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Cervical cancer screening behaviors and proximity to federally qualified health centers in South Carolina

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ABSTRACT

Introduction: Lack of participation in cervical cancer screening in underserved populations has been attributed to access to care, particularly among women in rural areas. Federally Qualified Health Centers (FQHCs) were created to address this need in medically underserved populations. This study observed proximity to three health centers in relation to cervical cancer screening rates in South Carolina.

Methods: Data were obtained from FQHC patient visits (from 3 centers) between 2007–2010 and were limited to women eligible for cervical cancer screening (n = 24,393). ArcGIS was used to geocode patients addresses and FQHC locations, and distance was calculated. Modified Poisson regression was used to estimate relative risk of obtaining cervical cancer screening within one yearor ever, stratified by residential area.

Results: Findings differed markedly by center and urban/rural status.

At two health clinics, rural residents living the furthest away from the clinic (~9 miles difference between quartile 4 and quartile 1) were more likely to be ever screened (RRs = 1.05 and 1.03, p-values < 0.05), while urban residents living the furthest away were less likely to be ever screened (RR = 0.85, p-value < 0.05). At the third center, only urban residents living the furthest away were more likely to be ever screened (RR = 1.02, p-value < 0.05).

Conclusions: Increased travel distance significantly increased the likelihood of cervical cancer screening at two FQHC sites while significantly decreasing the likelihood of screening at the 3rd site.

These findings underscore the importance of contextual and environmental factors that impact use of cervical cancer screening services.

1. Introduction

Cervical cancer incidence and mortality rates have declined over the past several decades attributed to prevention and early detection by screening programs, namely the widespread uptake of the Pap test [1,2]. Cancer-related health disparities, particularly cervical cancer, in South Carolina are among the largest in the nation [3]. The incidence of cervical cancer in South Carolina is similar to the U.S. average (8.0/10,000 population for South Carolina; 8.1/10,000 population for the U.S.); however, mortality is higher (2.7/10,000 population for South Carolina; 2.4 for the U.S.) [4]. African American women in South Carolina have significantly lower cervical cancer survival compared to European American women; even if they have the same cancer stage, grade, or histology [3].

The U.S. Preventive Services Task Force recommendation in 2003 (effective until the revised recommendation in 2012 and then again in 2018) was for women aged 21–65 to have cervical cancer screening at prescribed intervals [5–9]. Cervical cancer screening is beneficial to identify pre-cancerous cervical changes to prevent cancer, detect cancer early, as well as to improve survival rates. Overall five-year survival

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rates of cervical cancer are 66 %, if cervical cancer is found in early stage – localized, the five-year survival rate is 92 % [10]. Medically underserved women have higher cervical cancer incidence and mortality rates as compared to women with a regular and usual source of care. They are also more likely to be diagnosed with cervical cancer at later stages [11–13]. In 2000, 81.3 % of women aged 18 and over had a Pap test in the past three years, which was an all-time high. In 2010, 74.6 % of women in the United States reported that they had a Pap test within the past three years [14]. In 2015, only 70.2 % of women aged 18 and over had a Pap test in the past three years [15]. Cervical cancer screening rates are disproportionate by women's race and socioeconomic status. Hispanic, Asian American, uninsured or less educated women are less likely to have had cervical cancer screening at the recommended intervals [14,16]. Several national and local programs have been conducted to encourage cervical cancer screening among low-income, under or uninsured, or minority women [17–19], however, several populations remained unscreened [20].

