

# Role of sildenafil citrate in improving amniotic fluid indices in pregnant women with oligohydramnios: A comprehensive review



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**Abstract** This comprehensive review examines the potential role of sildenafil citrate in ameliorating oligohydramnios in pregnant women, focusing on its impact on amniotic fluid indices. Oligohydramnios, characterised by insufficient amniotic fluid, pose significant risks to fetal and maternal health. This review begins by elucidating the definition of oligohydramnios and its implications in pregnancy, emphasising the critical role of amniotic fluid in foetal development. The rationale for studying sildenafil citrate lies in its vasodilatory properties and potential to improve uteroplacental blood flow, thereby influencing amniotic fluid dynamics. The importance of amniotic fluid indices, particularly the amniotic fluid index (AFI), is discussed, highlighting their relevance as critical indicators of fetal well-being. This review synthesises evidence from experimental studies, both animal and human, exploring the effects of sildenafil citrate on amniotic fluid levels. Safety considerations, maternal and fetal outcomes, and the limitations of existing research are also addressed. The conclusions summarise vital findings, discuss implications for clinical practice, and emphasise the need for further research to establish the safety and efficacy of sildenafil citrate in managing oligohydramnios. This review contributes valuable insights for healthcare professionals, researchers, and policymakers seeking evidence-based approaches to enhance pregnancy outcomes in cases of oligohydramnios.

**Keywords:** sildenafil citrate, oligohydramnios, pregnancy, amniotic fluid index (AFI), intrauterine environment, gestation

## 1. Introduction

Oligohydramnios is defined as decreased amniotic fluid volume (AFV) for gestational age. The volume of amniotic fluid changes over gestation, increasing linearly until 34 to 36 weeks of gestation, at which point the AFV levels off (approximately 400 mL) and remains constant until term (Khan et al., 2022). Amniotic fluid plays a crucial role in fetal development, providing a protective environment and facilitating various physiological processes. Oligohydramnios is typically diagnosed when the amniotic fluid index (AFI) falls below the normal range, indicating a potential risk to both the fetus and the pregnant woman (Khan et al., 2022). Maintaining adequate amniotic fluid levels is paramount throughout gestation. Amniotic fluid contributes to fetal lung development, cushioning the fetus from external trauma, aiding in temperature regulation, and supporting proper fetal movement. Oligohydramnios is associated with an increased risk of adverse pregnancy outcomes, including foetal growth restriction, developmental abnormalities, and complications during labour and delivery (Fitzsimmons & Bajaj, 2024). The amniotic fluid index is a standardised way to assess the sufficient quantity of amniotic fluid during pregnancy. The amniotic fluid index is used in patients at least 24 weeks pregnant with a singleton gestation (Fitzsimmons & Bajaj, 2024).

This review aims to investigate the role of sildenafil citrate in addressing oligohydramnios during pregnancy. Sildenafil citrate, a well-known phosphodiesterase type 5 inhibitor, has been explored for its vasodilatory properties, which may have implications for uteroplacental blood flow. The rationale for studying sildenafil citrate lies in its potential to improve amniotic fluid indices and mitigate the associated risks for both the fetus and the mother. Understanding and monitoring amniotic fluid indices are crucial components of prenatal care. Amniotic fluid indices, such as the AFI, provide valuable information about fetal well-being and the intrauterine environment. Abnormalities in these indices, particularly the occurrence of oligohydramnios, warrant attention and intervention. This review will delve into the importance of amniotic fluid indices as critical indicators of fetal health and the potential impact of sildenafil citrate in modulating these indices for improved pregnancy outcomes.

## 2. Review

### 2.1. Oligohydramnios in pregnancy



2.1.1. Causes and risk factors

Postdate pregnancy, defined as a period exceeding two weeks past the due date, significantly elevates the risk of oligohydramnios. During this extended gestational period, the quantity of amniotic fluid typically diminishes, increasing the likelihood of oligohydramnios (Keilman & Shanks, 2024). Premature rupture of membranes has been identified as another significant contributor to oligohydramnios. When the amniotic sac ruptures before the onset of labour, it can significantly reduce amniotic fluid levels. This underscores the critical importance of maintaining the integrity of the amniotic sac until the appropriate delivery time (Bakhsh et al., 2021).

