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# ROLE OF HORMONAL AND ENVIRONMENTAL FACTORS IN BREAST CANCER DEVELOPMENT

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#### ABSTRACT

**Purpose** – This research investigates the impact of hormonal and environmental factors on breast cancer, particularly concentrating on the interconnections between estrogen metabolism, endocrine disrupting chemicals (EDCs), and socio-economic lifestyle constituents. The study seeks to develop strategies to mitigate the risk of breast cancer by exploring the interplay between hormonal transitions, changes in the environment, and the risk associated with breast cancer.

**Design/Methodology/Approach** – This study utilizes a cross-sectional quantitative research design where a literature review is coupled with primary data collection via structured questionnaires targeting healthcare workers, bioinformatics specialists, and patients. The survey measures the level of awareness among participants regarding the various themes associated with the development of breast cancer, their perceptions, and attitude towards risk factors as well as the adequacy of current preventive actions initiated towards breast cancer. The data entails complex statistical calculations designed to test the hypothesis that exists about environmental EDCs radiation and concealment of hormonal imbalances with the incidence of breast cancer.

**Overall Conclusions** – Initial findings suggest the likelihood of a causal relationship of increased chances of contracting breast cancer to be directly linked with the length of exposure to hormonal factors like estrogen and exposure to some environmental factors like endocrine disrupting chemicals. Estimations of high incidence rates of breast cancer which are early in the onset and positive ER cases are associated with phenomena such as the onset of menarche at a younger age and retirement of menstruation later in life along with hormone replacement therapy. Alongside these factors, there is growing concern regarding breast cancer risk associated with environmental pollutants like Bisphenol A and pesticides. But the complete understanding of the degree of impact of such exposures, especially regarding the extent of their impact over time remain puzzling according to the research.

**Conclusion** - Change in the focus regarding multi approach techniques to controlling the case of breast cancer that are hormonal driven along with environmental shifts needs to emphasize this much is clear as per the paper.

The excerpts make it clear that breast cancer genetically is tied to an individual intensely, but the consideration of hormone disruption along with an imbalance of cancer-causing elements served a danger in declining the situation. These aspects call attention to the need to study the ways in which such characteristics accelerate cancer to develop stronger measures aimed at public health. It is of utmost importance for learning the combined influence of elements related to hormones and environment on the individual body so as to bring forth tailored methods for preventive actions enhancing early identification and treatments of the disease.

**Practical Implications -** The research brings forth the need for defining clear public health policies aimed towards restraining the and exposure to EDCs (Endocrine Disrupting Chemicals) and environmental pollutants. Also, the researchers emphasize the need to educate the public and healthcare providers on the dangers of hormonal therapies and environmental toxins. Careful control of the marketing and use of dangerous products containing chemicals, as well as increasing attention to lifestyle choices that lead to hormonal shifts, could significantly decrease the chances of developing breast cancer.

**Originality/Value -** This research expands the existing studies concerning the causes of breast cancer in relation to the environment and hormones. This study's identification and assessment of critical hormonal and environmental risk factors will assist in developing efficient preventive measures while calling for a shift towards a comprehensive public health approach, which integrates clinical practice with proactive care. The results form the basis of subsequent studies on the control of hormonal and environmental variables to mitigate the incidence of breast cancer globally.

#### **INTRODUCTION:**

Breast cancer is still one of the most common cancers responsible for the morbidity and mortality of women. It is a highly heterogeneous disease with numerous subtypes that have varying clinical features and responses to therapies. With the ongoing research into breast cancer, the disease's complications can be traced down to the interplay of genetics, hormones, and environment. While genetics does play a vital part in the individual's breast cancer risk, there is more than adequate proof supporting the notion that environmental and hormonal factors are also pivotal in determining the entire risk and progression of the disease. Studying the relationships these factors have with one another is central to forming an adequate preventive blueprint, improving the disease diagnosis at its early stages, and treating it effectively [1, 2].

The hormonal factors involved in the disease are mostly associated with the control of estrogen and progesterone, the two primary reproductive hormones setting the pace for the development of breast tissues. Breast epithelial cells are responsive to estrogen and will undoubtedly proliferate during puberty and pregnancy because it is a strong motorbike. Nonetheless, persistently high estrogen levels due to endogenous changes (early menarche/later menopause, HRT) increases the likelihood of developing ER positive (ER+) breast cancer. Such breast tumors developed because of estrogen are highly prevalent amongst women and, on the bright side, the basic frameworks of cancer treatment have been studied extensively and innovatively designed pathways, driven by the sign of estrogen, modified for the treatment [3, 4]. Selective estrogen receptor modulators, such as tamoxifen, and aromatase inhibitors have been reported to diminish the chances of recurrence in women with ER+ breast cancer. Unlike other treatment options, however, some patients do not respond as expected, and the mechanisms behind this remain unsolved [5, 6]. On the other hand, factors like exposure to endocrine disrupting chemicals (EDCs), radiation, and one's diet have been identified as major contributors to the development of breast cancer. EDCs are substances that have the capability of imitating or disrupting the human endocrine system, thereby increasing the likelihood of various forms of cancer developing, breast cancer especially. These substances have been associated with the reproductive system, abnormal breast tissues, and the increased chances of cancer onset. A case in point is bisphenol A (BPA), whose claims of binding with estrogen receptors and activating breast tissue carcinogenesis pathways make it a prime example of EDC [7, 8]. Industrialization and urbanization have become a hallmark of modern living, which, coupled with the limited regulations imposed globally, increases the risk of developing endocrine disrupting chemicals. This phenomenon becomes more pronounced with the risk it poses to breast cancer. Ionizing radiation is also a well-established contributor to breast cancer alongside other exposures. Most women who go through these procedures or are diagnosed with Hodgkin's Lymphoma in their later stages of life may face the consequences of developing breast cancer due to multiple diagnostic tests such as mammograms [9, 10]. Each of these tests comes with a set radiation dose tailored specific to the purpose of imaging. The age of the individual, the exposure duration, and the dosage received greatly alters the chances of breast cancer. This stresses the consideration of the myriads of risk factors which interplay to worsen the overall prognosis of breast cancer. Mounting evidence suggests that the intricate processes at the cellular and molecular levels of breast cancer development lies the keystone for factors like genes and their subsequent interaction with the environment and disease susceptibility [11, 12].

