12-2006

Screening Mammography Compliance in Rural and Urban Women in Tennessee

Kathleen Conroy Brown
University of Tennessee - Knoxville

To the Graduate Council:

I am submitting herewith a dissertation written by Kathleen Conroy Brown entitled "Screening Mammography Compliance in Rural and Urban Women in Tennessee." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Human Ecology.

James J. Neutens, Major Professor

We have read this dissertation and recommend its acceptance:

Eugene C. Fitzhugh, Diane A. Klein, Priscilla Blanton, Paul Erwin

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

To the Graduate Council:

I am submitting herewithin a dissertation written by Kathleen Conroy Brown entitled "Screening Mammography Compliance in Rural and Urban Women in Tennessee." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree for Doctor of Philosophy, with a major in Human Ecology.

James J. Neutens

Major Professor

We have read this dissertation
and recommend its acceptance:

Eugene C. Fitzhugh

Diane A. Klein

Priscilla Blanton

Paul Erwin

Accepted for the Council:

Linda Painter

Interim Dean of Graduate Studies

(Original signatures are on file with official student records)

SCREENING MAMMOGRAPHY COMPLIANCE IN RURAL AND URBAN WOMEN IN TENNESSEE

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Kathleen Conroy Brown
December, 2006

DEDICATION

This dissertation is dedicated to my parents, Pat and Joe Conroy who instilled the value of education in me from a very early age. My only regret is that Dad is not here to celebrate this accomplishment.

ACKNOWLEDGEMENTS

This dissertation could not have been completed without the love, support, and encouragement of my entire family and many friends. Joey, my wonderful husband, endured many tedious moments but always managed to be a voice of reason, encouraging me, and often making dinner for me; I thank you. My beautiful daughters, Emily and Jordan, have been my staunchest supporters; their pride in my quest has gotten me through the times I felt like giving up.

I'd like to extend special acknowledgement to Dr. Bill Wallace, who got me started; Dr. Jim Neutens, my committee chair, for always being a realist, never mincing words, and keeping me going; and Dr. Eugene Fitzhugh, who went above and beyond for this process by being a mentor, taskmaster, and friend through it all. I want to thank my committee members Dr. Diane Klein for her encouragement, support, and willingness to listen, Dr. Priscilla Blanton, who so inspired me in her class with her dedication, commitment, and insights, and Dr. Paul Erwin who has actually been involved in this process longer than any other committee member as a former preceptor, community role-model and inspiring Public Health professional. I am very grateful.

ABSTRACT

Between 1990 and 2002, breast cancer mortality rates decreased by over 2% each year. Regular screening mammography is largely credited with the decline as it permits detection of breast cancer at its most treatable stage. In the United States approximately 75% of women over forty years of age report mammography screening within the past two years. However, rates vary by age, income, education, and residence.

The purpose of this study was to determine the prevalence of screening mammography compliance in women living in rural and urban areas of Tennessee; as well as the associated risk factors with special emphasis on risk associated with rural residence.

Using combined data from the Tennessee Behavioral Risk Factor Surveillance System (2001 and 2003), compliance with having accessed a screening mammogram within a two-year period was examined for a sample of 1922 women 40 years and older. Demographic, behavioral, and health-related variables were used to explore associations with compliance. Multivariate logistic regression was performed to identify the association between residence and compliance.

The prevalence of screening mammography compliance (71.3% 95% CI 67.4-75.2) in women living in rural areas of Tennessee was significantly different from the prevalence of compliance in women living in urban areas (78.3% 95% CI 75.9-80.7). Significantly higher rates of compliance were associated with income $\geq$ $50,000, having at least a high school education, having health insurance, having a personal healthcare

giver, non-smoking, recent use of alcohol, recent clinical breast exam or Pap test, and meeting the Healthy People 2010 (HP2010) recommendation for physical activity.

After controlling for all other factors, residence was not significantly associated with likelihood of compliance. Specific to rural women, identifying a personal healthcare giver and smoking status were significantly associated with increased likelihood of compliance. These associations can be used by health educators and service providers for identifying at-risk population and making programmatic decisions.

PREFACE

A note to the reader: this dissertation is written in journal style. That is, the body contains an article written for The Journal of Rural Health. The full-length methodology and literature review are contained in the Appendix, as well as the survey questions from the Behavioral Risk Factor Surveillance System (BRFSS).

TABLE OF CONTENTS

LIST OF TABLES

1. INTRODUCTION

The prevention of breast cancer in the general population is not yet a reality. Even risk reduction is limited as the greatest risk factors for breast cancer (gender and age) are non-modifiable.[1] However, decreasing mortality from breast cancer has become a reality. Between 1990 and 2002 breast cancer mortality rates have decreased by over 2% each year.[2] Regular screening mammography is largely credited with the decline because it permits detection of breast cancer at its most treatable stage.[3] In the United States approximately 70% of women over forty years of age report screening mammography within two years.[4] However, rates vary by age, race, income, and educational level.[4] The state of Tennessee has comparable rates of women who comply with screening recommendations and, like other states, has programs in the private and public sectors focused on reaching women who rarely or never screen. To improve screening compliance, identifying factors associated with screening mammography utilization is necessary. Identifying significant risk factors for screening non-compliance among population sub-groups is essential at the state and, or local level as national level data may not reflect the unique experience of these women.

Factors associated with the utilization of screening mammography by women in the United States are described by numerous studies.[5-20] The research indicates that higher income, greater levels of educational attainment, age[21-23] culture, [24-27] and urban residence are significant predictors of utilization.[21, 28-30] Risk associated with geographical residence, particularly rural residence, is of interest to the breast health community in Tennessee because of the size of the non-urban, rural population. In fact,

approximately 36% of the state's population is considered rural by residence; 21% greater than the U.S. rural by residence rate.[31] This is significant because rural residence is often associated with less-than optimal health status, outcomes, and health-promoting behaviors.[32]

Coughlin, Thompson, Hall, Logan, and Uhler[28] examined the association between residence and mammography utilization in a nationally representative sample of urban, suburban, and rural women living in the United States. They reported a significant association between degree of urbanicity and likelihood of compliance with mammogram screening having a mammogram within a two-year period. Their study, as well as one by Rakowski, Breen, and Meissner,[15] also found significant associations between mammography use and having seen a physician in the past year, higher educational attainment, good or excellent health, health insurance coverage, fewer than three person living in the household, and currently being married. Similar results were reported by Hall, Kaufman, and Ricketts,[33] Jerant Franks, Jackson, and Doescher,[22] Larson and Correa-de-Araujo,[34] and Zhang, Tao, and Irwin.[20]

Coughlin and colleagues utilized the Behavioral Risk Factor Surveillance System (BRFSS) to examine breast and other cancer screening behavior in women in several other studies as well.[8, 9, 35] The BRFSS is an annual behavior-based survey conducted collaboratively between the Centers for Disease Control (CDC) and the states in order to track the prevalence of risk factors associated with chronic disease among Americans.[36] BRFSS also queries respondents about preventive behaviors including screening access and frequency. Coughlin, Thompson, Hall, Logan, and Uhler[28] used specific survey questions from the BRFSS Women's Health Module to look at breast cancer screening

practices of women living in rural and urban areas of the United States in 1998 and 1999. The same Module was included in the 2001 Tennessee BRFSS[37] and the 2003 Tennessee BRFSS[38] surveys which allowed screening mammography compliance to be examined by demographic, socio-economic, and selected health-related factors. As such, the purpose of this study was to determine the prevalence of screening mammography compliance in women living in Tennessee; as well as the associated risk factors with special emphasis on risk associated with rural residence.

2. METHODOLOGY

Combined data from the 2001 and 2003 Tennessee Behavioral Risk Factor Surveillance System (BRFSS) was used for the current study. The BRFSS uses a random-digit-dialed telephone surveillance system that samples the non-institutionalized, U.S. civilian population aged 18 years and above within each state.[36] National response rates for the survey were 51.1% (33.3% - 81.5%) in 2001 and 53.2% (34.4 – 80.5%) in 2003. Estimated response rates for the 2001 and 2003 surveys in Tennessee were 56.1% and 58.9% respectively.[39, 40]

Using two years of BRFSS data was necessary to obtain an adequate sample size for sub-populations of women living in Tennessee. Survey years 2001 and 2003 were used because the Women's Health Module, containing the breast cancer screening questions, is only assessed on alternating years. In addition to mammography-related questions, relevant demographic, behavioral, and health-related questions were included for analysis. Participation was limited to non-Hispanic white and non-Hispanic Black women aged 40 and older who reported having utilized mammography screening; or who never had a mammogram. Race or ethnicity other than the aforementioned was excluded due to the small sample size. A total of 1,922 respondents met the inclusion criteria.

3. MEASURES

The dependent variable was defined as compliance with the recommendation for breast cancer screening; that is, having had a screening mammogram within the past 2 years. The determination to use this frequency was based on its use in previous studies by Coughlin, Thompson, Hall, Logan and Uhler,[28] Hall, Uhler, Coughlin, and Miller,[29] Rakowski, Breen, and Meissner, et al.,[14] Rauscher, Hawley, and Earp,[16] and Zhang, Tao, and Irwin.[20] Additionally, it reflected the Healthy People 2010 objective (3-13) to "increase the number of women aged 40 years and older who have received a mammogram within the past 2 years."[41] Respondents who had a screening mammogram within two years were considered compliant and coded "yes"; respondents indicating a time period greater than 2 years or never having had a mammogram were non-compliant and coded "no" for the dependent variable.

Independent variables for the study included age, marital status, number of adults in household, income, educational attainment, employment status, general health status, health insurance status, identifying a regular healthcare provider (physician or otherwise), current use of tobacco, current alcohol use, body mass index (BMI), physical activity status, time since last Papanicolau (Pap) test, time since last clinical breast exam (CBE), and geographical residence. Categorical strata were revised for several of the independent variables from the BRFSS questionnaire format to facilitate analysis. Respondents' age was grouped into one of three age categories, 40-49 years, 50-69 years, and $\geq$ 70 years of age. Income was collapsed into four categories: <$15,000, $15,000-$34,900, $35,000-$49,000 or $\geq$ $50,000 categories. Educational attainment was reflected by less than high

school, high school graduate or GED holder, having some college or attending a technical school, or college graduate categories. General health status was collapsed from four into 2 categories, excellent/very good/good or fair/poor. Dichotomous (yes/no) variables were created for identifying a personal caregiver, tobacco use, alcohol use within the last 30 days, CBE within 2 years, and Pap test within 3 years.

Rural residence was determined using Rural Urban Continuum Codes (RUCCs), the Department of Agriculture classification of counties by degree of urbanicity.[42] There were nine possible categories a county may be assigned, three of which indicate metropolitan (urban) status and six non-metropolitan (rural) areas. Definition of the codes and the codes for each county in the United States can be found at the Economic Research Service website (http://www.ers.usda.gov/). The study variable "METRO" used these codes to assign the 95 Tennessee counties as either rural (n = 57) or urban (n = 38).

4. STATISTICAL PROCEDURES

SAS 9.1 was used to initially manage the data and create the final dataset. SAS-callable SUDAAN statistical software program Version 9.0 was used for all remaining analyses to account for the complex sampling design of the BRFSS.[43] Using the PROC CROSSTAB procedure, descriptive statistics were calculated for the total sample. They were also calculated for the rural and urban sub-samples. Significance of main effects was determined by the Wald chi-square statistic and reported at the .05 level. Age-adjusted prevalence of mammogram screening compliance was determined for the study population using PROC DESCRIPT. Prevalence of compliance was also determined for demographic, health-status, and lifestyle markers.

Multivariate logistic regression analyses using PROC RLOGIST was performed to identify factors associated with compliance. Logistic regression was performed once on the complete study population, and separately for rural and urban women. Variables included in the model were year of survey, age, race, residence (rural/urban) marital status, education level, number of adults in the household, employment status, perceived health status, smoking status (current user or not) identifying a healthcare provider (MD or otherwise), and health insurance (insured or not). Income was excluded from this analysis due to large number of missing observations. Results were reported as odds ratios and the associated 95% confidence interval.

5. RESULTS

Weighted population estimates of the characteristics of women in Tennessee are reported in Table 1. In contrast to urban women, rural women were more likely to be white, report lower income, less education, and having poor or fair health. Rural women were more likely to abstain from alcohol, but were more likely to be overweight or obese. Prevalence of complying with the mammography recommendation for the total population, as well as for rural and urban women is presented in Table 2. After adjusting for age and year of study the overall prevalence of compliance for women in Tennessee was 76.1%. The prevalence of compliant women differed significantly between rural (71.3%, 95% CI 67.4 - 75.2) and urban (78.3%, 95% CI = 75.9 – 80.7) residence. For each demographic and behavioral characteristic, except for "unemployed", more urban women were compliant with the screening recommendation.

Women who were 50 to 69 years of age had higher rates of compliance than women of other ages. This pattern was significant regardless of residence. Younger (<50 years old) and older (70 and older) women had compliance rates similar to each other. Compliance was associated with income and generally increased with increasing income. Both rural and urban women with the lowest income screened less than women with higher income levels. Education level showed a similar relationship, but only in the overall statistics and among urban women. Increasing level of education was associated with increasing compliance with a significant difference between the highest and lowest levels. Women who were unable to work had significantly lower compliance rates

Table 1. Characteristics of study population.

