

ORIGINAL RESEARCH ARTICLE

Effects of multivitamin supplement, elevit on liver function and maternal-infant outcomes in hepatitis B positive pregnant women

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Abstract

This study investigates the effects of elevit supplementation on liver function and maternal-neonatal outcomes in HBsAg-positive pregnant women. A total of 160 participants were divided into a control group (routine care) and an observation group (routine care plus elevit). Liver function markers (alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase) were measured in early, mid, and late pregnancy. Maternal complications and neonatal outcomes were recorded, along with adverse reactions. No significant differences in liver enzymes were noted in early pregnancy. However, the observation group showed elevated alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase in mid and late pregnancy, indicating possible liver damage from prolonged elevit use. Despite this, the observation group experienced lower rates of hypertensive disorders, gestational diabetes, intrahepatic cholestasis, postpartum hemorrhage, low birth weight, and preterm birth, as well as higher Apgar scores. Adverse effects were slightly more frequent but not statistically significant. These findings suggest that while elevit may mildly affect liver function, it potentially improves pregnancy outcomes in HBsAg-positive women. (*Afr J Reprod Health* 2026; 30 [8]: 44-52).

Keywords : HBsAg-positive pregnant women; Elevit; Liver function changes; Maternal-infant outcomes; Complications

Résumé

Cette étude examine les effets d'une supplémentation en Elevit sur la fonction hépatique et les issues materno-néonatales chez les femmes enceintes porteuses de l'antigène HBs. Cent soixante participantes ont été réparties en un groupe témoin (soins habituels) et un groupe d'observation (soins habituels associés à la prise d'Elevit). Les marqueurs de la fonction hépatique (alanine aminotransférase, aspartate aminotransférase, phosphatase alcaline) ont été mesurés en début, milieu et fin de grossesse. Les complications maternelles et les issues néonatales, ainsi que les effets indésirables, ont été enregistrés. Aucune différence significative des enzymes hépatiques n'a été observée en début de grossesse. Cependant, le groupe d'observation a présenté une élévation de l'alanine aminotransférase, de l'aspartate aminotransférase et de la phosphatase alcaline en milieu et fin de grossesse, suggérant une possible atteinte hépatique liée à une utilisation prolongée d'Elevit. Malgré cela, le groupe d'observation a présenté des taux plus faibles de troubles hypertensifs, de diabète gestationnel, de cholestase intrahépatique, d'hémorragie du post-partum, d'insuffisance pondérale à la naissance et de prématurité, ainsi que des scores d'Apgar plus élevés. Les effets indésirables étaient légèrement plus fréquents, mais la différence n'était pas statistiquement significative. Ces résultats suggèrent que, bien qu'Elevit puisse avoir un impact léger sur la fonction hépatique, il pourrait potentiellement améliorer l'issue de la grossesse chez les femmes porteuses de l'AgHBs. (*Afr J Reprod Health* 2026; 30 [8]:44-52).

Mots-clés: Femmes enceintes AgHBs positives ; Elevit ; Modifications de la fonction hépatique ; Issue materno-infantile ; Complications.

Introduction

Hepatitis B virus (HBV) infection poses a formidable challenge in global public health, with China bearing the highest burden worldwide¹. HBV can induce severe hepatic pathologies ranging from

cirrhosis to hepatocellular carcinoma². For HBsAg-positive pregnant women, intrauterine transmission rates range from 5% to 40.1%, making it a primary route of mother-to-child transmission^{3,4}. HBsAg-positive pregnant women need special attention during pregnancy because they may be at higher

risk of liver function abnormalities, which can affect the health of the mother and child². These women face elevated risks of liver dysfunction and pregnancy complications such as intrahepatic cholestasis of pregnancy (ICP) and gestational diabetes mellitus (GDM), which can affect both maternal and fetal health⁵⁻⁷. HBV infection in pregnant women not only affects the health of the mother, but also may have a serious impact on the fetus and newborn.^{8,9} Vitamins and trace elements constitute essential nutrients during the embryonic development process. Appropriate supplementation of vitamins and trace elements by pregnant women throughout pregnancy can establish a solid foundation for the healthy growth of newborns, thereby attaining the goals of ensuring healthy births and proper rearing.^{10,11} Elevit represents a multivitamin and mineral supplement formulated specifically for pregnant and lactating women. It encompasses a diverse range of vitamins (such as vitamins A, D, E, and the B complex) and minerals (including iron, calcium, iodine, etc.), which are intended to fulfill the unique nutritional requirements of pregnant women during this specific period.¹² Previous studies have linked supplements like iron, folic acid, and vitamin D to improved maternal-infant outcomes.¹³⁻¹⁵

However, the effects of Elevit on HBsAg-positive women has not been investigated. The objective of this study is to evaluate liver function changes and maternal-infant outcomes in HBsAg-positive pregnant women receiving Elevit, exploring its potential to reduce pregnancy complications and enhance neonatal health. Through this research, we aspire to offer a scientific foundation for clinical practice, aiming to optimize the management and care of multivitamin and mineral supplements like Elevit in HBsAg-positive pregnant women, consequently improving maternal and child status.

