Texila International Journal of Medicine
ISSN: 2520-3118
DOI: 10.21522/TIJMD.2013.08.02.Art005

The Impact of Vitamin-B12 Deficiency on Miscarriage

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Abstract

Vitamin B12 is essential for bodily functions that are vital for human growth and well-being, especially during pregnancy when it plays a key role in the development of the fetus. Exploring the role of vitamin B12 in the early stages of pregnancy is the main focus of this review article. The focus is on how it impacts neural tube formation in the early stages of pregnancy. A comprehensive analysis of research was undertaken to investigate the impact of maternal vitamin B12 levels on fetal growth and pregnancy outcomes. Several studies have found a link between vitamin B12 levels and negative effects on the health of mothers and infants when pregnant. There could be factors contributing to this situation possibly linked to how vitamin B12 aids, in the production of blood cells that transport oxygen and essential nutrients to support the growth of the babies circulatory system early on in development Additionally vitamin B12 is involved in the growth of the system creation of myelin and closure of the neural tube. Insufficient levels of vitamin B12 have been associated with problems. Decreased cognitive abilities in the children of mothers according to research findings The study underscores the importance of maintaining adequate vitamin B12 levels for women who are pregnant or considering pregnancy suggesting that supplements could play a crucial role, in preventing adverse pregnancy outcomes and supporting the healthy growth of the babies brain. Insufficient levels of vitamin B12 may impact the development of the fetus in the womb. Increase the risk of neural tube defects or miscarriage, in pregnant women.

Keywords: *Fetal Development, Miscarriage, Pregnancy, Vitamin B12.*

Introduction

Vitamin B12, commonly known as cobalamin (refer to Figure 1), is a water vitamin with a complex chemical composition that includes a cobalt ion in the heart of a corrin ring structure similar to heme [1]. This specific structure contributes to the vitamin's functions within the body and is especially important during pregnancy.

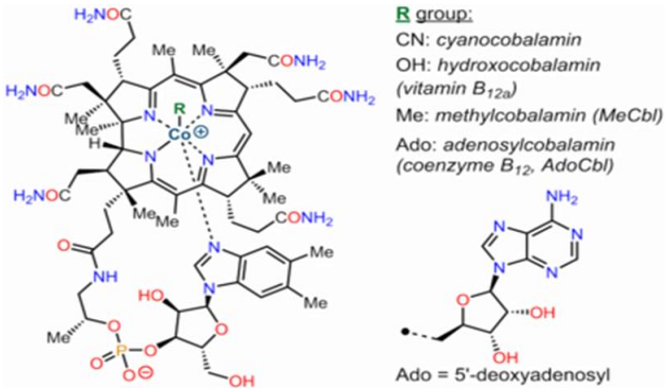

Figure 1. Chemical Structure of Vitamin B12 [1]

Received: 05.05.2025 ***Accepted: 11.06.2025*** ***Published on: 31.07.2025***

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In the world of vitamins and nutrition science (as shown in Figure 1) Vitamin B12 goes by the name cobalamin. Belongs to the water soluble vitamin family with a rather intricate molecular makeup that includes a cobalt ion nestled in the center of a corrin ring structure reminiscent of heme [1]. This unique structure plays a role in how the vitamin functions, in the body and becomes particularly crucial during pregnancy. Throughout pregnancy stages Vitamin B12 assists in breaking down carbohydrates and fats to help expectant mothers maintain energy levels despite their heightened nutritional needs. Insufficient consumption of Vitamin B12 while pregnant can result in issues such as fatigue and anemia [2]. If not addressed promptly and effectively managed it may develop into anemia condition involving the presence of unusually large and immature red blood cells with accompanying symptoms, like difficulty breathing [3].

Additionally " vitamin B12 plays a role in maintaining emotional health." A lack of vitamin B12 has been associated with changes in mood like feeling downcast or edgy and experiencing unease [4]. It is essential for women to ensure adequate levels of vitamin B12 for their mental well being and the proper development of their babys nervous system. Which includes the brain and spinal cord [5, 6]. Williamson (2004) emphasized the importance of obtaining vitamin B12 for optimal fetal growth and neurological development, throughout pregnancy. "Pregnant women are advised to ensure their B12 levels are adequate either through their diet or, by taking supplements.

Vitamin B12 deficiency could play a role in fertility problems as pernicious anemia resulting from lack of B12 is known to cause infertility. Research indicates that B12 levels decline postpartum and 20% of pregnant women, in mid pregnancy have inadequate levels of vitamin B12.

In a study by Scholing and colleagues in 2018 they examined 147 mothers in their second, to third trimester and found that 21% of the participants. Which amounts to 32 women. Had low levels of vitamin B12 [10]. Additionally, it was noted that poor eating habits were linked to higher plasma homocysteine levels, which are indicative of a lack of B12. B12 levels typically stabilize at 30% of their pre-pregnancy levels during the initial trimester [10].

