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SPECIAL ARTICLE

Obstetrics

Pregnancy after cancer: FIGO Best practice advice

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Abstract

Advances in cancer care have led to a growing number of cancer survivors globally. As cancer increasingly affects women and people of reproductive age, more individuals will be experiencing pregnancy after completing cancer treatment. This Best Practice Advice manuscript describes the epidemiology of pregnancy after cancer, recommended clinical evaluation before pregnancy, key components of pregnancy care for cancer survivors, considerations for delivery planning and postpartum care, and suggested steps for future health and prevention.

KEYWORDS
cancer, cancer survivorship, chemotherapy, childhood and adolescent cancer survivors, pregnancy, prematurity, radiotherapy

1 | EPIDEMIOLOGY OF PREGNANCY AFTER CANCER TREATMENT

Worldwide, approximately two million adult women of reproductive age (15–49 years) are diagnosed with cancer each year (Figure 1).[1] In 2022, the most common cancer types encountered were breast (32.8%), thyroid (15.1%), uterine cervical (12.5%), ovarian (4.4%), colorectal (4.3%), and lung (3.1%). Breast cancer is common in countries that are ranked both high and low on the Human Developmental Index (HDI),[2] whereas thyroid cancer is more common in high HDI countries, and uterine cervical cancer is more commonly diagnosed in low HDI countries (Figure 2).

The most common cancer types reported in pediatric populations include leukemia (53%), central nervous system tumors (22%), and neuroblastoma (9%).[3]

A recent US study of nearly 6000 early adolescent cancer survivors found that the most common malignancies were lymphoma (35%), soft tissue sarcomas (26%), leukemias (approximately 15%), central nervous system malignancies (approximately 11%), and Wilms tumors (0.6%).[4]

Pediatric and early adolescent cancer survivors experience behavioral, emotional, and social disruptions which impact on their life goals.[3] A recent meta-analysis identified that female pediatric cancer survivors had a two- to three-fold increased risk of post-traumatic

For affiliations refer to page 1124.

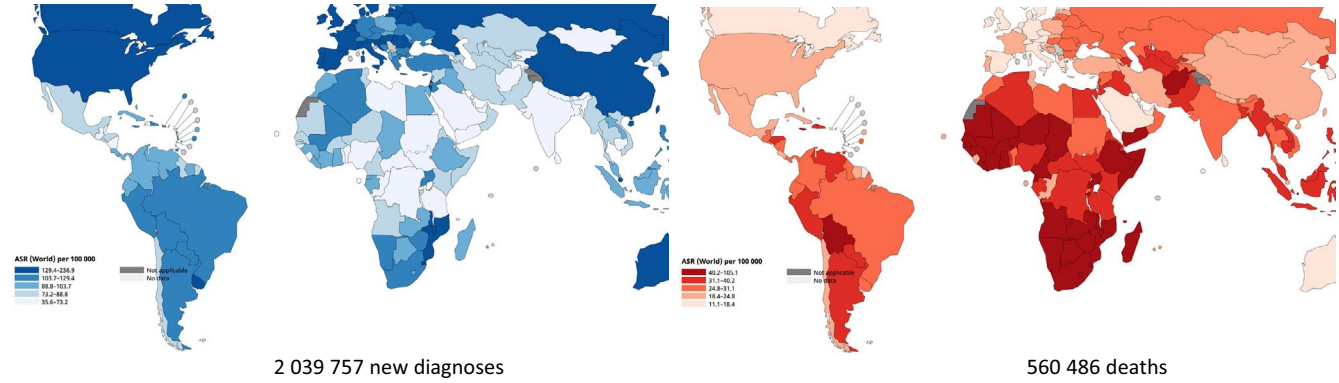

FIGURE 1 Incidence and mortality rates for all cancers in women aged 15–49 years worldwide. *Source*: GLOBOCAN, 2022.

