The Effect of Lifestyle Risk Factors on Reducing BRCA 1/2 Carriers Breast Cancer Risk

Sophie Goldstein

Introduction

Breast cancer is the second most common cancer among women in the US. About one in 8 women are diagnosed with breast cancer, and about 250,000 of those women are under the age of 40. While the causes of breast cancer are not completely known, important contributing factors include genetics, lifestyle factors, and diet.

Alcohol is a common cause of cancer because ethanol and acetaldehyde cause DNA to replicate incorrectly ("Diet and Breast Cancer"). Additionally, people who are overweight have a higher chance of getting breast cancer at an older age because their estrogen levels are higher than others. Oral contraceptives and other hormonal birth control methods can increase one's risk for breast cancer due to changes in hormone levels as well. Lastly, stress can cause cancer due to the behavioral responses people have to stress. For example, stress can lead to overconsumption of food and alcohol, which can increase the risk of getting cancer.

Genetics also account for a portion of breast cancer diagnoses. Specifically, chances of breast cancer are heightened with individuals who inherit a mutated BRCA gene (BReast CAncer gene). Everyone is born with two types of BRCA genes (BRCA 1 and 2) in every cell of their body. BRCA1 and BRCA2 function as tumor suppressor genes which repair DNA, and prevent cancerous changes in the cells ("Inherited Cancer Risk: BRCA Mutation"). Inheriting mutated/damaged copies of the BRCA1 or BRCA2 genes can increase the risk for breast cancer and ovarian cancer in women due to the decreased tumor suppressant capacity. Specifically, BRCA mutation carriers have a 70% chance of getting breast cancer before the age of 80. This chance is about 53% higher than the general population.

There is scant information on interventions BRCA 1/2 mutation carriers can take to lower their risk of being diagnosed with breast cancer. Since we are aware that lifestyle factors play a role in the initiation of breast cancer, the crux of this review is to determine if lifestyle interventions such as diet, stress relief, and exercise can reduce a BRCA1/2 mutation carrier's risk of getting breast cancer.

Diet and Breast Cancer

Some studies provide evidence that a bad diet directly correlates to the development of breast cancer. More specifically, doctors suspect that dietary fats, certain meats, and alcohol are the leading diet-related contributors to the development of breast cancer. A study was done on the consumption of alcohol which showed women who consumed "2-3 alcoholic drinks per day had a 20 percent higher risk" of being diagnosed with breast cancer than those who did not drink ("Diet and Breast Cancer"). Maintaining a healthy diet also includes sustaining a healthy weight due to the fact that obese individuals are more likely to develop breast cancer at an older age than people with a normal BMI. ("Diet and Breast Cancer") Consuming foods like fruits, vegetables, and organic snacks can guide an individual to a healthier diet, therefore a healthier lifestyle.

To make the correlation between breast cancer risk and diet, a study compared the effect of different types of foods on the development of breast cancer in women. The first food group was fruit, and it showed that the more fruit women ate, the lower their risk of getting breast cancer. Next, they tested the effect of vegetable intake. Women in the group with the most

vegetable consumption had a “lower risk of estrogen receptor-negative breast cancer” than those in the group with the least vegetable consumption (“Diet and Breast Cancer”). One explanation for this relationship could be due to carotenoids, an antioxidant, which is found in foods such as sweet potatoes, carrots, and some melons. Antioxidants work by tracking down free radicals and stabilizing their harmful effects which boosts immune response and makes cells less susceptible to cancer.

The results of this study show that eating healthy foods can not only promote a healthy BMI, but they can also decrease one’s risk of developing breast cancer.

In addition, there are ongoing studies that show a link between diet and breast cancer in BRCA gene mutation carriers. In 2020, a study found that soy intake helped to reduce the risk of the development of breast cancer in individuals with a BRCA gene mutation. Specifically, there was a 73% risk reduction in carriers of BRCA gene mutations (Greger). Interestingly, in individuals without the BRCA mutation, soy intake led to only a 30% risk reduction. Thus, increasing soy intake can decrease the risk of getting breast cancer in those with the BRCA mutation more than those without the mutation. Altogether, these results show that lifestyle factors, such as diet, can affect BRCA 1/2 mutation carriers' risk of developing breast cancer.

Stress and Breast Cancer

In recent years, stress has been indicated as a lifestyle risk factor for the development and/or the progression of breast cancer. Specifically, it was found that women who experience chronic psychological stress or social isolation have a greater chance of breast cancer metastasis and worse prognosis. Long term stress releases certain hormones (increased cortisol and adrenaline) which can negatively impact almost all of the body's natural processes (Mayo Clinic Staff). For example, when a person is stressed, they are more likely to develop a variety of disorders including anxiety, depression, sleep issues, digestive issues, and memory loss. Not only are these disorders damaging to a person’s health, but they can lead to the development of cancer. While the exact mechanism of stress in the development of cancer is still being studied, exposure to stress impairs the immune system which makes your body more hospitable to cancer. Moreover, studies have shown that exposure to chronic stress leads to metastasis due to the release of neurotransmitters like norepinephrine which stimulate cancer cells (“Is There a Connection between Chronic Stress and Cancer? | City of Hope”).

