

# Geographic Information System (GIS) Modeling Analysis and the Effects of Spatial Distribution and Environmental Factors on Breast Cancer Incidence

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## INTRODUCTION

Breast cancer is a major health issue in all countries affecting thousands of women (Tazzite et al., 2013; Dube & Gupta, 2015). So far its cause(s) are unknown and the national and international strategies to reduce its morbidity and mortality levels are based on early detection of cancer through screening and treatment according to clinical guidelines. Thus, knowledge of which women are at risk and why they are at risk is therefore essential component of disease prevention and screening. Researchers from the International Agency for Research on Cancer (IARC) and the World Health Organization (WHO) reports that globally breast cancer might contribute to the greatest burden on women's health when compared to other cancer sites (World Health Organization, n.d.). In 2015, an estimated 231,840 new cases of invasive breast cancer are expected to be diagnosed in women in the United States, along with 60,290 new cases of non-invasive (in situ) breast cancer (Siegel et al., 2015). However, all locations are not equal for breast cancer risk and thus support a major role of the geography in breast carcinogenesis (Akram & Nanna, 2003).

The purpose of this work is to provide a more detailed analysis of the breast cancer distribution in the United States by comparing the spatial distribution of breast cancer cases against

physical environmental factors using Geographic Information System (GIS) (Figure 1). Further, it gives background information to the GIS and its applications in health-related research.

## BACKGROUND

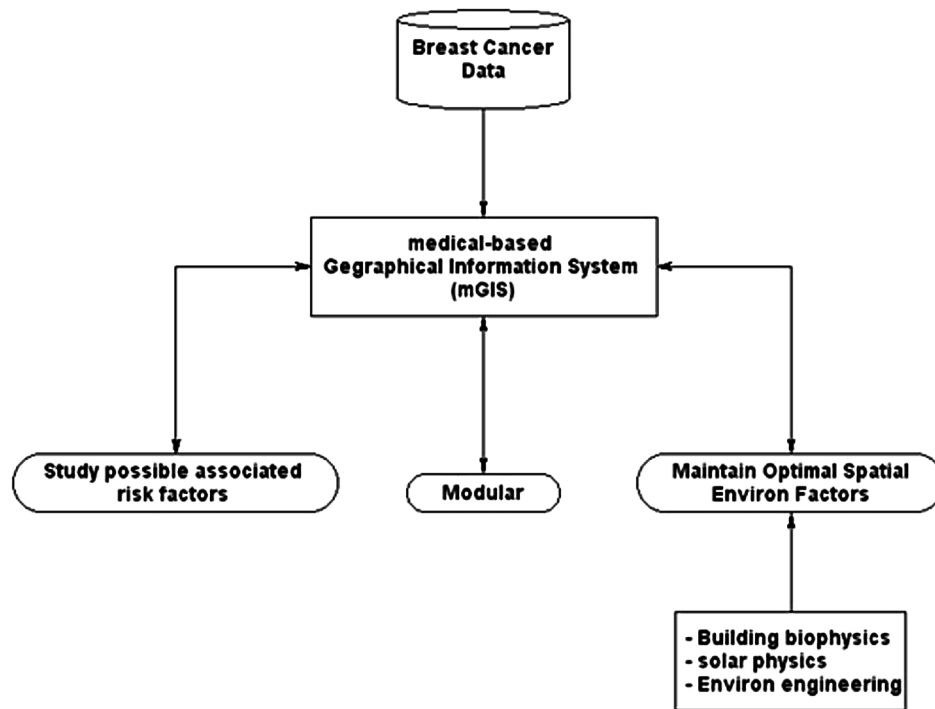
### Breast Cancer Facts/ Spatial-Based Patterns

Previous reports have shown that the Northeast United States has a 16% higher breast cancer mortality rate than the rest of the country (Kulldorff et al., 1997). The probability of breast cancer risk is not equal for all locations which indicate that geography plays a very important role in the etiology of breast cancer.

There are geographic patterns of high cases of breast cancer, and the analysis of these patterns is very important in the formulation of hypotheses about risks and focus investment more effectively in research and intervention on the most significant areas (Laden et al., 1997).

In general, breast cancer incidence rates have continued to increase since 1980, although the rate of increase slowed down in the 1990s, compared to the 1980s (American Cancer Society, 2004). Furthermore, during the more recent time period, breast cancer incidence rates have increased only

Figure 1. medical-based GIS



in those aged 50 and over. The mortality rates declined by around 1.4% per year during 1989-1995 and by 3.2% afterwards, with the largest decreases in younger women in both whites and African Americans. These decreases are probably due to the result of both earlier detection and improved treatment. Clearly, the ultimate cause of breast cancer is unknown (Roche, 1998), but several risk factors appear to play a role.

Previous literatures have shown that breast cancer mortality and incidence rates vary geographically according to the different regions of the United States (Devesa et al., 1999; Joseph et al., 2004). Generally, the disease is most common in North America and Western Europe, account for about one in four female cancers in these regions, while in the Far East (China and Japan) it is very much rare (Le et al., 2002). Furthermore, the disease rates among Asian-Americans are lower than those of U.S. whites but considerably higher than rates prevailing in Asia. Thus, it is suspected that migration to the US brings about a change in endocrine function among Asian women, although

reasons for this change remain obscure (Wu et al., 1996). In fact, the geographic patterns of cancer around the world and within countries have provided important clues to the causes of cancer (Robert, 1996). The highest incidence rates of all are found in Hawaii, where a rate of 93.9 per 100,000 female populations has been reported, and in US white women. The incidence rises with age from about age 30. Moreover, there are ethnic variations, such as a high incidence in Israeli Jews compared with non-Jews in Israel. It is more common in single women, in higher social classes, and in urban rather than rural areas. On the other hand, about 1% of cases occur in males. Mortality has increased less rapidly than incidence, but breast cancer is most common cause of cancer death.

### What is Geographic Information System (GIS)?

Maps are well-known to be one of the most used visual tools in our life today. They have very long tradition and they have been used from ancient

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