A number of factors have been shown to influence participation cervical cancer screening, [21] including patient characteristics, provider factors, and clinical systems. Having poor access to health care is a barrier to seeking care, including cancer screening [21]. In particular, women living in rural areas have challenges getting cervical cancer screening due to long travel distance to the health care facilities [22–24]. There is a paucity of literature describing the impact of travel on cancer screening; however there is a greater body of literature examining travel distance on stage of disease at diagnosis (an outcome for timely screening). A study conducted in the United Kingdom demonstrated a significant negative effect of increasing travel distance on attendance for mammography screening; a 10 km in distance resulted in a 13 % reduction in the odds of screening [25]. Another study conducted in Denmark, showed a significant increase in diagnostic intervals when patients had to travel longer distances [26]. When examining the outcomes for timeliness of screening, study results of the association between cancer stage at diagnosis and travel distance to health care facilities are inconsistent. A few studies have reported higher stage of disease or poorer survival among those who travel further distances for screening compared to those who lived closer to diagnostic facilities [27–29]. Others have reported that travel time to health care facility was not related to late stage of cancer at diagnosis [30–33].

The federally qualified health center (FQHC) program was introduced in the United States in 1989 to provide primary care services in underserved communities [34]. It mainly serves low-income and ethnically minority population; however, high quality primary care services are provided regardless of a client's ability or inability to pay and private insurance is accepted [35]. In 2011, there were 20 FQHC systems providing service through 150 delivery sites and serving 326,829 patients in South Carolina [36]. These FQHCs provide various on-site, preventive health services, including cervical cancer screening, and were one of the first providers of Pap services in the state [37,38]. Previous research with FQHCs in South Carolina has revealed insights into cancer screening, especially among medically underserved individuals living in rural settings [39–41]. One study on mammography demonstrated increased accessibility in areas served by FQHCs in South Carolina [39,40]. Further, FQHCs are ideal partners in research to reduce cancer-related health disparities among medically underserved individuals in South Carolina [34,41].

The purpose of this study was to explore geographical proximity to health centers and cervical cancer screening behaviors among women attending three FQHC systems in South Carolina. We hypothesized that cervical cancer screening rates would be increased by proximity to health centers, and that the residential area (urban/rural) mediates the relationship between geographical proximity and cervical cancer screening. We anticipated that rural dwelling residents would have a higher threshold for travel distances which would be prohibitive to seeking care compared to urban dwelling residents.

2. Methods

As no identifying data was transmitted to the investigative team, the study was determined to be exempt by the University of South Carolina Institutional Review Board. This multicenter retrospective cohort study utilized administrative data from 3 systems (out of 22 FQHC systems in South Carolina) with 31 delivery sites (202 total sites in SC). Our investigation was limited to these 3 systems as they were the only ones which had implemented electronic transfer of data to the state's 3rd party data warehouse system. Medical claims data from the FQHCs were obtained from the South Carolina Budget and Control Board, Revenue and Fiscal Affairs Office [42]. All three FQHCs entered into a data use agreement with the research team. Data from 33,115 women who were aged 18–64 and ever visited FQHCs during 2007–2010 were extracted from the three FQHCs. These data were used because it was the time period of overlap for all the centers contained within the 3rd party data warehouse repository. Analysis was performed in 2017. Women whose distance to FQHCs had changed due to a move were excluded n = 8722. A total of 24,393 women were included in our analysis sample. Patients' age, race, marital status, residential area urban/rural, FQHC visit dates, and cervical cancer screening dates were extracted from the dataset however, one of the three FQHCs did not collect patients' marital status information n = 6518. Patients' residence and FQHC facilities were geocoded to the exact housing number and street address using ArcGIS 10.0 Redlands, CA and network distance between the patients' residence and the FQHC was then calculated.

To determine whether patients had cervical cancer screening, medical claims data were reviewed. For each visit, patients were considered screened for cervical cancer if CPT/ICD-9 codes 079.4, V76.2, V72.31, 795.00–795.09 were included as the first diagnosis and indicated that patients had received 'screening for malignant neoplasm of the cervix', 'Papanicolaou smear', 'pap smear', or 'routine gynecological examination'. Timing of cervical cancer screening experiences were determined based upon the service date of the record and classified as screened within the last yearand ever screened. Since some patients visited FQHCs only within one or two years, those patients might be considered as non-screened if we did not consider their first date of visit to FQHCs within the context of the data available (2007–2010). Thus, we calculated the duration between the first and last FQHC visits (any visit, not just cervical screening visits) during the study period (2007–2010) and utilized this cohort period to define eligible subsamples for each analysis (ever andlast year screening). All patients were eligible for the analysis of ever-screened for cervical cancer. Those whose cohort period were a least 1 year apart were eligible for the analysis of cervical cancer screening last year (n = 13,277). Patients who were not included in some of the analyses (but were eligible for other analyses) were indicated as 'not eligible' in Table 1.

