An Ecological Examination of Cancer Screenings, Early Stage Incidence and Mortality in the State of Missouri

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1. Background

- In Missouri as in the U.S., colorectal cancer (CRC) and female breast cancer (BC) are two of the leading causes of cancer-related deaths. Missouri's cervical cancer (CC) mortality rates are in the top quartile of rates in the U.S., despite an overall downward trend in mortality.
- In 1992, Missouri began providing free BC and CC screenings to women meeting certain age, income and insurance guidelines. Missouri is also one of the first states to pass laws protecting insurance coverage for the full range of CRC screening exams.
- Population-based evidence regarding impact of the aforementioned screenings and cancer rates in Missouri is lacking.
- Missouri has conducted three surveys similar to the Behavioral Risk Factor Surveillance System (BRFSS) but with much larger sample sizes: the County-Level Study (CLS)

2. Purpose

- To examine relationships between prevalence of screenings and early stage incidence and mortality for these three types of screening-amenable cancers in Missouri's 114 counties and the City of St. Louis.

3. Methods

- Design: This is an ecological study based on county-specific estimates of selected cancer screening prevalences and early stage cancer incidence and cancer mortality.
- Data:
  - County-specific screening prevalence: Missouri County Level-Studies (CLS) in 2003, 2007 and 2011
  - County-specific early stage (i.e., in situ and localized only) incidence (2004 to 2013): Missouri Cancer Registry (MCR)
  - County-specific cancer deaths (2004 to 2013): Missouri Department of Health and Senior Services death records
- Analysis: Pearson's correlation; Poisson regression
  - SAS survey procedures were used to account for CLS's complex survey design.

4. Results

Table 1. Prevalence of cancer screenings in Missouri, Missouri County-Level Study 2003, 2007 and 2011 (N=116,890)

	All (n, %)	2003 (n, %)	2007 (n, %)	2011 (n, %)
Breast cancer screening				
Ever had CBE	50753 (93.0)	5950 (92.9)	21052 (94.3)	23750 (91.8)
Had CBE in last 2 yrs	39039 (83.5)	4844 (86.5)	16414 (83.6)	17780 (80.7)
Ever had mamm	50459 (89.5)	5646 (87.2)	20686 (91.3)	24126 (90.1)
Had mamm in last 2 yrs	39064 (82.2)	4569 (83.5)	16136 (83.2)	18358 (80.1)
Cervical cancer screening				
Ever had Pap test	42918 (96.4)	4665 (96.7)	17565 (97.5)	20688 (95.2)
Had Pap test in last 3 yrs	46279 (82.4)	6928 (84.9)	20031 (83.1)	19319 (79.2)
Colorectal cancer screening				
Ever had FOBT	29728 (39.43)	3445 (43.6)	12670 (41.5)	13613 (33.9)
Had FOBT in last yr	9397 (38.95)	1550 (55.2)	4048 (31.5)	3799 (28.7)
Ever had SoC	43504 (60.7)	3601 (51.6)	17258 (63.4)	22645 (66.2)
Had SoC in last 5 yrs	33827 (82.2)	2802 (84.6)	13776 (84.0)	17249 (79.0)

Breast cancer screening age was set as age ≥40 yrs; cervical cancer screening as 21 to 65 yrs; colorectal cancer screening as 50 to 75 yrs. CBE: clinical breast exam; FOBT: fecal occult blood test; mamm: mammogram; SoC: sigmoidoscopy or colonoscopy

Table 2. Correlation estimates of cancer screening prevalence and early stage incidence or mortality in Missouri counties

	Crude Early Stage Incidence		Crude Mortality	
	Pearson Correlation			
Breast cancer screening	r	P	r	P
Ever had CBE	0.28	0.002	-0.29	0.0016
Had CBE in 2 last 2 yrs	0.35	0.0001	-0.01	0.9
Ever had mamm	0.28	0.002	-0.01	0.9
Had mamm in last 2 yrs	0.38	<0.0001	-0.04	0.68
Cervical cancer screening				
Ever had Pap test	0.28	0.0026	-0.10	0.27
Had Pap test in last 3 yrs	0.02	0.81	-0.017	0.85
Colorectal cancer screening				
Ever had FOBT	-0.17	0.06	-0.19	0.04
Had FOBT in last yr	-0.026	0.78	-0.08	0.36
Ever had SoC	-0.23	0.01	-0.38	<0.0001
Had SoC in last 5 ys	0.018	0.85	-0.24	0.01

See the notes for Table 1. Incidence and mortality rates used the same age ranges as for the screening prevalences.