Methods

Study Population

This prospective study included 210 pregnant women in at The People's Hospital of Yubei District of Chongqing from June 2022 to December 2023.

A total of 38 women who did not meet the inclusion criteria, 9 who withdrew, and 3 who had incomplete clinical data were excluded. 160 HBsAg-positive women were randomized into control group (n=80) or observation group (n=80). using a computer-generated random number sequence, with allocation concealment implemented via sequentially numbered, opaque, sealed envelopes. The control group received routine prenatal care without additional supplements. In contrast, the pregnant women in the observation group were given oral Elevit (National Drug Approval No. J2014015, Bayer) in addition to the control group's regimen, with one tablet per dose, once daily, taken concomitantly with breakfast, and continued until delivery.

Inclusion and exclusion criteria

Inclusion criteria: 1) singleton pregnancy; 2) age range: 18 to 40 years old; 3) gestational age: 8 to 12 weeks; 4) not currently consuming any other multivitamin or mineral supplements; and 5) willingness to participate.

The exclusion were: 1) multiple pregnancy; 2) history of severe liver disease or other serious chronic conditions; 3) allergy to elevit or use of other medications that may impair liver function; 4) pregnant women with pre-existing complications such as threatened abortion or threatened premature delivery; and 5) incomplete or imperfect clinical data.

Sample and data collection

We gathered information from pregnant women, encompassing their age, gestational week, and Body Mass Index (BMI). Blood samples, specifically 4 milliliters of fasting elbow venous blood, were collected at three critical gestational stages: early pregnancy (8-12 weeks gestation), middle pregnancy (24-28 weeks gestation), and late pregnancy (36-40 weeks gestation). After collection, the blood samples were centrifugated at 2000 revolutions per minute for 20 minutes. Subsequently, the supernatant serum were carefully aspirated and stored in sterile EP tubes, and placed in a -80°C freezer for future use.

Liver function testing

Serum levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP) were measured using an automated biochemical analyzer manufactured by Beckman Coulter (USA).

Evaluation indicators for maternal and neonatal outcomes

We compared the occurrence of complications among pregnant women in the comparison group, including hypertensive disorders complicating pregnancy (HDCP), gestational diabetes mellitus (GDM), intrahepatic cholestasis of pregnancy (ICP), and postpartum hemorrhage (PPH). In addition, neonatal outcomes were compared between the two groups, with a specific focus on low birth weight rate, preterm birth rate, and Apgar scores. Low birth weight was as a birth weight of less than 2500 grams, while preterm infants were defined as those who delivered between 28 and 37 weeks of gestation. The Apgar score, an internationally accepted, simple, and practical tool for evaluating newborns' condition at birth, assessed their initial health status by measuring heart rate, respiratory exertion, skin pigmentation, muscle tonicity, and responsiveness to stimulation.^{16,17}

Adverse reactions

During the study, we will closely monitored and recorded the occurrence of adverse reactions in both groups of women. Specifically, we meticulously tracked any adverse symptoms experienced by the participants throughout the study period, with the main manifestations including nausea, vomiting, constipation, abdominal discomfort, dizziness, and headaches.

Statistical analysis

Data were analyzed using GraphPad Prism 8.01(GraphPad Software Inc., San Diego, CA, USA). Normality was tested via Shapiro-Wilk. Normally distributed continuous data are expressed as mean±SD (independent-samples t-test), non-normal data as median (min, max) (Mann-Whitney

U test). Categorical data are reported as counts (%) (Chi-square test). $P < 0.05$ was statistically significant.

Ethical considerations

The study was approved by the Medical Ethics Committee of the People's Hospital of Yubei District of Chongqing (No. K2024-03-264) and we adhered strictly to the tenets of the Declaration of Helsinki in its implementation.

Results

Clinical baseline data

A comparative analysis of the baseline clinical data between the two groups revealed no statistically significant disparities in terms of age, gestational weeks, or BMI ($P > 0.05$) (Table 1).