2.1. Statistical analysis

Descriptive statistics were computed for patients' age, race, marital status, residential area (urban/rural), cervical cancer screening, and distance to the FQHC stratified by FQHC. Chi-square tests and analysis of variance were performed to compare patients' characteristics at each FQHC. The proportion of patients screened was calculated for each FQHC separately. Modified Poisson regression with robust error variance [43] was used to estimate relative risk RR of getting cervical cancer screening by distance to the FQHC then stratified by FQHC and residential area urban/rural. Distance to FQHCs was categorized into quartiles, which are used frequently in epidemiological studies for easier interpretation of the level of exposure. Patients' age, race for all FQHCs, and marital status for two FQHCs were adjusted in modified Poisson regression model. Screening rates per 1000 population were calculated by each FQHC and residential area urban/rural. Population estimates were derived from 2010 Census data using the county in

Table 1
Characteristics of the patients in the three health centers (2007–2010).

Characteristics	Health Center 1 (n = 13,709) n(%)	Health Center 2 (n = 4166) n(%)	Health Center 3 (n = 6518) n(%)	p-value
Age				
18-24	3889 (28.4 %)	767 (18.4 %)	1302 (20.0 %)	< 0.001
25–34	3961 (28.9 %)	790 (19.0 %)	1705 (26.2 %)	
35-44	2490 (18.2 %)	745 (17.9 %)	1260 (19.3 %)	
45-54	1979 (14.4 %)	883 (21.2 %)	1328 (20.4 %)	
55-64	1390 (10.1 %)	981 (23.6 %)	923 (14.2 %)	
Marital Status				
Single	9319 (70.1 %)	1484 (42.3 %)	***	< 0.001
Married	2906 (21.9 %)	1251 (35.7 %)	***	
Divorced/Separated	786 (5.9 %)	324 (9.2 %)	***	
Widowed	192 (1.4 %)	83 (2.4 %)	***	
Unknown	89 (0.7 %)	364 (10.4 %)	***	
Race				
White	2535 (20.1 %)	1663 (42.3 %)	800 (14.7 %)	< 0.001
Black	8139 (64.7 %)	2117 (53.9 %)	2087 (38.3 %)	
Hispanic	1680 (13.4 %)	122 (3.1 %)	438 (8.0 %)	
Asian/Pacific Islander	151 (1.2 %)	9 (0.2 %)	2112 (38.8 %)	
Other	81 (0.6 %)	19 (0.5 %)	11 (0.2 %)	
Residential area				
Urban	10,497 (76.6 %)	974 (23.4 %)	4122 (63.2 %)	< 0.001
Rural	3,212 (23.4 %)	3192 (76.6 %)	2396 (36.8 %)	
Travel Distance to the Health Center (miles, mean ± SD)	10.9 ± 11.6	10.8 ± 13.1	8.2 ± 10.0	< 0.001
Ever Screened				
Yes	3968 (28.9 %)	1220 (29.3 %)	1491 (22.9 %)	< 0.001
No	9,741 (71.0 %)	2946 (70.7 %)	5027 (77.1 %)	
Screened Last Year				
Yes	2174 (28.9 %)	665 (21.8 %)	948 (35.1 %)	< 0.001
No	5349 (71.1 %)	2386 (78.2 %)	1755 (64.9 %)	
Not eligible	6186	1115	4015	

which the delivery sites were located.

As FQHC system was found to be a significant interaction covariate with distance ($p < 0.05$), all analyses were stratified by health center. Statistical significance was set as $p < .05$. SAS 9.3 (SAS Institute Inc., Cary, NC) was used for the statistical analyses.

