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The Role of Physical Activity in Breast Cancer Prevention

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WHAT IS CANCER?

Cancer is not a single condition, but a set of many diseases that share common characteristics. Cancer is primarily a disorder caused by DNA mutations and epigenetic changes that make an abnormal cell multiply uncontrollably with the potential to invade other parts of the body, rather than the natural immune system response, which leads to cell death. [1], [2]

The cancer researchers Douglas Hanahan and Robert Weinberg believe that cancer at a molecular level could be described in 10 basic steps. The first six were established in 2000 [3] another 4 in 2011 [4], which are two enabling hallmarks and two emerging characteristics.

They proposed that the properties of a cancer cell are:

1. They can grow self-sufficiently
2. They do not listen to anti-growth signals
3. They evade death (apoptosis)
4. They continue to replicate and do not age
5. They can feed themselves (angiogenesis)
6. They can invade surrounding tissue and spread
7. They have abnormal metabolism
8. Immune system detection and destruction
9. Tumour-promoting inflammation
10. Genomic instability and mutation

BREAST CANCER

Breast cancer is one of the world's most common diseases, matching lung cancer as the world's most common cancer, both contributing 12.3 per cent of the total number of new cases diagnosed in 2018 according to the World Cancer Research Fund. [5]

Among women in the United States, breast cancer mortality rates are higher than for any other disease, apart from lung cancer, with one-in-eight people having breast cancer at some point in their lifetime with 1-in-5 of those under the age of 50. Although breast cancer can occur in men, it is rare, less than one per cent of cases. [6],[7]

Initially thought to be a hereditary disorder, only about 5% to 10% of cancers are based on inherited genes [7], and the figure for breast cancer is even smaller as it is currently inherited by only 3% of patients with the disease. [5] The 3% for breast cancers are caused by mutations of single inherited genes such as a defective BRCA gene. BRCA1 is a tumour suppressor gene; BRCA2 has a role in DNA repair. These mutations of BRCA allow damaged DNA to go unrepaired, and the accumulation of DNA mutations can lead to cancer. Having a positive

hereditary test for cancer risk genes does not mean that cancer will develop, only that people have a higher than average risk of developing some types of cancer.

However, the risk does appear to be increasing over time. Women with a genetic predisposition to breast cancer such as a BRCA2 mutation are now four times more likely to get breast cancer by the time of 40 if they were born after 1958, compared to before 1958. [8] This strongly suggests that something in post-1958 lifestyles or environments has increased susceptibility to the disease in those who are already vulnerable.

Statistics show that breast cancer rates are highest in developed countries. When someone from a developing country, with a low breast cancer rate such as Japan, moves to a western country, with a higher incidence rate, such as the USA, they develop the same breast cancer risk as the residents of the country in which they live. This change in risk suggests that environmental and lifestyle factors of developed industrialised countries are a critical factor in breast cancer risk. [10][11]

Studies suggest that physical activity during adolescence and young adulthood reduces the incidence of pre-menopausal breast cancer in BRCA1 and BRCA2 carriers. [9]

WHAT ARE SOME OF THE MAIN RISK FACTORS INVOLVED IN BREAST CANCER?

Cancer is a complex disease; no single factor is likely to be the cause, and there are certain factors that we have little control over in breast cancer. For instance, some of the main intrinsic risk factors for developing breast cancer are:

- BEING A WOMAN - over 99% of new cases of breast cancer are in women. [39]
- INCREASING AGE - more than 80% of breast cancers occur in women over the age of 50. Most men who get breast cancer are over 60. [39] The probability of accumulating mutations associated with cancer increases with age. [40]
- MENARCHE AGE - The younger the age of the first period (menarche), the higher the risk. [41]
- MENOPAUSE AGE - The older the age at commencing menopause, the higher the risk. [41]

Now there are other factors we may have some influence over, for example, lifestyle choices could drastically impact the chances of developing breast cancer. These are known as external or behavioural and environmental risk factors. These comprise but are not limited to:

- alcohol consumption [12],[13]
- poor diet [15]
- contraceptive pill and hormone replacement therapy [16], [17], [18],[19],[20]
- overweight and obesity [14]
- physical inactivity [21]
- Sleep deprivation [22]

PHYSICAL ACTIVITY AND BREAST CANCER

Over the past two decades, there has been significant research into the impact exercise, and physical activity has on breast cancer.

