REVIEW
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A scoping review of studies on women's knowledge regarding Tdap vaccination during Pregnancy

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Author contributions

NAHT conducted a study and wrote the first draft of the manuscript. RSA supervised the study and revised the paper. All of the authors read and approved the final draft of the manuscript.

Competing interests

The authors declare no conflicts of interest.

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Abbreviations

DPT, Diphtheria pertussis and tetanus toxoid; KSA, Kingdom of Saudi Arabia; Tdap, tetanus, diphtheria and acellular pertussis; KAP, Knowledge Attitude and Practice; MCV4, meningococcal conjugate vaccine; HPV, human papillomavirus vaccine; MMR, measles mumps and rubella; MI, maternal immunisation; NIP, National Immunization Plan; PICOT, Population Intervention Comparison Outcome and Time.

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Abstract

This review aimed to determine and identify the knowledge and attitude of the mothers or pregnant women toward the Tdap vaccine during pregnancy. Whooping cough, Diphtheria disease and tetanus are infectious and pathogenic bacterial diseases that mainly affect children too young to complete basic vaccinations, and deaths associated with infectious diseases are frequent among them. Therefore, it is advisable for pregnant women to take the triple bacterial vaccine (tetanus, diphtheria and pertussis). This scoping review was conducted, and various electronic databases were searched, including Medline and PubMed. Moreover, Google Scholar, CDC, and immunization research group websites were searched to investigate the literature on the Tdap vaccine. As a result, 13 studies were included in this review. Based on the findings of this review, the level of knowledge of ladies and pregnant women about the importance of the vaccine depended upon several factors, including education level, occupation, age, sources of vaccine information, maternal desire, being born outside the country, lower household income, religious misconception, residing in a province or area where the pertussis vaccine was not free, having given birth to live children in the past, and receiving maternity care from a midwife. Therefore, it can be concluded that the increase in the level of knowledge about the importance of Tdap vaccine increased the percentage of women who supported and accepted the vaccine. Studies have also shown that some mothers refused vaccination due to reservations about vaccine safety and efficacy since they did not have sufficient knowledge or experience.

Keywords: pregnant women, vaccination, pertussis, Tdap vaccine, knowledge

Introduction

Vaccination during pregnancy introduces specific antibodies into mothers, which are passes to foetuses through placenta and to infants via breastfeeding [1]. The prevalence of neonatal tetanus was markedly reduced with the introduction of tetanus vaccination during pregnancy [2]. Likewise, severe pertussis was also reduced in young infants after implementing maternal immunization against pertussis [3–5]. Before the invention of vaccines, infectious diseases were considered childhood diseases [6]. Today, they mainly affect babies too young to have completed their full vaccination course; consequently, deaths associated with infectious diseases are common in newborns. Therefore, pregnant women should take the Diphtheria, pertussis and tetanus toxoid (DPT) vaccine, which acts as a combination vaccine to immunise against various infectious diseases, including pertussis [7]. Newborns were vaccinated, as several studies in the standard setting of the United States, the United Kingdom, Canada, and other countries showed the vaccine's efficacy and high absorption levels (about 70%) [8].

A contagious illness called Whooping cough or pertussis, brought on by pathogenic bacteria in the respiratory tract. [9]. It is a specific form of cough characterized by a shallow, intermittent cough accompanied by a high-pitched sniffing sound. Different microorganisms can cause an ailment that seems like pertussis isn't as serious. The pertussis vaccine is an antibody against the bacterium *Bordetella Pertussis*, which causes beating hack. There are two fundamental sorts: entire cell antibodies, which are 78% compelling, and acellular immunizations, which are 71–85% viable [10].