Although several risk factors have been noted, none predicts with certainty who will develop breast cancer, pointing to the interplay of genetics and environmental factors in modifying risk. For instance, the presence of certain mutations like BRCA1 or BRCA2 significantly increases an individual's susceptibility to breast cancer. But the risk due to these mutations could be further altered by such factors as diet, alcohol intake, or exposure to chemicals. This interaction between genetic possibilities and environmental factors highlights the need to evaluate the impact of external influences on cancer-related genes and the extent of genetic predisposition that exists which could enhance susceptibility to environmental carcinogens [13, 14]. In addition, the sequence of exposure to environmental risk factors is important in determining the likelihood of developing breast cancer. The critical window hypothesis argues that exposure to certain environmental risks at specific developmental stages, including prenatal, puberty, or early adulthood, can have profound and lasting impacts on breast tissue and its subsequent cancer susceptibility. For example, exposure to endocrine disrupting chemicals during fetal development can cause changes in the growth and development of the mammary gland which increases the chances of breast cancer in later life. Likewise, high exposures to external estrogen therapy or even the estrogenic stages of puberty may affect breast tissue and the risk of developing cancer during later stages of life [15, 16]. Alongside individually focused risks, population-based studies have shown that socio-economic level, geographic area, and availability of healthcare services have considerable impact on the risk of developing breast cancer and its associated outcomes. For instance, women in densely populated urban areas may suffer from higher levels of exposure to environmental pollutants owing to industrial activity, while rural women could be more exposed to pesticides used in agriculture. Economic factors also affect the risk of breast cancer, as women belonging to the lower income category face barriers to early detection and preventative healthcare services, including mammography and genetic counseling. These inequalities emphasize the need for international and regional strategies that aim to minimize the risk of exposure to detrimental environmental factors as well as improve healthcare services to vulnerable populations [17, 18].

There is an urgent need to study the relationship between hormonal and environmental factors on breast cancer to understand its pathology and design methods for effective prevention and treatment. Although some progress has been made in identifying the risk factors and developing appropriate therapies, further work is required in relation to the development of proactive approaches, especially involving environmental factors [19, 20].

Gaining a complete understanding of how hormonal and environmental factors increase the risks of breast cancer will enhance clinical practice and address public health efforts to reduce the incidences of breast cancer globally. Further research explaining the mechanisms of these multifaceted interactions will be crucial for the development of personalized preventative and early-detection strategies and treatment plans, helping alleviate the global burden of this devastating illness [21, 22].

As noted above, hormonal and environmental influences, along with genetic makeup, determine the risk profiles of individuals and populations for breast cancer. This introduction calls to action to explore the under-hormonally driven and exposed environment influences, as they may lead to new breakthroughs in the understanding of the disease's pathology. Their interactions alongside the disease mechanism processes will create novel pathways for intervention in the form of prevention, early detection, targeted therapies, which together will decrease the incidences and improve the prognosis of breast cancer patients [23, 24].

#### LITERATURE REVIEW:

Breast cancer is one of the most widespread and malignant cancers among women globally. The development of breast cancer is frequently associated with genetic factors such as hereditary mutations of the BRCA1 and BRCA2 genes. However, it is notable that an individual's lifestyle and reproductive characteristics equally influence the likelihood of developing breast cancer (IARC, 2012). This association, as well as its other correlative relations, remains a vital subject of studies around the world since knowing these determinants can greatly assist in the formulation of advanced methods for preventing disease and improving current therapies. This literature review analyzes the body of research concerning the hormonal and environmental influences on the development of breast cancer [25, 26].

It is well known that hormonal exposure, in particular estrogen, plays a crucial role in breast cancer pathogenesis. Estrogen facilitates the development of breast cancer by attaching itself to estrogen receptors (ER) on the membrane of the cell, which encourages cell division and likely increased mutations within the breast (Jansson et al., 2017). There is a known correlation between breast cancer and prolonged exposure to high levels of estrogen (Calle & Kakas, 2004). Other twigged factors with high lifetime estrogen exposure like early menarche, late menopause, and hormone replacement therapy (HRT) were reported to have a positive correlation with breast cancer (Two Roger et al., 2011) [27, 28].

Understanding the timing of menarche and menopause deepens the knowledge of the hormonal impact. Dorgan et al. (2009) have conducted a meta-analysis on the breast cancer risk and found that women who undergo menarche at age younger than 12 and go through menopause after age 55 develop cancerous cells at a significantly higher rate. This group is prone to high exposure of estrogen leading to more enhanced potential for mutations in the breast. In a similar vein, the risks associated with breast cancer are impacted using oral contraceptives and hormone replacement therapy (HRT), with some research reporting a slight risk increase to breast cancer with the long-term usage of hormonal contraceptives (Michaud et al., 2009). Nonetheless, the link is not definitive, with some studies positing that the risk may be reversible if hormonal contraceptives are stopped (Pappé et al., 2015).

Besides hormonal factors, reproductive elements such as the number of full-term pregnancies and breastfeeding notably change the likelihood of developing breast cancer. Existing literature claims that women who bear more children and breastfeed for extended durations tend to have lower chances of developing breast cancer (Kahlenberg et al., 2006). This is because pregnancy and lactation reduce the number of cycles a woman goes through in her lifetime, estrogen exposure, and cumulative menstrual cycles (Howe et al., 1999). Additionally, breastfeeding is thought to induce protective effects by changing the hormonal milieu within breast tissue and rendering it less vulnerable to mutations that promote cancer (Baral, 2000).

The "parity hypothesis" attributes the protective phenomena regarding breast cancer risks to the first trimester of pregnancy when the woman's body undergoes differentiation of the breast tissues, making the area less vulnerable to carcinogenic factors (Key et al., 2003). While this may hold true, women who attain their first birth later into life may not receive this protection to the same degree as those who have children at a younger age. In Gordis' 2004 study, he noted that women who do not breastfeed, or those who have fewer pregnancies are more likely to have prolonged exposure to estrogen, thus are at a greater risk of getting breast cancer [29, 30].

Exposure to certain environmental factors can significantly contribute to the development of breast cancer. Although hormonal factors are highly associated with the development of breast cancer, other environmental factors such as EDCs, which include pesticides, plastic, and other pollutants that hormones can disrupt and interfere with, increase the risk of breast cancer (Diamanti-Kandarie's et al., 2009). One of the most studied chemicals is bisphenol A, which is widely utilized in the production of plastics and resins. BPA mimics estrogen and increases the risk for the development of breast cancer (Soto et al., 1997).

Women with high body burdens of environmental toxins, especially those accumulated as a result of exposure to particular industrial chemicals, are at a greater risk for developing breast cancer (Brody et al., 2007).Research on occupational hazards has indicated that women employed in agriculture, manufacturing, and chemical industries have an increased prevalence of breast cancer, most likely from prolonged exposure to carcinogenic chemicals (Cohn et al. 2007). In addition, the association of urban residence with heightened breast cancer risk has also been linked to greater exposure to air pollution (Parks et al., 2011).

There is also some evidence indicating that exposure to polycyclic aromatic hydrocarbons (PAHs), generated by the incomplete burning of organic substances (for instance, tobacco, vehicle, and industrial smoke), might elevate the risk of breast cancer. According to a study by Rusiecki et al. (2008), women with high PAH exposure exhibited significant increases in DNA damage within breast tissue, indicating that such environmental exposures may lead to genetic damage capable of causing cancer.

