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A Statistical-Based Public Health Perspective: Effects of Dietary Behaviour on the Risk and Incidence of Breast Cancer

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Abstract

Background: The purpose of this statistical-based public health study was to examine the association between dietary behaviours and breast cancer risk and incidence.

Design and Methods: This is a literature review, including observational prospective and retrospective studies from the EBSCO host and Cochrane Library databases. The California Health Interview Survey, including 43,020 participants, was uploaded into the IBM SPSS program. Inclusion criteria were as follows: women from Caucasian, African American, Asian/Pacific Islander, Native/Alaska American Indian, and Latino/Hispanic ethnic backgrounds; age ≥ 40 years; confirmed diagnosis of breast cancer. The following variables were examined: obesity, measured by body mass index; fruit and vegetable consumption per day; abnormal mammogram result.

Results: Pearson's correlation p-value [$p=0.017$] and a one-tailed significance of <0.001 were used. Daily consumption of fruit and vegetables was not statistically significant [one-tailed test, $p=0.337$]. Linear regression using ANOVA [F value=6.024] showed a statistically significant association between breast cancer risk and dietary behaviours ($p=0.002$), with an increased risk of breast cancer among women who were obese and consumed less than five portions of fruit and vegetables, with OR: 2.1.

Conclusion: Obesity and low daily consumption of fruit and vegetables is strong predictor for the development of breast cancer. Health educational programs aimed at dietary behavioural modification are crucial to improve breast cancer incidence.

Keywords: Dietary behaviour; Breast cancer; Obesity; Risks; Incidence

Introduction

Over thousands of years, medicine has transformed into what is currently known as modern medicine. Through public health initiatives and research, modern medicine has improved the quality of life of patients and the safety of medical procedures and practices. With the emergence of chronic diseases, such as cancer, modern medicine has taken a multi-faceted approach to treatment and prevention, addressing social, lifestyle, environmental, political, and therapeutic factors. Public health has implemented programs, using evidence-based studies, to improve negative population behavioural habits.

Description of the Issue

A number of studies have examined risk factors for the development of various types of cancer. Cancer remains one of the leading causes of morbidity and mortality in the United States, despite the decline in cancer incidence and mortality due to advances in research, treatment, and screening programs [1]. Over the last two decades, the high incidence rates of breast cancer have remained stable, while breast cancer mortality has been slowly decreasing [2]. With scientific breakthroughs and potential new pharmaceutical interventions, the rate of decline of breast cancer mortality and incidence in the United States is greater than the anticipated national health targets. The World

Health Organization (WHO) and other organizations have conducted studies to examine lifestyle, environmental, and behavioural factors that can contribute to the risk, development, and treatment of breast cancer patients. Obesity and overweight associated with the Westernized diet, largely comprising fatty foods, slow the decreasing rate of breast cancer incidence and mortality. Over the last 30 years, the Western culture has adopted the fast-food eating lifestyle. Statistics show that Americans eat from fast-food restaurants at least twice per week. The decreasing prices of fast-food and increasing economic difficulties, can further impact the incidence of chronic diseases, such as cancer [3]. The WHO has concluded that dietary factors contribute to 30% of all cancers in the Western world and to 20% of cancers in developing countries. Persons whose diet includes a higher fruit and vegetable consumption have a lower risk of developing cancer, compared to persons whose diet has a higher content of red meats and animal products [4]. A number of studies have examined dietary factors affecting the pathophysiological mechanisms of cancer.

Dietary Effects of Cancer

Red meat and other animal products contain carcinogenic agents and biochemical precursors that can increase the growth of cancer cells. Animal products cooked under high temperatures yield, heterocyclic amines (HCA) and polycyclic aromatic hydrocarbons (PAH). These carcinogenic agents have the ability to intercalate into the DNA structure, causing mutations during the mitotic cycles. Studies have concluded that meat intake is a risk factor for breast

cancer, in conjunction with caloric intake and total fat intake. HCA and PAH contained in meat are distributed to the mammary glands and become activated within the human body [4]. The consumption of high fatty foods, such as meat and other animal products, can increase the production of oestrogen, which encourages cancer cell growth, particularly within the mammary area. Research has currently shown that, animal products are enriched and artificially comprises hormones and phytoestrogens, which can have implications on hormone sensitive tissues, such as breast, uterus, and ovaries [5]. Fatty food intake is associated with high levels of circulating oestradiol while increasing vegetable and fruit intake can decrease circulating oestradiol by 30% [4].

