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ONCOFERTILITY AS AN OPPORTUNITY FOR CANCER PATIENTS TO HAVE CHILDREN – A LITERATURE REVIEW

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ABSTRACT

Background: Oncofertility is a field that combines specialisations in oncology and reproductive medicine. Fertility preservation methods should be presented to the patient before the start of cancer treatment. Proposals should be tailored to the patient's age, gender, type of cancer and future treatment.

Aim: This review aims to present a comprehensive overview of the impact of cancer treatment on the gonads and methods of fertility preservation after cancer treatment.

Material and Methods: An in-depth literature review was performed using PubMed, Google Scholar and ScienceDirect, including keywords such as: 'oncofertility', 'oncology', 'cancer', 'gynaecological cancers', 'methods of fertility preservation', "chemotherapy" and 'cancer treatment'.

Results: Fertility preservation methods vary depending on gender and age. In women, we can use oocyte, embryo and ovarian tissue fragment freezing, hormonal suppression and oophorectomy. Research is ongoing to increase the range of methods offered, including uterine transposition, in vitro maturation, in vitro gametogenesis, uterine transplantation, and artificial ovaries. For male patients, options include ejaculate freezing, testicular tissue freezing, or hypothalamic-pituitary axis suppression. For patients before puberty, the only option for preserving fertility is to freeze fragments of the gonads.

Conclusion: The number of cancer diagnoses is increasing. Patients should be informed about all possible options for preserving fertility. Further research is needed to increase the options for having children for patients after cancer treatment.

KEYWORDS

Oncofertility, Oncology, Reproductive Medicine, Cancer Treatment, Fertility Preservation Methods

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Introduction

Cancer is the second leading cause of death worldwide. The number of diagnosed patients is increasing every year. According to official forecasts published by the International Agency for Research on Cancer (IARC), the number of new cancer cases is expected to rise to approximately 30 million per year by 2040. [1] The WHO estimates that at least 30-50% of cancers can be prevented through appropriate prevention and lifestyle changes. (World Health Organization.2025) Cancer affects all age groups, but different types of cancer predominate in each group. (Table 1) (Didkowska, J. et al.2022) They are most common in older people, which may be associated with the accumulation of risk factors and a decrease in cell repair efficiency. (Pilleron, S. et al. 2021) People of reproductive age and children account for about 10% of all cancer patients. Thanks to advances in medicine, cancer treatment does not necessarily mean a loss of reproductive capacity. (Cancer Research UK. 2024)

Oncofertility is a term coined in 2006 by Dr Teresa Woodruff. It is a field of medicine that combines oncology with reproductive medicine, and its main goal is to preserve fertility in people who will undergo cancer treatment (chemotherapy, radiotherapy). It is important to discuss all treatment options and their foreseeable effects with the patient. Unfortunately, knowledge about oncofertility is uneven around the world. In developed countries, such as the US and Western Europe, access to fertility preservation methods is relatively widespread, but in developing countries, i.e. regions of Africa, Asia and South America, access is difficult due to a lack of funds or trained personnel. (Grover, S. R. 2025)

Table 1. Incidence of cancer in different age groups.

Age group	Predominant types of cancer
0-14	ALL, brain and CNS tumours, neuroblastoma, Ewing's sarcoma, Wilms' tumour
15-39	Lymphomas (Hodgkin's, non-Hodgkin's), melanoma, seminoma, leukaemia
40-64	Breast cancer, lung cancer, colorectal cancer, prostate cancer, cervical cancer

Materials and Methods

In April 2025, a comprehensive literature review was conducted using PubMed, Google Scholar, and ScienceDirect. The authors searched the databases using the keywords 'oncofertility,' 'oncology,' 'cancer,' 'gynaecological cancers,' 'methods of fertility preservation,' 'chemotherapy,' and 'cancer treatment.' Relevant articles in English were selected after evaluating their titles, abstracts, and full texts. The review included original articles and review articles on oncofertility.

Discussion

The diagnosis of cancer itself is one of the factors contributing to infertility. It is important to make a decision about preserving fertility as soon as possible after receiving information about the disease.

1. Patients

Oncofertility concerns people affected by cancer who may lose their ability to have children as a result of cancer treatment. Depending on the patient's age, they may receive various proposals for preserving their fertility.

Children and adolescents.

Assessing biological maturity is important in order to select the appropriate fertility preservation technique for the patient. For pre-pubertal children, there are fewer options than for post-pubertal children. For girls before puberty, the only option is ovarian tissue cryopreservation. A detailed interview with the patient and their guardian should be conducted, along with a physical examination to assess the development of secondary sexual characteristics using the Tanner scale. (Marques, R. et al. 2022)

Young adults.

