Tab. 3. *List of possible consequences of lowered maternal magnesium levels manifested in maternal body systems*

Anatomical maternal body systems	Clinical manifestation	Frequency of clinical manifestations
exocrine or integumentary systems	skin aging[46]	
skeletal system	risk for osteoporosis[14]	
muscular system	muscle spasms and cramps, tingling, numbness[11], tetany[14]	frequently mentioned
nervous system	agitation, change in behaviour, tremor[11], headache[14], depression[5], anxiety[43], vertigo[32, 43], fatigue[14]	frequently mentioned
respiratory system	worsened lung functions in respiratory diseases[11] asthma[32]	
gastrointestinal and excretory systems	change in appetite, nausea[11]	
endocrine system (metabolic)	hypokalaemia[5, 11] and hypocalcaemia[5, 11] altered glucose homeostasis[14]	frequently mentioned (more prevalent in inpatient care)
circulatory and cardiovascular systems	different types of cardiac arrhythmia[11] hypertension[14] ECG changes[5, 11] atherosclerotic vascular disease[32] myocardial infarction[32]	frequently mentioned
immune and lymphatic systems	depressed activity of innate and adaptive immune system[47]	
renal and urinary systems	nephrolithiasis[14]	
reproductive system	narrowing of human uterine arteries[48] may worsen uteroplacental perfusion[48]	

Note: In the case of muscular and nervous systems, the clinical manifestation may overlap between these two anatomical systems.
Frequency was derived from data of non-pregnant patients and can vary from asymptomatic to life-threatening[5, 11, 14, 32].

For this purpose, **Table 3** was developed. The table does not represent all possible clinical manifestations. The frequency of clinical manifestations was derived from the general population of adult patients (5, 11, 14, 32).

Hypermagnesaemia in pregnancy

Hypermagnesaemia belongs to uncommon medical conditions (11), usually having iatrogenic causes. Other causes are worsening kidney function, bowel disorders, and age-related conditions (11). In pregnancy, hypermagnesaemia may occur in pre-eclamptic women after magnesium therapy (2). Overtreatment with magnesium can result in magnesium toxicity (5, 16). Hypermagnesaemia is absent in normal renal magnesium excretory processes (14).

Magnesium use may lower the risk of pregnancy complications

Magnesium therapy with off-label usage is used in adult non-pregnant patients with migraine (38), status asthmaticus (38), and arrhythmias (38). In pregnancy, magnesium can be indicated in the case of eclampsia or preeclampsia (38), where it is capable of preventing seizures or lowering the strength of seizures (38). In a study by Zarean et al. (2017), it was also confirmed that, in the oral magnesium supplement group, there was a decrease in preeclampsia rates (9). Magnesium supplementation can lower the risk of induced high blood pressure (49). The use of magnesium in the setting of preterm labour belongs to off-label indications (38). Magnesium supplementation can be helpful in preventing leg cramps (9) and in women with gestational diabetes mellitus (1).

Foetal hypomagnesaemia and overview of increased risk for foetal complications

A foetus is dependent on maternal magnesium levels (50). **Table 4** describes possible foetal complications that can arise due to lowered maternal magnesium levels or magnesium restrictions. Some of the conditions mentioned in the table are the subject of further research. The summary of foetal complications was obtained from sources describing hypomagnesaemia primarily from animal data, as well as from human data or theoretical data.

Magnesium safety in pregnancy and relationship with pharmaceutical dosage form

Magnesium supplementation seems to be safe for maternal and infant health (55), but patient compliance is required. Severe side effects may occur in patients with renal insufficiency (56). Oral administration of magnesium is recommended as a prophylactic strategy for pregnant patients without clinical symptoms; if clinical symptoms are present, it is advisable to increase the dosing, and the health care professional should consider each patient individually taking into account the cause of deficiency and the health status of the pregnant patient (56). In more severe cases, parenteral administration of magnesium is possible (56). Magnesium sulphate is used in obstetric practice, where the benefits should outweigh the potential risks (54). During $MgSO_4$ therapy, magnesium levels should be carefully checked (56) and safe practice procedures and monitoring should be followed (54, 56). The only indication for intravenous administration of magnesium sulphate in obstetrics is prophylaxis of seizures in pre-eclampsia and eclampsia (56, 57, 58).

The use of magnesium sulphate for inhibition of preterm birth is, according to FDA 2013 (U.S. Food and Drug Administration), off-label usage, and it is not recommended to use magnesium sulphate injection for more than 5–7 days to stop preterm birth (56, 59), because it can cause low calcium levels (59), osteopenia or pathologic fractures in the foetus (56). Parenteral administration of magnesium suphate can contribute to increase in maternal magnesium levels above normative levels, if not monitored, which can possibly lead to neonatal complications (60). The safety of the magnesium unfolds based on oral and parenteral administration during pregnancy. Allen et al. (2023), Calda (2013), and FDA report that magnesium sulphate was changed to safety class D (59) and is not recommended for use in the setting of preterm birth for longer than 5 to 7 days (38, 56). Therefore, there is an