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THE IMPACT OF ACTIVE OR PAST MATERNAL ANOREXIA NERVOSA ON FETAL GROWTH AND DEVELOPMENT

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ABSTRACT

Introduction: Anorexia nervosa (AN) is a psychiatric eating disorder that disrupts the hypothalamic–pituitary–ovarian axis, often causing amenorrhea and delaying conception. Although remission can restore fertility, both active and past AN are linked to obstetric and neonatal complications.
Aim of the Study: We aimed to systematically review the current knowledge about the effect of maternal anorexia nervosa on fetal growth and development.
Methodology: PubMed was searched (2005–2025) for original English clinical studies on maternal AN and fetal outcomes; reviews, case reports, and non-clinical articles were excluded, resulting in 17 eligible full-text studies.
Results: The most consistently reported finding was a significantly lower birth weight in infants born to mothers with a history of past or active AN. The main cause of low birth weight was low maternal pre-pregnancy body mass index (BMI) and insufficient weight gain during pregnancy. Other common adverse neonatal outcomes included small-for-gestational-age, preterm birth, and reduced head circumference, the latter being associated with potential neurocognitive developmental delays. The risk of complications was markedly higher for women with active AN during pregnancy.
Conclusions: Maternal AN increases the risk of adverse obstetric and neonatal outcomes. Multidisciplinary care with careful monitoring of maternal weight, nutritional status, and mental health is essential to minimize risks and optimize perinatal outcomes.

KEYWORDS

Anorexia Nervosa; Perinatal Outcomes; Low Birth Weight; Systematic Review

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Introduction.

Anorexia nervosa (AN) is classified as a psychiatric disorder within the broader category of eating disorders (EDs), with a prevalence among women ranging from 0.5% to 2.2%, most commonly affecting individuals between the ages of 14 and 24. (Letranchant et al., 2022; Smink et al., 2012) In adults, the female-to-male ratio is approximately 8:1, whereas among adolescents the gender disparity is significantly less pronounced. (Steinhausen & Jensen, 2015) More than half of all cases are diagnosed in girls before reaching adulthood. According to the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5), AN is defined as a restriction of energy intake relative to requirements, accompanied by a disturbance in body image perception and an intense fear of gaining weight. In contrast, the *International Classification of Diseases, 11th Revision* (ICD-11) specifies a body mass index (BMI) of less than 18.5 kg/m² in adults as a required criterion for diagnosis. An exception is made in cases of rapid weight loss exceeding 20% within six months—in such instances, a diagnosis of AN may still be made if the other diagnostic criteria are fulfilled. (Himmerich & Treasure, 2024)

AN carries the highest mortality risk among all eating disorders. (Fichter & Quadflieg, 2016) It is associated with a 6- to 12-fold increased risk of death compared to age-matched individuals in the general population. (Corcos et al., 2000)

Risk factors for the development of AN include genetic predisposition, psychosocial influences, and alterations in neural networks. Among adolescent patients, a significant association has been observed between the onset of the disorder and family-related circumstances. (Zipfel et al., 2015)

AN leads to widespread alterations across multiple organ systems, including the gastrointestinal, cardiovascular, and hematopoietic systems. It also causes damage to the skin and bones, and results in profound disruptions of the endocrine system and metabolic processes, which in turn affect fertility. (Baenas et al., 2024; Smythe et al., 2021; Stewart et al., 1990) The female reproductive system functions optimally only at an appropriate body weight. Eating disorders impair the hypothalamic–pituitary–ovarian (HPO) axis, (Rodino et

al., 2017; Schorr & Miller, 2017) leading to decreased levels of luteinizing hormone (LH) and follicle-stimulating hormone (FSH). The primary factor in the resumption of regular menstruation is reaching the so-called critical body weight threshold.(Frisch & Revelle, 1970; Rome & Ammerman, 2003)

A relationship between AN and reduced fertility in women has been well documented (Tabler et al., 2018). Fertility issues in women with AN are primarily associated with amenorrhea, anovulation, and decreased sexual activity. Scientific literature indicates that women with AN tend to conceive their first pregnancy at a later age, often requiring at least six months of attempting to conceive. (Tabler et al., 2018) Additionally, a higher rate of unplanned pregnancies has been reported among patients with AN. (Bulik et al., 2010; Easter et al., 2011; Micali et al., 2014) Some studies suggest that women who have recovered from AN and regained a normal body weight do not experience significantly higher rates of infertility compared to women with no history of AN. (Bulik et al., 1999; Chaer et al., 2020; Wentz et al., 2005) Nevertheless, pregnancy can present significant psychological challenges for individuals with a history of eating disorders. Body changes and gestational weight gain may contribute to relapse or re-emergence of disordered eating behaviors.