	Total			Rural Women			Urban Women		
	n	%	(95% CI)	n	%	(95% CI)	n	%	(95% CI)
Total study population	1922			620			1302		
Age									
40-49 years	563	30.0	(28.1–32.7)	181	29.3	(25.5–33.4)	382	30.8	(28.0–33.7)
50-69 years	963	50.1	(47.6–52.5)	327	53.8	(49.5–58.0)	636	48.3	(45.4–51.3)
≥ 70 years	396	19.6	(17.8–21.6)	112	16.9	(14.0–20.3)	284	20.9	(18.6–23.4)
Race/Ethnicity[a]									
Non-Hispanic White	1721	87.9	(86.0–89.5)	588	94.0	(91.3–95.9)	1133	85.1	(82.6-87.2)
Non-Hispanic Black	201	12.1	(10.5–14.0)	32	6.0	(4.1–8.7)	169	14.9	(12.8-17.4)
Marital Status									
Married	1038	64.3	(62.1-66.6)	349	65.9	(61.9–69.6)	689	63.7	(60.8–66.4)
Divorced/separated	392	15.6	(14.0–17.3)	115	14.1	(11.6–17.0)	277	16.3	(14.3–18.4)
Widowed	405	16.2	(14.7–17.9)	134	16.7	(13.9–19.8)	271	16.0	(14.2–18.1)
Never married	83	3.8	(3.0-4.9)	21	3.4	(2.1–5.5)*	62	4.0	(3.0–5.3)
Income[a]									
< $15,000	187	11.5	(9.9–13.4)	73	14.4	(11.3–18.1)	114	10.2	(8.4–12.3)
$15,000- $34,999	559	41.8	(38.9–44.7)	212	50.7	(45.5–55.9)	347	37.6	(34.1–41.2)
$35,000- $49,999	235	18.4	(16.1–20.8)	80	20.3	(16.3–24.9)	155	17.5	(14.9–20.5)
≥ $50,000	339	28.3	(25.7–31.1)	58	14.7	(11.3–18.8)	281	34.7	(31.3–38.3)
Educational Attainment[a]									
< HS Grad	355	18.0	(16.2–20.0)	140	21.5	(18.2–25.1)	215	16.4	(14.3–18.8)
HS Grad/GED	706	36.3	(34.0–38.7)	262	42.1	(37.9–46.4)	444	33.6	(30.9–36.5)
Some College /Tech	504	27.2	(25.0–29.4)	129	21.5	(18.2–25.3)	375	29.8	(27.1–32.6)
College graduate	353	18.5	(16.6–20.5)	89	14.9	(12.0–18.4)	264	20.1	(17.8–22.7)
Employment Status									
Employed	860	44.8	(42.2–47.3)	261	43.1	(38.9–47.4)	599	45.6	(42.7- 48.6)
Homemaker/retired	836	43.6	(41.2–46.0)	267	43.0	(38.8–47.3)	569	43.9	(40.9–46.9)
Unemployed	77	4.2	(3.3–5.4)	30	4.4	(2.9–6.5)*	47	4.1	(3.0–5.7)
Unable to work	148	7.4	(6.2–8.7)	62	9.5	(7.3–12.3)	86	6.3	(5.0–8.0)
Number adults >18 in household									
1	771	25.2	(23.5–27.1)	245	24.8	(21.8–28.0)	526	25.4	(23.3–27.7)
2	890	52.1	(49.7–54.6)	283	50.9	(46.6–55.2)	607	52.7	(49.7–55.7)
≥ 3	261	22.6	(20.3–25.1)	92	24.4	(20.4–28.9)	169	21.8	(19.1–24.9)
General Health Status[a]									
Good/Very good/ Excellent	1407	73.7	(71.5–75.8)	417	67.6	(63.4–71.4)	990	76.6	(73.9–79.0)
Fair/poor	511	26.3	(24.2–28.5)	203	32.4	(28.6–36.6)	308	23.4	(21.0–26.1)
Any Health Insurance									
Yes	1798	93.7	(92.4–94.8)	570	92.2	(89.6–94.2)	1228	94.4	(92.7–95.6)
No	122	6.3	(5.2–7.6)	50	7.8	(5.8–10.4)	72	5.6	(4.4–7.3)

Table 1. continued

	Total			Rural Women			Urban Women		
	n	%	(95% CI)	n	%	(95% CI)	n	%	(95% CI)
Identifies healthcare giver									
Yes	1689	91.0	(89.4–92.3)	548	90.7	(87.7–93.0)	1141	91.1	(89.3–92.7)
No	175	9.0	(7.7–10.6)	55	9.3	(7.0–12.3)	120	8.9	(7.3–10.7)
Current smoker									
Yes	407	20.8	(18.9–22.9)	149	23.0	(19.6–26.8)	258	19.8	(17.5–22.4)
No	1514	79.2	(77.1–81.1)	471	77.0	(73.2–80.4)	1043	80.2	(77.6–82.5)
Current alcohol use[a]									
Yes	361	18.6	(16.7–20.6)	79	12.2	(9.7–15.3)	282	21.5	(19.2–24.1)
No	1552	81.4	(79.4–83.3)	539	87.8	(84.7–90.3)	1013	78.5	(75.9–80.8)
Body Mass Index[a]									
Neither overweight nor obese	770	42.4	(39.9–44.9)	214	34.0	(30.0–38.3)	556	46.2	(43.1–49.4)
Overweight	572	32.5	(30.1–35.0)	200	36.9	(32.6–41.3)	372	30.5	(27.7–33.5)
Obese	429	25.1	(22.9–27.4)	154	29.1	(25.2–33.5)	275	23.3	(20.7–26.0)

[a] $p \leq 0.05$. Weighted population estimates, “don’t know,” “not sure,” and “refused” responses excluded.
* SE% between 20% and 30% of reported percent, interpreted with caution.

Table 2. Prevalence of screening mammography within previous two years by selected demographic, health-related, and behavioral characteristics among Tennessee women aged 40 and older.

	All Women		Rural		Urban	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
Total[a]	1922	76.1 (74.0–78.1)	620	71.3 (67.4-75.2)	1302	78.3 (75.9–80.7)
Age[b]						
40 – 49 years	563	71.0 (66.7–75.0)	181	64.8 (56.8-72.1)	382	73.8 (68.6-78.3)
50 – 69 years	963	82.9 (80.2–85.3)	327	78.3 (73.2–82.7)	636	85.2 (82.0-87.9)
≥ 70 years	396	66.5 (61.0–71.5)	112	63.3 (53.0-72.6)	284	67.7 (61.1-73.5)
Race/Ethnicity						
Non-Hispanic White	1721	75.6 (73.3–77.8)	588	72.2 (68.1-76.0)	1133	77.4 (74.5–79.9)
Non-Hispanic Black	201	79.3 (72.3–84.9)	32	**	169	81.8 (74.2–87.6)
Marital Status[b]						
Married	1038	78.0 (75.2–80.6)	349	74.9 (69.8–79.4)	689	79.5 (76.0–82.6)
Divorced/separated	392	72.6 (67.4–77.2)	115	67.0 (56.9–75.7)	277	74.8 (68.7–80.0)
Widowed	405	70.6 (65.3–75.5)	134	64.3 (54.3–73.2)	271	73.7 (67.4–79.1)
Never married	83	80.3 (69.5–87.9)	21	68.9 (45.3–85.6)	62	84.8 (72.8–92.0)
Number adults >18 in household						
1	771	72.0 (68.5–75.3)	245	67.1 (61.0–73.7)	526	74.0 (69.8–77.9)
2	890	77.6 (74.6–80.3)	283	72.4 (66.8–77.4)	607	79.9 (76.3–83.0)
≥ 3	261	77.1 (71.3–82.0)	92	74.9 (64.5–83.0)	169	78.2 (70.9–84.1)
Income[b]						
< $15,000	187	69.1 (61.4–75.9)	73	69.9 (57.2–80.1)	114	68.6 (58.7–77.1)
$15,000- $34,999	559	71.7 (67.4–75.7)	212	68.8 (61.6–75.1)	347	73.6 (68.1-78.5)
$35,000- $49,999	235	80.6 (74.5–85.6)	80	76.2 (64.4–85.0)	155	83.0 (75.6–88.4)
≥$50,000	339	84.8 (80.2–88.5)	58	83.6 (71.8–91.1)	281	85.0 (79.8–89.1)
Education Level[b]						
< High school grad	355	65.0 (59.3–70.2)	140	66.6 (57.6–74.6)	215	64.0 (56.6–70.7)
High school graduate/GED	706	74.9 (71.2–78.2)	262	71.5 (65.3–77.0)	444	76.8 (72.1–81.0)
Some college/tech school	504	80.8 (76.8–84.2)	129	76.4 (67.5–83.4)	375	82.2 (77.7–86.0)
College graduate	353	82.5 (77.4–86.6)	89	73.7 (61.9–82.9)	264	85.5 (80.0–89.7)
Employment Status[b]						
Employed	860	77.8 (74.6–80.7)	261	72.2 (65.9–77.8)	599	80.2 (76.5–83.5)
Homemaker/retired	836	76.5 (73.2–79.5)	267	73.7 (67.5–79.0)	569	77.8 (73.7–81.3)
Unemployed	77	74.2 (61.3–83.9)	30	74.0 (52.4–88.0)	47	74.3 (57.6–86.0)
Unable to work	148	64.0 (55.1–72.0)	62	60.7 (47.4–72.9)	86	66.2 (54.5–76.3)
General Health Status						
Good/Very good/Excellent	1407	77.0 (74.5–79.4)	417	72.9 (69.0–77.3)	990	78.7 (75.7–81.4)
Fair/poor	511	73.4 (69.0–77.3)	203	69.7 (62.3–76.1)	308	75.7 (70.1–80.6)

Table 2. continued

	All Women		Rural		Urban	
	n	% 995% CI)	n	% (95% CI)	n	% (95% CI)
Health Insurance [b]						
Yes	1798	77.7 (75.5–79.8)	570	73.8 (69.7–77.6)	1228	79.5 (76.9–81.9)
No	122	50.8 (40.9–60.6)	50	48.5 (33.7–63.5)	72	52.5 (39.2–64.9)
Identifies healthcare giver[b]						
Yes	1689	78.3 (76.1–80.4)	548	74.7 (70.6–78.5)	1141	80.0 (77.3–82.5)
No	175	52.9 (44.6–61.0)	55	44.0 (30.3-58.6)	120	57.2 (47.3–66.7)
Current smoker [b]						
Yes	407	65.6 (60.3–70.5)	149	56.8 (48.0–65.2)	258	70.3 (63.7-76.1)
No	1514	78.9 (76.5–81.1)	471	76.3 (71.8–80.3)	1043	80.1 (77.2-82.6)
Alcohol in last 30 day [b]						
Yes	361	81.9 (77.2–85.9)	79	73.7 (61.8–82.9)	282	84.1 (78.9-88.2)
No	1552	74.7 (72.2–77.0)	537	71.7 (67.3–75.7)	1013	76.3 (73.2-79.0)
CBE in last 2 years [b]						
Yes	1514	86.8 (84.8–88.6)	460	85.5 (81.7–88.7)	1054	87.4 (85.0-89.5)
No	163	25.2 (18.4–33.5)	68	24.6 (14.7–8.2)*	95	25.7 (17.2-36.4)
PAP within last 3 yrs [b]						
Yes	1516	83.8 (81.6–85.7)	455	81.3 (77.0–84.9)	1061	84.8 (82.2-87.0)
No	209	39.5 (32.5–46.9)	82	40.6 (29.8–52.3)	127	38.7 (29.9-48.4)
Physical Activity[b]						
Meets HP2010 Objective	512	83.4 (79.7–86.5)	151	77.9 (70.0–84.1)	361	85.5 (81.3-88.9)
Insufficient PA	659	76.4 (72.6–79.8)	200	72.6 (65.3–78.9)	459	78.0 (73.5-82.0)
No PA	553	70.6 (66.2–74.6)	190	67.1 (59.5–74.0)	363	72.2 (66.8-77.1)
BMI						
Neither overweight/obese	770	73.9 (70.2–77.2)	214	65.8 (58.4–72.5)	556	76.6 (72.4–80.3)
Overweight	572	79.3 (75.4–82.7)	200	76.8 (69.9–82.6)	372	80.6 (75.8–84.7)
Obese	429	77.8 (73.2–81.8)	154	73.3 (65.1–80.1)	275	80.4 (74.7–85.0)

[a] age-adjusted to 2000 standard population

[b] $p \leq .05$ test of significance for independence between characteristic and compliance for total population

Weighted population estimates, "don't know," "not sure," and "refused" responses excluded.

* SE% 20% - 30% reported percent, interpret with caution

** SE% > 30%, not reported

compared to employed women. Urban women who were unable to work also screened at a significantly lower rate than employed urban women.

Higher compliance rates were also associated with having insurance and having a personal healthcare giver for all women. Participation in other preventive screenings (CBE and Pap test) was also associated with compliance. In fact, the highest rate of compliance, regardless of residence, was associated with having had a recent clinical breast exam. Similarly, both rural and urban women who had a Pap test within three years complied with recommendation at rates much greater than those who did not.

Several behavioral factors were associated with compliance. Compliance among non-smoking women was greater than for current smokers. Women who met the Healthy People 2010 recommendation for physical activity screened at significantly greater rates than inactive women. This relationship with physical activity was also present in urban women. Current alcohol use was associated with compliance, but only so in the total population.

Results of the multiple regression analysis are reported in Table 3. After adjusting for all other factors, place of residence was not significantly associated with compliance. Though not significant, urban women were more likely to be compliant with the screening recommendation than rural women (OR 1.31; 95% CI 1.00 – 1.71). Specific to women living in rural residences, being able to identify a personal healthcare provider and smoking status were the only significant variables associated with compliance. Rural women who identified a personal healthcare giver complied with mammography recommendation at three times (OR 3.08; 95% CI = 1.52 – 6.24) the rate of rural women who did not identify a provider. Current smokers were significantly less likely to screen

Table 3. Odds risk ratio for compliance with screening mammography recommendation in women aged 40 and older in Tennessee

	All women (n = 1922)		Rural only (n = 620)		Urban only (n = 1302)	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Year of study						
2001	1.00		1.00		1.00	
2003	0.90	(0.70 – 1.17)	1.01	(0.67 – 1.53)	0.83	(0.60 – 1.15)
Age						
40-49 years	1.00		1.00		1.00	
50-69 years	1.91	(1.40 – 2.63)	1.58	(0.95 – 2.64)	2.24	(1.49 – 3.35)
≥ 70 years	0.56	(0.35 – 0.90)	0.66	(0.29 – 1.47)	0.55	(0.30 – 1.00)
Race						
Non-Hispanic White	1.00		1.00		1.00	
Non-Hispanic Black	1.35	(0.86 – 2.12)	0.65	(0.28 – 1.52)	1.75	(0.99 – 3.07)
Residence						
Rural	1.00			NA		NA
Non-rural	1.31	(1.00 – 1.71)		NA		NA
Marital Status						
Married/Unmarried couple	1.00		1.00		1.00	
Divorced	0.85	(0.56 – 1.29)	(0.93	(0.47 – 1.82)	0.87	(0.50 – 1.51)
Widowed	0.86	(0.55 – 1.36)	0.68	(0.32 – 1.45)	1.07	(0.59 – 1.94)
Never married	1.00	(0.53 – 1.89)	0.70	(0.24 – 2.02)	1.41	(0.60 – 3.30)
Educational Attainment						
< High School	1.00		1.00		1.00	
HS Grad/GED	1.31	(0.91 – 1.89)	1.03	(0.58 – 1.81)	1.61	(1.00 – 2.60)
Some college/tech	1.83	(1.24 – 2.72)	1.28	(0.65 – 2.51)	2.41	(1.48 – 3.93)
College graduate	1.99	(1.25 – 3.18)	1.09	(0.51 – 2.30)	3.02	(1.62 – 5.64)
Number Adults in Household						
1	1.04	(0.65 – 1.69)	0.99	(0.46 – 2.15)	0.94	(0.49 – 1.82)
2	1.02	(0.69 – 1.51)	0.83	(0.44 – 1.56)	1.09	(0.66 – 1.82)
3	1.00		1.00		1.00	
Employment status						
Employed	1.00		1.00		1.00	
Homemaker/Retired	1.19	(0.86 – 1.64)	1.14	(0.67 – 1.93)	1.25	(0.83 – 1.88)
Unemployed	1.21	(0.63 – 2.31)	1.35	(0.53 - 3.48)	1.24	(0.52 – 2.96)
Unable to work	0.45	(0.27 – 0.74)	0.52	(0.24 – 1.12)	0.41	(0.21 – 0.78)
General Health Status						
Good/Very good/Excellent	0.86	(0.62 – 1.18)	0.85	(0.52 – 1.40)	0.84	(0.55 – 1.29)
Fair/poor	1.00		1.00		1.00	
Current smoker						
Yes	0.51	(0.38 – 0.69)	0.41	(0.26 – 0.66)	0.56	(0.38 – 0.84)
No	1.00		1.00		1.00	
Personal healthcare provider						
Yes	2.78	(1.83 – 4.21)	3.08	(1.52 – 6.24)	2.87	(1.72 – 4.78)
No	1.00		1.00		1.00	
Health insurance						
Yes	3.10	(1.88 – 5.12)	2.08	(0.95 – 4.55)	3.83	(2.05 – 7.18)
No	1.00		1.00		1.00	

than non-smokers (OR 0.41; 95% CI 0.26 – 0.66). The associations were significant for urban residence as well.