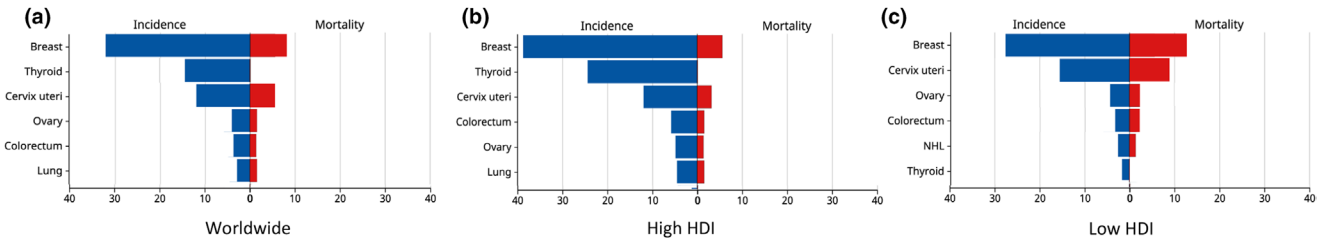

FIGURE 2 Estimated incidence and mortality rates for the most common types of cancer in women aged 15–49 years, worldwide (a) and by Human Development Index (HDI; b, c). *Source*: GLOBOCAN, 2022.

stress disorder compared with children without cancer, with the burden of surgery and treatments being an important cause.[5]

Treatments for cancer include traditional (surgery, chemotherapy, and radiotherapy) and emerging therapies.[6] Emerging therapies tend to be more targeted[6] and include stem cell, gene, nanoparticle-based, photodynamic,[7] and exosome-based therapies, immunotherapy, and immune checkpoint modulation.[8] While targeted to the specific condition, such therapies can result in significant organ dysfunction.[8]

Cancer and its treatment profoundly affect fertility, resulting in significantly reduced pregnancy rates among survivors. Garg et al.[9] reported that only 17.4% of cancer survivors had at least one subsequent live birth compared with 21.7% of age-matched controls, with an incidence rate ratio (IRR) of 0.69 across all cancer types. Certain cancers, such as leukemia (IRR 0.25) and breast cancer (IRR 0.44), exhibited the greatest reductions. Similarly, another large study observed a 32% deficit in births among adolescent and young adult cancer survivors compared with the general population, with cervical, breast, and genitourinary cancer survivors experiencing the most significant declines.[10]

2 | EVALUATION BEFORE PREGNANCY

2.1 | Fertility consideration

Fertility preservation and genetic counseling are important topics to discuss with cancer survivors and will be covered in detail separately in an upcoming FIGO Best Practice Advice document.

Fertility preservation techniques are not universally available, and uptake remains low, with only 8% of women accessing stored reproductive material post-treatment.[11] These findings emphasize the importance of early fertility counseling to mitigate the long-term impact on fertility and pregnancy outcomes.

2.2 | Time interval between cancer treatment and pregnancy

The time interval between completing cancer treatment or achieving remission and pursuing pregnancy should generally be 1–2 years. It is important to provide advice on appropriate contraception during this period to allow recovery from treatment and reduce the risk of cancer recurrence during pregnancy, as this timeframe aligns with the period of highest recurrence risk.[12]

2.3 | Past cancer surgery and treatments

In females diagnosed with gynecological cancer, surgery can include the partial or complete removal of the uterus, fallopian tubes, cervix, vagina, or ovaries.[13]

Other cancer-related surgeries such as nephrectomy, thyroidectomy, pneumonectomy, and hepatectomy may impact pregnancy health and require functional screening. Adverse effects include chronic fatigue, cognitive impairment, neuropathy, organ dysfunction,

such as cardiotoxicity, pulmonary toxicity, hepatic toxicity, and nephrotoxicity, as well as impaired sexual health, anxiety, distress, depression, and fear of recurrence.[14] These impacts are outlined in Tables 1 and 2.

2.4 | Pre-pregnancy assessment

A pre-pregnancy health assessment should focus on the woman's overall health status, while considering the long-term effects of cancer treatment that could impact fertility and pregnancy. Table 1 describes pregnancy considerations for major organ and system function.