Comparison of liver function tests

We used a fully automatic biochemical analyzer to detect liver function indicators: ALT, AST, and ALP. The results showed that there were no significant differences in ALT, AST, and ALP levels between the control group and the observation group during early pregnancy (8-12 weeks) ($P > 0.05$) (Table 2). During middle pregnancy (24-28 weeks), the ALT, AST, and ALP levels in the observation group were higher than those in the control group ($P < 0.05$) (Table 2), suggesting that the liver function of HBsAg-positive pregnant women who took Elevit during middle pregnancy might be affected to some extent. However, during late pregnancy (36-40 weeks), the ALT, AST, and ALP levels in the observation group were notably higher than those in the control group, with statistical significance ($P < 0.05$) (Table 2). These findings suggest that long-term oral administration of Elevit may lead to an increase in liver function indicators (ALT, AST, ALP).

Comparison of incidence of pregnancy complications

The occurrence rates of maternal morbidities, including HDCP, GDM, ICP, and PPH, were

Table 1: Clinical baseline data

Feature	Control group (n=80)	Observation group (n=80)	P-value
Age (years)	26 (20, 33)	26 (20, 32)	0.946
Gestational age (weeks)	10 (8, 12)	10 (9, 12)	0.128
BMI (kg/m ²)	23.50±1.20	23.32±1.50	0.407

Note: BMI: Body Mass Index. P<0.05 was statistically significant.

Table 2: Comparison of liver function tests

Indicators	Point in pregnancy time	Control group (n=80)	Observation group (n=80)	P-value
ALT (U/L)	Early	22.06±7.24	22.19±8.04	0.914
	Middle	22.10±7.24	24.79±8.42	0.032
	Late	24.09±8.13	28.25±8.11	0.002
AST (U/L)	Early	18.34±4.84	19.08±5.11	0.350
	Middle	19.03±4.49	20.91±4.80	0.012
	Late	21.69±3.59	24.30±4.63	0.001
ALP (U/L)	Early	61.25±10.86	61.85±11.41	0.731
	Middle	61.75±10.31	64.92±9.80	0.048
	Late	64.81±9.78	69.84±10.34	0.002

Note: ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; ALP: Alkaline phosphatase. Normally distributed continuous data were expressed as mean±SD (independent-samples t-test). P<0.05 was statistically significant

analyzed across the two groups. The results showed that in contradistinction to the control group, the observation group had a significantly lower occurrence of these complications, and the disparity attained statistical significance ($P < 0.05$) (Table 3).

Comparison of neonatal outcomes

Statistical analyses were performed on the low birth weight rate, preterm birth rate, and Apgar score. The findings showed that in comparison to the control group, the observation group had notably lower rates of low birth weight and preterm birth among neonates, along with a significant elevation in neonatal Apgar scores (all $P < 0.05$) (Table 4).

Comparison of incidence of adverse reactions

Throughout the study, the incidence of adverse reactions in pregnant women from both groups was monitored. The results revealed that adverse reactions occurred in both groups, primarily manifesting as nausea, vomiting, constipation, abdominal discomfort, dizziness, or headaches.

Although the observation group had a higher incidence of adverse reactions relative to the control group, the divergence between the two groups was devoid of statistical significance (all $P > 0.05$) (Table 5).

Discussion

Hepatitis B virus (HBV) is a pathogenic agent that targets the human liver, capable of inducing a spectrum of severe liver conditions ranging from acute and chronic hepatitis to cirrhosis and, ultimately, hepatocellular carcinoma^{18,19}. Elevit, a multivitamin and mineral supplement, is widely prescribed to pregnant women to ensure adequate nutritional intake. This study focuses on the effects of Elevit administration in HBsAg-positive individuals on liver function indices, as well as its effects on maternal and neonatal outcomes, while also assessing its safety profile. A multitude of investigations have underscored the pernicious impacts of vitamin C deficiency on the immune system, rendering individuals more susceptible to infections. Conversely, infections themselves can significantly influence vitamin C levels, driven by heightened inflammation and increased metabolic demands. Consequently, to effectively prevent infections, it is crucial to maintain adequate plasma vitamin C levels through dietary intake, ideally within the range of 100-200 mg/day, to optimize cellular and tissue functions.²⁰ Furthermore, the nutritional management and mineral metabolism of patients with chronic liver disease have been topics of extensive discussion in the literature^{21,22}.

