JMCH Journal of Maternal and Child Health (2025), 10(05): 288-303
Masters Program in Public Health, Universitas Sebelas Maret

Original Research
Open Access

# Cancer in Pregnancy in Indonesia: A Global Review and 2022–2025 Cohort Analysis of Maternal and Neonatal Outcomes

**Elita Rahmi[1,2], Muhammad Adrianes Bachnas[1,3], Sri Sulistyowati[1]**

[1]Department of Obstetrics and Gynecology, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia
[2]Universitas Sebelas Maret Hospital, Surakarta, Indonesia
[3]Dr. Moewardi General Hospital, Surakarta, Indonesia

*Received: 22 June 2025; Accepted: 9 May 2025; Available online: 16 September 2025*

## ABSTRACT

**Background:** Cancer during pregnancy is rare but presents serious challenges, especially in low- and middle-income countries like Indonesia. Limited national data, delayed diagnosis, and lack of standardized care make management difficult. Global awareness is growing, but regional differences in outcomes remain poorly understood. This study aims to provide a comprehensive overview of cancer during pregnancy, including its clinical characteristics and maternal-fetal outcomes both in Indonesian and global data.

**Subjects and Method:** This systematic review was conducted following PRISMA guidelines from databases of PubMed, EMBASE, Scopus, and additional search, published between 2022 and April 2025. The included studies reported the global depiction of pregnancy-associated cancer. Newcastle-Ottawa Quality Assessment Scale (NOS) was used to assess the quality of observational included studies, while the Joanna Briggs Institute checklists for assessment of case reports.

**Results:** A total of 14 studies were included based on the criteria, with a total population of 29,403 pregnant women associated with cancer. From this systematic review, the most found cancers during pregnancy were breast cancer, cervical cancer, and ovarian cancer, both from Indonesian data and global studies. Compared to global studies, obstetric complications were more prevalent in Indonesia, including preterm birth (64% vs 52%, respectively); very preterm birth (22% vs 15%, respectively); caesarean delivery (76% vs 65%, respectively); preeclampsia (18% vs 12%, respectively); and postpartum haemorrhage (15% vs 10%, respectively).

**Conclusion:** The global literature shows wide variation in cancer types, gestational timing, and outcomes. Indonesian cohort data show higher rates of preterm birth, low birth weight, and maternal complications compared to global averages. Delays in diagnosis and limited access to integrated cancer-obstetric care may explain these differences. The findings support the urgent need for national guidelines, early detection programs, and multidisciplinary care models for managing cancer in pregnancy in resource-limited settings.

**Keywords:** cancer, maternal outcomes, neonatal outcomes, pregnancy

**Correspondence:**
Muhammad Adrianes Bachnas. Maternal-Fetal Medicine Division, Department of Obstetrics and Gynecology, Faculty of Medicine, Universitas Sebelas Maret/ Dr. Moewardi Hospital, Surakarta, Central Java, Indonesia. E-mail: adrianesbachnas@staff.uns.ac.id.

**Cite this as:**
Rahmi E, Bachnas MA, Sulistyowati S (2025). Cancer in Pregnancy in Indonesia: A Global Review and 2022–2025 Cohort Analysis of Maternal and Neonatal Outcomes. *J Matern Child Health*. 10(05): 288-303. https://doi.org/10.26911/thejmch.2025.10.05.03.

## BACKGROUND

Cancer during pregnancy is rare, affecting around 1 in 1,000 pregnancies, but its incidence is rising globally due to delayed childbearing and increased cancer rates among women of reproductive age. Managing cancer in pregnancy presents a dual challenge: safeguarding the mother's health while minimizing harm to the fetus (Maggen et al., 2020; Bohlin et al., 2024). International studies have shown that pregnancy-associated cancer is linked to increased risks of preterm birth, low birth weight, NICU admission, and maternal complications. A systematic review reported significantly higher rates of venous thromboembolism and maternal death in these patients (Aranda-Gutierrez et al., 2024). Other studies have shown worse outcomes, especially when systemic therapy is required during pregnancy (Maggen et al., 2020; Bohlin et al., 2024). There is also growing concern about the long-term effects of in-utero exposure to chemotherapy on child development (Aranda-Gutierrez et al., 2024).

In low- and middle-income countries (LMICs) like Indonesia, the challenges are even greater. Delays in diagnosis, limited access to specialized care, and the lack of national data registries hinder effective management. Although some regional studies have emerged—such as reports on ovarian and cervical cancers in Bali and Java—Indonesian data remain scarce (Kurniadi et al., 2023; Syarief et al., 2025). A retrospective study from East Java, for example, linked the advanced cancer stage during pregnancy to higher rates of low birth weight and NICU admission (Kurniadi et al., 2023; Syarief et al., 2025). Projections also suggest that cancer in pregnancy will continue to rise in Indonesia through 2030 (Kurniadi et al., 2023; Syarief et al., 2025). However, there is still a limited understanding of how global findings translate to the Indonesian context. Questions remain about how cancer type, gestational timing, and treatment access influence maternal and neonatal outcomes in this setting. There is also an urgent need for clinical guidelines tailored to Indonesia's healthcare system.

This paper aims to (1) review global evidence on cancer in pregnancy and its maternal-neonatal impact and (2) present new Indonesian cohort data from 2022–2025 to describe local patterns and outcomes. By combining a PRISMA-based systematic review with retrospective analysis, this study provides a global-to-local perspective and offers recommendations for clinical care and future research in maternal-fetal oncology in Indonesia.

## SUBJECTS AND METHOD

### 1. Study Design

A systematic review of observational studies (case-control, cohort, cross-sectional) and case-report/case series was reported following the criteria of the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines. Due to the rarity and clinical heterogeneity of cancer during pregnancy, case reports were also included in this review to allow for a narrative synthesis within a systematic review framework. A literature search of this study was conducted in databases including PubMed, EMBASE, and Scopus. Additionally, a manual search on another source was performed to identify studies outside the searched database (grey literature), including ResearchGate, Garuda, Neliti, Google Scholar, and local university repositories. Furthermore, a retrospective cohort analysis of pregnant patients diagnosed with cancer between January 2022 and April 2025 across three tertiary hospitals in Indonesia was incorporated to assess the incidence and

clinical characteristics of cancer during pregnancy in Indonesia. This cohort analysis complements the systematic review by offering real-world insight into cancer-in-pregnancy outcomes within Indonesia's referral hospital settings.