Despite the possibility of achieving pregnancy in women with a history of anorexia nervosa (AN), this population is at increased risk for obstetric, perinatal, and postpartum complications. To date, relatively few studies have investigated the course of pregnancy and neonatal outcomes in women with active or remitted AN, and the findings remain inconclusive. This review aims to analyze and summarize the results of the largest studies conducted over the past 20 years in various centers worldwide, with particular focus on the impact of maternal AN on fetal growth and development. The purpose of this review is to raise awareness among healthcare professionals regarding the increasingly prevalent issue of eating disorders among women of reproductive age, and to emphasize the need for comprehensive, specialized, and multidisciplinary care for both these women and their offspring.

Methodology:

A comprehensive review of scholarly literature sourced from the PubMed database was performed. The following keywords were used: "anorexia nervosa," "maternal anorexia," "fetal complications," "birth outcomes," and "fetal growth," combined in various ways using the OR and AND logical operators. Systematic reviews, meta-analyses, reviews, case reports, letters to editors, commentaries, conference abstracts, guidelines/statements, expert opinions, and preprints were excluded. The statement: NOT review[Publication Type] was used. Full-text original clinical studies in English from the last 20 years (2005–2025) were included in the systematic review. The relevance and alignment with the topic were assessed based on titles and abstracts. It yielded 17 records that met the criteria. All 17 publications were retrieved in full text. Information gathered from the available literature was analyzed and synthesized.

Results:

Chatwin et al. performed a register-based cohort study and they analyzed 1 517 839 singletons born between 1991 and 2015 in Denmark. The control group consisted of children born to women with no history of eating disorders (ED). Women with ED were divided into two groups: with a recent (≤ 2 years before conception and during pregnancy) or past (> 2 years before conception) diagnosis. They reported increased risk of low birth weight (recent: RRR = 2.36 [95% CI = 1.76–3.18]; past: 1.22 [1.04–1.43]), small-for-gestational age (recent: 1.52 [1.01–2.26]; past: 1.37 [1.16–1.62]), and preterm birth (recent: 1.83 [1.37–2.45]; past: 1.17 [1.00–1.36]). A higher risk of complications occurred in recent anorexia nervosa (AN). (Chatwin et al., 2025) Dobrescu et al. included 51 patients with adolescent-onset AN and compared those with 51 matched controls. They found that the offspring of women with AN had significantly lower birth weight, length, and head circumference (HC). (Dobrescu et al., 2024) Baer et al. aimed to determine the association between underweight before pregnancy and gestational weight gain with adverse pregnancy outcomes in women with AN. They investigated 241 pregnant women with a diagnosis of AN. An increased risk of anemia, low birth weight and spontaneous preterm labor (adjusted relative risks ranged from 1.43 to 2.55) was observed in the study group. A higher risk of obstetric complications was associated with being underweight before pregnancy, and even more so with low weight gain during pregnancy. (Baer et al., 2024) Feferkorn et al. conducted a population-based study based on US population of 9,096,574 women without AN and 214 female patients with AN. They determined that maternal AN increases the risk of preterm labor (adjusted odds ratio [aOR] 2.98 CI 1.86 to 4.76, $P < 0.001$), placental abruption (aOR 3.41 CI 1.38 to 8.40, $P = 0.008$) and small for gestational age (SGA) children (aOR 5.32 CI 3.12 to 9.09, $P < 0.001$). (Feferkorn et al., 2023) Mantel et al. enrolled 7542 women with ED, consisting of 2769 patients with AN. The control group comprised 1,225,321 Swedish women

