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A Statistical Approach towards Breast and Vaginal Cancer in Women

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ABSTRACT

In this paper the statistical tools like the Baye's probability theory is used to study the incidences of breast cancer and the Binomial distribution is used for the study of Vaginal Cancer in women.

KEYWORDS: Baye's probability, Binomial distribution, breast cancer, vaginal cancer.

INTRODUCTION

Breast cancer starts when cells in the breast start to grow uncontrollably. These cells typically form a tumour which can be seen on an X-ray film or can be felt as a lump. The tumour is malicious (cancerous) if the cells spread into (invade) the neighbouring tissues or may extend (metastasize) to distant areas of the body. Breast cancer occurs almost completely in women, but men can also have breast cancer too. Breast cancers may begin from different parts of the breast. Most breast cancers start in the ducts which carry milk to the nipple (ductal cancers). Some begin in the glands of the breasts that produce milk (lobular cancers). There are also other types of breast cancers which are rare. A very few cancers also start in other tissues in the breast. These cancers are known as **sarcomas** and **lymphomas** and are not really considered as breast cancers. Even though many types of breast cancers may cause a lump in the breast, not all do. Most breast cancers are detected on **screening mammograms** which can spot cancers at an earlier stage, frequently before they can be felt, and before the symptoms grow. There are also other symptoms of breast cancer that a woman must watch for and report to a health care professional.

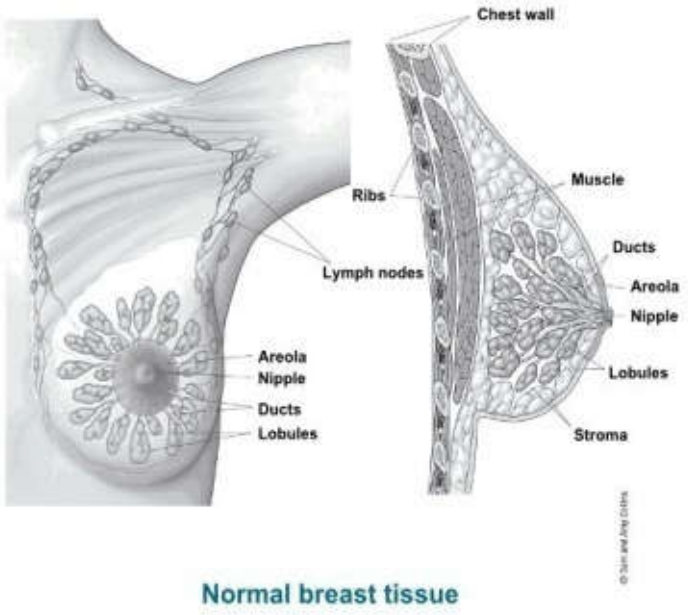

Figure 1: Normal breast tissue

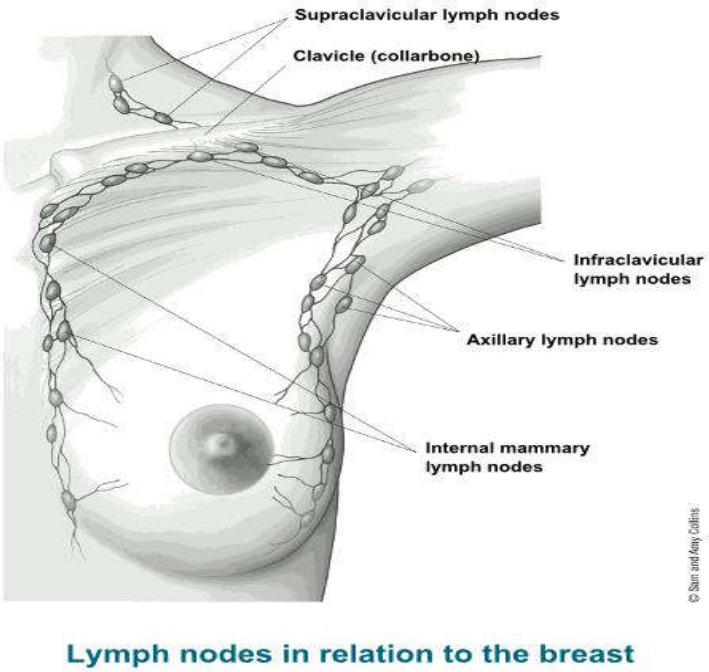

Figure 2: Lymph nodes in relation to the breast

Most of the lymph vessels of the breast drain into:

- Lymph nodes below the arm (axillary nodes)
- Lymph nodes in the region of the collar bone (supraclavicular [above the collar bone] and infraclavicular [below the collar cone] lymph nodes)
- Lymph nodes surrounded by the chest near the breast bone (internal mammary lymph nodes).