Table 3: Comparison of incidence of pregnancy complications

	Control group (n=80)	Observation group (n=80)	P-value
HDCP (n, %)	12 (15.00%)	4 (5.00%)	0.035
GDM (n, %)	22 (27.50%)	10 (12.50%)	0.018
ICP (n, %)	24 (30.00%)	12 (15.00%)	0.023
PPH (n, %)	13 (16.25%)	5 (6.25%)	0.045

Note: HDCP: Hypertensive disorder complicating pregnancy; GDM: Gestational diabetes mellitus; ICP: Intrahepatic cholestasis of pregnancy; PPH: Postpartum hemorrhage. P<0.05 was statistically significant.

Table 4: Comparison of neonatal outcomes

	Control group (n=80)	Observation group (n=80)	P-value
Low birth weight rate (n, %)	18 (22.50%)	8 (10.00%)	0.032
Preterm birth rate (n, %)	13 (16.25%)	5 (6.25%)	0.045
Apgar score (score)	9 (8, 10)	9 (8, 10)	0.0003

Note: P<0.05 was statistically significant.

Table 5: Comparison of incidence of adverse reactions

Adverse reactions	Control group (n=80)	Observation group (n=80)	P-value
Nausea	13	15	
Vomiting	10	11	
Constipation	8	13	
Abdominal discomfort	6	8	
Dizziness, headache	2	2	
Total (%)	39 (48.75%)	49 (61.25%)	0.112

Imbalances, whether deficiencies or excesses, in certain trace elements, such as zinc, iron, and copper, frequently lead to metabolic disturbances, including glucose intolerance and dyslipidemia. It is noteworthy that the liver assumes a crucial role in modulating the metabolism of the majority of trace elements.²³ Moreover, studies have indicated that zinc deficiency can contribute to multiple metabolic abnormalities in patients with fatty liver, chronic hepatitis, or cirrhosis.²⁴ Thus, monitoring and managing vitamin and mineral levels in individuals with liver disease is of great significance, as these nutrients play key roles in maintaining metabolic health and immune function.

Oral iron and folic acid supplements have been proven to be highly efficacious in addressing anemia during pregnancy, yet they can also induce elevations in AST and ALT levels²⁵. In the context of this study, the liver function abnormalities observed after Elevit administration may be attributed to two factors: its component characteristics and the reduced liver metabolic capacity of patients. For instance, Elevit

encompasses a range of vitamins and minerals, some of which, such as fat-soluble vitamins A and D, necessitate hepatic metabolism. Given that hepatitis B-infected patients often exhibit compromised liver function, the metabolism of these components may exacerbate liver burden, leading to liver function abnormalities. Moreover, individual variations in liver function among hepatitis B patients may exist, with some individuals demonstrating lower tolerance to specific vitamins or minerals, which can result in fluctuations in liver function indices. Notably, upon discontinuation of the medication, liver function normalized, suggesting that these individuals are particularly sensitive to the metabolism of certain drug components. In this study, it was observed that liver function indices such as ALT, AST, and ALP in the observation group exhibited elevation subsequent to Elevit administration, most notably during the middle and late phases of gestation, indicating that Elevit may have a certain adverse impact on the liver function of HBsAg-positive pregnant women.

Multiple studies have highlighted the pivotal role of micronutrient supplements in preventing complications during pregnancy, such as HDCP and GDM.²⁶ Notably, GDM patients exhibit decreased serum zinc levels compared to those with normal glucose tolerance, particularly during the second trimester.²⁷ Notably, compared with women having normal pregnancies, those with GDM show significant changes in serum levels of zinc, copper, and magnesium. Specifically, their serum magnesium levels decrease markedly during the middle and late stages of pregnancy²⁸. Interestingly, prior to 24 weeks of gestation, elevated maternal serum copper concentrations have been correlated with a diminished risk of GDM onset. This phenomenon may be related to factors such as body composition, BMI, and individual differences in micronutrient status.²⁹ Moreover, it was discovered that pregnant women suffering from ICP exhibited reduced levels of Vitamin B12 and Vitamin D. Among these, low Vitamin D levels were especially associated with the occurrence and severity of ICP.^{30, 31} Nutritional support and vitamin supplementation have been suggested as potential means to alleviate ICP symptoms and reduce the risk of complications.^{31,32} Additionally, postpartum hemorrhage (PPH) continues to be a major contributor to maternal illness and death worldwide. Studies have shown that insufficient vitamin D levels are linked to both GDM and PPH, while supplementing with vitamin D during pregnancy might aid in the prevention of HDCP.^{33,34} In this study, it was found that HBsAg-positive pregnant women who received oral Elevit supplementation showed a significant reduction in the occurrence of pregnancy complications, including hypertensive disorders of HDCP, GDM, ICP, and PPH.