without ED. The authors found an association between maternal ED and obstetric outcomes. They noticed increased risk of a preterm labor (RR, 1.6 [95% CI, 1.4-1.8] and of microcephaly in the offspring (RR, 1.9 [95% CI, 1.5-2.4]. Moreover, AN was associated with antepartum hemorrhage (RR, 1.6 [95% CI, 1.2-2.1]), with a higher risk observed in the group of patients with recent disease. (Mantel et al., 2020) Ante et al. reported the results based on a retrospective cohort study from Canada assessing pregnancy complications in patients with AN. They investigated 1,910 neonates (0.1%) of women with past or active disease. Patients recently hospitalized for AN were the most at risk for adverse outcomes in their offspring. In the study group, it was noted 1,32 times the risk of preterm delivery (95% CI 1,13-1,55), 1,52 times the risk of small for gestational age (SGA) neonates (95% CI 1,35-1,72) and 1,69 times the risk of low birth weight (95% CI 1,44-1,99). (Ante et al., 2020) Watson et al. performed a three-generation cohort study in Norway about maternal ED and perinatal outcomes. The study group included 70,881 pregnancies in grandmother–mother–child triads with ED during pregnancy and 52,348 pregnancies with a history of ED. Maternal AN has been associated with intrauterine growth restriction, small-for-gestational-age, and low birth weight in offspring. No significant association was found between maternal AN during pregnancy and preterm birth. (Watson et al., 2017) Micali and Stemann Larsen et al. analyzed together 83 826 women from the Danish National Birth Cohort to investigate association between maternal ED and low birth weight, fetal growth restriction and preterm birth. 1 609 patients with AN, 1 693 patients with BN, and 634 with both disorders were compared with 76 724 women with no history of an ED diagnosis. They noticed restricted intrauterine growth and higher risk of SGA in women with AN [respectively, OR= 1.6 [95% CI 1.3–1.8] and OR= 1.5 [95% CI 1.2–1.9)]. Moreover, it was determined that active AN affects lower birthweight, length, head and abdominal circumference, ponderal index, higher odds of SGA [OR= 2.90 (95% 1.98–4.26)] and preterm birth [OR= 1.77 (95% CI 1.00–3.12)]. (Micali et al., 2016) Koubaa, Hällström, Brismar et al. included 20 women with a history of AN and 17 women with BN and compared them with 59 controls. They showed that biomarkers of nutrition and stress in pregnant women correlate with head circumference and neurocognitive function in children. Decreased maternal ferritin levels, particularly in those with a history of AN, were connected to memory difficulties in their offspring ($r_s = -0.70$, $p < 0.001$), and maternal free thyroxine levels were linked to reduced head circumference at birth ($r = 0.42$, $p = 0.07$). (Koubaa et al., 2015) Linna et al. aimed to assess outcomes of pregnancy in women with history of ED. The study group consisted of 2 257 women treated at the Eating Disorder Clinic of Helsinki University Central Hospital. A total of 9028 women without a past ED diagnosis were assigned to the control group. Children of mothers with AN were born with a lower birth weight mean 3302 g [SD 562], adjusted $p<0.001$ in AN; mean 3520 g [539] in unexposed women). Very preterm births occurred with greater frequency. There was also fourfold risk of perinatal death (adjusted OR 4.06, 95% CI 1.15-14.35). (Linna et al., 2014) Koubaa and Hällström et al. obtained patient records from longitudinal cohort study assessing the neurocognitive development of offspring born to women with a history of ED. Head circumference in children was reduced at least until 18 months of age and was related to impaired neurocognitive development, including language skills. (Koubaa et al., 2013) Micali, De Stavola et al. based on the population-based cohort study in the Netherlands, they found no differences in mean birth weight, the prevalence of small-for-gestational-age newborns, or preterm births in women with ED compared to women unexposed to these disorders. (Micali et al., 2012) Eagles et al. investigated obstetric complications in 134 women with a history of AN in Scotland and contrasted them with outcomes in 670 matched women. Standardized birthweight (SBW) scores suggested that children of mothers with AN were more likely to experience fetal growth restriction (FGR) [relative risk (RR) 1.54; 95% confidence interval (CI) 1.11–2.13]. Women with AN were more prone to antepartum hemorrhage (RR 1.70; 95% CI 1.09–2.65). (Eagles et al., 2012) Wentz et al. analyzed together 48 women with history of AN and 48 compared women in a controlled community-based study. None of the six women with active disease became pregnant. 3 women had AN during pregnancy. The only observed complication was low birth weight of the newborn. Among children of women with AN, no more eating problems were diagnosed than in the control group. (Wentz et al., 2009) Micali and Simonoff et al. reported the results based on a longitudinal cohort study about the risks associated with eating disorders in pregnant women. In the group of women with AN, lower birth weight than the general population was observed ($P = 0.01$), a difference attributed to their lower pre-pregnancy body mass index. No increased risk of preterm birth was demonstrated in the offspring of women with AN. (Micali et al., 2007) Ekéus et al. conducted an analysis of pregnancy outcomes in patients with history of AN. They included 1000 women with this diagnosis. They did not find a correlation between a prior occurrence of AN and negative birth outcomes. The main deviation observed was the lower birth weight in infants of women with AN. (Ekéus et al., 2006) Koubaa, Hällström, Lindholm et al. enrolled 49 women with past or current ED, among them 24 with AN. 22% of the patients had a verified