**2. Steps of Systematic Review**

Two authors evaluated the article's initial search, screening, and subsequent in-depth review of full texts. Any disagreements were resolved in a consensus involving a third independent investigator. For article retrieval, the following combination of Medical Subject Headings (MeSH) terms and entry terms was applied: ("cancer in pregnancy" OR "pregnancy-associated cancer") AND ("obstetric outcomes" OR "neonatal outcomes") AND ("maternal oncology" OR "Indonesia") using Boolean operators to improve precision. The full text of selected articles was retrieved and assessed for Population, Intervention, Comparison, Outcomes, and Study Design (PICOs) eligibility criteria (Table 1). The eligible studies that fulfil the criteria of PICOs were included in this systematic review.

**Table 1. Population, intervention, comparison, outcomes, and study design (PICOS) framework**

| Criteria | Description |
|---|---|
| **Population** | Pregnant women (first to third semester) |
| **Intervention** | Diagnosis of cancer during pregnancy, including those who underwent active cancer treatment (chemotherapy and/or surgical) and those who did not receive such therapy |
| **Comparison** | Pregnant women without cancer |
| **Outcomes** | Maternal-neonatal outcomes (preterm birth, cesarean delivery, preeclampsia, postpartum haemorrhage, antenatal corticosteroid use, low birth weight, NICU admission, etc). |
| **Study Design** | Observational studies (cross-sectional, cohort, case-control) and case-report/case series studies |

**3. Inclusion Criteria**

The inclusion criteria of the studies were as follows: (1) observational studies and case-report studies published between 2022 and April 2025; (2) pregnant women diagnosed with cancer during gestation, including those who receive active therapy for cancer and those who did not receive such therapy; (3) birth delivery in hospital; (4) studies included completed documentation of perinatal outcomes, including obstetric or neonatal outcomes; (5) full-text articles; and (6) reported studies in English and Bahasa Indonesian.

**4. Exclusion Criteria**

Studies were excluded if: (1) cancer diagnoses not associated with pregnancy or occurred outside of pregnancy and/or the postpartum period; (2) incomplete or inaccessible data /medical records; (3) experimental studies (animal and laboratory studies), review articles, editorial articles, or conference abstracts; and (4) irrelevant interventions and outcomes.

**5. Quality Assessment**

The Newcastle-Ottawa Scale (NOS) was applied to assess the quality of observational included studies. The NOS contains three general parts: selection, comparability, and exposure. On the NO scale, the risk of bias is classified from 0 to 9 stars, for which a higher score indicates better quality (8 or 9 high, 6 or 7 moderates, and less than 5 low quality). Meanwhile, the quality assessment of case reports/case series studies included being assessed by the Joanna Briggs Institute checklists. Only moderate-to-high-quality

studies were included in the synthesis. Quality assessments were conducted by two authors. Any disagreements were resolved in a consensus involving a third independent investigator.

**6. Data Extraction and Analysis**

The data extracted included studies following information studies: the first author and years of publication, country, design study, gestational age at diagnosis, treatment approach, and outcomes (preterm birth, low birth weight, NICU admission, neonatal death, maternal complications).

This study also analyses the types of cancer most commonly occurring during pregnancy, with a particular focus on cases in Indonesia. In addition, it examines maternal obstetric outcomes associated with cancer in pregnancy, comparing the prevalence of these outcomes globally—based on systematic review data—with findings from cohort data in Indonesia. Lastly, this study presents a synthesis of neonatal outcomes and the impact of cancer therapy during pregnancy, as reported in the reviewed literature. Data were anonymized and analyzed descriptively to identify common patterns and compared with findings from the global literature.

## RESULTS

**1. Selection of studies**

The literature search and study selection process using the PRISMA flowchart is shown in detail in Figure 1. A total of 148 articles were identified. After removing 29 duplicates, 119 records underwent title and abstract screening. Based on irrelevant titles and abstracts, 56 studies were excluded. Subsequently, 55 studies did not meet the inclusion criteria for various reasons: no relevant design study, intervention, and outcomes. Of these, 8 full-text articles met the eligibility criteria. An additional 22 records were identified from grey literature and 3 retrospective cohorts from tertiary hospitals in Indonesia. Nine additional studies were excluded because of irrelevant criteria and design studies. The final review included 14 studies data, all published between 2022 and 2025. These studies offered diverse perspectives—from local challenges in referral and treatment to global comparisons across cancer types, gestational age at diagnosis, and outcome measures.

**2. Methodological quality assessment result**

The Newcastle-Ottawa Scale (NOS) score evaluated studies based on three major domains: 1). Selection of participants (4 items), Comparability of groups (1 item), and Outcome assessment (3 items). The item is scored based on specific criteria, with the total score ranges from 0 to 9. Each score or points on each item is given a star (*). The description of each domain (Wells et al., 2021):

a. Selection of participants (4 items)

1) Representativeness of exposed studies
   Question description: Is the cohort/cases representative of the target population from which they were derived? (Score 1)
2) Selection of non-exposed cohort or the controls
   Question description: Are the controls or non-exposed individuals selected from the same population as the exposed cohort? (Score 1)
3) Ascertainment of Exposure (for cohort studies) or Exposure Measurement (for case-control studies)
   Question description: Is the exposure clearly defined and measured using reliable methods? (Score 1)
4) Demonstration that outcome of interest was not present at the start of the study.
   Question description: Is there clear evidence that the outcome of interest was not present at the baseline? (Score 1)