3. Results

As shown in Table 1, the majority of patients across the FQHCs were aged 25–34 (although the largest percentage of patients at Center 2 were 55–64), Black, and single (though collected only for two FQHCs). Two FQHCs served patients from primarily urban locations, and one served a majority of patients from rural locations. There were statistically significant differences in patients' age, marital status, race, residential area, and distance to the health center in the three health centers ($p < 0.01$). The mean distance was 10.3 miles with the range from 0.0–205.0 miles. Cervical cancer screening rate within 1 year (21.8–35.1 %) and ever (22.9–29.3 %) varied significantly between the health centers ($p < 0.01$) (Table 1).

Patients living further from the health center were more likely to be screened within the last yearand ever for cervical cancer for health center 1 and 2 (Table 2). The association between distance to the health center and cervical cancer screening varied by the urban/rural designation of the patient's address (Table 3). Among women living in rural areas, those living further from the health center were more likely to have ever been screened for health centers 2 and 3, and within the last year for health center 2. Among women living in urban areas, women traveling further distances were significantly more likely to receive cervical cancer screening at Health Center 1 in the last yearand ever (RR = 1.03 95 % CI = 1.01,1.05; RR = 1.02 95 % CI = 1.01,1.04) and significantly less likely to receive screening at Center 2 in the last year or ever (RR = 0.93 95 % CI = 0.87,1.00; RR = 0.85 95 % CI = 0.80,0.90 Table 3). No significant differences were noted for urban women at Center 3.

Cervical cancer screening rates in the last yearand ever (Table 4) significantly increased along with increasing travel distance to the health center for women at centers 1 (p-value for linear trend equals 0.003and $p = 0.011$ respectively) and health center 2 (p-value for linear trend < 0.001 and = 0.040 respectively). At the greatest distance from the center, average screening rates were 289.0, 218.0, and 350.7 per 1,000 for health center 1, 2, and 3, respectively. Although it was not statistically significant, cervical cancer screening rates in the last year decreased as travel distance to the health center 3 increased (Table 4).

As with the previous results, when patient residence (urban versus rural) was accounted for, slightly different screening rates were observed (Table 5). In health center 1 and 2, the rates showed an inverse linear trend by residential area. Overall, screening rates for rural residing women decreased with increased travel distance at center 1 (average in Q4 = 309.7, $p = 0.032$ for screening last year); on the other hand, screening rates significantly increased for rural residing women with increased travel distance at health center 2 (average in Q4 = 180.1, $p < 0.001$), while urban residing women had significantly decreased screening rates with further travel distance (average in Q4 = 345.8, $p < 0.001$). There was no statistically significant relationship between distance to the health center 3 and cervical cancer screening rate (Table 5).

4. Discussion

In our investigation, we found a mixed effect for distance on cervical screening practices that was modified by the center and urban/rural residence of the patient. For two of the centers, rural residing women tended to be more likely to receive cervical cancer screening and had higher rates of screening the further they lived from the health center. Conversely, women residing in urban areas at one of the centers were less likely to receive cervical cancer screening and have lower screening rates with greater travel distances. Overall, findings from this study did not support studies that have shown lower breast and cervical cancer screening rates among rural female residents [22,29,44]. Additionally,

Table 2
Crude and adjusted risk ratios for cervical cancer screening among 18–64 years old, by travel distance in quartiles.

