Correlation Between Breast Cancer Cases and Socioeconomic Status in Washington State

Anisha Upasani

What is Breast Cancer?

Breast cancer is caused by abnormal cell growth in the breast tissue.

It has the highest rate of occurrence in women worldwide compared to other types of cancers.

There are two types of Breast Cancer:

Invasive ductal carcinoma (IDC):

It is the most common type of breast cancer accounting for 80% of all breast cancer diagnoses. The cancer cells begin in the breast ducts and spread to breast tissue outside the ducts and throughout the body.

Invasive lobular carcinoma (ILC):

Cancer cells begin in the lobules and then spread to nearby breast tissue. These invasive cancer cells can also spread to other parts of the body.

Symptoms of Breast Cancer

GENERAL SIGNS & SYMPTOMS

❑ A lump or thickening of the breast can be seen or felt

❑ The breast is red, purple, or sores appear in an area

❑ Fluid drains spontaneously & persistently from the nipple

❑ The breast shape changes or becomes large & swollen

❑ The breast skin dimples or puckers

❑ The nipple is pulled in toward the breast

❑ Skin around the nipple peels or flakes

❑ There is pitting of the breast skin (like the skin of an orange)

❑ Lumps appear under the arm

Risk Factors for Breast Cancer

Factors That Increase the Relative Risk for Invasive Breast Cancer in Women

Relative risk	Factor
>4.0	Age (65+ versus <65 years, although risk increases across all ages until age 80)
	Atypical hyperplasia
	Lobular carcinoma in situ
	Pathogenic genetic variations (e.g. *BRCA1, BRCA2, PALB2, TP53*)
2.1-4.0	Ductal carcinoma in situ
	High endogenous hormone levels (postmenopausal)
	High-dose radiation to chest (e.g. Hodgkin lymphoma treatment)
	Mammographically dense breasts
	Two or more first-degree relatives with breast cancer
1.1-2.0	Alcohol consumption
	Early menarche (<11 years)
	High endogenous estrogen or testosterone levels (premenopausal)
	Late age at first full-term pregnancy (>30 years)
	Late menopause (≥55 years)
	Never breastfed a child
	No full-term pregnancies
	One first-degree relative with breast cancer
	Obesity (postmenopausal)
	Personal history of ovarian or endometrial cancer
	Physical inactivity
	Recent and long-term use of menopausal hormone therapy containing estrogen and progestin
	Recent hormonal contraceptive use
	Weight gain in adulthood

Project Overview

Project Focus

- Comparative analysis of breast cancer occurrence in high & low-income households
- Socioeconomic disparities associated with breast cancer
- Explore potential racial disparity in breast cancer incidence & related mortality rate

Project Goals

- Raise awareness about the socioeconomic factors impacting breast cancer incidence and mortality rates
- Discuss social significance and psychological impact of breast cancer
- Understand new approaches / possible treatments

My Process

Research

I acquired WTN data with focus on breast cancer incidence & average yearly income in WA State.

I included external sources to expand the scope.

Analysis

I analyzed the data to identify patterns or trends.

I did a comparative analysis across different data sets to find potential correlations.

Conclusion/Thesis

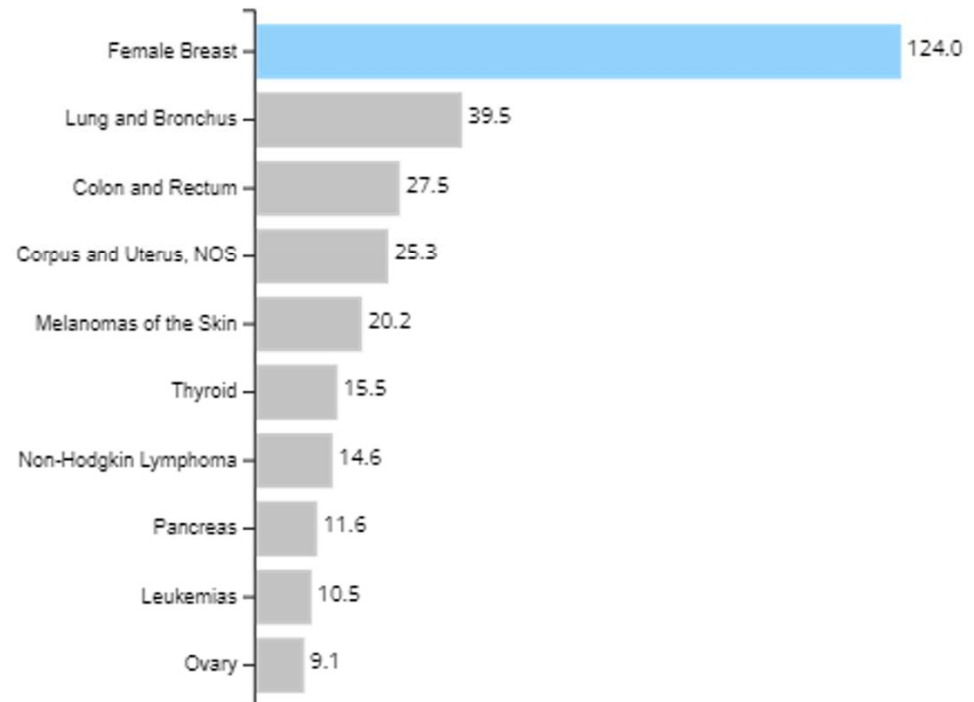I translated my observations into a conclusive thesis.

