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Unintended Pregnancies: A Systematic Review of Contraception and Women with Cancer

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Abstract

BACKGROUND—Women with past or current cancer diagnoses can benefit from planning pregnancies to optimize maternal health and birth outcomes.

OBJECTIVES—The purpose of this systematic review is to identify unmet needs for family planning services among women with cancer by describing the prevalence of contraception counseling, contraception use, unintended pregnancy, and abortion.

METHODS—Using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, 16 studies were included.

FINDINGS—Women with cancer experience unintended pregnancy and abortion throughout their care. Not all women reported receiving contraception counseling, and many reported inconsistencies between contraception counseling desired and received. A prominent theme was uncertainty about fertility status. Use of highly effective contraceptive methods was low to moderate in eight patient populations.

Unintended pregnancies can disrupt treatment and recovery for women of reproductive age with cancer. Approximately 13% of all cancers occur in people aged younger than 50 years (American Cancer Society, 2017). Although some cancers and cancer treatments impair fertility, many women with cancer are physically capable of conceiving. Cancer and cancer treatment-associated risks during pregnancy may be avoided by delaying pregnancy until treatment is complete and a woman is in remission (Laurence, Gbolade, Morgan, & Glaser, 2011; Royal College of Gynecologists, 2014). Because unintended pregnancies, including both unwanted pregnancies and those occurring sooner than desired, account for about 45% of all pregnancies in the United States (Finer & Zolna, 2016), investigating unintended pregnancy is imperative among patient populations at heightened risk for health complications. Little is known about unintended pregnancies, abortion, contraception use, and the delivery of contraception counseling in the context of cancer care.

Describing the prevalence of contraception counseling, contraception use, abortion, and unplanned pregnancy will clarify unmet family planning needs among women with cancer. Identifying patient preferences about contraception services is key to delivering evidence-based, patient-centered care (Patient-Centered Outcomes Research Institute, 2013; Spring, 2007). This review investigates the experiences and perspectives of women with cancer

(referring to cisgender women with a current or past cancer diagnosis in childhood or adulthood) relating to pregnancy prevention during the cancer care continuum (encompassing diagnosis, treatment, and survivorship) (Taplin et al., 2012). Thus, the review will address the following research questions:

1. How prevalent are unintended pregnancy and abortion among women with cancer?
2. What are the clinical needs and preferences of women with cancer related to contraception counseling?
3. What contraception methods are women using across the cancer care continuum?

Methods

PubMed and CINAHL were searched for English-language, peer-reviewed articles published in a fifteen year span from January 1, 2000 to October 1, 2015. MeSH (medical subject heading) terms were used in PubMed. Search strings were: ("Neoplasms"[Mesh] or cancer or neoplasm) AND ("Contraception"[Mesh]) AND (patient OR patients OR survivor OR survivors OR survivorship) OR ("Pregnancy, Unwanted"[Mesh] or "unwanted pregnancy") OR ("Pregnancy, Unplanned"[Mesh] or "unplanned pregnancy" or "mistimed pregnancy" or "unintended pregnancy") OR (pregnancy or pregnant) OR ("Reproductive Health"[Mesh]) OR ("Family Planning Services"[Mesh]) OR "sexual health"). The computerized search was supplemented by hand-searches of the reference lists of articles included in the review. After titles and abstracts were selected, full-text articles were reviewed. Inclusion criteria were (a) quantitative and qualitative empirical findings about contraception use, contraception counseling, unintended pregnancy, or induced abortion; (b) sample containing adolescent and premenopausal adult women capable of getting pregnant who were not seeking pregnancy; and (c) sample containing women with past and current cancer diagnosis, including adult and childhood cancers. Reviews, case reports, opinions, guidelines, commentaries, or abstracts of conference presentations were excluded. Reports were excluded if they exclusively described infertility, fertility preservation, sexuality, sexual function, sexual desire, or sexually transmitted infections, which were outside the scope of this review.

No articles were excluded based on quality because the purpose of the study was to describe the state of the science. However, quality and validity considerations are presented by weighing the generalizability and credibility of each study's findings. Results were synthesized by organizing findings in a table, performing thematic analysis, and evaluating patterns across reports. Variation in study design, outcomes collected, and populations sampled precluded meta-analysis, requiring a narrative synthesis approach.

