Distance to Mammography Facilities and Breast Cancer Screening: A GIS Approach

By

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Significance of Breast cancer

- One of the leading causes of death in women in USA
- Most commonly occurring cancer in women.
- 178,480 new cases and 40,460 deaths from breast cancer will occur among women in USA in 2007[1]

Significance of Mammography

- Due to the lack of primary prevention, secondary prevention of breast cancer through mammography has paramount importance.

1 ACS, Facts and Figure,2007

Objectives of the Study

- ***Primary objective****: To* examine whether geographic access to mammography facilities influences breast cancer screening.

- ***Secondary objective***: To examine whether the relationship of access with breast cancer screening is affected by demographics and other related factors.

Access

- People's ability to use health services when and where they are needed

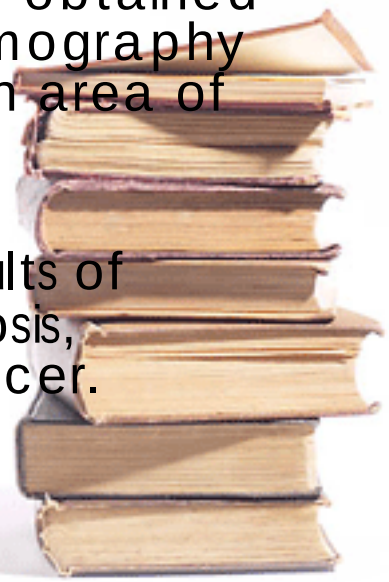
  (Aday, Anderson, 1981).

- Five dimensions of access to health care:
  - accessibility
  - availability
  - affordability
  - acceptability
  - accommodation .

Data Collection: CMAP

Colorado Mammography Project (CMAP)

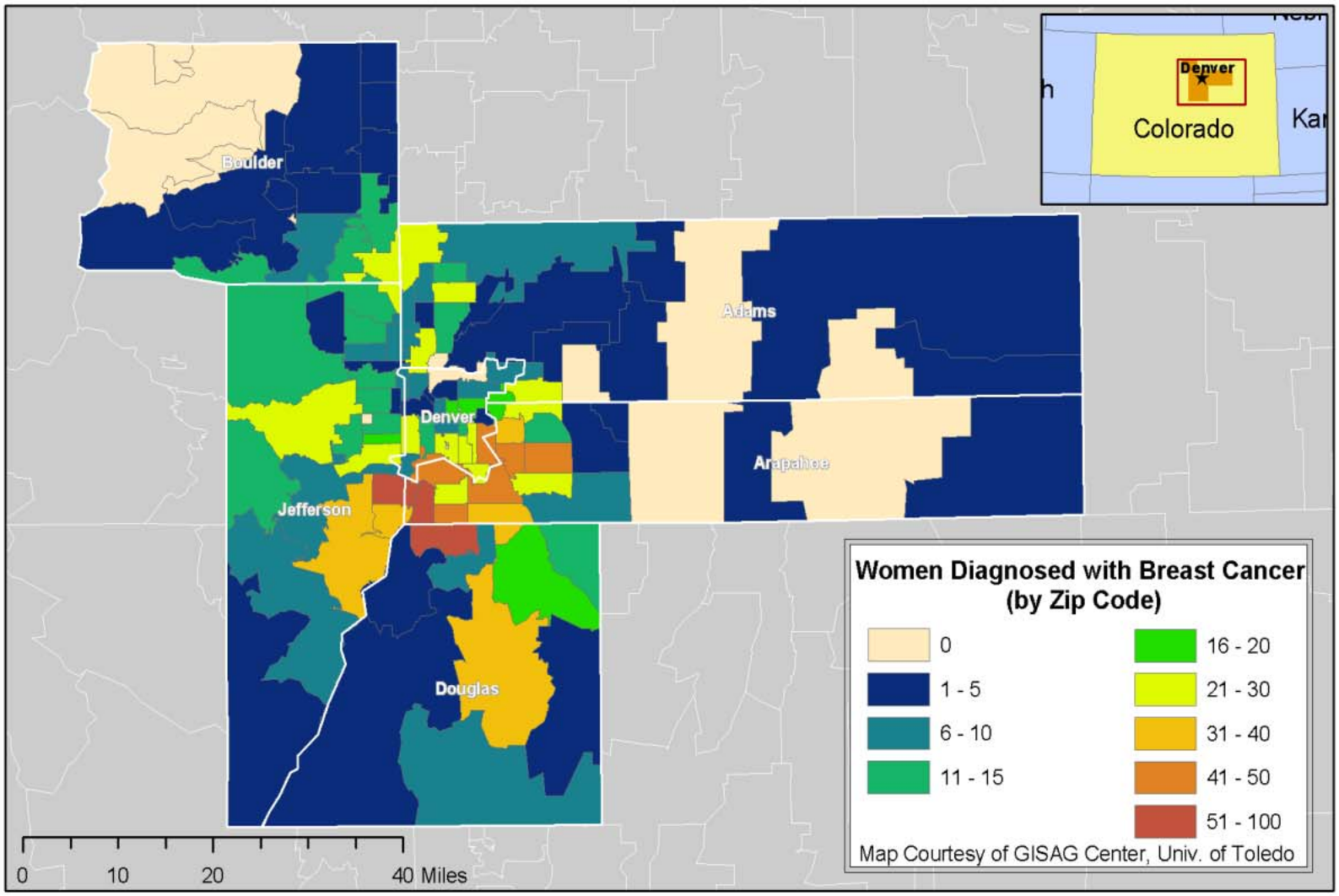
- A National Cancer Institute funded project that was in operation from 1994-2004.
- One member of a seven-site consortium, and obtained data on mammograms from half of all mammography facilities in the six-county Denver metropolitan area of Colorado.
- Collect and maintain a database on the results of mammograms, follow-up procedures, diagnosis, treatment and other correlates of breast cancer.



