

ORIGINAL ARTICLE

Prevention and treatment of complications in pregnant women with chronic diseases

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ABSTRACT

Objective. The aim of the study was to evaluate the effectiveness of a multidisciplinary approach in reducing obstetric and neonatal complications in pregnant women with chronic diseases compared with standard management.

Materials and Methods. The prospective cohort study, conducted at Kyiv City Clinical Hospital No. 5 from January 2023 to December 2024, analysed data from 150 patients in the intervention group (integrated strategy involving a cardiologist, endocrinologist, and nutritionist) and 150 patients in the control group (standard care).

Results. Significant reduction in the incidence of pre-eclampsia in the intervention group (12% vs 37%; relative risk 0.32; $p = 0.001$), preterm birth (14% vs 32%; $p = 0.003$), and gestational diabetes requiring insulin (8% vs 22%; $p = 0.01$). The mean time of pre-eclampsia debut in the intervention group was 32.5 ± 2.1 weeks versus 28.4 ± 3.5 weeks in the control group ($p = 0.02$). Neonatal outcomes demonstrated a higher average birth weight (3200 ± 450 g vs 2900 ± 500 g; $p = 0.002$), lower incidence of respiratory distress syndrome (4% vs 15%; $p = 0.01$) and hypoglycaemia (7% vs 20%; $p = 0.01$). The control of chronic diseases (hypertension, diabetes, autoimmune thyroiditis) in the intervention group was more effective: 89% of patients achieved the target blood pressure ($\leq 135/85$ mm Hg) vs 65% in the control group ($p = 0.01$), and 91% achieved the target thyroid hormone level (0.5-2.5 mIU/l) vs 60% ($p = 0.002$).

Conclusions. The findings confirm that a multidisciplinary approach reduces complications through individualised protocols, early monitoring, and non-pharmacological methods. These can

be integrated into clinical guidelines to improve perinatal outcomes in high-risk groups, with adaptations for local resources and sociocultural factors.

Key words

Gestational diabetes mellitus; arterial hypertension; multidisciplinary approach; neonatal indicators; pre-eclampsia.

Introduction

Chronic diseases during pregnancy, such as hypertension, diabetes mellitus, thyroid disease and autoimmune pathologies, significantly complicate the course of gestation and pose a threat to both mother and foetus. These conditions are associated with an increased risk of pre-eclampsia, gestational diabetes, preterm birth, intrauterine fetal growth retardation, placental dysfunction, and neonatal complications, including hypoxia, hypoglycaemia, respiratory distress syndrome, and the need for hospitalisation in the neonatal intensive care unit (NICU). Given the increasing prevalence of chronic diseases among women of reproductive age, due to both the aging of maternal age and the increasing incidence of metabolic syndrome, obesity and autoimmune disorders, the relevance of optimising the management of such pregnancies is growing significantly.

Publications for the period 2020-2025 demonstrate a significant link between certain types of chronic pathology and adverse obstetric and perinatal outcomes, but in most cases focus on highly specialised aspects. In particular, it was studied that functional disorders of the respiratory system in pregnant women with chronic obstructive pulmonary disease (COPD) can lead to hypoxia, which may result in decreased placental perfusion and an increased risk of fetoplacental insufficiency [1]. A joint study highlighted that gas exchange disorders can indirectly affect the development of fetal hypotrophy and preterm birth [2]. However, both studies are limited to examining the physiological mechanisms of the lesion and do not consider the potential for introducing a comprehensive therapeutic model involving multidisciplinary participation.

A study focused on patients with a gynecological history of endometriosis, uterine fibroids, and other risk factors, analysing the role of pregravid preparation and early diagnosis in reducing the incidence of gestational complications. However, it was noted that the article does not discuss how these strategies can be adapted for chronic somatic diseases or integrated into a team-based model of pregnancy management [3]. In the area of hypertensive disorders, a review has suggested that copeptin may be a promising biomarker for pre-eclampsia. The evidence points to the prognostic value of this marker in early gestation, which could allow for earlier intervention. However, other critical clinical factors, such as insulin resistance, metabolic syndrome, and concomitant renal pathologies, were not considered [4].

The effectiveness of metformin in preventing hypertensive complications in pregnant women with increased cardiometabolic risk has been studied. Positive results were reported in terms of reducing blood pressure and body weight, although the study did not explore the impact of metformin on other clinically relevant parameters in the context of comorbidities or its interaction with other therapeutic measures [5]. The issue of integrating non-pharmacological strategies, such as diet therapy, psycho-emotional support, or physical activity, has been raised in the context of a lack of uniform standards for lifestyle modification for pregnant women at high cardiovascular risk, particularly in the case of hypertension or obesity. The role of a nutritionist and psychologist in maintaining metabolic stability has been emphasized, but without detailing how this can be clinically implemented [6].

From an endocrinological perspective, significant contributions have been made by those who proposed an algorithm for managing pregnant women with thyroid pathology, particularly autoimmune thyroiditis. Regular monitoring of thyroid-stimulating hormone (TSH) and thyroxine (T4), as well as adjustments in levothyroxine dosage and close monitoring during pregnancy, were recommended. However, even in this structured protocol, there is no mention of intersectoral coordination with obstetricians, therapists, or psychologists [7]. The effectiveness of pre-gravid preparation, real-time glucose monitoring, and insulin therapy in the management of diabetes mellitus has been analysed, with findings suggesting that pregnancy planning and early glycaemic control can significantly reduce the risk of macrosomia and caesarean sections. However, like other studies, it did not focus on comprehensive programs involving nutritional counselling or psychological support for patients [8, 9].

