World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(REVIEW ARTICLE)

Check for updates

# A systematic review: On the prevalence, risk factors, and interventions related to major birth defects and inflammatory conditions: a review of population-based and clinical studies

Syahra Adinda Pramesti [1,*], Manggala Pascawardhana [2,3], Risa Etika [4] and Muhammad Ilham Aldika Akbar [2]

[1] *Faculty of medicine, Universitas Airlangga Surabaya.*
[2] *Department of Obsetric and gynecology, faculty of medicine, Universitas Airlangga, Surabaya.*
[3] *Department of Obsetric and gynecology, dr.soetomo general academic hospital, Surabaya.*
[4] *Department of Pediatrics, faculty of medicine. Universitas Airlangga. Surabaya.*

World Journal of Advanced Research and Reviews, 2025, 28(01), 1261-1265

Publication history: Received on 05 September 2025; revised on 15 October 2025; accepted on 17 October 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.28.1.3537

## Abstract

Major congenital anomalies (CAs) represent a significant global burden as one of the leading causes of neonatal mortality and long-term morbidity in both developed and developing countries. This review aims to systematically evaluate the prevalence, associated risk factors, and interventions targeting congenital anomalies and related chronic inflammatory conditions based on recent population-based and clinical studies. A systematic literature review was conducted following the PRISMA guidelines, with sources obtained from PubMed, ScienceDirect, and Google Scholar for studies published between 2020 and 2025. The findings revealed variations in the prevalence of CAs, including 1.3% in Qatar and 2.6% in Northeast India, with the most affected organ systems being cardiovascular, gastrointestinal, central nervous, and musculoskeletal. Identified risk factors include maternal age, parity, fetal sex, gestational age, and obstetric complications such as chorioamnionitis and nuchal edema. Meanwhile, chronic inflammation associated with obesity is also linked to adverse developmental outcomes, with lifestyle interventions such as High-Intensity Interval Training (HIIT) and anti-inflammatory dietary patterns proven to reduce inflammatory biomarkers and improve metabolic health. In conclusion, integrating risk-based prenatal screening and evidence-based lifestyle modifications is a crucial strategy to reduce the incidence of congenital anomalies and long-term inflammatory damage. This review recommends multidisciplinary collaboration among clinicians, nutritionists, and policymakers to develop sustainable and contextually relevant interventions.

**Keywords:** Major congenital anomalies; Birth defects; Prevalence; Maternal risk factors; Chronic inflammation

## 1. Introduction

Major congenital anomalies are a significant global public health issue because they are a leading cause of neonatal mortality and long-term morbidity in children across various countries, both developing and developed. These abnormalities include structural, functional, metabolic, and genetic issues that arise during the intrauterine period and can be detected at birth or later in life. Population-based studies across various regions show that the prevalence of congenital anomalies ranges from 1.3% to over 6% of all live births, depending on the organ system involved, geographical, and sociodemographic factors, as well as access to antenatal care. Several studies, including those in Northeast India and Northern Greece, highlight the importance of hospital-based reporting and fetal autopsies in detecting the prevalence and patterns of these anomalies. Risk factors such as maternal age, parity, consanguinity, exposure to infections or teratogenic substances, and pregnancy complications like gestational diabetes have been shown to have a statistically significant relationship with the occurrence of congenital anomalies. The classification of disorders based on body systems shows that the gastrointestinal, central nervous, musculoskeletal, and cardiovascular

* Corresponding author: Manggala Pascawardhana

systems are the most frequently affected organ groups. These findings not only provide an epidemiological overview but also serve as the foundation for evidence-based health promotion, prevention, and policy actions. [1].

On the other hand, the process of biological aging accelerated by obesity and chronic low-grade inflammation is also a significant concern in the field of modern public health. Obesity, which has reached epidemic proportions globally, not only contributes to metabolic disorders such as type 2 diabetes mellitus and hypertension but also worsens the body's inflammatory status, which in turn accelerates tissue damage, weakens immunity, and leads to degenerative diseases. In this context, lifestyle-based intervention approaches such as High-Intensity Interval Training (HIIT) and anti-inflammatory nutritional intake are promising non-pharmacological strategies. Various literature studies indicate that HIIT can significantly reduce visceral fat, improve insulin sensitivity, and decrease inflammatory biomarkers such as IL-6 and TNF-α.