Based on a systematic review of 19 cohort studies and 29 case-control studies in 2007, there was substantial evidence of the impact of physical activity on post-menopausal breast cancer with risk reductions ranging from 20% to 80% as compared to the least active women. This positive impact has been confirmed in multiple population and demographic groups. [23]

A meta-study conducted in 2014, which reviewed 73 individual studies, revealed that women could significantly reduce the risk of breast cancer by an average of 25 per cent if they exercise regularly. The correlation was most evident in post-menopausal women who performed moderate-to-vigorous exercises regularly sustained over a lifetime. Vigorous-intensity activity was better evidenced to reduce the risk of pre-menopausal breast cancer [24].

The National Cancer Institute (NCI) also conducted a comprehensive review of 31 different studies examining the impact of physical activity, revealing that the average risk reduction for breast cancer is 12%. The figure is the same for both pre- and post-menopausal women [25].

Women who tend to be more physically active after menopause also have a lower risk of breast cancer than women who are inactive. [26],[27]

Finally, the Susan G. Komen Foundation, a leading organization in the fight against breast cancer, estimates that regular exercise, based on a statistical study, could reduce the risk of breast cancer from between 10 to 20 per cent [28].

HOW CAN PHYSICAL ACTIVITY HELP PREVENT BREAST CANCER?

While medical researchers are pretty much agreed that physical activity helps prevent breast cancer, the mechanisms that make it possible are less known.

One prevailing theory is that physical activity helps lower circulating steroid hormone levels (mainly oestrogen, progesterone, testosterone) and other key hormones such as leptin and insulin, as well as associated growth factors such as IGF-1. Physical activity reduces levels of chronic inflammation markers in the body, for instance, CRP (C-reactive protein), which can contribute to breast cancer risk, development and progression. Physical activity also enhances immune system surveillance and decreases oxidative stress. [24],[29]

Research suggests that elevated circulating oestrogen levels are associated with an increased risk of breast cancer, this is also true for men. [30],[31]

Oestrogen encourages a high rate of cell division which means there is less time for DNA repair and an increased risk of mutations, potentially leading to cancer in the breast cells. [32]

Some researchers claim there is an indirect effect of physical exercise as it helps to reduce overweight and obesity. By helping control weight, especially around the waist, physical activity plays a vital role in increasing the risk factors associated with chronic disease and cancer risk. However, more importantly, the physical activity itself has a protective effect, which is independent of its impact on body weight; in other words, it is beneficial even if there is no weight loss [33]

There are also other ways to reduce the risk of breast cancer by using physical activity. The National Cancer Institute (NCI) states that exercise is also very good at bolstering your immune system. The more robust the immune system, the more potent it is when it comes to tackling cancer cells. The NCI also notes that physical activity might lessen exposure to carcinogens by reducing the time it takes food to travel through the digestive tract. [34]

HOW MUCH PHYSICAL ACTIVITY IS RECOMMENDED?

Advice from the World Health Organisation (WHO), US Surgeon General, The National Cancer Institute (NCI) and the U.S. Department of Health and Human Services recommends a minimum of 150 minutes per week of moderate-intensity physical activity for general health. If the intensity is vigorous, then the time commitment can be reduced to 75 minutes per week for a similar benefit. Public health recommendations also suggest at least two days of strength or resistance training weekly. [35]

However, there is evidence that more is better - with a 6% decrease in relative breast cancer risk for each additional hour of physical activity per week. The most significant reduction in risk is found with exercise during reproductive years with at least 300 minutes of strenuous activity per week. [23]

High-intensity interval training (HIIT) results in a more significant increase in natural killer cell count than with moderate-intensity exercise [36]. Natural killer cells are notable for killing virally infected cells and in the surveillance and destroying of the early signs of cancer. [38]

PHYSICAL ACTIVITY EXAMPLES

Examples of moderate-intensity physical activity would be a brisk walk, light gardening or ballroom dancing. Examples of vigorous-intensity physical activity would include running, animal moves such as Bear Crawls or Crab Walks, aerobic and energetic dancing, for instance dancing at a party, or jump rope. Examples of high-intensity interval training include alternating maximal effort periods with low-intensity breaks, such as a few rounds of 20 second max-effort sprints with a walking recovery of 40-60 seconds. A simple example of resistance exercise is bodyweight exercise; examples include air squats and pushups or the use of additional force as in weight-lifting. [37]

CONCLUSION

Increasing levels of physical activity are associated with lower risks of breast cancer. There may be a benefit in conducting exercise trials to provide more precision regarding the suitable type, dose, and intensity of physical activity relating to breast cancer risk reduction. The promotion of physical activity as a critical component of cancer prevention efforts is advisable.

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