Stress is a common risk factor in many diseases, but is especially detrimental to individuals who have a mutation in the BRCA gene. Carriers of a BRCA 1/2 genetic mutation often experience an excess amount of stress when thinking about developing breast cancer. When an individual is aware they have the BRCA 1/2 genetic mutation or if a close family member is a BRCA 1/2 carrier, it can add unnecessary stress to their lives because the individual assumes they will eventually be diagnosed with breast cancer. Finding treatments such as therapy, meditation, and other stress relief techniques could potentially reduce one's risk of developing breast cancer from the BRCA gene mutation. After an individual finds they have the BRCA 1/2 gene mutation, they usually become extremely stressed because “this information adds a unique psychological, social, and health-specific burden.” Even further, a study reported that BRCA 1/2 carriers who experience greater levels of stress and anxiety have a biomarker profile that is immune suppressive, suggesting a greater probability of developing cancer (Wenzel et al.). However, doctors say that if individuals with the BRCA 1/2 genetic mutation understand how to cope with stress the correct way, they can reduce their risk of developing breast cancer.

Exercise

Women who exercise regularly have a 30-40% lower risk of developing breast cancer than women who do not exercise regularly. Exercise helps individuals maintain or lower their BMI, which affects the development of breast cancer as previously mentioned. Exercise also lowers blood estrogen levels and boosts the immune system which can "kill or slow the growth of cancer cells" ("Breast Cancer Risk: Exercise"). Studies have proven that incorporating daily exercise into one's teenage years can lower risk of developing breast cancer before menopause ("Breast Cancer Risk: Exercise"). Not only can exercise lower risk of developing breast cancer, but it can lead to a healthier lifestyle by reducing stress, which is a major risk of cancer.

Additionally, women who incorporate exercise into their lives after going through breast cancer treatment have a significantly lower chance of breast cancer recurrence. A study in 2020 was conducted on individuals who were already diagnosed with breast cancer (before, during, and after chemotherapy) to see if exercise could reduce their risk of breast cancer recurrence. "Our data strongly suggest that the more consistently active patients were, the better they did" (NCI Staff). The results showed that women who exercised at "least 2.5 to 5 hours of moderate-intensity physical activity or 1.25 to 2.5 hours of vigorous-intensity aerobic physical activity per week" before chemotherapy and up to two years after treatment, only had a 45% chance of breast cancer recurrence, while individuals who did not exercise had about a 55% chance of recurrence (NCI Staff). The study also found that exercise keeps the human body healthy, therefore increasing the lifespan of a person with or without breast cancer. In conclusion, exercise reduces the risk of breast cancer recurrence because it enforces a healthy lifestyle for people who have had breast cancer in the past.

Furthermore, exercise has been shown to be equally as effective in lowering breast cancer risk in BRCA mutation carriers. In 2009, 725 BRCA 1/2 gene mutation carriers (218 of those people were diagnosed with breast cancer) were surveyed. The results of the survey revealed a direct correlation between exercise and reduced risk of breast cancer. In addition, from the study, researchers concluded that the most effective way to reduce one's risk of developing breast cancer while having a mutation in the BRCA gene is to increase the number of hours one exercises before they turn 30 years old. Thus, this study shows that keeping a consistent workout plan throughout childhood, teenage and young adult years may decrease the chances of developing breast cancer if an individual carries the BRCA 1/2 gene mutation (Pijpe et al.).

Discussion

Many sources and studies support the conclusion made here that lifestyle interventions such as diet, stress relief, and exercise can reduce a BRCA 1/2 mutation carrier's risk of getting breast cancer. To start, a clean diet can reduce one's risk of developing breast cancer. Doctors suggest that BRCA 1/2 gene mutation carriers should avoid dietary fats, certain meats, and alcohol. These individuals should consume more fruits and vegetables (specifically ones that contain carotenoids) because they promote a healthy lifestyle through inducing an antioxidant response. Additionally, stress relief can also reduce one's risk of developing breast cancer due to the fact that long term stress releases toxins into the body, therefore disturbing the body's internal regulation. Along with disturbing the body's natural processes, long-term stress can cause a person to develop anxiety, depression, sleep issues, digestive issues, and memory loss. Finally, increasing exercise can reduce one's risk of developing breast cancer as well.

Exercise has been proven to reduce cancer risk, specifically a study showed correlative affects between amount of aerobic exercise and cancer incidence. It has the propensity to shift someone's genetic makeup. All in all, these three lifestyle interventions could potentially build a strong immunity to breast cancer for those who carry the BRCA 1/2 genetic mutation.

As genetic testing becomes more widely available, more people will be informed that they carry gene mutations which predispose them to certain types of cancer. This knowledge can lead to increased stress and/or anxiety as those people may feel as if they have limited options for prevention. However, through better understanding and implementation of lifestyle changes (diet, stress relief, and exercise), people can reduce their risk. By making the benefits of these lifestyle changes more known, it could alleviate the stress and/or anxiety that accompanies a genetic predisposition diagnosis.