I maintained focus on correlation, causation and equity impact.

Breast Cancer Incidence Rates

Amongst the female population in Washington state, breast cancer has the highest incidence rates out of all cancers.

Breast cancer incidence rates are over twice as high as the second most common type of cancer (lung and bronchus cancer).

Top 10 Cancers by Rates of New Cancer Cases Washington, 2020, All Races and Ethnicities, Female

Cancer Type	Rate
Female Breast	124.0
Lung and Bronchus	39.5
Colon and Rectum	27.5
Corpus and Uterus, NOS	25.3
Melanomas of the Skin	20.2
Thyroid	15.5
Non-Hodgkin Lymphoma	14.6
Pancreas	11.6
Leukemias	10.5
Ovary	9.1

Breast Cancer Incidence by County
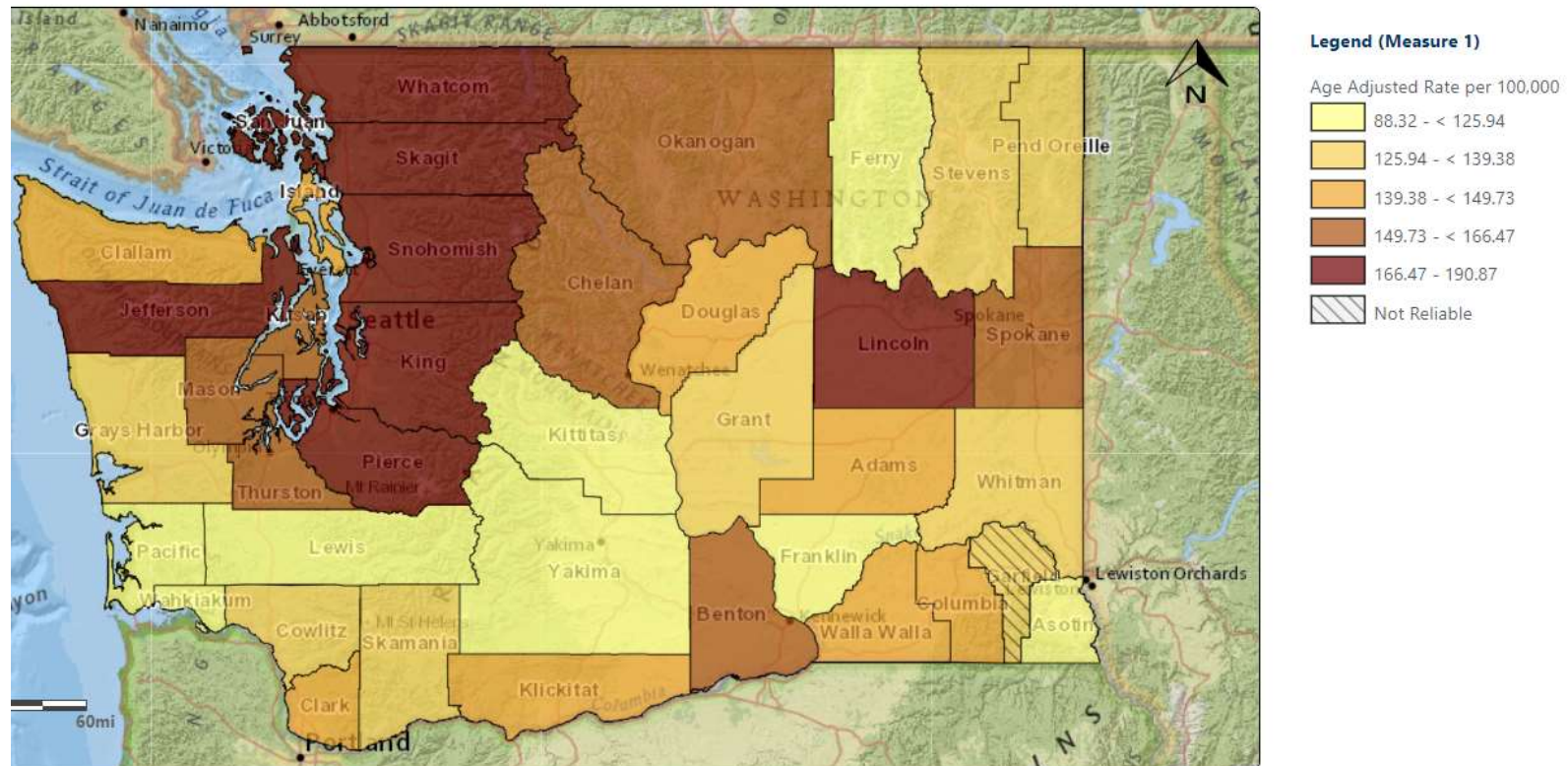
Breast Cancer Incidence in Females
Washington Tracking Network (WTN) – Map View