Significance of Breast Cancer and Obesity

Breast cancer remains one of the leading causes of cancer among women worldwide, followed by lung cancer, which is the primary cause of cancer related mortality. The association between diet and the development of breast cancer has been controversial [6]. Studies have shown that women with the greatest consumption of fruits and vegetables were 3% to 9% less likely to develop breast cancer. In view of this limited protective effect of fruit and vegetables, researchers have considered the overall diet, rather than specific components, as well as other factors, such as body mass index, adipose composition, and obesity [7]. Public health strategies aimed at implementing dietary programs for cancer survivors and populations at risk of developing breast cancer can have an impact on the prevalence and incidence of breast cancer and may also result in improved quality of life.

According to the most recent data, in 2007, approximately 202,964 women were diagnosed with breast cancer, and almost 41,000 women died from breast cancer [8]. Approximately one-third, which is 33.8% of the adults in the United States are obese, largely affecting women of lower socioeconomic status or lower income, compared to women with a higher income status [8]. Obesity and fatty food intake increase the risk cancer, particularly breast cancer in post-menopausal women. This can limit the decline in the incidence of breast cancer in the United States.

Purpose of the Study

Animal studies on rat mammary cancer cells have examined proliferative growth patterns associated with exposure and culture in environments with high saturated fats or lipids and unsaturated fats. These findings corroborate those of studies conducted on humans indicating that diet has an impact on the risk of breast cancer. This study is based on data from the California Health Interview Survey (CHIS) and will examine the association between breast cancer incidence and the consumption of vegetables and fruits and obesity (high caloric intake).

A study was conducted at the University Hospital of Santa Maria in 2006 and involved 71 consecutive women with breast cancer. The following variables were assessed: body mass index (BMI), percentage body fat, dietary intake, and carcinoma biopsy. Patients were aged between 36 and 90 years of age; 82% patients were either overweight or obese and, of these, 89% scored a BMI of over 30%; 61% of patients accrued further weight over the course of a year. There was a strong association between the more histologically aggressive cancers and increased BMI, percentage of body fat, and unhealthy dietary intake, characterized by a higher saturated fat intake. Maintaining a healthy body fat percentage and BMI, and a healthy dietary intake can have a protective effect against breast cancer [7].

A further study examined the benefits of physical activity and dietary intake on the risk of breast cancer. Several women with early stage breast cancer were assessed by a questionnaire to evaluate their level of physical activity and fruit and vegetable consumption. The results of the study concluded that physical activity, combined with a diet rich in fruit and vegetables, has a protective effect against breast cancer in oestrogen-positive receptor patients [2]. A comparable prospective questionnaire-based study was conducted between 2007 and 2008. The study involved 438 Chinese women with primary breast cancer and 438 Chinese women with no breast cancer and examined the dietary fibre effects on oestrogen and progesterone receptors. Dietary fibre and fibre fractions were found to be inversely associated with breast cancer risk. An inverse association was also observed between total dietary fibre, comprising fruits and vegetables, and positive and negative oestrogen and progesterone receptor tumours [3].

Epidemiological Reviews of Studies and Articles

The Department of Social and Administrative Health Sciences in California, Berkley, conducted a review of approximately 200 studies examining the association between fruit and vegetable intake and cancer. Overall, 128 out of 156 dietary studies found a statistically significant protective effect of fruits and vegetables, expressed in terms of relative risk. Furthermore, the lowest one-quarter of the population consuming low amounts of fruits and vegetables experienced approximately twice the risk of cancer compared to those individuals with a higher fibre intake [9].

A further review was conducted using the WCRF/AICR database, including up to date studies published after 2006, to conclude the accuracy of judgment of dietary implications on cancer. Two studies found a modest, yet significant, increase in the risk of breast cancer with an odds ratio of 1 for women with a fat intake of more than 20 g per day. A further study found that a low-fat diet reduced the risk of breast cancer with borderline significance. However, studies have also concluded that there is no association between specific fatty acids or lipids and the risk of breast cancer; while others studies only show risk for overweight post-menopausal women, with a lower risk for premenopausal women [10]. A review of 19 articles published between 1995 and 2008 and using an exploratory approach, reported an association between dietary patterns and breast cancer. Most articles reported an association between the risk of breast cancer and dietary patterns, although 6 articles reported that there was no association. While a number of studies found a significant correlation between diet and breast cancer, there still lies a lack of evidence that dominates which prospective should be established within public health and medical practice [6].

Perceptions of the population on breast cancer risk and diet

The implementation of public health policies and practices for patients with breast cancer and obesity may not be sufficient to modify and influence the perceptions of the population in changing dietary lifestyle to decrease their risk of developing breast cancer. One study conducted a pilot study to assess adherence to a 12 month diet and an exercise intervention program to achieve a five percent or greater weight loss compared to the cohort receiving usual care, in the form of written advice. The study involved 40 premenopausal women at risk of

developing breast cancer, 39 women in the usual care group. The experimental group achieved a ≥ 5% weight loss, with large reductions in energy intake, including fat intake, compared to the usual care group, although there were no measurable differences in the risk of cancer [11]. A comparable study was conducted in Canada, assessing the beliefs of 29 breast cancer survivors, between the ages of 40 to 60 years, regarding diet, health, and breast cancer. Individual interviews were conducted and beliefs were categorized according to three perspectives: traditional, focusing on regular animal products; alternative, focusing on toxins and carcinogens; and mainstream, focusing on fruit and vegetables. The study concluded that the women's beliefs and perspectives about health and diet were not related to their breast cancer status. Therefore, the range and conviction of the belief of the protective or harmful effects of food influence the overall nutritional perspective [12].