Study Subjects:

- Women from CMAP database, who were diagnosed with breast cancer from 1999 to 2001.
- Breast cancer included invasive cancers and carcinoma *in situ.*
- Those women who had previous cancers were excluded from the study.

Map 1: Six-County Study Area and Study Population of Women Diagnosed with Breast Cancer (by Zipcode)



Methods

Steps taken were:

- Acquiring subject's data (from CMAP) and provider's data (a list of mammography facilities from the Colorado Dept of Public Health and Environment).
- Geocoding both women's data and mammography facilities data.
- Calculating straight-line distance between the centroids of two Zip codes (woman's residence Zip code and mammography facility Zip code) with ZipFind Deluxe 5.0 software.
- Calculating access to mammography facilities by considering all available facilities women might use within a defined arbitrary radius by using FCA method (Wang and Leu' 2004).

Access to mammography facilities
(considering all available facilities a woman might use)

- Two steps IN FCA methods:
  - ***First step*, availability of each of the facilities was calculated inversing the total number of women within an arbitrary radius of that specific facility.**
  - ***Second step*, accessibility was calculated for each woman by adding the availability of all the facilities within the same arbitrary radius of her Zip code.**
- Access ratio for several different radii such as 10 miles, 20 miles, 30 miles, 40 miles, and 50 miles were measured and compared.

Defining Variables

- Dependent variables:
  - Previous mammogram
    - Yes
    - No

- Independent variables:
  - Access to mammography facilities
  - Breast cancer stage at diagnosis
  - Age
  - Race/Ethnicity
  - Level of education
  - Health insurance
  - Family history
  - Hormone replacement therapy
  - Physician recommendation

Dependent variable: Utilization of mammography

Previous mammogram (Yes)

- *she has had a previous mammogram recorded in the database or*
- *she answered, "yes" on her patient information form when asked about her previous mammogram history*

Previous mammogram (No)

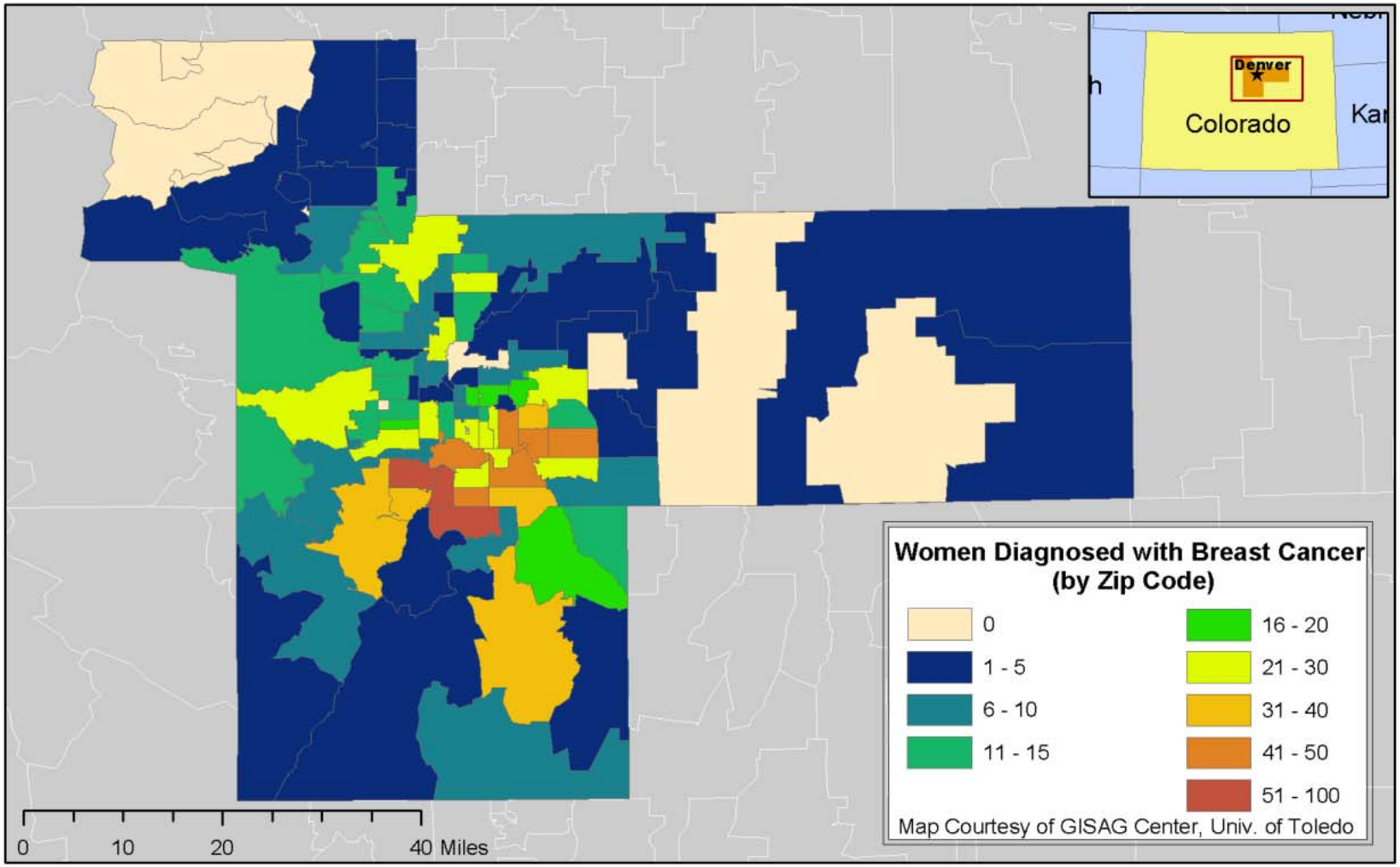
- *she does not have any previous records in the database and*
- *she stated on her patient information form that she has never had a previous mammogram*