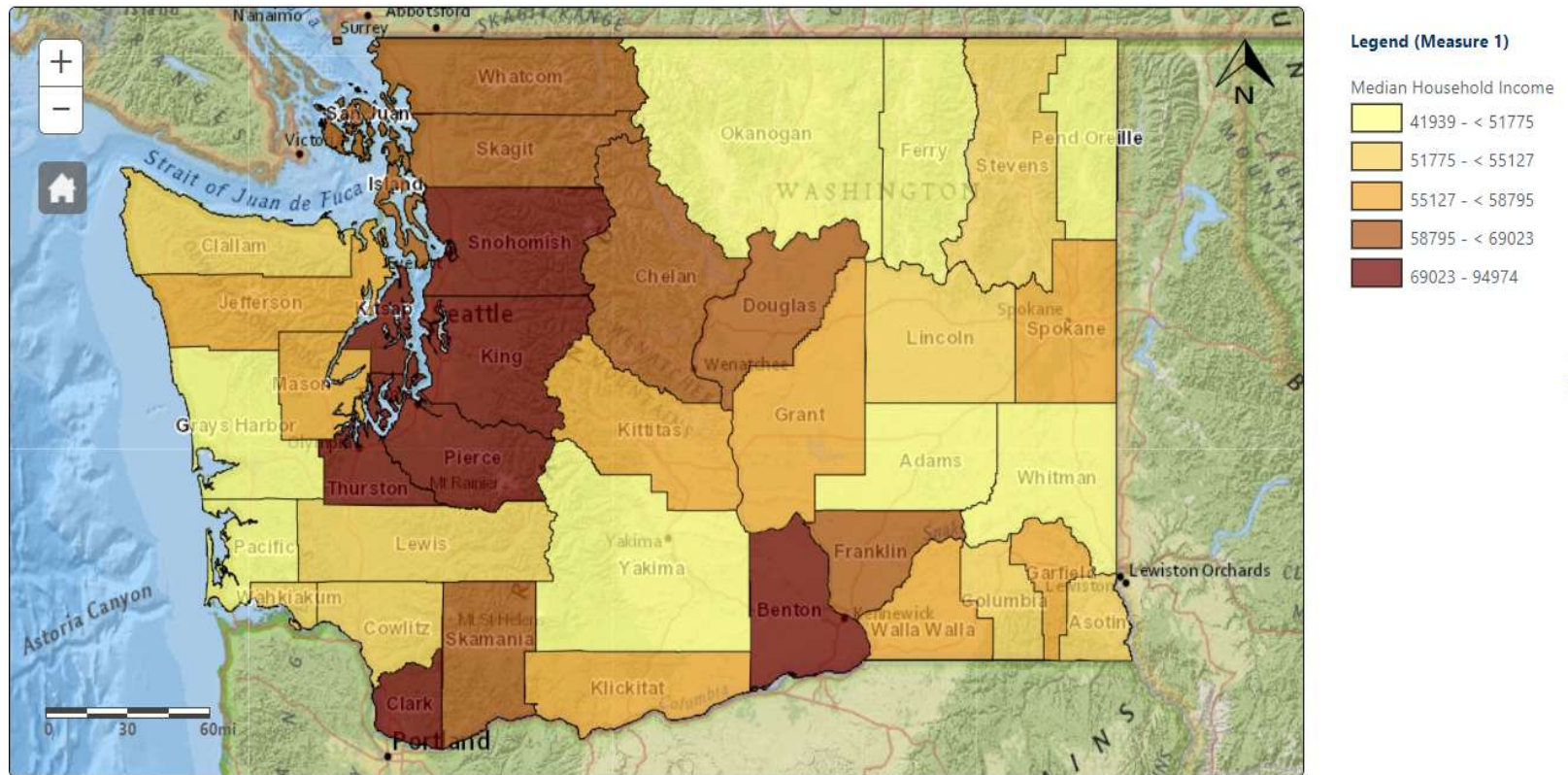# Median Household Income by County

Median Household Income
Washington Tracking Network (WTN) – Map View

What does this comparison show?

- The counties with the highest incidence rates are Pierce, King, Snohomish, Skagit, Whatcom, Jefferson, and Lincoln.

- The counties with the highest median household income are Pierce, King, Snohomish, Whatcom, and Benton.

- There appears to be a correlation between median household income and breast cancer rates across counties. Specifically, counties with higher median household incomes tend to report higher breast cancer rates, and conversely, counties