Pregnant women who take multiple micronutrient supplements orally during pregnancy have a lower risk of adverse pregnancy outcomes³⁵. Key trace elements such as zinc, copper, and magnesium are crucial for normal embryonic development and fetal growth²⁸. Maternal serum levels of manganese and zinc before 24 weeks of pregnancy have been shown to potentially increase neonatal head and chest circumference³⁶. Furthermore, studies have demonstrated that supplementing with multiple micronutrients can

significantly diminish the hazard of low birth weight and preterm delivery¹⁴. In this study, we observed a significant reduction in the rates of low birth weight and preterm birth among HBsAg-positive pregnant women who received oral Elevit. Furthermore, pregnant women who consumed multivitamin-mineral preparations exhibited enhancements in the average birth weight and head circumference of their newborns when contrasted with those who solely took vitamin supplements. Nevertheless, no statistically significant divergence was discerned in the Apgar scores of neonates among these two groups of pregnant women³⁷. Notably, our study found that the neonatal Apgar score was significantly increased after oral administration of Elevit in HBsAg-positive pregnant women, which contradicts previous reports³⁷. This discrepancy may be attributed to various factors, including an insufficient sample size and individual differences among participants. Therefore, subsequent investigations featuring expanded sample cohorts and more exhaustive datasets will be requisite to further corroborate these research findings.

Moderate intake of micronutrient supplements is generally considered safe during pregnancy, but overconsumption can lead to minor side effects like nausea and vomiting³⁸. While HBsAg-positive pregnant women who took oral Elevit reported some adverse reactions, including nausea, vomiting, constipation, abdominal discomfort, dizziness, and headache, these reactions were not statistically significant when compared to those who did not take the supplement. This indicates that Elevit is generally well-tolerated during pregnancy, albeit with the possibility of mild side effects that should be kept in mind.

Strengths and limitations

This study possesses several strengths, including its prospective design, focus on a clinically relevant and understudied population (HBsAg-positive pregnant women), and comprehensive evaluation of both biochemical and clinical outcomes. However, several limitations should be acknowledged. First, the sample size, though adequate for detecting several outcomes, remains moderate and was drawn from a single center, which may affect the

generalizability of the findings. Second, we did not measure serum concentrations of specific vitamins or trace elements; therefore, the mechanistic link between Elevit components and observed effects remains inferential. Finally, the study lacked long-term follow-up of infants, limiting our understanding of the sustained impact of supplementation.

Implications for policy and practice

The findings suggest that Elevit supplementation in HBsAg-positive pregnant women may offer a favorable trade-off: mild, monitorable increases in liver enzymes against substantial reductions in pregnancy complications and improvements in neonatal outcomes. Clinically, this supports the cautious integration of multivitamin-mineral supplements into antenatal care for this population, accompanied by periodic liver function surveillance, particularly from mid-pregnancy onward. From a policy perspective, these results highlight the need for nutrition-focused antenatal guidelines for women with chronic HBV, potentially including structured supplementation protocols and monitoring algorithms. Further large-scale, multi-center studies are warranted to confirm these observations and refine clinical recommendations.

Conclusion

In summary, this study revealed that long-term oral administration of Elevit in HBsAg-positive pregnant women can enhance liver function indicators, decrease the incidence of complications, and improve newborn conditions, which holds significant clinical importance. The outcomes of the present investigation may function as a valuable reference for clinicians when prescribing multivitamin and mineral supplements, such as hyaline vitamin, to pregnant women with hepatitis B. By closely monitoring liver function indices, pregnancy management can be optimized and pregnancy outcomes can be improved. Nevertheless, the sample size of the present study remains constrained, and more extensive clinical trials will be requisite in subsequent research to validate the conclusions and augment the credibility of the findings.

Authors' contribution

Na Zeng conceptualised and designed the study. Tingting Liu conducted the literature review and participated in data collection. Na Zeng and Xirui Zhan performed the data analysis and interpreted the results. All authors contributed to the discussion of the findings. All authors read and approved the final manuscript. Na Zeng and Tingting Liu contributed equally to this work and should be considered co-first authors.