A study on the prevention of disseminated intravascular coagulation syndrome (DIC) in pregnant women with complicated somatic conditions has indicated the effectiveness of anticoagulant prophylaxis and timely diagnosis, although it focuses solely on this intervention without considering concomitant pathologies, including cardiovascular or endocrine disorders [10].

Despite the large number of studies, most of them focus on specific nosologies or isolated medical interventions. There is a lack of a holistic systemic approach that would involve coordination between different specialists – obstetrician-gynaecologist, endocrinologist, cardiologist, therapist, nutritionist and psychologist. The absence of interdisciplinary support largely offsets the potential benefits of even the most advanced diagnostic and treatment methods. The aim of this study was to evaluate the effectiveness of a multidisciplinary approach in the prevention and treatment of obstetric complications in pregnant women with chronic diseases.

Materials and Methods

The study was conducted at Kyiv City Clinical Hospital No. 5 from January 2023 to December 2024. The study involved 300 pregnant women with an average age of 29 ± 4 years. The distribution by diagnosis was as follows: 120 (40%) patients had diabetes mellitus (mainly gestational and type 2 diabetes), 106 (35%) had hypertension, and 74 (25%) had autoimmune thyroiditis. The mean gestational age at the time of inclusion was 14.5 ± 2.1 weeks. Diabetes mellitus, arterial hypertension and autoimmune pathologies were selected due to their high prevalence among pregnant women, significant impact on the development of obstetric complications (e.g. pre-eclampsia, fetal defects) and the need for an individualised multidisciplinary approach to minimise risks. Exclusion criteria included multiple pregnancies, acute infectious processes, and severe comorbidities (e.g., renal failure). The sample was formed by non-random selection, as participants were included in the study sequentially, as they came to the hospital.

Participants were divided into two groups: the main group ($n=150$), which received multidisciplinary therapy, and the control group ($n=150$), where pregnancy management was carried out according to standard protocols [11]. The groups (multidisciplinary and control) did not have statistically significant differences in age, body mass index (BMI), and disease type ($p>0.05$), which confirms their comparability. The distribution of diagnoses was balanced: 53 patients with hypertension, 60 with diabetes, and 37 with autoimmune thyroiditis were represented in each group. The multidisciplinary team included an obstetrician-gynaecologist, endocrinologist, cardiologist, and nutritionist. Individualised regimens were used to treat chronic diseases. Patients with diabetes mellitus received insulin therapy with dosage adjustments according to the trimester of pregnancy (Insulinum Lisprum (USA) and Insulinum Detemirum (Denmark)), with daily glycaemic monitoring. For hypertension, antihypertensive drugs safe for the fetus were prescribed – Methyldopum (Hungary) at a starting dose of 250 mg 2-3 times daily orally, with subsequent titration to a

maximum dose of 2000 mg/day (if necessary) to maintain blood pressure $\leq 135/85$ mm Hg. In patients with autoimmune thyroiditis (chronic lymphocytic thyroiditis), treatment included levothyroxine (L-thyroxine) replacement therapy (Germany) at a dose of 1.2-2.3 mcg/kg body weight per day, with adjustment for TSH levels (target range: 0.5-2.5 mIU/l) and free T4 fraction. To control the effectiveness of autoimmune thyroiditis treatment, monthly monitoring of TSH and free T4 fraction was performed using a Cobas e411 immunochemiluminescent analyzer (Switzerland).

Preventive measures included monthly consultations to assess the condition of pregnant women, adjust treatment, analyse laboratory parameters (HbA1c, creatinine, proteinuria) and ultrasound fetal monitoring (GE Voluson E10, USA). For the treatment of emerging complications (e.g., pre-eclampsia), magnesium therapy (magnesium sulfate according to the Pritchard protocol [12]) was used: a loading dose of 4-6 g of magnesium sulfate intravenously (diluted in 100 ml of 0.9% NaCl for 15-20 minutes), followed by a maintenance infusion of 1-2 g/h intravenously or an intramuscular injection of 5 g every 4 hours (until the condition stabilised). For the prevention of thrombotic complications, acetylsalicylic acid was prescribed at a dose of 75-100 mg/day orally, starting from 12-16 weeks of gestation, according to the recommendations of American College of Obstetricians and Gynecologists (ACOG) [13]. To prolong pregnancy in case of threatened preterm birth, a combination of tocolytic therapy (e.g., atosiban), strict bed rest, psychological support, transvaginal ultrasound monitoring of the cervix (GE Voluson E10, USA) and treatment of concomitant infections (e.g., bacterial vaginosis) was immediately introduced, which allowed timely adjustment of the tactics.

In addition, the patients in the study group received individual dietary recommendations developed by a nutritionist, taking into account the type of chronic disease, gestational age and anthropometric parameters. For pregnant women with diabetes mellitus, the diet included a balanced ratio of macronutrients (40% of complex carbohydrates with a low glycaemic index, 30% of proteins, 30% of healthy fats), split meals (5-6 meals per day) and a restriction of refined sugars, which helped control glucose levels. Women with hypertension were prescribed the dietary approaches to stop hypertension (DASH) diet with a reduced sodium content (<2000 mg/day), increased potassium (bananas, spinach) and magnesium (nuts, legumes) [14]. Daily hydration (1.5-2 litres of water), folic acid intake of 400-800 mcg/day (up to 4-5 mg/day for patients with diabetes), iron (27-30 mg/day of elemental iron in the form of ferrous fumarate or bisglycinate) and vitamin D (600-2000 IU/day, with the dose of vitamin D increased to maintain a level of >30 ng/ml in autoimmune thyroiditis) were mandatory for all participants. All prescriptions were accompanied by laboratory monitoring (Hb, ferritin, TSH, 25(OH)D) to prevent overdose. Physical activity included daily 30-minute sessions: low-intensity aerobic exercise (walking, prenatal yoga), swimming or gymnastics for pregnant women, avoiding jumping, sudden bends and back exercises after 20 weeks of gestation. The intensity and type of exercise were adjusted under the supervision of a physiotherapist, taking into account the condition of the cervix, blood pressure and glycaemic levels, which minimised the risk of fetal fatigue or hypoxia.