Meanwhile, the consumption of unsaturated fats, antioxidants, omega-3 fatty acids, and fiber that promotes the production of short-chain fatty acids (SCFAs) in the gut has a modulating effect on inflammatory pathways and the immune system. Therefore, it is important to review the relationship between the prevalence and predictors of congenital anomalies with inflammatory conditions, as well as the effectiveness of lifestyle interventions as an integrated promotional and preventive effort. This systematic review aims to integrate evidence from population and clinical studies regarding the prevalence, risk factors, and intervention approaches for major congenital anomalies and inflammatory conditions, serving as a scientific basis for the development of more effective and contextual health policies and interventions [2].

## 2. Material and methods

This study employs a systematic literature review approach to identify, analyze, and synthesize findings from various relevant studies on the prevalence, risk factors, and interventions for major congenital anomalies and related inflammatory conditions, adhering to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) reporting standards. A systematic literature search was conducted on three major databases: PubMed, ScienceDirect, and Google Scholar, with a publication range from 2020 to 2025. The keywords used in the search include combinations of terms such as "congenital anomalies," "birth defects," "prevalence," "risk factors," "maternal outcomes," "inflammation," "HIIT," "anti-inflammatory nutrition," and "obesity," which are adjusted with Boolean operators (AND, OR, NOT) to narrow the search results.

Included studies were scientific journal articles with quantitative designs (cohort, cross-sectional, and retrospective studies), qualitative designs (observational descriptive), and literature reviews that addressed at least two of the three main aspects: prevalence, risk factors, and interventions for congenital abnormalities or chronic inflammatory conditions. Articles that were not available in full text, were not in English or Indonesian, or did not have a clear abstract and results were eliminated from the selection process. The selection process was conducted in stages thru title and abstract screening, followed by full content review to determine eligibility for inclusion. Data from each study that met the selection criteria were manually coded and extracted, then qualitatively analyzed by comparing prevalence patterns, key risk factors, and the types and effectiveness of reported interventions. The validity of the results is strengthened thru a process of cross-source triangulation and critical analysis of the potential biases and limitations of each study.

## 3. Results and Discussion

**Table 1** Summary of Previous Research on Major Congenital Anomalies and Inflammatory Conditions

| No | Research Title | Method & Population | Main Findings | Risk Factors / Interventions |
|---|---|---|---|---|
| 1 | *Prevalence, predictors, and outcomes of major congenital anomalies: A population-based register study (Qatar)* | Retrospective data from the PEARL-Peristat registry, 25,204 births (2017–2018) | Prevalence of CAs: 1.3%; dominant systems are CVS (35%), MCA (21%), and genetic (15%). | Parity ≥1, multiple pregnancies, maternal age, ethnicity, infant gender; hospital mortality 15.4%, premature birth, NICU |
| 2 | *Gross Congenital Anomalies at Birth in Northeast India: A* | Retrospective, 13,290 live births, | Retrospective, 13,290 live births, NICU Guwahati (2019) Narrative review, | Parity, maternal age, birth weight, gestational age, |

| | | | | |
|---|---|---|---|---|
| | *Retrospective Observational Study* | NICU Guwahati (2019) | various global sources (2018–2024) | gender; GIT is dominant in Northeast India. |
| 3 | *High-Intensity Interval Training (HIIT), Anti-Inflammatory Nutritional Intake, and Aging in Obese Patients: Literature Review* | Narrative Review, Various Global Sources (2018–2024) | HIIT is effective in reducing visceral fat, inflammation, and metabolic risk; anti-inflammatory nutrients like omega-3 and polyphenols are beneficial. | Lifestyle interventions: HIIT, anti-inflammatory diet; target systemic inflammation reduction and slowing aging |
| 4 | *Epidemiological and Histopathological Characteristics of Fetuses with Congenital Disorders: A Study in Greece* | Retrospective fetal autopsy,649 samples (1992–2008) | Prevalence of CAs: 39.5%; predominantly musculoskeletal (17.3%), neurological (14.5%), and cardiovascular (12.5%). | Significant association with nuchal edema, single umbilical artery, iatrogenic abortion, chorioamnionitis; higher gestational age → protective. |