Another significant environmental factor that may influence the development of breast cancer is dietary habits. There is increasing evidence suggesting that a diet rich in red and processed meats increases the risk of breast cancer. Increased consumption of preserved meats with a high content of nitrates, and other additives, have shown to be detrimental to breast cancer, alongside other forms of cancer (Sinha et al, 2009). Likewise, animal fat in a person's diet tends to increase estrogen level. That enhanced estrogen increase might be a contributing factor to the development of breast cancer which is dependent on hormones (Fredrico et al. 2012).

On the contrary, whole grains, vegetables, or fruits are associated with the reduction in risk of getting breast cancer (Zhang et al. 2009). Also, certain micronutrients such as folate, vitamin D, and polyphenols assist in combating the effects of oxidative stress and mitigate the possibility of getting breast cancer. It has also been shown that diets rich in those specific foods lower the

probability of getting breast cancer (Kirk et al. 2010). Furthermore, other studies suggest that diets inclusive of fish or olive oil, and foods high in omega-3s can help reduce the likelihood of breast cancer (Gonzalez et al. 2011).

Engaging in physical exercises is another component that can substantially reduce the risks of breast cancer. Studies of McTiernan et al (2003) show that women who participated in regular physical activity, particularly during their teenage and young adult years, tend to have lower chances of developing breast cancer compared to women who don't. Exercise is known to reduce estrogen levels in a woman's body as well as insulin and insulin-like growth factors (IGF) levels, all of which are vital in the development of breast cancer (Holmes et al., 2005). Moreover, exercise may aid in weight control which is known to be a risk factor for developing breast cancer, more so in postmenopausal women (Renehan et al., 2008).

Liu et al. (2011) cite a large cohort study conducted under the American Cancer Society that showed women who undertook at least 7 hours of moderate-level physical activity a week had considerably reduced risks of getting breast cancer compared to inactive women. In addition to this, participation in sports at a younger age was shown to have significant long-term benefits, further stressing the importance of lifelong exercise. The interplay between hormonal and environmental facets as well as the factors that influence the diagnosis of breast cancer are intricate and involve countless interdependencies.

Hormonal factors such as exposure to estrogen pose a significant risk for breast cancer, with early menarche, late menopause, and the use of contraception relating to increased risk. Moreover, the number of full-term pregnancies and breastfeeding offers protection against breast cancer. Other notable risks include environmental factors such as exposure to endocrine disrupting chemicals, air pollution, and breast cancer specific dietary habits. Other non-environmental uncontrolled risks include lack of physical exercise which influences breast cancer risk through hormones.

Despite the well-known connections between these factors and breast cancer, the relationships among all these variables require additional study. The combination of environmental factors along with hormonal factors and genetic vulnerabilities needs further study in relation to risk exposure to breast cancer. There is a need to shift focus toward emphasizing the environmental risks of toxins along with promoting diet and exercise to reduce breast cancer risk for public health initiatives. Findings incorporated showed that the process involved in prompting breast cancer is complex and intricate but ultimately relies on numerous different factors.

Despite the genetic factors of breast cancer receiving extensive focus in the last few years, an equally important understanding of its progression stems from the disease's biological and environmental determinants. It is crucial to understand how these factors are interconnected and how they may affect the pathways at the cellular level associated with the disease.

The blend of genetic vulnerability with environmental or hormonal factors further complicates things. Breast cancer is a predominant and clinically significant disease for women with familial BRCA1 and BRCA2 mutations. It is noted, however, that these mutations do not manifest defected genes in all cases (Struewing et al., 1997). Environment and hormonal factors appear to control the expression of certain genetic modifications through epigenetic changes. Also, epigenetics is defined as processes that mediate expression of a particular sequence in cells without physically changing its DNA nucleotides but instead altering its surroundings like food, lifestyle and contaminants (Schaefer & Karpf, 2011). Research has demonstrated that exposure to certain environmental compounds, including BPA, has the potential to cause epigenetic alterations which may impact the likelihood of developing certain hormone-related cancers, with breast cancer being one of them (Gonzalez et al., 2014). Such epigenetic changes may disrupt the normal regulation of apoptosis, cell growth, and DNA repair, thereby promoting cancer. Likewise, the development of breast cancer could also be impacted by a woman's personal history with sex and reproductive cycle related epigenetic changes due to the rest of her life hormonal events such as menstruation, pregnancy and menopause. This highlights the need for more research looking at the intersection of genes and the environment, along with the importance of these factors in the prevention and management of breast cancer.

Moreover, breast cancer incidence is primarily affected by lifestyle aspects like diet, physical activity, alcohol and tobacco use, which tend to reflect a person's socioeconomic status. It has been noted that individuals with higher socioeconomic status (SES) tend to have better access to healthcare and consume healthier food, along with greater participation in physical activity, which may reduce the risk of breast cancer (Jiang et al., 2015). On the other hand, some studies do point out that certain socioeconomic factors, particularly in developed countries, correlate with increased rates of obesity and alcohol consumption, both of which are known to increase the likelihood of developing breast cancer (Goodwin et al., 2003). Moreover, individuals from higher SES groups

have greater access to hormone replacement therapy, which is known to increase the risk of breast cancer. However, this relationship is not straightforward as it depends on the timing and type of HRT used (Fournier et al., 2005).

On the contrary, people from lower socioeconomic backgrounds tend to have less access to primary healthcare services, which contributes to a poor diet and higher rates of smoking and obesity, potentially increasing the risk of breast cancer (Bradshaw et al., 2017). In addition, some people from low SES groups may be surrounded by higher levels of environmental pollutants or toxins because of industrialization or living in urban areas with poor air quality, compounding their risk of developing breast cancer. For the effective formulation of breast cancer prevention strategies, it is important to analyze how socioeconomic inequalities impact breast cancer prospects. In the United States and other European nations, the incidence of breast cancer is high which correlates with hormonal exposure alongside dietary and lifestyle influences. Many developing countries have been known to have low rates of breast cancer, but this is rapidly changing as these countries adopt western lifestyles which include changes in diet, increased consumption of alcohol, and decreased physical activity. (Yip et al, 2010). These differences observed between countries underscore the significance of non-genetic aspects that contribute towards the development of breast cancer. For example, obesity is one of dietetic modification able risk factors associated with breast cancer and the Western diet which is characterized by high red meat, refined grain and processed foods consumption, has been linked with greater incidence of breast cancer (World Cancer Research Fund, 2018). On the other hand, traditional diets in many Asian countries which are predominantly plant-based with abundant fruits, vegetables and fish are believed to have protective effects against breast cancer (Chayes et al., 2014). However, breast cancer rates are on the rise in these countries due to globalization and the associated changes in diet and lifestyle. Furthermore, the impact of environmental pollutants, specifically endocrine disruptors, may be more pronounced in those areas with advanced industrialization. It has been suggested that the most affected women are those living in urban areas especially in the vicinity of industrial complexes and heavily trafficked roads (Davis et al., 2012). Hence, any global initiative aimed at the prevention of breast cancer should focus on the most exposed region with consideration of the lifestyle, environment, healthcare, and access of the population. Informed by the latest research in breast cancer, new hypotheses of the disease have emerged integrating the interplay of hormonal and environmental factors with a woman's genetic predisposition to breast

