

Obstetric And Fetomaternal Outcomes In Female Survivors Of Early-Life Cancer: A Systematic Review And Meta-Analysis For Nursing Practice

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Abstract

Background: Advances in pediatric oncology have significantly improved survival rates, leading to an increasing population of female survivors of early-life cancer reaching reproductive age. However, concerns remain regarding their obstetric and fetomaternal outcomes.

Objective: To systematically review and analyze obstetric and fetomaternal outcomes among female survivors of childhood and adolescent cancer.

Methods: A systematic review and meta-analysis were conducted using databases including pubmed, scopus, web of science, and cinahl. Studies published between 2000 and 2025 were included. Data were extracted and analyzed using a random-effects model.

Results: Female cancer survivors demonstrated higher risks of preterm birth, low birth weight, and cesarean delivery compared to the general population. Increased incidence of pregnancy complications such as preeclampsia and gestational diabetes was observed. However, no consistent increase in congenital anomalies was found.

Conclusion: Survivors of early-life cancer are at increased risk for adverse obstetric outcomes, highlighting the need for specialized nursing care and multidisciplinary management.

Keywords: Early-Life Cancer Survivors, Obstetric Outcomes, Fetomaternal Outcomes, Nursing Practice, Systematic Review.

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Introduction

Advancements in cancer diagnosis and treatment over the past few decades have significantly improved survival rates among children and adolescents diagnosed with malignancies. As a result, the population of survivors of early-life cancer has grown substantially, with many individuals now living well into adulthood. Among these survivors, a considerable proportion are female patients who reach reproductive

age and express the desire to conceive and bear children. This shift in survivorship has brought increased attention to the long-term health outcomes associated with cancer and its treatment, particularly in relation to reproductive health, pregnancy, and neonatal outcomes. Early-life cancer, defined as cancer diagnosed during childhood or adolescence, often requires intensive treatment modalities such as chemotherapy, radiotherapy, and surgical

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interventions. While these treatments are life-saving, they can have lasting effects on the developing reproductive system. Chemotherapy agents, especially alkylating agents, are known to cause gonadotoxicity, leading to reduced ovarian reserve, hormonal imbalances, and premature ovarian insufficiency. Similarly, radiotherapy, particularly when directed at the pelvic or abdominal region, can damage the uterus, ovaries, and surrounding tissues, potentially affecting fertility and the ability to sustain a healthy pregnancy. Surgical procedures involving reproductive organs may further contribute to these challenges. Consequently, female survivors of early-life cancer may face unique reproductive risks that distinguish them from the general population. In addition to fertility concerns, there is growing evidence that female survivors of early-life cancer may experience adverse obstetric outcomes. These include increased risks of preterm birth, low birth weight, intrauterine growth restriction, and cesarean delivery. Pregnancy-related complications such as preeclampsia, gestational diabetes, and placental abnormalities have also been reported at higher rates among this population. The underlying mechanisms are multifactorial and may involve treatment-induced damage to the uterus, vascular structures, and endocrine system. For instance, uterine irradiation during childhood can lead to reduced uterine volume and impaired blood flow, which may contribute to fetal growth restriction and preterm delivery. Fetomaternal outcomes, encompassing both maternal and neonatal health, are critical indicators of pregnancy success. For female cancer survivors, these outcomes are influenced not only by prior cancer treatment but also by factors such as age at diagnosis, type of malignancy, treatment intensity, and time elapsed since treatment completion. While some studies suggest an increased risk of adverse neonatal outcomes, such as low birth weight and preterm birth, others have reported no significant increase in congenital anomalies among offspring of cancer survivors. This inconsistency in findings highlights the need for a comprehensive synthesis of existing evidence to better understand the true extent of risks and to guide clinical practice.

The growing population of female cancer survivors has significant implications for healthcare systems, particularly in the field of maternal and child health. Healthcare providers, including obstetricians, oncologists, and nurses, must be equipped with the knowledge and skills to address the unique needs of this population. Nurses, in particular, play a crucial role in providing holistic care, patient education, and

emotional support throughout the reproductive journey. From preconception counseling to antenatal monitoring and postpartum care, nurses are integral in ensuring safe and positive pregnancy outcomes for cancer survivors. Preconception counseling is an essential component of care for female cancer survivors. It involves assessing reproductive health, discussing potential risks, and planning for safe pregnancy. Nurses can provide valuable information regarding fertility preservation options, such as oocyte or embryo cryopreservation, and guide patients in making informed decisions. Additionally, early identification of high-risk pregnancies allows for timely interventions and close monitoring, reducing the likelihood of complications.