Oligohydramnios is intricately linked to potential fetal complications, encompassing conditions such as intrauterine growth restriction, congenital disabilities, and impaired fetal kidney function. These factors collectively exert an adverse influence on the production of amniotic fluid, emphasising the crucial role of amniotic fluid in supporting normal fetal development (Bakhsh et al., 2021). Maternal health issues also play a significant role in the development of oligohydramnios. Conditions such as chronic hypertension, vascular disease, or uteroplacental insufficiency contribute to an imbalance in the regulation of amniotic fluid levels. This highlights the interconnected nature of maternal and fetal health in the context of oligohydramnios (Bakhsh et al., 2021; Opichka et al., 2021).

Oligohydramnios may, in some cases, be idiopathic or associated with factors such as maternal dehydration or specific medications. Vigilant monitoring of amniotic fluid levels through ultrasound and other diagnostic tests is essential for healthcare providers to promptly detect and manage oligohydramnios, as it has the potential to lead to various pregnancy complications and impact the overall well-being of the developing baby (Figuroa et al., 2020). The prognosis and management of oligohydramnios depend on factors such as underlying causes, gestational age at diagnosis, and severity of the condition (Keilman & Shanks, 2024). These findings underscore the need for a comprehensive and individualised approach for addressing oligohydramnios on the basis of its diverse etiological factors. Causes and risk factors for oligohydramnios during pregnancy are shown in Figure 1.

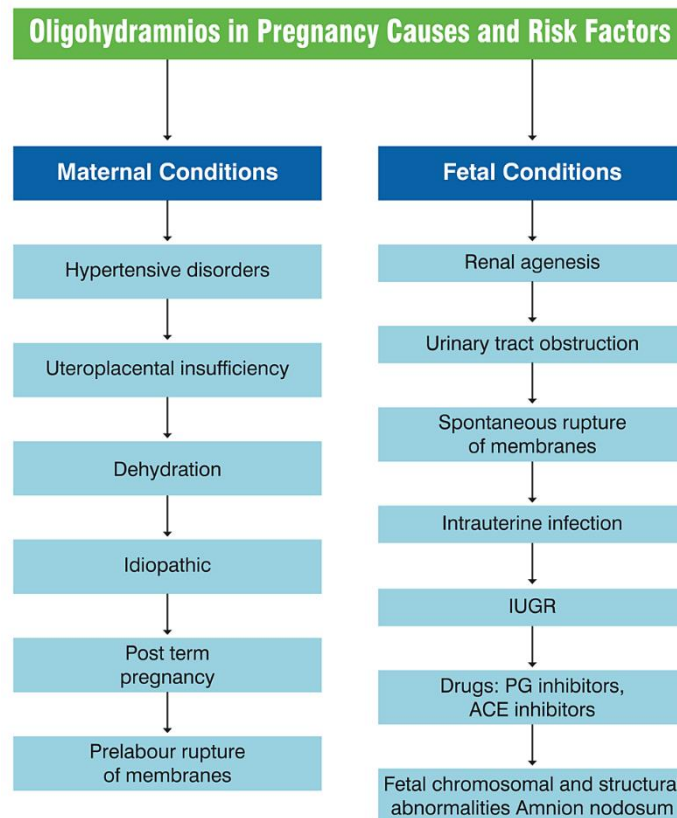


Figure 1 Causes and risk factors for oligohydramnios during pregnancy.

2.1.2. Complications for the fetus and mother

Studies exploring the impact of sildenafil on foetal outcomes have suggested a potential association with increased foetal weight at birth in cases of placental insufficiency. This observation implies a potential therapeutic role for sildenafil in mitigating foetal growth restriction, signifying a potentially less severe condition for the foetus (Ferreira et al., 2019). However, it is crucial to approach these findings cautiously, acknowledging the preliminary nature of the evidence and underscoring the



imperative for further research to substantiate and validate these potential benefits. In contrast, a randomised clinical trial assessing the effects of sildenafil on perinatal outcomes revealed no significant reduction in the risk of perinatal mortality or major neonatal morbidity compared with a placebo (Pels et al., 2017). These findings suggest that while sildenafil may exhibit potential benefits in specific aspects of fetal development, these advantages may not necessarily translate into substantially reduced overall perinatal risk.

Research has indicated that the incidence of preeclampsia and HELLP syndrome remains comparable between mothers treated with sildenafil and those administered a placebo (Pels et al., 2017). These findings suggest that, on the basis of current evidence, sildenafil may not have a significant protective effect against these severe maternal complications during pregnancy. The recognised role of sildenafil in treating pulmonary hypertension, a severe condition during pregnancy, highlights its importance in maternal care; for pregnant women with pulmonary hypertension, reliable postpartum contraception and consistent consultation with a specialist pregnancy and heart clinic are deemed essential throughout the gestational period to ensure appropriate management and monitoring (De Bie et al., 2022).

