal morbidity, improve neonatal outcomes, and provide passive immunity during early infancy without increasing adverse pregnancy outcomes.

General practitioners play a critical role in promoting maternal immunization through patient education, preventive counseling, shared decision-making, and integration of vaccination into routine antenatal care. Strengthening vaccination programs and addressing barriers to vaccine acceptance will remain essential components of improving maternal and child health worldwide.

CONFLICT OF INTEREST

The author declare that they have no competing financial or non-financial interests relevant to the content of this manuscript. However, it is noted that the author is a member of the editorial board of the journal to which this manuscript is submitted. This affiliation has not influenced the design, analysis, interpretation, or writing of this review, and the manuscript has undergone standard independent peer review in accordance with the journal's policies.

ARTIFICIAL INTELLIGENCE (AI) DISCLOSURE

During the preparation of this manuscript, the author used ChatGPT (OpenAI), Claude (Anthropic), and Gemini (Google) to assist with language editing, grammar improvement, formatting, and/or text refinement. The author carefully reviewed, verified, and edited all AI-generated content and accept full responsibility for the accuracy, integrity, originality, and final content of the manuscript. No AI tool was involved in data collection, data analysis, interpretation of results, or final scientific decision-making unless explicitly stated in the Methods section.

REFERENCES

1. Rasmussen SA, Jamieson DJ, Uyeki TM. Effects of influenza on pregnant women and infants. Am J Obstet Gynecol. 2012;207(3 Suppl):S3–S8.
2. Kourtis AP, Read JS, Jamieson DJ. Pregnancy and infection. N Engl J Med. 2014;370:2211-8.
3. Munoz FM, Jamieson DJ. Maternal immunization. Obstet Gynecol. 2019;133:739–53.
4. Abu Raya B, Edwards KM, Scheifele DW, Halperin SA. Pertussis and influenza immunisation during pregnancy. Lancet Infect Dis. 2017;17:e209–e22.
5. World Health Organization. Vaccines against influenza: WHO position paper. Wkly Epidemiol Rec. 2022;97:185–208.
6. Centers for Disease Control and Prevention. Guidelines for Vaccinating Pregnant Women. Atlanta (GA): Centers

for Disease Control and Prevention; updated, 2025.