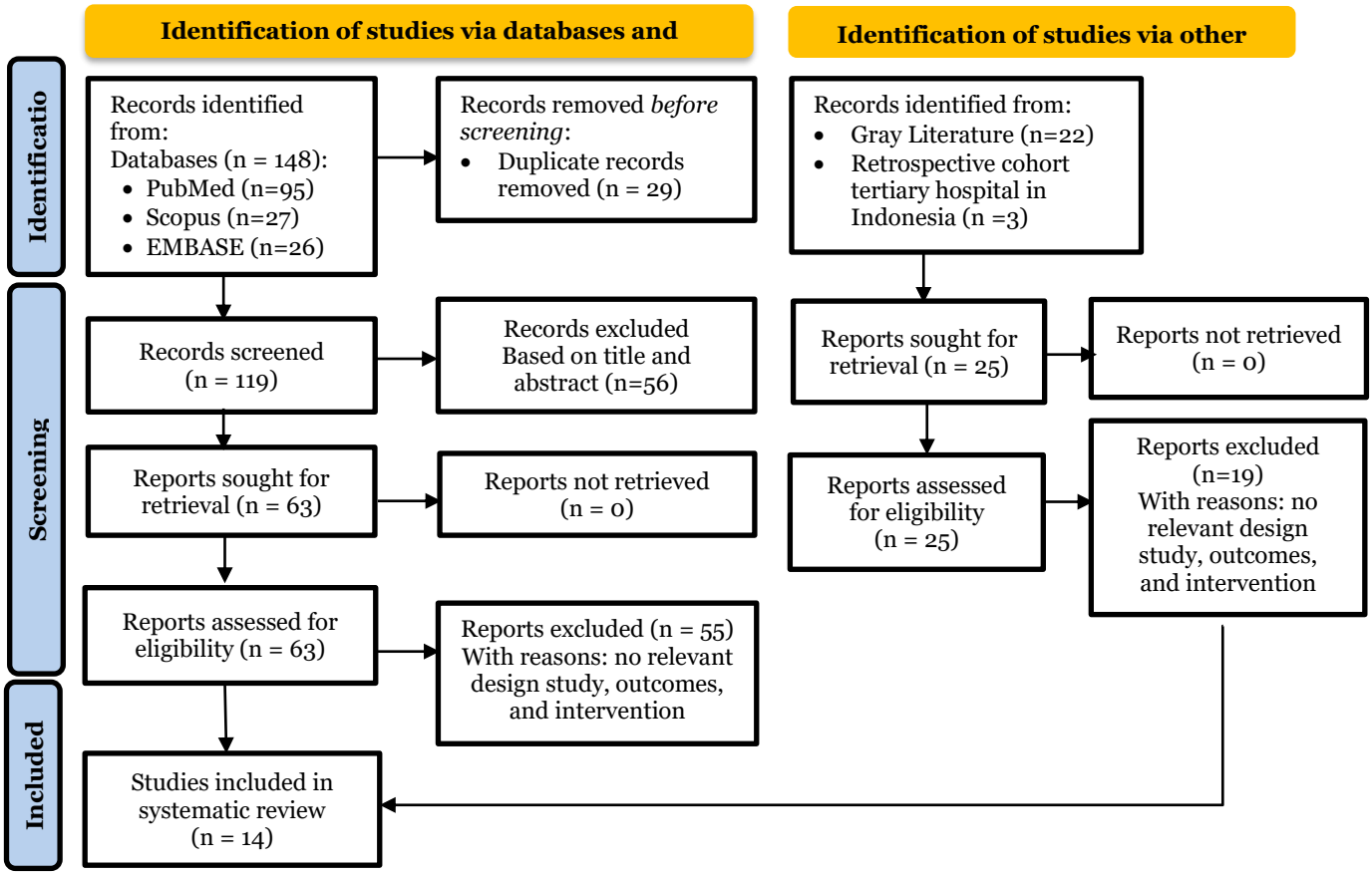


**Figure 1. PRISMA Flow Diagram Illustrating Literature Selection for Systematic Review and Narrative Synthesis on Cancer in Pregnancy and Cohort Analysis Including Indonesian Cases**

**b. Methodological quality assessment result**

5) Comparability of groups (1 item)

Comparability of Cohorts on basis design or analysis controlled for confounders.

Question description: Does the study adjust for potential confounders (e.g., age, gender, comorbidities) and/or other factors to ensure comparability between groups?

a) The study controls for age, gender, comorbidities (Score 1)

b) Study controls for the other factors (list) (Score 1)

6) Outcome Assessment (3 items)

a) Assessment otf the outcome

Question description: Is the outcome clearly defined and measured using objective criteria? (Score 1)

b) Follow-up long enough for outcomes to occur.

Question description: Was the follow-up period sufficient to allow for the occurrence of the outcomes of interest? (Score 1)

c) Adequacy of follow-up cohort/control

Question description: Was the follow-up sufficiently complete, with minimal loss to follow-up, and was the loss appropriately handled? (Score 1)

Assessed with the Newcastle-Ottawa Scale, all the observational studies met the criteria and most had good quality, with several studies having moderate quality, as shown in Table 2. Meanwhile, for four case-report studies assessed by the Joanna Briggs

Institute, checklists show good quality and meet the criteria for this review.

**Table 2. Quality assessment of included observational studies (Newcastle-Ottawa Scale)**

| Author (Year) | Design Study | Selection | Comparability | Outcome | Total Score | Quality |
|---|---|---|---|---|---|---|
| Naoum (2023) | Cross-Sectional | **** | ** | ** | 8 | Good |
| Mantilidewi (2023) | Retrospective Cohort | **** | * | ** | 7 | Moderates |
| Huang (2024) | Retrospective Cohort | **** | ** | *** | 9 | Good |
| Greiber (2022) | Retrospective Cohort | **** | ** | *** | 9 | Good |
| Wen (2025) | Cross-Sectional | **** | ** | * | 7 | Moderates |
| Safi (2023) | Retrospective Cohort | **** | ** | ** | 8 | Good |
| Saad (2023) | Retrospective Cohort | **** | ** | *** | 9 | Good |
| Yu (2023) | Retrospective Cohort | **** | ** | *** | 9 | Good |
| Fortheringham (2023) | Retrospective Cohort | **** | ** | ** | 8 | Good |
| Kanbergs (2025) | Retrospective Cohort | **** | ** | *** | 9 | Good |

**Note**: Each asterisk (*) represents a score of 1.

### 3) Characteristics of included studies

The characteristics of the fourteen included studies in this review are shown in Table 3. The total sample was 29,403 pregnant women associated with cancer during pregnancy. Selected studies were four case reports in Indonesia, two cross-sectional studies, and eight retrospective cohorts. The studies were published between 2022 and 2025 conducted in Indonesia (n=6), USA (n=2), China (n=2), Denmark (n=1), Canada (n=1), and New South Wales (n=2). All data were collected in hospital inpatient settings. Among the studies reviewed, most cancer diagnoses during pregnancy were made around the second trimester and were often undetected before that point, although some studies did not specify the gestational age at diagnosis. Several studies have identified that the most frequently encountered cancers during pregnancy include breast cancer, cervical cancer and ovarian cancer. Additionally, cases of lung cancer, melanoma, gastric cancer, non-Hodgkin lymphoma, and others have also been reported. From the synthesis of all included studies, it is evident that pregnancy-associated cancer (PAC) is associated with significantly higher maternal and neonatal complication risks compared to normal pregnancies. Common maternal outcomes in PAC include caesarean delivery, with less frequent occurrences of abortion, pregnancy loss, hypertensive pregnancy disorders, postpartum haemorrhage, venous thromboembolism, and sepsis. For neonatal outcomes, PAC is linked to a higher incidence of preterm birth, small for gestational age, low birth weight (<2500 g), and NICU admissions compared to normal pregnancies. Some neonatal abnormalities,

such as congenital defects and neonatal morbidity, were also observed, though at a lower incidence. As for cancer therapy management, most journals do not provide detailed information on the regimens. However, some journals report therapy involving surgery combined with chemotherapy using a paclitaxel-doxorubicin regimen post-delivery, along with radiotherapy following delivery.