While some studies have not strongly linked sildenafil with severe neonatal side effects, continuous monitoring of baby health remains paramount. The pregnancy category for this drug is B, and pharmacokinetic data suggest that 25–50 mg of sildenafil be administered orally as the initial dose for most patients (De Bie et al., 2022). This cautious approach acknowledges the limited scope of existing research on the effects of sildenafil on neonates and reinforces the need for ongoing surveillance to discern potential implications for newborn well-being (De Bie et al., 2022). Importantly, extensive research on the application of sildenafil in pregnant women is lacking, emphasising the urgent need for further investigations to comprehensively understand the potential risks and benefits associated with its use during pregnancy.

### 2.1.3. Current Management Strategies

Oligohydramnios, characterised by decreased amniotic fluid levels, demand careful management, particularly when identified in the second or third trimester of pregnancy. The prognosis and management of oligohydramnios hinge on crucial factors such as the underlying cause, the gestational age at diagnosis, and the severity of the condition (Twesigomwe et al., 2022). Treatment strategies primarily revolve around preserving the pregnancy as long as it remains safe to do so. This often entails collaboration with maternal–fetal medicine specialists and neonatologists to tailor individualised care plans, determine the optimal timing for delivery, and ensure comprehensive postpartum care (Twesigomwe et al., 2022). When oligohydramnios is detected in the last trimester, potential complications may include congenital disabilities, preterm birth, or stillbirth (Figueroa et al., 2020). The diagnosis of oligohydramnios is typically conducted through ultrasound examinations, allowing healthcare providers to assess amniotic fluid levels accurately. Close monitoring becomes imperative, involving regular prenatal visits, additional ultrasounds, and nonstress tests to track fetal well-being and adjust the management plan as needed (Debbink et al., 2021). While no foolproof method prevents oligohydramnios, some studies suggest that maintaining adequate hydration may support amniotic fluid levels (Debbink et al., 2021). This underscores the importance of holistic prenatal care, including lifestyle considerations, vigilant monitoring, and medical interventions, to mitigate the potential risks associated with oligohydramnios.

## 2.2. Sildenafil citrate

### 2.2.1. Overview

**Mechanism of action:** Sildenafil functions through the selective inhibition of phosphodiesterase 5 (PDE5), an enzyme responsible for degrading cyclic guanosine monophosphate (cGMP), a crucial regulator of blood flow in both the penile and pulmonary vasculature (Huang & Lie, 2013). By impeding PDE5 activity, sildenafil effectively halts the breakdown of cGMP, leading to elevated levels of cGMP within the smooth muscle cells of the corpus cavernosum and pulmonary vasculature. This, in turn, induces relaxation and vasodilation (Huang & Lie, 2013). The resulting vasodilatory effect promotes increased blood flow to the penis, facilitating erectile function in the presence of sexual stimulation. Additionally, it reduces pulmonary vascular resistance in patients with pulmonary arterial hypertension (Ghofrani et al., 2006). The molecular structure of sildenafil closely resembles that of cGMP, enabling it to competitively bind to the catalytic site of PDE5, thereby inhibiting the breakdown of cGMP and prolonging its vasodilatory effects (Turko et al., 1999).

**Medical uses:** Sildenafil, classified as a phosphodiesterase type 5 (PDE5) inhibitor, is instrumental in augmenting blood flow to the penis, thereby enabling erections during sexual stimulation. The brand name Viagra is a widely utilised treatment for erectile dysfunction (ED) in men (Huang & Lie, 2013). Additionally, sildenafil has been applied to address pulmonary arterial hypertension (PAH), which is characterised by elevated blood pressure in the vessels transporting blood to the lungs. Its mechanism involves relaxing blood vessels in the lungs, facilitating smoother blood flow. When marketed under the brand names Revatio and Grandipam, sildenafil should not be used concomitantly with nitrates because of the potential for a dangerous drop in blood pressure. Moreover, its usage with alpha-blockers may result in a severe reduction in blood pressure. Notably, sildenafil is effective only when it is coupled with sexual stimulation and does not increase sexual desire or serve as a preventive measure for pregnancy or sexually transmitted diseases (Huang & Lie, 2013).