To optimise the mother antibody response, negative antibody transfer, and concentrations within the neonate, pregnant women are recommended to receive the Tdap vaccine between weeks 27 and 36 of their pregnancy [11]. However, the Tetanus, Diphtheria, and acellular pertussis (Tdap) vaccine can also be injected safely during pregnancy to prevent outbreaks of pertussis or other infections [11]. There is no proof that giving pregnant women an inactivated bacterial, viral, or toxic vaccine will have a negative impact on their baby [12]; moreover, data shows that adolescents and adults in the family, as well as guardians previously not vaccinated, should take a single dose of Tdap to protect against pertussis [13]. Owing to the rapid growth of knowledge on this topic, in Asian countries, Tdap vaccination is mandatory during pregnancy; however, no data are available regarding the prevalence of uptake of this vaccination among pregnant women [1].

On the international level, pregnant females Tdap immunisation coverage in the US was 50.4% in 2017 and 48.8% in 2016. A survey conducted from October to January 2020 reported that 53.5% of respondents received Tdap during pregnancy [14]. Furuta et al. (2017) systematically reviewed 15 articles involving 203,835 mothers with their infants from countries including the US and the UK. Belgium, Israel, and Vietnam [15]. The review reported that vaccines given between 19 and 37 weeks of pregnancy are linked to significantly higher antibody levels in the participant's blood than a placebo or no immunisation [15]. This study aims to analyse the research articles that studied the level of knowledge of mothers and pregnant women regarding the Tdap vaccine.

Methodology

A scoping review retrieved the relevant evidence and synthesised the findings. This scoping review was based on by Arksey and O'Malley [16] framework.

Identifying the Research Question

The following research question was assessed: "What is the prevalence of uptake of Tdap vaccination among pregnant women?" The "Population, Intervention, Comparison, Outcome and Time (PICOT)" format was used to search the chosen databases.

PICOT Format

P: pregnant women

I: Tdap vaccination

C: nil

O: safety of newborns from pertussis, tetanus and diphtheria

T: during pregnancy

Identifying the Relevant Studies

In the second stage, databases were searched (i.e., 2012) until October 2022 to identify all articles that focus on the knowledge and attitudes of pregnant women and women who have previously been pregnant. Various electronic databases were searched, including Medline and PubMed. Moreover, Google Scholar and immunisation research group websites were searched to investigate the literature on the Tdap vaccine.

The selected studies' bibliography was investigated manually to identify any additional related articles. The search used key terms, which included "pregnant women," "knowledge," "attitude," and "vaccination."

Selecting the Studies

Inclusion criteria were developed and designed to guide the selection process: articles in English; articles focusing on pregnant women, post-pregnancy women, and women who have previously been pregnant; quantitative and descriptive articles; articles based on information on the Knowledge, Attitude and Practice (KAP) model; and articles including women's knowledge of the importance of the vaccine, their attitudes during pregnancy, and impact of women's knowledge and attitude on the child after birth. Experimental studies and studies conducted in other languages were excluded from the review. The articles were examined using a PRISMA flowchart (Elements of Reporting Related to Systematic Reviews and Analysis).

Data extraction

After the initial screening of the abstracts, 2,657 studies were found concerning knowledge, attitude, and awareness of mothers toward the pertussis vaccine, of which 2,387 articles were excluded after studying their titles, and 105 were excluded after finding duplication among different databases. Next, 165 abstracts were reviewed, and further papers that failed to satisfy the inclusion requirements were also not retrieved. The reasons for this exclusion are as follows: language other than English ($n = 35$) and published outside the period considered in this study (i.e., pre-2012; $n = 75$).

The full text of 55 articles was reviewed comprehensively to identify gaps in the literature, after which 42 articles were excluded for several reasons. (Some studies targeted relatives other than mothers ($n = 62$). Finally, 13 articles were retrieved for the review, covering knowledge, attitude, and mothers' awareness toward the pertussis vaccine (Figure 1).

Results

In this section, recent studies published between 2012 and 2022 will be presented to identify the efficiency of the Tdap injection during pregnancy and evaluate knowledge and attitude of mothers or pregnant women worldwide toward the Tdap vaccine during pregnancy. The included articles' characteristics are presented in Table 1.