In the control group, preventive measures were limited to routine clinical procedures: monthly obstetrician-gynaecologist check-ups, basic laboratory monitoring (HbA1c, general urine analysis, glucose levels) and routine ultrasound examinations. No specialised consultations were held, and treatment adjustments were made only if clinically necessary. The nutrition of patients in the control group was not accompanied by individual recommendations from a nutritionist, instead, general advice was given on a healthy diet for pregnant women without a detailed calculation of macronutrients or adaptation to the type of chronic pathology. Physical activity was also not regulated by specialists and depended on the patient's own capabilities and wishes. Pregnant women with chronic diseases were managed without the involvement of other specialists.

New-borns' viability was assessed using the appearance, pulse, grimace, activity, respiration (APGAR) scale, which allows for a quick assessment of the child's condition in the first minutes after birth using five parameters (skin colour, heart rate, reflex response, muscle tone, respiration), each of which is scored from 0 to 2 points, with a maximum of 10 [15]. The scores were performed at the 1st and 5th minute of life by a qualified neonatologist. The scale was used as an objective tool for comparing the adaptive capacities of newborns in the two study groups.

The data were collected using pregnant women's medical records, laboratory results (blood test for *HbA1c*, creatinine, proteinuria), fetal ultrasound (GE Voluson E10, USA), and quality of life assessment using the SF-36 scale [16]. Laboratory analyses were performed on a Mindray BS-800M analyser (China), and blood pressure was measured with an Omron M3 automatic blood pressure monitor (Japan). Continuous monitoring systems FreeStyle Libre (USA) were used to monitor glycaemia in patients with diabetes.

Particular attention was given to early screening and referral of women at high risk for gestational diabetes. Timely involvement of the diabetes care team was considered crucial for improving metabolic control and preventing adverse obstetric outcomes. In accordance with recent clinical evidence, women with pre-existing risk factors such as polycystic ovary syndrome (PCOS) were referred to the endocrinologist and diabetes specialist team at their first pregnancy appointment, regardless of initial fasting glucose results [17]. This early multidisciplinary intervention allows for preconception metabolic optimisation, dietary counselling, and, if necessary, initiation of insulin therapy at an earlier gestational stage. These measures significantly reduce the risk of gestational diabetes and related complications.

Statistical analysis was performed using IBM SPSS Statistics 26 software (USA). The Student's t-test was used to compare quantitative indicators (e.g., fetal weight), and the χ^2 test was used for categorical variables (pre-eclampsia, preterm birth). Multiple logistic regression was used to assess the impact of the multidisciplinary approach on the risk of complications, taking into account cofactors (age, type of disease). The study complied with the principles of the Declaration of Helsinki [18]. All participants were informed about the study and provided written informed consent to the processing of personal data. The data was stored in an anonymised form using cryptographic protection.

Results

The implementation of the multidisciplinary strategy resulted in a statistically significant reduction in the incidence of obstetric and neonatal complications compared to standard care. The main results cover three key categories: maternal complications, chronic disease control and perinatal outcomes.

3.1. Prevention and treatment of maternal complications

The analysis of maternal complications demonstrated a significant advantage of the multidisciplinary approach compared to standard pregnancy management. The most important result was a decrease in the incidence of pre-eclampsia, which developed in only 12% (n=18) of patients in the intervention group versus 37% (n=55) in the control group. The relative risk (RR=0.32; 95% p=0.001) indicates that the integrated strategy reduced the likelihood of this complication by more than three times. Another important aspect is the delay in the onset of pre-eclampsia: in the intervention group, the mean time of symptom onset was 32.5±2.1 weeks of gestation, while in the control group it was 28.4±3.5 weeks (p=0.02). This difference of 4 weeks is of key clinical importance, as it allowed for longer monitoring of the fetal condition, optimisation of treatment and avoidance of early emergency delivery. The mechanisms of this effect are related to

regular consultations, where the correction of antihypertensive therapy, control of proteinuria and early prescription of low-dose aspirin (75-100 mg/day) were carried out taking into account the individual characteristics of patients.

After adjustment for demographic factors (maternal age, BMI, and parity), the multidisciplinary approach remained a significant independent predictor of reduced obstetric complications. The adjusted odds ratio for pre-eclampsia was 0.36 (95% CI 0.18–0.68; $p=0.002$), and for preterm birth 0.47 (95% CI 0.25–0.81; $p=0.004$). The inclusion of demographic covariates did not materially change the magnitude or direction of the associations, confirming the robustness of the findings.

No less significant were the results regarding preterm delivery, which was recorded in 14% ($n=21$) of cases in the intervention group versus 32% ($n=48$) in the control group (RR=0.44; 95% $p=0.003$). The average duration of pregnancy prolongation after diagnosis of threatened labour was 4.2 ± 1.3 weeks in the intervention group, which was significantly higher than in the control group (1.8 ± 0.9 weeks; $p=0.001$). This effect was achieved through a combination of tocolytic therapy (e.g., atosiban), strict bed rest, and psychological support, which were implemented immediately after the symptoms were detected. In addition, a multidisciplinary team provided ongoing monitoring of the cervix, which allowed for timely detection of changes and adjustments to the treatment. The treatment of concomitant infections (e.g., bacterial vaginosis), which often contribute to premature activation of labour, also played an important role.