cancer. These discoveries have facilitated the integration of genetic predisposition along with family history into a more complex lifestyle change frameworks for early detection. For instance, personalizedsperbreastcancerpreventionstrategiesconsideringanindividual'sgeneticprofile hormonal past and environmental surroundings are being incorporated into clinical practice more often nowadays (Hewitt & Lee, 2016). Such personalized methods enhance the effectiveness of health systems by providing tailored dietary and exercise regimens, as well as preventive medications and some screening surveillance to individuals at higher risks due to family histories or genetic predispositions. Dietary habits and exposure to endocrine disrupting chemicals and other pollutants are among the myriads of environment-related factors that contribute to the development of disease. In addition, socioeconomic status, ancestry, and factors such as genetic predisposition and epigenetic alterations add complexity to the disease in breast cancer diagnosis and treatment. Recent developments in breast cancer research highlight the need to study the synergy of environmental and hormonal risk factors. The use of hormonal therapy for the treatment of breast cancer has evolved with the introduction of selective estrogen receptors modulators (SERMs) and aromatase inhibitors, substantially improving the management of breast cancer with positive estrogen receptors. The long-term impacts of these therapies, including benefits and disadvantages, remain contentious, particularly in the context of external environmental elements like endocrine disrupting chemicals (EDCs) and their consequential impact on the safety and efficacy of the treatment (Clarke et al. 2018). Newer research suggests that some EDCs, including bisphenol A (BPA), phthalates, and certain pesticides, interfere with hormonal control within the body and may alter cancer risk by affecting estrogen signaling pathways. Numerous studies indicate that these compounds can undermine tamoxifen efficacy, resulting in detrimental therapeutic outcomes for women with hormone dependent breast cancer (Vandenberg et al, 2012). This is the first time a cross disciplinary approach is taken to study the molecular level of an epidemiological issue: breast cancer, uncovering the impact of environmental exposure and genetic makeup on the risk of developing breast cancer.

The multifaceted cellular and molecular approaches taken to understanding how environmental toxins impact an individual's metabolism have coincided with a parallel focus on the role of microRNAs in the development of cancer. Certain microRNA signatures have been associated with the regulatory control of clinically relevant genes governing cell cycle progression, programmed cell death, and DNA damage repair, which are central to the etiology of breast cancer

4431

(He et al., 2010). Thus, integrating the assessment of environmental exposures with more sophisticated molecular techniques may improve risk assessment models and help classify higher risk individuals using a combination of genetic and environmental factors.

The critical window theory postulates that certain life stages, including prenatal age, adolescence, and menopausal age, are important windows of environmental exposure that can impact the risk of developing breast cancer in later life. Growing evidence suggests that some endocrinedisrupting chemicals, encountered during the prenatal stage, could result in permanent alterations to breast tissue structure and function, thereby increasing cancer risk in later life (Karamus et al., 2009). For instance, smoking during pregnancy or exposure to certain pesticides has been associated with increased risk of developing breast cancer later in life. The impact of early exposures may, through epigenetic modifications, change the development of breast tissue and increase the likelihood of cancer later in life. Schnabel et al. (2018) states that the teenage years and early adulthood are also critical for the onset of breast cancer since the mammary glands are actively developing and differentiating. Advances in hormonal exposures like early menarche, late menopause, and the use of oral contraceptives tend to modify the tissues of the breasts and make them more susceptible to cancer. The use of hormonal contraceptives has created a controversial debate with recent studies suggesting a slight rise in breast cancer risk for women who use these contraceptives for long periods of time (Baral et al., 2015). Despite this, the contribution of hormonal contraceptives to the risk of breast cancer remains controversial among experts. Results vary greatly based on the type, duration, age of use and contraceptive used.

Factors such as air pollution, urbanization, and pesticide use are additional risk factors that have garnered attention more recently. There is a growing body of evidence suggesting that air pollution, and especially fine particulate matter (PM2.5), might impact the risk of breast cancer. Various research associate incidences of breast cancer to regions with elevated levels of air pollution, possibly attributing it to particulate matter which has mutagenic properties (Valeramides et al., 2008). Moreover, health risks for women enduring living in more advanced industrial or urbanized areas might be due to increased endocrine disrupting chemicals in the environment, further aggravating the risk. With the apparent correlation between breast cancer risk and environmental and hormonal factors, there is observable shift in focus of public health promotion initiatives towards proactive risk modification strategies. The primary goal is to limit risk factors associated with lifestyle, including diet, exercise, and exposure to known carcinogens. For

example, there is considerable evidence that the risk of breast cancer can be reduced by following certain guidelines, such as limiting alcohol intake, maintaining a healthy body weight, and participating in regular physical activity (Colditz et al., 2006). Adopting measures to maintain healthy body weight and physical activity reduce circulating levels of estrogen and insulin-like growth factors, which play a role in the development of breast cancer. At the same time, there is a critical need for policies aimed at reducing environmental pollutants. Tightening controls on industrial emissions, pesticides, and endocrine-disrupting compounds is crucial in managing the carcinogenic danger these substances present. Public health initiatives aimed at reducing harmful environmental exposures, especially in high-risk populations, can markedly lessen the burden of breast cancer. Moreover, further research into non-toxic consumer products and food packaging is vital for protecting the public from deleterious chemicals linked to breast cancer, such as BPA and phthalates. An integrated approach will be vital as we advance breast cancer research, one that examines the interplay of hormones, genetic factors, and the environment working in concert. Future studies ought to emphasize longitudinal cohort studies that monitor individuals' environmental and hormonal interactions to assess cancer risk across different life stages. In addition, more research is needed to evaluate the role of environmental influences in both sporadic and familial cases of breast cancer. Identifying previously uncontrolled environmental exposures in high-risk populations could unlock novel avenues for prevention and early detection. The study of environmental breast cancer risk factors requires a broader focus on environmental carcinogens and includes a wider variety of less-studied chemicals. More thoroughly understanding these chemicals' interactions with genetic and endocrine factors will aid in constructing innovative therapeutic approaches of prostate cancer that focus on the underlying issues rather than surface manifestations. The highly intricate nature of breast cancer's origins requires that integrating multi-disciplinary approaches such as genetics, epidemiology, toxicology, and public health will be needed for comprehensive solutions for prevention and treatment of the disease.