The research looked at more than serum B12. It also examined B12-binding proteins. B12 is associated with red blood cells. The study found changes in B12 transport proteins even though there were no obvious signs of a deficiency [11]. These results back up the idea that pregnancy leads to a decrease in vitamin B12 levels in the mother's bloodstream [12].

Overview of the Month-by-Month Effects of Vit-B12 on Pregnancy

Throughout the duration of pregnancy, vitamin B12 is crucial, as it impacts fetal development significantly at each stage of the process, and its absence or insufficiency can have a notable effect on fetal growth and health outcomes. During the month of pregnancy vitamin B12 helps in forming the structure that becomes the basis for the brain and spinal cord; its deficiency at this stage has been linked to issues such as spina bifida. As the pregnancy advances further B12 remains crucial in promoting the growth of the fetus and a lack of it could lead to a delay, in fetal development. During pregnancy month by month ensuring an adequate intake of vitamins is vital for the proper development of the placenta to provide nutrients and oxygen to the baby; a deficiency can impact the placentas function and jeopardize the baby's well-being. In a given month, during pregnancy it is crucial to have ample B12 for the baby's brain development to prevent potential cognitive issues in the future.[13].

Throughout pregnancy month by month Vitamin B12 plays a role in forming the babys immune system. Insufficient levels during this time can lower immunity leaving the body susceptible to illnesses. Additionally Vita-B12 is vital for the growth of the system during pregnancy. Inadequate levels may result in challenges, with muscle and nerve control.Throughout pregnancy your baby requires vitamin B12 for growth and development. Inadequate levels could lead to a birth weight. As the months progress B12 remains essential in aiding your babys development. A deficiency during this period may result in problems post birth. Ultimately vitamin B12 is crucial, in ensuring your baby undergoes development throughout the month. Ensuring an intake of vitamin B12 is vital during pregnancy to promote optimal fetal development and prevent potential health complications like vision problems that may arise due to a deficiency, in this nutrient [13-15].

Vitamin B12 and Pregnancy Complications

Low levels of vitamin B12 in women have been associated with health concerns for both the mother and the baby throughout pregnancy as research has shown a clear link between maternal vitamin B12 levels and potential issues, in fetal brain development according to various studies like the one carried out by Afman et al., where they highlighted instances of neural tube defects (NTDs) in pregnancies affected by B12 deficiency [16]. In a study that focused on 110 women with a history of miscarriages or premature births, in the pasts revealed that approximately 10 percent of them initially had insufficient serum vitamin B12 levels below 180 pg/mL. After receiving B12 supplements as treatment, 40 percent of these women were able to have successful pregnancies afterward, indicating a possible beneficial effect of B12 in such situations [15].

Low levels of vitamin B12 are commonly linked to concentrations of homocysteine and methylmalonic acid (known as MMA), which are indicators used to assess B12 levels in the body's functioning processes. Levels of homocysteine in both fetal bloodstreams show a strong connection; increased levels during a baby's early development might signal issues with B12 activity. Research has noted rises in MMA among infants under six months old, but the actual impact of this remains uncertain according to studies referenced in literature [16,17].

The study led by Monsen et al. (2003), and involving 700 children and adolescents aged 4 to 19 years old, found that plasma homocysteine levels were notably higher during the six months of life in those with a deficiency in vitamin B12 as compared to those with normal levels of folate [18]. Babies who are breastfed face a risk of B12 deficiency if their mothers adhere to vegetarian or macrobiotic diets that lack sufficient cobalamin intake, whereas formula-fed babies consuming fortified milk tend to be less affected by this issue [18]. Neurological and developmental issues are outcomes of vitamin B12 deficiency in infants that can lead to delayed myelination and neurodevelopmental challenges even when mothers don't display any obvious signs of lacking B12 nutrients in their bodies. Across those cases where this occurs first before symptoms like megaloblastic anemia [19]. Studies have also shown levels of MMA and lower methionine levels in babies between 10 and 20 months who follow macrobiotic diets, suggestive of an ongoing risk of insufficiency [20].

Homocysteine levels generally decrease during gestation when comparative to non-pregnant periods. Especially in the second trimester. With a slight increase noted around the 32nd week until birth, yet these fluctuations cannot be solely attributed to kidney function or plasma albumin levels [21]. High levels of homocysteine in mothers have

been tied to issues like insufficient placenta function and recurring miscarriages. It can also lead to conditions such as growth restrictions during pregnancy and premature birth. Additionally, preeclampsia. A condition characterized by blood pressure that affects a small percentage of pregnancies. Can cause significant health problems for both the mother and baby [22]. The underlying endothelial dysfunction and inflammation seen in cases of preeclampsia may also increase the chances of developing heart problems in life among affected women [23, 24].