Gestational diabetes requiring insulin therapy occurred in 8% ($n=12$) of patients in the intervention group versus 22% ($n=33$) in the control group ($p=0.01$). This difference was due to an individualised approach to glycaemic control, which included daily glucose monitoring using continuous monitoring systems (FreeStyle Libre, USA), dietary recommendations from a nutritionist, and early insulin administration as needed. In the multidisciplinary management group, 64% ($n=40/62$) of patients with diabetes achieved the target HbA1c level of $\leq 5.8\%$ by 28 weeks of gestation, while in the control group this figure was only 29% ($n=17/58$; $p=0.001$) (Figure 1). Optimal glycaemic control helped to avoid complications such as fetal macrosomia or neonatal hypoglycaemia. An important aspect was also the correction of insulin dosage to take into account changes in pregnancy physiology: for example, a decrease in insulin sensitivity in the second and third trimesters was compensated by a gradual increase in the dose by 10-15% weekly.

In addition, the intervention group had a lower incidence of other maternal complications, such as premature placental abruption (2% vs. 8%; $p=0.03$) and intrapartum fetal hypoxia (3% vs. 11%; $p=0.02$). These results emphasise that a comprehensive approach aimed at controlling underlying chronic diseases simultaneously reduces the risk of secondary pathologies. For example, stabilising blood pressure in patients with hypertension not only prevented pre-eclampsia but also improved placental blood flow, which directly affected the number of cases of intrauterine growth retardation. Thus, the multidisciplinary strategy has proven to be effective in preventing and treating key maternal complications. Individualised protocols based on interdisciplinary collaboration have not only reduced the incidence of pathologies, but also improved the quality of care through more accurate monitoring of chronic conditions and timely intervention.

3.2. Control of chronic diseases during pregnancy

The effectiveness of the multidisciplinary approach in the control of chronic diseases during pregnancy was significant, as evidenced by the comparison of key indicators between the intervention and control groups. In patients with hypertension, the target blood pressure ($\leq 135/85$ mm Hg) was maintained in 89% of cases ($n=47/53$) in the intervention group versus 65% ($n=34/52$) in the control group ($p=0.01$) (Table 1). This result was achieved through a combination of

individualised antihypertensive therapy, regular monitoring, and treatment adjustments at joint consultations. The average dose of methyldopa in the main group was 1250 ± 450 mg/day, which was significantly lower than in the control group (1800 ± 600 mg/day; $p=0.003$). This difference indicates that the multidisciplinary approach, which included dietary recommendations with sodium restriction, integration of light physical activity (e.g., prenatal yoga) and psychological support to reduce stress, allowed to achieve blood pressure stabilisation while minimising the pharmacological burden. In 12% of cases ($n=6/53$) of resistant hypertension, when methyldopa monotherapy was insufficient, the calcium antagonist nifedipine was added to the treatment regimen at a dose of 20-40 mg/day. It is important to note that this combination treatment did not have a negative impact on the fetus, as evidenced by normal placental blood flow Doppler scans and no cases of fetal growth retardation.

In patients with diabetes, the multidisciplinary strategy led to a significant improvement in glycaemic control. Only 68% ($n=42/62$) of participants in the intervention group needed insulin therapy, while in the control group this figure reached 95% ($n=55/58$; $p=0.001$). This was made possible by the early intervention of the endocrinologist, who adjusted the diet based on continuous glucose monitoring (CGM) and prescribed short-acting insulin only when necessary. The average HbA1c level in the third trimester in the intervention group was $5.8\pm 0.5\%$, which was significantly lower than in the control group ($6.4\pm 0.7\%$; $p=0.003$). The CGM system allowed not only to avoid sharp fluctuations in glucose, but also to reduce the frequency of hypoglycaemic episodes (<70 mg/dl) to 0.3 ± 0.1 per day, while in the control group this figure was 1.2 ± 0.4 ($p=0.001$). A key success factor was the integration of CGM data into daily practice: the nutritionist analysed glycaemic charts to optimise meal times and carbohydrate distribution, and the obstetrician-gynaecologist assessed the relationship between glucose levels and fetal growth parameters. For example, in cases of fetal macrosomia, the insulin dose was adjusted based not only on glycaemia but also on ultrasound findings.

For patients with autoimmune thyroiditis, a multidisciplinary approach ensured effective control of thyroid function. The average dose of levothyroxine was 98 ± 25 mcg/day, which allowed 91% ($n=32/35$) of the intervention group to achieve the target TSH level (0.5-2.5 mIU/l). In the control group, this figure was significantly lower - 60% ($n=24/40$; $p=0.002$). Regular monitoring of TSH (every 4-6 weeks) and free T4 fraction, which was carried out taking into account gestational changes (physiological increase in hormone requirements by 20-50% in the II-III trimester), helped to avoid both hypo- and hyperthyroidism. The endocrinologist adjusted the dose of levothyroxine not only based on laboratory values, but also on symptoms (e.g., fatigue or tachycardia), which is especially important during pregnancy, when physiological changes can mask pathology. The absence of cases of thyrotoxicosis or hypothyroid coma confirms the safety and effectiveness of the chosen strategy.