Results

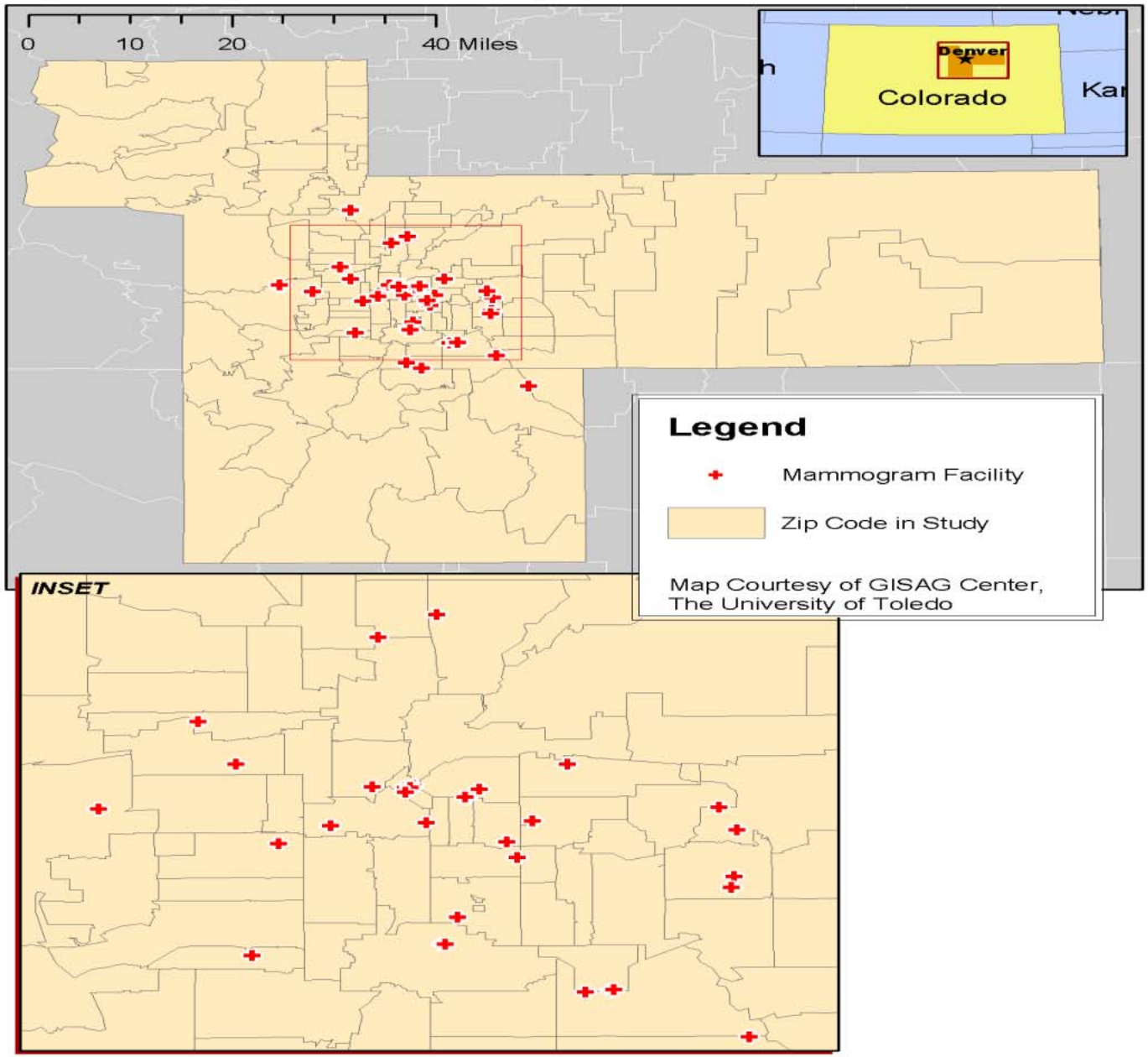
Characteristics of Study Population

- Majority of the women were white
- Ages ranged from 25 to 98 years
- Mostly non-Hispanic in origin
- Health insurance
  - Almost three-quarters had private insurance,
  - one-fifth had Medicaid and/or Medicare and
  - very few women were without health insurance.
- Breast cancer stage at diagnosis:
  - Most of the women had their cancer diagnosed at a non-advanced stage,