Results

The search strategy produced 657 articles, of which 228 were duplicates and 429 were unique. After titles and abstracts were reviewed, 42 articles remained eligible. The full text of the 42 remaining articles was screened. Twenty-six records were excluded because they were not empirical work; they did not include women with cancer of reproductive age; or

they did not discuss contraception, contraception counseling, unintended pregnancy, or abortion. Sixteen articles were eligible for inclusion. Tables 1 and 2 describe the studies and aspects of study design which may affect quality and validity. Cancer registries from which participants were sampled are summarized in Figure 1.

Prevalence of Unintended Pregnancy and Abortion

No studies captured the overall rate of unintended pregnancy or abortion among women with cancer. Five studies documented the occurrence of unintended pregnancies throughout the cancer care continuum: in the time period between cancer diagnosis and end of treatment (Güth, Huang, Bitzer, Tirri, & Moffat, 2015; Patel et al., 2015), in the years following diagnosis with cancer (Connell, Patterson, & Newman, 2006; Dominick et al., 2015), and five years after diagnosis (Zebrack, Casillas, Nohr, Adams, & Zeltzer, 2015).

Rates of abortion among cancer survivors were compared to healthy control groups in two studies, which demonstrated different patterns of abortion use in American and Danish samples. In an American study, 17% of 4,029 pregnancies reported by 1,915 survivors of childhood cancer ended in abortion, and cancer survivors had abortions at higher rates than healthy siblings (Green et al., 2002). Conversely, in a Danish study, the percentage of pregnancies that ended with abortions was similar among cancer survivors (20%), their healthy siblings (19%), and the general population of Denmark (20%) (Winther, Boice, Svendsen, Frederiksen, & Olsen, 2009). In addition, both studies noted exceptions to the overall patterns. In the United States, survivors of non-Hodgkin lymphoma had fewer abortions than their siblings, and in Denmark, survivors of bone cancer had more abortions than their healthy siblings and the general population. Explaining those trends was outside of the scope of both studies. In the Danish study, more than 92% of abortions occurred in the first trimester, and the small percentage of second trimester abortions was attributed to maternal or fetal health indications by the similar percentages of cancer survivors, sibling controls, and population controls.

Women with cancer discussed their perspectives on abortion in four studies. In a sample of Turkish women diagnosed with breast cancer in the past year, the majority said they would have an abortion if they became pregnant, but a minority said their religious views precluded termination (Karaöz, Aksu, & Küçük, 2010). Eight of 20 American women indicated they would terminate if pregnant during treatment (Patel et al., 2009), and 3 of 5 women with unintended pregnancies in another study did choose to have an abortion (Dominick et al., 2015). One Australian woman with an unintended pregnancy was considering an abortion but did not disclose her final decision to the authors (Connell, Patterson, & Newman, 2006).

Contraception Counseling Needs and Preferences

Contraception during treatment was endorsed as “very important” by 81% of cancer survivors (N = 107) (Maslow et al., 2014). Women acknowledged that they were overloaded with information at diagnosis but contended that they needed the information early to make treatment decisions and that fertility issues became an increasingly high priority over time (Thewes et al., 2005; Thewes, Meiser, Rickard, & Friedlander, 2003). Women expressed uncertainty about the tradeoffs of contraception, fearing that pregnancy and hormonal

contraception threatened their health (Connell, Patterson, & Newman, 2006). In a study of reproductive age Swiss women with breast cancer, the authors calculated that 62 of 100 participants needed contraception counseling at time of cancer diagnosis; women were considered in need of contraception counseling at diagnosis if they were not using a highly effective contraception method or if they were using a method which had potential safety issues for women with cancer (Güth et al., 2015). Approximately 17% of women in an Australian sample (N = 228) never had their question, “What should I do about contraception?” answered during their cancer care (Thewes et al., 2005).

A prominent theme was uncertainty about both ability to conceive and need for contraception. Women with breast cancer expressed frustration about this uncertainty and described fertility as the aspect of cancer treatment least in their control (Thewes et al., 2003). Misconceptions among women with cancer included the belief that women could not get pregnant after cancer treatment (Connell, Patterson, & Newman, 2006; Patel et al., 2009). Despite having no clinical diagnosis of infertility, some women believed they were infertile and, because of that belief, did not use contraception during treatment (Maslow et al., 2014; Zebrack et al., 2004), which led to unintended pregnancy (Zebrack et al., 2004). Some women reported that providers discussed fertility status with them (Zebrack et al., 2004), but pretreatment general counseling about fertility did not diminish risk of unintended pregnancy after controlling for age and desire to parent (Quinn et al., 2014).