relapse in ED during pregnancy. In women with a history of disorders, an increased risk of hyperemesis ($P < .01$), lower birth weight ($P < .01$) and smaller head circumference ($P < .001$) were observed. The authors noticed higher frequency of microcephaly ($P < .05$) and small for gestational age infants ($P < .05$). (Koubaa et al., 2005)

Discussion:

In the studies reviewed, the most common and significant complication observed in the offspring of women with a history of past or active AN was a lower birth weight compared to the general population. This finding was confirmed in all analyzed scientific articles, with the exception of one study. (Micali et al., 2012) In that study, the absence of significant differences between infants of women with AN and those of unexposed women was attributed to the low incidence of specific complications. Eagles et al. demonstrated that when pre-pregnancy maternal BMI was accounted for, the difference in birth weight ceased to be statistically significant. (Eagles et al., 2012) Similarly, Micali et al. attributed reduced neonatal birth weight to the low maternal BMI. (Micali et al., 2007) Additionally, it has been shown that inadequate gestational weight gain, below recommended guidelines, is associated with this complication in the offspring. (Baer et al., 2024)

Other potential causes of low birth weight in infants may include persistent hormonal disturbances in the mother, such as abnormal levels of hormones that play a critical role in fetal growth regulation and placental metabolism, including estrogens, progesterone, leptin, and insulin-like growth factor 1 (IGF-1). In women with anorexia nervosa (AN), placental dysfunction may also occur due to impaired placental blood flow, resulting in reduced oxygen and nutrient transport. This condition can lead to fetal growth restriction (FGR). Another contributing factor may be psychological stress and fear of weight gain, which are associated with elevated cortisol levels. Excess cortisol has been shown to negatively affect fetal development. Additional risk behaviors often observed in this population include smoking—used as a coping mechanism for stress—excessive physical activity, and avoidance of obstetric and gynecological care due to fear of weight monitoring and control during pregnancy.

Micali et al. emphasized that the direct cause of neonatal complications in women with a history of anorexia nervosa remains unclear. One hypothesis suggests that these outcomes may result from active restriction of caloric intake or compensatory behaviors during pregnancy. On the other hand, they may stem from the long-term physiological consequences of the illness. (Micali et al., 2016) In some women, disruptions of the hypothalamic–pituitary–ovarian (HPO) axis may persist for years, leading to lower estrogen levels and anovulatory cycles. Additionally, eating disorders can alter gut microbiota, potentially impairing nutrient absorption even long after weight restoration. Reduced bone mineral density, frequently observed in women with a history of AN, is associated with calcium metabolism disturbances and may affect the availability of minerals transferred across the placenta. Another critical factor is the increased risk of relapse during pregnancy, triggered by body image changes, gestational weight gain, and anxiety related to loss of control.