In Canada, the level of knowledge on the importance of the vaccine was high, reaching 90.3%, even though the percentage of those who were infected was negligible (5.8%); moreover, 68.2% admitted that pertussis represents a greater risk to newborns, so they had a supportive attitude toward immunisation. Conversely, only 10% of women in Canada refused the vaccination. Here, the high extent of women's knowledge (90%) can be attributed to a high level of education and higher instances of pregnancies where the doctor or healthcare worker explained the importance of vaccination to mothers, positively affecting mothers' tendency to immunise. However, 89.9% either were against or strongly opposed that vaccination was no longer necessary because pertussis was so rare. Therefore, it can be concluded that the increase in knowledge of the importance of the vaccine increased the percentage of women who

supported and accepted the vaccine [17].

D'Alessandro et al. (2018) conducted a cross-sectional study in Italy to find out how well-informed pregnant women are about vaccinations, whether they think they're acceptable, and which traits are associated with them; their results revealed that only 4.5% of the respondents had some understanding of the diphtheria vaccine, 7% of the tetanus vaccine, 7.3% of the pertussis vaccine, and 21% of the seasonal influenza vaccine, indicating a very low awareness of the vaccination advised during pregnancy. Overall, 24.7% of people knew at least one of the suggested vaccinations, but just 2.8% knew all four. Four factors were linked to this knowledge, including the knowledge of one of the required immunizations during gestation, having at least one child, middle school education level, and baccalaureate graduate degree [18].

Singh et al. (2019) adopted a cross-sectional study design to assess and measure the knowledge and attitude of post-natal mothers towards vaccination in Malaysia; they found that the association between age, education, occupation and knowledge score towards immunisation was found to be statistically significant. The attitude towards childhood vaccination did not significantly correlate with either ethnicity, work status, or delivery method. On the other hand, mothers' attitudes about vaccinations for children were substantially connected with their level of education, age, and employment [19].

Dudley et al. (2020) explored the knowledge and beliefs regarding vaccines among pregnant women in Georgia and Colorado the results