	Health Center 1(n = 13,709)			Health Center 2(n = 5492)			Health Center 3(n = 6157)		
	N	Crude	Adjusted[a]	N	Crude	Adjusted[a]	N	Crude	Adjusted[b]
Screening in the last Year									
Travel Distance (by quartile)									
Q1	1,881	Referent	Referent	764	Referent	Referent	676	Referent	Referent
Q2	1,880	1.00 (0.99–1.02)	1.00 (0.98–1.02)	762	**1.02 (1.00–1.05)**	1.02 (1.00–1.05)	676	1.00 (0.97–1.04)	1.00 (0.97–1.03)
Q3	1,881	**1.03 (1.01–1.04)**	**1.02 (1.00–1.04)**	765	1.00 (0.98–1.02)	1.01 (0.99–1.03)	676	1.00 (0.97–1.03)	1.00 (0.97–1.03)
Q4	1,881	**1.02 (1.00–1.04)**	1.02 (1.00–1.03)	760	**1.05 (1.02–1.07)**	**1.03 (1.00–1.05)**	675	1.00 (0.97–1.03)	1.00 (0.97–1.03)
Ever screening									
Travel Distance (by quartile)									
Q1	3,436	Referent	Referent	1,043	Referent	Referent	1630	Referent	Referent
Q2	3,414	1.01 (1.00–1.02)	1.01 (0.99–1.02)	1,040	1.02 (1.00–1.05)	**1.03 (1.00–1.05)**	1,629	1.01 (0.99–1.03)	1.00 (0.98–1.02)
Q3	3,432	**1.02 (1.01–1.03)**	**1.01 (1.00–1.03)**	1,042	1.00 (0.98–1.02)	1.01 (0.99–1.04)	1630	1.01 (0.99–1.02)	1.00 (0.98–1.02)
Q4	3,427	**1.02 (1.01–1.03)**	1.01 (1.00–1.03)	1,041	**1.03 (1.00–1.05)**	1.03 (1.00–1.05)	1,629	1.01 (0.99–1.02)	1.00 (0.98–1.02)

These depict odds ratios whose 95% confidence limits do not include one (i.e., are significant at the nominal alpha = 0.05).
[a] Adjusted for age, race, and marital status.
[b] Adjusted for age and race.

our findings are not consistent with other studies that found that distance was not a factor in cervical cancer screening uptake [23,45].

As this work represents a partnership with the three FQHC center, after completing our analysis, we met with each center to explore their reactions and input. Based upon this initial feedback, we conducted additional analyses examining cervical cancer screening rates at their request. We then met again with the center administration to discuss the findings. This was critical in helping to provide important contextual information that could have impacted or explained our findings. The following points in our discussion represent the conclusions of the partnership (academia and FQHC's).

We speculate that urban dwelling residents have different perceptions of travel distances which would be prohibitive to seeking care compared to rural dwelling residents. Indeed, our divergent findings for rural versus urban FQHC systems provide indirect evidence for this. Still yet another important contextual factors are the programs and policies that rural FQHC's may implement to overcome access to care barriers. Most of the overall sample was comprised of patients living in urban residential areas, with the exception of health center 2, which served the largest number of patients living in rural locations. It is also important to note that although health center 2 had a patient population that was mostly older, patients living the furthest away from the health center were more likely to be screened for cervical cancer within the last year than those that lived closest to the health center. Health center 2 was also located in the region for the highest cervical cancer incidence rates in South Carolina. The Best Chance Network, a CDC funded breast and cervical cancer screening program (NBCCEDP), offers free screening services for underserved women and was fully operational in health centers across South Carolina at the time of this study. It is possible that the locations of the health centers in our study could have been a part of a focus area of the Best Chance Network during the 2007–2010 time frame. None of the centers or the BCN program administration at the state health department were able to provide historical documentation on when the centers became a provider for the BCN program. The only information available was that all three health centers in this study are currently participating in the Best Chance Network.

According to the study findings, the only indication that cervical cancer screening rates (not accounting for urban or rural residence) increased with closer distance to the health center was found in health center 3 but was not found to be significant. The most salient findings indicate that distance was not a factor for cervical cancer screening among the patient population in health centers 1 and 2. This could be due to transportation subsidies provided to patients by the clinics as a funding requirement to insure healthcare access to patients residing in more distant geographic areas. As part of many federal grant mechanisms for FQHCs, service grants are often required or choose to incorporate transportation initiatives to increase access to care [35]. This may have had an impact on why we saw the highest screening rates in the health center that had the greatest travel distance as well as the

Table 3
Adjusted risk ratios for cervical cancer screening among 18–64 years old, by travel distance in quartiles and stratified by residential location.