### 2.2.2. Previous applications in obstetrics

**Role in improving uteroplacental blood flow:** The role of sildenafil citrate in enhancing uteroplacental blood flow has been substantiated through various studies. In nonpregnant nulliparous women, a study demonstrated that sildenafil citrate effectively increases uterine blood flow, highlighting its potential to enhance uteroplacental perfusion (Hale et al., 2010). Moreover, in the context of fetal growth restriction (FGR), research has indicated that sildenafil citrate contributes to vasodilatation, suggesting that it is a potential therapeutic avenue for improving uteroplacental blood flow in pregnancies affected by FGR (Panda et al., 2014). The implications of sildenafil citrate as a treatment for intrauterine growth restriction (IUGR) have been explored in studies that suggest its positive impact. The medication has promoted myometrial small artery vasodilatation, thereby reducing peripheral resistance and increasing blood flow within the uteroplacental bed (Sharp et al., 2018). The Maternal Sildenafil for Severe Fetal Growth Restriction (STRIDER) study has further hypothesised that sildenafil has the potential to enhance uteroplacental perfusion, consequently leading to improved fetal growth and overall well-being (Rakhanova et al., 2023). The administration of sildenafil citrate to pregnant individuals has demonstrated noteworthy effects on fetal and placental hemodynamics, offering insights into its potential utility in managing IUGR (Rakhanova et al., 2023). These findings collectively underscore the promising role of sildenafil citrate in optimising uteroplacental blood flow and suggest its potential as a therapeutic intervention for conditions associated with impaired fetal growth and well-being.

**Potential benefits for oligohydramnios:** Sildenafil citrate has notable potential in addressing complications associated with oligohydramnios, as evidenced by various research findings. One significant outcome is its capacity to increase amniotic fluid volume, particularly in pregnancies where oligohydramnios poses a challenge. Multiple studies have consistently demonstrated the efficacy of sildenafil citrate in elevating amniotic fluid levels, positioning it as a promising therapeutic option for mitigating the impact of oligohydramnios (Vahid Dastjerdi et al., 2022). Moreover, in cases of idiopathic oligohydramnios, sildenafil citrate has emerged as a potential solution for improving the amniotic fluid index (AFI). This observation suggests the targeted effectiveness of sildenafil citrate in addressing idiopathic instances of oligohydramnios, thereby offering a tailored approach to increase amniotic fluid levels (Nasrolahi et al., 2023). The potential benefits of sildenafil citrate extend to the realm of fetal maturity. Optimising amniotic fluid dynamics is believed to contribute to prolonging the window of fetal maturity. This extension of gestational duration promises to reduce neonatal morbidity by providing more time for fetal development and preparedness for birth (Choudhary et al., 2016). Encouragingly, sildenafil citrate shows promise in impacting delivery outcomes. A randomised controlled trial indicated that women administered sildenafil citrate have a lower rate of cesarean delivery than those receiving hydration alone. This finding suggests a potential influence of sildenafil citrate on delivery methods, potentially decreasing the need for cesarean sections in specific scenarios (Choudhary et al., 2016). Another noteworthy outcome from the same trial is the reduced likelihood of neonates born to women receiving sildenafil citrate being admitted to the neonatal intensive care unit (NICU). This finding underscores the potential of sildenafil citrate to improve neonatal outcomes, potentially lessening the need for intensive care interventions (Choudhary et al., 2016). Furthermore, the ability of sildenafil citrate to prolong pregnancy by more than two weeks is important for fetal development. This additional time within the womb may offer crucial moments for maturation. However, further research is needed to confirm the safety and effectiveness of sildenafil citrate in treating oligohydramnios. While the findings of the Stricker study suggest that sildenafil may not be universally effective, it does not report any severe adverse effects for either mothers or neonates, opening a potential avenue for therapeutic intervention (Choudhary et al., 2016).