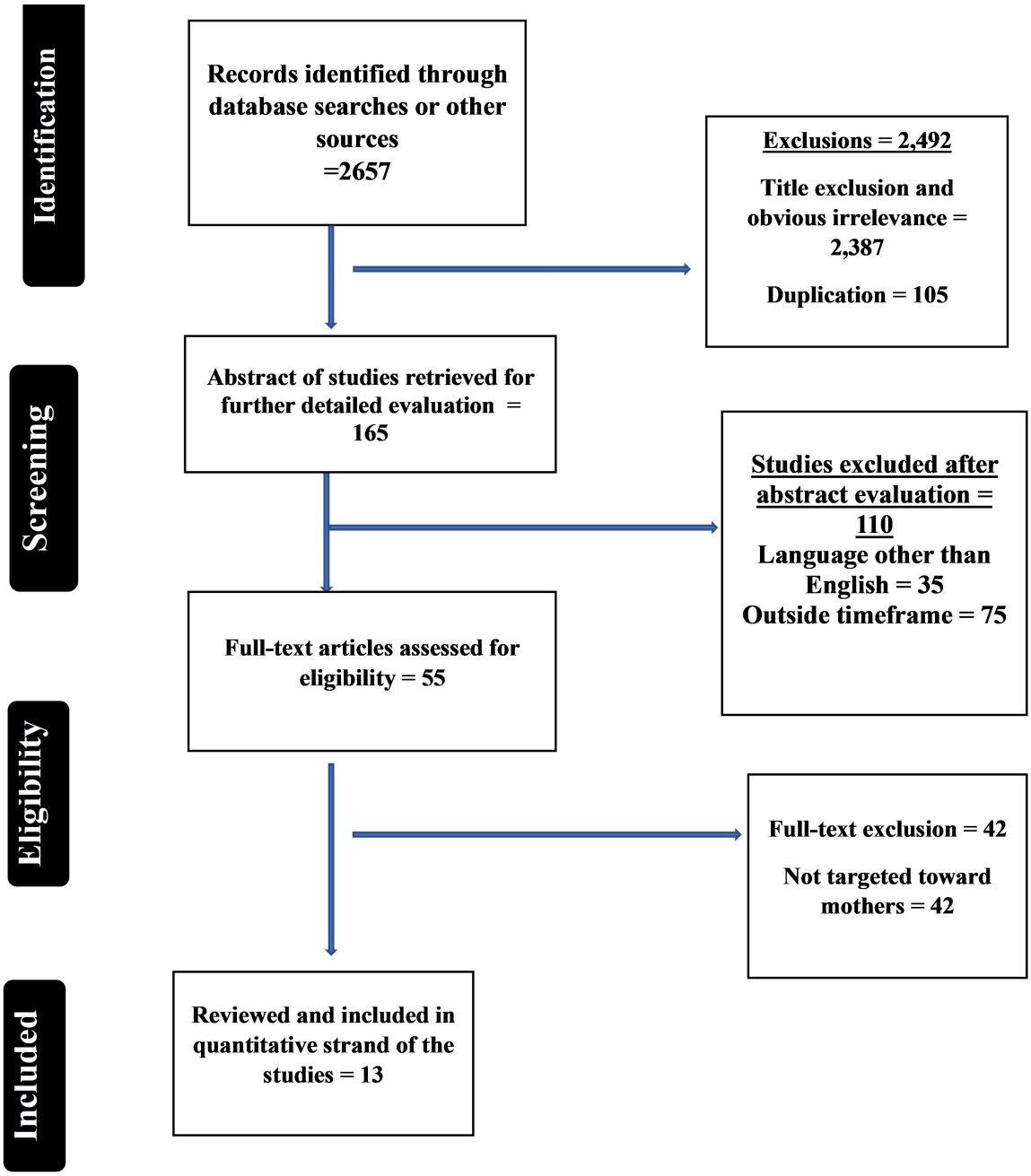

Figure 1 PRISMA Flow chart summarising the selection of articles for review

Table 1 Characteristics of included Articles

Author Year Reference	Study Design/type	Study population and sample size	Important findings
MacDougall et al. 2016 [17]	Randomized Controlled Trial (RCT)	346 women	Low level of knowledge regarding pertussis and its vaccine. Ten attitudinal statements have positive responses, ranged from 51.7% to 94.7% of women, indicating that attitudes towards maternal immunisation were generally favourable. Notably, 89% of pregnant women showed their willingness to receive pertussis vaccine if doctor recommended it. 61.6% showed reservation regarding vaccine safety.
D'Alessandro et al. 2018 [18]	cross-sectional study	358 Pregnant women	4.5% knew about diphtheria vaccine, 7% tetanus vaccine, 7.3% pertussis vaccine, and 21% seasonal influenza vaccine. Only 2.8% of respondents correctly identified all four immunisations, and one-fourth knew at least one of those that were advised.
Singh et al. 2019 [19]	cross-sectional study	200 postnatal mothers	The statistically significant association between age ($p = 0.031$), education ($p = 0.021$), occupation ($p = 0.013$) and knowledge score towards vaccination.
Dudley et al. 2020 [20]	cross-sectional study	2196 pregnant women	56% of pregnant women received both influenza and Tdap vaccines. 68% planned to immunize their baby with all proposed vaccines. Belief in vaccine safety and efficacy, perceived risk of vaccine-preventable diseases, social norms, and trust in vaccine information sources are attitude constructs associated with the intention to vaccinate.
Hong et al. 2021 [21]	cross-sectional survey	252 pregnant women	Despite less-than-ideal vaccination rates, 63% of survey participants had an overall good attitude towards vaccination. Of the women who think that pertussis can be fatal for babies, half think so. 50% of the women who think that pertussis can be fatal for babies.
Marchetti et al. 2021 [22]	cross-sectional survey	850 pregnant women	54.5% know the pertussis risks for infants. 59.8% know high risk of hospitalisation. 47.2% were aware that Tdap maternal immunisation was offered free of charge under the National Immunization Program
Mohammed and Al-Zahrani 2021 [23]	Cross-sectional study	210 women	While the majority of the moms in the study had appropriate immunisation practises, over two thirds had inadequate information.
Fuss et al. 2022 [24]	Cross-sectional study	28 pregnant women	All participants had gotten routine vaccines for themselves and their children and had positive opinions about them. Compared to other vaccines, attitudes were less favourable for the influenza vaccine. 86.2% were vaccinated against pertussis. 49.8% were vaccinated against influenza.
Areta et al. 2022 [25]	Multicentric, Prospective survey	950 women	In comparison to the pertussis vaccine, the influenza vaccine was five times more likely not to be offered (8.9% vs. 1.7%) and three times more likely to be rejected when offered (26.6% vs. 8%). Lack of maternal desire for either vaccine—rather than vaccine fear—was the main justification for refusal. At univariate analysis, maternal parity 1 was substantially related to vaccination against pertussis. Results revealed that females were considerably more expected to believe influenza vaccine if they had a university degree or had not given birth in a midwife-only run delivery centre.