Limitations to the study

A number of studies have demonstrated a significant association between dietary patterns and the risk of breast cancer. The results of these studies are consistent; however, there is a lack of evidence on the etiological role of dietary components [6] and therefore, there is insufficient evidence to make dietary recommendations affecting breast cancer risk. Specifically, no study has examined the biochemical mechanisms underlying fatty acids or fat intake in the cellular signaling or proliferation of breast cancer on the molecular level. Of note, these studies have different hypotheses and methodologies. A number of studies examined BMI and body percentage, while others examined fatty acid or fibre on the oestrogen receptors, with higher specificity towards postmenopausal women. More congruency is needed in this area to make clear and concise recommendations for dietary modifications among women with higher breast cancer risk. Confounding limitations include age distribution of the population, in addition to racial and genetic pre-dispositions to breast cancer.

Methodology of the Study

The CHIS is the one of the largest state surveys in the United States and analyses the health situation and health care of a large and diverse population, including largely underrepresented minority populations. The survey is conducted every two years, via a randomized telephone dialing system, which also includes calls to cell-phones. CHIS ensure that populations such as African Americans, Latino/Hispanic, Asian/Pacific Islanders, and American/Alaska Native Indians are represented [8]. The survey covers approximately 50,000 households, including all 58 counties and covering topics such as obesity, cancer, diabetes, health status, health care policy, health related behaviours, and other demographic factors [8]

Study design, study variables and measurements

This study is a cross-sectional study examining the causal association between variables on the basis of data extrapolated from specific groups over a specified time, between breast cancer and obesity, fatty food intake, and fruit and vegetable intake. The study population includes the following: persons meeting the diagnostic criteria for obesity, persons consuming fast food meals at least 5 times per week, persons with an increased weekly consumption of fruit and vegetables, and persons with abnormal mammogram [8].

Study participants

This study included women from a range of ethnical backgrounds, including Caucasian, African American, Asian/Pacific Islander, Native/Alaska American Indian, and Latino/Hispanic, aged ≥ 40 years with a confirmed diagnosis of breast cancer. The total number of participants was approximately n=43020 [8].

Data and Outcomes

This study assesses the risk of developing breast cancer due to dietary pattern behaviours. The diagnosis of breast cancer is the dependent variable, while daily consumption of fruits and vegetables and overweight or obesity is the predictors, or independent variables. The hypothesis is that unhealthy consumption of foods, among overweight or obese persons is associated with a statistically significant increase in the risk and incidence of breast cancer. It is also postulated that unhealthy caloric intake is a significant predictor for the development of breast cancer. The 2011 CHIS was used for the analysis of this hypothesis.

Statistical methods

The questions regarding breast cancer, daily consumption of fruit and vegetables, and overweight or obese status, are categorical variables and were asked as a dichotomous "yes" or "no" question. Pearson's correlation was used to examine the association between predictor and dependent variables. A linear regression method was used to further determine the strength of the association between the predictor and the dependent variable and identify strong predictors of breast cancer and variables inversely associated with breast cancer.

Data analysis and conclusion

The IBM SPSS Statistics 20.0 Standard program was used for statistical analysis. Pearson's correlation test revealed that obesity or overweight was a statistically significant indicator of breast cancer (p=0.017; one-tailed significance of 0.000), while daily consumption of fruit and vegetables was not statistically significant (p=0.002; one-tailed significance of 0.337) (Table 1). Using linear regression, within the ANOVA chart the F value was 6.024, with a significance of 0.002[b], showing the regression analysis was statistically significant (Table 2). Within the Coefficients box, the significant column shows that obesity or being overweight is a significant predictor for developing or being diagnosed with breast cancer at a value of 0.001. Daily consumption of fruit and vegetables was inversely associated with breast cancer (Table 3).

Conducting the odds ratio, including ages and women from 18 to 90 years old, the number of participants for obese and non-obese with breast cancer is approximately n=400,000 and the number of participants with five and greater and five and lesser daily consumption of fruits and vegetables is approximately n=350,000 The combined odds ratio for breast cancer risk for obese participants consuming less than five daily portions of fruit and vegetables is 2.1 times higher than the odds ratio for non-obese participants consuming more than five daily portions of vegetables and fruit. Figures 1 and 2 shows how Odds ratio was calculated.