Developing global policies aimed at mitigating environmental risks associated with breast cancer should be prioritized. Stricter legislation on carcinogenic substances and active modifiable risk factors such as smoking, alcohol, and unhealthy dietary habits necessitate unison action from researchers, policymakers, and organizations specializing in environmental health. Combating public health concerns, which aim to lower the incidence of breast cancer, will provide tangible benefits to society that combat the pervasive issue of breast cancer. The development of breast cancer is the result of an intricate interplay between hormonal and environmental factors. Although genetics accounts for a significant portion of the risk, the contribution of environmental pollutants and endocrine disruptors is equally substantial. Emphasizing the need for molecular epidemiology and furthering the understanding of the geneenvironmental nexus is crucial for devising efficient preventive and therapeutic initiatives. In addition, it is necessary to focus public health policies on the elimination of carcinogenic elements in the environment and the promotion of lifestyle changes that support better health to reduce the risk of breast cancer. This area of study will continue to advance and refine the strategies of breast cancer prevention, early diagnosis, and tailored treatment, enhancing the prognosis for patients globally.

### **METHOD:**

**Study Design:** The objective of this study is to analyze both hormonal and environmental factors that may contribute to the development of breast cancer. This study is cross-sectional and quantitative in nature, meaning that it relies on an online survey to measure the relationships between different hormonal and environmental factors and breast cancer. The study attempts to assess the impact of breast cancer risk factors such as reproductive history, history of contraceptive use, environmental pollution, nutrition, and exercise. With this study, we hope to gain insights into the perceptions and lived realities of individuals facing these factors as well as identify relevant angles aimed at the primary prevention of breast cancer.

#### **Survey Instrument**

To construct the survey, we utilized literature detailing the hormonal and environmental aspects of breast cancer to create a comprehensive questionnaire. We aimed to capture both quantitative and qualitative information on participants' reproductive history, contraceptive usage, exposure to environmental pollutants, dietary practices, and activity levels. The survey is organized into several major components:

**1. Demographic Information:** In this section we solicit basic demographic information which includes age, gender, and occupation. Analyzing sample population and studying participant's history and risk factors for breast cancer requires guys to pay attention to the demographic characteristics of the subjects participating in the breast cancer study.

**2. Hormonal and Reproductive History:** Here, respondents are requested to indicate their full-term pregnancy count as well as the age at which they first menstruated (menarche). In addition,

these respondents are asked to disclose any history of hormone replacement or oral contraceptive use. This is to ascertain the possible the impact of reproductive history and hormonal exposures on the cancer risk for the respondents.

**3. Environmental Exposures:** This section deals with the respondents' exposure to environmental toxins including chemicals, pesticides, and pollutants. Participants are asked to give details regarding the amount of time (frequency) they met such substances and what their opinion is on the association of such exposures and their health.

**4. Dietary Habits:** This section attempts to record the diet of respondents, especially the intake of red and processed meat which is suspected to increase the risk of breast cancer. The survey seeks to determine how often in a week respondents eat red or processed meat together with fruits and vegetables.

**5.Physical Activity Level:** Participants are queried on the level of physical activity they partake per week, including the total number of hours spent in moderate to vigorous exercise. Since physical activity is known to lower the risk for developing breast cancer, it's crucial to understand participants' activity levels to evaluate the role of exercise in the prevention of breast cancer.

**6.Perceived Risk and Awareness:** This measure assesses participants' knowledge of various hormonal and external factors that may contribute to the development of breast cancer. Also, it analyzes risk perception related to one's own lifestyle choices and environmental contact history.

Section	Description	Type of	Purpose
		Questions	
Demographic	Collects age, gender,	Multiple	To contextualize responses
Information	and professional	Choice, Open-	based on demographic
	background	ended	factors
Hormonal and	Questions about	Multiple	To assess the influence of
Reproductive	pregnancies, menarche,	Choice, Likert	hormonal exposures on
History	contraceptive use	Scale	breast cancer risk
Environmental	Frequency of exposure	Likert Scale,	To evaluate the impact of
Exposures	to environmental toxins	Multiple	environmental toxins on
		Choice	health

Dietary Habits	Frequency of red meat,	Multiple	To examine the role of diet
	processed food, and fruit	Choice, Likert	in breast cancer
	intake	Scale	development
Physical Activity	Hours of exercise per	Multiple	To assess the protective
Levels	week	Choice, Likert	role of physical activity
		Scale	against breast cancer
Perceived Risk and	Participants'	Likert Scale,	To gauge participants'
Awareness	understanding of risk	Open-ended	awareness of breast cancer
	factors and prevention		risks

### **Participants**

With respect to the criteria stated above, it aims to identify the patient population that has varying exposure to hormonal and environmental risks, suggesting that patients come from different walks of life and have varying levels of experience with risk factors. The following are the primary groups who the survey will target for distribution:

• **Healthcare workers** such as physician assistants, nurse practitioners, breast surgeons, and specialty oncologists engrossed in the prevention and treatment of breast cancer.

• **Bioinformatics, data science, and engineering** professionals in the interdisciplinary fields of medicine and environmental science, with specialization in the technological and ecological determinants of breast cancer.

• **Cancer patients** who have undergone mastectomy or are concerned with their risk due to certain exposures.

• **General Club** The rest of the population void of any medical background who wish to gain insight about breast cancer and its hormonal and environmental risk factors.

To serve a set goal of ensuring that a representative sample is captured for the population, participants will be retrieved and approached through marketing adverts which will be placed on internet websites, web-based medical platforms, and social media platforms. All participants will sign informed consent prior to taking the survey where it will be explained to them that the study sought to survey the public's knowledge of breast cancer risk factors, highlighting the voluntary nature of participation along with potential risks.

#### **Inclusion and Exclusion Criteria**

# **Inclusion Criteria:**

• Asserted age is greater than or equal to eighteen.

• Affiliated with or interested in areas of biomedical sciences such as healthcare, bioinformatics, data science, or environmental health.

• Individuals for whom hormonal exposure has been reported, e.g., women who have used birth control pills, hormone replacement therapy.

- Subjects who have had exposure to environmental toxins as part of their daily activities or occupation.
- Subjects of any age who are willing to complete the entire study and provide consent.

# **Exclusion Criteria:**

• People younger than the age of 18.

Participants do not have seamless access or the ability to complete the survey online.

• Participants lacking sufficient knowledge on the environmental or hormonal risks associated with breast cancer do not qualify for participation.

• Participants who do not complete all survey items or withdraw from the study before completing the survey.

Table 4	: Survey	Instrument	<b>Overview</b>
	•/		

Section	Description	Type of	Purpose
		Questions	
Demographic	Collects age, gender, and	Multiple	To contextualize responses
Information	professional background	Choice, Open-	based on demographic
		ended	factors
Hormonal and	Questions about	Multiple	To assess the influence of
Reproductive	pregnancies, menarche,	Choice, Likert hormonal exposures	
History	contraceptive use	Scale	breast cancer risk
Environmental	Frequency of exposure	Likert Scale,	To evaluate the impact of
Exposures	to environmental toxins	Multiple	environmental toxins on
		Choice	health
Dietary Habits	Frequency of red meat,	Multiple	To examine the role of diet
	processed food, and fruit	Choice, Likert	in breast cancer
	intake	Scale	development

Physical Activity	Hours of exercise per	Multiple	To assess the protective
Levels	week	Choice, Likert	role of physical activity
		Scale	against breast cancer
Perceived Risk and	Participants'	Likert Scale,	To gauge participants'
Awareness	understanding of risk	Open-ended	awareness of breast cancer
	factors and prevention		risks

# **Data Collection Procedure**

For this study, the data will be collected using an online questionnaire that participants will administer themselves. The survey will be sent out via email or shared through social media. It will remain accessible for two months, which would allow participants to fill it out at their convenience.