**Table 3. Characteristics of studies included in the review**

| Author (Year) | Country | Study Design | Sample Size (PAC) | GA Cancer diagnosis | Type of Cancer | Obstetrics- Neonatal Outcomes & Management of Cancer |
|---|---|---|---|---|---|---|
| Kurniadi et al. (2023) | Indonesia | Case Report | 1 (Case) | 10-11 weeks | Cervical cancer stage IIB | Obstetric Outcomes: Caesarean delivery followed by bilateral salpingectomy and ovarian transposition. Neonatal Outcomes: Low birth weight (2330gr) Management of Cancer: Postpartum radiotherapy (EBRT) |
| (Syarief et al., 2025) | Indonesia | Case Report | 1 (Case) | 17-18 weeks | Ovarian Cancer stage IA | Obstetric Outcomes: Caesarean delivery with no complications Neonatal Outcomes: Not reported. Management of Cancer: Oophorectomy in the second semester (18 weeks) |
| (Praja and Perbowo, 2024) | Indonesia | Case Report | 1 (Case) | 24 weeks | Ovarian Cancer stage IC | Obstetric Outcomes: Caesarean delivery at 34 weeks GA. Neonatal Outcomes: Preterm birth (34w), Small gestational Age, Low birth weight (1,600g) Management of Cancer: Unilateral salpingo-oophorectomy omentectomy followed by paclitaxel-carboplatin chemotherapy after delivery |
| (Naoum and Darmawan, 2023) | Indonesia | Cross-Sectional | 54 | 1st semester (60%) | Cervical cancer (8.4%); Ovarian cancer (8.4%) Breast cancer (7.5%) Leukemia, thyroid cancer, lung cancer, uterus cancer, gastric cancer | Obstetric Outcomes: Caesarean delivery with no complications Neonatal Outcomes: Fetal death (31.4%), low birth weight, low APGAR scores. Management of Cancer: Not reported. |
| (Disastra et al., 2025) | Indonesia | Case Report | 1 (Case) | 33 weeks | Breast Cancer (T1N1M0) | Maternal outcomes: Mild tricuspid regurgitation with EF 59%, spontaneous preterm delivery (36 weeks) Neonatal Outcomes: Preterm delivery, low birth weight (1,950 g), asphyxia Management of Cancer: Left mastectomy followed by six cycles of chemotherapy of Cyclophosphamide, epirubicin, and 5-Fluorouracil completed during unknown pregnancy. |
| (Mantilidewi et al., 2023) | Indonesia | Retrospective cohort | 160 | 10.79±4.646 | Gestational Trophoblastic Neoplasia (GTN) | Maternal outcomes: Hyperthyroid, cesarean delivery Neonatal Outcomes: Not reported. Management of Cancer: Methotrexate, in combination with EMCO |
| (Huang et al., 2024) | China | Retrospective cohort | 204 | Before pregnancy (43%, third semester (22%) | Cervical cancer (25%), Thyroid cancer (24%) Ovarian cancer (15%), etc | Obstetric Outcomes: Gestational diabetes, PPROM, infection (9%), Hypertensive disorder and anemia (8%), maternal cardiac disease and fetal distress (3%), etc. |

| Author (Year) | Country | Study Design | Sample Size (PAC) | GA Cancer diagnosis | Type of Cancer | Obstetrics- Neonatal Outcomes & Management of Cancer |
|---|---|---|---|---|---|---|
| (Greiber et al., 2022) | Denmark | Retrospective Cohort | 1,068 | Not reported | Breast cancer, Cervical cancer, ovarium cancer, melanoma | Neonatal Outcomes: Preterm delivery (34%), low birth weight (30%), small gestational age (12%), hyperbilirubinemia (20%) and ARDS (19%)<br>Management of Cancer: Oophorectomy in the second semester (18 weeks)<br>Obstetric Outcomes: Abortion (36.2 %), Spontaneous pregnancy loss (22.2%), preterm birth, caesarean delivery (23.4%), etc<br>Neonatal Outcomes: small gestational age (3.4%), congenital malformation (6.5%), NICU admission (15.5%), ARDS (12.9%), etc<br>Management of Cancer: Chemotherapy |
| (Wen et al., 2025) | USA | Cross-sectional | 22,625 | Not reported | Breast cancer (4.6%), NHL, thyroid and parathyroid, leukemia, cervical cancer, etc | Obstetric Outcomes: Preterm birth, caesarean delivery, hypertensive disorders of pregnancy, postpartum haemorrhage, and venous thromboembolism<br>Neonatal Outcomes: Not reported.<br>Management of Cancer: Not reported |
| (Safi et al., 2023) | New South Wales | Retrospective cohort | 2,373 | Not Reported | Melanoma (24.5%), Breast (22.2%), Thyroid (15.95), gynaecology (11%), etc | Obstetric Outcomes: Need for transfusion, Increased odds of induction, caesarean delivery, preterm birth.<br>Neonatal Outcomes: Preterm birth, low birth weight, small gestational age, NICU admission.<br>Management of Cancer: Not reported |
| (Saad et al., 2023) | Canada | Retrospective Cohort | 59 | 19.7 ±9.2 | Breast (28.8%), Hodgkin lymphoma (10.2%), Thyroid (8.5%), etc | Obstetric Outcomes: Antenatal corticosteroid and hospitalization (40.7%), caesarean delivery (35.6%), PPROM (8.5), Abnormal fetal surveillance (13.6%), hypertension disease of pregnancy (5.1%), post-partum haemorrhage (5.1%), etc.<br>Neonatal Outcomes: preterm birth (29.1%), low birth weight (29.1%), NICU admission (32.7%), congenital abnormalities (14.5%), etc.<br>Management of Cancer: Chemotherapy (33.9%), None (32.2%), Surgical intervention (32.2%) |
| (Yu et al., 2023) | China | Retrospective Cohort | 2,583 | Not Reported | Thyroid cancer (1.15%), breast (0.25%) and gynecology (0.23%) | Obstetric Outcomes: Caesarean delivery (55.79%)<br>Neonatal Outcomes: Low birth weight (6.16%), preterm birth (9.79%), small gestational age (8.71%) and birth defect (13.43%)<br>Management of Cancer: Not reported |
| (Fotheringham et al., 2024) | New South Wales | Retrospective cohort | 70 | Not Reported | Cervical cancer (42.9%), Ovarian cancer (38.6%) | Obstetric Outcomes: Caesarean delivery (62.9%)<br>Neonatal Outcomes: Preterm birth (22.2%), low birth weight (22.2%), SGA (8.3%) and NICU admission (34.7%).<br>Management of Cancer: Not reported |
| (Kanbergs et al., 2024) | USA | Retrospective cohort | 503 | 2nd semester | Cervical cancer, Ovarian cancer, Breast cancer | Obstetric Outcomes: Caesarean delivery (48.1%), Hysterectomy, and sepsis (4.8%).<br>Neonatal Outcomes: preterm birth (34.8%), SGA (16.9%) and neonatal |

| Author (Year) | Country | Study Design | Sample Size (PAC) | GA Cancer diagnosis | Type of Cancer | Obstetrics- Neonatal Outcomes & Management of Cancer |
|---|---|---|---|---|---|---|
| | | | | | | morbidity (12.5%)<br>Management of Cancer: Not reported |

Abbreviations: PAC=Pregnancy-associated Cancer; GA= Gestational Age; ARDS=acute respiratory distress syndrome; EF=Ejection Fraction; SGA=Small for Gestational Age

### 1) Prevalence and Trends of Cancer in Pregnancy

Cancer during pregnancy remains rare but is increasing worldwide, with an estimated rate of 1 in 1,000 pregnancies. This rise is linked to delayed maternal age and the growing prevalence of non-communicable diseases in reproductive-age women (Maggen et al., 2020; Bohlin, Brännström and Dahm-Kähler, 2024). Between 2022 and 2025, Indonesian data remain limited, with no national registry to monitor cancer in pregnancy.