### 2.3. Effects of sildenafil citrate on amniotic fluid indices

#### 2.3.1. Experimental studies

Sildenafil citrate has demonstrated efficacy in increasing the amniotic fluid volume among pregnant women diagnosed with oligohydramnios, as substantiated by several studies. A randomised controlled trial specifically highlighted the capacity of sildenafil citrate to increase amniotic fluid production in pregnant women experiencing oligohydramnios and borderline oligohydramnios, revealing no significant adverse effects for either the mother or fetus (HI et al., 2016). Another study focused on pregnancies complicated by oligohydramnios; sildenafil citrate was associated with increased amniotic fluid volume, and neonates born to mothers in the sildenafil group presented a reduced likelihood of being admitted to the neonatal intensive care unit (Choudhary et al., 2016). The administration of sildenafil citrate in the third trimester has emerged as an effective and safe treatment for idiopathic oligohydramnios, with notable improvements in the amniotic fluid index (Vahid Dastjerdi et al., 2022). However, findings from a randomised controlled trial raised considerations, suggesting that sildenafil, when combined with fluid therapy, might not yield significant improvements in pregnancy outcomes for pregnant women with idiopathic borderline oligohydramnios. Despite this, the trial did not report any severe adverse effects on maternal or neonatal health (Gizzo et al., 2015). Overall, the collective evidence suggests that sildenafil citrate holds promise as a therapeutic intervention for managing oligohydramnios, presenting a balance between efficacy and safety in improving pregnancy outcomes.

### 2.3.2. Mechanisms underlying improvement

**Vasodilatory effects:** Sildenafil citrate has vasodilatory effects that potentially increase amniotic fluid indices in pregnant women experiencing oligohydramnios. The mechanism involves the inhibition of phosphodiesterase type 5 (PDE5), an enzyme that rapidly degrades cyclic guanosine monophosphate (cGMP) upon its formation. This inhibition leads to increased cGMP levels, stimulating the activity of soluble guanylate cyclase (sGC), which further produces cGMP. The resulting vascular relaxation and increased uterine blood flow potentially contribute to improvements in amniotic fluid indices (Vahid Dastjerdi et al., 2022). Notably, the vasodilatory effects of sildenafil citrate may sometimes decrease blood pressure, which can manifest asymptotically or lead to symptoms such as headache and flushing (Vardi et al., 2002).

**Impact on fetal renal function:** The precise mechanisms underlying the enhancement of fetal renal function by sildenafil citrate are not entirely understood. However, insights from studies on fetal renal development and function have shed some light on potential interactions. During pregnancy, one study reported a 50% increase in the glomerular filtration rate (GFR) compared with prepregnancy levels; however, the exact mechanisms driving this elevation remain incompletely understood (Terstappen et al., 2019). Another study delves into the evaluation of fetal renal function, considering factors such as amniotic fluid volume, ultrasonographic appearance of kidneys, urine production, and the biochemical composition of fetal urine (Ezuruike et al., 2022). While various methods can be used to quantify postnatal renal function, options for assessing fetal renal function are limited. Sildenafil citrate has demonstrated its ability to increase amniotic fluid production in pregnancies marked by oligohydramnios and borderline oligohydramnios, resulting in later deliveries, reduced cesarean delivery rates, and a decrease in neonates admitted to the neonatal intensive care unit (Ezuruike et al., 2022). Nevertheless, further research is imperative to understand the specific mechanisms underlying the positive impact of sildenafil citrate on fetal renal function.

## 2.4. Safety considerations

### 2.4.1. Maternal side effects

**Maternal side effects:** Various clinical studies have documented mild maternal side effects associated with sildenafil usage, including headaches, flushing, visual disturbances, dizziness, palpitations, arthralgia, dyspepsia, and epigastric pain. Notably, these studies did not identify an increased risk of these side effects compared with a placebo (Vahid Dastjerdi et al., 2022). While these effects are generally considered mild, continuous monitoring and further research are necessary to assess the overall impact on maternal well-being comprehensively.

**Pregnancy and breastfeeding:** The typical use of sildenafil during pregnancy is linked to the treatment of severe conditions such as pulmonary hypertension. If a woman becomes pregnant while taking sildenafil, it is crucial to maintain the medication regimen and communicate this information to the healthcare team. The evidence suggests that sildenafil is unlikely to cause adverse effects in the baby, and it is generally considered safe for use during breastfeeding, provided that the baby is healthy (Zhang & Huangfu, 2022). Nevertheless, vigilant oversight and ongoing research are warranted to ensure a thorough understanding of the potential implications for the mother and the infant.

**Fetal outcomes:** A systematic review and meta-analysis revealed an association between sildenafil usage and increased fetal weight at birth in pregnancies complicated by conditions such as placental insufficiency. However, the existing evidence is limited, underscoring the need for additional research to fully elucidate the effects of sildenafil on fetal outcomes (Ferreira et al., 2019). This highlights the importance of a cautious and informed approach to the use of sildenafil during pregnancy, considering its potential impacts on fetal development.