India's burden of breast cancer is only rising and regrettably, this type of cancer is becoming more general in the younger women population in our country. Furthermore, India pursues to have a low endurance rate for breast cancer with less than 60 percent of the women suffering from breast cancer are existing.

The Asia pacific journal of clinical oncology, reports that the breast cancer has ranked as the number one cancer amongst Indian females with an age-adjusted rate as high as 25.8 per 100,000 women and mortality rate of 12.7 per 100,000 women. Data reports from different recent national cancer registries were compared for incidence, mortality rates. The age-adjusted occurrence rate of carcinoma of the breast was reported as high as 41 per 100,000 women for Delhi, Chennai (37.9), Bangalore (34.4) and Thiruvananthapuram district (33.7). A statistically important rise in age-adjusted rate over time (1982–2014) in all the PBCRs namely Bangalore (annual percentage change: 2.84%), Barshi (1.87%), Bhopal (2.00%), Chennai (2.44%), Delhi (1.44%) and Mumbai (1.42%) was noted. The Breast Cancer Awareness Month is observed every year in the month of October to make awareness in the public concerning this fatal disease and while the statistics are shocking there are a small number of things that one can do to prevent breast cancer. An individual contracts breast cancer due to a grouping of factors and it is significant for an individual to recognize the risk factors linked with it and to know that who are more prone to contract breast cancer. However, one should also identify that there are a few things that put one in the risk of breast cancer and there isn't much one can do about it. **In 2018, 1,62,468 new cases and 87,090 deaths were reported for breast cancer in India**

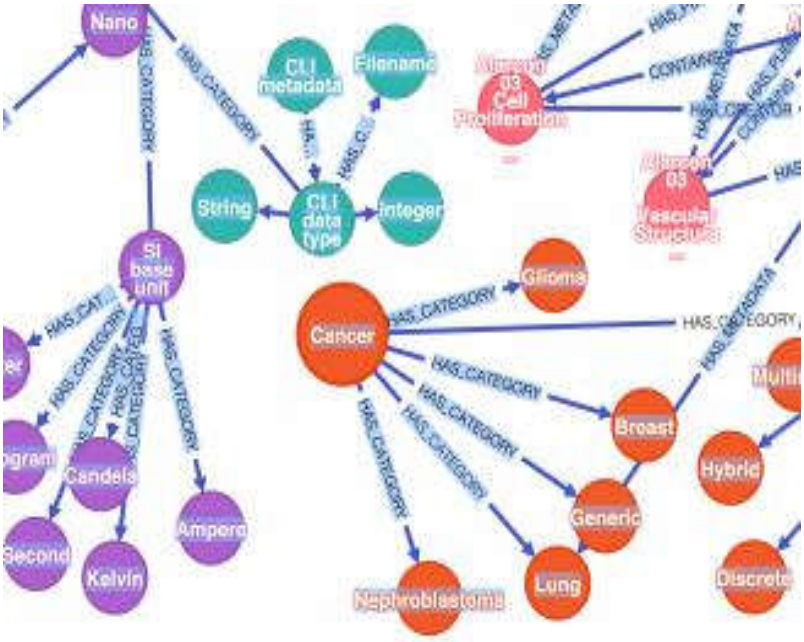

Figure 3:

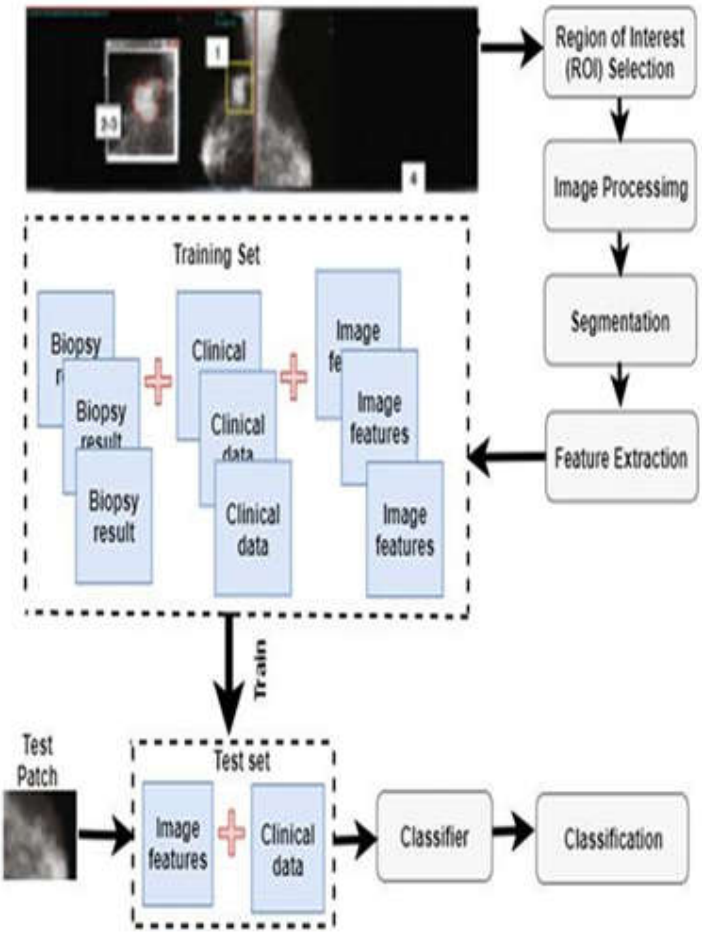

Figure 4:

(i) Breast Cancer Staging

Breast Cancer staging is based on the following criterion:

- The volume of the lesion/lump/tumor,
- Whether the cancer is restricted to breast only,
- Whether cancer has extend to the lymph nodes,
- Whether the cancer has spread to other parts of the body away from the breast.

TNM staging system

Tumor volume (T stands for tumor)
Lymph node association (N stands for node)
Whether the cancer has metastasized (M stands for metastasis), or stimulated beyond the breast to other parts of the body.

(ii) Treatment of Breast Cancer

- Surgery
- Radiotherapy
- Chemotherapy
- Hormone therapy

An individual's treatment is planned based on the following factors:

- Clinical stage of breast cancer
- Histopathologic grade of cancer
- Menopausal status
- Presence or absence of hormone receptors
- Overall general health

SURGERY FOR BREAST CANCER

Different types of surgery procedures are as follows:
Lumpectomy: Only the lump/tumor or region of cancer is isolated.

Quadrantectomy: About a quarter of the breast tissue involved by the lump is isolated.

Simple mastectomy: Elimination of the breast tissue and the tissues that wrap the chest muscles.

Radical mastectomy: Removes the muscles of the chest wall together with the structures introduced in mastectomy.

Modified radical mastectomy: Elimination of breast, nipple, lymph nodes in armpit but the chest wall muscles are secured.

RADIOTHERAPY FOR BREAST CANCER

Radiotherapy treatment uses ionizing radiation to demolish cancer cells. It is a general treatment for breast cancer after surgery. After breast-conserving surgery (lumpectomy or wide local excision), women typically have radiotherapy for the whole of the remaining breast tissue.

External beam radiation: This is the most normally used type of radiotherapy for breast cancer. External beam radiation works by focusing a beam of radiation from a machine to its target, the region of the body affected by cancer.

Brachytherapy: This type of radiotherapy uses an implant to send radiation to the cancer site. For breast cancer, radioactive seeds or pellets are located inside the breast close to the cancer.

CHEMOTHERAPY FOR BREAST CANCER

Chemotherapy refers to the use of anti-cancer drugs to destroy breast cancer cells. Chemotherapy can be used for three major reasons:

Adjuvant therapy: The target is to prevent or put off cancer from coming back after the first surgery and radiation.

Neo-adjuvant therapy: The chemotherapy drugs are given prior to the surgery to contract the tumor to make the surgery easier.

Treatment of metastatic disease: Chemotherapy can be one of the major ways to destroy cancer cells that spread to other parts of the body.

HORMONE THERAPY FOR BREAST CANCER

Hormone therapy is used in women with certain types of breast cancer whose tumors are receptive to estrogen or progesterone (hormones that cause the cancer to grow). Not all breast cancers are hormone-receptive, hence not all breast cancers will react to a hormone-blocking treatment.

These drugs slow down or end the growth of cancer cells possessing hormone receptors. As an add-on therapy, endocrine therapy helps stop the original breast cancer from returning and also helps decrease the risk of the growth of new cancers in other breast.

Prevention by varying lifestyle-related risk factors

- Maintain perfect body weight
- Exercise habitually
- Stop smoking and alcohol consumption
- Breast-feed the baby
- Avoid redundant radiation exposure.

Prevention by Genetic Testing

If one has a history of breast cancer in the family (either mother, sister or daughter with breast cancer), then one can have hereditary testing for the occurrence of BRCA1 and BRCA2 gene mutations. Nevertheless, having a replica of mutated gene does not mean that the concerned individual will surely get breast cancer. If the hereditary tests are positive, the individual may need genetic counselling and suggestion by the attending surgeon.