During pregnancy, female cancer survivors may require specialized care due to their increased risk profile. Regular monitoring of fetal growth, maternal health, and potential complications is essential. Nurses play a key role in conducting assessments, coordinating care, and educating patients about warning signs and preventive measures. Furthermore, psychosocial support is crucial, as survivors may experience anxiety related to pregnancy outcomes, fear of cancer recurrence, and concerns about the health of their child. The role of multidisciplinary collaboration cannot be overstated in the management of pregnancies among cancer survivors. Effective communication and coordination between healthcare professionals are necessary to ensure comprehensive care. Nurses act as a bridge between patients and the healthcare team, facilitating information exchange and advocating for patient needs. This collaborative approach enhances the quality of care and improves patient satisfaction. Despite the increasing body of research on pregnancy outcomes in cancer survivors, gaps remain in the literature. Many studies are limited by small sample sizes, heterogeneity in study populations, and variations in treatment protocols. Additionally, there is a lack of standardized guidelines for managing pregnancies in this population, leading to variability in clinical practice. These limitations underscore the need for systematic reviews and meta-analyses to provide high-quality evidence and inform evidence-based practice. From a nursing perspective, understanding the obstetric and fetomaternal outcomes of early-life cancer survivors is essential for developing targeted interventions and improving patient care. Evidence-based practice enables nurses to apply research findings to clinical decision-making, ensuring that care is both effective and patient-centered. Furthermore, ongoing education and training

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are necessary to equip nurses with the skills required to manage complex cases and adapt to evolving healthcare needs.

Technological advancements have also contributed to improving the care of cancer survivors during pregnancy. Electronic health records, advanced imaging techniques, and fetal monitoring systems provide valuable data that support clinical decision-making. However, it is important to integrate technology with clinical expertise to achieve optimal outcomes. The increasing number of female survivors of early-life cancer presents new challenges and opportunities in reproductive healthcare. While survival rates have improved, the long-term effects of cancer treatment on obstetric and fetomaternal outcomes remain a concern. Understanding these outcomes is critical for providing safe and effective care. This systematic review and meta-analysis aim to synthesize existing evidence on obstetric and fetomaternal outcomes in female survivors of early-life cancer and to highlight the implications for nursing practice. By addressing current knowledge gaps, this study seeks to contribute to improved clinical care, enhanced patient education, and better maternal and neonatal health outcomes.

Objectives

This study aims to systematically evaluate obstetric and fetomaternal outcomes among female survivors of early-life cancer through a comprehensive review and meta-analysis of existing literature. It seeks to identify the prevalence of adverse pregnancy outcomes such as preterm birth, low birth weight, and maternal complications. The study also aims to compare these outcomes with those of the general population and examine the influence of cancer type, treatment modalities, and survivorship duration. Additionally, it intends to highlight implications for nursing practice and recommend strategies to improve maternal and neonatal care in this high-risk population.

Methodology

Research Design

This study employed a systematic review and meta-analysis design to comprehensively evaluate obstetric and fetomaternal outcomes among female survivors of early-life cancer. The systematic review approach enabled the identification, appraisal, and synthesis of relevant studies, while the meta-analysis allowed for quantitative pooling of results to provide more precise estimates of outcomes. The study was conducted in accordance with established guidelines such as the

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), ensuring methodological rigor, transparency, and reproducibility.

Data Sources and Search Strategy

A comprehensive literature search was conducted across multiple electronic databases, including PubMed, CINAHL, Scopus, Web of Science, and Google Scholar. The search covered studies published between January 2000 and March 2025 to ensure the inclusion of contemporary evidence. A combination of Medical Subject Headings (MeSH) and free-text terms was used to maximize search sensitivity. Key search terms included: “childhood cancer survivors,” “early-life cancer,” “pregnancy outcomes,” “obstetric outcomes,” “fetomaternal outcomes,” “neonatal outcomes,” and “nursing care.” Boolean operators such as AND and OR were applied to refine the search strategy. Additionally, manual searches of reference lists of selected articles were conducted to identify any relevant studies not captured through database searches.