with lower median incomes tend to have lower rates of breast cancer. This suggests that socioeconomic factors may play a role in the incidence of breast cancer.

- While acknowledging the possibility of outliers, like Benton and Okanogan counties, where this correlation doesn't hold as strongly, it's crucial to recognize that such exceptions are common in any analysis. The correlation seen here is too strong to disregard.

Age-Adjusted Incidence Rate
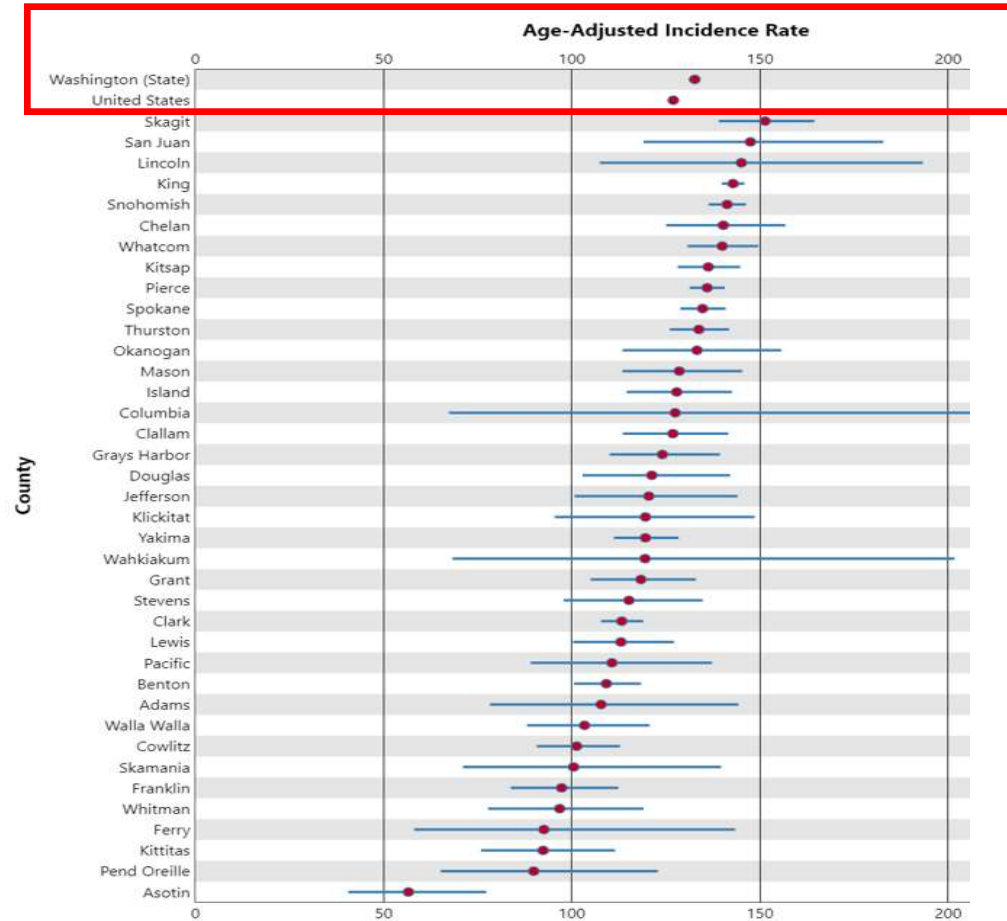
First graph shows Breast cancer incidence rate by county. It also shows occurrence rates in Washington as compared to the US (see top of the chart).