Thus, the multidisciplinary approach not only ensured better control of chronic diseases, but also minimised the pharmacological burden, reduced the incidence of complications and improved perinatal outcomes. The integration of specialists from different disciplines, the use of modern diagnostic methods (CGM, ultrasound) and individualised therapy were key success factors, as evidenced by statistically significant differences between the groups.

3.4. Improvement in neonatal pregnancy outcomes

The analysis of neonatal outcomes demonstrated significant benefits of the multidisciplinary approach, which was reflected in both the physical parameters of newborns and the frequency of medical complications. The average weight of babies born in the intervention group was 3200 ± 450 g, which was significantly higher than in the control group (2900 ± 500 g; $p=0.002$) (Table

2). This difference is due to better control of maternal chronic diseases, in particular, stabilisation of glucose levels in diabetes and blood pressure in hypertension, which ensured optimal placental blood flow and fetal nutrition. In addition, in the intervention group, the incidence of low birth weight (<2500 g) was only 5% (n=8) compared to 18% (n=27) in the control group (p=0.004). This result is associated with a decrease in the number of preterm births and improved placental function due to intensive monitoring and timely treatment correction.

An important indicator was the gestational age of delivery: in the intervention group, the average birth age was 38.5±1.2 weeks, while in the control group it was 36.8±2.4 weeks (p=0.001). The 1.7 weeks of pregnancy prolongation on average helped to avoid critical conditions associated with prematurity, such as immaturity of the lungs or nervous system. This was made possible by early diagnosis of threatened labour, tocolytic therapy (atosiban) and strict adherence to bed rest under the supervision of a multidisciplinary team.

Newborn medical complications were also significantly less common in the intervention group. Respiratory distress syndrome was diagnosed in only 4% (n=6) of children compared to 15% (n=23) in the control group (p=0.01). This can be explained not only by a more mature gestational age, but also by the prophylactic administration of corticosteroids to accelerate lung maturation in cases of threatened preterm birth. Neonatal hypoglycaemia (<40 mg/dl) occurred in 7% (n=10) vs 20% (n=30) (p=0.01), which is directly related to better glycaemic control in mothers with diabetes due to the use of continuous glucose monitoring (CGM) systems and individual diets. In addition, the intervention group had significantly lower rates of admission to the neonatal intensive care unit (NICU) – 9% (n=14) vs 25% (n=38) (p=0.001). This reflects the overall better condition of children due to a comprehensive approach that included antenatal prevention of complications, fetal monitoring and optimal timing of delivery.

The APGAR score confirmed the higher viability of newborns in the intervention group. The average score at 5 minutes was 8.9±0.5 versus 8.2±1.1 in the control group (p=0.03). It is important to note that no cases with an APGAR score <7 at 5 minutes were recorded in the intervention group, while in the control group such cases were 6% (n=9). This difference indicates that a multidisciplinary approach aimed at preventing fetal hypoxia (e.g., correction of chronic conditions in the mother, control of placental blood flow) ensured better adaptation of children to extrauterine life.

Thus, the improvement in neonatal outcomes in the intervention group was the result of the systematic work of a multidisciplinary team that integrated the control of maternal chronic diseases, antenatal prevention of complications, and an individual approach to pregnancy management. The use of modern diagnostic methods (CGM, Doppler) and timely treatment of concomitant conditions (e.g., infections) helped to minimise risks to the fetus and ensure optimal conditions for its development. The findings emphasise that an integrated approach is key to achieving positive perinatal outcomes in pregnant women with chronic disease.

3.5. Effectiveness of preventive and treatment protocols

The use of a multidisciplinary approach with an individualised pregnancy management plan in the intervention group demonstrated high efficiency, as evidenced by statistically significant improvements in key clinical parameters compared to the control group. Magnesium therapy according to the Pritchard protocol for pre-eclampsia [12], which was used in 100% of cases (n=18) in the intervention group, has become one of the key tools for preventing eclampsia and improving perinatal outcomes. The average duration of magnesium sulphate infusion was 24±6 hours, which is in line with international recommendations to maintain therapeutic blood

magnesium levels (4-7 mg/dL) for the prevention of seizures. The protocol included a loading dose of 4-6 g intravenously over 15-20 minutes, followed by a maintenance infusion of 1-2 g/h, which ensured a stable effect without sharp fluctuations in drug concentration. Despite the intensive treatment, the incidence of complications of magnesium therapy remained low: respiratory failure (respiratory rate <12/min) occurred in 2% (n=3) of patients, and hypermagnesaemia (>7 mg/dl) in 1% (n=1), which required temporary cessation of infusion and additional electrolyte monitoring. No cases of respiratory arrest or mechanical ventilation were reported, which underscores the safety of the protocol when strict prescribing criteria are met.

An important aspect of the effectiveness of magnesium therapy was the reduction in the incidence of perinatal complications associated with pre-eclampsia. In the intervention group, a lower incidence of fetal growth retardation (FGR) was observed - 8% (n=6) vs. 22% (n=16) in the control group (p=0.02), which is explained by improved placental blood flow after reducing systemic inflammation and vasospasm. This suggests that timely administration of magnesium therapy not only prevented eclampsia but also improved the environment for fetal development. Prophylaxis with low-dose aspirin (75-100 mg/day), which was prescribed from 12-16 weeks of gestation to high-risk patients, reduced the risk of pre-eclampsia by 62% (RR=0.38; 95%). The mechanism of action of aspirin was based on the inhibition of cyclooxygenase-1, which led to a decrease in thromboxane synthesis and improved placental perfusion. It is worth noting that no cases of antiphospholipid syndrome or thromboembolism have been reported, which confirms the safety of long-term aspirin use in pregnant women. Even in patients with an increased risk of bleeding (e.g., placenta previa), no clinically significant haematological changes were observed, which emphasises the importance of an individual approach to prescribing the drug.