Additionally, the levels of methionine in mothers that can forecast the amounts of homocysteine in fetuses decrease as they flow from mother to fetus, emphasizing the role of mothers in the metabolism of fetuses. Vit-B12 plays a role in determining the overall thiol status of the fetus. In line to Murphy et al. (2002), there is a correlation between maternal homocysteine levels and newborn weight. Mothers with fertility rates were found to have a fourfold higher risk of delivering low-birth-weight babies. The results back up the link between levels of homocysteine in mothers and lower birth weights along with insufficient levels of vitamin B12 in mothers [23].

Elevated levels of homocysteine in the blood during pregnancy can interfere with the development of the fetus and have a significant impact on various systems like the nerves and bones as well as blood vessels. Inherited metabolic conditions that impact homocysteine processing can worsen these effects, resulting in lasting health issues like stunted bone growth, cognitive difficulties, and higher vulnerability to heart problems [25].

Effect of Vitamin B12 on Placental Function

During pregnancy [26], vitamin B12 plays a role in supporting the placenta's development and functionality as it acts as a vital connection point between the mother and fetus. Optimal levels of vit-B12 are necessary for the forming of the placenta. The process allows for nutrients and oxygen to move from the mothers bloodstream to the fetus [27] which is crucial for the fetuss development and advancement. Moreover vitamin B12 plays a role in producing blood cells and supporting adequate blood flow, to the placenta to ensure a steady provision of nutrients and oxygen to the growing fetus [28].

Lack of levels of vitamin B12 could impact the development and operation of the placenta leading to undernutrition for the unborn baby and impeding its growth prospects [29]. Vitamin B12 is essential for DNA production and the splitting of cells in both the placenta and embryo while also being pivotal, in controlling genes via methylation routes well as aiding in hormone manufacturing and crucial metabolic processes that bolster overall wellbeing while shielding against oxidative stress [30].

Adequate levels of vitamin B12 play a role in assisting hormonal balance and promoting the growth of the placenta during pregnancy by interacting with various micronutrients and metabolic pathways [31]. Additionally, vitamin B12 boosts the mother's immune system function to safeguard the placenta against infections and inflammation. Noteworthy research has shown a correlation between B12 deficiency and an elevated likelihood of developing preeclampsia—a condition marked by blood pressure and organ damage that predominantly affects the placenta [32]. Ensuring levels of vitamin B12 may help reduce the risk associated with this condition. Changes in gene expression during pregnancy due to modifications that do not affect the DNA sequence could potentially be impacted by the levels of vitamin B12[33].

Lack of vitamin B12 can worsen insufficiency. A problem where the placenta struggles to provide enough oxygen and nutrients to the unborn baby [34]. Vitamin B12 plays a role in producing red blood cells and

helps prevent maternal anemia. Anemia during pregnancy could affect blood flow to the placenta. Raise the chances of giving birth prematurely [35].

Effect of Vitamin B12 on Fetal Development

During fetal development, processes are supported by vitamin B12, which is crucial for the health of the central nervous system (CNS) [36]. It plays a role in producing myelin to shield and insulate nerve fibers and is necessary for the healthy growth of the fetal brain and spinal cord [35]. Additionally, B12 plays a role in DNA synthesis, which is essential for cell growth, division, and organ formation during embryo development [37].

Vitamin B12 plays a role in the formation of red blood cells to help ensure that enough oxygen reaches the tissues of the developing fetus. This process supports waste removal. Contributes to the overall metabolic health of the fetus. Furthermore vitamin B12 influences how genes are expressed by being involved in metabolic processes and methylation pathways [38].

Besides aiding in iron metabolism and utilization to improve oxygen transport and prevent iron deficiency anemia in both the mother and fetus [39] Vitamin B12 is also vital for sealing the tube in pregnancy. Insufficient levels of this vitamin during this period have been associated with birth defects like spina bifida [40]. Moreover Vitamin B12 is essential for cell growth and tube formation because of its involvement, in DNA synthesis [39]. Modulating gene expression through methylation processes is beneficial as it influences the development of systems like the nervous system and aids in neural tube closure [38]. Ensuring an intake of B12 is crucial for pregnant women to prevent neural tube abnormalities. Particularly important for groups like vegetarians who are more susceptible, to deficiency concerns [40].

Conclusion

While not a direct cause of miscarriage on its own a lack of vitamin B12 can play a role in pregnancy related complications that may increase the likelihood of such outcomes happening. To support the growth of the baby during pregnancy mothers should maintain a diet and receive adequate prenatal care. The absence of vitamin B12 has been associated with issues like preeclampsia, low birth weight and premature birth. Additionally inadequate levels of vitamin B12 and folate can impede processes such as DNA synthesis and cell division, which are crucial, for the proper development of the embryo. Folate insufficiency is significantly connected with neural tube abnormalities and plays an important role in encouraging a successful pregnancy and preventing problems by ensuring adequate vitamin B12 levels throughout pregnancy.

Acknowledgement

Many thanks and gratitude to everyone who played a role in supporting this study.

Conflict of Interest

None.

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