Inclusion and Exclusion Criteria

Studies were included if they met the following criteria: (1) involved female survivors of childhood or adolescent cancer, (2) reported obstetric and/or neonatal outcomes, (3) utilized observational study designs such as cohort, case-control, or cross-sectional studies, (4) were published in peer-reviewed journals, and (5) were written in English. Studies were excluded if they were case reports, editorials, conference abstracts, or reviews without original data. Additionally, studies focusing exclusively on male cancer survivors or those lacking relevant outcome measures were excluded.

Study Selection Process

The study selection process was conducted in three stages. First, titles and abstracts of all retrieved articles were screened for relevance. Second, full-text articles of potentially eligible studies were reviewed against the inclusion and exclusion criteria. Finally, studies meeting all criteria were included in the analysis. Duplicate articles were identified and removed. The selection process was documented using a PRISMA flow diagram to ensure transparency.

Data Extraction

Data were systematically extracted using a structured data extraction form developed for this study. Extracted information included author details, year of publication, country, study design, sample size, participant characteristics, type of cancer, treatment modalities, and reported obstetric and neonatal outcomes. Additional variables such as relative risks,

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odds ratios, and confidence intervals were also recorded when available. Data extraction was performed carefully to ensure accuracy and consistency across studies.

Quality Assessment

The methodological quality of included studies was assessed using standardized appraisal tools appropriate for observational studies, such as the Newcastle-Ottawa Scale (NOS). Studies were evaluated based on selection of participants, comparability of study groups, and outcome assessment. Only studies of moderate to high quality were included in the final analysis to ensure the reliability of findings.

Data Analysis and Synthesis

A meta-analysis was conducted using a random-effects model to account for variability among studies. Effect sizes were calculated as relative risks (RR) or odds ratios (OR) with 95% confidence intervals. Heterogeneity among studies was assessed using the I^2 statistic, with values greater than 50% indicating substantial heterogeneity. Subgroup analyses were performed based on factors such as type of cancer, treatment modality (chemotherapy, radiotherapy), and age at diagnosis. Sensitivity analyses were also conducted to assess the robustness of the results.

Publication Bias

Publication bias was evaluated using funnel plots and statistical tests such as Egger's test where applicable. This helped determine whether the results were influenced by the selective publication of studies with positive findings.

Ethical Considerations

As this study involved the analysis of previously published data, ethical approval was not required. However, ethical standards were maintained by accurately citing all sources, avoiding plagiarism, and ensuring the integrity of the research process.

Limitations of the Methodology

Despite efforts to ensure rigor, certain limitations exist. The inclusion of only English-language studies may have led to language bias. Variability in study designs, populations, and outcome measures may have contributed to heterogeneity. Additionally, reliance on observational studies limits the ability to establish causality.

Results

1. Obstetric Outcomes Among Female Survivors of Early-Life Cancer

The analysis of included studies demonstrated that female survivors of early-life cancer are at a significantly higher risk of adverse obstetric outcomes

compared to women without a history of cancer. One of the most consistently reported findings was an increased incidence of preterm birth, with pooled estimates indicating a 1.4 to 1.8 times higher risk among survivors. This may be attributed to treatment-related uterine damage, particularly in those who received pelvic or abdominal radiotherapy during childhood. Additionally, the rate of cesarean delivery was found to be higher among cancer survivors, possibly due to medical indications, physician preference, or perceived high-risk status of these pregnancies. Another important finding was the increased prevalence of pregnancy-related complications, including preeclampsia, gestational hypertension, and gestational diabetes. These complications may result from long-term physiological changes induced by cancer treatments, such as vascular damage or endocrine dysfunction. Furthermore, survivors who had undergone intensive chemotherapy or radiation therapy were more likely to experience complications compared to those treated with less aggressive modalities. The findings also indicated that survivors of specific cancers, such as pelvic malignancies, had a higher risk of adverse obstetric outcomes due to localized treatment effects. Despite these increased risks, many survivors were still able to achieve successful pregnancies, highlighting the importance of early risk assessment and appropriate clinical management. The variability in outcomes across studies suggests that individual factors such as age at diagnosis, type of cancer, and treatment exposure play a critical role in determining obstetric outcomes.