2.5 | Primary cancer recurrence risk

Consultation with the oncology team to assess preconception staging, the risk of cancer recurrence, and the safety of discontinuing any ongoing treatment is recommended. Women are advised to defer pregnancy until after the period of highest recurrence risk; for breast cancer and gynecologic cancers, a 2-year waiting period post-treatment is recommended to minimize recurrence risk during pregnancy.[40]

2.6 | Secondary malignancies

Cancer survivors who have undergone chemotherapy or radiation therapy are at risk of developing secondary malignancies later in life.[41] Approximately 17%–19% of patients who survive primary malignancy suffer from secondary malignancies, which include gastrointestinal, breast, and central nervous system solid tumors, as well as leukemia and soft tissue sarcoma.[41]

2.7 | Graft-versus-host disease

Female cancer survivors who have undergone stem cell or bone marrow transplantation are at risk of developing graft-versus-host disease (GVHD) during pregnancy. GVHD is managed through immunosuppression and should be well controlled before planning pregnancy.[42]

2.8 | Special considerations

Pregnancy following treatments such as surgery, chemotherapy, and radiation may be at increased risk for long-term effects that require monitoring before or during a future pregnancy. Common cancers in reproductive aged women are shown in Table 2.

3 | PREGNANCY CARE

Recent investigation[43] and a confidential enquiry into maternal death and morbidities in the UK reported that around 20% of women who

TABLE 1 Impact of prior cancer and cancer treatment on pregnancy health and practical advice for management.

Impact on system
Cardiac
• Anthracyclines, the most commonly reported cardiotoxic chemotherapeutic agents, cause dose-dependent cardiotoxicity[15] • Coronary artery diseases can appear a long time after radiation therapy and it has been reported that 5%–10% of cancer survivors can develop moderate to severe heart disease[16] • The incidence of new-onset heart failure during pregnancy is very low in female cancer survivors, with normal cardiac function before pregnancy. However, those with cardiotoxicity before pregnancy carry an increased risk of cardiac failure during or shortly after childbirth. It is recommended to have a cardiomyopathy investigation with echocardiography before conception for all women cancer survivors[17,18]
Endocrine
• Individuals who undergo radiation therapy and those exposed to alkylating agents (e.g., carboplatin, cisplatin, chlorambucil, cyclophosphamide) are at risk of developing endocrine complications.[19] Cancer treatment-related endocrine disorders include hypopituitarism, gonadotropin deficiency, hypothyroidism, hyperthyroidism, hypothalamic dysfunction, gonadal dysfunction, hypertriglyceridemia, and hyperprolactinemia[20] • Thyroid function tests (TFTs) are recommended annually for survivors who received radiotherapy to the neck, spine, or brain, especially in childhood
Respiratory
• Respiratory complications of chemotherapy can be manifested as alveolar damage, eosinophilic pneumonia, or pulmonary hemorrhage, arising from direct toxicity from chemotherapy or radiotherapy, or related to lung infections resulting from immunosuppression[21] • Pulmonary function tests (PFTs) are recommended in those treated with bleomycin, or chest or total body irradiation
Thrombotic risk
• History of venous thrombotic events (VTEs): a detailed history of any previous VTEs is crucial for women with a past history of malignancy who are planning pregnancy or are currently pregnant • Thromboprophylaxis should be based on the individual risk assessment
Renal
• Cisplatin causes nephrotoxicity attributed to injury to mitochondrial DNA, initiation of inflammatory mechanisms, and activation of cell death pathways.[22] Manifestations include acute and chronic kidney disease, proteinuria, and tubulopathies • Additional chemotherapeutic agents associated with nephrotoxicity include bendamustine and clofarabine[23] • Renal function tests and urinalysis before pregnancy are recommended[24]
Hepatic
• Chemotherapy may cause liver conditions, including sinusoidal obstructive syndrome, steatosis, acute hepatitis, liver cirrhosis, and liver failure[25] • Radiation-induced liver disease is characterized by high serum transaminases and jaundice[26] • In cancer survivors, late-onset liver complications have been associated with radiotherapy, viral hepatitis, and elevated body mass index[27] • Liver function and enzyme tests should be assessed before pregnancy[28]

TABLE 2 Special considerations for common cancers in reproductive-aged women.