The results of the four reviewed studies indicate that major congenital anomalies (CAs) remain a significant challenge in maternal and child health across various regions, in both developed and developing countries. A population-based study in Qatar reported a prevalence of 1.3%, with the cardiovascular system being the most affected, while in Northeast India, a higher prevalence of 2.6% was found, with the gastrointestinal system being the most impacted organ. Meanwhile, a study in Greece using a fetal autopsy approach identified CAs in as many as 39.5% of cases, indicating that the number of births with anomalies could be much higher than recorded in live birth data alone. Maternal and perinatal risk factors consistently found across various studies include maternal age, parity, fetal sex, gestational age, and obstetric conditions such as multiple pregnancies and the presence of placental complications. These factors indicate that risk-based early intervention is urgently needed, ranging from antenatal screening and pregnancy counselling to improving the quality of obstetric services in referral hospitals.

On the other hand, chronic inflammatory conditions such as those occurring in obesity and aging also show a significant link to systemic health, including the risk of metabolic disorders and impaired vital organ function. A study reviewing the effects of HIIT exercise and an anti-inflammatory diet showed that lifestyle approaches can contribute to lowering inflammatory biomarkers, improving body composition, and slowing down the aging process, particularly in obese patients. This is important because chronic systemic inflammation that is not addressed early can worsen pregnancy risks and quality of life in later years. Therefore, the integration of population-based medical interventions and lifestyle-based promotive-preventive approaches becomes crucial in long-term health program planning, both for pregnant women, newborns, and other vulnerable groups. The findings in this review support the need for a cross-disciplinary framework between clinicians, nutritionists, and policymakers in designing holistic strategies for preventing congenital anomalies and chronic inflammation.

### 3.1. Prevalence and Pattern of Major Congenital Anomalies

Major birth defects or congenital anomalies are pathological conditions characterized by developmental disturbances of organ structures or functions from the time of conception, which can be detected at birth or may not become apparent until later stages of development. From the studies reviewed, significant differences in prevalence rates were observed between regions and between different types of study approaches. A retrospective study based on birth registry data in Qatar showed a prevalence of births with anomalies of 1.3% out of 25,204 births, with the cardiovascular system being the most frequently affected organ (35%), followed by multiple congenital anomalies (MCA), genetic/chromosomal disorders, and the central nervous system (CNS). Meanwhile, an observational study in Northeast India using NICU data over one year recorded a prevalence of 2.6% out of 13,290 live births, with the gastrointestinal system (33.8%) being the most commonly affected organ, followed by the central nervous system and craniofacial system. Even higher, a study in Greece analyzing 649 fetal autopsies showed that 39.5% of the samples had major congenital anomalies, with the musculoskeletal system, central nervous system, heart, and urinary system being the dominant organ groups. This significant difference indicates that the detection and coverage approach of the recording system strongly influences the reported incidence rates, with autopsy-based studies potentially capturing more cases than live birth-only studies, as they can include cases of miscarriage, stillbirth, or pregnancy termination due to severe abnormalities [4].

The pattern of affected organs also appears to vary depending on regional characteristics, genetic and environmental factors, and the ability of the healthcare system to perform early detection. In Qatar, the high rate of cardiovascular abnormalities may reflect a screening system that is quite sensitive to congenital heart defects, while the dominance of gastrointestinal cases in India can be attributed to the nutritional patterns of pregnant women, infectious status, and

lack of access to prenatal screening. Meanwhile, studies in Greece show a relatively balanced pattern between musculoskeletal and neurological abnormalities, most likely due to the data coverage including results from fetal autopsies and abortions for medical indications. These findings underscore the importance of hospital and regional-based epidemiological data as a foundation for designing more precise public health strategies and policies, including strengthening the capacity for recording births with anomalies and expanding early detection services such as detailed anatomical ultrasound and genetic screening. Additionally, a consistent and standardized classification system across regions is crucial for global data on CAs to be comparable and effectively used within the framework of maternal and child health policies. [5].