  - one-quarter of the women had their cancer diagnosed at an advanced stage
- Almost 90% of women had a previous mammogram

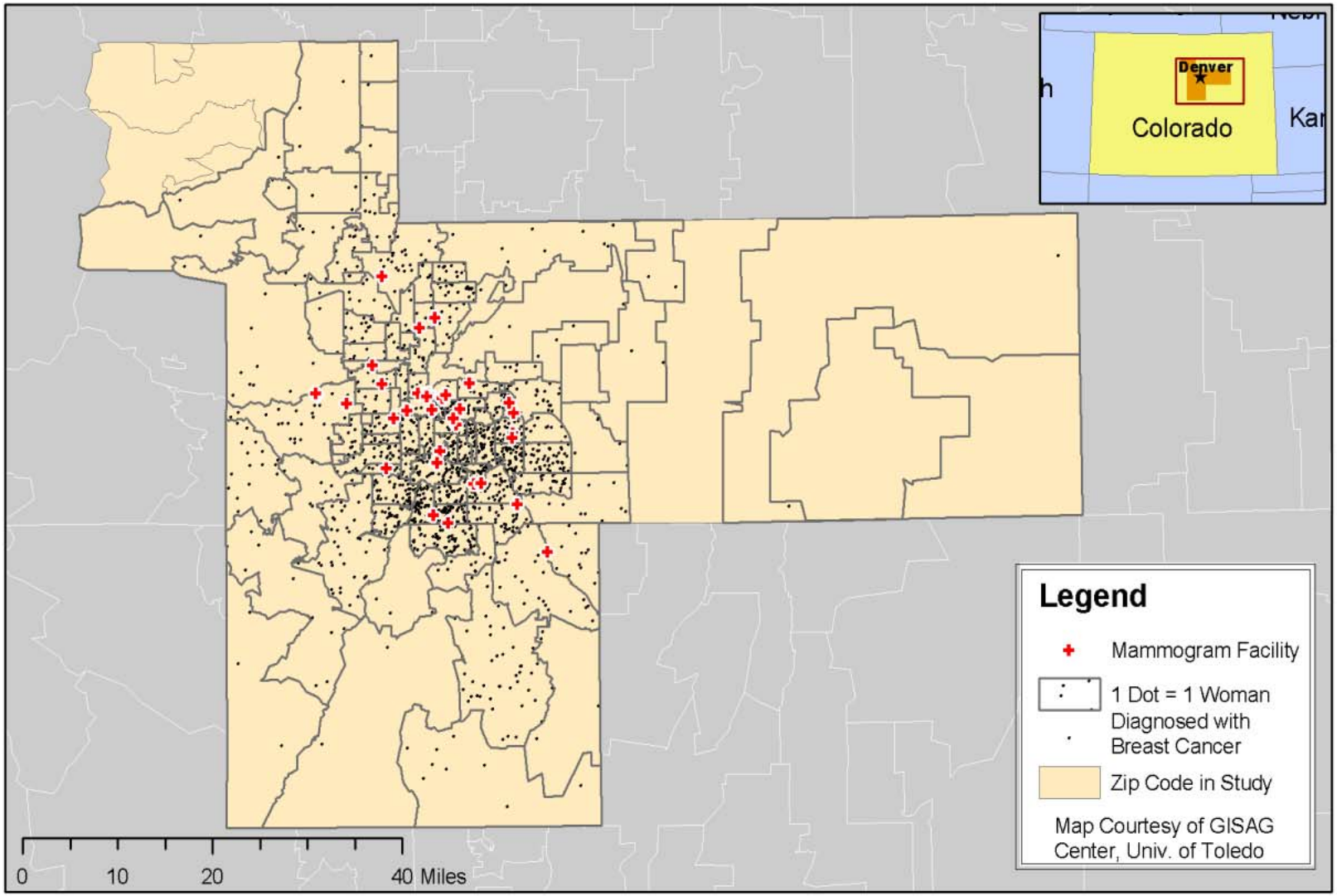
Map 2: Study Population of Women Diagnosed with Breast Cancer (by Zipcode)



Map 3: Mammogram Facilities in Study Area



Map 4: Mammogram Facilities with Population of Women Diagnosed with Breast Cancer (by Zip Code)



Straight-line distance to a specific mammography facility

- Mean distance for women was 13.43 miles
  - (SD 41.42 miles)

