https://doi.org/10.29289/259453942024V34S2032

28624 – BREAST CANCER MORTALITY AND PESTICIDE USE IN THE WESTERN MESOREGION OF SANTA CATARINA, BRAZIL

Marcelo Moreno*, Maria Isabel Gonçalves da Silva, Clodoaldo Antônio de Sá, Carlos Alberto Rizzi, Eduardo Augusto Werneck Ribeiro, Márcia Orth Ripke, Vanessa da Silva Corralo

***Corresponding author:** marcelounocco@icloud.com

Introduction: Santa Catarina has significant agricultural productivity and ranks among the ten largest consumers of pesticides in Brazil. The state is notable for grain production, which exceeded 6.5 million tons in the 2021/2022 harvest. In the western mesoregion of the state, grain production is also prominent, especially with maize and soybean cultivation, where endocrine-disrupting pesticides are systematically used throughout the production chain of these transgenic crops. In Santa Catarina, considering female deaths from malignant neoplasms in 2020, 35% were related to breast cancer. There is a growing trend of breast cancer mortality among women residing in the state, evidenced by a mortality rate of 18.24 deaths per 100,000 women, higher than the Brazilian average rate of 14.23 deaths per 100,000 women. Breast cancer is the leading cause of cancer-related deaths among women and constitutes a significant public health problem worldwide. The etiology of breast cancer is multifactorial. Consequently, factors such as aging, heredity, hormonal and reproductive history, lifestyle, along with genetic and environmental factors, may trigger the disease. The cells of breast tissue undergo regulated proliferation by hormones, and the development of some invasive carcinomas of the mammary parenchyma can be influenced by hormonal stimuli. Chronic exposure to low concentrations of pesticides may not produce immediate health effects in a given population, but over time, they can contribute to an increase in cancer rates. Some pesticides are classified as endocrine disruptors, capable of exhibiting biochemical properties similar to endogenous hormones and consequently provoking additional hormonal stimuli in the female organism. In this context, the high production levels of the agricultural sector and the intensive use of pesticides raise concerns regarding occupational and environmental exposure, as well as the occurrence of diseases such as cancer. **Methodology:** This is a quantitative, retrospective ecological study that used publicly available secondary databases, which provide data on breast cancer mortality and agricultural production by cultivated area in the western mesoregion of the state of Santa Catarina (SC), Brazil. To collect data on breast cancer mortality by municipality, death records due to malignant mammary neoplasia, code C50 from the Tenth Revision of the International Classification of Diseases (ICD-10), provided by the Mortality Information System (SIM) of the Department of Informatics of SUS (DATASUS), were examined. The death data were grouped by age brackets: 20–39, 40–49, 50–59, 60–69, 70–79, and >80 years — for each municipality, considering deaths occurring between 2015 and 2019. Population projections were obtained from the preliminary estimates developed by the Ministry of Health (MS), Secretariat of Health Surveillance (SVS). The data were organized into spreadsheets in Microsoft Excel® (version 19), in which annual mortality coefficients per 100,000 women were calculated. To derive standardized cancer rates, the direct method was used, considering the Brazilian population as the standard, as per the 2010 Demographic Census, with age-specific coefficients applied accordingly. The average coefficients for 2015 to 2019 were then calculated. Regarding agricultural production, the annual sum of the planted area for maize, soybean, and wheat crops, measured in hectares (ha), was calculated for the period between the years 2000 and 2004. Data regarding the planted areas were obtained from the website of the Brazilian Institute of Geography and Statistics (IBGE), through the IBGE Automatic Recovery System. Due to the lack of public data on pesticide consumption in the state, an estimate was made following the methodology described by Dutra and Ferreira (2017), with some adaptations. The recommended dose, applied per crop (L or kg/ha) for each pesticide, was multiplied by the planted area in hectares, as recommended on the product labels. Information on the pesticides used in the selected crops was accessed via the website of the Santa Catarina Integrated Agricultural Development Company (CIDASC). All endocrine-disrupting pesticides approved for use in Santa Catarina were reviewed through the Santa Catarina Agriculture Defense Management System (SIGEN) (Cidasc, 2016). Endocrine-disrupting pesticides were identified based on classifications proposed by Mnif et al. (2011). The spatial analysis in this study started from investigating the data on breast cancer mortality and pesticide use in each municipality of the western region of Santa Catarina

(SC). This study did not focus on neighborhood relations but rather on how the two variables relate within each municipality. The correlation criterion involved crossing values above the mean for both the mortality rate and pesticide consumption. Thematic mapping was utilized, employing methods of data classification aimed at identifying spatial clustering trends. In the scatter plot, the numbers correspond to the following patterns: 1 "low," 2 "medium," 3 "high," and 4 "very high." The distribution of the number of municipalities in the western mesoregion of Santa Catarina was organized into a balloon chart, totaling 118, categorized by types of crossings. Warm colors indicate the number of municipalities where the class intersections are equivalent: "low pesticide use x low mortality rate," "medium use x medium rate," "high use x high rate," and "very high use x very high rate." Dark blue colors represent the number of municipalities where the crossing occurs above the average, for both breast cancer mortality rate and pesticide consumption history. The primary spatial analysis technique employed was classification into ranges using the cartometric method in Quantum GIS, known as the interquartile (quartile) method. According to the breast cancer mortality rates for the female population in 2020 in Brazil (11.84), the Southern Region (12.79), and the state of Santa Catarina (12.71 deaths per 100,000 women), as reported by the Ministry of Health (Inca, 2022), the mortality rates in the western mesoregion of Santa Catarina were classified into four ranges: "low" (0–5), "medium" (6–15), "high" (16–20), and "very high" (21–53.6). The overlay method was used to examine the spatial correlation between the mortality rate and the pesticide consumption history. This research was conducted following approval by the Research Ethics Committee of the University of the Region of Chapecó (UNOCHAPECÓ), via the Plataforma Brasil, under the Certificate of Presentation for Ethical Review (CAAE) number 33356720.9.0000.0116.
Conclusion: In this study, it was found that in 79% of the municipalities in the western mesoregion of Santa Catarina, breast cancer mortality occurred at a frequency above the regional average. Similarly, in municipalities where the use of endocrine-disrupting pesticides exceeded the regional average, there was a comparable trend. Therefore, it was demonstrated that there is a proportional correlation between breast cancer mortality rates and the use of pesticides in maize, soybean, and wheat crops during the studied period.