At the moment, reducing cancer occurrence through targeted lifestyle changes is the only way to combat a genetic-based diagnosis. Although we see numerous organizations raising money to cure cancer, exploring ways to eradicate genetic-based cancer risk is not as mainstream. While this research does not offer a way to definitively eliminate a cancer diagnosis, it does shed a positive light on how to change the body's environment to minimize the risk of cancer development.

In the future, it is imperative that the medical community emphasize prevention plans as much as treatment plans. Instead of waiting for those with genetic mutations to develop cancer, it is important to understand how to change our health habits before the cancer diagnosis. Even if we increase screenings and improve treatment plans, understanding how to prevent a diagnosis should be the ultimate goal of cancer research. Knowing one has a genetic mutation that predisposes one to cancer often results in an increase in stress. This increase in stress may result in poor diet choices, lack of exercise, and lack of sleep. Living with stress, poor diet habits, and a lack of sleep create an ideal environment for cancer growth and development. Understanding how to prevent this cycle can greatly reduce the number of diagnoses for those born with BRCA 1/2 mutations. The tools exist to quantify the importance of mental and physical lifestyle interventions. Through this ground-breaking work, we can change the environment in which cancer grows to eradicate incidence and promote prevention.

References

"Breast Cancer Risk: Exercise." *Susan G. Komen®*, www.komen.org/breast-cancer/risk-factor/lack-of-exercise/#:~:text=Women%20who%20get%20regular%20exercise%20%28physical%20activity%29%20have. Accessed 12 Dec. 2022.

Chiriac, Valentina-Fineta, et al. "PSYCHOLOGICAL STRESS and BREAST CANCER INCIDENCE: A SYSTEMATIC REVIEW." *Medicine and Pharmacy Reports*, vol. 91, no. 1, 30 Jan. 2018, pp. 18–26, www.ncbi.nlm.nih.gov/pmc/articles/PMC5808262/, 10.15386/cjmed-924. Accessed 12 Dec. 2022.

"Diet and Breast Cancer." *Susan G. Komen®*, 8 Mar. 2022, www.komen.org/breast-cancer/risk-factor/diet/. Accessed 12 Dec. 2022.

Greger, Michael. "What to Eat and Avoid for Women with BRCA Gene Mutations." *NutritionFacts.org*, 31 Mar. 2020, nutritionfacts.org/2020/03/31/what-to-eat-and-avoid-for-women-with-brca-gene-mutations/. Accessed 12 Dec. 2022.

Heid, Markham. "How Stress Affects Cancer Risk." *MD Anderson Cancer Center*, Dec. 2014, www.mdanderson.org/publications/focused-on-health/how-stress-affects-cancer-risk.h21-1589046.html.. Accessed 12 Dec. 2022.

"Inherited Cancer Risk: BRCA Mutation." *Www.hopkinsmedicine.org*, 7 Sept. 2021, www.hopkinsmedicine.org/health/conditions-and-diseases/breast-cancer/inherited-cancer-risk-brca-mutation.

"Is There a Connection between Chronic Stress and Cancer? | City of Hope." *Www.cityofhope.org*, www.cityofhope.org/living-well/is-there-a-connection-between-chronic-stress-and-cancer. Accessed 12 Dec. 2022.

Kotepui, Manas. "Diet and Risk of Breast Cancer." *Współczesna Onkologia*, vol. 1, 2016, pp. 13–19, www.ncbi.nlm.nih.gov/pmc/articles/PMC4829739/#CIT0010, 10.5114/wo.2014.40560. Accessed 12 Dec. 2022.

Mayo Clinic Staff. "Chronic Stress Puts Your Health at Risk." *Mayo Clinic*, Mayo Foundation for Medical Education and Research, 8 July 2021, www.mayoclinic.org/healthy-lifestyle/stress-management/in-depth/stress/art-20046037. Accessed 12 Dec. 2022.

NCI Staff. "Exercise and Survival for Women with Breast Cancer - National Cancer Institute." *Www.cancer.gov*, 15 May 2020, www.cancer.gov/news-events/cancer-currents-blog/2020/breast-cancer-survival-exercise. Accessed 12 Dec. 2022.

Pijpe, Anouk, et al. "Physical Activity and the Risk of Breast Cancer in BRCA1/2 Mutation Carriers." *Breast Cancer Research and Treatment*, vol. 120, no. 1, 1 Feb. 2010, pp. 235–244, pubmed.ncbi.nlm.nih.gov/19680614/, 10.1007/s10549-009-0476-0. Accessed 12 Dec. 2022.

Wenzel, Lari, et al. "Biopsychological Stress Factors in BRCA Mutation Carriers." *Psychosomatics*, vol. 53, no. 6, Nov. 2012, pp. 582–590, www.ncbi.nlm.nih.gov/pmc/articles/PMC4572843/, 10.1016/j.psym.2012.06.007. Accessed 12 Dec. 2022.

"What Kind of Impact Does Stress Have on Breast Cancer?" *National Breast Cancer Foundation*, www.nationalbreastcancer.org/breast-cancer-faqs/what-kind-of-impact-does-stress-have-on-breast-cancer/. Accessed 12 Dec. 2022.