### 3.2. Maternal and Perinatal Risk Factors

Various maternal and perinatal risk factors play a significant role in determining the likelihood of major congenital anomalies, and identifying these factors can serve as the basis for more targeted preventive interventions. The results of the study in Qatar indicate that parity ≥1, multiple pregnancies, maternal body mass index (BMI), maternal age, and ethnicity are significantly associated with an increased incidence of CAs. The baby's gender was also found to be a relevant variable, with male infants being at higher risk for certain types of abnormalities. In Northeast India, factors such as maternal age, parity, low birth weight, and short gestational age have been statistically proven to increase the risk of birth defects, with multiparous women having a higher incidence rate compared to primiparous women. Meanwhile, studies in Greece added more complex variables, such as nuchal edema, the presence of a single umbilical artery, and pathological conditions like chorioamnionitis and placental infarction, as significant determinants. These findings confirm that the risk of CAs is not only determined by basic demographic factors, but also by obstetric complications and the quality of care during pregnancy [6].

Mapping these risk factors is crucial for strengthening reproductive health services, particularly in terms of antenatal care. Pregnant women with high parity, twin pregnancies, a history of metabolic diseases, or suboptimal gestational age require more attention thru a more intensive early detection program. Interventions such as high-risk pregnancy screening, nutritional counselling, and management of comorbid diseases like gestational diabetes should be systematically integrated into primary care services. Additionally, it's important to emphasize the importance of public education about healthy family planning, including avoiding teratogenic substances, planning for ideal gestational age, and the importance of regular checkups during pregnancy. Thus, the risk factors identified in this study can serve as a reference for national and local policies to strengthen risk-based interventions, thereby sustainably reducing the incidence of CAs [7].

### 3.3. Lifestyle Interventions for Chronic Inflammatory

Conditions Chronic inflammatory conditions, particularly those occurring in obese and elderly patients, are a growing global health issue closely linked to metabolic, immunological, and systemic dysfunction, including risks to abnormal pregnancies and fetal development disorders. A literature review on HIIT and anti-inflammatory diets confirms that lifestyle interventions based on high-intensity physical exercise and dietary improvements can significantly reduce systemic inflammation, characterized by decreased levels of biomarkers such as IL-6, TNF-α, and CRP. HIIT has been shown to improve insulin sensitivity, reduce visceral fat, and improve cardiorespiratory capacity in obese populations, including the elderly. On the other hand, a diet that prioritizes anti-inflammatory intake such as omega-3 fatty acids, fiber, antioxidant vitamins, and polyphenolic compounds has an immunomodulatory effect that helps regulate the inflammatory response and slow down tissue damage caused by oxidative stress. This combination of exercise and diet has become a highly promising non-pharmacological approach, not only in the context of weight management but also in the context of preventing degenerative diseases and pregnancy complications related to inflammation [8].

In a broader context, integrating these lifestyle interventions into reproductive and prenatal health programs becomes highly relevant, considering that chronic inflammation also contributes to pregnancy disorders such as preeclampsia, preterm labor, and intrauterine growth restriction (IUGR). By strengthening community-based interventions such as fitness classes for pregnant women, nutritional counselling, and promoting regular physical activity for the obese group, the disease burden due to inflammation can be significantly reduced. Additionally, these findings serve as the foundation for a transdisciplinary approach involving doctors, nutritionists, fitness trainers, and policymakers to develop sustainable and evidence-based promotional and preventive programs. Although most research on HIIT and anti-inflammatory diets is still limited to the general adult population, their potential to improve quality of life and reduce the risk of inflammation makes them an important additional strategy to explore in the prevention of congenital disorders [9]. Thus, this integrative approach not only targets treatment but also prioritizes primary prevention against underlying risk factors for developmental disorders from early life [10].