Second graph shows that Washington's average yearly income is above the US average.

Breast cancer incidence rates in Washington are also above the US average.

Additional Research

ACS Study Backs Observation

The American Cancer Society conducted a study examining the impact of socioeconomic status (SES) on health outcomes, specifically focusing on breast cancer prevalence.

A significant disparity in breast cancer rates across different income levels was observed. Low-income women experienced the lowest breast cancer prevalence rate. High-income women experienced the highest breast cancer rates. Prevalence rates among middle-income women fell almost exactly in the middle.

This data suggests a correlation between socioeconomic status and breast cancer incidence, where higher SES is associated with an increased rate of breast cancer.
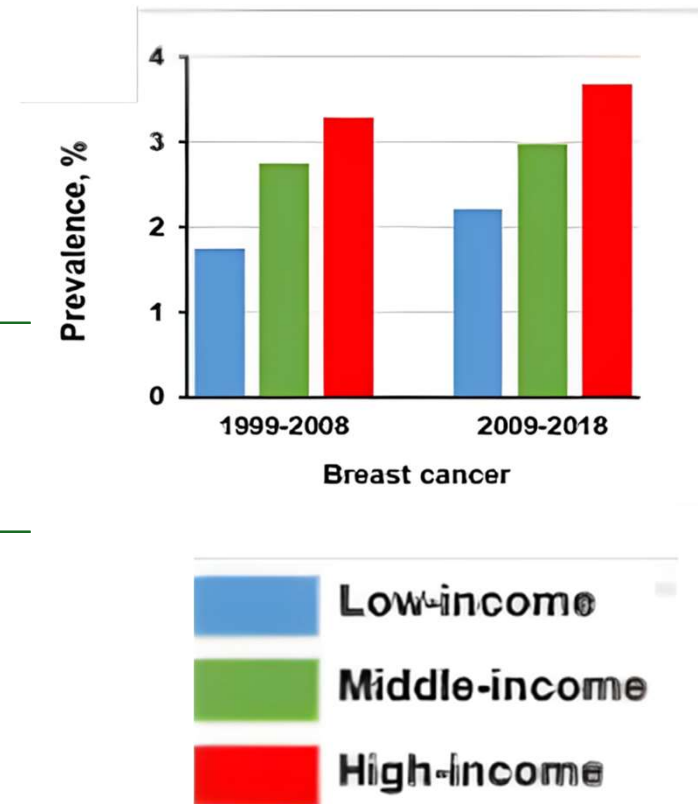
Breast Cancer Mortality Rates

The more populated counties like King, Pierce, and Snohomish, have the highest number of cases. These are also the more affluent counties.

As expected, likely due to the high number of cases, they also have the highest number of deaths.

The incidence **rates** here, however, are much higher than in lower-income counties.

While lower-income counties like Gray's Harbor, Yakima & Ferry have lower incidence rates, it is seen that the death rates in these counties are higher than the affluent ones.

This is likely due to women in higher income groups having better access to healthcare and being diagnosed earlier.