To uphold confidentiality, no identifying data will be collected, and all responses will be kept secret. Each participant will be given confidentiality by assigning them a random identification code. The survey will be created in a way that does not need to be completed in one sitting and participants will have the option to skip questions that they do not wish to answer.

Before starting the survey, participants will be asked to check a box containing the informed consent prescription document. This document will detail the goals of the study, possible adverse effects, and the voluntary context of participation. Moreover, participants will be made aware that they can opt-out of the study whenever they want without implications.

# **Ethical Considerations**

The voluntary nature of the study will be explained in the informed consent forms along with objectives, risks, and how confidentiality will be maintained. These details will help ensure that participants' privacy remains protected throughout the entire duration of the study, thus making sure that ethical standards are fully approached when conducting this research. Participants will be guaranteed that their answers will be confidential and that all the information collected will be kept safe under the custody of the research team only.

The study will apply to the Institutional Review Board (IRB) to guarantee that there is no unethical issue regarding the research process. Participants will be free to withdraw from the study at any stage without incurring any consequences.

#### Limitations

A few limitations must be considered in this study. Firstly, the survey will mostly focus on people who, as a minimum, understand or have come across the risk factors of breast cancer, hence the findings may not be applicable to the general population. Secondly, as a cross-sectional study, the survey will only gather data from respondents at one particular time or instance which restricts the conclusions that can be made on causal relationships between the factors and the development of breast cancer. Finally, because the study is based on data provided by participants as opposed to actual observation, there will be some biased responses given, for example, recall bias or social desirability bias. To overcome these limitations, other studies in the future could adopt these suggestions by using longitudinal approaches to observe shifts in risk factors over time or include a broader population. Also, other forms of qualitative research could help capture the experiences of participants concerning the effects of hormones and the environment on breast cancer.

**ANALYSIS:** The outcomes of the questionnaire which aimed to study the contribution of hormones and the environment to breast cancer development shed light on a myriad of pertinent social, environmental, and biological risks. We intend to analyze data within five categories: a history of reproductive activities and hormonal factors, the use of hormonal contraceptives, environmental "exposures," lifestyle and dietary consumption patterns, and level of physical activity, to try and draw some conclusions that could illustrate the relationships between these factors and breast cancer. Data on hormonal factors and reproductive history reveals some important patterns. Most of the participants (45 out of 145, which constitutes 31%) indicated that they have had one full term pregnancy and then 35 respondents (24%) indicated that they have had two. Only a handful of respondents (10), which is about 7%, indicated that they had four or more children, which shows that there is a lower probably lower moderate having large families. Parenthood and especially multiple full-term pregnancies are certainly one of the factors regarding the risk of breast cancer. The risk of developing breast cancer is slightly higher in women who have fewer or later pregnancies because of the lifetime estrogen exposure in relation to the number of cycles they undergo. With regards to the age of onset of menstruation (menarche), the most common response (45 or 31%) was age 13, followed directly by 40 respondents (28%) who reported age 12. Notably, the highest group of respondents, 45, indicate that a good number of women are experiencing menarche at 12 or 13 which is consistent with average national data. Because menarche happens earlier than its counter parts in other countries, for estimation purposes

is certainly a critical aspect given that a younger age at this event is thought to correlate with greater risk of breast cancer owing to longer lifetime estrogen exposure. Generally, the information illustrates a standard reproductive pattern as observed from the amount of pregnancies which is modest alongside most respondents having menarche in the range of 12 to 13, providing a baseline for greater and lower risk factors against the likelihood of developing breast cancer. Considering that early menarche combined with low number of pregnancies indicate greater risks, the scope in this instance may give answers as to how such elements correspond with the likelihood of breast cancer. In evaluating the risk of breast cancer, questions pertaining to the use of hormonal contraceptives remain within the context of great attention. The survey results show that a significant number of respondents (50 out of 145 total or 34%) reported never using hormonal contraceptives. This is significant because previous literature does indicate that the continued use of birth control pills, particularly among young women, does elevate the chances of developing breast cancer, though the overall chances are minimal and tends to lower after one stop using the pill. Nonetheless, 34% of respondents who reported not using any form of contraception could be viewed as lessening the exposure to these risks. A further breakdown of responses showed that 35 respondents (24%) had used hormonal contraceptives for 1-5 years and 30 (21%) for 6-10 years. This is indicative that a sizeable amount of female population has been subjected to the use of hormonal contraceptives for an elongated duration. Long-term usage of hormonal contraceptive methods can have significant health benefits but also serious drawbacks. Some studies suggest that when used for long durations, especially over 5 years, there is a slight risk of increased breast cancer. That said, the risk may also reduce after the contraceptive methods are stopped, which illustrates the convoluted nature of contraceptives and cancer. These data suggest that even though the usage of hormonal contraceptives is popular, most women do not know the risks associated with it, especially for those women who have been using birth control for more than a decade. There is increasing interest in the field of breast cancer research regarding exposure to environmental toxins and chemicals. This is because some studies indicate that a few factors such as pesticides, industrial chemicals, and home cleaning products can contribute toward the development of cancer. The data tells a concerning story: A significant portion of respondents (45 or 31%) reported being exposed to chemicals "sometimes," while 30 respondents (21%) indicated

or 31%) reported being exposed to chemicals "sometimes," while 30 respondents (21%) indicated they exposed "often." These large figures support the notion that several women may met cancercausing materials on a routine basis. Curiously, 40 respondents (28%) said they were exposed to these toxins only "rarely" and only 20 (14%) stated "never" being exposed. While these numbers suggest that some participants try to mitigate their exposure to such chemicals, they also indicate that knowledge of the dangers posed by certain chemicals is limited among this sample population. Such information is particularly sad because constant exposure to these chemicals which act as endocrine disruptors, found in some pesticides and cleaning agents, are linked to increasing the risk of breast cancer. This piece of data shows why there needs to be more control and focus on these chemicals, since many people do not seem to be taking the necessary actions to avoid harmful substances. The role of lifestyle factors, particularly nutrition, on breast cancer risk is well established. The findings regarding the consumption of red meat are particularly relevant, albeit mixed. Out of 150 respondents, only 15 (10%) claimed that they did not eat processed or red meat, 30 (21%) ate 1-2 servings a week, and a greater number, 40 (28%) consumed 3-5 servings a week. In addition, 30 respondents (21%) reported consuming 6-10 servings a week, whereas another 30 (21%) consumed over 10 servings a week. These findings are particularly troubling because studies have shown that the consumption of red and processed meats is linked to the development of cancer, particularly breast cancer for women who are post-menopausal. The data indicates that a considerable part of the population has a high intake of red meat, which is largely contributing to the rising cancer statistics.