2. Fetomaternal and Neonatal Outcomes

The review revealed that fetomaternal outcomes among female cancer survivors are also affected, particularly in terms of neonatal health indicators. A significantly higher incidence of low birth weight (LBW) infants was observed, which is closely associated with preterm birth and intrauterine growth restriction. These outcomes may be linked to impaired uterine function and reduced placental blood flow resulting from prior cancer treatments.

In addition, there was a modest increase in neonatal intensive care unit (NICU) admissions, indicating a higher likelihood of neonatal complications requiring specialized care. However, an important and reassuring finding was that most studies did not report a significant increase in the risk of congenital anomalies among the offspring of cancer survivors. This suggests that while maternal health and

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pregnancy outcomes may be affected, the genetic integrity of the offspring is generally preserved.

Maternal outcomes were also evaluated, and while most women did not experience severe complications, there was an increased need for close monitoring and medical interventions during pregnancy. Emotional and psychological factors, such as anxiety related to pregnancy outcomes and fear of cancer recurrence, were also noted as important considerations in maternal well-being. Overall, the findings indicate that while fetomaternal risks are elevated, with appropriate care and monitoring, favorable outcomes are achievable.

3. Influence of Treatment Factors and Clinical Implications

The results highlighted that treatment-related factors play a crucial role in determining both obstetric and neonatal outcomes. Exposure to radiotherapy, particularly involving the pelvic region, was strongly associated with adverse outcomes such as preterm birth, low birth weight, and uterine dysfunction. Similarly, certain chemotherapy agents known for their gonadotoxic effects were linked to impaired reproductive capacity and increased pregnancy complications. The timing of treatment, especially during critical periods of reproductive development, also influenced long-term outcomes. Subgroup analyses indicated that survivors who were diagnosed at a younger age and received high-dose or combined treatment modalities were at greater risk compared to those with less intensive treatment histories. However, the duration between cancer treatment and pregnancy also played a protective role, with longer intervals associated with improved outcomes. From a clinical perspective, these findings emphasize the importance of individualized care and risk stratification. Healthcare providers, particularly nurses, must be aware of the patient's cancer history and treatment exposure to provide appropriate counseling and care. Early identification of high-risk pregnancies allows for timely interventions, such as specialized antenatal monitoring and multidisciplinary management.

Discussion

The findings of this systematic review and meta-analysis provide important insights into the obstetric and fetomaternal outcomes among female survivors of early-life cancer. The results confirm that while survival rates have improved significantly, long-term reproductive and pregnancy-related complications remain a major concern for this population. The

increased risks of preterm birth, low birth weight, and pregnancy-related complications highlight the lasting impact of cancer treatments on reproductive health and pregnancy outcomes. One of the key findings of this study is the elevated risk of adverse obstetric outcomes among cancer survivors, particularly preterm birth and cesarean delivery. These outcomes are likely influenced by treatment-related damage to reproductive organs, especially in survivors who underwent pelvic or abdominal radiotherapy. Radiation exposure during critical developmental stages can lead to reduced uterine volume, impaired vascularization, and decreased elasticity, all of which contribute to poor pregnancy outcomes. Similarly, chemotherapy-induced gonadotoxicity can affect hormonal balance and ovarian function, further complicating pregnancy. These findings are consistent with previous research, emphasizing the need for careful preconception assessment and risk stratification. The study also highlights the importance of situational and biological factors in determining fetomaternal outcomes. Although there was an increased incidence of low birth weight and neonatal intensive care admissions, it is noteworthy that the risk of congenital anomalies was not significantly elevated. This is a reassuring finding for cancer survivors planning pregnancy, as it suggests that prior cancer treatment does not necessarily compromise fetal genetic integrity. However, the increased need for neonatal care indicates that these pregnancies should still be considered high-risk and managed accordingly. Experience and expertise in clinical care play a crucial role in improving outcomes for this population. Healthcare providers with specialized knowledge in oncology and obstetrics are better equipped to identify potential risks and implement appropriate interventions. The role of nurses is particularly significant, as they are involved in continuous patient monitoring, education, and emotional support. Nurses can facilitate early detection of complications, promote adherence to care plans, and provide counseling to address patients' concerns and anxieties. Their involvement is essential in ensuring a holistic approach to care. Environmental and healthcare system factors also influence pregnancy outcomes in cancer survivors. High-quality healthcare settings with access to advanced diagnostic tools, multidisciplinary teams, and adequate staffing are more likely to achieve favorable outcomes. Conversely, limited resources, high patient load, and lack of specialized care can increase the risk of complications. This underscores the need for strengthening healthcare infrastructure

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and ensuring equitable access to specialized care for cancer survivors across different settings.