**Overall safety:** Results from a randomised controlled trial offer some reassurance regarding the safety profile of sildenafil citrate in pregnancy, particularly in enhancing amniotic fluid production for women with oligohydramnios. Notably, this trial did not identify significant issues for the mother or the fetus (Vahid Dastjerdi et al., 2022). However, while these findings are encouraging, the safety and effectiveness of sildenafil during pregnancy necessitate further rigorous research. Ongoing investigations are essential to establish a comprehensive understanding of the potential benefits and risks associated with sildenafil use in the context of pregnancy.

### 2.4.2. Fetal and neonatal outcomes

**Fetal and neonatal outcomes:** Sildenafil may be associated with an increase in fetal weight at birth, particularly in cases of placental insufficiency, suggesting potential benefits for pregnancies characterised by fetal growth restriction (FGR) (Ferreira et al., 2019). These findings highlight a potential avenue for improving fetal and neonatal outcomes, but further research is essential to establish the broader safety and efficacy of sildenafil in diverse pregnancy conditions (Vahid Dastjerdi et al., 2022).

**Recommendations and precautions:** Sildenafil is currently advised against the use of sildenafil to treat foetal growth restriction, and women taking sildenafil during pregnancy are strongly encouraged to inform their healthcare team. Any alterations to the medication regimen should be made only under the guidance of a healthcare professional (Pels et al., 2020). The utilisation of sildenafil during pregnancy necessitates careful consideration due to legal and ethical implications, and it is

not approved for use in some countries. Consequently, women are urged to exercise caution and seek medical advice before incorporating sildenafil into their pregnancy management (De Bie et al., 2022).

**Limited research and ethical considerations:** Despite the intriguing potential benefits, comprehensive research on the safety and efficacy of sildenafil use during pregnancy remains scarce. Many studies on this topic are either small or possess limitations that hinder definitive conclusions (De Bie et al., 2022). Women are advised to meticulously weigh the potential risks and benefits, considering individual circumstances on a case-by-case basis (De Bie et al., 2022). The evolving research landscape underscores the need for more robust studies to establish a clearer understanding of the implications of sildenafil use in the complex context of pregnancy.

#### *2.4.3. Long-term implications*

An examination of 67 double-blind placebo-controlled trials and the postmarketing safety database revealed that sildenafil at 50 and 100 mg doses exhibited general tolerability, even among elderly men, with no observed causal link to cardiovascular events (Giuliano et al., 2010). While sildenafil is generally well tolerated, it can induce specific side effects with varying frequencies. Importantly, it should not be used concurrently with any other medication or device designed to induce erections, and caution is advised for individuals with preexisting heart conditions, as sildenafil can lead to serious side effects in such cases (Hatzimouratidis, 2006). A comprehensive study investigating the prolonged safety and efficacy of sildenafil citrate in men with erectile dysfunction revealed that it was well tolerated and effective for a duration of up to four years (McMurray et al., 2007). While some studies indicate improved outcomes for women with pulmonary arterial hypertension treated with sildenafil, further research is imperative to enhance our understanding of its effects (McMurray et al., 2007).

#### *2.5. Current challenges and limitations*

##### *2.5.1. Limited evidence*

Numerous studies have suggested the potential of sildenafil citrate in increasing amniotic fluid indices among pregnant women with oligohydramnios. However, the current body of evidence remains limited, emphasising the need for more robust, well-designed, and large-scale trials to conclusively establish the safety and efficacy of this treatment (Vahid Dastjerdi et al., 2022). The existing findings, while promising, necessitate further validation through comprehensive research efforts.

##### *2.5.2. Unclear mechanism of action*

The precise mechanism underlying how sildenafil citrate augments amniotic fluid production remains unclear. It is hypothesised that this medication may enhance uteroplacental blood flow, potentially increasing amniotic fluid levels. However, this hypothesis requires further substantiation through additional research to elucidate the intricate mechanisms at play (Dastjerdi et al., 2012). A comprehensive understanding of the mechanism is pivotal for optimising the application of sildenafil citrate in the context of amniotic fluid management.