Women described discrepancies between the contraception counseling received and desired. Nurses or physicians who specialized in oncology were the most desired source of contraception counseling by Turkish women with breast cancer, who expressed fear of receiving inaccurate information from other sources; however, 8 of these 20 women recalled getting contraceptive counseling from nurses or physicians outside the oncology clinic (Karaöz et al., 2010). An individual consultation with a fertility or menopause specialist was the preferred source among Australian women with breast cancer, most of whom recalled actually getting contraceptive counseling from their oncology team (Thewes et al., 2003; Thewes et al., 2005).

Contraception counseling generally fostered contraception use. Maslow et al. (2014) found that 65% of their sample received contraception counseling, and women who had contraception counseling had almost seven times greater odds of using highly effective methods than women who had no contraception counseling. Dominick et al. (2015) found that 56% of their sample reported receipt of contraception counseling since diagnosis, and users of highly effective contraception methods were more likely to have received family planning counseling than users of less effective methods.

Contraception Methods

At every stage of the cancer care continuum, women were sexually active without desiring to conceive and without using contraception, which equates to a risk for unintended pregnancy. Among women with cancer, use of highly effective contraception methods was sporadic, and highest after an intervention to improve reproductive health service delivery was pilot tested (Patel et al., 2015). In a sample of women with various cancers, 40 of 107 women (37%) affirmed that they were sexually active during treatment, and of those 40 sexually active

women, 6 used no contraception (Maslow et al., 2014). In two studies, women stopped taking estrogen-containing oral contraceptive pills when diagnosed with breast cancer (Güth et al., 2015; Maslow et al., 2014), rendering them unprotected from unintended pregnancy in absence of contraception counseling and initiation of a new method. Of the women surveyed by Patel et al. (2009), 9 of 20 women were sexually active without contraception, but only 4 out of those 9 women desired pregnancy at that time. Klosky et al. (2012) and Klosky et al. (2014) found that 11 of 75 female survivors of childhood cancer (14.6%) reported use of no contraception the last time they had sex, which was not significantly different from the rate reported by their healthy siblings. In another study among survivors of non-gynecological cancers, 58 of 275 women (21%) did not use contraception, despite not desiring pregnancy and having resumed menstruation, which was used as a proxy for fertility (Quinn et al., 2014). When Dominick et al. (2015) compared a cancer survivor sample to the general population as described by the 2006–2010 National Survey for Family Growth, cancer survivors were significantly less likely to use highly effective contraception than women in the general population. Additionally, 10% of survivors were not using contraception while sexually active despite not seeking pregnancy, which was not significantly different but trending higher than the 8% of women in the general population (Dominick et al., 2015). As a point of comparison with more recent analyses, no contraception was used by 10% of sexually active American women ages 15–44 who are not seeking pregnancy, pregnant, postpartum, or non-contraceptively sterile (Guttmacher, 2016). Factors associated with not using contraception included being at risk of emotional discomfort or low self-esteem (Klosky et al., 2014); being partnered (Dominick et al., 2015; Quinn et al., 2014); age, with odds increasing by 7% with each additional year (Quinn et al., 2014); and not having graduated college (Quinn et al., 2014).

Discussion

The data available indicate that women with cancer are not consistently using contraception in alignment with their pregnancy goals, thereby experiencing unintended pregnancy and having an abortion. Misconceptions and confusion about the effect of cancer on fertility are pervasive. Women's uncertainty was not consistently addressed by contraception counseling, and women expressed dissatisfaction with the source and content. The primary implication for practice is that women with cancer or cancer history need more effective family planning service delivery, including contraception counseling and contraception provision.