Four additional independent variables: insurance status, age, education, and employment, were also found to be significant for compliance with screening mammography recommendations. Of these, having health insurance showed the most robust relationship. Women with health insurance were at least three times (OR 3.10; 95% CI=1.88 – 5.12) more likely to comply than women without health insurance. Specific to age, women 50 – 69 years of age (OR 1.91; 95% = CI 1.40 – 2.63) compared to the referent group (40 – 49 years of age) were likely to comply. Being older ($\geq$ 70 years of age) significantly decreased the likelihood of compliance, those women were more than 50% less likely to be compliant (OR 0.56; 95% = CI 0.35 – 0.90) compared to women 40 -49 years of age. A similar association was seen among urban women but was absent among rural women.

A significant relationship between education and compliance was present; but like the association with age, was present among urban women but not among rural women. It was only significant, however, when women had gone beyond a high school education. Women having any college or graduating from college were almost twice as likely to be compliant (OR 1.83; 95% CI = 1.24 – 2.72 and OR 1.99; 95% CI = 1.25 – 3.18) as women with less than a high school education. The association among urban women was even stronger. Urban college graduates were more than three times (OR 3.02; 95%CI = 1.62 – 5.64) as likely to screen as the least educated women.

Screening compliance was also less likely among women who could not work. Those women were 55% less likely to be compliant with mammography screening. Once again, the relationship was significant for urban residence but not rural.

6. DISCUSSION

This study determined the prevalence of compliance with screening mammography within a two-year period for women living in rural and urban areas of Tennessee. It also examined those factors associated with compliance. Results of this study found a high overall rate of compliance in women in Tennessee for the study years. The overall compliance rate was, in fact, equal to the 2002 national compliance rate of 76.1%.[44] This level of compliance is cause for optimism considering the less-than-ideal state of women's health in Tennessee; evidenced by at least two national reports. In 2004, The Institute for Women's Policy research ranked women's health in Tennessee forty-sixth in the nation in "The Status of Women in the United States" report.[45] It was ranked only slightly better (42nd) in "Making the Grade on Women's Health: A National State-by-State Report Card 2004" which assessed social, political, and environmental conditions as they impact women's health within the state.[46] Specific to preventive health, the report ranked the rate of screening mammography in Tennessee 31st among the states; this being one of the only factors to receive a "satisfactory" grade.

The overall compliance rate also meant that women in Tennessee surpassed the Healthy People 2010 (HP 2010) objective of 70% screening mammography compliance every two years.[44] This is an important benchmark that likely reflects the national trend of increasing screening utilization that has occurred over the past 20 years.[2] The absence of disparity for screening rates between non-Hispanic white and non-Hispanic black women in Tennessee is another point of optimism and reflects progress in the national goal to eliminate health disparities.[41] The higher compliance rates demonstrated by non-

Hispanic black women in Tennessee is indicative of prioritized efforts and resources in Tennessee to improve screening rates among those women. Similar rates for this demographic population have been found in other studies.[21, 47]

The overall rate is encouraging but by no means warrants complacency. An examination of sub-populations of adult women living in Tennessee revealed compliance rates that were less than the benchmark for certain groups of women. Compliance by age showed that younger rural women (40 – 49 years old) and both rural and urban older women (>70 years old) living in Tennessee screened at less than the HP 2010 rate. This is not unique to Tennessee as reflected by Coughlin, Thompson, Hall, Logan, and Uhler[28] who found a similar age-related screening pattern in their national study on screening mammography compliance rtes. For younger rural women this could reflect a number of things related to screening mammography including lack of resources, lack of perceived risk, or the presence of lifestyle factors associated with low compliance rates. For older women, similar factors may contribute to lower screening mammography compliance, in addition to factors related to widowhood and/or living alone (each significant for compliance in this study).

Women with the least education also fell below the HP 2010 screening mammography benchmark. This came as no surprise as the association between education and screening mammography compliance has been well-established.[5,11,13,20, 28] The more pronounced relationship between education and screening compliance seen in urban women justifies prioritization of the least educated for education and interventions to improve compliance. Also, based on their compliance performance more highly educated women in rural areas are still in need of intervention efforts to improve

screening rates. This is important for breast health educators and service coordinators to appreciate as target populations are identified.

Screening mammography compliance determined by this study found a significant difference between rural and urban screening prevalence rates. However, when subjected to controlling for possible confounders, several of the factors associated with screening compliance including residence (urban vs. rural), lost significance. A possible explanting for this may be the greater prevalence of other factors associated with lower screening (i.e. lower income and education).[20, 34]

Overall, there were two significant factors associated with increased likelihood of compliance common to all women regardless of residence. The first, identifying a personal healthcare giver was strongest for rural women while only marginally less robust for urban women. This has implications on several levels. For the individual, a usual source of care increases the likelihood of receiving preventive services and this is associated with increased compliance.[29] Women who access related screening tests, specifically Clinical Breast Exam and Pap have been found to utilize screening mammography more often.[48] This may be due to the increased likelihood of physician referral which is one of the strongest determinants of screening mammography.[16, 48, 49] This impact of a personal healthcare giver may also extend beyond the immediate measure of screening mammography compliance. A regular healthcare provider has been shown to be an indicator for better overall health as the likelihood of early detection of any abnormal health condition is enhanced.[48]

The importance of having a healthcare provider has implications for breast health programmers and healthcare organizations, as well. Focused interventions connecting

women to healthcare resources, specifically providers, could have a broader impact on overall health than interventions focused on increasing screening rates, alone. A media campaign to raise awareness of community resources is a means by which this might be accomplished. Health resource directories are another way to facilitate the connection between women and providers.

The significance of a personal healthcare provider may also have implications for health policy in Tennessee. In 2004, 48 of Tennessee's 95 counties were designated as a *Health Professional Shortage Area*, a federal designation for inadequate coverage for primary care.[50] This suggests that many of Tennessee's residents specific to healthcare and preventive services are underserved. However, several potentially mitigating resources have been put into place, an example being local health departments. Health departments are present in every county throughout Tennessee and coordinate the national Breast and Cervical Cancer Early Detection Program (BCCEDP) which provides screening, diagnostics, and treatment to uninsured or underinsured women.[51] There are also 41 Federally Qualified Health Centers (FQHCs) providing services to underserved women in many of the counties. If these resources are part of a "safety net" for otherwise vulnerable populations, they need to be supported with public health policy and funding that strengthens and protects their sustainability.

Specific to urban women, the concept of a "health-home," the combination of having a personal physician and having health insurance could be a discriminating factor for identifying women at risk of non-compliance. Having health insurance increased the likelihood of compliance by three times for urban women (OR 3.83; 95% CI 2.05 – 7.18).

Even though insurance was not significant for rural women, insured rural women were at least twice more likely to be compliant.

Though the study revealed an insured rate of over 90% for women in Tennessee, a recent healthcare-related event in the state may potentially impact healthcare coverage that could affect screening mammography compliance rates. In 2005, the state of Tennessee disenrolled approximately 200,000 persons from TennCare, the state administered health insurance program for the medically and categorically needy, as part of a major program reform. For the women affected by this policy change, the likelihood of securing any healthcare much less preventive healthcare is jeopardized. The potential effect may be greater on urban women as insurance was highly predictive of compliance for this population. This is important for health planners. Having a system by which the impact of insurance or lack, thereof, can be detected is both desirable and prudent. The BRFSS survey provides this type of information. Conducting the survey at regular intervals can provide specific information related to insurance coverage and screening mammography. The impact of the TennCare reform has yet to be quantified and is anecdotal, at best. However, use of studies that originate from the state level can help detect change by serving as a basis for comparison of screening mammography compliance as it relates to insurance status in the future.

The other significant factor affecting likelihood of compliance in rural and urban women was smoking status. Women smokers have consistently reported a lower rate of screening mammography since the 1980's.[52] The use of preventive measures in general is lower in smokers.[20] It is likely that factors associated with smoking provide better explanation for lower compliance than the behavior of smoking, alone. Because smoking

is related to a cluster of risk behaviors [32] addressing this issue is a far-more difficult challenge than screening rates alone. The greater issues of poverty and social policy are implicated and these are no simple measures.

Even though residence (rural-vs-urban) was not significantly related with the likelihood of screening, the geography of Tennessee may help to explain the lower rates of screening mammography compliance found among rural women. Access to a mammography facility is probably affected by several factors in Tennessee, both positively and negatively. Geographic isolation associated with rurality for some women[53] is common in Tennessee, but may be modified somewhat by the presence of six major urban areas. These are spread across the state (per rural-urban coding) as opposed to being centrally located or at one end of the state or other. While this may be positive, the fact remains that much of the rural area in Tennessee remains a federal shortage area.

Specific to screening mammography resources, the General Accounting Office reported 207 mammography facilities for Tennessee in 2001 with a slight decrease to 199 in 2003.[54] The number of mammography facilities in Tennessee is comparable to states of similar size and population.[55] Seventy-three facilities are located in rural counties according to the RUCC definition. In addition to mammography centers, mobile mammography may help to modify the effect of rurality on access.[5, 56] Three mobile units serve the East Tennessee area; at least one serves the south central part of the state; and one serves the western part of Tennessee. According the Breast Health Outreach Program at the University of Tennessee Medical Center,[57] these highly utilized, mobile units provide services to both urban and rural communities. While they undoubtedly provide

part of the “safety net” for underserved women through free or low-cost mammography today, the impact of mobile mammography during the study’s years is unknown.

7. LIMITATIONS

Interpretation of the findings reported here should be done with caution. Results can be generalized only to non-Hispanic White and non-Hispanic Black women living in Tennessee. The study is also limited by the use of self-reported data. However, Caplan, McQueen, Qualters, Leff, Garrett, and Calonge[58] found high sensitivity in BRFSS data for assessing mammography screening.

Excluding women of race or ethnicity other than non-Hispanic white and non-Hispanic black does not truly reflect the changing demographics of Tennessee, especially in the Hispanic population. However, the small sample size within the data used for Hispanic or other ethnic groups would provide unreliable statistics. Using more years of data in aggregate could provide larger samples, therefore future BRFSS years of data should better capture the screening status of these women as the population changes and representative samples are collected.

Selecting a definition of rural residence is also a limiting factor in this study. A standardized method for defining rural-urban residence was absent in the research literature. Rather, a variety of schemes for defining rural residence were noted. The particular means by which rural is defined could potentially affect the outcome of the study.

8. CONCLUSIONS

Several conclusions can be drawn from this study. After controlling for all other factors, residence was not associated with screening mammography compliance in Tennessee. Factors found to be significantly associated with likelihood of screening compliance differed for rural and urban women and may warrant consideration by planners, educators, and service providers for programmatic decisions.

As well, the importance of a having a personal healthcare giver for women living in Tennessee cannot be understated. This has implications for breast health outreach agencies designing targeted interventions for at-risk populations. This also has health-policy implications in that women without a regular provider may be at risk for non-compliance and ultimately late-stage diagnosis of breast cancer. The prevention of late-stage disease through utilization of screening mammography benefits not only the individual but the family, the community, and the nation as a whole.

REFERENCES

References

1. American Cancer Society. What are the risk factors for breast cancer? Available at: http://www.cancer.org/docroot/CRI/content/CRI_2_4_2X_What_are_the_risk_factors_for_breast_cancer_5.asp. Accessed November 4, 2005.
2. American Cancer Society. *Breast Cancer Figures 2005-2006.* Atlanta: American Cancer Society, Inc.; 2005.
3. U.S. Preventive Task Force. Screening for breast cancer. Available at: http://www.ahrq.gov/clinic/3rduspstf/breastcancer/brcanrr.htm. Accessed January 20, 2006.
4. Centers for Disease Control and Prevention. Women aged 40+ who have had a mammogram within the past two years. *Behavioral Risk Factor Surveillance System Survey Data* [http://apps.nccd.cdc.gov/brfss/display.asp?cat=WH&yr=2004&qkey=4421&state=TN. Accessed January 20, 2006.
5. Barrett K, Legg J. Demographic and health factors associated with mammography utilization. *Am J Health Promot.* 2005;19(6):401-405.
6. Blumenthal SJ, Kagen J. The effects of socioeconomic status on health in rural and urban America. *JAMA.* Jan 2 2002;287(1):109.
7. Carlos RC, Fendrick AM, Patterson SK, Bernstein SJ. Associations in breast and colon cancer screening behavior in women. *Acad Radiol.* 2005;12(4):451-458.
8. Coughlin S, Thompson TD, Seeff L, Richards T, Stallings F. Breast, cervical, and colorectal carcinoma screening in a demographically defined region of the southern U.S. *Cancer.* 2002;95(10):2211-2222.
9. Coughlin SS, Uhler RJ, Hall HI, Briss PA. Nonadherence to breast and cervical cancer screening: what are the linkages to chronic disease risk? *Prev Chronic Dis.* 2004;1(1):A04.
10. Eheman CR, Benard VB, Blackman D, et al. Breast cancer screening among low-income or uninsured women: results from the National Breast and Cervical Cancer Early Detection Program, July 1995 to March 2002 (United States). *Cancer Causes Control.* 2006;17(1):29-38.
11. Hiatt RA, Klabunde C, Breen N, Swan J, Ballard-Barbash R. Cancer screening practices from National Health Interview Surveys: Past, present, and future. *J Natl Cancer Inst.* 2002;94(24):1837-1846.
12. O'Malley MS, Earp JA, Hawley ST, Schell MJ, Mathews HF, Mitchell J. The association of race/ethnicity, socioeconomic status, and physician recommendation for mammography: who gets the message about breast cancer screening? *Am J Public Health.* 2001;91(1):49-54.
13. Peek ME, Han JH. Disparities in Screening Mammography. Current Status, Interventions, and Implications. *J Gen Int Med.* 2004;19(2):184-194.
14. Rakowski W, Breen N, Meissner H, et al. Prevalence and correlates of repeat mammography among women aged 55-79 in the Year 2000 National Health Interview Survey. *Prev Med.* 2004;39(1):1-10.

