BRCA1

The *BRCA1* gene is a tumor suppressor gene. Tumor suppressor genes slow down cell division, repair DNA mistakes, or tell cells when to die. When they don't work properly, cells can grow out of control, which can lead to cancer. The primary role of *BRCA1* is repairing damaged DNA before a cell divides to make more copies of itself. *BRCA1* works together with other genes such as *BARD1*, *PALB2*, and *BRCA2* to direct the repair of the DNA damage.

Like most genes, each person has two copies of the *BRCA1* gene: one inherited from each parent. A mutation in a single *BRCA1* gene inherited from either parent is known to increase risk of breast, ovarian, prostate, and pancreatic cancer over a lifetime.

How common are mutations in the *BRCA1* gene?
Mutations in the *BRCA1* gene are rare—found in approximately 1 in 450 individuals in the general population and 1 in 40 Ashkenazi Jewish individuals.[1,2]

How mutations in this gene impact risk

Women
If a woman has a mutation in the *BRCA1* gene, her chances of developing breast, ovarian and pancreatic cancer are greater than that of the average US woman. This does not mean that she has a diagnosis of cancer or that she will definitely develop cancer in her lifetime.

Cancer by age 80	Average US woman[3]	With *BRCA1* mutation
Breast	10%	81%[4]
Ovarian	1%	54%[4]
Pancreatic	<1%	Elevated (3-5%)[5]

Elevated: Risk is increased, but further research may clarify the exact risk figure.

[1] Prevalence and penetrance of BRCA1 and BRCA2 mutations in a population-based series of breast cancer cases. Anglian Breast Cancer Study Group. Br J Cancer. 2000;83(10):1301-8.
[2] Moyer VA on behalf of the US Preventive Services Task Force. Risk assessment, genetic counseling, and genetic testing for BRCA-related cancer in women: US Preventive Services Task Force recommendation statement. *Ann Intern Med.* February 2014;160(4):271-81.
[3] Surveillance, Epidemiology, and End Results (SEER) Program, National Cancer Institute. 2010-2012. DevCan software (http://surveillance.cancer.gov/devcan) V 6.7.0, Accessed June 2015.
[4] King MC, Marks JH, Mandell JB, New York Breast Cancer Study Group. Breast and ovarian cancer risks due to inherited mutations in BRCA1 and BRCA2. *Science.* October 2003;302(5645):643-6.
[5] Mocci E, Milne RL, Mendez-Villamil EY, et al. Risk of pancreatic cancer in breast cancer families from the breast cancer family registry. *Cancer Epidemiology Biomarkers Prev.* May 2013;22(5)803-11.

Men

If a man has a mutation in the *BRCA1* gene, his chances of developing male breast, prostate, and pancreatic cancer are greater than that of the average US man. This does not mean that he has a diagnosis of cancer or that he will definitely develop cancer in his lifetime.

Cancer by age 80	Average US man[3]	With *BRCA1* mutation
Male breast	<0.1%	1.8%[6,7]
Prostate	12%	Elevated[7,8]
Pancreatic	1.1%	Elevated (3-6%)[5]

Elevated: Risk is increased, but further research may clarify the exact risk figure.

Additional information

The *BRCA1* gene was the first gene linked to families with hereditary breast and ovarian cancer. The evidence for increased cancer risk associated with mutations this gene was discovered by Dr. Mary-Claire King. Researchers have identified hundreds of different mutations in the *BRCA1* gene that cause an increased risk of cancer since that time.

Screening guidelines

Below is a summary of screening guidelines from the NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines®) established by experts at the National Comprehensive Cancer Network (NCCN).[9] They are for individuals who have a mutation in the *BRCA1* gene. If you have a mutation in this gene, your healthcare provider may use these NCCN Guidelines® to help create a customized screening plan for you.

[6] Tai YC, Domchek S, Parmigiani G, Chen S. Breast cancer risk among male BRCA1 and BRCA2 mutation carriers. *J Natl Cancer Inst.* December 2007; 99(23):1811-4.
[7] Liede A, Karlan BY, Narod SA. Cancer risks for male carriers of germline mutations in BRCA1 or BRCA2: a review of the literature. *J Clin Oncol.* February 2004; 22(4):735-42.
[8] Leongamornlert D, Mahmud N, Tymrakiewicz M, et al. Germline BRCA1 mutations increase prostate cancer risk. *Br J Cancer.* May 2012; 106(10):1697-701.
[9] Referenced with permission from the NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines®) for Genetic/Familial High-Risk Assessment: Breast and Ovarian V.1.2017. © National Comprehensive Cancer Network, Inc 2016. All rights reserved. Accessed September 20, 2016. To view the most recent and complete version of the guideline, go online to NCCN.org. NATIONAL COMPREHENSIVE CANCER NETWORK®, NCCN®, NCCN GUIDELINES®, and all other NCCN Content are trademarks owned by the National Comprehensive Cancer Network, Inc.

Women

Breast and ovarian cancer[10]

- Starting at age 18: Breast awareness - Women should be familiar with their breasts and promptly report changes to their healthcare provider. Performing regular breast self exams may help increase breast awareness, especially when checked at the end of the menstrual cycle.
- Starting at age 25: Breast exam by your provider every 6-12 months.
- Between ages 25-29 or individualized based on family history: Breast MRI screening with contrast (preferred) every year or mammogram if MRI is unavailable.
- Between ages 30-75: Mammogram and breast MRI screening with contrast every year. Your provider may wish to alternate between these two screenings every 6 months.
- Between ages 35-40, or after you are finished having children: NCCN recommends a risk-reducing salpingo-oophorectomy (the surgical removal of the ovaries and fallopian tubes) to lower the risk of developing breast and ovarian cancer.
- After age 75: Your provider may discuss an individualized management plan with you.
- Your provider may discuss the option of having a risk-reducing bilateral mastectomy (the surgical removal of both breasts).
- Your provider may discuss the use of medications that might reduce the risk of developing breast or ovarian cancer.
- While there may be circumstances where ovarian cancer screening with transvaginal ultrasound and a blood test for a protein called CA-125 are helpful, these techniques have not been shown to be effective in detecting early ovarian cancer.

Pancreatic cancer[10]

- Currently, there are no pancreatic cancer screening guidelines from the NCCN specific to *BRCA1* mutation carriers. Please discuss your risk of pancreatic cancer with your healthcare provider.

Men

Male breast cancer[10]

- Starting at age 35: Breast self-exam training and education. Breast exam by your provider every year.

Prostate cancer[10]

- Starting at age 45: Your healthcare provider may discuss prostate cancer screening.

Pancreatic cancer[10]

- Currently, there are no pancreatic cancer screening guidelines from the NCCN specific to *BRCA1* mutation carriers. Please discuss your risk of pancreatic cancer with your healthcare provider.

[10] National Comprehensive Cancer Network. Genetic/Familial High-Risk Assessment: Breast and Ovarian. *NCCN Guidelines Version 1.2017.* Available at www.nccn.org. Published September 2016.