##### *2.5.3. Potential side effects*

While existing studies have not identified significant side effects for either the mother or the fetus using sildenafil citrate, it is essential to acknowledge that this medication carries inherent risks. As a phosphodiesterase-5 inhibitor commonly employed to address erectile dysfunction in men, concerns arise regarding potential long-term effects on the fetus. Despite the absence of reported significant issues in current studies, a vigilant approach is warranted, given the medication's pharmacological nature (De Bie et al., 2022). Continuous monitoring and further investigations are imperative to delineate potential risks comprehensively.

##### *2.5.4. Limited understanding of optimal dosing*

Establishing the optimal dosage for sildenafil citrate to improve amniotic fluid indices remains an ongoing challenge. While many studies have employed a dosage regimen of 50 mg every 8 hours, the efficacy and safety of this dosage regimen have yet to be definitively determined. A comprehensive exploration of dosing strategies is essential for refining and optimising the therapeutic application of sildenafil citrate in this context (Vahid Dastjerdi et al., 2022).

##### *2.5.5. Limited understanding of long-term effects*

Despite the demonstrated short-term efficacy in improving amniotic fluid indices, the potential long-term effects of sildenafil citrate on both the mother and the fetus remain uncertain. Further research endeavors are imperative to ascertain the enduring safety and efficacy of sildenafil citrate in this specific clinical context (Choudhary et al., 2016). A comprehensive understanding of the long-term implications is crucial for guiding clinical practice and ensuring the well-being of both the mother and the fetus over an extended period.

### 2.5.6. Limited understanding of the role of fetal growth restriction

While specific studies have proposed that sildenafil citrate might enhance fetal growth and positively influence Doppler patterns in uterine and umbilical arteries in pregnancies complicated by oligohydramnios and fetal growth restriction, a conclusive understanding of its role in this context remains elusive. Further research is imperative to validate and establish the specific contribution of sildenafil citrate in addressing foetal growth restriction (Choudhary et al., 2016).

### 2.5.7. Limited understanding of the role of early-onset fetal growth restriction

Some studies have suggested the potential of sildenafil citrate to improve amniotic fluid indices and foetal growth in pregnancies affected by early-onset foetal growth restriction. However, the current understanding of the precise role of sildenafil citrate in mitigating early-onset foetal growth restriction is limited, necessitating additional research to corroborate its efficacy in this specific scenario (Choudhary et al., 2016).

### 2.5.8. Limited understanding of the role of preeclampsia in pregnant patients

The exclusion of women with preeclampsia from certain studies has left an information gap regarding the safety and efficacy of sildenafil citrate in pregnancies complicated by preeclampsia. Comprehensive research is essential to elucidate whether sildenafil citrate is a safe and effective option in the context of pregnancies with preeclampsia, considering the potential implications for maternal and fetal well-being (Gillis et al., 2016).

### 2.5.9. Limited understanding of the role of sildenafil citrate in women with allergies

Allergic reactions to sildenafil citrate may pose challenges for some women, and the effectiveness of alternative treatments remains uncertain. To address this knowledge gap, further research is needed to comprehensively understand the role of sildenafil citrate and explore suitable alternatives for women with allergies to this medication (Gillis et al., 2016).

### 2.5.10. Limited understanding of the role of women with other medical conditions

The potential influence of other medical conditions on the response to sildenafil citrate remains inadequately understood. Given the varied health profiles of women, additional research is imperative to unravel the role of sildenafil citrate in individuals with diverse medical conditions, providing valuable insights into its broader applicability and potential limitations (Gillis et al., 2016).

## 3. Conclusions

In conclusion, this comprehensive review on the role of sildenafil citrate in addressing oligohydramnios in pregnant women presents a promising avenue for improving fetal outcomes. These findings underscore the potential of sildenafil citrate to increase vasodilation, uteroplacental blood flow, and fetal renal function, collectively contributing to the maintenance of adequate amniotic fluid levels. The implications for clinical practice suggest that integrating sildenafil citrate into the management of oligohydramnios could be a valuable strategy for mitigating associated risks. However, carefully considering safety profiles, optimal dosages, and individual patient characteristics is paramount before its routine use in obstetric care. This review recommends further research through large-scale randomised controlled trials to solidify the evidence base, explore optimal treatment parameters, and identify specific patient subgroups that may benefit the most. A collaborative effort between researchers and clinicians is crucial for refining clinical guidelines and ensuring the responsible and effective incorporation of sildenafil citrate into obstetric practices, ultimately enhancing patient outcomes and maternal–fetal well-being.

### Ethical Considerations

Not applicable.

### Conflict of Interest

The authors declare no conflicts of interest.

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