15. Rakowski W, Truchil R, Schneider K, Meersman S, Clark MA. Correlates of mammography in a national analysis compared to results in quintile- and regionally-defined samples. *Prev Med.* 2006;In Press, Corrected Proof.
16. Rauscher GH, Hawley ST, Earp JAL. Baseline predictors of initiation vs. maintenance of regular mammography use among rural women. *Prev Med.* 2005;40(6):822-830.
17. Schonberg MA, McCarthy EP, Davis RB, Phillips RS, Hamel MB. Breast cancer screening in women aged 80 and older: Results from a national survey. *J Am Geriatr Soc.* 2004;52(10):1688-1695.
18. Schootman M, Jeffe DB, Reschke AH, Aft RL. Disparities related to socioeconomic status and access to medical care remain in the United States among women who never had a mammogram. *Cancer Causes Control.* 2003;14(5):419-425.
19. Young RF, Severson RK. Breast cancer screening barriers and mammography completion in older minority women. *Breast Cancer Res Treat.* 2005;89(2):111-118.
20. Zhang P, Tao G, Irwin KL. Utilization of preventive medical services in the United States: a comparison between rural and urban populations. *J Rural Health.* 2000;16(4):349-356.
21. Husaini BA, Emerson JS, Hull PC, Sherkat DE, Levine RS, Cain VA. Rural-urban differences in breast cancer screening among African American women. *J Health Care Poor Underserved.* 2005;16(4 Suppl A):1-10.
22. Jerant AF, Franks P, Jackson JE, Doescher MP. Age-related disparities in cancer screening: Analysis of 2001 Behavioral Risk Factor Surveillance System Data. *Ann Fam Med.* 2004;2(5):481-487.
23. Rahman SM, Dignan MB, Shelton BJ. Factors influencing adherence to guidelines for screening mammography among women aged 40 years and older. *Ethn Dis.* 2003;13(4):477-484.
24. Garza MA, Luan J, Blinka M, et al. A culturally targeted intervention to promote breast cancer screening among low-income women in East Baltimore, Maryland. *Cancer Control.* 2005;12 Suppl 2:34-41.
25. Paskett ED, Tatum C, Rushing J, et al. Racial differences in knowledge, attitudes, and cancer screening practices among a triracial rural population. *Cancer.* 2004;101(11):2650-2659.
26. Russell KM, Perkins SM, Zollinger TW, Champion VL. Sociocultural Context of Mammography Screening Use. *Oncol Nurs Forum.* 2006;33(1):105-112.
27. Bushy A. Needed: A more inclusive research paradigm to learn about the health needs of rural women. *Womens Health Issues.* 2005;15(5):204-208.
28. Coughlin SS, Thompson TD, Hall HI, Logan P, Uhler RJ. Breast and cervical carcinoma screening practices among women in rural and nonrural areas of the United States, 1998-1999. *Cancer.* 2002;94(11):2801-2812.
29. Hall HI, Uhler RJ, Coughlin SS, Miller DS. Breast and Cervical Cancer Screening among Appalachian Women. *Cancer Epidemiol Biomarkers Prev.* 2002;11(1):137-142.

30. McElroy JA, Remington PL, Gangnon RE, Hariharan L, Andersen LD. Identifying geographic disparities in the early detection of breast cancer using a geographic information system. *Prev Chronic Dis.* 2006;3(1):A10.
31. U. S. Department of Agriculture Economic Research Service. Measuring rurality: What is rural? Available at: http://www.ers.usda.gov/Briefing/Rurality/WhatIsRural/. Accessed June 1, 2006.
32. Ricketts TC, Johnson-Webb KD, Randolph RK. Populations and Places in Rural America. In: Ricketts TC, ed. *Rural health in the United States*. New York: Oxford University Press; 1999.
33. Hall SA, Kaufman JS, Ricketts TC. Defining urban and rural areas in U.S. epidemiologic studies. *J Urban Health.* 2006;V83(2):162-175.
34. Larson S, Correa-de-Araujo R. Preventive health examinations: A comparison along the rural-urban continuum. *Womens Health Issues.* 2006;16(2):80-88.
35. Coughlin SS, Uhler RJ, Bobo JK, Caplan L. Breast cancer screening practices among women in the United States, 2000. *Cancer Causes Control* 2004:159(112).
36. Centers for Disease Control and Prevention. About the BRFSS. Available at: http://www.cdc.gov/brfss/about.htm. Accessed June 4, 2006.
37. Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System Survey Questionnaire 2001.* Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2001.
38. Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System Questionnaire 2003.* Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2003.
39. Centers for Disease Control and Prevention. 2001 Summary Data Quality Report. Available at: http://www.cdc.gov/BRfss/technical_infodata/2001QualityReport.htm. Accessed August 5, 2006.
40. Centers for Disease Control and Prevention. 2003 Summary Data Quality Report. Available at: http://www.cdc.gov/BRfss/technical_infodata/2003QualityReport.htm. Accessed August 5, 2006.
41. U.S. Department of Health and Human Services. *Healthy people 2010.* Washignton, DC: US Department of Health and Human Services; 2000.
42. U.S. Department of Agriculture Economic Research Service. 2003 Rural Urban Continuum Codes. Available at: http://www.ers.usda.gov/Data/RuralUrbanContinuumCodes/2003/. Accessed January 4, 2006.
43. *SUDAAN* [computer program]. Version 9.0.1. Research Triangle Park; 2005.
44. Centers for Disease Control and Prevention. Behavior Risk Factor Surveillance System Prevalence Data. Available at: http://apps.nccd.cdc.gov/brfss/display.asp?cat=WH&yr=2002&qkey=4421&state=UB.
45. Werschkul M, Williams E. *The status of women in the states.* Washington, D.C.: The Institute for Women's Policy Research; 2004.

46. Waxman JG, Cohen EN, Patchias E, Greenberger MD, Berlin M. *Making the Grade on Women's Health, A National and State-by-State Report Card.* Washington, DC: National Women's Law Center and Oregon Health and Science University; 2004.
47. Magai C, Consedine N, Conway F, Neugut A, Culver C. Diversity matters: Unique populations of women and breast cancer screening. *Cancer.* 2004;100(11):2300-2307.
48. Ahmed NU, Fort JG, Elzey JD, Bailey S. Empowering factors in repeat mammography: insights from the stories of underserved women. *J Ambul Care Manag.* 2004;27(4):348(348).
49. Shell R, Tudiver F. Barriers to cancer screening by rural Appalachian primary care providers. *J Rural Health.* 2004;20(4):368-373.
50. Health Resources and Services Administration. Health Professional Shortage Areas. Available at: http://bhpr.hrsa.gov/shortage/. Accessed September 15, 2006.
51. Centers for Disease Control and Prevention (CDC) Division of Cancer Prevention and Control About the Program. *National Breast and Cervical Cancer Early Detection Program.* Available at: http:\\www.cdc.gov/cancer/nbccedp/about.htm. Accessed September 2, 2006.
52. Rakowski W, Clark MA, Truchil R, Schneider K, Meersman S. Smoking status and mammography among women aged 50-75 in the 2002 behavioral risk factor surveillance system. *Women Health.* 2005;41(4):1-21.
53. Hughes-Gaston M. 100% access and 0 health disparities: changing the health paradigm for rural women in the 21st century. *Womens Health Issues.* 2001;11(1):7-16.
54. United States General Accounting Office. *Mammography Capacity Generally Exists to Deliver Services.* Washington, D. C. 2002.
55. Centers for Devices and Radiological Health. Mammography. Available at: http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfMQSA/mqsa.cfm. Accessed September 22, 2006.
56. Suter LG, Nakano CY, Elmore, JG. The personal costs and convenience of screening mammography. *J Womens Health Gend Based Med.* 2002;11(7):667-672.
57. Huggler, Paige. Personal interview October 15, 2006.
58. Caplan LS, McQueen DV, Qualters JR, Leff M, Garrett C, Calonge N. Validity of women's self-reports of cancer screening test utilization in a managed care population. *Cancer Epidemiol Biomarkers Prev.* 2003;12(11 Pt 1):1182-1187.

APPENDICES

Appendix I

Expanded Methodology

The following section provides a detailed description of the methodology employed in the study. The study used secondary data analysis of Behavioral Risk Surveillance System (BRFSS) survey data, for women in Tennessee, 2001 and 2003. The dataset, sample, measures, and statistical procedures are described herein.

The study revolved around the relationship of residence with complying with recommended breast cancer screening. Residence was dichotomized as rural or urban. Compliance was defined as having had a screening mammogram within two years. The research questions asked were:

1. What is the prevalence of mammography screening across demographics (age, race, marital status, income, and education attainment), health resources (insurance and regular healthcare provider), and lifestyle factors (perceived health status, smoking, alcohol consumption, occurrence of clinical breast exams (CBE) and Papanicolaou (PAP) screening, weight status, and physical activity status) among women in Tennessee?
2. How do factors associated with screening compliance differ between rural and urban women in Tennessee?
3. To what degree is residence associated with likelihood of breast health screening?

Data: Behavioral Risk Factor Surveillance System

The Behavioral Risk Factor Surveillance System (BRFSS) is a population-based survey designed to measure behaviors and risk associated with chronic disease. It is a state-based, random-digit-dialed telephone surveillance system that samples the non-

institutionalized, U.S. civilian population aged 18 years and above. Institutionalized persons, nursing home residents and residents of households without telephones are not included in the survey. Household telephone coverage ranges from 87% to 98% and was estimated to be 91.96% in 2001 in Tennessee.[1] Specific coverage information could not be found for 2003. Response rates were also noted for the survey years. Response rates for 2001 and 2003 (in Tennessee) were 56.1% and 58.9% respectively.[2, 3]

BRFSS utilizes a complex survey design. The probability of selection is influenced by non-response and non-coverage and must be accounted for. Data weighting provides the means by which this potential bias is controlled.[4] The annual state BRFSS data is weighted inversely to the respondent's probability of being selected and the age-race-sex-specific population data using U. S. Census Bureau projections in order to optimize generalizability.[4]

According to a BRFSS technical note, the general formula for the weight variable for each respondent is as follows (where a factor does not apply its value is set to one for calculation):

FINALWT = STRWT * 1 OVER NPH * NAD * POSTSTRAT

FINALWT is the final weight assigned to each respondent.

STRWT accounts for differences in the basic probability of selection among strata (subsets of area code/prefix combinations). It is the inverse of the sampling fraction of each stratum. There is almost never a complete correspondence between strata, which are defined by subsets of area code/prefix combinations, and regions, which are defined by the boundaries of government entities.

1/NPH is the inverse of the number of residential telephone numbers in the respondent's household.

NAD is the number of adults in the respondent's household.

POSTSTRAT is the number of people in an age-by-sex or age-by-race/ethnicity-by-sex category in the population of a region or a state divided by the sum of the preceding weights for the respondents in that same age-by-sex or age-by-race/ethnicity-by-sex category. It adjusts for non-coverage and non-response and forces the sum of the weighted frequencies to equal population estimates for the region or state [2, 3].

Study Sample

Study criteria limited inclusion to non-Hispanic White and non-Hispanic Black females aged 40 and above who indicated having had a screening mammogram at some time, or never having had a mammogram. Race other than the aforementioned yielded a sample size too small for securing reliable statistics. The combined years of data included a total of 5,513 respondents (males and females). Of the 3,616 females, 2382 were 40 years of age or above, and 2301 were Non-Hispanic white or non-Hispanic black. There were 2,013 women who indicated having had a screening mammogram or never having had a mammogram. A total of 1,949 women met the age, race, and screening criterion. However, the value for the variable county (needed for determining rural-urban status) was missing for 27 women so the final data set for calculating prevalence was 1922 women.

Measures

BRFSS was designed to collect data on health-related behaviors. The validity of self reported data can be questionable. McGovern, Lurie, Margolis, and Slater[5]looked at the accuracy of self-reported mammograms and found a 72.4% positive predictive value and a 90.6% negative predictive value for recall of mammography. Overall, they felt that accuracy was relatively poor for medical practice but acceptable for population-based surveys like BRFSS, however the population was limited to low-income urban women .[5] Caplan, McQueen, Qualters, Leff, Garrett, and Calonge[6] examined the validity of self-report data for breast and cervical cancer screening behavior and found fairly high accuracy. Specificity for determining if a mammogram was actually within two years was over 95% and agreement between self-report and medical record was over 88%.[6] However, the population was a managed care population and an abbreviated form of the BRFSS was used. Moderate reliability and validity have been determined for BRFSS measures including when last mammogram was received and time since most recent clinical breast exam.[7] Several demographic measures were also of high reliability and validity (2001).

The annual BRFSS questionnaire contains three components. The core component contains standard questions asked in every state. “Core” questions remain fairly consistent year-to-year unless otherwise noted in the technical documentation. Optional “Modules” contain questions based on topics of interest which can be added at each state’s discretion. Additionally, state-added questions can be included in the survey.

The Module of interest germane to this study was the Women’s Health Module. This module contained questions specific to breast and cervical screening. Because the

state of Tennessee included the Women's Health Module on alternating years, and to secure an adequate sample size with population subgroups, data from TN BRFSS year 2001 and year 2003 was combined for the study. After receiving IRB approval, data was requested and received from David Ridings coordinator of the TN BRFSS in the Tennessee BRFSS office housed in the Tennessee Department of Health in Nashville, TN. Additionally, the national BRFSS website at http://www.cdc.gov/brfss/index.htm provided technical reports and documentation to assist with managing and understanding the nuances of the datasets.

The Tennessee 2001 BRFSS contained 296 variables and 2924 observations (males and females). The Tennessee 2003 dataset contained 295 variables and 2589 observations (males and females). Each of the years contained variables present in one and not the other and variables modified from one year to the next. To initially reduce the number of variables a review of the questionnaires was conducted to identify variables of interest. These included weighting, socio-demographic, health-status, lifestyle, and breast health-related variables. Male-specific, child-specific, and disease-specific (other than breast cancer) items were not included. Based upon a narrowed list of 45 variables, subsets were created for each year using the KEEP function in SAS. Several steps were taken to perform quality control. SAS PROC COMPARE provided a comparison of the two subsets by variable, format, label and values. PROC FREQ provided frequencies for quantifying the approximate frequencies that should be present in the combined dataset. It also provided a check for consistency when new variables were created.

To create the dependent variable (MEETREC) indicating compliance with screening mammography recommendation several variables were used. The new variable

limited responses to women who had a screening mammogram or who never had a mammogram. The BRFSS questionnaire asked women the reason for having a mammogram. The response options differed between survey years. The 2001 question asked "Was your last mammogram done as part of a routine checkup, because of a breast problem other than cancer, or because you've already had breast cancer?" The response options were: 1= routine checkup, 2=breast problem other than cancer, 3=had cancer, 7=don't know/Not sure, and 9= Refused (WHYDONE). The 2003 question asked "Many mammograms are done as a routine check-up. Sometimes a mammogram is done to check something that might be a problem, such as a lump or discomfort. Were either of your two most recent mammograms OR your most recent mammogram, done to check a possible problem?" Response options included: 1=Yes, 2=No, &= don't know/Not sure or 9=Refused (WHYDONE3). Because the study focused only on screening behavior it was necessary to limit responses only to those that indicated the reason for the mammogram was screening. A new variable (RSNMAM) was created in each subset (2001 and 2003) where 1 = screening mammogram and 2 = non-screening mammogram. Where the 2001 responses was 1 (routine check-up) RSNMAM was set to equal 1; if WHYDONE = 2 or 3, RSNMAM was set to equal 2. Refused, don't know, or missing responses were coded as missing (.). In the 2003 subset where WHYDONE3 =1 (indicating mammogram for other than screening) RSNMAM = 2; where WHYDONE3 = 2 (indicating screening) RSNMAM = 1.