Type of cancer	Guide to counseling
Breast[29–32]	• Consider the duration of tamoxifen treatment, as current advice is to be off tamoxifen for 9 months prior to conception. Discuss resuming tamoxifen post-delivery • Consider the duration of trastuzumab (Herceptin®) treatment, pausing during peri-conception given its potential embryotoxicity, and resuming treatment post-delivery
Thyroid[33,34]	• Women free of disease prior to pregnancy show no evidence of disease progression or recurrence due to pregnancy. Those with persistent disease before pregnancy have a higher risk of progression • Perinatal outcomes are reassuring in thyroid cancer survivors treated with radioactive iodine
Melanoma[35,36]	• Studies have shown that pregnancy does not adversely affect mortality or disease-free survival in melanoma patients, even when pregnancy occurs within 5 years of diagnosis. However, vigilance is necessary as physiologic skin changes in pregnancy may obscure disease recurrence
Cervical[37,38]	• Pregnancy after cervical cancer is possible due to fertility preservation techniques which include radical trachelectomy and conization. Cervical length measurement by transvaginal ultrasound in the second trimester is suggested, and if cervical length <25 mm, consider progesterone prophylaxis and/or cervical cerclage (if cervical suture not already in place) • Studies show varying rates of successful pregnancies after trachelectomy, ranging from 36% to 56%. There is a high rate of preterm births (60%–80%), and cesarean delivery is indicated • Gestational surrogacy with frozen–thawed material allows for pregnancy after cervical cancer, an alternative for achieving biological offspring[39]
Gastrointestinal	• Nutritional considerations: given the impact of gastrointestinal tract cancer and its treatment on nutritional absorption, emphasize the need for nutritional counseling to ensure both maternal and fetal health during pregnancy
Leukemia and lymphoma	• Review the patient's treatment history, including types of chemotherapy, radiation therapy, and bone marrow or stem cell transplants • Offer genetic counseling to assess the risk hematological cancer or treatment-related genetic changes to offspring

died due to cancer in pregnancy, or within 6 weeks of giving birth, entered the pregnancy with a history of past or recurrent cancer.[44] Growing evidence suggests there is no increased risk of miscarriage or stillbirth among first pregnancies achieved after a cancer diagnosis.[45] Pregnancy after recent cancer treatment requires individualized planning and holistic care for optimal fetal and maternal wellbeing.

Referral to a maternal fetal medicine specialist or an obstetric physician (where available) for pre-pregnancy counseling and optimal contraception should continue until it is safe to be pregnant.[44] Otherwise, assessment in the first trimester can take place for individualization of risks and choices,[44] including discussion around termination of pregnancy, where appropriate.[40] Vigilance is needed if new symptoms arise, to avoid confusion with physiological changes in pregnancy. Ideally, pregnant individuals with new symptoms should receive prompt evaluation, including appropriate imaging and referral to oncology as appropriate.[44]

Depending on the cancer and treatment history, a detailed risk assessment at booking should include nutritional status (see https://www.figo.org/news/figo-nutrition-checklist), venous thromboembolism risk,[46] gestational hypertension (pre-eclampsia) risk[47] as well as a mental health assessment.[48] There is no evidence for increased risk of hypertensive disorders in pregnancy or gestational diabetes in pregnancy following a previous malignancy. Low-dose aspirin should be considered in line with FIGO initiative on pre-eclampsia.[47] During pregnancy, all women with recent cancer in pregnancy should receive updated vaccine prophylaxis as per regional policy.[49]

All pregnant women should be offered aneuploidy screening as per local protocol. This may include non-invasive prenatal testing for aneuploidy screening, in the absence of cancer recurrence. Serial fetal surveillance by ultrasound in the third trimester should be considered, as cancers and cancer treatments, such as radiation to abdomen or pelvis, may increase the risk of fetal growth restriction up to 50%, as well as stillbirth.[50]

4 | DELIVERY PLANNING

Depending on the type of cancer and previous or ongoing treatment, some women have an increased risk of cesarean birth but no increased risk of assisted vaginal delivery.[51] When there has been radiation to the abdomen and pelvis, women more often give birth by elective cesarean section, but they do not seem to run an increased risk for an emergency cesarean birth.[51]

Obstetric anesthetic assessment may be advisable prior to delivery in situations where there is known cardiac or other medical conditions arising from past cancer treatment.