However, six recent publications—including case reports and hospital-based studies—highlight a consistent rise in reported cases. Breast, cervical, and ovarian cancers remain the most frequently diagnosed malignancies during pregnancy in Indonesian centres (Kurniadi et al., 2023; Mantilidewi et al., 2023; Naoum and Darmawan, 2023; Praja and Primandono Perbowo, 2024; Disastra et al., 2025; Syarief et al., 2025). For example, a regional study from East Java reported 14 confirmed cancer-in-pregnancy cases during 2022–2024 across three referral hospitals, suggesting a steady if underreported burden. Other institutional case reports from Jakarta, Bali, and Central Java documented additional cases of gastric, thyroid, and lung cancers during pregnancy (Naoum and Darmawan, 2023).

Internationally, breast cancer remains the most common malignancy during pregnancy, followed by hematologic and cervical cancers. In high-income countries, screening allows earlier diagnosis, while in Indonesia and other LMICs, most diagnoses occur at an advanced stage, affecting both treatment and prognosis (Huang et al., 2024). The absence of a national surveillance system in Indonesia limits the ability to track trends or build risk models suited to the local context. Developing a centralized maternal cancer registry is essential for strengthening clinical decision-making and shaping future policy (Kurniadi et al., 2023; Mantilidewi et al., 2023; Naoum and Darmawan, 2023; Praja and Primandono Perbowo, 2024; Disastra et al., 2025; Syarief et al., 2025). Trends in cancer types diagnosed during pregnancy (2022–2025) in Indonesia are summarized in Figure 2.

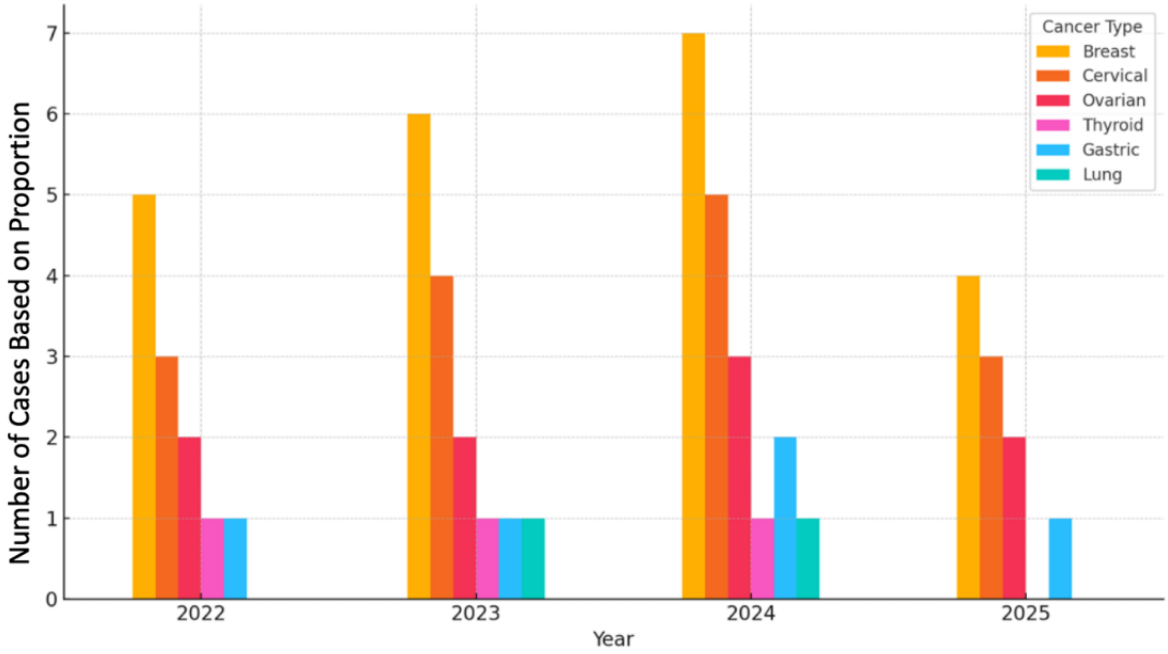


**Figure 2. Trends in cancer types diagnosed during pregnancy in Indonesia (2022-2025)**

**5) Types and staging of cancer diagnosed during pregnancy**

Between 2022 and 2025, breast and cervical cancers were the most frequently diagnosed malignancies during pregnancy in Indonesia, accounting for over 60% of cases across reported hospital series. Ovarian cancer followed as the third most common. Less frequently, gastric, lung, and thyroid cancers were also documented in individual case reports from tertiary centres in Bandung and Surabaya (Kurniadi et al., 2023; Naoum and Darmawan, 2023; Disastra et al., 2025). These findings align with global trends, where breast cancer remains the most common pregnancy-associated malignancy, followed by hematologic cancers and melanoma. Recent international studies published in 2022–2025 continue to show that younger, reproductive-age women are more likely to develop malignancies such as lymphoma, leukemia, and melanoma during pregnancy due to age-related epidemiology (Greiber et al., 2022).

Cancer stage at diagnosis plays a key role in determining treatment options and outcomes. In Indonesia, most pregnancy-associated cancers are diagnosed at advanced stages (Stage III-IV), primarily due to delayed detection, limited access to oncology services, and the absence of routine screening in antenatal care. This contrasts with high-income countries, where Stage I–II cancers are more often identified early (Walters et al., 2024; Wen, Fish and Friedman, 2025).The summaries of cancer types and staging diagnosed during pregnancy from our review of the retrospective studies in Indonesia are detailed in Table 4.

Although international staging systems such as FIGO (for gynecologic cancers) and TNM (for solid tumours) are commonly used, their integration into obstetric oncology care in Indonesia is still inconsistent. No local validation studies exist, highlight-

ing the need for future research and adaptation of these systems to local clinical workflows (Greiber et al., 2022; Wen et al., 2025).