The second part of the recoded mammogram compliance variable quantified time since last screening mammogram. The dependent variable MEETREC was created as a dichotomous variable indicating "yes or no" if a respondent indicated having a screening

mammogram within the recent two year period. The two-year parameter was determined primarily by the Healthy People 2010 objective (3-13) to "increase the proportion of women age 40 years and older who have received a mammogram within the preceding 2 years." Several studies including Coughlin, Thompson, Hall, Logan, and Uhler[8] used a two year frequency measure.

A main effect, residence of a participant, whether rural or urban, was a central consideration of the analysis. To classify counties in Tennessee as such, a new variable was needed. The variable was created using the Rural Urban Continuum Codes (RUCC), the Department of Agriculture, Economic Research Service (ERS) classification of counties by degrees of urbanicity.[9] Each county in the United States is assigned a continuum code between 1 and 9. These were used to create a preliminary variable assigning the appropriate code to each county. A second variable METRO was created which identified counties as either rural (codes 5,6,7,8, and 9) or urban (1, 2, and 3). There were 57 rural counties and 38 urban counties. Approximately 30% of the respondents resided in the rural counties.

A second geographically-based variable was created based on the Tennessee Department of Health metropolitan and regional health department definitions. TNRURAL assigns "1" to a county within a regional health department or "2" to a county home to a metropolitan health department. Logistic regression (see Table 4 in Appendix) women showed women in metro areas significantly more likely (OR 1.46; 95% CI = 1.10 – 1.93) to be compliant than women in the regions. While this particular means of designating rural is unique to the state of Tennessee, it may have contribute more to state and local programming and /or decision making. An additional comparison

with the Rural Association of Counties designations was included in the table as an incidental finding of this study.

Independent variables included: age (40-49, 50-69, or ≥ 70), race (non-Hispanic white or non-Hispanic black) number of adults in the household (1,2,or ≥3), employment status (employed, homemaker/retired, unemployed, or unable to work), general health status (good/very good/excellent or fair/poor), smoking status (current smoker, yes or no), alcohol use (alcohol use within 30 days, yes or no), clinical breast exam within 2 years (yes or no), Pap test within 3 years (yes or no), level of physical activity (meets HP2010 recommendation, insufficient physical activity, or o physical activity), and Body Mass Index (BMI) (neither overweight nor obese, overweight, or obese), identifies personal healthcare provider (yes or no), health insurance status (has insurance, yes or no).

Statistical Procedures

The study dataset was initially managed using SAS 9.1. This included combining the two years of data, running descriptive statistics and refining variables (as previously noted). Concatenating appends the observations from one data set to another. After limiting each separate dataset using the SAS KEEP statement, the datasets were combined to form the study dataset. A DATA COMBINED statement creates a dataset in the order the datasets were entered in the SET statement. SAS-callable SUDAAN[10] was used for the remaining statistical procedure. SUDAAN statistical software was utilized to account for the complex sampling design of BRFSS.

Descriptive statistics were generated using PROC CROSSTAB for the full sample, the rural sub-sample, and the urban sub-sample using all variables. The variables were tested for significant association with residence using the Chi Square test of independence and reported for $p \leq 0.05$ (see Table 1. in Results).

To address Research Questions 1 and 2 prevalence of the dependent variable (MEETREC) in the full sample, the rural sub-sample, and the urban sub-sample by each independent variable was determined and tested for significance. PROC DESCRIPT was used to generate age-adjusted prevalence for the total sample, the rural sub-sample and the urban sub-sample. Age-adjustment was to the 2000 Standard Population. PROC CROSSTAB was used to generate prevalence by all other variable strata. Using the Chi Square test of independence, significant bivariate associations for compliance and the independent variables by residence were reported for $p \leq 0.05$ (see Table 2. in Results). Overall compliance for each Tennessee region was also calculated (see Table 5. Appendix III).

Multivariate analysis of factors associated with screening utilization using logistic regression techniques was done to determine the association between rurality and screening for breast cancer. Variables in the model included: Year of study, age, race, residence, marital status, educational attainment, number of adults in household, general health status, smoking status, identifying a personal healthcare provider, and health insurance status. This was run on the full sample and for the rural and urban sub-samples (see Table 3. in Results). The model was also run using the Tennessee Department of Health designation for residence. In doing so, Research Question 3 was addressed.

Limitations

The data source has inherent limitations for the study. Variables are restricted to those within the survey. Even with documented validity, self-reported data still imparts some question about validity and reliability.[5-7] Respondents can refuse or answer untruthfully to answer any question. Recall bias is likely.

Generalizability is limited to non-Hispanic white and non-Hispanic black women residents of Tennessee. The rural-urban dichotomy is still broad and may fail to capture some of the subtle differences that are likely to occur within these designations.

The determination of which counties are rural and which are not is possible with more than one scheme and thus a limitation of this study. Using Rural Urban Continuum Codes as opposed to another definition may affect the outcome. Results should only be compared to areas defined as rural with RUCCs.

Summary

The previous section discussed the methodology employed to conduct the study. The Behavior Risk Factor Surveillance System was discussed to provide background on the database utilized. The study sample, measures and statistical procedures were detailed. On a final note, conducting secondary data analysis requires gaining an intimate knowledge of the data and utilizing appropriate software to account for the complex survey design of large national survey data.

References

1. Centers for Disease Control and Prevention (CDC). Estimated Percentages of Households With and Without Telephones by State, 2001. Available at: http://www.cdc.gov/brfss/technical_infodata/surveydata/2000/table3_00.htm. Accessed July 5, 2006.
2. Centers for Disease Control and Prevention. 2001 Summary Data Quality Report. June 22, 2005. Available at: http://www.cdc.gov/BRfss/technical_infodata/2001QualityReport.htm. Accessed August 5, 2006.
3. Centers for Disease Control and Prevention. 2003 Summary Data Quality Report. June 22, 2005. Available at: http://www.cdc.gov/BRfss/technical_infodata/2003QualityReport.htm. Accessed August 5, 2006.
4. Centers for Disease Control and Prevention (CDC). 2003 BRFSS Overview. Available at: http://www.cdc.gov/BRFSS/technical_infodata/surveydata/2003.htm. Accessed October 1, 2006.
5. McGovern PG, Lurie N, Margolis KL, Slater JS. Accuracy of self-report of mammography and Pap smear in a low-income urban population. *Am J Prev Med.* 1998;14(3):201-208.
6. Caplan LS, McQueen DV, Qualters JR, Leff M, Garrett C, Calonge N. Validity of women's self-reports of cancer screening test utilization in a managed care population. *Cancer Epidemiol Biomarkers Prev.* 2003;12(11 Pt 1):1182-1187.
7. Nelson DE, Holtzman D, Bolen J, Stanwyck CA, Mack KA. Reliability and validity of measures from the behavioral risk factor surveillance system (BRFSS). *Soz Praventivmed.* 2001;46 Suppl 1:S3-42.
8. Coughlin SS, Thompson TD, Hall HI, Logan P, Uhler RJ. Breast and cervical carcinoma screening practices among women in rural and nonrural areas of the United States, 1998-1999. *Cancer.* 2002;94(11):2801-2812.
9. U.S. Department of Agriculture Economic Research Service. 2003 Rural Urban Continuum Codes. Available at: http://www.ers.usda.gov/Data/RuralUrbanContinuumCodes/2003/. Accessed January 4, 2006.
10. *SUDAAN* [computer program]. Version 9.0.1. Research Triangle Park; 2005.

Appendix II

Review of the Literature

Introduction

Review of the literature provides background information supporting the research questions and the methodology used to address them. Because the study examined the prevalence of screening mammography in women in rural Tennessee, the review considered each of the key concepts within that purpose. Review of the literature revealed several means by which rural was defined. A description of these methods was included to provide perspective for interpreting the subsequent research. To dispel the notion of homogeneity (often assumed because of the rural designation) the demographic and socio-economic characteristics of rural women were presented. Finally, a review of research centered on factors known or suspected to influence utilization of preventive healthcare was conducted. Studies that utilized secondary data analyses were particularly relevant as models for the methodology employed by the current study.

Defining Rural

No single definition of rural was found. As such, there are implications for analyses and interpretation. The means by which rural is defined could potentially mask the true experience.[1] Understanding the operational definition of rural became significant for interpretation and/or comparison across the literature. Population density was the most common factor considered in most of the definitions. Other factors such as economics were added depending on frame-of-reference and item of analysis. Several

schemes for determining rural status found in the literature were examined and are briefly presented to provide insight to this potential confounder.

The current study used Rural Urban Continuum Codes (RUCCs) to identify rural areas in Tennessee. RUCCs are a product of the United States Department of Agriculture.[2] This system assigns codes to each county in the United States on a scale of 1 through 9 based on level of urbanization and adjacency. Codes 1 - 3 are considered Metropolitan, or "core", areas and 4 – 9 "non-core". According to the codes 57 counties in Tennessee were "non-core", or rural and 38 were "core", or urban counties. This schema was found in rural-urban-based research by Coughlin, Thompson, Hall, Logan, and Uhler,[3]Coughlin, Thompson, Seeff, and Stallings,[4] Kakefuda and Stallones,[5] and Larson and Correa-de-Arraujo.[6] In comparison, the Rural Caucus of the National Association of Counties (NACo) designates 68 Tennessee counties as rural. The NACo uses the U.S. Census Bureau criteria of a county population of less than 50,000 persons to identify rural counties.[7]

The U.S. Census Bureau classifies rural as "all territory, population, and housing units located outside urbanized areas (UA) and urban clusters (UC)".[8] These designations are based on population density. This definition categorizes 21% of the U.S. population as rural residents.[8] The Census Bureau further divides "rural" households into Farm or Non-Farm depending on the presence of income from agricultural sales.[9]

The White House's Office of Management and Budget (OMB) considers economic factors in addition to population density to identify rural American. The OMB designates areas as Core-Based Statistical Areas (CBSAs) or non-Core-Based Statistical Areas (non-CBSAs).[10] CBSAs include Metropolitan Statistical Areas (MSAs) (containing

urbanized areas of at least 50,000 people) or Micropolitan Statistical Areas (MiSAs) (urban clusters of 10,000 to 49,999 persons). Additional sub-designations are defined for densely populated areas and areas adjacent to MSAa or MiSAs. Areas outside the CBSAs are simply designated as non-CBSAs. According to this schema 82.6% of the U.S. population reside in Metropolitan CBSAs, 10.5% in Micropolitan CBSAs, and 6.9% reside outside CBSAs (non-CBSA).[1]

A final consideration was the Tennessee Department of Health (TDOH) divisions. The TDOH divides the state into eight "regions" (more than one county) and six "metros" (single counties) based on MSAs.[11] Comparison between regions and metros could be used for rural-urban comparisons. According to this, an even greater proportion of the population in Tennessee was considered rural than either NACo or RUCCs classification schemes.

Several methods for defining rural areas in the United States were briefly presented. Each definition varies somewhat and uses different language. When the different methods were applied to Tennessee the discrepancy in what could be considered rural was evident. They were not necessarily comparable and as such, have implications for research. The importance of clearly identifying which definition of rural is being used, and any limitations therein, is emphasized.

Rural Women: subpopulations

While "rural" is often used as a descriptor of a population, the designation may diminish the real diversity and heterogeneity of the women who live there. Great variation within the rural population exists; rural populations differ across regions,

between, and even within states. Geography alone is not perceived to determine health status but the regional and cultural differences in conjunction with socioeconomic factors within geographical locale may.[12] The following attempts to presents a picture of women living in rural American, with particular consideration for women in rural Tennessee.

Approximately 20% of the U.S. female population lives in rural (non-metropolitan) areas.[13] Of these 20%, 10% are racial and ethnic minority females.[13] More than two-thirds (36%) of the Tennessee's population, including 19.8% of the minority population, live in rural communities.[2] Greater rurality, especially in areas with a population density fewer than 10,000 people, is associated with poorer health status and higher mortality rates.[14, 15] Women living in rural areas are considered a vulnerable population.[16] They experience cultural, political, and economic inequities which may adversely affect health status.[13] Understanding these factors is necessary to improve health status.

The majority of rural American women are Caucasian as are rural women in the state of Tennessee.[17] These women are more likely to experience lower educational attainment, greater poverty, and poorer health than women in urban parts of the state.[18] There is diversity even within this group of women. For example, Caucasian women in Appalachia have unique culture and ideation that is not necessarily shared by rural Caucasian women in other parts of the state.[19]

Twenty-nine percent of the U.S. female population is of varying racial and ethnic backgrounds. Of these racially and ethnically diverse women, 10% live in rural areas.[8] There is additional variation within each racial and ethnic rural groups including "sub-groups who have diverse languages, cultures, degrees of acculturation, and histories." [20]

Rural women experience similar health disparities as their urban counterparts but to a greater degree.[21] In general, mortality among minority women exceeds Caucasian mortality by four to five times, even greater disparity exists for rural minority women.[22]

The African American population accounts for 13% of the US population and 6% of the rural population.[23] The Census reports that compared to non-Hispanic Whites, non-Hispanic Blacks were less likely to earn a high school diploma (79% vs. 89%), more likely to rely on public health insurance (22.6% vs. 8.1%), more likely to be uninsured (18.8% vs. 11%), and have a median family income $15,500 less.[24] At all ages, African American women have a shorter life expectancy by several years than White women. They also experience earlier onset of chronic conditions such as diabetes and hypertension.[25] Poorer access to health services is compounded for the rural African American woman and is associated with greater morbidity.[26] Another contributing factor "may be the limited or more restricted access to stress management and leisure activities (which are generally uncommon in rural areas) by African American women."[27]

African Americans make up 16.8% of the population in Tennessee; and 4.2% of the rural population.[28] The majority of the African American population lives in the western part of the state. Two-thirds of the population lives in only two counties.[29] Sixty percent of the population has household incomes under $34,999 compared to 44.7 percent of non-Hispanic white households.[30] Compared to non-Hispanic whites, they are less likely to have health insurance. This population is more likely to be overweight or obese and less likely to report regular physical activity. These factors are all associated with poorer health status for women.[31]

Hispanic women are 11% of the total U.S. female population. They are second only to African American women (13%) in the four major groups making up the ethnic and racial minority groups of the U.S. female population.[20] The Hispanic population has the lowest rate of health insurance coverage of all other major racial or ethnic groups in the United States.[32] They also experience low educational attainment and high rates of poverty.[33]

In 2000 Tennessee's Hispanic population was 2.2% of the total population and 1.4% of the rural population.[17] It is projected to be 3.7% of the total population by 2010, representing an 84.8% increase.[17] About half of the this population in Tennessee lives in rural areas.[34] The Hispanic population tends to be young, only 4.8% of Hispanic women versus 12% of all women in the U.S. is over 65 years of age.[33]

Great diversity exists within the Hispanic population in Tennessee but, like the Hispanic population nationally, is primarily Mexican American.[35] Language can be a significant barrier to healthcare especially in small rural communities where resources may be limited. And not all Hispanics speak Spanish, dialects and indigenous languages are common among population sub-groups[35] In addition to language; dietary patterns, gender-roles, religious practices, and traditions also vary within each sub-group and may affect health status. Consideration and integration of these belief systems is important to the delivery of effective interventions to promote screening participation.