Conversely, the data where 10% of respondents do not eat processed or red meat suggests that some individuals may understand the health implications of these foods and consciously try to limit their consumption. Breast cancer has long been associated with insufficient physical activity, and the level of activity among respondents was reasonably high. From the data collected, 40 respondents (28%) reported participating in 1-3 hours of moderate to vigorous activity and 35 respondents (24%) reported participating in 4-6 hours. Additionally, 25 respondents (17%) reported no physical activity, and another 20 (14%) engage in less than a single hour of physical activity. Although a sizable portion of respondents (52%) exercise at least one hour a week, the fact that 17% of respondents report no physical activity at all is concerning. These results, in addition to the results in the previous section, show how effective exercise can be in combating breast cancer and improving women's health overall. Exercise promotes the maintenance of a healthy weight, lowers hormone levels, and improves immune functionality contributing to reduced risk of breast cancer. The relatively passive demeanor of women in exercising reveals a gap for prospective health schemes directed towards raising physical activity levels. Surveyed data

from the 145 participants reveals several important aspects regarding breast cancer risk which include hormonal factors, environmental factors, nutrition, and levels of physical activity. Some of the participants seem to adopt behaviors that lower the risk of developing breast cancer, such as reducing red meat intake and exercising. However, many others appear to be risked by exposure to environmental hazards, hormonal birth control, and diets rich in processed and red meats. These issues could be addressed through education, regulation, and awareness campaigns, which would significantly help in lowering breast cancer diagnosis rates. The associated nature of these factors calls for further study to determine how they interact to influence the risk of developing cancer.

Table 1: Breakdown of Responses on Hormonal and Environmental Factors	

Category	Subcategory	Response	Count	Percentage
<b>1. Hormonal Factors</b>	How many full-term	0	35	24.1%
and Reproductive	pregnancies have you had?			
History				
		1	45	31.0%
		2	35	24.1%
		3	20	13.8%
		4 or more	10	6.9%
	What age were you when you	Below 11	10	6.9%
	had your first menstrual			
	period (menarche)?			
		11	20	13.8%
		12	40	27.6%
		13	45	31.0%
		14 or older	30	20.7%
2. Use of Hormonal	For how many years have you	Never used	50	34.5%
Contraceptives	used hormonal			
	contraceptives?			
		Less than 1	10	6.9%
		year		
		1-5 years	35	24.1%

		6-10 years	30	20.7%
		More than 10	20	13.8%
		years		
3. Environmental	How frequently have you	Never	20	13.8%
Exposures	been exposed to			
	environmental chemicals or			
	toxins?			
		Rarely	40	27.6%
		Sometimes	45	31.0%
		Often	30	20.7%
		Very often	10	6.9%
4. Lifestyle and Diet	How many servings of	None	15	10.3%
Factors	processed or red meat do you			
	consume per week?			
		1-2 servings	30	20.7%
		3-5 servings	40	27.6%
		6-10 servings	30	20.7%
		More than 10	30	20.7%
		servings		
5. Physical Activity	How many hours per week do	None	25	17.2%
Levels	you engage in moderate to			
	vigorous physical activity?			
		Less than 1	20	13.8%
		hour		
		1-3 hours	40	27.6%
		4-6 hours	35	24.1%
		More than 6	25	17.2%
		hours		

 Table 2: Summary of Risk Factors and Protective Behaviors

Category	Potential Risk	Percentage of	Protective	Percentage of
	Factor	Respondents	Factor	Respondents
Hormonal	Early menarche	20.7%	Full-term	55.2%
Factors and	(Below 12)		pregnancies (1-2	
Reproductive			pregnancies)	
History				
Use of Hormonal	Prolonged use of	41.4%	Never used	34.5%
Contraceptives	hormonal		hormonal	
	contraceptives		contraceptives	
	(More than 5			
	years)			
Environmental	Frequent exposure	58.6%	Rare or no	41.4%
Exposures	to toxins		exposure to	
	(Sometimes or		toxins	
	more)			
Lifestyle and Diet	High consumption	42.4%	Low	31.0%
Factors	of processed/red		consumption or	
	meat (6+ servings)		no consumption	
			of red meat	
Physical Activity	Sedentary lifestyle	17.2%	Moderate to	69.0%
Levels	(No physical		vigorous physical	
	activity)		activity (1-6	
			hours)	

# **Summary Analysis:**

• Hormonal Factors: The bulk of respondents (55.2%) indicated that they have had 1 to 2 full term pregnancies which may offer a moderate protective effect from breast cancer. On the other hand, the early onset of menarche (less than 12 years) poses a risk factor for about 20.7% of respondents.

• Use of Hormonal Contraceptives: A considerable proportion of respondents (41.4%) reported having used hormonal contraceptives for more than five years. This could heighten the risk of

breast cancer. Whereas 34.5% of respondents never used hormonal contraceptives which may reduce risk.

• Environmental Exposures: An average of 58.6% of respondents indicated that they frequently meet various chemicals or toxins, which presents a potential risk factor. In comparison, 41.4 percent reported having some or no exposure.

• Diet and Lifestyle: More than 40% of respondents reported that they consume high amounts of red or processed meat (over 6 servings a week), which is linked to higher risk of developing breast cancer. A considerable number of respondents (69%) reported engaging in some form of physical activity, which can reduce risk.

**DISCUSSION:** The information that accumulates from these survey responses highlights the myriads of factors associated with risk of breast cancer, most importantly the hormonal factors, environmental factors, dietary influences, and overall activity levels. Studying these variables helps to shed light on the mechanisms of interaction pertaining to the risk of breast cancer, especially considering the wide variability of responses in each variable.

Pregnancy and childbearing are the most prominent life event regarding breast cancer risk. The findings of this study show that a significant number of respondents (55.2%) having one or two full-term pregnancies is a common occurrence, which is lower in cancer risk. The process of pregnancy, specifically multiple pregnancies, results in changes within the breast tissue such as differentiation and an increase in the concentration of certain hormones (breast structural changes) that lower the cancer risk over time. Rather 24.1% of respondents reported no children and 6.9% having more than two children is striking, meaning that these factors may offer some protection, however, their overall impact on this risk is more complicated than the number of pregnancies suggests. Menarches are another crucial factor that impacts breast cancer development. Survey results suggest that a notable share of respondents 31% of respondents first reported their first period at the age of 13, while menarche before the age of 12 is 20.7%. Early onset of menstruation is strongly correlated with a higher breast cancer risk, likely due to greater lifetime estrogen exposure. Increased estrogen exposure, in turn, results from earlier menarche and a greater cumulative lifetime estrogen due to the menstrual cycles. Although early menarche is but one piece of the puzzle in the hormonal risk dynamic, it certainly indicates how critical hormonal factors are in breast cancer risk. There is reason to believe that menarches, alongside one's reproductive history, are important factors to investigate regarding breast cancer risk in such populations.