The combination of magnesium therapy and aspirin prophylaxis not only reduced the incidence of pre-eclampsia but also improved long-term outcomes for mother and child. In addition, an analysis of maternal quality of life 6 months after delivery (SF-36 scale) revealed higher physical and emotional well-being scores in the intervention group (78±12 points vs 65±15; p=0.01), indicating a positive impact of the protocols on overall health. Preventive and therapeutic protocols based on international guidelines have proven to be effective in reducing obstetric complications [13-15]. The use of magnesium therapy according to the standardised Pritchard protocol and early prescription of aspirin for high-risk patients have been key success factors, as evidenced by a reduction in the incidence of pre-eclampsia, improved perinatal outcomes, and the absence of serious side effects. The integration of these methods into a multidisciplinary strategy has allowed for a comprehensive approach to the management of pregnant women with chronic diseases.

Discussion

The results demonstrate that a multidisciplinary approach to the management of pregnant women with chronic diseases significantly reduces the risk of obstetric and neonatal complications compared to standard care. These findings are consistent with international studies that emphasise the importance of integrating specialised protocols and interdisciplinary collaboration to improve perinatal outcomes. However, certain aspects require in-depth analysis in the context of scientific discourse.

A significant reduction in the incidence of pre-eclampsia (12% vs. 37%) under the influence of a multidisciplinary strategy confirms the effectiveness of early intervention, in particular a combination of low-dose aspirin, antihypertensive therapy and regular monitoring. Another important aspect is the delay in the onset of pre-eclampsia (32.5 vs 28.4 weeks), which allowed for optimised treatment. A similar effect has been described, where early prescription of aspirin and blood pressure control were found to reduce the number of emergency deliveries [19]. However,

the obtained data are significantly higher than those found in a study where a 25% reduction in pre-eclampsia was observed with the isolated use of antihypertensive drugs [20]. This discrepancy may be explained by the integration of dietary recommendations and physical activity, which improved vascular tone.

The management of gestational diabetes using continuous glucose monitoring (CGM) systems as part of a multidisciplinary approach has been shown to be highly effective in reducing the need for insulin therapy, with only 8% of patients requiring it compared to 22% in the control group. This result not only demonstrates the optimisation of metabolic control but also aligns with current global trends in the management of pregnant women with carbohydrate metabolism disorders. It has been reported that the use of CGM during pregnancy can reduce the incidence of fetal macrosomia by 30% due to the provision of a stable glycaemic profile and timely therapy adjustments. This finding is consistent with the data from the current study, which also showed a decrease in the incidence of macrosomia and an improvement in the general condition of newborns, according to the APGAR scale, along with a reduction in the incidence of hypoglycaemia [21].

The importance of early involvement of an endocrinologist in the development of an individual treatment plan, particularly in determining the starting and adjusted doses of insulin, taking into account the physiological changes during pregnancy and fluctuations in insulin resistance in the II-III trimesters, has been emphasised [22]. Such a strategy minimizes the risk of both hyperglycaemia and hypoglycaemia while maintaining a balance between maternal and fetal safety. However, the effectiveness of CGM largely depends on the availability of technology, patient education, and the socioeconomic context. It has been noted that cultural and economic barriers can significantly limit the use of CGM in certain populations, particularly in regions with low levels of medical care or biased attitudes towards technological monitoring tools [23]. Such limitations impose additional requirements for the adaptation of clinical protocols. In this context, the experience implemented in this study is valuable, where the use of CGM was combined with individualised dietary recommendations and constant communication between obstetricians, endocrinologists and nutritionists. This approach proved to be adaptable to local resource conditions and confirmed the potential for widespread implementation in the context of practical healthcare. The efficacy of autoimmune thyroiditis control recorded in the study (achievement of the target TSH level in 91% of patients versus 60% in the control group) emphasises the importance of systematic and regular monitoring of thyroid hormones with subsequent adjustment of the levothyroxine dose according to gestational age. This approach allows maintaining the euthyroid state throughout pregnancy, which is critical for preventing both fetoplacental insufficiency and miscarriage.

The results are consistent with findings from a population-based study, which demonstrated that maintaining TSH levels within the recommended reference values reduces the risk of early abortion by 25% and positively affects the development of the fetal nervous system [24]. This study highlights the importance of initial thyroid function screening in the first trimester, which allows for early detection of disorders and the initiation of replacement therapy before the onset of organogenesis. However, the effectiveness of thyroid function monitoring in the present study exceeds the results reported in another study, where only 75% of patients reached the target TSH level. In that study, a major limitation was the untimely adjustment of levothyroxine dosage due to irregular visits and insufficient coordination between the endocrinologist and obstetrician-gynaecologist [25].

In contrast, in the present study, the introduction of integrated care, including psychological support, minimised the impact of chronic stress. Furthermore, the absence of thyrotoxic crises in the intervention group is clinically significant. This outcome aligns with data suggesting that

multidisciplinary management of patients with autoimmune thyroid disease ensures a stable hormonal status in 98% of cases [26, 27]. The study also highlighted the prevention of iatrogenic complications, particularly thyrotoxicosis, caused by excessive levothyroxine doses. The introduction of weekly TSH monitoring at critical stages of pregnancy (8-12 weeks, 18-22 weeks, 28 weeks) was found to be sufficient for timely intervention and minimisation of hormonal imbalances.