Approximately 75% of Native American women live in rural areas.[36] Women from many different tribes make up this group of rural women. These women experience significant health disparities, even greater than other rural women.[27] A lifestyle characterized by inactivity, processed foods, and stress contributes to the disparities these

women experience in morbidity and mortality.[27] The Native American population in Tennessee is relatively small, only 0.3% of the state population.[37] There is a need for information on this population as little is currently available.

Asian/Pacific Islanders make up approximately 0.6% of the U.S. rural population and about 0.3 percent of the rural population in Tennessee.[34] Like other minority women with deep ethnic ties, there are cultural and behavioral challenges to optimal health which are compounded by their rurality.[38] There are also many sub-populations in this group of women, each having unique characteristics, language, and belief systems. Culturally appropriate health promotion programs are not likely in areas with very small population subgroups.[39] This is especially important because breast cancer is the leading cause of death for this group of women who also have the lowest rate of screening mammography utilization in the United States.[40]

The aging (65 and over) population equals nearly 24% of the U.S. population and 15% of the U.S. rural population.[12] The aging women in rural Tennessee are likely to be white, single, and poor.[41] Aging rural women experience chronic disease at a rate greater than urban aging women and resources may be scarce.[36] One explanation for this is the comparatively lower Social Security benefits received by this population.[12] In addition, Mead, Witkowski, Gault, and Hartmann[31] found that even when poor women had health insurance their access to care did not necessarily improve.

The effect of rurality is thought to be even greater for aging minority women who already experience poorer health and greater mortality than non-Hispanic white women.[42, 43] Contributing factors include greater poverty and lower educational

attainment.[44] The role educational attainment and income play in determining health status seems pivotal for all rural women.

Rural Women: education and income

In general, the rural population experiences lower educational attainment than the urban population, with women experiencing even greater disparity.[45] The literature indicates that a relationship between educational attainment and health status persists across race, ethnicity, and geographical residence.[31, 46] Mead, Witkowski, Gault, and Hartmann[31] used data from the Commonwealth Fund 1998 Survey of Women's Health to explore the relationship between socioeconomic factors and health status.[31] They found that the poorest health status was reported by women who did not finish high school.[31]

This difference in educational attainment is evident in Tennessee's population. County rates of Tennessee adults 25 years of age or older having a high school diploma or GED ranges between 55% and 90%.[47] Approximately 19% of the state population has less than a high school education. Counties with the least educated populations tend to be among the rural counties.[48] High school dropout rates are another measure of educational status. The female dropout rate in Tennessee counties ranges between 1% and 20.8%.[49] Some of the highest dropout rates were reported in rural counties. If education level is, indeed, a predictor of health status, then significant risk exists in the rural counties in Tennessee.

The rural population tends to experience lower per capita income than metropolitan populations with an even greater impact on rural women. Average per capita income of rural America versus urban America differs by approximately seven

thousand dollars ($19K versus $26K).[50] The difference is apparent in hourly wages as well; rural women earn almost three dollars less per hour than a similarly employed urban woman.[50]

Rural poverty rates are about 3% greater than urban poverty rates.[36] The difference is even greater for women householders. Women head 46% of rural households, 27% of which are in poverty compared with 9% of male-headed households.[36] The overall poverty rate in Tennessee is approximately twelve percent to fifteen percent.[49] However, for women householders the poverty rate is approximately 33%. The prevalence of low income among women in rural areas is a significant determinant of adverse physical health.[51] Low-income women in rural areas secure preventive services less and report higher rates of untreated health problems.[14, 31]

Rural Women: access to care

The geographical locale of rural residents often precludes convenient access to health care facilities, providers, and services.[52] In general rural women do not receive as much preventive care as other Americans. Access to care is often cited as the cause. Eleven percent of physicians practice in rural America where 25% of the population resides.[53] The distribution of provider-type in metropolitan areas compared to non-metropolitan areas also varies. As urbanization decreases, the number of general practice physicians rises slightly while the supply of specialty physicians decreases markedly.[54]

The federal government quantifies the level of primary care physician coverage in each county in the United States. Physician/population ratios are used to identify areas lacking adequate coverage. Such areas are designated as *Health Professional Shortage*

Areas (HPSA).[55] The degree of need is further quantified by other health indicators (infant mortality, poverty rates, and fertility rates).[55] In 2004, 48 of Tennessee's 95 counties were designated as a Federal Health Professional Shortage area for primary care.[11] Sixteen additional counties had areas within the county or special populations that met the criteria and were assigned a partial designation. Many of these were rural counties. It is likely, then, that women in rural areas of Tennessee face difficulties accessing care.

Rural hospitals are likely to offer limited services.[56] Rural hospitals comprise 20% of all hospital beds in the nation, are likely to be government owned and controlled, and more dependent on Medicare and Medicaid patients.[57] This is yet another barrier to optimal health for rural populations.

For the current study access to mammography facilities was of particular interest. The Food and Drug Administration maintains a register of all certified mammography facilities.[58] There are currently 195 facilities in Tennessee. However, they are not all equally accessible to women as they may be part of private physician practices, restricted by insurance terms, or financial unattainable.

In summary, living in a rural area appears to predispose women to poorer health.[27] Women in rural Tennessee are no exception. They are likely to be economically disadvantaged and less educated; both of which are associated with less than optimal health. Access to facilities and services is limited in many parts of the state, compounding the risk for poorer health.

Utilization of Preventive Services

The use of preventive health services has gained importance as a deterrent to chronic disease.[59] Utilization of preventive services occurs at different rates among population groups. Disparity between rural and urban utilization has been demonstrated in numerous studies.

Much of the difference is attributed to socio-economics. Using data from the 1994 National Health Interview Survey (NIHS) to explore the rural-urban difference Zhang, Tao, and Irwin[60] compared women's use of Pap testing (ages 18 – 65), mammography (ages 50 to 69), and flu shot acquisition (ages 65 and older). The Office of Management and Budget designation for Metropolitan Statistical Areas was used to dichotomize residence into rural or urban. The study characterized rural women as older, having lower household income, and lower levels of education.[60] Bivariate analysis showed that rural women used mammography at a significantly lower rate (61%) than urban women (68%); however the relationship was no longer significant (OR 0.83, 95% CI 0.66-1.03) after adjusting for education, income, and health insurance status.

Unlike Zhang, Tao, and Irwin[60] Coughlin, Thompson, Hall, Logan, and Uhler[3] found a significant association between the use of screening exams and rural residence. Behavior Risk Factor Surveillance System (BRFSS) data from 1998-1999 was used to examine breast and cervical screening practices among women in rural and urban areas in the United States. In contrast to the previous study, participants were assigned a rural, suburban, or urban designation based on the U.S. Department of Agriculture's Rural Urban Continuum Codes rather than a dichotomous designation. Prevalence of screening mammography within a two year period was determined for socio-demographic,

behavioral, and other health-related factors. The study found that rural women in the U.S. were predominantly white, older, less educated, and of lower income. They were less likely to have health insurance, more likely to smoke, and more likely to report fair or poor health status than suburban or urban women. The prevalence of screening mammography in rural women 66.7% (95% CI = 65.8% - 67.6%) was significantly different from screening prevalence among women in larger metropolitan areas (75.4% (95% CI = 74.9% - 75.9%). Multivariate analysis was conducted to identify the effect of rurality. After controlling for other factors, a significant association persisted between greater urbanicity and likelihood of recent mammography (Suburban OR 1.19, 95% CI = 1.08-1.30; Metropolitan OR 1.46, 95% CI=1.38-1.54).[3]

Larson and Correa-de-Araujo[6] analyzed data from the Medical Expenditure Panel Survey (MEPS) to contrast use of preventive services by women in the United States. The study included interviews from 9,358 women. One item of contrast was residence, defined on a continuum of rural (counties with less than 10,000 residents) to large metropolitan areas. Geographic residence was assigned into one of four categories (large metropolitan areas, small metropolitan areas, adjacent to metropolitan areas, or not adjacent to metropolitan areas) based on Urban Influence Codes, number of physicians in the count, and the county population. The last category on this urban-rural continuum was considered rural for analysis. Participants were asked how long it had been since their last screening mammogram in addition to a battery of other screening-related questions. Bivariate descriptive analysis by residence, as well as a comparison of the four residence categories was conducted. The study further used logistic regression to determine odds ratio of likelihood of screening utilization along the urban-rural

continuum. Descriptive analysis found that rural women were more likely to older, married, non-Hispanic white, and poor. In general, preventive services were accessed less by rural women than women living in other areas.[6] Logistic regression showed that the most rural women were significantly less likely to have had their cholesterol checked in the past year or two years, to have had a fecal occult blood test in the past two years, a dental exam in the past two years, a clinical breast exam in the past one or two years, or a Pap smear in the past one or two years. They were also significantly less likely to have had a mammogram over the past year (OR .74, SE 0.10, $p < .05$) or in the past two years (OR .65, SE 0.10, $p < .01$).[6]

Schootman and Fuortes[61] estimated breast cancer screening prevalence in women with activity limitations in rural Iowa as it related to late stage disease presentation. The study used BRFSS data as well as cancer incidence and mortality data from the Surveillance, Epidemiology, and End Results (SEER) program to explore the relationship. The study design place women into one of three categories: women without limitations, women with some limitations, and women with severe limitations. The researchers devised a population density formula for determining rural status. They divided the number of county residents by county square miles, then imposed a 5-point ordinal scale for <20, 20-29, 30-39, 40-99, and >100 residents per square mile.[62] Counties with the fewest residents per square mile were considered rural and those with over 100 residents per square mile were considered urban.

Screening rates were low overall (37.3% – 56.4%) for rural women. As population density increased, screening prevalence increased. Women with some limitations screened at rates between 35.1% and 52.5%. Women with severe limitations

screened at rates between 16.0%-48.3% depending on population density. Lower rates of screening were also associated with lower rates of in situ breast carcinoma.[62] This study concluded that to decrease late-stage diagnosis in all rural women screening rates need to improve.

Appalachia is a primarily rural area crossing thirteen states, including Tennessee. The Appalachian population has lower income, less education, is older, and is associated with poorer health practices.[19] Screening for breast and cervical cancer among 20,785 women in the 406 Appalachian counties was examined by Hall, Uhler, Coughlin, and Miller.[63] Pooled BRFSS data from 1996 through 1998 was used to conduct the study. The study found that women in Appalachia screened at significantly lower rate than the national rate. The prevalence of biennial screening mammography was 68.8% (95% CI 67.8-69.9) compared to 71.8% for other women. Screening was associated with higher education, higher income levels, and having a source of healthcare, however the associated factors were less prevalent in rural women.[63]

In an effort to identify an underserved rural population, screening practices of women residing in the "Southern Black Belt" (an area of mostly rural agricultural counties with large African American populations in the southeastern U.S.) were examined and compared with women living in other southern counties[4] The U.S. Department of Agriculture 1993 Rural Urban Continuum Codes 6 – 9 were used to designate rural residence. Residence was also classified according to whether it was a Primary Care Health Professional Shortage Area. Age-adjusted rates of screening were calculated. Multivariable logistic regression models were used to identify factors associated with screening. Overall prevalence of screening was lower in the Black Belt

African American population (66.3%) and the white Black Belt population (69.3%) compared to other counties and the US rates which were all over 70%. Significant relationships were found for age (50 – 69), marital status, higher education attainment, reporting good/excellent health, nonsmoking. The strongest association was with having seen a physician in the past year (OR 6.31, 95% CI 5.15-7.73), followed by having health insurance (OR 2.07, 95% CI 1.67-2.57). After controlling for other factors, residence was not significantly associated with recent screening (OR 1.14, 95% CI 0.94-1.38).

Utilization of Preventive Services: other associated factors

Compliance with screening recommendations is influenced by many factors. Rahman, Dignan, and Shelton[64] developed a predictive model for adherence to recommended screening frequency based on predisposing, enabling, and cues to action factors. They looked at the mammography record of 27,778 participants in the Colorado Mammography Project (CMAP). The women were 40-90 years of age, predominantly white, and mostly insured (90%). Mammography utilization over a 5-year period was quantified through record review. Forty-one percent of the participants were considered adherent with screening recommendations. The definition of adherence was somewhat complex but comprehensive. "1) for women 50 and over, as well as for women between 40 and 49 with a family history of breast cancer, adherence was defined as completing at least 2 mammograms within a one-year interval; 2) for women between 40 and 49 without a family history of breast cancer, adherence was defined as completing at least 2 mammograms within a 2-year interval."[64] Adjusted odds ratio showed that race, education, insurance, and income were significant predictors of compliance. Adherence

was lowest for black women. This contradicts other studies where Hispanic women and Native American women screen at the lowest rates.[64] The refined criteria and longitudinal design permitted more insight to screening behavior, including patterns of utilization, than other studies.

There is a lack of consensus on recommending screening mammography for women over seventy years of age.[65] The decision to forgo screening among older women is often explained by comorbidity or frailty. To test this assumption responses to the 2000 National Health Interview Survey (NHIS) about mammography, disease burden, and functional status were analyzed for a nationally representative sample of 882 female respondents aged 80 and older.[66] Comorbidity was present in 52% of the study population (32.8% had one significant disease and 19.6% had two or more significant diseases). Participants were categorized by likelihood of a benefit realized by screening: possibly beneficial (age 80 – 84, no significant disease, no functional impairment, and life expectancy of at least 10 years); unlikely to be beneficial (age 80 – 84, at least one significant disease or at least one Activity of Daily Living (ADL) dependency, or, age 85 and older with no significant disease or functional impairment); or very unlikely to be beneficial (aged 80 – 84 with at least one significant disease and at least one ADL dependency, or aged 85 and older with at least one significant disease and/or at least one ADL dependency). Screening mammography had occurred in 50.8% of the participants within the past two years (from point of interview) interpreted as compliant with national recommendations for screening. Non-compliance was significantly associated with decreasing education level (< HS: OR 0.25 95% CI = 0.13-0.47), annual income < $20,000 (OR 0.45, 95% CI = 0.22-0.90), living in the South (OR 1.73, 95% CI 1.12-

2.77), lacking a usual source of care (OR 0.15, 95% CI = 0.30-0.64), and having more than one ADL dependency (OR 0.44, 95% CI = 0.22-0.88).[66] Many of the women who reported compliance indicated their physician had recommended mammography. The study indicated that many women over eighty who received mammography were unlikely to benefit because of their current health status and the associated social and economic costs may be considerable. As such, failing to control for likelihood of benefit may mask the true screening rate for aging women.