**Table 4. Summary of Cancer Types and Staging Diagnosed During Pregnancy in Indonesia (2022–2025)**

| Cancer Type | Number of Cases | Predominant Stage at Diagnosis | Notes |
|---|---|---|---|
| Breast Cancer | 4 | Stage II–III | Most common; affects women aged 31–40 |
| Cervical Cancer | 3 | Stage IB2–IIIA | Delayed diagnosis due to limited screening |
| Ovarian Cancer | 2 | Stage III | Often detected during routine antenatal ultrasounds |
| Gastric Cance | 1 | Stage IV | Rare; diagnosed at advanced stage |
| Lung Cancer | 1 | Stage III | Rare; limited data available |
| Vulvar Melanoma | 1 | Stage III | Very rare; aggressive progression observed |

Note: Data compiled from case reports and institutional studies conducted between 2022 and 2025.

These findings underscore the need for improved cancer screening and diagnostic services for pregnant women in Indonesia to facilitate earlier detection and better outcomes.

### 6) Obstetric Outcomes in Pregnant Women with Cancer (2022–2025)

Pregnancy complicated by cancer is strongly associated with adverse obstetric outcomes, both globally and in Indonesia. Between 2022 and 2025, hospital-based studies in Indonesia reported higher rates of preterm birth, caesarean delivery, and maternal complications such as preeclampsia and postpartum haemorrhages in women with cancer (Kurniadi et al., 2023; Mantilidewi et al., 2023; Naoum and Darmawan, 2023; Praja and Primandono Perbowo, 2024; Disastra et al., 2025; Syarief et al., 2025). In Indonesian settings, iatrogenic preterm birth—especially via caesarean—is often planned to allow urgent maternal treatment (e.g., chemotherapy or surgery). However, resource constraints, including limited NICU capacity, pose challenges. Deliveries before 36 weeks gestation were frequently reported, and antenatal corticosteroid use was often inconsistent or delayed (Disastra et al., 2025). Recent global studies (2022–2025) echo these findings (Wen et al., 2025). For example, a large systematic review analysis in Europe showed significantly higher rates of both spontaneous and planned preterm deliveries among women with cancer during pregnancy (Walters et al., 2024). Furthermore, in Indonesia, the decision for early delivery is often made to balance maternal disease progression and fetal maturity, but it increases the risk of neonatal complications. The lack of standardized care pathways and multidisciplinary planning contributes to inconsistent delivery timing. While caesarean delivery is commonly chosen due to maternal or fetal indications, early delivery without coordinated neonatal care adds further risk.

A comparison of obstetric outcomes between Indonesian and international studies is provided in Table 5, and key neonatal outcome disparities are illustrated in Figure 3. These findings highlight the urgent need for integrated protocols and collaborative planning between obstetricians, neonatologists, and oncologists to improve both maternal and fetal outcomes.

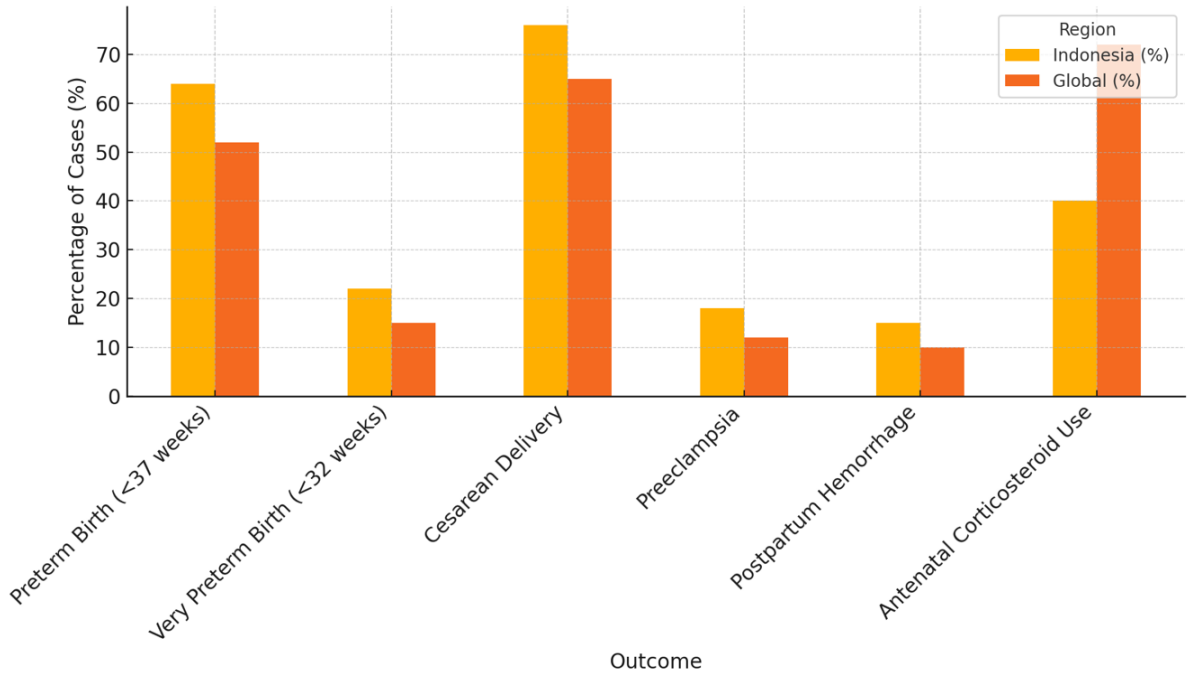


**Figure 3. Comparative analysis of obstetric outcomes in pregnant women with cancer: Indonesia vs. global data (2022–2025)**

**Table 5. Comparison of obstetric outcomes in pregnant women with cancer (2022–2025)**

| Outcome | Indonesia (%) | Global (%) | Notes |
|---|---|---|---|
| Preterm Birth (<37 weeks) | 64 | 52 | Mostly iatrogenic to allow early maternal treatment |
| Very Preterm Birth (<32 weeks) | 22 | 15 | Higher risk in advanced-stage cancers |
| Cesarean Delivery | 76 | 65 | Often elective; fetal or maternal indications |
| Preeclampsia | 18 | 12 | Possibly linked to advanced disease or delayed ANC |
| Postpartum Hemorrhage | 15 | 10 | Frequently reported in late-stage or surgical cases |
| Antenatal Corticosteroid Use | 40 | 72 | Lower coverage in Indonesia due to limited protocol adherence or delays |

### 7) Neonatal Outcomes and Impact of Cancer Therapy (2022–2025)

Neonatal outcomes in pregnancies affected by cancer depend on both the disease itself and the treatment administered. Current global evidence (2022–2025) suggests that chemotherapy after the first trimester, especially with anthracycline-based regimens, is generally safe and not linked to major birth defects. However, the long-term developmental impact remains under investigation (Cardonick and Lacobucci, 2004; Amant et al., 2012; Safi et al., 2023; Petca et al., 2025).