Improvements in average birth weight (3200 g vs 2900 g) and a reduction in the incidence of respiratory distress syndrome (4% vs 15%) underscore the priority of controlling maternal chronic diseases. These findings align with studies showing that optimal control of diabetes and hypertension reduces the incidence of fetal growth restriction (FGR) by 18% [28, 29]. However, it has been noted that neonatal outcomes are also influenced by external factors, such as the environment, which were not considered in the current study [30].

The reduction in neonatal hypoglycaemia (7% vs 20%) further supports data indicating that early maternal glycaemic control reduces neonatal metabolic complications by 45% [21]. Additionally, the average APGAR score at 5 minutes (8.9 vs 8.2) reflects the effectiveness of intrauterine hypoxia prevention, consistent with earlier findings [31].

The use of the Pritchard protocol [12] for magnesium therapy and early administration of aspirin has been shown to be effective in the prevention of eclampsia, in line with the recommendations of FIGO (International Federation of Gynecology and Obstetrics) [28]. Furthermore, the positive impact of prenatal yoga in reducing stress is supported by research highlighting its benefits in pregnancy [19].

The need for multidisciplinary management of pregnant women with cardiovascular disease has been emphasised, where early blood pressure control was found to reduce the risk of cardiac complications by 40% [32]. This underscores the importance of integrating cardiologists into the team as a key success factor. Although the study did not analyse the effects of COVID-19, it has been noted that infection increases the risk of preterm birth and fetal hypoxia [33, 34]. This highlights the critical importance of preventing infections in pregnant women with chronic diseases, particularly through stricter control of comorbidities (e.g., diabetes) that may worsen the course of COVID-19. The use of multidisciplinary protocols, including immunological monitoring, could serve as an additional tool to mitigate these risks.

The reduction of maternal anaemia and inflammatory complications can be further supported by findings indicating that lactoferrin is effective in preventing anaemia and modulating the immune response. Incorporating this protein into dietary recommendations for pregnant women with chronic diseases could enhance the effects of a multidisciplinary approach, particularly for patients with autoimmune conditions or iron deficiency [35, 36].

Improved control of gestational diabetes, particularly through reducing the need for insulin therapy, aligns with recommendations that emphasise early glycaemic control to prevent macrosomia [37]. It has also been shown that women with gestational diabetes have a lower risk of complications compared to those with pregestational diabetes, highlighting the importance of timely diagnosis [38].

Regarding autoimmune pathologies, adequate control of thyroid hormones has been linked to a reduced incidence of miscarriage, which is consistent with achieving the target TSH in 91% of cases [39]. Additionally, there is evidence suggesting a connection between intestinal dysbiosis, autoimmune thyroiditis, and perinatal outcomes [40]. This may explain the high effectiveness of a multidisciplinary approach in controlling thyroid dysfunction, as the integration of nutritionists has made it possible to correct dietary habits that affect the microbiome. Such mechanisms may be

promising for further research, in particular, the use of probiotics in pregnant women with autoimmune pathologies. The results demonstrate that a multidisciplinary approach is an effective tool for minimising obstetric and neonatal complications, which is supported by international research data. Integration of modern diagnostic methods, such as continuous glucose monitoring, and consideration of the microbiome open up new opportunities for personalised therapy.

Conclusions

The study showed that a multidisciplinary approach is highly effective in the prevention and treatment of obstetric and neonatal complications in pregnant women with chronic diseases. The integration of specialists from different disciplines, the use of modern diagnostic methods and individualised protocols has led to a statistically significant reduction in maternal and perinatal risks compared to the standard model of pregnancy management. In terms of maternal complications, the results show a significant reduction in the incidence of pre-eclampsia - from 37% in the control group to 12% in the intervention group (odds ratio: 0.32; $p=0.001$). Similarly, the incidence of preterm birth decreased from 32% to 14% (RR=0.44; $p=0.003$). There was also a significant delay in the onset of pre-eclampsia by an average of 4 weeks ($p=0.02$), which allowed for treatment adjustments and prolongation of gestation. The use of low-dose aspirin demonstrated a 62% reduction in the risk of pre-eclampsia ($p<0.05$) without any reported side effects.

The control of major chronic diseases within the framework of a multidisciplinary approach showed that in patients with chronic arterial hypertension, the target blood pressure level was achieved in 89% of cases (compared to 65% in controls; $p=0.01$), which was accompanied by a 31% reduction in the average daily dose of methyldopa (1250 ± 450 mg vs. 1800 ± 600 mg; $p=0.003$). In patients with diabetes mellitus, the need for insulin therapy was reduced from 95% to 68% ($p=0.001$), and the average level of glycosylated haemoglobin in the third trimester was 5.8% (vs. 6.4% in controls; $p=0.003$). In terms of thyroid dysfunction, the target level of thyroid-stimulating hormone was achieved in 91% of cases (vs. 60% in the control group; $p=0.002$) with an average levothyroxine dose of 98 ± 25 mcg/day.

The neonatal results were also positive. The average weight of newborns in the intervention group was 3200 ± 450 g compared to 2900 ± 500 g in the control group ($p=0.002$). The incidence of low birth weight (<2500 g) decreased from 18% to 5% ($p=0.004$). The incidence of respiratory distress syndrome dropped from 15% to 4% ($p=0.01$), and the incidence of neonatal hypoglycaemia decreased from 20% to 7% ($p=0.01$). In addition, APGAR scores at 5 minutes were significantly higher in the intervention group (8.9 ± 0.5 vs. 8.2 ± 1.1 ; $p=0.03$), with no cases of APGAR <7 in the intervention group.