- Category: distance from the mammography facility:
  - **636** women within a distance of **less than 5 miles,**
  - **835** women within a distance between **5.01-15 miles,**
  - **146** women within a distance between **15.01-25 miles,**
  - **35** women within a distance between **25.01-30 miles**, and
  - **120** women within a distance of **30.01 miles or greater**

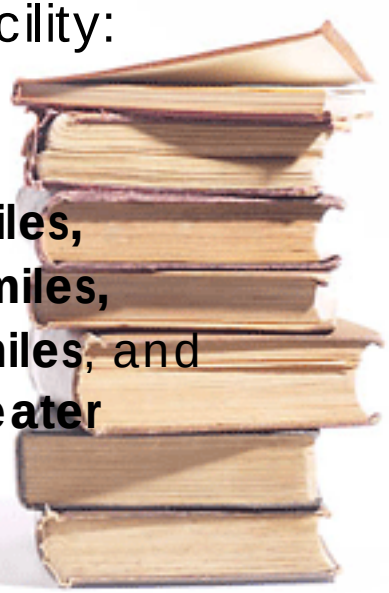
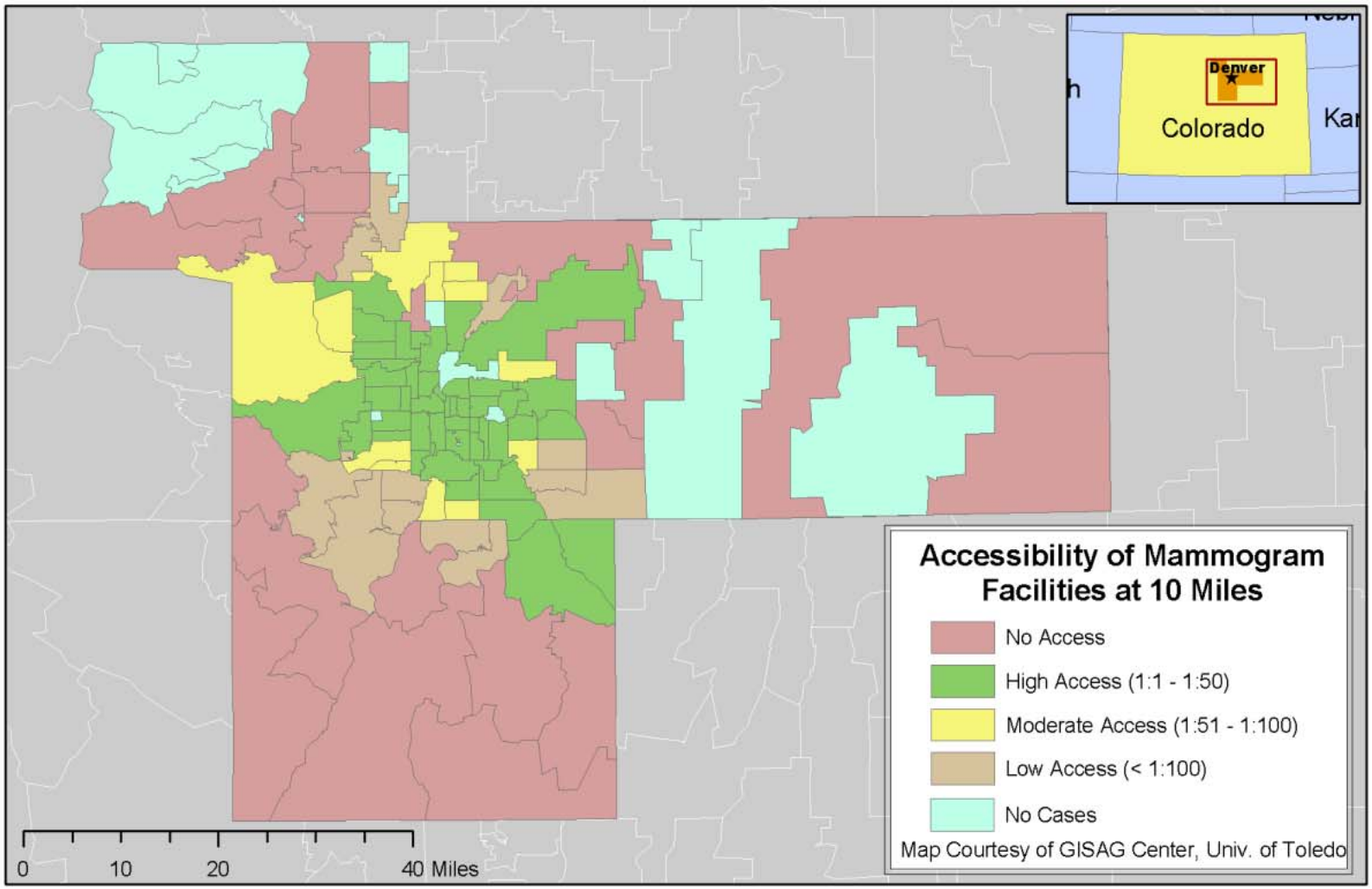