Correlations				
Pearson Correlation	Breast cancer diagnosed early or late stage	1	0.017	0.002
	Overweight Or Obese	0.017	1	-0.016
	Consume 5+fruits/vegs per day	0.002	-0.016	1
Sig. (1-tailed)	Breast cancer diagnosed early or late stage	.	0	0.337
	Overweight Or Obese	0	.	0.001
	Consume 5+fruits/vegs per day	0.337	0.001	.
N	Breast Cancer diagnosed early or late stage	43020	43020	43020
	Overweight Or Obese	43020	43020	43020
	Consume 5+fruits/vegs per day	43020	43020	43020

Table 1: Pearson's correlation: Breast cancer diagnosis, obesity, and vegetable consumption.

ANOVA						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	0.527	2	0.263	6.024	.002b
	Residual	1881.554	43017	0.044		
	Total	1882.081	43019			
a. Dependent Variable: Breast cancer diagnosed early or late stage						

Table 2: ANOVA analysis of breast cancer and breast cancer staging of disease.

Coefficients[a]											
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**	**95.0% Confidence Interval for B**		**Correlations**		
		B	**Std. Error**	**Beta**	**Lower Bound**		**Upper Bound**	**Zero-order**	**Partial**	**Part**	
1	(Constant)	-0.99	0.003		-287.967	0	-0.997	-0.984			
	overweight or obese	0.007	0.002	0.017	3.445	0.001	0.003	0.011	0.017	0.017	0.017
	Consume 5+ fruits/vegs per day	0	0.001	0.002	0.476	0.634	-0.001	0.002	0.002	0.002	0.002
a. Dependent Variable: Breast cancer diagnosed early or late stage											

Table 3: Standardized and unstandardized coefficients and confidence intervals.

	Cases	Non-Cases
Obese	1,81,000	43,31,000
Non-Obese	1,74,000	42,05,000

Figure 1: Breast cancer.

Vegetable & Fruit Intake	Cases	Non-Cases
5 < daily	1,53,000	35,52,000
5 > daily	1,99,000	49,42,000

Figure 2: Vegetable intake.

Discussion and Conclusion

A number of studies have concluded that there is an association between breast cancer, particularly the more histologically aggressive cancers, and unhealthy consumption of fatty foods, high caloric intake, or obesity or overweight. Consumption of fruit and vegetables can decrease the risk of developing breast cancer. It is well established that persons who are obese or overweight consume more calories than those being burned or oxidized. Obesity or being overweight is a strong predictor of the risk of breast cancer. Studies have also shown that cancers that were most aggressive and patients with breast cancer were also more likely to have low consumption of fruits and vegetables, be overweight or obese, have a high BMI, and high fatty food consumption. Conversely, fruit and vegetables have a protective effect and decrease the risk of developing breast cancer. Daily consumption of fruits and vegetables was not a predictor for breast cancer and was inversely associated with breast cancer. Therefore, daily consumption of fruit and vegetables has a protective barrier against breast cancer and decreases the risk of developing breast cancer, correlating with the previous studies conclusions.

Public health strategies implementing dietary programs for cancer survivors and populations at risk of developing breast cancer can affect the prevalence and incidence of breast cancer, also increasing quality of life. These findings, along with those of previous studies, can be used to develop future health behaviour programs focusing on the risk of breast cancer amongst women. One study found a weak association between the perception of diet and breast cancer risk. Increased funding and education, along with partnerships with health professionals, providers, and political advocators, can inform women, during medical visits and community gatherings, of the imperativeness of modifying eating patterns and lifestyle in order to ameliorate health outcomes. Policies can be implemented to mitigate the environment in areas where access to healthier food choices is difficult and food is of poorer quality. One study concluded that African American communities had twice the numbers of access of fast-food restaurants per square radius compared to Caucasian communities [13]. Research has also shown that poorer communities, such as African American communities, have a reduced access to healthy choices of restaurants and grocery stores [14].

Public health must utilize the core functions, along with business tactics that detail the evidence-based theories and scientific valid conclusions which strategize methods of mitigating the health conditions of the women's population, in terms of breast cancer risks, decreasing breast cancer incidence and mortality [15,16]. There is considerable evidence that diet is associated with breast cancer. Breast cancer, and obesity, remains a considerable problem in the United States. Public health requires programs, prevention strategies, and interventions to further study and educates the women about the association between breast cancer and obesity in order to decrease the rate of incidence and modify the perceptions of health and breast cancer risk [17]. Currently, only 5% of the National Cancer Institute funding is allocated to prevention, while 3% is spent on scientific models and systems, 14% is spent on aetiology of the disease [2]. It will be immensely abstruse to conduct more studies on truncated funding; therefore, it is imperative that public health initiatives focus on the allocation of funding for prevention and intervention [18,19].

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