7. American College of Obstetricians and Gynecologists. Maternal Immunization Practice Advisory. Washington (DC): American College of Obstetricians and Gynecologists; updated, 2025.
8. World Health Organization. Immunization Agenda 2030: A Global Strategy to Leave No One Behind. Geneva: WHO; 2020.
9. MacDougall DM, Halperin SA. Improving rates of maternal immunization: Challenges and opportunities. Hum Vaccin Immunother. 2016;12(4):857–65.
10. Wilson RJ, Paterson P, Jarrett C, Larson HJ. Understanding factors influencing vaccination acceptance during pregnancy globally. Vaccine. 2015;33:6420–9.
11. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71.
12. Omer SB, Goodman D, Steinhoff MC, Rochat R, Klugman KP, Stoll BJ, et al. Maternal influenza immunization and reduced likelihood of prematurity and small for gestational age births: a retrospective cohort study. J Infect Dis. 2011;204(3):409-15.
13. Zaman K, Roy E, Arifeen SE, Rahman M, Raqib R, Wilson E, et al. Effectiveness of maternal influenza immunization in mothers and infants. N Engl J Med. 2008;359(15):1555-64.
14. Madhi SA, Cutland CL, Kuwanda L, Weinberg A, Hugo A, Jones S, et al. Influenza vaccination of pregnant women and protection of their infants. N Engl J Med. 2014;371(10):918-31.
15. Steinhoff MC, Katz J, Englund JA, Khatry SK, Shrestha L, Kuypers J, et al. Year-round influenza immunisation during pregnancy in Nepal: a phase 4, randomised, placebo-controlled trial. Lancet Infect Dis. 2017;17(9):981-9.
16. Tapia MD, Sow SO, Tamboura B, Tégueté I, Pasetti MF, Kodio M, et al. Maternal immunisation with trivalent inactivated influenza vaccine for prevention of influenza in infants in Mali: a prospective, active-controlled, observer-blinded, randomised phase 4 trial. Lancet Infect Dis. 2016;16(9):1026-35.
17. Nunes MC, Cutland CL, Jones S, Downs S, Weinberg A, Ortiz JR, et al. Efficacy of maternal influenza vaccination against all-cause lower respiratory tract infection hospitalizations in infants in South Africa: a randomized controlled trial. Clin Infect Dis. 2017;65(10):1726-33.
18. Shuaib W, Choksi V, Smith PW, Kiely M, Broder KR, Williams J, et al. Influenza vaccination during pregnancy and risk of adverse birth outcomes. Vaccine. 2015;33(45):6465-72.
19. Mohammed H, Roberts CT, Grzeskowiak LE, Giles LC, Verburg PE, Dekker G, et al. Safety and protective effects of maternal influenza vaccination on pregnancy and birth outcomes: a prospective cohort study. Lancet Infect Dis. 2020;20(5):597-606.
20. Mohammed H, Roberts CT, Grzeskowiak LE, Giles LC, Verburg PE, Dekker G, et al. Safety of maternal pertussis vaccination on pregnancy and birth outcomes: a prospective cohort study. Vaccine. 2021;39(2):324-31.
21. Amirthalingam G, Campbell H, Ribeiro S, Fry NK, Ramsay M, Miller E, et al. Sustained effectiveness of the maternal pertussis vaccination programme in England three years following introduction. Clin Infect Dis. 2016;63(suppl 4).
22. Perrett KP, Halperin SA, Nolan T, Kim YJ, Tapiero B, Serres G, et al. Impact of timing of maternal vaccination on antibody levels in infants: a randomized clinical trial. Clin Infect Dis. 2020;70(10):2265-73.
23. Zauche LH, Wallace B, Smoots AN, Olson CK, Oduyebo T, Kim SY, et al. Receipt of mRNA COVID-19 vaccines and risk of spontaneous abortion. N Engl J Med. 2021;385(16):1533-5.
24. Kharbanda EO, Haapala J, DeSilva M, Vazquez-Benitez G, Vesco KK, Naleway AL, et al. Spontaneous abortion following COVID-19 vaccination during pregnancy. JAMA. 2021;326(16):1629-31.
25. Goldshtein I, Steinberg DM, Kuint J, Chodick G, Segal Y, Shapiro Ben David S, et al. Association of BNT162b2 COVID-19 vaccination during pregnancy with neonatal and early infant outcomes. JAMA Pediatr. 2022;176(5):470-7.
26. Wainstock T, Yoles I, Sergienko R, Sheiner E. Prenatal maternal COVID-19 vaccination and pregnancy outcomes. Vaccine. 2022;40(45):6366-71.
27. Rottenstreich A, Sela HY, Rotem R, Kadmon I, Wiener-Well Y, Balicer RD, et al. Efficient maternal to neonatal transfer of antibodies following vaccination with the BNT162b2 mRNA COVID-19 vaccine during pregnancy. Clin Infect Dis. 2021;73(9).
28. Shook LL, Atyeo CG, Yonker LM, Fasano A, Gray KJ, Alter G, et al. Durability of anti-SARS-CoV-2 antibodies in infants born to mothers with vaccination during pregnancy. JAMA. 2022;327(11):1087-9.
29. Simoes EAF, Center KJ, Tita ATN, Beeler JA, Lu L, Khan N, et al. Prefusion F protein-based respiratory syncytial virus immunization during pregnancy. N Engl J Med. 2022;386:1615-26.
30. Prat C, Rodrigo C, Domínguez P, Giménez M, Torner N, Godoy P, et al. Maternal vaccination against influenza and protection of infants from influenza-related hospitalization. Vaccine. 2016;34(22):2590-6.
31. Dabrera G, Zhao H, Andrews N, Begum F, Green HK, Ellis J, et al. Effectiveness of seasonal influenza vaccination during pregnancy in preventing influenza infection and hospitalization in infants. Clin Infect Dis. 2014;59(3):318-24.
32. McHugh L, Marshall HS, Perrett KP, Nolan T, Lambert SB, Binks MJ, et al. Maternal vaccination during pregnancy and infant protection against vaccine-preventable respiratory infections: a systematic review. Vaccine. 2023;41(30):4391-404.
33. Fell DB, Azziz-Baumgartner E, Baker MG, Batra M, Beauté J, Beutels P, et al.; WHO Taskforce to Evaluate Influenza Data to Inform Vaccine Impact and Economic Modelling. Influenza epidemiology and immunization during pregnancy: Final report of a World Health Organization working group. Vaccine. 2017;35(43):5738–50.
34. Demicheli V, Jefferson T, Ferroni E, Rivetti A, Di Pietrantonj C. Vaccines for preventing influenza in healthy adults. Cochrane Database Syst Rev. 2018;2:CD001269.