The largest group covered by oncofertility programmes. This includes people of reproductive age who do not yet have children.

Adults.

Nowadays, the decision to become a parent is being postponed to a later stage in life. It is worth remembering that with age, the risk of female infertility increases due to a decrease in ovarian reserve, and male infertility due to a decline in sperm quality and parameters. Older patients also have a higher risk of obstetric failure. (Steinberg, B. et al. 2022)

Patients with genetic cancers.

This group includes patients with gene mutations that may impair their ability to reproduce, as well as patients who are scheduled for preventive organ removal surgery. In carriers of the BRCA1 and BRCA2 mutations, which significantly increase the risk of breast and ovarian cancer, the ovarian reserve may be reduced, which is associated with faster depletion of the ovarian cell pool and earlier onset of menopause. (Chan, J. L., et al. 2017). Prophylactic removal of the ovaries and fallopian tubes is often planned for carriers. It is also important to take care of the mental health of these patients, who have many concerns about future motherhood, which can lead to a reduced quality of life and depression. (Di Nisio, V., et al. 2024)

2. Therapeutic options in cancer treatment.

The treatment method is selected depending on the type, stage and location of the cancer. The patient's general health is also important.

Chemotherapy.

One of the main methods of cancer treatment, several types of cytostatic drugs are used, which target rapidly dividing cells – such cells are abundant in human gonads. The gonadotoxicity of chemotherapeutic agents depends on their type, dosage and the initial condition of the gonads. (Marques, R. et al. 2022) Drugs used in chemotherapy are divided into groups, e.g. alkylating agents, antimetabolites, topoisomerase inhibitors, anthracyclines. They are characterised by varying degrees of toxicity to the gonads, from high (doxorubicin, dacarbazine) to moderate (vinblastine, cisplatin) to low (methotrexate, 5-fluorouracil). (Coker Appiah, L., et al. 2021) In male patients undergoing chemotherapy, damage to the seminiferous epithelium and a decrease in testosterone occur, resulting in damage to Leydig cells. (Suzuki, Y., et al. 2025) In women, the effects of chemotherapy can vary on the endometrium and uterine muscle. However, compared to the endometrium, which can be easily sampled and examined, there is insufficient research on how chemotherapeutics affect the myometrium. (Chemerinski, A., & Morelli, S. S. 2022).

Radiotherapy.

In men, ionising radiation can damage spermatogenesis, i.e. the process of sperm production in the testicles. This treatment option affects every characteristic of male ejaculate, including sperm count, motility and quality. (Fukunaga, H., et al. 2022) The table below (Table 2) shows the effects on fertility depending on the radiation dose, based on the article by De Felice et al. 'Radiation effects on male fertility'. (De Felice, F., et al. 2019)

Table 2. Effect of radiation dose on spermatogenesis.

Radiation dose	Effect on spermatogenesis
0,1-0,2 Gy	short-term reduction in sperm count
0,3-0,5 Gy	inhibition of spermatogonia division, decrease in sperm count, return to normal within a few months
0,5-1 Gy	significant inhibition of spermatogenesis, decrease in sperm count and motility, return to normal after 12–18 months
2-3 Gy	damage to spermatogonia, risk of oligozoospermia/azoospermia for several years
4-6 Gy	permanent azoospermia in most men
>6 Gy	irreversible loss of fertility

Radiotherapy in women has a very different effect on the ovaries and uterus, depending on the site of irradiation. Radiotherapy can damage the ovaries, the degree of damage depending on the radiation dose administered – oocytes are impaired at doses of 1-5 Gy. (Łubik-Lejawka, D., et al. 2024) In young patients, before puberty, a higher dose of ionising radiation can cause damage to the reproductive organs compared to older patients. (Onkologia-Dziecięca.pl, 2018) The risk of premature ovarian failure increases with age and the dose of radiation received. (Wallace, W. H., et al. 2005) Radiotherapy may also cause fibrosis of the uterine muscle, which may hinder future embryo implantation and cause difficulties in carrying a pregnancy to term. (Marques, R. et al. 2022, Coker Appiah, L., et al. 2021)

Hormone therapy.

Used in hormone-dependent cancers – endometrial, breast, prostate and some testicular gonadal tumours. In addition, GnRH agonists (goserelin) are used during chemotherapy to suppress ovarian function, thereby reducing the risk of premature ovarian failure in women. (Alesi, L. R., et al 2023) Early endometrial cancer can be treated with progestogens, and in women under 40 years of age, results comparable to hysterectomy can be achieved. (Suzuki, Y., et al. 2025) In men, hormone therapy can lead to a decrease in testosterone levels and inhibition of spermatogenesis, which is associated with a decrease in ejaculate quality. (Crosnoe, L. E., et al. 2013)

Immunotherapy.