Jerant, Franks, Jackson, and Doescher[67] examined the relationship between age and screening rates for colon cancer, breast cancer, and prostate cancer using BRFSS data. The study showed that mammography screening was most utilized by women aged 55 to 59 years for all race and ethnic group except "Other Race", followed by progressive decrease by age-group.[67] Interestingly, the results indicate higher usage among African American women as compared to White women for all age groups until age 80 and above. To explain the disparity in usage the authors suggest that providers may assume less receptivity to screening by the aging population. A presumed lack of benefit of screening may also be a factor as noted in Schonberg, McCarthy, Davis, Phillips, and Hamel.[66]

In a prospective cohort study conducted over seven years, Rauscher, Hawley, and Earp[68] identified predictors of initiation and regular mammography use by older rural women in North Carolina.[68] The purpose of the study was to facilitate the development of interventions that would improve utilization of screening. The 650 participants (341 African Americans and 354 White women) aged 52 and older were part of the control group of the North Carolina Breast Cancer Screening Program. The women were

categorized by mammography utilization: prior never use; prior occasional use; or prior regular use. Information was gathered through interview at three time points over the seven years. The data included demographic variables, health care utilization and access, family history of cancer, current health status and attitudinal variables. Rauscher, Hawley, and Earp[68] reported that the greatest barrier to regular screening appeared to be the initiation of screening. They reported that African American women were half as likely to initiate screening as White women. Age (65 and older) was also significantly associated with low likelihood of screening initiation. The role of positive attitude towards mammography, however, was significant for initiation of screening, and physician recommendation was the strongest predictor of all. The study identifies relationships consistent with other research but may be of greater value because of the longitudinal design.

Evidence that low-income is a risk for non-adherence with screening was determined through analysis of BRFSS responses from women in 35 metropolitan areas in the United States.[69] this report indicated that 68.4% (95% CI 65.5% to71.3%) of women with low incomes (<$15,000 per year) screened within the desired frequency compared to 75.3% (95% CI 73.9% to 76.8%) of women with income of $15,000 to $34,999 per year and 82.5% (95% CI 83.6%) of women with >$50,000 annual income. Barrett and Legg[46]found similar associations when they compared mammography utilization with the Healthy People 2010 targets. They used also used BRFSS data from 2002 to conduct their analysis. Nationally, women without health insurance, without a personal doctor, and not receiving basic preventive care were less likely to meet the screening recommendations.[46]

Low income was also the main factor examined in a study by Adams, Florence, Thorpe, Becker, and Joski.[70] The study centered on the impact of the amount of federal funding and the age of the National Breast and Cervical Cancer Early Detection Program (NBCCEDP) on likelihood of being screened for breast and cervical cancer. The NBCCEPD is a federally funded program administered by each state, to increase screening mammography among low-income women. The effect of insurance and income was also evaluated. Separate analysis was conducted on younger (<65 years of age) and elderly (>64 years of age) women to account for the differences in insurance status i.e. all older women have access to Medicare.

The study used annual screening mammography as the measure of compliance as reported through pooled BRFSS data (1996-2000). The study found that non-Hispanic Black women screened at 34% greater rate than non-Hispanic Whites. Multivariate analysis showed a significant increase in screening rates of nonelderly women from 1996 to 2000 (AOR 1.59, 95% CI = 1.34-1.88). The study also showed that a significant association between income and insurance and screening. However, the adjusted odds ratio (AOR) of the lowest income group (AOR 1.16, 95% CI = 1.07-1.26) were not significantly different from those in highest income group (AOR 1.51, 95% CI = 1.23 – 1.84) for screening mammography. The researchers suggest that the role of income may be modified by access to free screening such as that provided by the NBCCEDP.[70]

Race and ethnicity are often used to explain less frequent mammography utilization. However, the diversity within race and ethnic groups is often overlooked. Magai, Consedine, Conway, Neugent, and Culver[71] demonstrated this in their study of 1,364 women ages 50 – 70, from 6 urban ethnic groups (African American, English

Caribbean, Haitian, Dominican, Eastern European, or European American). Screening history, cognitive factors (fatalism, perception of person risk, and health beliefs), beliefs about breast cancer, and socio-emotional factors (stress, cancer worry, and discomfort with mammograms) were analyzed as predictors of compliance using 2-step regression. The women who were less likely to screen regularly were single (30% less likely), English Caribbean (45% less likely), Haitian (55% less likely), or Eastern European (74% less likely). The significance was reduced when cognitive and socio-emotional variables were entered into the model. This suggests that race and ethnicity may not fully explain disparities in screening frequency; that beliefs and emotions may be an underappreciated factor. Results of this study were consistent with other studies identifying factors associated with screening compliance. Significant relationships were found for higher education, and being married. The most robust factors were physician recommendation and insurance.[71] Importantly, equivalent screening rates for African American and European-American women suggest an absence of disparity.[62, 70]

Jacobs, Karavolos, Rathouz, Ferris, and Powell[72] examined the relationship between English proficiency and receipt of health screening (Papanicolaou test, clinical breast exam, and mammography). 1,247 women were surveyed at baseline and annually for five years.[72] Information on screening frequency and acculturation were based on self-report. The participants were categorized into “no-English”, “another language more fluently than English”, or “only English, or English and another language equally well” groupings. Using logistic regression the researchers found a significant, negative association between “no English” and receipt of screenings. The relationship was not explained by socio-economics as one might expect. The findings emphasize the need for

language diversity in the healthcare system. This has particular relevance for the state of Tennessee in light of the changing demographics.

Summary

Several things were gleaned from the review of the literature. The positive association between education, income, and insurance and screening mammography was well supported in the research; while the association between residence and screening was less so. Additionally, the use of other screening tests and having a personal physician were also significant factors.

Sub-populations may demonstrate different screening utilization than that of the larger population. They should be considered for their unique experience and associated factors of significance. Finally, it was evident that the BBRFSS data is frequently used to assess screening behaviors and determine risk. However, studies using BRFSS data cannot examine culture, perceptions, or attitudes. Understanding why women do not screen is as important as knowing how many women do not screen. Qualitative study needed to answer this question, at present it is limited.

References

1. Hall SA, Kaufman JS, Ricketts TC. Defining Urban and Rural Areas in U.S. Epidemiologic Studies. *J Urban Health.* 2006;V83(2):162-175.

2. U.S. Department of Agriculture Economic Research Service. 2003 Rural Urban Continuum Codes. Available at: http://www.ers.usda.gov/Data/RuralUrbanContinuumCodes/2003/. Accessed January 4, 2006.

3. Coughlin SS, Thompson TD, Hall HI, Logan P, Uhler RJ. Breast and cervical carcinoma screening practices among women in rural and nonrural areas of the United States, 1998-1999. *Cancer.* 2002;94(11):2801-2812.

4. Coughlin S, Thompson TD, Seeff L, Richards T, Stallings F. Breast, cervical, and colorectal carcinoma screening in a demographically defined region of the southern U.S. *Cancer.* 2002;95(10):2211-2222.

5. Kakefuda I, Stallones L. Comparisons of Colorado women's cancer screening practices by residence: metropolitan, non-metropolitan, and farm. *J Agric Saf Health.* 2006;12(1):59-69.

6. Larson S, Correa-de-Araujo R. Preventive health examinations: A comparison along the rural-urban continuum. *Womens Health Issues.* 2006;16(2):80-88.

7. National Association of Counties Rural Action Caucus. RAC County Data - rural Counties Found for Tennessee. Available at: http://www.naco.org/RuralTemplate.cfm?Section=RAC_County_Data&Template=/cffiles/rac/rac_res.cfm. Accessed July 1, 2006.

8. U.S. Census Bureau. GCT-P1. Urban/Rural and Metropolitan/Nonmetropolitan Population: 2000. November 2, 2005; Available at: http://factfinder.census.gov/servlet/GCTTable?_bm=y&-geo_id=D&-ds_name=D&-_lang=en&-redoLog=false&-format=DI-1&-mt_name=DEC_2000_SF2_U_GCTP1_US1. Accessed September 2, 2006.

9. U.S. Census Bureau. "Glossary of Decennial Census Terms and Acronyms". Available at: http://www.census.gov/dmd/www/glossary.html. Accessed November, 1, 2005.

10. U. S. White House Office of Management and Budget. Press relesase 2003-18: OMB announces 49 new Metopolitan Statistical areas, 2003. Available at: http://www.whitehouse.gov/omb/pubpress/2003-18.pdf. Accessed September 25, 2006.

11. Tennessee Department of Health Office of Rural Health. Rural Health. Available at: http://www2.state.tn.us/health/rural/index.html. Accessed September2, 2006.

12. Rosenthal TC, Fox C. Access to health care for the elderly. *JAMA.* 2000; 284(16):2034-2036.

13. Hargraves M. Elevating the voices of rural minority women. *Am J Public Health.* 2002;92(4):514-515.

14. Blumenthal SJ, Kagen J. The effects of socioeconomic status on health in rural and urban America. *JAMA.* 2002;287(1):109.

15. Litaker D, Koroukian SM, Love TE. Context and healthcare access: looking beyond the individual. *Med Care.* 2005;43(6):531-540.

16. Gamm L, Hutchison L, Bellamy G, Dabney BJ. Rural healthy people 2010: Identifying rural health priorities and models for practice. *J Rural Health.* 2002;18(1):9-14.
17. Tennessee Department of Health/ Division of Health Statistics. The Hispanic Population in Tennessee. Available at: http://www2.state.tn.us/health/statistics/PdfFiles/TNHispanic00.pdf. Accessed December 8, 2005.
18. U.S. Department of Agriculture Economic Research Service. Rural economy data sets. Available at: http://www.ers.usda.gov/Browse/RuralEconomy. Accessed February 13, 2006.
19. Behringer B, Friedell GH. Appalachia: where place matters in health. *Prev Chronic Dis.* 2006;3(4):A113.
20. Satcher D. American women and health disparities. *J Am Med Womens Assoc.* 2001;56(4):131-132, 160.
21. Hughes-Gaston M. 100% access and 0 health disparities: changing the health paradigm for rural women in the 21st century. *Womens Health Issues.* 2001;11(1):7-16.
22. Gardner P, Hudson BL. *Advanced report of final mortality statistics, 1993.* Hyattsville, MD: National Center for Health Statistics; 1996.
23. U.S. Census Bureau. Profiles of demographic characteristics: 2000. Available at: http://www.census.gov/prod/cen2000dp1/2kh00.pdf. Accessed August 25, 2006.
24. McKinnon J. The Black Population: 2000. Available at: http://www.census.gov/prod/2001pubs/c2kbr01-5.pdf. Accessed June 1, 2006.
25. Schulz A, Parker E, Israel DB, Fisher DT. Social context, stressors, and disparities in women's health. *J Am Med Womens Assoc.* 2001;56(4):143-149.
26. Arcury TA, Gesler WM, Preisser JS, Sherman J, Spencer J, Perin J. The Effects of geography and spatial behavior on health care utilization among the residents of a rural region. *Health Serv Res.* 2005;40(1):135-156.
27. Winstead-Fry P, Wheeler E. Rural Women's Health. In: Loue S, Quill BE, eds. *Handbook of Rural Health.* New York: Kluwer Academics/Plenum Publishers; 2001.
28. U. S. Census Bureau. Tennessee Selected Economic Characteristics:2005. *American Community Survey, 2005.* Available at: [http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=04000US47&-qr_name=ACS_2005_EST_G00_DP3&-ds_name=&-redoLog=false. Accessed September 20, 2006.
29. Tennessee Department of Health. Health Information Tennessee, Tennessee Population Data. Available at: http://hit.state.tn.us/. Accessed September 2, 2006.
30. Centers for Disease Control and Prevention (CDC). Behavioral Risk factor Surveillance System Survey Data.
31. Mead H, Witkowski K, Gault B, Hartmann H. The influence of income, education, and work status on women's well being. *Womens Health Issues.* 2001;11(3):160-172.

32. U. S. Census Bureau. *Health Insurance Coverage: 2000. Current Population Report P60-215* 2001. Available at: http://www.census.gov/prod/2001pubs/p60-215.pdf

33. Ramirez R. We the People: Hispanics in the United States. *Census 2000 Special Reports* Available at: http://www.census.gov/prod/2004pubs/censr-18.pdf. Accessed September 20, 2006.

34. U.S. Census Bureau. Tennessee - Urban/rural and Inside/Outside Metropolitan Area. *Census 2000 summary File 1, Matrix P8.* Available at: http://factfinder.census.gov/servlet/GCTTable?_bm=y&-context=gct&-ds_name=DEC_2000_SF1_U&-CONTEXT=gct&-mt_name=DEC_2000_SF1_U_GCTP6_US19&-tree_id=4001&-redoLog=true&-_caller=geoselect&-geo_id=04000US47&-format=ST-1&-_lang=en. Accessed October 1, 2006.

35. Baer RD, Nichols J. Ethnic Issues. In: Loue S, Quill BE, eds. *Handbook of Rural Health*. New York, NY: Kluwer Academic/Plenum Publishers; 2001.

36. Muldar PL, Kenkel M, Schellenberger S, et al. *The behavioral health care needs of rural women*: American Psychological Association; 2001.

37. Center for Business and Economic Research. Census 2000 Summary File: Detail Data. *Tennessee State Data.* Availalbe at: http://cber.utk.edu/census/tnpopdat.htm. Accessed May 10, 2006.

38. Aday LA, Quill BE, Reyes-Gibby CC. Equity in rural health and health care. In: Loue S, Quill BE, eds. *Handbook of Rural Health*. New York, NY: Kluwer Academic/Plenum Publishers; 2001.

39. Yu M-y, Wu T-y. Factors Influencing Mammography Screening of Chinese American Women. *J Obstet Gynecol Neonatal Nurs.* 2005;34(3):386-394.

40. American Cancer Society. *Breast Cancer Figures 2005-2006.* Atlanta: American Cancer Society, Inc.; 2005.

41. Health Information Tennessee. Tennessee fact in rural areas. Available at: http://hitspot.state.tn.us. Accessed August 5, 2006.

42. Powell ME, Carter V, Bonsi E, et al. Increasing mammography screening among African American women in rural areas. *J Health Care Poor Underserved.* 2005;16(4 Suppl A):11-21.

43. Young RF, Severson RK. Breast cancer screening barriers and mammography completion in older minority women. *Breast Cancer Res Treat.* 2005;89(2):111-118.

44. Gaston MH. 100% access and 0 health disparities: Changing the health paradigm for rural women in the 21st century. *Womens Health Issues.* 2001;11(1):7-16.

45. Ricketts TC, Johnson-Webb KD, Randolph RK. Populations and Places in Rural America. In: Ricketts TC, ed. *Rural Health in the United States*. New York: Oxford University Press; 1999.

46. Barrett K, Legg J. Demographic and health factors associated with mammography utilization. *Am J Health Promot.* 2005;19(6):401-405.