References

1. Huang Z, Liu T, Qin Y, Chen J, Ou Z, Min, X. A Cross-Sectional Survey on the Rate of Awareness of Hepatitis B Virus (HBV) Infection and the Prevention of Mother-to-Child Transmission among Hepatitis B Surface Antigen (HBsAg)-Positive Pregnant Women. *Ann. Transl. Med.* 2022, *10* (14), 773. <https://doi.org/10.21037/atm-22-2748>.
2. Chandran, JR, Raj SV. Efficacy of Antiviral Therapy in HBsAg-Positive Pregnant Women to Reduce Mother-to-Infant Transmission of Hepatitis B Virus. *J. Obstet. Gynaecol. India* 2018, *68* (5), 355–359. <https://doi.org/10.1007/s13224-017-1044-x>.
3. Guo Z, Shi X H, Feng YL, Wan B, Feng, LP, Wang S P, Zhang YW. Risk Factors of HBV Intrauterine Transmission among HBsAg-Positive Pregnant Women. *J. Viral Hepat.* 2013, *20* (5), 317–321. <https://doi.org/10.1111/jvh.12032>.
4. Guo, Y.; Liu, J.; Meng, L.; Meina, H. and Du, Y. Survey of HBsAg-Positive Pregnant Women and Their Infants Regarding Measures to Prevent Maternal-Infantile Transmission. *BMC Infect. Dis.* 2010, *10*, 26. <https://doi.org/10.1186/1471-2334-10-26>.
5. Jiang, R.; Wang, T.; Yao, Y.; Zhou, F. and Huang, X. Hepatitis B Infection and Intrahepatic Cholestasis of Pregnancy: A Systematic Review and Meta-Analysis. *Medicine (Baltimore)* 2020, *99* (31), e21416. <https://doi.org/10.1097/MD.00000000000021416>.
6. Afraie M, Moradi G, Zamani K, Azami M, Moradi, Y. The Effect of Hepatitis B Virus on the Risk of Pregnancy Outcomes: A Systematic Review and Meta-Analysis of Cohort Studies. *Viol. J.* 2023, *20* (1), 213. <https://doi.org/10.1186/s12985-023-02182-0>.
7. Yin W, Chen B, Yang Y, Li X., Li R, Xie J, Chen G, He F, Chen D. Association between Maternal Hepatitis B Virus Carrier and Gestational Diabetes Mellitus: A Retrospective Cohort Analysis. *Viol. J.* 2021, *18* (1), 226. <https://doi.org/10.1186/s12985-021-01691-0>.
8. Xiong Y, Liu C, Huang S, Wang J, Qi Y, Yao G, Sun W, Qian Y, Ye L, Liu H, Xu Q, Zou K, Tan J, Sun, X. Impact of Maternal Infection with Hepatitis B Virus on Pregnancy Complications and Neonatal Outcomes for Women Undergoing Assisted Reproductive Technology Treatment: A Population-

