



Novel Application of Spatial Analyses to Investigate Environmental Factors and Hormone Receptor-Positive Breast Cancer

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Our findings suggest some spatial overlap in proportions of incident HR+ breast cancer between pre- and postmenopausal women; the overlap may indicate shared environmental risk factors for HR+ breast cancer between age groups in these regions.

BACKGROUND

- Hormone-sensitive tumors, of which breast cancer is the most prevalent, are increasing in incidence globally.
- Our work with 2000-2016 USA cancer surveillance data for women 20-49 years showed average annual percentage increases in incidence for hormone receptor-positive (HR+) breast cancer.
- With environmental agents thought to be associated with HR+ breast cancer, we explored spatial clustering of breast cancer to identify geographic regions with excess HR+ breast tumors in Iowa, USA.

METHODS

- Data for 46,609 women with a primary diagnosis of breast cancer and reported HR status during 2000-2021 with no prior cancers were obtained from the Iowa Cancer Registry.
- Using the corresponding International Classification of Diseases (ICD)-O-3 codes for breast cancer, an HR+ tumor was defined as having either positive or borderline estrogen receptor (ER) or progesterone receptor (PR) status; an HR-negative (HR-) tumor was defined as having both ER- and PR- status (see examples below).

ICD-O-3 Code and Description	Total	Hormonal	Non-Hormonal	Unknown
8211 – Tubular adenocarcinoma	337	303	2	32
8480 – Mucinous adenocarcinoma	957	896	14	47
8510 – Medullary carcinoma, NOS	162	43	110	9
8575 – Metaplastic carcinoma, NOS	196	35	148	13

- Spatial patterns of HR+ tumors as a proportion of women with breast cancer with known HR status were examined by county (n=99) and residence for pre- (15-49 years; n=9,344) and post- (≥50 years; n=37,265) menopausal aged women.
- Proportions were analyzed using Bayesian logistic regression with spatial correlation via intrinsic conditional auto-regressive (ICAR) models at the county level and general additive models (GAMs) at the residence level.
- For county-level analyses, each estimated rate for HR+ tumors by age group in each county was compared to the state average for the corresponding age group to obtain an exceedance probability.
- Hot spots were defined as counties with rate estimates above the state average with 90% probability; cold spots were those with estimates below the average with 90% probability.