5 | POSTPARTUM CARE

Women with a history of treated cancer do not need additional thromboprophylaxis, such as low-molecular-weight heparin (LMWH),

unless there is a recurrence diagnosed in pregnancy or there is another obstetric indication for LMWH to be administered.

The follow-up and monitoring for recurrence of patients with cancer during the postpartum period should follow the same recommendations as for non-pregnant individuals.[52]

Oncological treatment of patients with breast cancer can be resumed immediately after vaginal birth and 2 weeks after a cesarean section.[53] Lactation is generally contraindicated while receiving systemic therapy for cancer.

As prophylactic mastectomy and salpingo-oophorectomy improves prognosis in BRCA1 and BRCA2 carriers, women are encouraged to have prophylactic surgery at 35–40 years of age, or after completion of their family.[54] In women who carry the BRCA1 or BRCA2 gene, who are having a cesarean section for obstetric reasons, and who have completed their family, the option of bilateral salpingo-oophorectomy at the time of cesarean should be considered.

As pediatric and adult cancer survivors may experience mental health challenges related to the diagnosis, treatment, and fear of recurrence, all patients should be screened for mental health issues. The inability to lactate and/or avoidance of breastfeeding and chestfeeding following prior cancer treatment and surgery further complicate postpartum mental health status and may affect mother–child bonding.[55]

Some forms of hormonal contraception may be appropriate with appropriate counseling and monitoring. Barrier methods and non-hormone containing intrauterine devices (IUD) are safe. IUDs may be placed immediately postpartum or during cesarean section.[52]

Women who have had breast surgery and/or radiation therapy may experience reduced milk production. Breastfeeding while receiving chemotherapy is not recommended. For those who can breastfeed, it appears to be safe in terms of breast cancer recurrence.[56–59] Breastfeeding for 12 months or more is linked to a lower risk of developing breast cancer, although there is less research about whether it can help reduce the risk of breast cancer recurrence after treatment. A summary of the management approaches for women who are pregnant following a cancer diagnosis is presented in Table 3.[60]

6 | PREVENTION OF FUTURE HEALTH ISSUES

The FIGO Committee on the Impact of Pregnancy on Long-term Health advocates for a life-course approach for health conditions that may have interactions with pregnancy and women's health. Counseling during pregnancy and postpartum regarding lifestyle and behavior modification considering a past cancer diagnosis and associated treatment can help improve women's longevity and quality of life.

Cervical cancer and breast cancer screening according to local and international guidelines should be encouraged.

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Treatment-induced premature ovarian insufficiency extends beyond menopausal symptoms and may increase the risk of cardiovascular disease and osteoporosis. Menopausal hormone therapy is often not contraindicated in many cancer survivors and is effective in treating vasomotor symptoms.[61] Hormone therapy, however, may be contraindicated following breast cancer, especially in estrogen receptor-positive disease and women over 50 years.[62] Cognitive behavioral therapy, where available, offers a non-pharmacological management strategy for menopausal symptoms and is effective in improving sleep and depressive symptoms and reducing bother due to vasomotor symptoms.[63]

Non-hormonal options for managing vasomotor symptoms include antidepressants and anticonvulsants such as gabapentin and pregabalin, oxybutynin and clonidine.[64,65] Vaginal lubricants are recommended to alleviate vaginal dryness and dyspareunia. Low-dose vaginal estrogen may be safely offered to patients with persistent genitourinary symptoms of menopause, after robust discussion on risks and benefits.[66]

TABLE 3 Summary of management of women with pregnancy after cancer: Synopsis of FIGO recommendations.

