



Health Physics Society
Specialists in Radiation Safety

Radiation Exposure and Pregnancy



Photo courtesy of Steve Sugarman

The birth of a child is a life-changing experience. It is hard to prepare yourself for the joys—and yes, anxieties—of pregnancy and the subsequent raising of your child. It can be a truly joyful, yet uncertain, experience. During this journey, the time may come when a health care professional advises you to undergo a medical procedure that you perceive puts your unborn baby at risk. The information in this fact sheet is intended to help answer the question “Does a medical procedure involving radiation during pregnancy increase my baby’s health risks?” The short answer is that it is exceedingly rare that a medical procedure involving radiation would cause harm to your baby. This fact sheet

will provide general information about radiation exposure during pregnancy and references for further reading. Also available is a short video covering the highlights of this paper:

<https://www.youtube.com/watch?v=y2JqkFGKU40>.

Everyone is exposed to radiation. According to the National Council on Radiation Protection and Measurements (NCRP) Report No. 160 (NCRP 2009), the average annual radiation dose to a member of the US population due to natural background radiation is about 3.1 millisieverts* (mSv). But of course, there is a large degree of variability in this number across the United States. For example, about 2.5 million of the 300 million people living in the United States receive annual background doses in excess of 20 mSv. Naturally occurring radioactive materials are found in the foods we eat, such as potassium-40 (⁴⁰K) in bananas. Naturally occurring uranium and thorium may be found in building materials such as brick and concrete. We also get a constant external dose from radionuclides in the ground (terrestrial sources) and from the radiation that arrives from outer space and the sun. While it is not possible to avoid exposure to ionizing radiation, there is good news: our bodies and, indeed, all life on earth have evolved to live in an environment with radiation.

In addition to unavoidable background radiation, one may be exposed to radiation from medical procedures such as nuclear medicine scans or medical x rays. If you are, or think there is a possibility that you may be, pregnant and are told you need a diagnostic or therapeutic procedure involving radiation or radioactive materials, you should discuss possible radiation risks with your health care provider prior to the procedure.

* Units of millisieverts are used to describe absorbed dose and equivalent dose to improve ease in reading and comprehending the information.

It must be remembered, however, that pregnancy in itself has inherent risks and the background risk of a negative outcome exists. Every healthy woman without a personal or family history of reproductive or developmental problems begins her pregnancy with a 3% risk for birth defects such as major congenital malformation ([NCRP 2013](#)), 4% risk of minor congenital abnormalities ([NCRP 2013](#)), 4% risk of intrauterine growth retardation ([ICRP 2000](#)), 4–10% risk of incidence of genetic abnormalities ([ICRP 2000](#)), and 15% risk for miscarriage ([Marx 2018](#)). These are background risks for all healthy pregnant women.

A number of studies of women exposed to radiation before becoming pregnant and during pregnancy have been performed on atomic bomb survivors from Hiroshima and Nagasaki as well as on pregnant women who received x-ray exams, radionuclide medical tests, and other medical procedures. Since the discovery of x rays over a century ago, the number of women exposed to medical radiation has increased dramatically while the rate of birth defects and miscarriages has changed very little. Low doses of radiation, those that would typically be expected during a medical imaging procedure, are not linked to an increase in birth defects or miscarriages. In addition, radiation-induced genetic effects, that is, genetic mutations from radiation exposure of the parent which are passed to the child, have not been seen to date in humans.

Potential radiation effects vary depending on the stage of fetal development and on the amount of the radiation doses received ([ICRP 2003](#); [McCullough et al. 2007](#)). It is known that the developing fetus is more sensitive to radiation than the mother, based primarily on mammalian animal studies ([NCRP 2013](#)). According to NCRP Report No. 174 ([NCRP 2013](#)), doses below 100 mSv should not increase the risk of reproductive effects (birth defects or miscarriage). As a pregnancy progresses, the dose needed to cause harm to the fetus increases, until about 20 weeks into the pregnancy. After 20 weeks, the dose associated with harm to the fetus remains about the same throughout the rest of the pregnancy. While it is true that

More questions and answers about radiation and pregnancy can be found on the Health Physics Society "[Ask the Experts](#)" Web site.

elevated radiation doses can result in fetal abnormalities, it is rare that fetal dose levels of this order are encountered in the medical setting. Radiation doses to a fetus tend to be lower than the dose to the mother, due to protection from the uterus and surrounding tissues ([CDC 2019](#)).