VAGINAL CANCER

Vaginal cancer is an uncommon cancer that affects women. The vagina is a tube-like organ that links the cervix (the lower part of the uterus) to the vulva (the outside female genitals). The vagina is lined by a coat of flat cells called squamous cells. This layer of cells is moreover called epithelium since it is formed by epithelial cells. At birth, a baby passes through the vagina when he or she is born, so the vagina is sometimes called the birth canal. Vaginal cancer is more frequent in women aged 60 years and older. More or less part of cases occur in women who are 70 years or older. Only about 15% of cases are found in women younger than 40.

There are various types of vaginal cancer, which affect different types of cells in the vagina. These consist of:

Squamous cell carcinoma: This is the most general type of vaginal cancer. Squamous cell carcinoma occurs for about 70% of all cases. This cancer starts in the cells that line the vagina and occurs next to the cervix.

Adenocarcinoma: This type of cancer starts in gland cells in the vagina. It accounts for about 15% of vaginal cancer, typically affecting women over age 50. Clear cell adenocarcinoma is the exemption, frequently affecting younger women who were exposed to diethylstilbestrol (DES) in their mother's womb.

Melanoma: A more rare type of vaginal cancer, making up about 9% of all cases. Melanoma usually occurs in the external part of the vagina.

Sarcoma: An uncommon form of vaginal cancer that makes up about 4% of cases. This type of cancer starts inside the walls of the vagina, not on the surface. There are various types of sarcoma. Rhabdomyosarcoma is the most general and is mostly found in children. Leiomyosarcoma occurs more usually in women over the age 50.

CAUSES OF VAGINAL CANCER

Human papilloma virus (HPV): This sexually transmitted disease is the most common source of vaginal cancer.

Previous cervical cancer: HPV frequently causes cervical cancer as well.

In-Utero exposure to diethylstilbestrol (DES): This prescription used to be given to pregnant women to avoid miscarriage. Nevertheless, doctors stopped prescribing it in the 1970's. Vaginal cancer caused by the DES is now really rare.

Figure 5: Vaginal Cancer

DIAGNOSIS OF VAGINAL CANCER

First, the doctor takes the patient's medical history to observe more about her symptoms and probable risk factors. They then perform a pelvic examination to look for probable causes of her symptoms. They also do a pap smear to verify for any abnormal cells in her vaginal locale.

If the pap smear shows any abnormal cells, the doctor uses a magnifying instrument called colposcope to observe the vaginal walls and cervix to see where the unusual cells are.

This method is similar to a normal pelvic exam: the patient is in stirrups, and the doctor makes use of a speculum. Once the doctor finds where the abnormal cells are, he does a biopsy to see if the cells are cancerous.

If the cells are cancerous, the doctor will probably do an MRI, CT scan, or PET scan to see if the cancer has extended to other parts of the body.

STAGES OF VAGINAL CANCER

Vaginal Intraepithelial Neoplasia (VAIN): VAIN is a type of pre cancer. There are unusual cells in the vaginal lining, but they are not increasing or spreading yet. VAIN isn't cancer.

- **Stage 1**: Cancer in the vaginal wall.
- **Stage 2**: Cancer has extended to the tissue next to the vagina but hasn't yet reached the pelvic wall.
- **Stage 3**: Cancer has extended further into the pelvis and pelvic wall. It may have also extend to close by lymph nodes.
- **Stage 4**: Stage 4 is separated into two sub stages:
- In **stage 4A**, cancer has extended to the bladder, rectum, or both.

- In **stage 4B**, cancer has extended further all over the body to organs, such as the lungs, liver, or more distant lymph nodes.

PREVENTION OF VAGINAL CANCER

While one may not be able to find her risk of vaginal cancer to zero, there are steps youone can take to help decrease her risk. These include:

Proceed to lower her risk of HPV: This includes using condoms every time one has any type of sex (vaginal, oral, or anal) and getting the HPV vaccine. To trace out more about the HPV vaccine, one can talk to her doctor.

If one presently smokes, then she must quit it. Smoking is the major risk factor for vaginal cancer and other cancers.

Drink only in moderation: There is some evidence that heavy drinking raises one's risk of vaginal cancer.

One should get usual pelvic exams and pap smears, this will help her doctor find pre cancers before they turn into vaginal cancers or locate vaginal cancers early, sooner than it spreads or causes serious symptoms.