	Health Center 1(n = 13,709)				Health Center 2(n = 5492)				Health Center 3(n = 6157)			
	N	Rural[a]	N	Urban[a]	N	Rural[a]	N	Urban[a]	N	Rural[b]	N	Urban[b]
Screening in the last year												
Travel Distance (Quartile)												
Q1	434	Referent	1455	Referent	589	Referent	175	Referent	256	Referent	421	Referent
Q2	419	0.98 (0.95-1.02)	1454	0.99 (0.98-1.01)	588	0.99 (0.96-1.01)	174	1.01 (0.95-1.09)	255	0.99 (0.95-1.04)	420	0.98 (0.94-1.02)
Q3	426	0.99 (0.96-1.03)	1454	1.01 (0.99-1.03)	589	1.00 (0.98-1.03)	174	1.01 (0.94-1.08)	255	0.98 (0.93-1.03)	421	1.01 (0.97-1.05)
Q4	426	1.01 (0.98-1.05)	1455	**1.03 (1.01-1.05)**	588	**1.04 (1.01-1.07)**	174	**0.93 (0.87-1.00)**	255	1.05 (0.99-1.10)	420	0.98 (0.94-1.02)
Ever screening												
Travel Distance (Quartile)												
Q1	803	Referent	2625	Referent	799	Referent	244	Referent	599	Referent	1,031	Referent
Q2	803	1.00 (0.97-1.03)	2625	1.01 (1.00-1.03)	799	0.99 (0.97-1.02)	243	0.97 (0.91-1.04)	599	1.00 (0.97-1.02)	1,030	1.02 (1.00-1.05)
Q3	803	1.00 (0.98-1.03)	2623	1.01 (1.00-1.03)	796	1.01 (0.99-1.04)	244	0.98 (0.91-1.05)	599	1.00 (0.97-1.03)	1,031	1.02 (0.99-1.04)
Q4	803	1.01 (0.98-1.04)	2624	**1.02 (1.01-1.04)**	798	**1.05 (1.02-1.08)**	243	**0.85 (0.80-0.90)**	599	**1.03 (1.00-1.06)**	1,030	1.01 (0.98-1.03)

These depict odds ratios whose 95% confidence limits do not include one (i.e., are significant at the nominal alpha = 0.05).
[a] Adjusted for age, race, and marital status.
[b] Adjusted for age and race.

Table 4
Cervical screening rates[a] among 18–64 years old by travel distance in quartiles and stratified health center.

	Health Center 1 (n = 13,709)			Health Center 2 (n = 5492)			Health Center 3 (n = 6157)		
	# screened	Rate	p-value	# screened	Rate	p-value	# screened	Rate	p-value
Screening in the last year									
Travel Distance (Quartile)									
Q1	503	267.8	0.003	150	191.1	< 0.001	224	357.8	0.979
Q2	542	272.6		169	217.2		252	349.5	
Q3	597	311.4		147	190.9		240	347.3	
Q4	532	305.7		199	277.2		232	348.9	
Total	2,174	289.0		665	218.0		948	350.7	
Ever screened									
Travel Distance (Quartile)									
Q1	923	268.6	0.011	283	271.3	0.040	357	219.0	0.708
Q2	985	288.5		320	307.7		384	235.7	
Q3	1,030	300.1		286	274.5		373	228.8	
Q4	1,030	300.6		331	318.0		377	231.4	
Total	3,968	289.4		1220	292.8		1491	228.8	

[a] Rates are per 1000 women.

highest cervical cancer incidence. Quality improvement initiatives are currently a primary focus among two of the health centers, however, preliminary activities may also have been implemented within certain health centers that could have impacted the screening rates in relation to residential area. It is also worthy to note that the Pap test is a scheduled appointment which allows for travel planning and potentially other appointments to be scheduled at the same time and/or location.