In Indonesia, neonatal outcome data remain limited. Reports from recent cases (2022–2025) show that babies born to mothers with advanced-stage cancer often experience low birth weight, preterm delivery, and NICU admission. Structured long-term follow-up for neurodevelopmental outcomes is not yet available in most

Indonesian settings. Access to NICU care is uneven across the country, which presents a major challenge when early delivery is needed for maternal treatment. In many hospitals, especially outside major cities, this may increase the risk of preventable neonatal complications (Kurniadi et al., 2023; Mantilidewi et al., 2023; Naoum and Darmawan, 2023; Praja and Perbowo, 2024; Disastra et al., 2025; Syarief et al., 2025).

Based on Table 6 show that summarizes neonatal risks by cancer type and treatment timing. Although international literature remains cautiously optimistic about the safety of in-utero chemotherapy, Indonesia's lack of neonatal surveillance and limited critical care capacity calls for urgent integration of neonatal services into cancer-in-pregnancy care pathways.

**Table 6. Neonatal risks by cancer type and treatment timing**

| No | Cancer Type | Common Treatment | Timing of Treatment | Neonatal Risks |
|---|---|---|---|---|
| 1 | Breasts | Anthracycline-base d Chemotherapy | 2nd-3rd trimester | Preterm birth, low birth weight, NICU admission |
| 2 | Cervical | Radiotherapy avoided, Chemo case-by-case | Usually deferred or limited to later trimesters | Preterm birth, low birth weight |
| 3 | Ovarian | Surgery ± Chemo (2nd-3rd trimester) | 2nd trimester onward | Surgical delivery risk, preterm birth |
| 4 | Gastric | Limited chemo use, supportive care | Rarely before delivery | High neonatal mortality risk |
| 5 | Lung | Supportive care or delayed treatment | Delayed until postpartum | High neonatal and maternal risk |
| 6 | Lymphoma | Systemic chemotherapy | After 1st trimester | Preterm birth, neutropenia, NICU admission |

## DISCUSSION

This review reveals a significant gap between global advances in managing cancer during pregnancy and the current state of care in Indonesia. International data from 2022–2025 confirm that with early diagnosis and coordinated, multidisciplinary care, favourable outcomes for both mother and baby are achievable—even in the presence of active malignancy (Petca et al., 2025).

In contrast, recent Indonesian studies highlight persistent challenges: late diagnosis, limited treatment options, and high rates of adverse neonatal outcomes. While the cancer types seen in Indonesia—such as breast, cervical, and ovarian—mirror global patterns, the absence of a national registry, standardized screening, and timely access to specialist care continues to undermine outcomes (Kurniadi et al., 2023; Mantilidewi et al., 2023; Naoum and Darmawan, 2023; Praja and Perbowo, 2024; Disastra et al., 2025; Syarief et al., 2025).

This result is related to previous systematic reviews and meta-analyses of global studies on pregnancy-associated breast cancer which show data indicating that the incidence rate of cancer and complications appears to be slightly higher in developing countries (Asian and African countries) compared to developed countries (North America, Europe, and Australia) (Akhlaqi et al., 2025). These disparities are further compounded by uneven antenatal care utilization, especially outside urban areas. To close this gap, global guidelines must be adapted to Indonesia’s health system realities, considering resource limitations, patient literacy,

and cultural-religious factors.

Integrating reproductive cancer screening into routine antenatal care—especially in high-risk settings—should be a national priority (Safi et al., 2023). Across both local and global literature, gestational timing at diagnosis emerges as a key factor influencing maternal and neonatal outcomes. International guidelines support the use of chemotherapy after 14 weeks gestation, with planned delivery around 34–36 weeks to balance maternal treatment and fetal maturity (Cardonick and Lacobucci, 2004; Amant et al., 2012).

In Indonesia, delayed cancer detection (often in the third trimester) remains common. Cases reported between 2022 and 2025 describe women presenting late with advanced disease, limiting safe treatment options during pregnancy. Without structured protocols, care is often reactive—emergency cesarean sections are performed to allow urgent postpartum chemotherapy, rather than as part of planned, multidisciplinary perinatal management. To improve outcomes, Indonesia must develop and implement structured perinatal oncology pathways, including: 1). standardized staging and diagnosis protocols during pregnancy; 2). early triage and referral to equipped hospitals; 3). clear national guidance on chemotherapy timing and delivery planning; 4). training for obstetric teams on managing cancer in pregnancy, and 5). teleconsultation access to oncologists for remote or underserved areas. These steps are essential to reduce the care gap and bring Indonesian practice closer to global standards—while remaining sensitive to local healthcare realities.

This is the first review focused on Indonesia that combines global insights with national clinical data. The findings support the urgent need for national guidelines, early detection programs, and multidisciplinary care models for managing cancer in pregnancy, especially in resource-limited settings. However, this review lacks a previously greater sample size of cancer in pregnancy, especially with limited data and reports in Indonesia. Future research should focus on developing pregnancy-associated cancer-adapted screening tools and early detection, evaluating the safety of emerging cancer therapies during gestation, and assessing long-term outcomes for both mothers and neonatal. Strengthening health systems to integrate oncology into routine antenatal care is essential, particularly in low-resource settings.

In conclusion, cancer during pregnancy presents complex clinical challenges, particularly in low-resource settings like Indonesia. This review highlights significant disparities between global standards and local realities, including delayed diagnosis, limited access to care, and high rates of maternal and neonatal complications. While international evidence supports safe and effective management with early detection and multidisciplinary planning, Indonesia urgently needs context-specific guidelines, integrated perinatal oncology pathways, and improved surveillance. Strengthening collaboration between obstetricians, oncologists, and neonatologists is essential to improve outcomes for both mother and child.

## AUTHOR CONTRIBUTION

Elita Rahmi contributed to the manuscript by drafting and developing the main text, integrating references, and organizing the initial structure of the paper. Muhammad Adrianes Bachnas contributed to the conceptualization and development of the core idea, provided critical revisions, and oversaw the scientific accuracy and final content of the manuscript. Sri Sulistyowati

contributed to the study design, methodology, and performed the data analysis and interpretation. Manuscript preparation and finalization were completed collaboratively, with the approval of all authors.

## CONFLICT OF INTEREST

There is no conflict of interest.

## FUNDING AND SPONSORSHIP

None.

## ACKNOWLEDGEMENT

The authors appreciate the endeavours of all the authors of previous research to provide data for this manuscript.