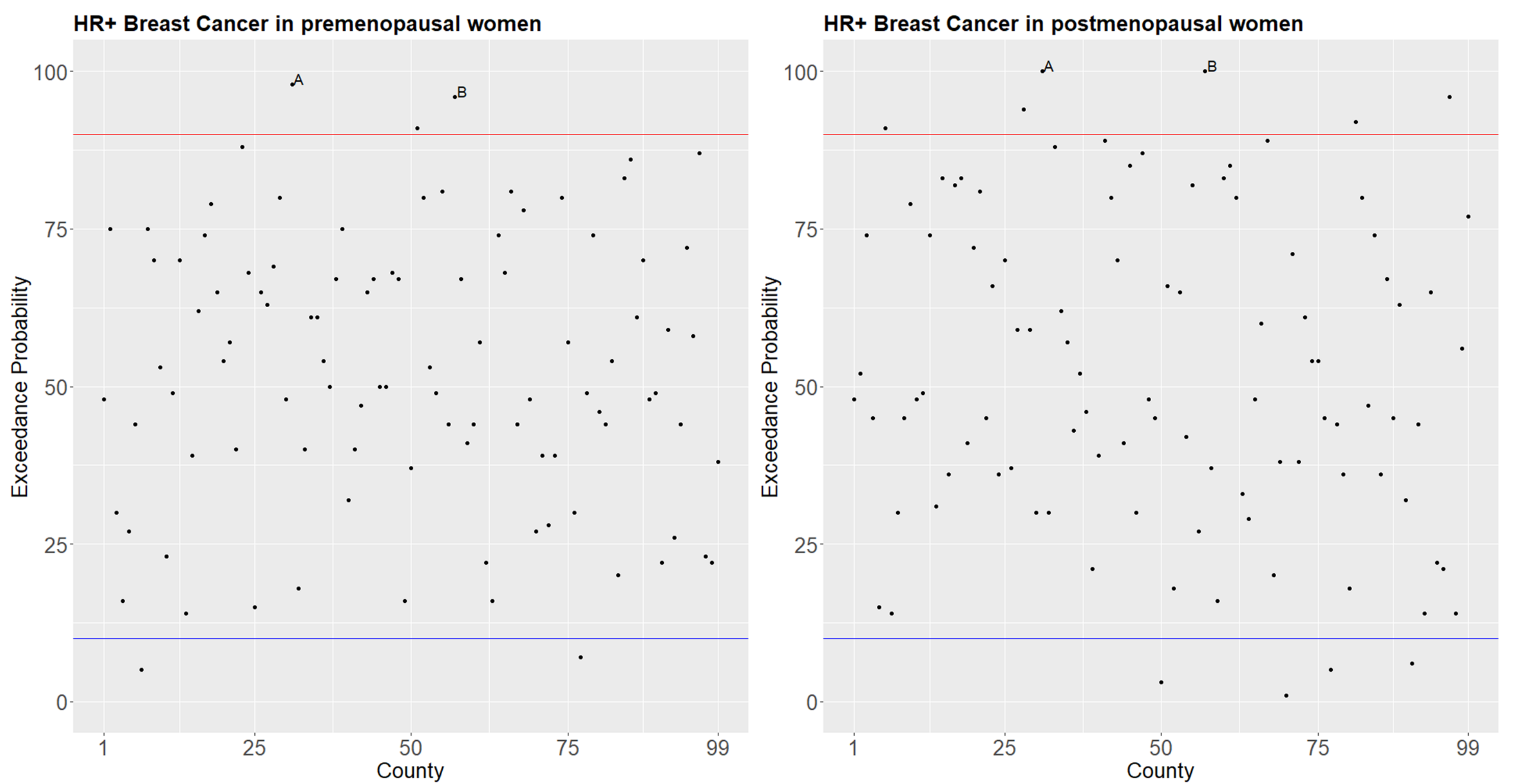
RESULTS

- HR status was classified for 9,344 premenopausal (7,350 HR+; 1,994 HR-) and 37,265 postmenopausal women (31,646 HR+; 5,619 HR-).
- Statewide, HR+ cancers accounted for 79.0% of premenopausal and 84.9% of postmenopausal breast tumors.
- For premenopausal women, three counties were identified as hot spots above the state average and two counties as cold spots (see premenopausal probability plot).
- For postmenopausal women, six counties were identified as hot spots above the state average, and four counties were identified as cold spots below the state average (see postmenopausal probability plot).
- Two counties (A and B) overlapped as hot spots for both pre- and postmenopausal women (see probability plots).