Gilbert et al. 2022 [26]	cross-sectional study	5091 women	90% recalled whether they had received a pertussis vaccination; 43% had, whereas 57% had not. Mothers' primary excuse for not getting vaccinated was ignorance of the recommended pertussis immunisation schedule.
Scatigna et al. 2022 [27]	cross-sectional study	251 women	5.6% of women vaccinated against influenza, 16.4% immunized with Tdap during gestation, while 1.2% received both.
Wiley et al. 2015 [28]	cross-sectional study	815 women	Most women mentioned their healthcare provider, the hospital or clinic they attended, or the government when discussing influences on their attitudes and actions surrounding vaccination.
Wiley et al. 2013 [29]	cross-sectional study	815 women	80% reported willingness to take pertussis vaccine during pregnancy. 34% of women intended to receive pertussis vaccine postpartum, 17% had received it previously, and 45% had never heard of it, had not thought about it

showed that more than half of expecting women planned to vaccinate against influenza and Tdap during gestation, and 68% expected to immunise their unborn child against all advised vaccines before delivery. The following attitude dimensions are associated with intention to vaccinate perceived risk of vaccine-preventable diseases (ORs: 2–6), trust in sources of vaccine information, societal norms (ORs: 4–10), and confidence in vaccine safety (ORs: 16–38) and efficacy (ORs: 4–19). Compared to females who had previously given birth, first-time mothers were concerned about their intents to vaccinate both themselves and their unborn children, report having insufficient knowledge or information about vaccinations, and report feeling this way (p 0.01) [20].

Hong et al. (2021) found that most of the participants were knowledgeable that prenatal vaccinations have advantages for the unborn child and that vaccines are not contraindicated in gestation. The public's have good knowledge about influenza and superior to that of pertussis. Most did not know about local regulations and guidelines regarding vaccinations for pregnant and neonatal patients [21].

Another study results revealed that the increased risk of hospitalisation was known by two-thirds of the 54.5% who were aware of the pertussis dangers for neonates, and 47.2% who were aware that the National Immunization Plan (NIP) provided free Tdap maternal immunisation (MI). 47.4% of respondents believed that when making this decision, safety information pertaining to both the mother and the newborn was more important than safety information referring to the newborn alone (29.5%). About 52.2% of respondents indicated they would embrace MI, while 25.3% said they would require further information [22].

Mohammed and Al-Zahrani (2021) conducted a cross-sectional study in Sudan they found that more than two-thirds of recruited moms had low understanding. Whereas their practice was good towards vaccination, proving that there was no statistically significant correlation between their knowledge and practice [23].