Surveillance of pregnancy after cancer
- Offer investigations for cancer surveillance as indicated per non-pregnant clinical indication (with some adjustments based on gestational age) and within the same timeframe. Inform radiology of pregnancy status, and gestation for accurate interpretation
- Referral to oncology teams as per non-pregnant early cancer referral pathway (usually 2 weeks) if suspicion of recurrence or red flag signs
- If wider multidisciplinary team is not feasible, clear plan for cancer surveillance to be communicated to obstetric teams

Pregnancy surveillance
- Obstetric review in first trimester
- Discuss options – continuation vs. termination of pregnancy, especially if unplanned pregnancy or conceived within 2 years of treatment
- Detailed history at booking and risk assessment for nutrition, venous thrombotic events (VTEs), pre-eclampsia, gestational diabetes, and mental health assessment
- Consider using FIGO nutritional checklist
- Testing for diabetes if recent exposure to steroids or any other risk factors
- Consider low-dose aspirin if high risk in line with FIGO initiative on pre-eclampsia
- Ultrasound:
  - Routine first-trimester combined screening
  - No contraindication to cell-free DNA testing, if no suspicion of recurrence
  - Fetal echocardiography if recent exposure to chemotherapy; consider fetal medicine review for anatomy scans if conceived on or within 3 months of cytotoxic treatment
  - Consider monthly scans for fetal wellbeing in third trimester
  - Cervical length assessment (2- to 4-weekly) in second trimester and consider progesterone if length <25 mm
- Optimize general pregnancy health (e.g., nutrition, hemoglobin, vitamin D, vaccines, infections etc.)
- Offer maternal investigations (if not recently performed), e.g., echocardiography, lung function tests, where indicated (Table 1)

(Continues)

TABLE 3 (Continued)

Venous thromboembolism prophylaxis
- Women with a history of treated cancer do not need thromboprophylaxis, unless there is a recurrence or there is any other obstetric indication for them to be on low-molecular-weight heparin (LMWH)
- If diagnosis of active cancer (recurrence), LMWH from 28 weeks or from first trimester if there are other risk factors such as hospitalization, chemotherapy, nausea and vomiting in pregnancy, generally unwell, immobility, or surgery
- Re-evaluate VTE risk assessment in each trimester for other non-malignancy-related obstetric risk factors

Delivery
- *Timing*
  - Avoid iatrogenic prematurity unless obstetric indication
  - Optimize fetal health (lung maturation, neuroprotection) if preterm delivery is predictable
- *Mode*
  - Offer vaginal delivery where appropriate
  - No absolute indication for induction of labor
  - Cesarean section for obstetric indications or previous cancer treatments like cervical, vulval cancers or extensive radiotherapy
  - Obstetric anesthetic review especially if known cardiorespiratory changes due to cytotoxic drugs or radiotherapy
  - No evidence of increase in postpartum hemorrhage
  - Cover with intravenous steroids if ongoing steroid treatment in pregnancy

Postnatal care
- Breastfeeding: encourage unless there is a contraindication to this
- Contraception: individualize options, intrauterine devices can be offered immediately postpartum
- VTE prophylaxis
- Offer psychological and mental health support
- No specific considerations for the neonate based on previous cancer diagnosis

All recurrences at any stage in pregnancy should be managed as active cancer (see FIGO Best Practice Advice on Cancer in Pregnancy)

7 | CONCLUSIONS FOR CLINICIANS IN ALL RESOURCE SETTINGS

Review Figure S1 for a visual synopsis.

- Obtain a detailed history of a past cancer diagnosis, associated treatments, and complications of treatment. Where possible, obtain appropriate screening for common complications such as cardiac, pulmonary, renal, hepatic, and endocrine toxicities. Screening may include cardiac auscultation, electrocardiogram, and lung function testing such as spirometry. If there are concerns for potential cancer-related cardiac dysfunction such as cardiomyopathy, it is advisable to obtain assessment by an obstetric physician or obstetrical provider with appropriate expertise.
- If possible, advise patients to wait 1–2 years after completing their cancer treatment before becoming pregnant.
- Provide advice on nutrition and healthy lifestyle for pregnancy and for the long term after pregnancy.
- Ensure adequate folic acid supplementation.
- Support breastfeeding in women without contraindications.
- Begin low-dose aspirin prophylaxis for patients at risk for gestational hypertension.
- Monitor and support patients for mental health conditions given the impact of past cancer diagnosis and treatment.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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