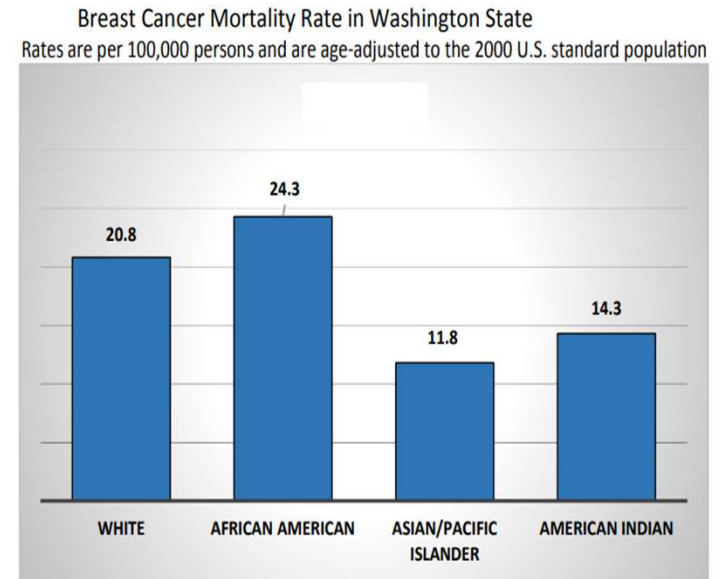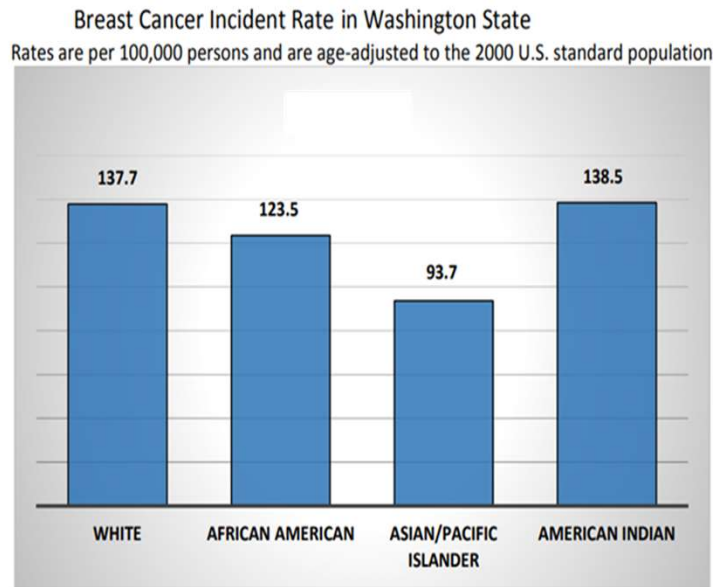Women in lower income groups may not have adequate access to healthcare, are typically diagnosed later, and have potentially weak access to treatment options – thus resulting in higher mortality rates.

| County | Incidence 2016-2018 Annual Average | | | Death 2016-2018 Annual Average | | |
| | Average New Cases per Year | Age Adjusted to 2000 US Census Population | | Average Deaths per Year | Age Adjusted to 2000 US Census Population | |
		Rate per 100,000	95% CI for Rates		Rate per 100,000	95% CI for Rates
Adams	11	146.1	(99 - 210)	n/c	n/c	n/c
Asotin	10	55.1	(35 - 86)	n/c	n/c	n/c
Benton	167	150.2	(137 - 165)	25	21.9	(17 - 28)
Chelan	73	141.9	(122 - 164)	11	20.7	(14 - 30)
Clallam	97	138.2	(121 - 159)	16	22.9	(16 - 33)
Clark	396	133.9	(126 - 142)	62	20.6	(18 - 24)
Columbia	4	106.4	(49 - 266)	n/c	n/c	n/c
Cowlitz	89	123.2	(108 - 140)	16	21.5	(16 - 30)
Douglas	38	144.6	(118 - 176)	6	20.1	(11 - 34)
Ferry	7	97.8	(57 - 182)	n/c	n/c	n/c
Franklin	46	118.3	(99 - 141)	6	14.6	(8 - 24)
Garfield	n/c	n/c	n/c	n/c	n/c	n/c
Grant	70	137.2	(119 - 158)	12	24.2	(17 - 34)
Grays Harbor	69	131.1	(113 - 153)	15	24.1	(17 - 34)
Island	96	138.6	(121 - 159)	12	15.6	(11 - 24)
Jefferson	45	141.6	(114 - 179)	5	18.7	(9 - 42)
King	2,207	192.0	(187 - 197)	220	18.6	(17 - 20)
Kitsap	302	160.8	(150 - 173)	34	16.8	(13 - 21)
Kittitas	32	126.8	(101 - 159)	6	20.2	(11 - 36)
Klickitat	23	139.6	(104 - 187)	5	23.3	(13 - 47)
Lewis	67	117.0	(101 - 136)	14	21.8	(16 - 31)
Lincoln	16	180.8	(128 - 261)	n/c	n/c	n/c
Mason	77	162.6	(140 - 188)	7	16.1	(9 - 27)
Okanogan	43	137.8	(113 - 168)	10	33.4	(22 - 51)
Pacific	19	96.3	(68 - 138)	4	16.4	(8 - 41)
Pend Oreille	16	144.7	(102 - 208)	4	34.7	(17 - 76)
Pierce	821	162.4	(156 - 169)	93	18.2	(16 - 21)
San Juan	24	151.0	(114 - 212)	4	27.0	(11 - 75)
Skagit	152	182.9	(165 - 202)	20	21.9	(16 - 29)
Skamania	12	149.7	(102 - 224)	n/c	n/c	n/c
Snohomish	825	172.2	(165 - 179)	86	18.4	(16 - 21)
Spokane	540	173.9	(165 - 183)	76	23.4	(20 - 27)
Stevens	47	146.4	(121 - 178)	5	17.2	(9 - 32)
Thurston	274	148.1	(138 - 159)	39	20.1	(16 - 24)
Wahkiakum	3	107.3	(39 - 282)	n/c	n/c	n/c
Walla Walla	50	129.5	(108 - 155)	7	17.3	(10 - 29)
Whatcom	243	177.5	(164 - 192)	29	19.4	(15 - 24)
Whitman	25	138.6	(107 - 178)	n/c	n/c	n/c
Yakima	167	120.1	(110 - 131)	27	18.6	(15 - 23)
WA STATE	7,206	164.0	(162 - 166)	890	19.4	(19 - 20)