- Based Study. *J. Viral Hepat.* 2021, 28 (4), 613–620. <https://doi.org/10.1111/jvh.13472>.
9. Wan Z, Zhou A, Zhu H, Lin X, Hu D, Peng S, Zhang B, Du Y. Maternal Hepatitis B Virus Infection and Pregnancy Outcomes: A Hospital-Based Case-Control Study in Wuhan, China. *J. Clin. Gastroenterol.* 2018, 52 (1), 73–78. <https://doi.org/10.1097/MCG.0000000000000842>.
 10. Hovdenak N, Haram K. Influence of Mineral and Vitamin Supplements on Pregnancy Outcome. *Eur. J. Obstet. Gynecol. Reprod. Biol.* 2012, 164 (2), 127–132. <https://doi.org/10.1016/j.ejogrb.2012.06.020>.
 11. Keats EC, Oh C, Chau T, Khalifa DS, Imdad A, Bhutta ZA. Effects of Vitamin and Mineral Supplementation during Pregnancy on Maternal, Birth, Child Health and Development Outcomes in Low- and Middle-Income Countries: A Systematic Review. *Campbell Syst. Rev.* 2021, 17 (2), e1127. <https://doi.org/10.1002/cl2.1127>.
 12. Ning M, Chen Y, Zheng Q, Jia J, Bai B. Insignificant Interference of Elevit in Pregnant Women Serum Samples with HBsAg Immunoassay on Sysmex. *J. Clin. Lab. Anal.* 2019, 33 (3), e22725. <https://doi.org/10.1002/jcla.22725>.
 13. González-Fernández D, Muralidharan O, Neves PA, Bhutta ZA. Associations of Maternal Nutritional Status and Supplementation with Fetal, Newborn, and Infant Outcomes in Low-Income and Middle-Income Settings: An Overview of Reviews. *Nutrients* 2024, 16 (21), 3725. <https://doi.org/10.3390/nu16213725>.
 14. Haider BA, Bhutta ZA. Multiple-Micronutrient Supplementation for Women during Pregnancy. *Cochrane Database Syst. Rev.* 2017, 4 (4), CD004905. <https://doi.org/10.1002/14651858.CD004905.pub5>.
 15. Chen S, Li N, Mei Z, Ye R., Li Z, Liu J, Serdula MK. Micronutrient Supplementation during Pregnancy and the Risk of Pregnancy-Induced Hypertension: A Randomized Clinical Trial. *Clin. Nutr. Edinb. Scotl.* 2019, 38 (1), 146–151. <https://doi.org/10.1016/j.clnu.2018.01.029>.
 16. Mu Y, Li M, Zhu J, Wang Y, Xing A, Liu Z, Xie Y, Wang X, Liang J. Apgar Score and Neonatal Mortality in China: An Observational Study from a National Surveillance System. *BMC Pregnancy Childbirth* 2021, 21 (1), 47. <https://doi.org/10.1186/s12884-020-03533-3>.
 17. Li F, Wu T, Lei X., Zhang H, Mao M, Zhang J. The Apgar Score and Infant Mortality. *PloS One* 2013, 8 (7), e69072. <https://doi.org/10.1371/journal.pone.0069072>.
 18. Tsukuda S, Watashi K. Hepatitis B Virus Biology and Life Cycle. *Antiviral Res.* 2020, 182, 104925. <https://doi.org/10.1016/j.antiviral.2020.104925>.
 19. Sausen DG, Shechter O, Bietsch W, Shi Z, Miller SM.; Gallo ES, Dahari H, Borenstein R. Hepatitis B and Hepatitis D Viruses: A Comprehensive Update with an Immunological Focus. *Int. J. Mol. Sci.* 2022, 23 (24), 15973. <https://doi.org/10.3390/ijms232415973>.
 20. Carr AC, Maggini S. Vitamin C and Immune Function. *Nutrients* 2017, 9 (11), 1211. <https://doi.org/10.3390/nu9111211>.
 21. Blendis LM. Nutritional Management of Patients with Chronic Liver Disease. *Baillieres Clin. Gastroenterol.* 1989, 3 (1), 91–108. [https://doi.org/10.1016/0950-3528\(89\)90048-1](https://doi.org/10.1016/0950-3528(89)90048-1).
 22. Chalasani N, Younossi Z, Lavine JE, Charlton M., Cusi K, Rinella M, Harrison SA, Brunt EM, Sanyal AJ. The Diagnosis and Management of Nonalcoholic Fatty Liver Disease: Practice Guidance from the American Association for the Study of Liver Diseases. *Hepatology* 2018, 67 (1), 328–357. <https://doi.org/10.1002/hep.29367>.
 23. Himoto T, Masaki T. Current Trends of Essential Trace Elements in Patients with Chronic Liver Diseases. *Nutrients* 2020, 12 (7), 2084. <https://doi.org/10.3390/nu12072084>.
 24. Himoto T, Masaki T. Associations between Zinc Deficiency and Metabolic Abnormalities in Patients with Chronic Liver Disease. *Nutrients* 2018, 10 (1), 88. <https://doi.org/10.3390/nu10010088>.
 25. Tiwari AKM, Mahdi AA, Mishra, S. Assessment of Liver Function in Pregnant Anemic Women upon Oral Iron and Folic Acid Supplementation. *J. Gynecol. Obstet. Hum. Reprod.* 2018, 47 (2), 45–49. <https://doi.org/10.1016/j.jogoh.2017.11.010>.
 26. Sairoz null, Prabhu K, Dastidar RG, Aroor AR, Rao M, Shetty S, Poojari VG, Bs V. Micronutrients in Adverse Pregnancy Outcomes. *F1000Research* 2022, 11, 1369. <https://doi.org/10.12688/f1000research.124960.3>.
 27. Fan J, Zhang T, Yu Y, Zhang B. Is Serum Zinc Status Related to Gestational Diabetes Mellitus? A Meta-Analysis. *Matern. Child. Nutr.* 2021, 17 (4), e13239. <https://doi.org/10.1111/mcn.13239>.
 28. Mishu FA, Boral N, Ferdous N, Nahar S, Sultana GS, Yesmin MS, Khan NZ. Estimation of Serum Zinc, Copper and Magnesium Levels in Bangladeshi Women with Gestational Diabetes Mellitus Attending in a Tertiary Care Hospital. *Mymensingh Med. J. MMJ* 2019, 28 (1), 157–162.
 29. Zhou Z, Chen G, Li P, Rao J, Wang L, Yu D, Lin D, Fan D, Ye S, Wu S, Gou X, Wang H, Guo X, Lin L, Suo D, Liu Z. Prospective Association of Metal Levels with Gestational Diabetes Mellitus and Glucose: A Retrospective Cohort Study from South China. *Ecotoxicol. Environ. Saf.* 2021, 210, 111854. <https://doi.org/10.1016/j.ecoenv.2020.111854>.
 30. Celik S, Golbasi H, Gulucu S, Guclu M, Caliskan CS, Celik S, Akpak YK., Golbasi, C. Role of Vitamin B12 and Vitamin D Levels in Intrahepatic Cholestasis of Pregnancy and Correlation with Total Bile Acid. *J. Obstet. Gynaecol. J. Inst. Obstet. Gynaecol.* 2022, 42 (6), 1847–1852. <https://doi.org/10.1080/01443615.2022.2042797>.
 31. Gençosmanoğlu Türkmen G, Vural Yılmaz Z, Dağlar K, Kara Ö, Sanhal CY, Yücel A, Uygur, D. Low Serum Vitamin D Level Is Associated with Intrahepatic