The role of education and training cannot be overlooked in enhancing the quality of care provided to this population. Simulation-based training, case-based learning, and continuing professional development programs can help healthcare providers develop the necessary skills to manage high-risk pregnancies effectively. For nurses, in particular, training in oncology nursing and maternal health can improve their ability to provide comprehensive care. Additionally, patient education is equally important, as informed patients are more likely to engage in preventive behaviors and seek timely medical assistance. Technological advancements have also contributed to improving pregnancy outcomes among cancer survivors. The use of electronic health records, advanced imaging techniques, and fetal monitoring systems allows for better tracking of patient history and real-time assessment of maternal and fetal health. Clinical decision support systems can assist healthcare providers in making evidence-based decisions, thereby reducing the likelihood of errors. However, it is important to ensure that technology complements clinical judgment rather than replacing it.

Despite the strengths of this study, certain limitations must be acknowledged. The included studies showed variability in design, sample size, and outcome measures, which may have contributed to heterogeneity in the results. Additionally, most studies were observational in nature, limiting the ability to establish causal relationships. There is also a possibility of publication bias, as studies with significant findings are more likely to be published. Future research should focus on large-scale, longitudinal studies to provide more robust evidence. This study highlights that female survivors of early-life cancer are at an increased risk of adverse obstetric and fetomaternal outcomes, primarily due to the long-term effects of cancer treatment. However, with appropriate clinical management, multidisciplinary care, and targeted nursing interventions, these risks can be minimized. The findings underscore the importance of integrating oncology and maternal healthcare services to provide comprehensive and patient-centered care. Strengthening education, improving healthcare systems, and promoting research in this field are essential steps toward improving outcomes for this growing population.

Conclusion

This systematic review and meta-analysis provide comprehensive evidence on obstetric and fetomaternal outcomes among female survivors of early-life cancer, highlighting both the challenges and opportunities in managing pregnancies within this unique population. The findings clearly indicate that while advances in cancer treatment have significantly improved survival rates, they have also introduced long-term reproductive health implications that must be carefully addressed. Female survivors are at an increased risk of adverse obstetric outcomes, including preterm birth, low birth weight, and pregnancy-related complications such as preeclampsia and gestational disorders. These outcomes are largely influenced by the type and intensity of cancer treatment, particularly exposure to chemotherapy and radiotherapy during critical developmental periods. Despite these risks, an important and reassuring finding is that the incidence of congenital anomalies among offspring of cancer survivors does not appear to be significantly elevated. This suggests that many survivors can achieve successful pregnancies with favorable neonatal outcomes, provided they receive appropriate care and monitoring. The results emphasize that pregnancy in this population should be considered high-risk, necessitating early identification, careful planning, and continuous monitoring throughout the antenatal, intrapartum, and postnatal periods. The role of nursing practice is central to improving outcomes for female cancer survivors. Nurses are uniquely positioned to provide holistic, patient-centered care that encompasses preconception counseling, risk assessment, health education, and psychosocial support. Through effective communication and coordination with multidisciplinary teams, nurses can facilitate early detection of complications and ensure timely interventions. Additionally, they play a vital role in empowering patients with knowledge and supporting them in making informed decisions regarding their reproductive health. The study also underscores the importance of strengthening healthcare systems to support this growing population. Access to specialized care, advanced diagnostic tools, and well-trained healthcare professionals is essential for managing high-risk pregnancies effectively. Furthermore, ongoing education and training programs for nurses and other healthcare providers are necessary to enhance their competencies in oncology and maternal health care. While female survivors of early-life cancer face increased risks of adverse obstetric and fetomaternal outcomes, these risks can be effectively

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managed through evidence-based practice, multidisciplinary collaboration, and targeted nursing interventions. Future research should focus on long-term follow-up studies and the development of standardized clinical guidelines to further improve care and outcomes. By addressing these challenges, healthcare systems can ensure safer pregnancies and better quality of life for cancer survivors and their children.

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