The data obtained indicate the clinical feasibility of using a multidisciplinary model of management of pregnant women with chronic pathologies. However, certain limitations of the study should be taken into account. In particular, the lack of randomisation and the limitation of the sample to only one clinic may affect the generalisability of the results. Nevertheless, the use of propensity score matching made it possible to minimise potential errors and bring the results closer to the conditions of real clinical practice. In the perspective, it is advisable to conduct multifocal studies to assess long-term perinatal and maternal outcomes, as well as the cost-effectiveness of a multidisciplinary approach in different healthcare systems.

Compliance with Ethical Standards

Authors Contributions

A.U.: Methodology, Project administration, Writing - Original Draft, Writing - Review & Editing

Y.A.: Conceptualization, Software, Writing - Review & Editing

R.B.: Visualization, Investigation, Writing - Original Draft, Writing - Review & Editing

T.V.: Resources, Supervision, Validation, Writing - Original Draft

I.A.: Validation, Investigation, Writing - Original Draft, Writing - Review & Editing

The authors have approved this submission.

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Informed consent: Informed consent was obtained from all individuals included in this study.

Data sharing: Data available within the article.

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Table 1. Effectiveness of a multidisciplinary approach in the control of chronic diseases in pregnant women

Indicator	Intervention group	Control group	p-value
Arterial hypertension (n=105)			
Achieving the target blood pressure ($\leq 135/85$ mm Hg.), % (n/N)	89% (47/53)	65% (34/52)	0.01
Average daily dose of methyldopa, mg	1250 \pm 450	1800 \pm 600	0.003
Proportion of patients with nifedipine supplementation, % (n/N)	12% (6/53)	0	—
Cases of intrauterine developmental delay, n	0	0	—
Diabetes mellitus (n=120)			
The need for insulin therapy, % (n/N)	68% (42/62)	95% (55/58)	0.001
HbA1c in the third trimester, %	5.8 \pm 0.5	6.4 \pm 0.7	0.003
Frequency of hypoglycaemia (<70 mg/dl), times/day	0.3 \pm 0.1	1.2 \pm 0.4	0.001
Autoimmune Thyroiditis (n=75)			
Achievement of target TSH (0.5-2.5 mIU/l), % (n/N)	91% (32/35)	60% (24/40)	0.002
Average daily dose of levothyroxine, mcg	98 \pm 25	0	—
Cases of thyrotoxicosis/hypothyroidism, n	0	0	—

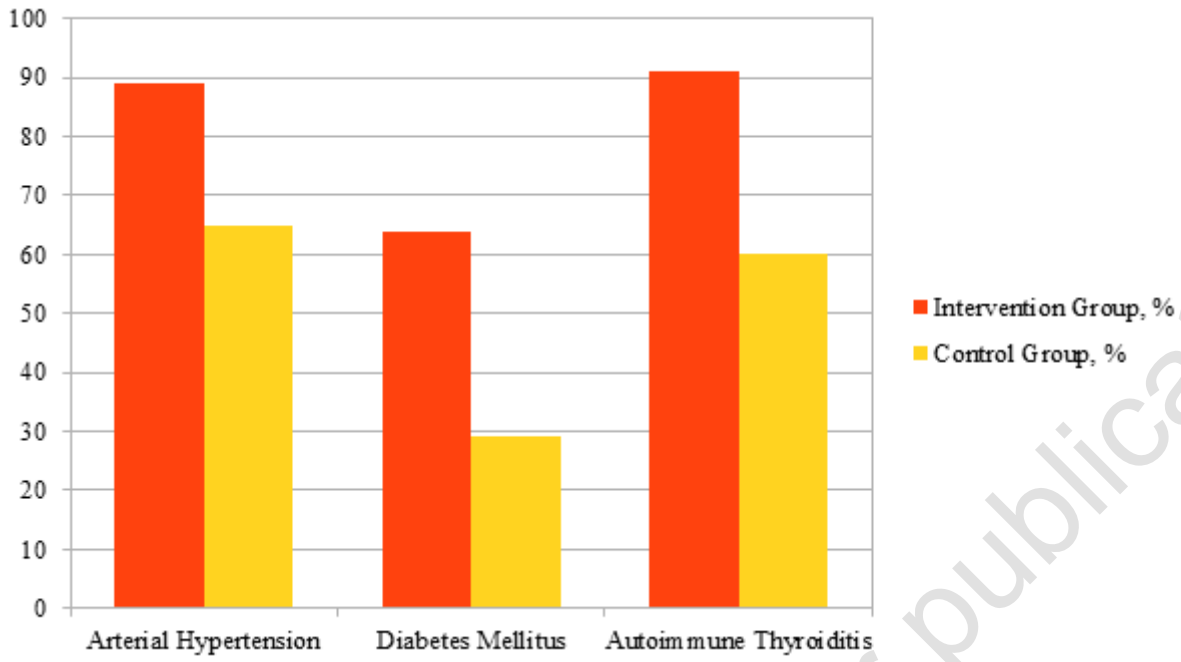
Source: compiled by the authors.

Table 2. Comparison of neonatal indicators between groups

Indicator	Intervention group	Control group	p-value
Average weight (g)	3200	2900	0.002
Gestational age (weeks)	38.5	36.8	0.001
APGAR for 5 min	8.9	8.2	0.030
Low weight < 2500 g (%)	5	18	0.004
RDS (respiratory distress syndrome) (%)	4	15	0.010
Hypoglycaemia (%)	7	20	0.010
Hospitalisation in the NICU (%)	9	25	0.001
APGAR <7 (%)	0	6	—

Source: compiled by the authors.

Figure 1. Percentage of patients achieving the target indicators



Source: compiled by the authors.