ACKNOWLEDGEMENTS

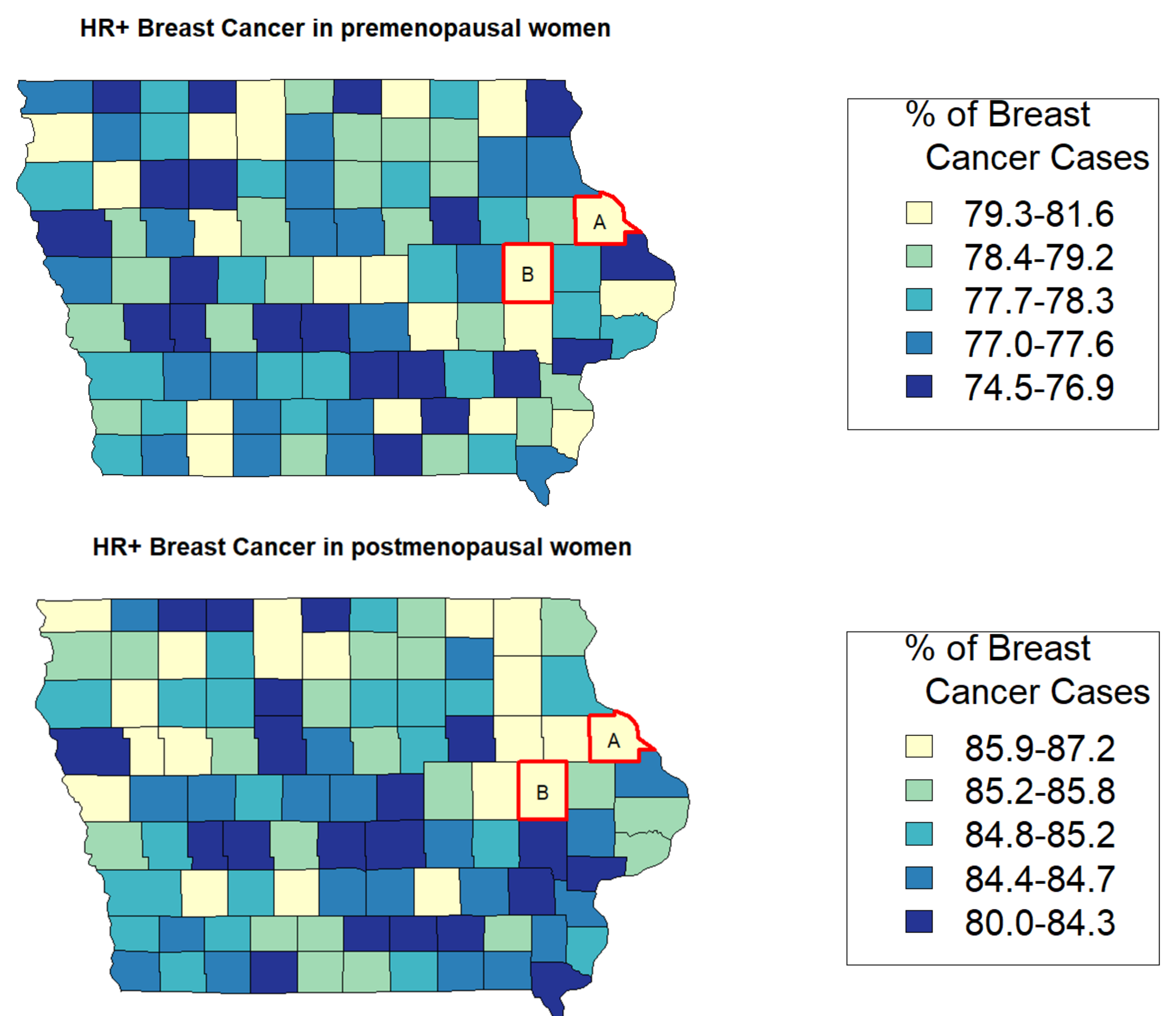
This work was funded by the National Institute for Environmental Health Sciences (University of Iowa Environmental Health Sciences Research Center, P30 ES005605), and USA Centers for Disease Control and Prevention (University of Iowa Center for Birth Defects Research and Prevention, U01 DD001035 and U01 DD001223).

RESULTS (continued)



Exceedance probabilities comparing each county's estimated rate to the respective state average of HR+ breast cancer in pre- and postmenopausal women are displayed. Counties with exceedance probabilities above the red line are considered hot spots and below the blue line are considered cold spots with 90% probability.

- Spatial trends across the state appear similar for premenopausal and postmenopausal women. After spatial smoothing, the main overlapping areas of higher proportions of HR+ breast cancer remain along the northern border of the state and lead into the northeast. Lower proportions appear in the southern half of the state (see maps). Counties A and B refer to overlapping hot spots among pre- and postmenopausal women identified from the probability plots.
- At the residence level, GAMs indicated similar patterns compared to those observed at the county level (data not shown).



CONCLUSIONS

- Our findings suggest some spatial overlap in proportions of incident HR+ breast cancer between premenopausal and postmenopausal women.
- The overlap may indicate shared environmental risk factors for HR+ breast cancer between age groups in these regions.
- Future analyses of this dataset will explore temporal differences in these incident cancers.
- Our approach provides a model to be applied across broader geographical regions and other hormone sensitive cancers, such as endometrial and thyroid.