Table: Comparison of accessibility measures

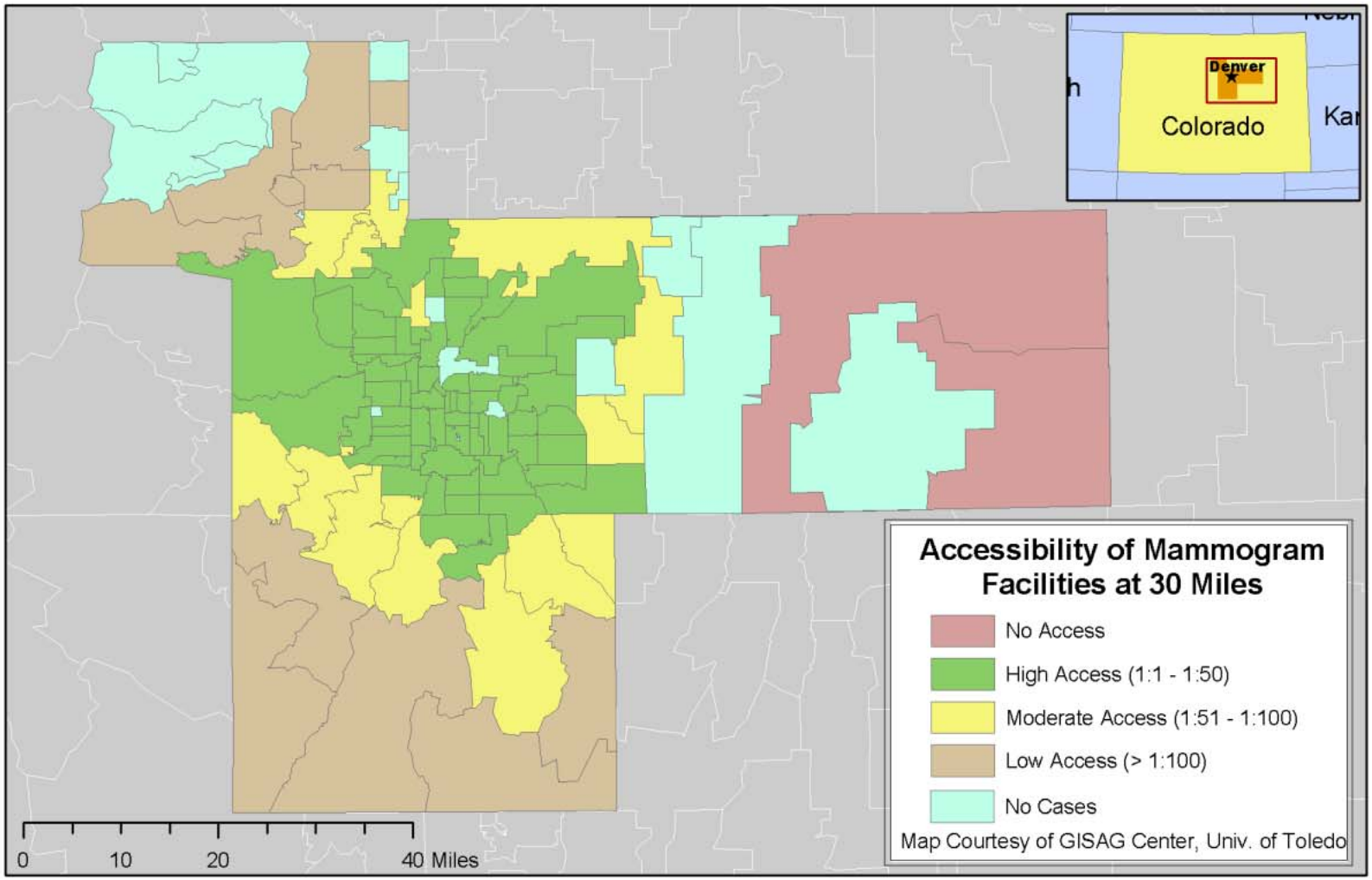
Radius	Total number	Minimum	Maximum	Mean	Std. Deviation
10_Mile	1745	0.00	0.11	0.03	0.026
20_Mile	1745	0.00	0.08	0.03	0.014
30_Mile	1745	0.00	0.05	0.03	0.008
40_Mile	1745	0.00	0.04	0.03	0.006
50_Mile	1745	0.001	0.03	0.03	0.004