## 4. Conclusion

Based on the results of a systematic review of four relevant studies, it can be concluded that major congenital anomalies remain a global challenge in maternal and child health systems, with varying prevalence rates depending on the detection approach and geographical region, and are determined by various maternal and perinatal risk factors such as maternal age, parity, fetal sex, gestational age, as well as obstetric complications and genetic factors. On the other hand, chronic inflammatory conditions due to obesity are also strongly linked to systemic dysfunction and an increased risk of pregnancy complications and suboptimal fetal development, which can be mitigated thru evidence-based lifestyle interventions such as HIIT exercises and anti-inflammatory diets. These two issue domains, although etiologically distinct, are interconnected thru complex biological and social pathways, thus demanding a transdisciplinary preventive approach.

Therefore, it is important for the government, medical personnel, nutritionists, and policymakers to strengthen early detection programs, healthy pregnancy education, and the integration of lifestyle-based preventive and promotive strategies into primary healthcare services. It is recommended that future research explore the causal relationship between chronic inflammatory conditions and the occurrence of congenital anomalies with a stronger longitudinal and interventional approach, and develop a holistic, risk-based policy model that is adaptable to the local context. Additionally, strengthening the recording and reporting system for congenital anomalies at the hospital and regional levels is crucial for building accurate and sustainable epidemiological data, supporting evidence-based decision-making, and formulating more targeted interventions to reduce the long-term health burden caused by developmental anomalies and systemic inflammation.

## Compliance with ethical standards

### *Disclosure of Conflict of interest*

The author states that no conflict of interest arose from this research. There were no financial, personal, or professional relationships that could have influenced the research findings or data interpretation.

## References

[1] Yuan S, Larsson SC (2023) Epidemiology of sarcopenia: Prevalence, risk factors, and consequences. Metabolism 144:155533

[2] Alda AS, Madjid DA, Eva F, Darma S, Maulani D (2024) Fakumi medical journal. J Mhs Kedokt 4:359–367

[3] Abdi F, Mehrvarp M, Valizadeh S, Mazaheri M (2019) Investigation of Some Modifiable Risk Factors That Lead to Congenital Anomalies: A Review Article ARTICLE INFO ABSTRACT Corresponding author. 71 World J Peri Neonatol 2:71–79

[4] Das M, Bhoktiari M, Rahman M, Kotoky N, Basumatary LJ, Kashyap MP (2023) Gross Congenital Anomalies at Birth in Northeast India- A Retrospective Observational Study. J Clin Diagnostic Res. https://doi.org/10.7860/jcdr/2023/63034.17970

[5] Nteli D, Nteli M, Konstantinidis K, et al (2025) Epidemiological and Histopathological Characteristics of Fetuses with Congenital Disorders: A Study in Greece. Biology (Basel) 14:626

[6] Al-Dewik N, Samara M, Younes S, et al (2023) Prevalence, predictors, and outcomes of major congenital anomalies: A population-based register study. Sci Rep 13:1–12

[7] Mokhaberi N, Schneider EP, Aftzoglou M, et al (2025) Risk factors and surgical outcomes in pediatric patients with congenital heart disease and ischemic colitis. Pediatr Surg Int. https://doi.org/10.1007/s00383-024-05950-3

[8] Lampus H, Candy C, Rendy L, Saputra SP (2022) Risk Factors Associated with Postoperative Outcome of Congenital Anomalies. e-CliniC 10:228

[9] Ayu I, Pidada S (2025) High-Intensity Interval Training ( HIIT ), Anti-Inflammatory Nutritional Intake , and Aging in Obese Patients : Literature Review. 6:634–640

[10] Kurniaputri, G. A., Pinzon, R. T., Veronica, V., & Pramudita, E. A. (2022). Prevalensi dan faktor risiko carpal tunnel syndrome pada perawat. Jurnal Ilmu Kesehatan Masyarakat (The Public Health Science Journal), 11(5), 411–416. http://journals.stikim.ac.id/index.php/jikm