4.1. Strengths and limitations

Our study has several strengths. We examined cervical cancer screening uptake among women seeking care in FQHCs to understand the role of distance on screening. To date, there have been limited studies examining this question. The three health centers included in this study included representation from urban and rural settings along with patients who lived in urban and rural areas. Recent national focus on addressing cancer prevention and control in rural settings underscores the importance of examining the influences of rurality on screening practices [46–49]. However, there are important limitations to note. We could not determine whether the same person visited more than one FQHC in our study sites due to the de-identification of the available data. The possibility of duplication of inclusion of patients could have affected observed cervical cancer screening rates. Alternatively, we believe that since our sample size is large, we have assumed that it would not have a significant influence on the results. Additionally, we did not analyze income data which may have given clues to the number of women that may have taken advantage of the Best Chance Network program. Future studies working with FQHCs should consider special initiatives or quality improvement activities that occur in efforts to influence screenings rates. While these initiatives are significant to public health practice, one must also consider the capacity of systems to document the impact of those initiatives on an ongoing basis. Academic and clinical partnerships would mutually benefit from the availability of such information, particularly for retrospective studies in order to demonstrate the impact that FQHCs are having in rural health disparities.

5. Conclusion

In conclusion, travel distance had a mixed impact on cervical cancer screening according to health center and the urban or rural status of the patient's residence. At the largely urban health center, likelihood of screening increased as distance from the center increased among urban dwelling residents. At a largely rural health center, the likelihood of screening decreased for urban dwellers, yet increased for rural dwelling women as the distance to the center increased. During the discussion and dissemination of these findings with the participating health

Table 5
Cervical screening rates[a] among 18–64 years old by travel distance in quartiles and stratified by health center and residential area.

	Health Center 1					Health Center 2					Health Center 3				
	Rural		Urban			Rural		Urban			Rural		Urban		
	# screened	rate	# screened	rate	p-value	# screened	rate	# screened	rate	p-value	# screened	rate	# screened	rate	p-value
Screening in the last year															
Travel Distance (Quartile)															
Q1	136	313.4	387	266.0		99	168.1	70	400.0		88	343.8	150	356.3	
Q2	117	279.2	383	263.4		67	113.9	65	373.6		81	317.6	146	347.6	
Q3	132	309.9	416	286.1		93	157.9	68	390.8		78	305.9	162	384.8	
Q4	143	335.7	460	316.2		165	280.6	38	218.4		102	400.0	141	335.7	
Total	528	309.7	1,646	282.9	0.032	424	180.1	241	345.8	< 0.001	349	341.8	599	356.1	0.450
Ever screened															
Travel Distance (Quartile)															
Q1	236	293.9	680	259.0		185	231.5	133	545.1		130	217.0	210	203.7	
Q2	232	288.9	760	289.5		148	185.2	110	452.7		122	203.7	261	253.4	
Q3	242	301.4	756	288.2		194	243.7	122	500.0		123	205.3	253	245.4	
Q4	247	307.6	815	310.6		272	340.9	56	230.5		153	255.4	239	232.0	
Total	957	297.9	3,011	286.8	0.225	799	250.3	421	432.2	< 0.001	528	220.4	963	233.6	0.219

[a] Rates are per 1000 women.

centers, administrators were very engaged and interested in both the content and implications of our results. This provided direct evidence to the centers on the impact of various travel subsidization initiatives on quality care metrics. It also provided important avenues for future quality care initiatives aimed at increasing utilization of cancer screening services. Overall, our findings speak to the importance of environmental, contextual, and clinical factors on decisions to seek health care.

Author contributions

Swann Adams conceptualized and designed the study, secured the data sets and drafted the initial manuscript. Venice Haynes assisted with developing and editing the manuscript as well as interpretation of the results. Seul Ki Choi conducted the statistical analysis and contributed to the interpretation of results. Heather Brandt assisted with the study design, editing, and critical review of the manuscript. Vicky Young provided access to the data and contextual information for the participating health centers. Jan Eberth, James Hébert, and Daniela Friedman contributed to the interpretation of the manuscript results and to the drafting of the discussion section. All authors have critically reviewed the manuscript.

Declaration of Competing Interest

The authors have no conflicts of interest to disclose.

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