## REFERENCES

Akhlaqi M, Ghofrani A, Najdi N, Ranjkesh M, Almasi-Hashian A (2025). A systematic review and meta-analysis of pregnancy-associated breast cancer incidence rate. BMC Cancer. 25(1):1-13. doi: 10.1186/s12885-025-14091-2.

Aranda-Gutierrez A, Guajardo ASF, Vaca-cartagena BF, Gonzales-Sanchez DG, Ramirez-Cisneros A, Becerril-Gaitan A, Azim HA, et al (2024). Obstetric and neonatal outcomes following taxane use during pregnancy: A systematic review. BMC Cancer. 24(9). doi: 10.1186/s12885-023-11704-6.

Bohlin KS, Brännström M, Dahm-Kähler P (2024). Gynecological cancer during pregnancy—From a gyne-oncological perspective. cta Obstet Gynecol Scand. 103(4): 761–766. doi: 10.1111/aogs.-14763.

Amant F, Loibl S, Neven P, Calsteren KV (2012). Breast cancer in pregnancy. Lancet. 379 (9815): 570–579. doi: 10.1016/S1470- 2045(11)70363-1.

Cardonick E, Lacobucci A (2004). Use of chemotherapy during human pregnancy. Lancet Oncol. 5(5):283-291. doi: 10.1016/S1470-2045(04)01466-4.

Disastra YP, Setyawan A, Sutrisno, Permadi W (2025). Normal baby born in spontaneous preterm delivery in patient with pregnancy-associated breast cancer: case report. Indones J Obstetr Gynecol Sci. 8(1): 119. doi : 10.24198/-obgynia.v8i1.764.

Fotheringham P, Safi N, Li Z, Anazodo A, Remond M, Hayen A, Currow D, et al (2024). Pregnancy-associated gynecological cancer in New South Wales, Australia 1994–2013: A population-based historical cohort study. Acta Obstet Gynecol Scand. 103(4): 729–739. doi : 10.1111/aogs.14530.

Greiber IK, Viuff JH, Mellemkjaer L, Hjortshoj CS, Lidegaard O, Storgaard L, Karlsen MA (2022). Cancer in pregnancy and the risk of adverse pregnancy and neonatal outcomes: A nationwide cohort study. BJOG: Int J Obstet Gy. 129(9):1492–1502. doi: 10.1111/1471-0528.17074.

Huang X, Zhang C, Zhu J, Li Y, Tang J (2024). Influence of cancer in pregnancy on obstetric and neonatal outcomes: An observational retrospective cohort study. J Gynecol Oncol. 35 (6): 1-13. doi: 10.3802/jgo.2024.35.e74.

Kanbergs A, Clapp M, Wu CF, Melamed A, Agusti N, Viveros-Carreño D, Zamorano AS, Virili F, Rauh-Hain JA, Nitecki Wilke R (2025). Cancer diagnosis during pregnancy is associated with severe maternal and neonatal morbidity. Am J Obstet Gynecol. 232 (5):466.e1-466.e29. doi: 10.1016/-j.ajog.2024.10.022.

Kurniadi A, Setiawan D, Kireina J, Suardi D, Salima S, Erfiandi F, Andarini MY (2023). Clinical and management dilemmas concerning early-stage cervical cancer in pregnancy – A case report. Int J Womens Health. 15 (1):

1213–1218. doi: 10.2147/IJWH.S42-0801.

Maggen C, Wolters VE, Cardonick E, Fumagalli M, Halaska MJ, Lok CAR, de Haan J, et al. (2020). Pregnancy and Cancer: the INCIP Project. Curr Oncol Rep. 22(17):1-10. doi: 10.1007/s11912-020-0862-7.

Mantilidewi KI, Zaenudin AR, Harsono AB, Anwar AD, Kireina J (2023). Characteristics of referral patients with gestational trophoblastic neoplasia in Dr. Hasan Sadikin General Hospital Bandung. Indones J Cancer. 17(3):198. doi: 10.33371/ijoc.v17i3.990.

Naoum NAM, Darmawan E (2023). Risk factors of fetal/infant outcome in pregnant women with cancer in East Java Indonesia: Epidemiological Study. Media Gizi Kesmas. 12(1): 277–284. doi: 10.20473/mgk.v12i1.2023.-277-284.

Petca A, Niculae LE, Tocariu R, Noditi A, Petca R, Rotar IC (2025). Evaluating offspring after pregnancy-associated cancer: A systematic review of neonatal outcomes. Cancers. 17 (299): 1-11. doi :10.3390/cancers17020299.

Praja DW, Primandono P (2024). The management of ovarian cancer in pregnancy: a rare case report. Bali Med J. 13(2):610–613. doi: 10.15562/bmj.-v13i2.4900.

Saad M, Murphy MS, McGee SF, El-Chaar D (2023). Pregnancy and neonatal outcomes following malignancy in pregnancy at a tertiary care Canadian center: a retrospective chart review. J Matern Fetal Neonatal Med. 36(1): 2198631. doi: 10.1080/14767058.20-23.2198631.

Safi N, Li Z, Anazodo A, Remond M, Hayen A, Currow D, Roder D, Hamad N, Nicholl M, Gordon A, Frawley J, Fotheringham P, Sullivan E (2023). Pregnancy associated cancer, timing of birth and clinical decision making-a NSW data linkage study. BMC Pregnancy Childbirth. 23(1):105. doi: 10.11-86/s12884-023-05359-1.

Syarief SDR, Ritonga MA, Anwar R, Suardi D (2025). Management of ovarian cancer in the second trimester of pregnancy: A case report and literature review. Indones J Obstetr Gynecol Sci. 8(1): 189-193. doi: 10.24198/obgynia.-v8i1.778.

Walters B, Midwinter I, Chew-Graham CA, Jordan KP, Sharma G, Chappell LC, Crosbie EJ, Parwani P, Mamas MA, Wu P (2024). Pregnancy-Associated Cancer: A Systematic Review and Meta-Analysis. Mayo Clin Proc Innov Qual Outcomes. 8(2):188-199. doi: 10.1016/j.mayocpiqo.2024.02.002.

Wen T, Fish MG, Friedman AM (2025). Trends and outcomes associated with cancer diagnoses during delivery hospitalizations. Semin Perinatol. 49(2):152046. doi: 10.1016/j.semperi.-2025.152046.

Wells G, Shea B, O'Conell D, Peterson J, Welmch V, Losos M, Tugwell P (2021). The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. Ottawa Hospital Research Institute. https://www.ohri.ca/programs/clinical_epidemiology/oxford.asp.

Yu H, Bao P, Qiao J, Pang Y, Zang J, Wu C, Wang C, et al. (2023). Adverse birth outcomes among offspring born to women diagnosed with cancer: a population-based cohort study. Am J Obstet Gynecol MFM. 5(8): 101036. doi: 10.1016/j.ajogmf.2023.101036.