Fuss et al. (2022) interviewed 28 pregnant women who attended antenatal care at a safety-net hospital in the United States to assess general attitudes towards immunisations and influenza and tetanus, diphtheria, and pertussis immunisation during pregnancy. It was revealed that all participants endorsed routine vaccinations and had both their own and their children's immunisations. Other immunisations were met with more favourable reactions compared to the influenza vaccination. Participants claimed they obtained their vaccine knowledge from several sources [24]. Myths about vaccine injury concerned participants even when they did not accept the origins of the inaccurate information. They all concurred that their medical professionals provided the most trustworthy information. According to the participants, the two key messages for promoting maternal immunisation are that it is safe for mother and child and protects the newborn after birth. Participants were not urged to acquire vaccinations despite learning about how important maternal sickness is [24].

Areta et al. (2022) aimed to ascertain the percentage of pregnant women in Geneva (Switzerland) who received the COVID-19 pandemic vaccines for pertussis and influenza. No statistically significant difference was found in the proportion of people who had gotten an influenza vaccination between the research periods. The influenza vaccine was three times more likely to be rejected when offered (26.6% vs. 8%) and five times more likely not to be offered than the pertussis vaccine (1.7% vs. 8.9%). The main rationale for refusal, rather than vaccine anxiety, was the lack of mother's willingness for either vaccine [25].

Gilbert et al. (2022) undertook a study to assess the sociodemographic characteristics related to non-vaccination and to gauge the uptake of pertussis vaccination during pregnancy in Canada; researchers found that mothers cited ignorance of the required pertussis vaccination as their primary excuse for not being vaccinated. Being born outside of Canada, having a lower household income, residing in a province or territory where the pertussis vaccination was not administered without charge, having previously given birth alive, and receiving prenatal care from a midwife were all factors independently linked to non-vaccination [26].

Scatigna et al. (2022) conducted a cross-sectional study in Italy to investigate Tdap. According to their findings, only 1.2% of individuals had received both vaccines, whereas 16.4% of pregnant women and 5.6% of women had received Tdap. The evaluation of the psychometric attitudinal variables has shown that women are more likely to be willing to accept the Tdap vaccine than the influenza vaccine since the former is thought to be more vital for the mother and the unborn child. Concerns about vaccine safety, a lack of knowledge, and misconceptions about the necessity of vaccination have been cited by healthcare professionals as obstacles to immunisation among pregnant women [27].

Discussion

This research aimed to investigate pregnant women's attitudes, knowledge, and behaviours toward the Tdap vaccine through a systematic review of the existing literature. Many countries are dealing with groups that refuse or ignore recommended vaccines. This is why the issue needs national immunisation programs to develop methods and strategies to address vaccination frequency as well as to introduce and make vaccination mandatory. Examining opinions regarding vaccination requirements could aid in the more efficient implementation of immunisation campaigns. An increasing number of studies on this subject are being conducted in different countries, especially in Europe (nine studies), the United States [27], Germany (seven), Italy [7], and Turkey (six); this confirms the extent of interest in this issue.

Mothers' attitudes toward Tdap vaccination differ among these studies, with some studies showing mothers' support toward Tdap vaccines and some studies showing that mothers did not know the importance of the vaccine or were ignorant of pertussis. Most of the studies showed that the response rate and the extent of mothers' knowledge about the significance of the vaccine were high. Therefore, mothers' attitudes toward vaccination and their acceptance of it were high. Nonetheless, some of them could not take it during pregnancy for several reasons, including economic, religious, and societal reasons. In addition, some of them increased their rate of taking the vaccine since they knew that the Ministry of Health had recommended it and made it compulsory. In some countries, it helped to include a inquire about whether the doctor or healthcare worker had introduced vaccination to women. Other studies included healthcare workers' attitudes toward vaccinations in Ireland and their keenness to clarify or explain the importance of vaccination to expectant mothers. The perspective of healthcare provider on vaccination is a significant factor in this regard, especially in light of studies that have shown that parents rely on it as a source of information. Studies have also shown that some mothers refused vaccination due to concerns about vaccine safety and efficacy since they did not have sufficient knowledge or experience. Thus, increasing the education and awareness of mothers about the necessity of vaccination and clarifying its importance for newborns will help to increase the vaccination rate.