If during your pregnancy you are considering having an abdominal/pelvic x ray or computed tomography (CT) exam, nuclear medicine test, or any type of radiation therapy, talk

with your physician or obstetrician, as certain medical procedures may give doses potentially resulting in an increased risk ([ACR/RSNA 2017](#)). Your doctor may consult with a qualified physicist, radiologist, oncologist, or nuclear medicine physician (depending on the type of procedure) to determine the best treatment option. Your doctor will help you understand whether any potential increased risk is significant. If there is a considerable risk, the physician should discuss with you whether the procedures may be delayed until after the child is born or whether another medical procedure, such as an ultrasound or magnetic resonance imaging (MRI) exam, could be used instead ([RSNA 2017](#)). If you are in a life-or-death situation, your physician will determine which procedures are appropriate (with your input if you are able to discuss it).

According to the American College of Radiology and the Radiological Society of North America, if the abdomen or pelvis is not being imaged (such as in a chest or head CT scan), radiation-related concerns for the baby are minimized. Very few individual diagnostic x-ray procedures will result in doses exceeding the 100 mSv threshold ([ACR/RSNA 2017](#)).

Nuclear medicine procedures involve radioactive materials that are introduced into the body. Radioactivity in a pregnant woman's urine or intestines could give a moderate dose to the fetus, and some compounds can cross the placenta as well. Once the baby is born, a woman who chooses to breast-feed

may have to stop breast-feeding for a period of time after receiving a radiopharmaceutical for a nuclear medicine exam. The nuclear medicine staff should provide information to pregnant women regarding potential fetal doses, as well as to breast-feeding mothers when they need to interrupt breast-feeding.

If you discover you are pregnant after you have had a test or treatment that causes you concern, you should consult with the doctor who ordered the test. If the doctor does not know the information, he or she should consult with a medical physicist or health physicist to estimate the radiation dose to your fetus. The calculated radiation dose and developmental stage of your fetus will help the medical team determine the potential health risks. This information should be shared with your personal physician.

According to the International Commission on Radiological Protection (ICRP), “*The interruption of pregnancy is rarely justified because of radiation risk to the embryo or fetus from a radiologic examination.*” In addition, the ICRP states, “*Prenatal doses from most properly done diagnostic procedures present no measurably increased risk of prenatal death, malformation, or impairment of mental development over the background incidence of these entities.*” ([ICRP 2000](#))

The bottom line is that a medical procedure involving radiation is unlikely to have a negative impact on your developing fetus ([McCullough et al. 2007](#)). If you are pregnant and medical procedures involving radiation or radioactive materials are scheduled, always inform the person performing the exam that you are pregnant. If you are concerned about radiation exposure during pregnancy, discuss those concerns with your physician. Your doctor has access to radiation professionals, including members of the Health Physics Society, who can help gather and interpret the information you need to make the best decision for your situation.