- Total population 2042
- Frequency missing 297

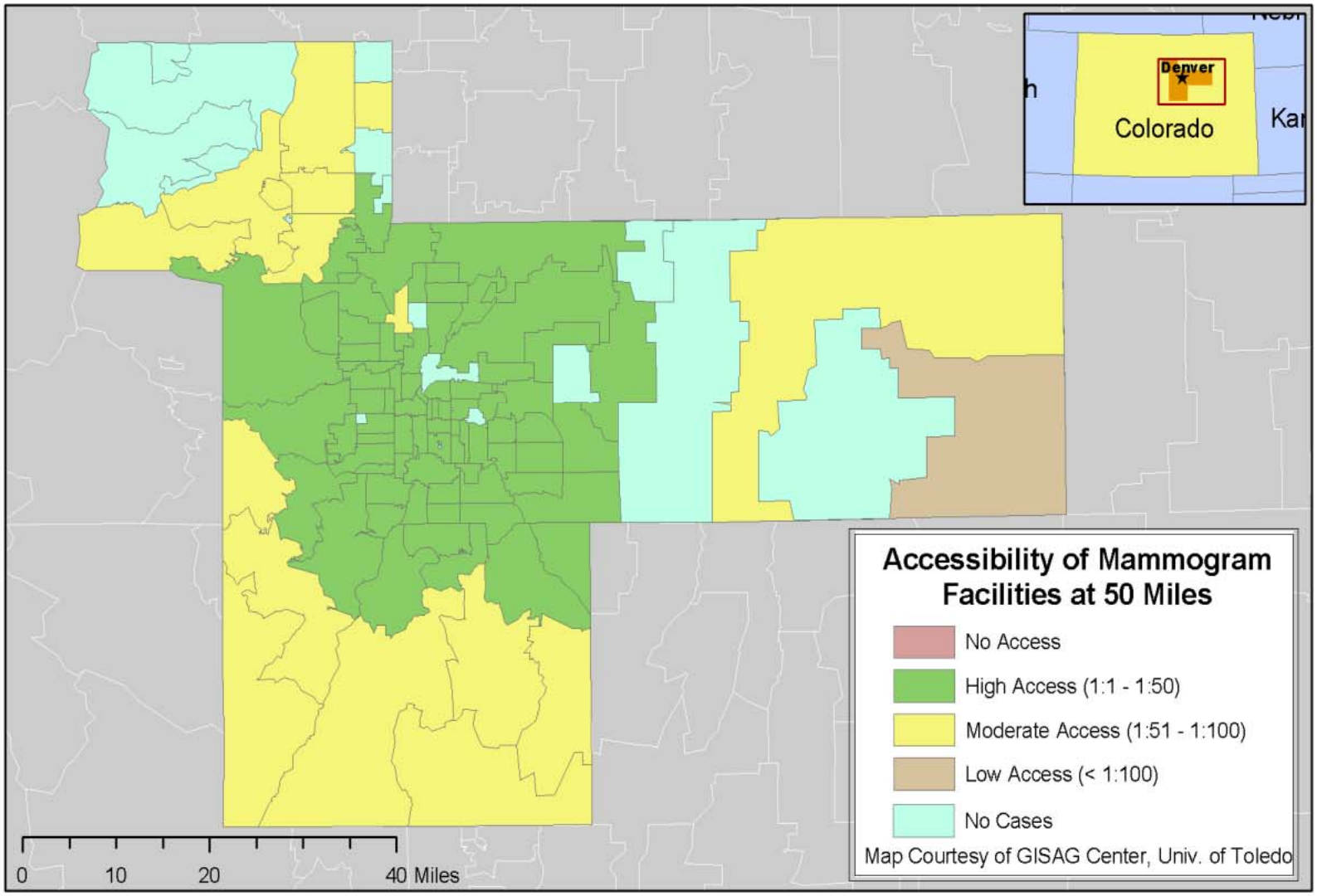
Map 7: Accessibility of Mammogram Facilities at 10 Miles (by Zip Code)



Accessibility of Mammogram Facilities at 30 Miles (by Zip Code)



Map 11: Accessibility of Mammogram Facilities at 50 Miles (by Zip Code)



Logistic Regression Predicting who had a Previous Mammogram Using Access Measure

Factors	Crude OR	95% CI	Adjusted OR	95% CI
Age Group				
40-49	1.00		1.00	
Below 40 years	0.13	0.07-0.22*	**0.11**	**0.06-0.22***
50-59	3.24	1.81-5.80*	1.63	0.80-3.32
60-69	2.79	1.44-5.40*	1.72	0.77-3.90
70 years and above	0.73	0.47-1.14	1.02	0.50-2.09
Family History				
Yes	1.00		1.00	
No	0.18	0.11-0.28*	**0.37**	**0.19-0.69***
Hormone replacement therapy				
Yes	1.00		1.00	
No	0.09	0.06-0.14*	**0.15**	**0.08-0.27***
Physician Recommendation				
Diagnostic	1.00		1.00	
Evaluative	1.23	0.85-1.77	**2.00**	**1.24-3.23***

Access to mammogram facilities		Crude OR	95% CI	Adjusted OR	95% CI
Within 10 miles radius	High access	0.46	0.27-0.77*	**0.41**	**0.22-0.76***
	Medium access	0.42	0.25-0.71*	**0.42**	**0.23-0.76***
	Low access	1.00		1.00	
Within 20 miles radius	High access	0.60	0.38-0.96*	0.58	0.34-1.00
	Medium access	0.81	0.49-1.35	0.72	0.39-1.31
	Low access	1.00		1.00	
Within 30 miles radius	High access	0.68	0.42-1.10	**0.52**	**0.29-0.91***
	Medium access	0.67	0.41-1.09	0.85	0.49-1.49
	Low access	1.00		1.00	
Within 40 miles radius	High access	0.58	0.35-0.97*	**0.51**	**0.28-0.92***
	Medium access	0.79	0.47-1.32	0.68	0.37-1.25
	Low access	1.00		1.00	
Within 50 miles radius	High access	0.91	0.50-1.63	0.82	0.41-1.61
	Medium access	0.81	0.46-1.44	0.78	0.40-1.51
	Low access	1.00		1.00	