Mott et al. (2021) analysed cohorts of mother-infant pairs found in the databases. The Tdap immunisation during pregnancy lowers the risk of pertussis by 36% during the first six months of life. Preterm babies, who have the highest risk of contracting pertussis and benefit most from this immunisation, are included in the vaccination when administered soon after 27 weeks of gestation [30].

In a South African study, there was good knowledge among 60% of the population covered, and four out of every six pregnant women explained the concept well. Further, 80% of the participants supported the immunisation of mothers if its importance was presented to them. However, pricing beyond what one can afford acted as an obstacle, especially considering that clinics in South Africa do not charge pregnant women for examinations. Religion was another reason for some not choosing to go ahead with vaccination, as they were worried

that the ingredients might include alcohol. Nevertheless, overall, there was a generally positive attitude regarding maternal vaccination [31].

Villarreal Perez et al. (2017) explored a randomised clinical trial (RCT) of the extent of safety and immunogenicity offered by the Tdap vaccine to pregnant females in Mexico and found that the formation of anti-pertussis antibodies in children of mothers who received the Tdap vaccine was delayed for up to 6 months. However, the Tdap vaccination of pregnant women produces antibodies in the mother that can be lost in as little as two months. Tdap vaccination, however, appears to be a workable and secure method of transferring pertussis antibodies from the mother's body to the child [32]. It is imperative that we accept the limitations of our review to be as specific as possible. Few studies were published outside Europe and the United States; this may be due to language limitations, given that our search excluded all studies published in other languages.

As revealed from this review, many countries (Mexico, USA, Italy, Switzerland, Canada, Sudan, Malaysia and Singapore) are currently dealing with groups that refuse or ignore recommended vaccines. National vaccination programmes are therefore necessary to address the issue and provide methods and strategies to increase vaccination frequency and introduce and make vaccination mandatory. The amount of knowledge of ladies and pregnant women about the importance of the vaccine depended upon several factors, including education level, occupation, age, sources of vaccine information, maternal desire, being born outside the country, lower household income, religious misconception, residing in a province or area where the pertussis vaccine was not free, having given birth to live children in the past, and receiving maternity care from a midwife.

There are some myths related to vaccination adverse events like autism associated with the measles, mumps, and rubella (MMR) vaccine. However, there are some documented adverse events associated with vaccination, including pain, erythema and fever in some cases, intussusception with rotavirus vaccine and other vaccines, human papillomavirus vaccine (HPV), Tdap, and quadrivalent meningococcal conjugate vaccine (MCV4) might slightly increase the risk of syncope in adults. Dtap vaccine fourth dose is associated with an increased risk of fever and erythema than the first dose [33]. A cross-sectional study was conducted to find the Tdap vaccine-related adverse events, including injection site reaction, pain, erythema, and fever; other adverse events include headache, dizziness, nausea, and arthralgia. This study also reported serious events including bleeding, preterm labour, eclampsia, tachycardia and hypertension [34]. Another study reported no such adverse reactions [35]. However, these were reported in observational studies. Therefore, causal relationships cannot be concluded.

Mothers' attitudes toward Tdap vaccination differ among the presented studies above, with some studies showing mothers' support toward Tdap vaccines [19–21, 24, 25] and some studies showing that mothers did not know the importance of the vaccine or were ignorant of pertussis [18, 23, 26, 27]. Therefore, it can be concluded that the increase in knowledge of the importance of the vaccine increased the percentage of women who supported and accepted the vaccine. Studies have also shown that some mothers refused vaccination due to concerns about the safety and efficacy of the vaccine since they did not have sufficient knowledge or experience. Thus increasing the education and awareness of mothers about the necessity of vaccination and clarifying its importance for newborns. This study investigated Tdap vaccine acceptability and examined reasons for vaccine refusal.

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