Figure 6:

METHODOLOGY

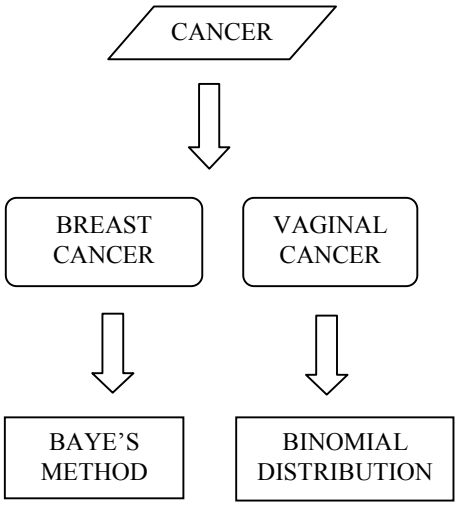

Figure 7: Methodology

Naive Bayes: It is a special algorithm whose background lies in the well-known foundation laid down by Bayes theorem and belongs to probabilistic way of classifiers. Bayes Classifier also known as generative model has its secret in computing class conditional probability in terms of posterior and earlier probabilities.

Binomial Distribution: This method is used to find the probability of the percentage of people affected by vaginal cancer. In order to reduce the death percentage of people who are affected by vaginal cancer, this method is quite useful.

Example:
In a city A there are 11,57,300 people and in city B there are 5,87,300 people, in which number of people affected by breast cancer in both the cities is 16,2468. Find the Probability of breast cancer in city B.

Solution:

City A	1157300	162468
City B	587300	162468

$$P(A_2/A) = 12\% = 162468/1319768$$
$$P(B_2/B) = 21.6\% = 162468/749768$$

$$P(^{A}/_{B}) = \frac{1.23.\frac{12}{100}}{1.23.\frac{12}{100}+1.23.\frac{21.6}{100}} = \frac{0.1476}{0.1476+0.26568} = \frac{0.1476}{0.41328} = 35\%$$

Hence, Breast cancer affected people in City B is 35%

Example

In a city if 10% of the women are affected by vaginal cancer then what is the probability that 4 women being selected has a vaginal cancer?

Solution:

Here $n = 10$ and $x = 4$

$$P(X) = \frac{n!}{x!\,(n-x)!} = \frac{10!}{4!\,6!} = \frac{3628800}{24 \times 720} = 210$$

$p = 0.1$ and $q = 0.9$

$$P = 210(0.1)^4(0.9)^6$$
$$= 210(0.0001)(0.531441)$$
$$= 0.0111$$

Hence 1 among 4 women are affected by vaginal cancer.

Table 1: Number of new cases in 2018, both sexes, all ages

Cancers	**Percentage**	**Total**
Breast	14	162468
Lip, oral cavity	10.4	119992
cervix uteri	8.4	96922
Lung	5.9	67795
Stomach	5	57394
Other cancers	56.4	652723
		1157294

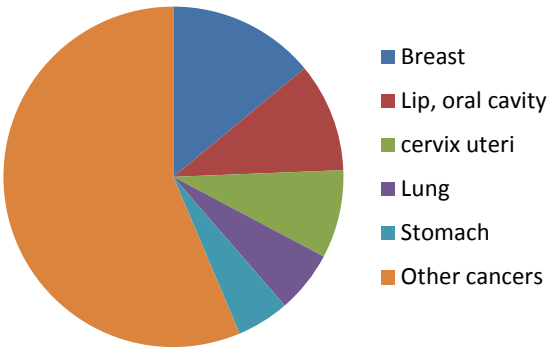

Figure 8: Number of new cases in 2018, both sexes, all ages

Table 2: Number of new cases in 2018, Females, all ages

Cancers	Percentage	Total
Breast	27.7	162468
Cervix uteri	16.5	96922
Ovary	6.2	36170
Lip, Oral cavity	4.8	27961
Colorectum	3.4	20064
Other cancers	41.5	243644
		587249

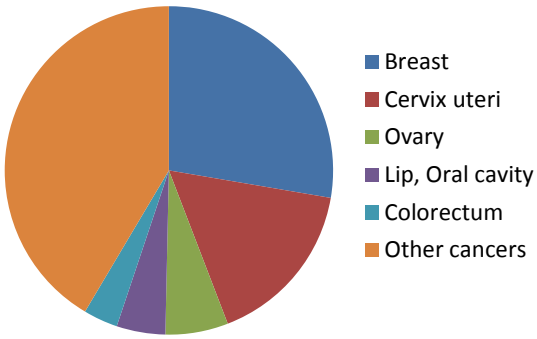

Figure 9: Number of new cases in 2018, Females, all ages

CONCLUSION

In this paper, Staging, Treatment, Surgery and Prevention, methods and statistical data of both cancer such as Breast cancer and vaginal cancer have been discussed. This paper is also helpful for further improvements in practices that can be brought into patients care with advancing technology and medical treatment.

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