Fig 1. Age-adjusted early stage incidence rates of breast, cervical and colorectal cancer in Missouri, 2004-2013

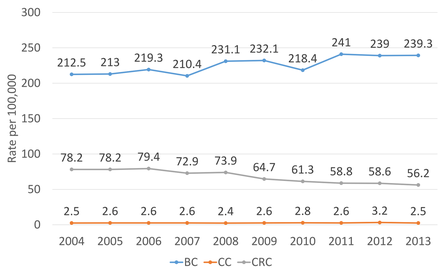
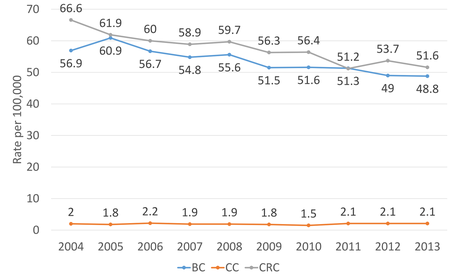


Fig 2. Age-adjusted mortality rates of breast, cervical and colorectal cancer in Missouri, 2004-2013



Breast cancer only included female cases. Early stage included in situ and localized for breast and colorectal cancer; only localized for cervical cancer.

Table 3. Incidence rate ratio and mortality rate ratio of three cancers across levels of cancer screening in Missouri

	Early stage incidence rate ratio				Mortality rate ratio			
	Unadjusted model		Adjusted model[1]		Unadjusted model		Adjusted model[1]	
Breast Cancer		P		P		P		P
Ever had CBE	1.035 (1.021-1.049)	<.0001	1.014 (0.998-1.030)	0.08	0.977 (0.963-0.990)	0.0009	0.975 (0.960-0.989)	0.0007
Had CBE in last 2 yrs	1.021 (1.011-1.032)	<.0001	1.013 (1.006-1.021)	0.0002	1.002 (0.994-1.011)	0.61	0.999 (0.992-1.007)	0.92
Ever had mamm	1.023 (1.010-1.039)	0.004	1.008 (1.001-1.016)	0.03	0.999 (0.989-1.011)	0.97	1.003 (0.994-1.012)	0.52
Had mamm in last 2 yrs	1.021 (1.017-1.025)	<.0001	1.011 (1.008-1.014)	0.0002	1.004 (0.999-1.008)	0.36	1.001 (0.996-1.004)	0.89
Cervical cancer								
Ever had Pap test	1.033 (0.986-1.083)	0.17	1.076 (1.012-1.114)	0.01	0.923 (0.892-0.988)	0.02	0.964 (0.910-1.026)	0.24
Had Pap test in last 3 yrs	0.995 (0.980-1.003)	0.54	1.015 (0.983-1.050)	0.36	0.984 (0.961-1.007)	0.16	0.990 (0.966-1.014)	0.41
Colorectal cancer								
Ever had FOBT	0.995 (0.991-0.999)	0.16	0.995 (0.992-0.998)	0.10	0.994 (0.986-1.001)	0.13	0.996 (0.992-1.000)	0.04
Had FOBT last yr	1.004 (1.000-1.010)	0.06	1.001 (0.997-1.006)	0.57	1.004 (0.995-1.013)	0.39	0.999 (0.996-1.003)	0.64
Ever had SoC	0.996 (0.990-1.004)	0.33	0.992 (0.985-1.000)	0.04	0.988 (0.984-0.992)	<.0001	0.992 (0.987-0.998)	0.009
Had SoC in last 5 yrs	1.005 (0.993-1.018)	0.37	1.007 (0.997-1.018)	0.18	0.988 (0.981-0.996)	0.002	0.998 (0.991-1.004)	0.49

[1] Poisson regression rate ratio estimates (IRR and MRR) adjusted for county-level covariates including mean age, % whites, % with low income, % with less than high school, % without insurance coverage, % attempted to access care but could not get it.

5. Discussion

- This study highlights Pap test's role in CC prevention and control in Missouri.
- It showed a small but significant effect of CBE in detecting BC at early stage and in reducing mortality.
- A statistically significant reduction of CRC mortality associated with FOBT and SoC screenings was observed.
- The findings suggest further incentive to promote population-based screening programs among Missouri residents.

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