Using contraception to time pregnancies for periods of better health is highly relevant to women with a recent cancer diagnosis, survivors of cancer in adulthood, and survivors of childhood cancer. Pregnancy during cancer is often possible but rife with uncertainty. Because few large cohort studies or randomized clinical trials have addressed questions about pregnancy during cancer, the available evidence is somewhat limited (Morice, Uzan & Uzan, 2012). Pregnancy does not always directly affect cancer prognosis (Stensheim, Møller, van Dijk, & Fosså, 2009), but cancer treatment options can pose great threats to fetal health and declining treatment can affect recovery. Ionizing radiation used for staging and therapy can cause significant damage to the fetus at 0.1–0.2 Gy; although many conventional radiographic examination techniques deliver less than 0.1 Gy to the fetus, pelvic or abdominal computed tomography can deliver 0.1–0.4 Gy (Kal & Struikmans, 2005). In a

2012 literature review, Amant, Loibl, Neven, and Van Calsteren found that most pregnant women can safely undergo anesthesia and surgery for cancer treatment, but pain can stimulate preterm labor. Breast cancer hormonal therapy with tamoxifen (Nolvadex®) is contraindicated during the first trimester, with some evidence of it being less dangerous later in pregnancy. All chemotherapy is contraindicated for the first 10 weeks gestation, and certain types are contraindicated throughout pregnancy, particularly methotrexate (Trexall®), a well-known abortifacient. Chemotherapy can cause hematopoietic suppression, so women were advised to plan on ending three weeks before delivery to minimize the risks of excessive bleeding and infection at the time of delivery. However, anticipating the delivery date can be challenging since women with cancer are at risk for preterm birth.

Approximately 80% of childhood cancer survivors are achieving a five-year survival (Phillips et al., 2015). However, Oeffinger et al. (2006) found that 73% of survivors of childhood cancer have additional chronic health conditions later in life, and 42% have severe, disabling, life-threatening, or terminal conditions. Contraception can be understood as a valuable tool for timing pregnancies for periods of better health, which also provides women desiring children an opportunity to initiate preconception care and early prenatal care to further optimize fetal outcomes.

Unintended pregnancy should be given more attention in the context of cancer care, given the evidence synthesized in this review, which builds on the body of literature about the prevalence and challenges of unintended pregnancy among women managing other chronic illnesses (Choquet, Du Pasquier, Fediaevsky, & Manfredi, 1997; Chor, Rankin, Harwood, & Handler, 2011; Miauton, Narring, & Michaud, 2003; Suris & Parera, 2005; Suris, Resnick, Cassuto, & Blum, 1996). Recognition is increasing that reproductive health issues are amenable to intervention in the time from cancer diagnosis and treatment as well as later in survivorship. Multiple studies indicate the vast majority of the women of reproductive age want to have children in the future (Gonçalves, Sehovic, & Quinn, 2013; Salem et al., 2013; Schover, Rybicki, Martin, & Bringelesen, 1999), and the American Society of Clinical Oncology (ASCO) recommends that women diagnosed with cancer receive fertility preservation before treatment (Loren et al., 2013). Like fertility preservation, contraception counseling is time sensitive; unintended pregnancies during active cancer management can complicate and limit treatment options. Nurses can deliver more patient-centered care by initiating conversations about pregnancy during cancer and then providing support, education, and resources based on women's clinical factors, reproductive goals, and contraception preferences. Nurses seeking to improve their understanding of these issues may use resources listed in Figure 2. One resource specifically designed to provide nurses is Enriching Communication Skills for Health Professionals in Oncofertility, an eight-week online training about the information and counseling skills needed to fulfill the ASCO recommendations for reproductive health care (Vadaparampil et al., 2016).

Limitations

The findings are fragmented because the studies vary by size, rigor, sample, setting, and focus. The 2000–2015 time frame was used to increase the number of studies eligible for inclusion, but consequently some of the research is dated. Comparing rates of contraception

use or unintended pregnancy was challenging because the denominator – number of women potentially at risk of unintended pregnancy – is not determined in a standardized way. Some studies only included women who were menstruating, but this excludes women who have not yet menstruated but might get pregnant with the first ovulation and fails to exclude women who have occult ovarian failure while menstruating. Other studies did not document pregnancy intentions, masking desire or ambivalence that can influence contraception choices. Contraception survey questions like, “used method to prevent pregnancy or sexually transmitted disease at last intercourse” or “pregnancy prevention at last intercourse” are commonly asked of youth, but do not capture long-term use, and more effective contraception methods were not distinguished from less effective methods (Klosky et al., 2012; Klosky et al., 2014). However, this review shows the current state of knowledge, which can be difficult to extract from the scholarly literature because so much discourse around contraception and cancer concerns whether contraception causes cancer, not the management of pregnancy and fertility.