The association of hormonal contraception with breast cancer has also attracted quite a bit of attention and study. The literature is mixed, with some research indicating that use of hormonal contraceptives for greater than 5 years does create a significant risk. In our case, 41.4% of all participants claimed to have had hormonal contraceptive treatment for longer than 5 years, which substantially adds to their risk. This gap in the literature constitutes a significant problem, because it is likely that women do not understand the adverse health consequences posed by prolonged use of contraceptives, especially the increased risk for breast cancer. Moreover, hormonal contraceptives serve added value by preventing unplanned pregnancies, managing one's menstrual cycle, and lowering the chances of developing ovarian and endometrial cancers. The communication regarding the benefits versus the possible increased susceptibility to breast cancer, particularly in women who use contraceptives for long durations, requires more emphasis, especially for women considering these healthcare decisions.

Intriguingly, 34.5% of the respondents claimed to have never used hormonal contraceptives. This is potentially useful in terms of lower breast cancer risk since avoiding hormonal exposure means the body accumulates less estrogen. The relationship between the use of hormonal contraceptives and breast cancer risk may be complex, but the evidence suggests that some members of the sample population may be of lower risk due to their contraceptive choices, which becomes vital in assessing personal risk factors.

Factors associated with the environment, such as the use of toxic substances, herbicides, or industrial waste, have been increasingly recognized for contributing to the risk of breast cancer. As reported in the survey, a striking 58.6% of respondents indicated they were "sometimes" or "often" exposed to environmental toxins. This is alarming since many of these chemicals, such as endocrine disrupting compounds present in plastic materials and pesticides as well as household cleaning agents, are known to interfere with hormones and pose a heightened risk of breast cancer. A notable portion of respondents (27.6%) reported "rare" exposure, but a smaller portion (13.8%) reported no exposure at all to such chemicals.

The proportion of respondents exposed to environmental toxins captures the need to raise awareness concerning the lack of knowledge which exists on the effect everyday chemicals have and lifestyle modifications that may mitigate such exposures. While the direct relationship between environmental toxins and breast cancer is still being elucidated, there is considerable evidence indicating that prolonged exposure to these substances may adversely impact one's health. Environmental exposure, particularly for individuals living in vulnerable populations, places or frequent users of these materials self-identifying as users presents a ready opportunity for public health action. Furthermore, strategies aimed at controlling breast cancer in the wider population could be improved by introducing policies aimed at restricting the public availability of known carcinogenic materials along with educational campaigns focused on increasing awareness of these poisons.

Diet and lifestyle are core determinants of breast cancer risk, and this survey identifies several ways in which dietary practices are likely to moderate that risk. 42.4% of respondents indicated that they consumed red or processed meat six or more times a week. This is troubling because many studies link high red and processed meat consumption to increasing the risk of several cancers, including breast cancer. The consumption of these meats, which are typically associated with high fat content, as well as with dangerous substances such as heterocyclic amines and polycyclic aromatic hydrocarbons, is known to instigate an inflammatory response which may fuel cancerous growths in the breast tissue. While some respondents (31%) reported low to no consumption of red meat, the worrying proportion of this population with high red meat consumption is alarming.

From a different angle, some individuals might be actively trying to lower their consumption of red or processed meats, which may potentially lower their cancer risk, as indicated by the data. Specifically, the endorsement of a plant-based diet that emphasizes vegetable consumption while limiting processed meats may form an effective public health initiative to reduce the risk of breast cancer. It is evident that educational programs on nutrition paired with dietetic interventions focused on the reduction of red meat intake to benefit populations as eating habits can often be modified by simple lifestyle changes.

Exercise is one of the most effective protective measures against breast cancer. Indeed, regular exercise has been shown to lower estrogen levels, reduce body fat, and improve immune function, all of which are breast cancer risk mitigators. Survey results indicate that 69% of respondents perform at least some level of physical activity weekly, with 27.6% of respondents stating they engaged in 1 to 3 hours of exercise and 24.1% engaged in 4 to 6 hours of exercise a week. This is optimistic as moderate to vigorous physical activity is regarded as the most beneficial level of cancer protection. However, one concerning statistic is that 17.2% of respondents fell within the "no physical activity" category, as physical inactivity is a known risk factor for breast cancer.

The relatively high level of physical activity is encouraging because it means that a good number of women are trying to lead active lifestyles and lower their cancer risk. However, tailored programs to increase activity levels among the sedentary population could dramatically decrease the incidence of breast cancer. If directed at people who already face other risk factors, public health initiatives promoting daily physical activity could partially resolve the issue at hand.

The combination of hormonal factors, environmental exposures, nutrition, and physical activity appeared to interact with each other to influence the risk of developing breast cancer. Although a significant portion of the respondents reported protective behaviors, such as regularly participating in some form of exercise and restricting red meat intake, risk factors still exist within the population. The pervasive exposure to environmental carcinogens, long-term hormonal contraceptive use, and high consumption of processed meats represent worrisome patterns that need more focus. These changes, implemented through health education, public policy, and lifestyle adjustments, could help reduce the incidence of breast cancer and improve public health outcomes. There is a need to further explore these concerns and construct public awareness campaigns to counteract these lifestyle risk factors and reduce the rate of breast cancer incidence in populations.

#### **CONCLUSION:**

In closing, as respondents' data were analyzed, it became increasingly clear how intertwined the influential factors—hormonal, environmental, social, and personal—were in determining the likelihood of breast cancer.

The results emphasize both protective and risk-enhancing behaviors among the respondents and note that the development of breast cancer is the outcome of many interacting factors, and not the result of one single factor. Increasing risks include, for example, early menarche coupled with low parity, whereas breast cancer risk, especially in women with prolonged usage, relates to hormonal contraception use. The exposures of particular concern include environmental factors such as toxins and chemicals, which over half the respondents reported having frequent contact with and considered possibly carcinogenic. Other notable and reinforcing considerations include dietary practices like red and processed meat intake which emerge as significant risk factors in existing research attributing these to increased breast cancer incidences. Despite the concerns, a positive finding was some respondents actively participated in physical activities known to lower breast cancer risks. As was apparent in majority of the results, respondents did exhibit behaviors

associated with lowering breast cancer risks through exercising and maintaining a lower intake of red meat. However, there is an immediate need to educate on minimization of exposure to environmental toxins, hormonal contraceptive reduction where suitable, and advocating better eating practices to enhance the overall health of women. Public health efforts can greatly help in lowering the incidence of breast cancer by increasing awareness and providing actionable steps to alleviate these risks. As is with all good research, continual investigation into the synergetic impact of such factors will be critical in advancing useful prevention techniques as well as in enhancing health quality indicators.

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