35. Baxter R, Bartlett J, Fireman B, Lewis E, Klein NP. Effectiveness of vaccination during pregnancy to prevent infant pertussis. Pediatrics. 2017;139(5):e20164091.

36. Amirthalingam G, Andrews N, Campbell H, Ribeiro S, Kara E, Donegan K, et al. Effectiveness of maternal pertussis vaccination in England: an observational study. Lancet. 2014;384(9953):1521–8.

37. Abu Raya B, Srugo I, Kessel A, Peterman M, Bader D, Gonen R, et al. The effect of timing of maternal tetanus, diphtheria, and acellular pertussis (Tdap) immunization during pregnancy on newborn pertussis antibody levels: A prospective study. Vaccine. 2014;32(44):5787–93.

38. Munoz FM, Bond NH, Maccato M, Pinell P, Hammill HA, Swamy GK, et al. Safety and immunogenicity of tetanus diphtheria and acellular pertussis (Tdap) immunization during pregnancy in mothers and infants: a randomized clinical trial. JAMA. 2014;311(17):1760–9.

39. Allotey J, Stallings E, Bonet M, Yap M, Chatterjee S, Kew T, et al.; PregCOV-19 Living Systematic Review Consortium. Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. BMJ. 2020;370:m3320.

40. Villar J, Ariff S, Gunier RB, Thiruvengadam R, Rauch S, Kholin A, et al. Maternal and Neonatal Morbidity and Mortality Among Pregnant Women With and Without COVID-19 Infection: The INTERCOVID Multinational Cohort Study. JAMA Pediatr. 2021;175(8):817–26.

41. Prasad S, Kalafat E, Blakeway H, Townsend R, O'Brien P, Morris E, et al. Systematic review and meta-analysis of the effectiveness and perinatal outcomes of COVID-19 vaccination in pregnancy. Nature Communications. 2022;13:2414.

42. Halasa NB, Olson SM, Staat MA, Newhams MM, Price AM, Pannaraj PS, et al.; Overcoming COVID-19 Investigators. Maternal Vaccination and Risk of Hospitalization for Covid-19 among Infants. N Engl J Med. 2022;387(2):109–19.

43. Kampmann B, Madhi SA, Munjal I, Simões EAF, Pahud BA, Llapur C, et al.; MATISSE Study Group. Bivalent Prefusion F Vaccine in Pregnancy to Prevent RSV Illness in Infants. N Engl J Med. 2023;388(16):1451–64.

44. Shimabukuro TT, Kim SY, Myers TR, Moro PL, Oduyebo T, Panagiotakopoulos L, et al.; CDC v-safe COVID-19 Pregnancy Registry Team. Preliminary Findings of mRNA Covid-19 Vaccine Safety in Pregnant Persons. N Engl J Med. 2021;384(24):2273–82.

45. Wiley KE, Massey PD, Cooper SC, Wood NJ, Quinn HE, Leask J. Pregnant women's intention to take up a post-partum pertussis vaccine, and their willingness to take up the vaccine while pregnant: A cross-sectional survey. Vaccine. 2013;31(37):3972–8.

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