Breast Cancer Incidence vs Mortality Rate By Race

Breast Cancer Incident Rate in Washington State
Rates are per 100,000 persons and are age-adjusted to the 2000 U.S. standard population

137.7 123.5 93.7 138.5
WHITE AFRICAN AMERICAN ASIAN/PACIFIC ISLANDER AMERICAN INDIAN

Breast Cancer Mortality Rate in Washington State
Rates are per 100,000 persons and are age-adjusted to the 2000 U.S. standard population

20.8 24.3 11.8 14.3
WHITE AFRICAN AMERICAN ASIAN/PACIFIC ISLANDER AMERICAN INDIAN

While African American women are less likely to be diagnosed with breast cancer than White women, the mortality rate in African American females is higher.
Similarly, Asian women have a higher incidence rate than the mortality rate, which can also be attributed to their higher median income.

Correlation:
Socioeconomic Status and Breast Cancer Incidence

- Initial observations suggested a correlation between socioeconomic status and the incidence of breast cancer.
- It was revealed that households with higher median income have increased rates of breast cancer in certain areas.
- This correlation was initially surprising, given the common perception that diseases more severely impact lower-income regions.

Causation:
Understanding The Underlying Factors

- Further research revealed a causative pattern that explains the higher incidence rates of breast cancer among women from higher socioeconomic backgrounds.

- This pattern is largely attributed to differences in reproductive events and lifestyle choices like Early Menstruation & Late Menopause, Delayed Childbearing, Hormone Replacement Therapy (HRT), Access to Diagnostic Tests. Details below …

Causation continued...
Understanding The Underlying Factors

Early Menstruation & Late Menopause: Women with higher incomes tend to begin menstruation earlier and enter menopause later. This results in a longer lifetime exposure to estrogen, a hormone known to play a role in breast cancer development

Delayed Childbearing: Having children at a later age, which is more common among women with higher socioeconomic status, also increases breast cancer risk. This is because pregnancy and breastfeeding are known to have a protective effect against breast cancer, and delaying these events reduces their protective impact.

Hormone Replacement Therapy (HRT): The use of HRT is more prevalent among affluent women, further increasing their exposure to hormones and, consequently, their risk of developing breast cancer.

Access to Diagnostic Tests: Women in higher-income areas have better access to healthcare services, including diagnostic tests like mammograms. This increased access leads to more frequent diagnoses of breast cancer, contributing to the observed correlation.

Equity:
Racial Disparities in Breast Cancer Outcomes

- The issue of equity emerges when considering the disparities in breast cancer outcomes across different racial groups. Despite the higher incidence of breast cancer among affluent women, racial disparities in healthcare access, quality, and treatment contribute to worse outcomes for black women who:

- **Are Diagnosed at Later Stages**: Black women are more likely to be diagnosed with breast cancer at more advanced stages, reducing the effectiveness of treatment options.

- **Face Barriers to Accessing Care**: Systemic barriers, including socioeconomic factors, limit access to timely and appropriate cancer treatment for black women, contributing to disparities in survival rates.

- **Experience Differences in Treatment Quality**: Even when healthcare access is available, differences in the quality of treatment can further exacerbate disparities in outcomes.

Social Significance

- An affluent woman may experience confusion or shock from a positive diagnosis as wealthy people are less likely to expect such a serious diagnosis.