Birth weight is an important indicator of fetal well-being and proper development, and it significantly influences the child's health later in life. (Eriksson et al., 2001; Gluckman et al., 2008) Both fetal growth restriction and preterm birth increase the risk of developing cardiovascular diseases, metabolic disorders, and psychiatric conditions in adulthood. (Bohnert & Breslau, 2008) Possible consequences of low birth weight (LBW) include neurological developmental problems, such as delayed psychomotor development, attention deficits, and difficulties in social interactions. Due to adaptation to a nutrient-deficient intrauterine environment, infants born with low birth weight often exhibit excessive fat accumulation postnatally when exposed to a normal environment. This predisposes them to a higher risk of metabolic syndrome in adulthood, characterized by hypertension, type 2 diabetes mellitus, and central obesity, as well as cardiovascular diseases. In childhood, low birth weight may lead to growth disturbances, including shorter stature relative to peers, reduced muscle mass, and decreased physical performance. Children with low birth weight also have a higher incidence of respiratory infections, attributable to an impaired immune system. Furthermore, women who were born with low birth weight themselves are at increased risk of delivering offspring with low birth weight, reflecting the phenomenon of transgenerational effects of fetal malnutrition.

In women with a history of anorexia nervosa, LBW in their offspring is primarily attributable to low maternal pre-pregnancy BMI. This represents a significant and potentially preventable risk factor, underscoring the importance of raising awareness about complications among women with a history of AN and encouraging them to engage in careful pregnancy planning.

A particularly important pregnancy outcome observed in several studies was the statistically significant reduction in head circumference (HC) among infants born to women with anorexia nervosa (AN), as reported

by Koubaa in 2005, 2013, and 2016, and by Dobrescu. (Dobrescu et al., 2024; Koubaa et al., 2015; Koubaa et al., 2013; Koubaa et al., 2005) Koubaa et al. demonstrated that postnatal weight gain in children of mothers with AN is relatively rapid, allowing them to catch up on low birth weight within a short time. However, this catch-up growth does not extend to head circumference, which remains delayed until approximately 18 months of age. This delay may be related to intrauterine malnutrition and maternal stress. Restricted head growth may have significant implications for brain development, potentially leading to neurocognitive developmental delays, which manifest as difficulties in social skills and expressive language abilities. It is crucial for neonatologists and pediatricians to recognize the association between developmental problems in children and maternal eating disorders, ensuring that affected children receive long-term, comprehensive, and attentive care. (Koubaa et al., 2013)

Other, somewhat less common perinatal complications observed in the studies included in this systematic review comprised:

- Small for gestational age (SGA) (Chatwin (Chatwin et al., 2025), Baer (Baer et al., 2024), Feferkorn (Feferkorn et al., 2023), Ante (Ante et al., 2020), Watson (Watson et al., 2017), Micali 2016 (Micali et al., 2016), Eagles (Eagles et al., 2012), Koubaa 2005 (Koubaa et al., 2005))
- Preterm birth (Chatwin (Chatwin et al., 2025), Baer (Baer et al., 2024), Feferkorn (Feferkorn et al., 2023), Mantel (Mantel et al., 2020), Ante (Ante et al., 2020), Linna (Linna et al., 2014))
- Microcephaly (Mantel (Mantel et al., 2020), Koubaa 2005 (Koubaa et al., 2005))
- Perinatal death (Linna (Linna et al., 2014))
- Preeclampsia (Baer (Baer et al., 2024))
- Antepartum haemorrhage (Baer (Baer et al., 2024), Mantel (Mantel et al., 2020), Eagles (Eagles et al., 2012))
- Anemia (Baer (Baer et al., 2024))
- Oligohydramnios (Baer (Baer et al., 2024))
- Placental abruption (Feferkorn (Feferkorn et al., 2023))

In some articles, the authors did not confirm an increased incidence of preterm birth among women with anorexia nervosa. (Micali et al., 2007; Watson et al., 2017) Wentz et al. and Ekeus et al. observed no other adverse pregnancy or neonatal outcomes apart from low birth weight in newborns (Ekéus et al., 2006; Wentz et al., 2009)

Women with active AN face a significantly higher risk of complications compared to those with a history of the disorder who currently maintain a normal body weight. The active form of the disease is associated with an increased incidence of cesarean deliveries, (Bulik et al., 1999; Franko et al., 2001) preterm birth, (Brinch et al., 1988; Bulik et al., 1999) and perinatal mortality (Brinch et al., 1988). Comparisons between complications in women with active versus past AN have also been conducted by authors of the studies included in this analysis. (Ante et al., 2020; Chatwin et al., 2025; Mantel et al., 2020; Micali et al., 2016)