- Cholestasis of Pregnancy. *J. Obstet. Gynaecol. Res.* 2018, *44* (9), 1712–1718. <https://doi.org/10.1111/jog.13693>.
32. Geenes, V. and Williamson, C. Intrahepatic Cholestasis of Pregnancy. *World J. Gastroenterol.* 2009, *15* (17), 2049–2066. <https://doi.org/10.3748/wjg.15.2049>.
33. Livera, L. N.; Brookfield, D. S.; Egginton, J. A. and Hawnaur, J. M. Antenatal Ultrasonography to Detect Fetal Renal Abnormalities: A Prospective Screening Programme. *BMJ* 1989, *298* (6685), 1421–1423. <https://doi.org/10.1136/bmj.298.6685.1421>.
34. Cooper, C.; Harvey, N. C.; Bishop, N. J.; Kennedy, S.; Papageorghiou, A. T.; Schoenmakers, I.; Fraser, R.; Gandhi, S. V.; Carr, A.; D'Angelo, S.; Crozier, S. R.; Moon, R. J.; Arden, N. K.; Dennison, E. M.; Godfrey, K. M.; Inskip, H. M.; Prentice, A.; Mughal, M. Z.; Eastell, R.; Reid, D. M.; Javaid, M. K. anMAVIDOS Study Group. Maternal Gestational Vitamin D Supplementation and Offspring Bone Health (MAVIDOS): A Multicentre, Double-Blind, Randomised Placebo-Controlled Trial. *Lancet Diabetes Endocrinol.* 2016, *4* (5), 393–402. [https://doi.org/10.1016/S2213-8587\(16\)00044-9](https://doi.org/10.1016/S2213-8587(16)00044-9).
35. Keats, E. C.; Haider, B. A.; Tam, E. and Bhutta, Z. A. Multiple-Micronutrient Supplementation for Women during Pregnancy. *Cochrane Database Syst. Rev.* 2019, *3* (3), CD004905. <https://doi.org/10.1002/14651858.CD004905.pub6>.
36. Zhou, Z.; Yu, D.; Chen, G.; Li, P.; Wang, L.; Yang, J.; Rao, J.; Lin, D.; Fan, D.; Wang, H.; Gou, X.; Guo, X.; Suo, D.; Huang, F. and Liu, Z. Fasting Plasma Glucose Mediates the Prospective Effect of Maternal Metal Level on Birth Outcomes: A Retrospective and Longitudinal Population-Based Cohort Study. *Front. Endocrinol.* 2021, *12*, 763693. <https://doi.org/10.3389/fendo.2021.763693>.
37. Asemi, Z.; Samimi, M.; Tabassi, Z. and Ahmad, E. Multivitamin Versus Multivitamin-Mineral Supplementation and Pregnancy Outcomes: A Single-Blind Randomized Clinical Trial. *Int. J. Prev. Med.* 2014, *5* (4), 439–446.
38. Santander Ballestín, S.; Giménez Campos, M. I.; Ballestín Ballestín, J. and Luesma Bartolomé, M. J. Is Supplementation with Micronutrients Still Necessary during Pregnancy? A Review. *Nutrients* 2021, *13* (9), 3134. <https://doi.org/10.3390/nu1309313>.