- Less affluent women may experience stronger feelings of hopelessness and despair, as healthcare is expensive, and possible treatment to cure the disease may seem out of their reach.

UNHEALTHY STRESS SYMPTOMS EXPERIENCED BY BREAST CANCER PATIENTS

Physical Reaction

48% of black and 44% of white patients experienced:
- High blood pressure
- Sexual problems
- Dizzy spells
- Feeling physically unwell
- Erratic bowel function

Psychological Reaction

46% of black and 44% of white patients experienced:
- Being afraid of cancer
- Lack of self-confidence
- Feeling gossiped about
- Feeling no one wants to work with them
- Depression
- Overly self-critical
- Feeling tense

Behavioural Reaction

57% of black and 48% of white patients experienced:
- Nail biting
- Loss of appetite
- Drop in personal standards
- Poor concentration
- Procrastination
- Emotional outbursts
- Restlessness

Psychological Effects of Breast Cancer

MAKE YOUR DIALOGUE COUNT

THE PSYCHOLOGICAL IMPACT OF ADVANCED BREAST CANCER

The emotions surrounding an incurable disease like advanced breast cancer are profound and affect more than just the women living with the disease.

ONCOLOGISTS

42% say that treating advanced breast cancer patients has a **significant negative emotional impact** on them

81% agree it's **unprofessional** to let emotions impact treatment recommendations

HOWEVER,

23% say emotions have **kept them** from sharing full information with patients

4 in 5 know it's very important to **show compassion** both at initial diagnosis and when treatment changes

CAREGIVERS

86% say their role is a **choice**, not an **obligation**

94% say that they try to maintain a **positive outlook**

Still, **3 in 4** agree their caring role has been an **emotional burden**

PATIENTS

More than half feel like a **burden** on their family

46% of patients **feel like less of a woman** AND **44%** say cancer has **stolen their dignity**

New Approaches: Early Detection & Cure

- **New imaging tests:** Early detection is key for patient survival. New tests such as scintimammographies (molecular breast imaging), elastographies, and positron emission mammographies (PEM), can help diagnose breast cancer in the earliest possible stages.

- **Artificial Intelligence:** AI can improve early cancer detection and can formulate personalized treatment plans based on the patient's medical history and diagnosis.

- **Gene testing**: Since 2003, when the first map of the human genome was created, genetic testing has been the pinnacle of cancer testing and treatment. By analyzing the patient's and the cancer's genetic makeup, oncologists can formulate precise medicine designed to target the specific genetic makeup of the tumor, and address and mutations found.

Low-Cost Treatment Plans in Washington State

Washington State has implemented measures to ensure those facing socioeconomic barriers are able to access the healthcare they need.

Fred Hutchinson Cancer Center offers financial aid to patients who are unable to afford the necessary cancer healthcare.

Low-income patients over the age of sixty-five may qualify for Medicaid, which as a public insurance program designed to provide financial assistance for healthcare.

The Washington State Department of Health provides breast cancer diagnostic services to eligible people, including those who have low income, or don't have health insurance.

Washington has a few low-cost treatment plans in place. However, the rising rates of breast cancer may prove to be more than the state can currently handle.

Conclusion

- Breast cancer rates have risen significantly in the last twenty years.

- These new treatment methods can help significantly reduce the incidence rates of breast cancer.

- Washington's low-cost treatment plans will allow everyone to get the treatment they need, leading to a big step in the direction of lowering cancer rates, and breaking down socioeconomic barriers.

- The goal of these new measures is to reduce breast cancer incidence and death rates across Washington state.

Reflection

This year, I had the opportunity to participate in the HOSA pathophysiology competition, where I learned about numerous diseases. Among these, cancer piqued my interest, prompting me to dive deeper into this topic. I chose to focus on breast cancer, given its prevalence as the most common type of cancer among women, and with the aim of raising awareness around this critical issue.

My research began on the WTN website where I found a wealth of information pertinent to breast cancer. I supplemented this data with additional research from external sources.

The most challenging aspect of this project was identifying a meaningful correlation amidst the vast amount of data and potential connections. After thorough analysis, I identified a particularly strong and intriguing correlation, that was also interesting to learn more about.

Throughout this project my primary objective was to conduct a comprehensive analysis based on data and avoid making superficial observations. My peers played a supportive role, primarily serving as sounding boards for my ideas until I got a logical direction for my research.

Through the process of creating this project, I learned to how read charts, graphs, and various data representations. I also learned how to make insightful connections based on my observations and explain my analyses in a logical manner.

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