47. Center for Literacy Studies. Tennessee County Profiles. Available at: http://cls.coe.utk.edu/counties/profiles.html. Accessed December 5, 2005.

48. U. S. Census Bureau. QT-P20 Educational attainment by sex: 2000. Available at: http://factfinder.census.gov/home/saff/main.html?_lang=en. Accessed June 15, 2006.
49. U. S. Department of Agriculture Economic Research Service. Measuring rurality: What is rural? Available at: http://www.ers.usda.gov/Briefing/Rurality/WhatIsRural/. Accessed June 1, 2006.
50. *Rural Healthy People 2010: A Companion Document to Healthy People 2010.* College Station, Texas: The Texas A&M University System Health Science Center, School of Rural Public Health, Southwest Rural Health Research Center; 2003.
51. Wickrama KA, Romas JA. The relationship of individual, family, and community characteristics with physical health: an adult study in 27 rural Minnesota counties. *J Rural Health.* 2005;21(4):378-382.
52. Chan L, Hart LG, Goodman DC. Geographic access to health care for rural Medicare beneficiaries. *J Rural Health.* 2006;22(2):140-146.
53. Ricketts TC, ed. *Rural Health in the United States*. New York: Oxford University Press; 1999.
54. *Health United States, 2001 with urban and rural health chartbook.* Hyattsville, MD: Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics; 2001.
55. Health Resources and Services Administration. Health Professional Shortage Areas. Available at: http://bhpr.hrsa.gov/shortage/. Accessed September 15, 2006.
56. Winters CA, Mayer DM. Special Feature: An Approach to Cardiac Care in Rural Settings. *Critical Care Nurs Q.* 2002;24(4):75.
57. Ricketts TC, Heaphy PE. Hospitals in rural America. *West J Med.* 2000;173(6):418-422.
58. U. S. Food and Drug Administration. Mammography. July 7, 2006; Available at: http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfMQSA/mqsa.cfm. Accessed July 11, 2006.
59. U.S. Preventive Services Task Force. *Screening for Breast Cancer*. Washington, D.C.: Agency for Healthcare Research and Quality; 2002.
60. Zhang P, Tao G, Irwin KL. Utilization of preventive medical services in the United States: a comparison between rural and urban populations. *J Rural Health.* 2000;16(4):349-356.
61. Schootman M, Fuortes LJ. Breast and cervical carcinoma: the correlation of activity limitations and rurality with screening, disease incidence, and mortality. *Cancer.*1999;86(6):1087-1094.
62. Schootman M, Jeffe DB, Reschke AH, Aft RL. Disparities related to socioeconomic status and access to medical care remain in the United States among women who never had a mammogram. *Cancer Causes Control.* 2003;14(5):419-425.
63. Hall HI, Uhler RJ, Coughlin SS, Miller DS. Breast and Cervical Cancer Screening among Appalachian Women. *Cancer Epidemiol Biomarkers Prev.* 2002;11(1):137-142.

64. Rahman SM, Dignan MB, Shelton BJ. Factors influencing adherence to guidelines for screening mammography among women aged 40 years and older. *Ethn Dis.* 2003;13(4):477-484.
65. Peek ME. Screening mammography in the elderly: a review of the issues. *J Am Med Womens Assoc.* 2003;58(3):191-198.
66. Schonberg MA, McCarthy EP, Davis RB, Phillips RS, Hamel MB. Breast cancer screening in women aged 80 and older: Results from a national survey. *J Am Geriatr Soc.* 2004;52(10):1688-1695.
67. Jerant AF, Franks P, Jackson JE, Doescher MP. Age-related disparities in cancer screening: Analysis of 2001 Behavioral Risk Factor Surveillance System data. *Ann Fam Med.* 2004;2(5):481-487.
68. Rauscher GH, Hawley ST, Earp JAL. Baseline predictors of initiation vs. maintenance of regular mammography use among rural women. *Prev Med.* 2005;40(6):822-830.
69. Centers for Disease Control and Prevention. Breast Cancer Screening and Socioeconomic Status - 35 Metropolitan Areas, 2000 and 2002. *Morb Mortal Wkly Rep.* 2005/39(54):981-985.
70. Adams EK, Florence CS, Thorpe KE, Becker ER, Joski PJ. Preventive care: Female cancer screening, 1996-2000. *Am J Prev Med.* 2003;25(4):301-307.
71. Magai C, Consedine N, Conway F, Neugut A, Culver C. Diversity matters: Unique populations of women and breast cancer screening. *Cancer.* 2004;100(11):2300-2307.
72. Jacobs EA, Karavolos K, Rathouz PJ, Ferris TG, Powell LH. Limited English proficiency and breast and cervical cancer screening in a multiethnic population. *A J Public Health.* 2005;95(8):1410-1416.

Appendix III

Additional Tables

Table 4. Comparison of odds risk ratios for compliance with mammography by rural-urban designation.

Rural-Urban Designation	OR (95% CI)
Rural (RUCCs)	1.00
Urban (RUCCs)	1.31 (1.00 – 1.71)
Rural (TNDOH Regions)	1.00
Urban (TNDOH Metros)	1.46 (1.10 – 1.93)
Rural (RAC)	1.00
Urban (RAC)	1.39 (1.06 – 1.83)

Table 5. Percentage of Tennessee (TDoH regions vs. Metros) women aged 40 and above, reporting screening mammography compliance.

	n	% (95% CI)
All Regions	**1178**	**73.2 (70.4-75.9)**
All Metros	**744**	**80.5 (77.1-83.5)**
Regions		
Northwest	103	62.9 (51.9-72.6)
East	235	69.3 (62.4-75.4)
Southwest	98	71.2 (60.4-80.1)
Northeast	130	72.1 (62.3-80.2)
South Central	135	74.0 (65.2-81.2)
Southeast	111	75.9 (66.6-83.3)
Upper Cumberland	113	77.2 (68.1-84.3)
Mid-Cumberland	253	78.8 (73.0-83.7)
Metros		
Kingsport	52	73.5 (58.7-84.5)
Jackson	30	74.7 (54.2-88.0)
Knoxville	149	76.5 (67.9-83.4)
Chattanooga	108	80.2 (70.1-87.6)
Nashville	152	83.9 (77.0-89.1)
Memphis	253	92.8 (76.9-87.5)

Appendix IV

Questions and Variable Codes per BRFSS Data Layout

Lists only questions utilized for study from "Sections/core questions (I), "Modules" (II) and III "Calculated Variables." Unless otherwise noted questions and variable names were the same for 2001 and 2003

I
I. SECTION/CORE QUESTIONS

IDENTIFICATION INFORMATION

Interview Year
Variable Name: (IYEAR)

How many members of your household, including yourself, are 18 years of age or older?
Variable Name: NUMADULT
__ __=Number of adults

SAMPLE DESIGN AND WEIGHTING VARIABLES

Annual Sequence Number or Primary Sampling Unit
Variable Name: _PSU

HEALTH STATUS

Would you say that in general your health is excellent, very good, good, fair, or poor:
Variable Name: GENHLTH
1=Excellent
2=Very good
3=Good
4=Fair
5=Poor
7=DK/NS
9=Refused

HEALTH CARE ACCESS

Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare?
Variable Name: HLTHPLAN
1=Yes
2=No
7=DK/NS
9=Refused

Do you have one person you think of as your personal doctor or health care provider?
Variable Name: PERSDOC2
1=Yes, only one
2=More than one
3=No
7=DK/NS
9=Refused

EXERCISE

During the past 30 days, other than your regular job, did you participate in any physical activities or exercise such as running, calisthenics, golf, gardening, or walking for exercise?
Variable Name: EXERANY2
1=Yes
2=No
7=DK/NS
9=Refused

DEMOGRAPHICS

What is your age?
Variable Name: AGE
__ __=Code age in years
7=DK/NS
9-Refused

Are you: (marital status)
Variable Name: MARITAL
1=Married
2=Divorced
3=Widowed
4=Separated
5=Never married
6=A member of an unmarried couple
9=Refused

What is the highest grade or year of school you completed?
Variable Name: EDUCA
1=Never attended school or only attended kindergarten
2=Grades 1 through 8 (Elementary)
3=Grades 9 through 11 (Some high school)
4=Grade 12 or GED (High school graduate)
5=College 1 year to 3 years (Some college or technical school)
6=College 4 years or more (College graduate)
9=Refused

Are you currently:
Variable Name: EMPLOY
1=Employed for wages
2=Self-employed
3=Out of work for more than 1 year
4=Out of work for less than 1 year
5=Homemaker
6=Student
7=Retired
8=Unable to work
9=Refused

Is your annual household income from all sources:
Variable Name: INCOME2
1=Less than $10,000
2=Less than $15,000
($10,000 to less than $15,000)
3=Less than $20,000
($15,000 to less than $20,000)
4=Less than $25,000
($20,000 to less than $25,000)
5=Less than $35,000
($25,000 to less than $35,000)
6=Less than $50,000
($35,000 to less than $50,000)
7=Less than $75,000
($50,000 to less than $75,000)
8=$75,000 or more
77=Don't know/Not sure
99=Refused

(2001)What county do you live in?
(2003) In what county do you live?
Variable Name: CTYCODE
__ __ __=FIPS county code
777=DK/NS
999=Refused

Indicate sex of respondent. (Ask only if necessary.)
Variable Name: SEX
1=Male
2=Female

PHYSICAL ACTIVITY

When you are at work, which of the following best describes what you do?
1=Mostly sitting or standing
2=Mostly walking
3=Mostly heavy labor or physically demanding work
7=DK/NS
9=Refused

We are interested in two types of physical activity: vigorous and moderate. Vigorous activities cause large increases in breathing or heart rate while moderate activities cause small increases in breathing or heart rate. Now, thinking about the moderate physical activities you do in a usual week, do you do moderate activities for at least 10 minutes at a time, such as brisk walking, bicycling, vacuuming, gardening, or anything else that causes small increases in breathing or heart rate?
Variable Name: MODPACT
1=Yes
2=No
7=DK/NS
9=Refused

How many days per week do you do these moderate activities for at least 10 minutes at a time?
Variable Name: MODPADAY
__ __=Days per week
88=Do not exercise at least 10 minutes weekly
77=DK/NS
99=Refused

II MODULES

WOMEN'S HEALTH MODULE

A mammogram is an x-ray of each breast to look for breast cancer. Have you ever had a mammogram?
Variable Name: HADMAM
1=Yes
2=No
7=DK/NS
9=Refused

How long has it been since you had your last mammogram?
Variable Name: HOWLONG
1=Within the past year
2=Within the past 2 yrs
3=Within the past 3 yrs
4=Within the past 5 yrs
5=>5 yrs
7=DK/NS
9=Refused

2001: Was your last mammogram done as part of routine checkup, because of a breast problem other than cancer, or because you've already had breast cancer?
Variable Name: WHYDONE
1=Routine checkup
2=Breast problem other than cancer
3=Had breast cancer
7=DK/NS
9=Refused

2003: Many mammograms are done as a routine check-up. Sometimes a mammogram is done to check something that might be a problem, such as a lump or discomfort. Were either of your two most recent mammograms, OR your most recent mammogram done to check a possible problem?
1=Yes
2=No
7=DK/NS
9=Refused

A clinical breast exam is when a doctor, nurse, or other health professional feels the breast for lumps. Have you ever had a clinical breast exam?
Variable Name: PROFEXAM
1=Yes
2=No
7=DK/NS
9=Refused

How long has it been since your last breast exam?
Variable Name: LENGEXAM
1=Within the past year
2=Within the past 2 years
3=Within the past 3 years
4=Within the past 5 years
5=5 or more years ago
7=DK/NS
9=Refused

A Pap smear is a test for cancer of the cervix. Have you ever had a Pap smear?
Variable Name: HADPAP
1=Yes
2=No
7=DK/NS
9=Refused

How long has it been since you had your last Pap smear?
Variable Name: LASTPAP
1=Within the past year
2=Within the past 2 years
3=Within the past 3 years
4=Within the past 5 years
5=5 or more years ago
7=DK/NS
9=Refused

Was your last Pap smear done as part of a routine exam or to check a current or previous problem?
Variable Name: WHYPAP
1=Routine checkup
2=Check current or previous problem
3-Other
7=DK/NS
9=Refused

III CALCULATED VARIABLES

Sample Design Stratification Variable
Variable Name: _STSTR
Combines the values for the variables STATE, GEOSTR, and DENSTR2.

Final Weight
Variable Name: _FINALWT
Final weight or the popst stratification weight multiplied by the product of the stratum adjustment and the unequal selection probability weight or the design weight. POSTSTR * WT2
POSTSTR/Post stratification weight (Population estimate for age/sex/race categories divided by the (weighted sample frequency by multiplied by age/race/sex) * WT2/ Design Weight ((STRWT: household density stratum weight) * (RAW:raw weighting factor or the unequal selection probability weight (number of adults in household/the number of phone #'s reaching household))).

Reported age in five-year age categories
Variable Name: _AGEG5YR
01=18-24
02=25-29
03=30-34
04=35-39
05=40-44
06=45-49
07=50-54
08=55-59
09=60-64
10=65-69
11=70-74
12=75-79
13=80+
14=KK/NS/Refused

Race
Variable Name: RACE2
1=White Only, Non-Hispanic
2=Black Only, Non-Hispanic
3=Asian Only, Non-Hispanic
4=Native Hawaiian, or other Pacific Islander Only, Non-Hispanic
5=American Indian or Alaska Native Only, Non-Hispanic
6=Other Race Only, Non-Hispanic
7=Multiracial, Non-Hispanic
8=Hispanic
9=DK/NS or refused one or more component questions

Body Mass Index categorized
2001 Variable Name: _BMI2CAT
2003 Variable Name: _BMI3CAT
1=Neither overweight nor obese (_BMI2 < 25.0)
2=Overweight (_BMI2 25.0 to 29.9)
3=Obese (_BMI2 30.0 or greater)
9=DK/NS or refused one or more component questions

Computed smoking status
Variable Name: _SMOKER2
1=Current smoker/now smokes every day
2=Current smoker/now smokes some days
3=Former smoker
4=Never smoked
9=DK/NS or refused one or more component questions

Leisure time physical activity
Variable Name: _TOTINDA
1=Leisure time activity in past month
2=No leisure time activity in past month
9=Unknown

Meets recommendations for physical activity
Variable Name: _RFPAREC
1=Not at risk
2=At Risk
3=DK/NS or refused one or more component questions

Drink any alcoholic beverages in past 30 days
2001 Variable Name: DRNKANY2
2003 Variable Name: DRNKANY3
1=yes
2=no
7=DK/NS
9=Refused/Missing

VITA

Born and raised in New Jersey, Kathleen Brown received her B.S. in Nursing from the University of South Carolina in 1977. Following twelve years of nursing she received her Master of Public Health degree from The University of Tennessee in1993. She taught at the University for another twelve years and in December, 2006 will receive a PhD in Human Ecology with a major in Community Health. She has recently accepted a position as an Epidemiologist at the Knox County Health Department, Knox County, Tennessee.