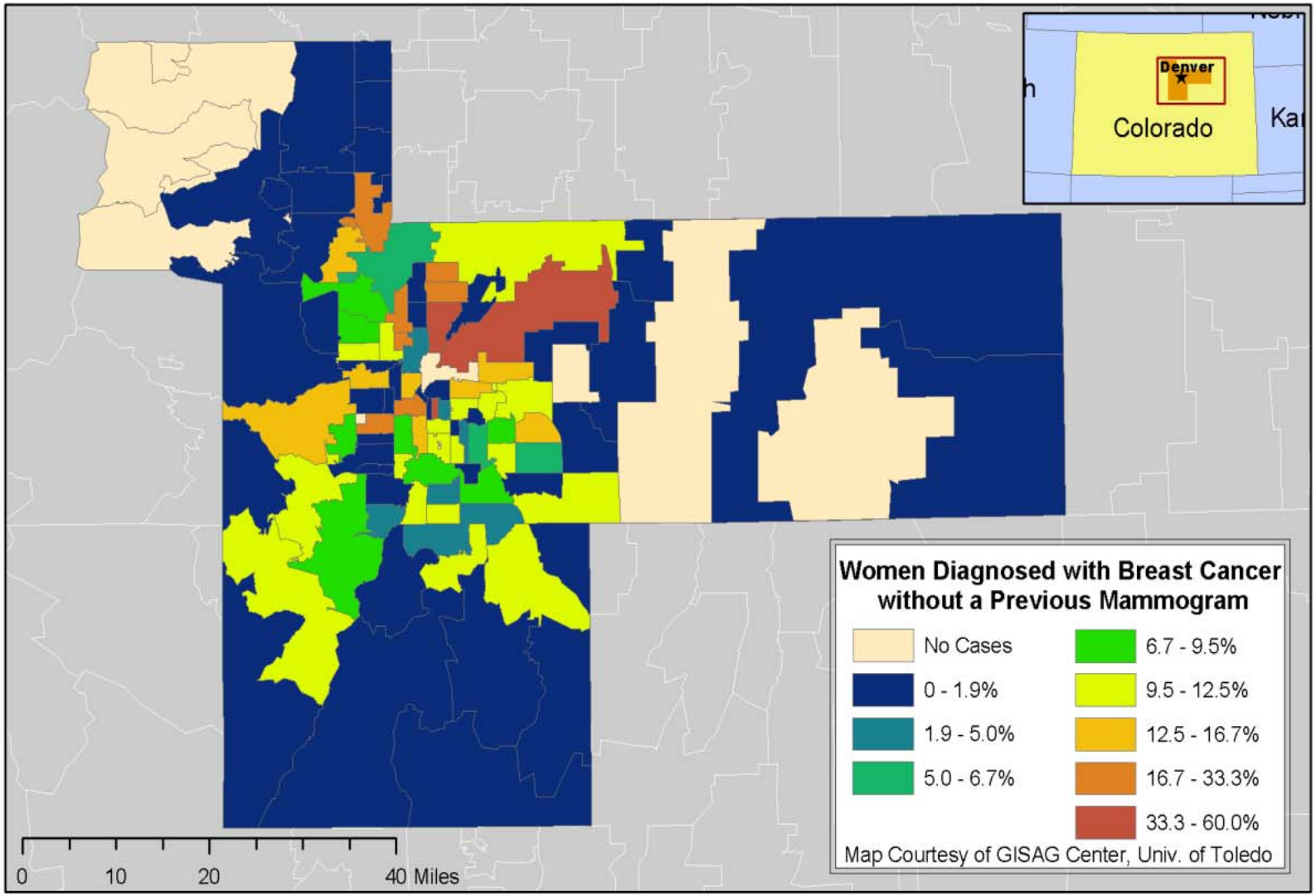
Note. OR = Odds ratio; CI = Confidence interval; * = statistically significant.
(Adjusted Odds ratio for all the independent variables are taken from the logistic model for 30 mile radius

Summary of the results

- Age, Family history, Hormone replacement therapy, Physician recommendation, and Breast cancer stage at diagnosis was significant predictors of **having had a previous mammogram**

- Women who had high access were found to be less likely to have had a previous mammogram compared to women who had low access, and the finding was statistically significant for 10 miles, 30 miles and 40 miles radiuses.

Map 5: Percentage of Women Diagnosed with Breast Cancer without a Previous Mammogram (by Zip Code)



Conclusion

- Access to mammography facilities could not explain mammography utilization behavior

- Further research should consider broader dimension of access measure

Limitations of the Study

- All the facilities were considered as having equal capacity
- Data limited to only six county areas.
- Arbitrary radius for preventive service is not well defined in the literature
- Geocoding data using women's Zip codes rather than street address.
- Straight-line distance was measured without considering any travel impedances .
- Absence of data on income or socio-economic status
- Considerable missing data on some of the variable

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Questions ?

Thank you all!

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