This type of treatment uses immune checkpoint inhibitors (ICI) – PD-1/PD-L1 inhibitors and CTLA-4 inhibitors. The toxic effects on fertility are poorly understood. (Marques, R. et al. 2022) However, there are indications of an impact on gonadal function through two mechanisms, primary or secondary hypogonadism, but the actual impact of their action is unknown. (Silvestris, E., et al. 2024)

Surgery.

During cancer treatment, in addition to complete organ removal, in some cases, sparing surgery may be used. In patients with small testicular tumours, tumours in one testicle, testicular sparing surgery (TSS) may be used. During the operation, a histopathological examination should be performed and an adequate margin of healthy tissue should be preserved. It is worth noting that during pelvic surgery, the nerves responsible for erection and ejaculation may be damaged. (Djaladat, H. 2015).[24] Thanks to limited excision, there may be a lower risk of fertility disorders and greater sexual comfort for patients. In patients with early cervical cancer, the cervix can be removed while preserving the body of the uterus, as a result of which the patient retains the ability to develop a normal pregnancy. (Salman, L., & Covens, A. 2024)

3. Methods of fertility preservation.

Currently, there are many methods that can be used in the process of fertility preservation. The choice of option depends on gender and stage of maturation. There are many more options for preserving female fertility. (Table 3)

Options for females.

Cryopreservation of oocytes and embryos.

This is possible for patients who do not need to undergo treatment immediately after diagnosis, have a partner or want to use donor ejaculate. One cycle of hormonal stimulation of the ovaries for approx. 10-14 days is necessary. Gonadotropins, GnRH analogues, hCG, aromatase inhibitors (Letrozole), progesterone and oestrogens are used for stimulation. (Ovarian Stimulation TEGGO, Bosch, E., et al. 2020) As a result, several mature oocytes are obtained, which are retrieved with a needle via vaginal access under ultrasound guidance. Ovarian puncture is performed under short intravenous anaesthesia. (Di Nisio, V., et al 2024) The preservation of oocytes remains the main goal of the oncofertility strategy, enabling the preservation of reproductive capacity after cancer treatment.

Inhibition of ovarian function.

The use of GnRH agonists, which induce temporary menopause and protect ovarian follicles from the toxic effects of anticancer therapy, e.g. chemotherapy. GnRH agonists lead to desensitisation of the pituitary gland and a reduction in LH and FSH levels through negative feedback, resulting in ovarian suppression. Studies show that this method may increase the chance of resuming regular menstrual cycles and restoring normal ovarian function. (Roof, K. A., 2024)

Ovarian tissue cryopreservation (OTC).

A major advantage of this method is that it is the only option used in prepubertal girls. (Jach, R., et al 2021) In adults, ovarian tissue is harvested when ovarian stimulation for oocyte retrieval or postponement of treatment poses a risk to the patient. There are two cryopreservation techniques: slow freezing, a traditional method, less technically complex but with a higher risk of cell damage, and vitrification, which involves rapid freezing of tissue using high concentrations of cryoprotectants. (Ramirez, T., & Pavone, M. 2024)

Oophoropexy (ovarian transposition).

This method is recommended for patients undergoing radiotherapy, as the ovaries are very sensitive to radiation. It involves moving the ovaries from the pelvis to a location less exposed to ionising radiation. The procedure is most often performed laparoscopically, typically moving the ovaries above the hip plate, along the lateral wall of the abdominal cavity. The best results are achieved in patients under 40 years of age. (Turkgeldi, L., et al. 2019) Thanks to the relocation of the ovaries, they are exposed to less than 2-3 Gy, which allows them to maintain their hormonal function. (Donovan, E. K., et al. 2022)

Uterine Transposition.

Another method of preserving fertility, recommended for patients undergoing pelvic radiotherapy, but not yet widely used. It involves moving the uterus above the pelvic cavity and immobilising it, which allows menstruation to continue. Thanks to this method, the patient is more likely to carry a pregnancy to term after pelvic radiotherapy. (Ribeiro, R., et al. 2023)

In Vitro Maturation (IVM).

An experimental method performed on women who cannot delay the start of cancer treatment. It involves collecting immature oocytes, which are brought to maturity before being frozen. (McClam, M., & Xiao, S. 2022)

In Vitro Gametogenesis (IVG).