Conclusion

This systematic review identifies a problem in cancer management. Women with cancer are receiving inadequate contraception services and experiencing unintended pregnancies. When women are consistently using contraception through the cancer care continuum, they can avail themselves of more cancer treatment options and can pursue their reproductive life plans while managing their health. Improving reproductive healthcare for women with cancer has potential to improve cancer management and survivorship care.

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BASEL BREAST CANCER DATABASE (BBCD)

The BBCD contains health records about newly diagnosed primary invasive breast cancer diagnosed at the University Women’s Hospital in Basel, Switzerland, since 1990.

- www.baselbc.org

CALIFORNIA CANCER REGISTRY (CCR)

The CCR is run by the California Department of Public Health’s Chronic Disease Surveillance and Research Branch, to whom all new cancer diagnoses in the state have been reported since 1988, by law. Demographic, diagnostic, and treatment information on individual cancer cases is extracted from medical reports.

- www.ccrca.org

CHILDHOOD CANCER SURVIVORS STUDY (CCSS)

The CCSS registry contains survivors, diagnosed when they were aged younger than 21 years from January 1, 1970, to December 31, 1986, of central nervous system cancer, Hodgkin lymphoma, non-Hodgkin lymphoma, kidney cancer (Wilms tumor), neuroblastoma, soft tissue sarcoma, and bone cancer.

- www.ccss.stjude.org

CHILDREN’S ONCOLOGY GROUP (COG)

COG, formerly the Children’s Cancer Group, is a consortium of more than 200 centers in Australia, Canada, New Zealand, and the United States that conducts treatment and research on childhood cancers, including hematologic malignancies, solid tumors, central nervous system tumors, and rare cancers.

- www.childrensoncologygroup.org

DANISH CANCER REGISTRY (DCR)

The DCR was founded in 1943 and has been run by the National Board of Health since 1997. Providers are mandated to report all new cancer diagnoses.

- <http://bit.ly/2mno7Y>

FIGURE 1.
CANCER REGISTRIES FOR CONTRACEPTION COUNSELING, CONTRACEPTION USE, UNPLANNED PREGNANCY, AND ABORTION

TRAINING FOR PROVIDERS

ECHO (Enriching Communication Skills for Health Professionals in Oncofertility): An eight-week online training program for allied health professions (social workers, psychologists, physician assistants, and nurses)

- www.rhoinsitute.org/echo/the-program

Earn continuing nursing education: Current evidence supporting fertility and pregnancy among young survivors of breast cancer

- Meneses & Holland, 2014

RESOURCES FOR PROVIDERS

U.S. medical eligibility criteria for contraceptive use

- www.cdc.gov/mmwr/volumes/65/rr/rr6503a1.htm

Discussing safe sexual practices during cancer treatment

- Kelvin, Steed, & Jarrett, 2014

Contraception and cancer treatment in young persons

- Laurence & Rousset-Jablonski, 2012

Oncococontraception

- Patel et al., 2014

Cancer and contraception

- Patel & Schwarz, 2012

RESOURCES FOR PATIENTS

American Cancer Society: Sexuality for the woman with cancer

- <http://bit.ly/1rTICty>

Bedsider: How to talk doctor

- <https://bedsider.org/features/172-how-to-talk-doctor>

National Cancer Institute: Sexuality and fertility problems (women)

- <http://bit.ly/2mprYFc>

FIGURE 2.
RESOURCES ABOUT CONTRACEPTION AND FEMALE SEXUALITY

TABLE 1

QUALITATIVE STUDIES ABOUT CONTRACEPTION COUNSELING, CONTRACEPTION USE, UNINTENDED PREGNANCY, AND ABORTION AMONG WOMEN WITH CANCER