References

- American College of Radiology/Radiological Society of North America. Computer tomography (CT) safety during pregnancy [online]. April 2017. Available at <https://www.radiologyinfo.org/en/info/safety-ct-pregnancy>. Accessed 31 March 2022.
- Centers for Disease Control and Prevention. Radiation and pregnancy: a fact sheet for clinicians [online]. 2019. Available at <https://www.cdc.gov/nceh/radiation/emergencies/prenatalphysician.htm>. Accessed 31 March 2022.
- International Commission on Radiological Protection. Pregnancy and medical radiation [online]. Oxford: Pergamon Press; ICRP Publication 84; 2000. Available at <https://www.icrp.org/publication.asp?id=icrp%20publication%2084>. Accessed 31 March 2022.
- International Commission on Radiological Protection. Biological effects after prenatal irradiation [online]. Oxford: Pergamon Press; ICRP Publication 90; 2003. Available at https://journals.sagepub.com/doi/pdf/10.1177/ANIB_33_1-2. Accessed 31 March 2022.
- Marx MV. Baby on board: managing occupational radiation exposure during pregnancy. *Tech Vasc Interv Radiol* 21(1):32–36 [online]; 2018. Available at <https://pubmed.ncbi.nlm.nih.gov/29471998/>. Accessed 31 March 2022.
- McCullough CH, Schueler BA, Atwell TD, Braun NN, Regner DM, Brown DL, LeRoy AJ. Radiation exposure and pregnancy: when should we be concerned? *Radiographics* 27(4):909–917 [online]; 2007. Available at <https://pubs.rsna.org/doi/10.1148/rg.274065149>. Accessed 31 March 2022.
- National Council on Radiation Protection and Measurements. Ionizing radiation exposure of the population of the United States [online]. Bethesda, MD: NCRP; NCRP Report No. 160; 2009. Available at <https://ncrponline.org/publications/reports/ncrp-report-160-2/>. Accessed 31 March 2022.

National Council on Radiation Protection and Measurements. Preconception and prenatal radiation exposure: health effects and protective guidance [online]. Bethesda, MD: NCRP; NCRP Report No. 174; 2013. Available at <https://ncrponline.org/publications/reports/ncrp-report-174/>. Accessed 31 March 2022.

Radiological Society of North America. RSNA statement on safety of the developing fetus in medical imaging during pregnancy [online]. April 2018. Available at https://www.rsna.org/uploadedfiles/rsna/content/role_based_pages/media/rsna-imaging-during-pregnancy-statement.pdf. Accessed 31 March 2022.

Resources for More Information

Brent RL. Saving lives and changing family histories: appropriate counseling of pregnant women and men and women of reproductive age, concerning the risk of diagnostic radiation exposures during and before pregnancy. *Am J Obstet Gynecol* 200(1):4–24; 2009.

Health Physics Society. Ask the Experts provides questions and answers on a wide variety of radiation-related topics. Available at <http://hps.org/publicinformation/ate/>. Accessed 31 March 2022.

Health Physics Society. Pregnancy and radiation [online video]. 2019. Available at <https://www.youtube.com/watch?v=y2JqkFGKU40>. Accessed 31 March 2022.

Health Physics Society. Radiation Answers provides answers to questions about radiation in easy-to-understand language. Available at <https://www.radiationanswers.org/>. Accessed 31 March 2022.

International Atomic Energy Agency. Pregnancy and radiation – what patients need to know [online]. 2010. Available at <https://www.iaea.org/resources/rpop/patients-and-public/pregnant-women>. Accessed 31 March 2022.

National Council on Radiation Protection and Measurements. Radionuclide exposure of the embryo/fetus. Bethesda, MD: NCRP; NCRP Report No. 128; 1998.

The Radiation Dose Assessment Resource (RADAR) website includes radiation dose calculators, risk communication, internal dose information, and other pertinent links. Available at <http://www.doseinfo-radar.com/>. Accessed 31 March 2022.

The Radiation Emergency Assistance Center/Training Site (REAC/TS) provides tools that can be used to estimate the magnitude of radiation doses. Available at <https://orise.orau.gov/reacts/>. Accessed 31 March 2022.

Stabin M, Breitz H. Breast milk excretion of radiopharmaceuticals: mechanisms, findings, and radiation dosimetry. *J Nucl Med* 41(5):863–73; 2000.

US Nuclear Regulatory Commission. Instruction concerning prenatal radiation exposure. Washington, DC: USNRC; NUREG 8.13, Revision 3; June 1999.

The Health Physics Society is a nonprofit scientific professional organization whose mission is excellence in the science and practice of radiation safety. Formed in 1956, the Society has approximately 3,500 scientists, physicians, engineers, lawyers, and other professionals. Activities include encouraging research in radiation science, developing standards, and disseminating radiation safety information. The Society may be contacted at 950 Herndon Parkway, Suite 450, Herndon, VA 20170; phone: 703-790-1745; fax: 703-790-2672; email: HPS@BurkInc.com.