The possibility of restoring fertility in patients undergoing cancer treatment who have lost their ability to reproduce as a result. It involves the creation of oocytes and spermatocytes in vitro from somatic cells, e.g. skin fibroblasts collected by biopsy. (Wesevich, V. G., et al. 2023) At this point, this option has many technical, ethical and safety limitations and is not used.

Uterine transplantation.

Mentioned in the literature as an experimental option for urgent hysterectomy due to endometrial cancer. (Di Nisio, V., et al. 2024) In a systematic review conducted by Tsarna E. et al., out of 701 women applying for transplantation, 60 were patients with gynaecological cancers, accounting for 8.6% of applicants. The results indicate the potential effectiveness of this procedure, although it requires further research and development. (Tsarna, E., et al. 2024)

Artificial ovaries – innovative technology.

Work is underway on artificial ovaries, a technology that will involve culturing follicles in three-dimensional structures and bioengineering approaches to replace removed tissue. (Gupta, D., et al. 2023) The standard method of freezing ovarian tissue and transplanting it after treatment may cause a recurrence of cancer through the reintroduction of cancer cells. An artificial ovary would enable the safe restoration of reproductive and hormonal capacity without the risk of cancer recurrence. (Varlas, V. N., et al. 2023)

Options for males.

Sperm cryopreservation.

The most standard method for preserving male fertility. It involves freezing sperm before treatment begins and is considered the best preventive option. (Abram McBride, J., & Lipshultz, L. I. 2018) This method is used for boys who have reached stage 3 on the Tanner scale and have a testicular volume of 10-12 ml. A semen sample can be obtained through masturbation or vibratory stimulation of the penis in children. (Marques, R., et al. 2022)

Testicular tissue cryopreservation (TTC).

An experimental method of fertility preservation. Considered in boys who cannot provide a semen sample before puberty. (Williams, D. H., IV. 2013). It involves taking a piece of testicular tissue and cryopreserving it. (Picton, H. M., 2025)

Hormonal suppression.

It works on the same principle as ovarian suppression in women. After administration of GnRH agonists, which stimulate the pituitary gland to produce large amounts of gonadotropic hormones (FSH, LH), these lead to receptor desensitisation. The result of this process is the suppression of testosterone production and the inhibition of sperm maturation. In a study conducted by Salama M et al., the method is described as experimental. The use of GnRH agonists is more common in countries with greater financial resources and more experienced specialists. (Salama, M., et al. 2023)

Table 3. Methods of fertility preservation depending on gender.
Methods of fertility preservation commonly used are marked in green,
while experimental methods are marked in red.

Women	Men
Oocyte cryopreservation	Sperm cryopreservation
Embryo cryopreservation	Cryopreservation of testicular tissue
Ovarian suppression	Hormonal suppression
Cryopreservation of ovarian tissue	
Oophoropexy	
Uterine transposition	
In Vitro Maturation	
In Vitro Gametogenesis	
Uterine transplantation	
Artificial ovaries	

4. Psychological care for cancer patients.

A very important aspect of cancer treatment is ensuring that each patient receives appropriate psychological care. Psycho-oncological support should be an integral part of cancer therapy. (Stiefel, F., et al. 2023) A cancer diagnosis causes a high level of anxiety, which can lead to adjustment disorders and depression. The news of cancer received by patients of reproductive age may cause additional stress related to the possibility of losing fertility.

A clinical study by Koizumi et al. demonstrated the positive effects of a two-session psychoeducational programme conducted in pairs (Oncofertility! PsychoEducation and Couple Enrichment- O!PEACE). This resulted in a reduction in PTSD symptoms in women with breast cancer, and their partners showed improved stress management and communication skills and were more supportive of their sick partners. (Koizumi, T., et al. 2023)

In the field of oncofertility, there is the concept of a patient navigator, who is a specialist coordinating the patient's path between doctors: an oncologist and a fertility specialist. They support the patient and their family in making informed decisions and inform them about the possible effects of treatment. However, further research into this role is needed to improve access to reproductive care specialists for oncology patients of reproductive age. (Whiteside, S. L., et al. 2023)

Conclusions

The number of cancer cases is increasing every year. Thanks to the development of oncofertility, cancer patients have access to methods that allow them to preserve their fertility. All available methods should be discussed with a specialist before starting treatment. Proposals should be tailored to the patient's age, gender, type of cancer and future treatment.

Cancer treatments such as chemotherapy and radiotherapy have a gonadotoxic effect, which can cause infertility, premature menopause in women and negative psychological effects. Fertility preservation methods are limited for patients who have not yet reached puberty; in this case, ovarian or testicular tissue freezing should be chosen. There is a need for further research into expanding fertility preservation options for cancer patients. Psychological therapy should be one of the components of cancer treatment.

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