| Study | Design | Sample | Diagnosis | Quality and validity |
|-----------------------|---|---|---|---|
| Connell, et al., 2006 | Longitudinal; three face-to-face semistructured interviews 60 minutes long and six months apart. | 13 women aged 29–40 years with a mean age of 37 years; purposeful sample; Australia | Breast cancer diagnosed within the past four years | Reflexivity via field notes; multiple coders; 83–90% inter-rater reliability with spot checks; confirmed interpretation with participants |
| Karaöz, et al., 2010 | Single face-to-face, semi-structured interviews. 25–35 minutes long | 20 women; average age of 40.2 years (SD = 5.2 years); convenience sampling; Aydin, Turkey | Breast cancer diagnosed within the past year | Interview guide pilot tested |
| Thewes et al., 2003 | Four face-to-face focus groups of four women each (N=16) for 90 minutes; semistructured interviews by phone and written questionnaire with one question (N=8) | 24 women aged 26–45 years at time of diagnosis with a mean age of 34 years; convenience sample; Sydney, Australia | Breast cancer diagnosed within the past five years | Reflexivity via field notes; 66% participation rate; confirmed interpretation with participants |
| Zebrack et al., 2004 | Telephone semistructured interviews 90 minutes long | 14 women aged 19–37 years with a mean age of 24.2 years; convenience sample; recruited from the Children's Cancer Group; California | Childhood cancer survivors at least five years from diagnosis | Multiple coders; 90% inter-rater reliability |

TABLE 2

QUANTITATIVE STUDIES ABOUT CONTRACEPTION COUNSELING, CONTRACEPTION USE, UNINTENDED PREGNANCY, AND ABORTION AMONG WOMEN WITH CANCER

| Study | Design | Sample | Diagnosis | Quality and validity |
|-----------------------|---|---|--|--|
| Dominick et al., 2015 | Secondary analysis of online or telephone survey | 289 women aged 20–44 years with a mean age of 31.6 years; United States | Any diagnosis, breast cancer most common; mean time since diagnosis = 2.4 years | 85% response rate in original study |
| Green et al., 2002 | Online survey | 1915 women; cohort sample from CCSS registry; random sample of survivor siblings; United States and Canada | Childhood cancer survivors at least five years from diagnosis | 70% response rate from survivors; 44% response rate from siblings |
| Guth et al., 2015 | Secondary analysis of database records | 100 women aged 26–40 years with a mean age of 35.9 years; sample from BBCD of women diagnosed between 1990–2007; Switzerland | Breast cancer; at diagnosis | |
| Klosky et al., 2012 | Mailed survey | 184 women aged 15–20 years with a mean age of 18.1 years; cohort sample from CCSS; random sample of survivor siblings aged from 14–20 years; United States and Canada | Childhood cancer survivors at least five years from diagnosis | 68% response rate from survivors and 51% from siblings; sibling controls randomly selected; instrument (CHIP-AE): Cronbach alpha for questions about “Risk-Individual (with sex questions)” = 0.78–0.8 |
| Klosky et al., 2014 | Secondary analysis of data gathered in Klosky et al, 2012 | | | |
| Maslow et al., 2014 | Survey | 107 women aged 18–45 years; sample from a large tertiary health care system; United States | Any cancer diagnosed within last 5 years | |
| Patel et al., 2009 | Face-to-face reproductive health survey and demographics through EHRs | 20 women aged 15–44 years; convenience sample; Chicago, Illinois | Any cancer, 90% breast cancer | |
| Patel et al., 2015 | Prospective observational pilot study of an original clinical algorithm; face-to-face reproductive health assessment and blood sample every 3 months for 24 months. | 11 women aged 23–48 years with a mean age of 39 years; convenience sample; Chicago, Illinois | Breast cancer diagnosed within last three months | No controls |
| Quinn et al., 2014 | Online or mailed questionnaire | 476 non-sterile women with menstrual bleeding; average age = 41.3 (SD = 8.4 years); randomly sampled from California Cancer Registry | Breast cancer, leukemia, gastrointestinal cancer, Hodgkin lymphoma, non Hodgkin lymphoma, other nongynecologic cancers; diagnosed from age 19–40 years | 41% response rate |
| Thewes et al., 2005 | Mailed questionnaire | 288 women aged 20–40 years with a mean age of 35.3 years at diagnosis; cohort sampling; Australia | Breast cancer diagnosed within the past 6–60 months | 83% response rate |

| Study | Design | Sample | Diagnosis | Quality and validity |
|----------------------|----------------|--|--|--|
| Winther et al., 2009 | Record linkage | 1688 women; cohort sampling from the Danish Cancer Registry; Denmark | Childhood cancer survivors born between 1950–1984; diagnosed before age 20 years, with pregnancies between 1977–2003 | Siblings controls; general population controls |

BBCD – Basel Breast Cancer Database; CCSS – Childhood Cancer Survivors Study; CHIP-AE – Child Health and Illness Profile - Adolescent Edition; EHR– electronic health records

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