Ante et al. emphasized that pregnant women with active anorexia nervosa should receive specialized multidisciplinary care, which may include psychotherapy, behavioral therapy, family-involved group psychoeducation, combined with restoration of a healthy body weight. (Ante et al., 2020) In their 2007 study, Micali et al. highlighted that experts recommend encouraging women to plan pregnancy only after complete remission of eating disorders. (Sollid et al., 2004). They suggested that raising awareness about the potential impact of the disorder on fertility and informing women about the possible adverse outcomes for their offspring could motivate them to engage in therapy and the recovery process. (Micali et al., 2007) However, in 2012 Eagles et al. published a study concluding that previous recommendations—to postpone pregnancy until complete remission of the disorder and to conduct routine, intensive pregnancy monitoring—may have been excessively stringent. The recovery process is often slow, and pregnancy itself can sometimes serve as motivation for recovery and the adoption of positive behaviors. It is primarily severe active anorexia nervosa during pregnancy that is harmful to the fetus, and it remains a contraindication for conception planning. (Eagles et al., 2012)

It is crucial to raise awareness among healthcare professionals about the significant impact of active and past eating disorders in women who are planning or become pregnant. Specialists should recognize that these patients belong to a high-risk group among pregnant women. (Mantel et al., 2020) They are more likely to experience various obstetric complications and require heightened attention. (Feferkorn et al., 2023) Due to the fact that some patients may remain undiagnosed or conceal their condition, screening programs for pregnant women have been proposed, (Eagles et al., 2012; Mantel et al., 2020; Micali et al., 2007) as well as

adjustments to obstetric care to improve the identification of patients with active eating disorders. Primary care physicians also have a responsibility to engage with women with active or past anorexia nervosa, preparing them for pregnancy planning and helping to prevent adverse outcomes in their offspring. (Micali et al., 2016)

All analyzed studies emphasized the need for comprehensive, multidisciplinary care for pregnant women with a history of anorexia nervosa. Increased monitoring of women with past or active AN during pregnancy was recommended to reduce adverse obstetric outcomes. (Chatwin et al., 2025) Obstetricians should pay particular attention to the woman's pre-pregnancy body weight and closely monitor weight gain throughout pregnancy, as this can significantly improve perinatal outcomes for both mothers with AN and their offspring. For women with a history of eating disorders, collaboration between gynecologists and psychiatrists is crucial to ensure continuous mental health monitoring. These women must not be left unsupported due to the higher risk of relapse of psychiatric issues during pregnancy.

Furthermore, children of women with eating disorders should receive specialized follow-up care from neonatologists and pediatricians, especially if born with low birth weight. Newborns with reduced head circumference require thorough and long-term neurodevelopmental and cognitive assessment. Early identification can facilitate timely intervention and help prevent later adverse outcomes. (Koubaa et al., 2013)

It is critically important to promote training of medical personnel in the clinical specifics of anorexia nervosa, as well as to develop and implement multidisciplinary teams to ensure continuity of care for these patients—from the initiation of treatment through at least six months postpartum.

Conclusions:

In summary, both active and past maternal anorexia nervosa increase the risk of certain obstetric complications, which has significant implications for preventing adverse fetal outcomes. The primary and most frequently observed negative consequence is the birth of infants with low birth weight, a critical risk factor that affects lifelong health by contributing to developmental disorders, chronic and lifestyle-related diseases, and reduced quality of life. Another important neonatal complication described is reduced head circumference, which may lead to delayed neurocognitive development. It is crucial to emphasize that active, severe AN markedly increases the risk of complications in offspring compared to a history of past AN. Based on the reviewed evidence, it can be concluded that pregnant patients with eating disorders require comprehensive and specialized care throughout pregnancy. They need a multidisciplinary approach involving close collaboration among obstetricians, psychiatrists, neonatologists, and pediatricians. Attention must be drawn to the rising prevalence of eating disorders among women of reproductive age, with the aim of preventing and minimizing adverse outcomes in their offspring.

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Authors' contributions:

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