Published in final edited form as:
Gynecol Oncol. 2019 January ; 152(1): 112–118. doi:10.1016/j.ygyno.2018.11.010.

Evaluating the urban-rural paradox: The complicated relationship between distance and the receipt of guideline-concordant care among cervical cancer patients

Lisa P. Spees, PhD[1], **Stephanie B. Wheeler, PhD, MPH**[2,3], **Mahesh Varia, MD**[4], **Morris Weinberger, PhD**[2], **Christopher D. Baggett, PhD**[3,5], **Xi Zhou, MS**[3], **Victoria M. Peterman, BSN, RN**[6], and **Wendy R. Brewster, MD, PhD**[3,5,7]

[1]The Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill

[2]Department of Health Policy and Management, University of North Carolina at Chapel Hill

[3]Lineberger Comprehensive Cancer Center, University of North Carolina at Chapel Hill

[4]Department of Radiation Oncology, University of North Carolina at Chapel Hill

[5]Department of Epidemiology, University of North Carolina at Chapel Hill

[6]School of Nursing, University of North Carolina at Chapel Hill

[7]Department of Obstetrics & Gynecology, University of North Carolina at Chapel Hill

Abstract

Objective: Urban-rural health disparities are often attributed to the longer distances rural patients travel to receive care. However, a recent study suggests that distance to care may affect urban and rural cancer patients differentially. We examined whether this urban-rural paradox exists among patients with cervical cancer.

Methods: We identified individuals diagnosed with cervical cancer from 2004–2013 using a statewide cancer registry linked to multi-payer, insurance claims. Our primary outcome was receipt of guideline-concordant care: surgery for stages IA1-IB1; external beam radiation therapy (EBRT), concomitant chemotherapy, and brachytherapy for stages IB2-IVA. We estimated risk ratios (RR) using modified Poisson regressions, stratified by urban/rural location, to examine the association between distance to nearest facility and receipt of treatment.

Corresponding author: Lisa P. Spees, 1102-G McGavran Greenberg, CB#7411, Chapel Hill, NC 27599, (619)-992-0221, lspees21@live.unc.edu.

Author Contributions
LPS, WRB, MV, MW, and SBW designed the study. LPS, CDB, XZ acquired data and prepared data. XZ conducted the formal analysis. LPS, WRB, MV, MW, CDB, VMP, and SBW interpreted the results. LPS prepared the first draft of the manuscript. All authors critically reviewed this first draft and contributed to subsequent versions of the manuscript. All authors approved submission of the final version of the manuscript.

Conflicts of Interest
The authors have no conflicts of interest to disclose.

Results: 62% of 999 cervical cancer patients received guideline-concordant care. The association between distance and receipt of care differed by type of treatment. In urban areas, cancer patients who lived ≥15 miles from the nearest surgical facility were *less* likely to receive primary surgical management compared to those <5 miles from the nearest surgical facility (RR: 0.77, 95% CI: 0.60–0.98). In rural areas, patients living ≥15 miles from the nearest brachytherapy facility were *more* likely to receive treatment compared to those <5 miles from the nearest brachytherapy facility (RR: 1.71, 95% CI: 1.14–2.58). Distance was not associated with the receipt of chemotherapy or EBRT.

Conclusions: Among cervical cancer patients, there is evidence supporting the urban-rural paradox, i.e., geographic distance to cancer care facilities is not consistently associated with treatment receipt in expected or consistent ways. Healthcare systems must consider the diverse and differential barriers encountered by urban and rural residents to improve access to high quality cancer care.

Keywords

guideline-concordant care; cervical cancer patients; urban/rural; distance to care; disparities

Introduction

Cervical cancer patients suffer from substantial treatment and survival disparities compared to other cancer populations [1–2]. A disproportionate number of individuals diagnosed with cervical cancer are of low socioeconomic status (SES) and minority backgrounds [3–4] making them particularly susceptible to not receiving guideline-concordant care [5]. Patients with cervical cancer face numerous access barriers to treatment including lack of health knowledge, poor social or financial support, and logistical concerns such as lack of transportation [6–7]. The increasingly uneven burden of cervical cancer among these vulnerable populations [2, 8–9] makes it essential that resources be focused on increasing their access to treatment centers.

Urban/rural health disparities are often attributed to the longer distances rural patients must travel to receive care [10]. However, in qualitative studies, patients in urban areas report distance as a barrier to care more often than rural patients [11]. Recent findings also support the notion that distance to care has a differential influence on urban and rural patients: among Medicare-insured breast cancer patients in urban areas, those living farther from radiation facilities were *less likely* to receive guideline-concordant radiotherapy, while patients in rural areas living farther from these facilities were *more likely* to receive radiotherapy than those who lived closer to treatment [12]. There would be substantial implications for how to develop effective access to care interventions for urban and rural patient populations if evidence continues to support this urban-rural paradox in distance to care.

While cancer outcomes nationally are improving over time with better screening and treatment, rural populations have not equally benefitted from these advancements and continue to suffer from worse cancer outcomes [13–14]. Understanding the differential effects of distance among urban and rural populations is important, especially as healthcare systems consider how to effectively provide access to care for urban and rural patients. We explored whether the urban-rural paradox found among breast cancer patients was observed in individuals with cervical cancer, a disproportionately vulnerable cancer population. Specifically, we examined whether distance to the nearest treatment center is associated with receipt of stage-specific guideline-concordant care for cervical cancer patients and whether this association differs by urban/rural residence. We hypothesize that distance to care will differentially affect the receipt of guideline-concordant care among cervical cancer patients residing in urban and rural areas. Specifically, we predict that distance to care will be a larger burden for urban patients rather than for rural cancer patients.

Methods

Data

We used data from the Cancer Information and Population Health Resource (CIPHR), which links the North Carolina Central Cancer Registry to statewide, multipayer, insurance claims [15]. Registry data were used to identify cervical cancer patients, as well as their stage and other tumor-specific information, and insurance claims data were used to measure treatment received. We also linked our dataset to the Area Health Resource File (AHRF), which collects county aggregate variables from sources such as the American Medical Association and the US Census Bureau [16]. Our final dataset included patient demographics, tumor information, healthcare utilization of services for both public and private insurance providers, and county-level contextual factors. These data were ideal for assessing distance to care since it included physician identifiers and geocoded patient and physician locations. The study was approved by the North Carolina Institutional Review Board.

Study Population

The study cohort included insured female patients diagnosed with cervical cancer between January 1, 2004 and June 30, 2013 (Figure S1). We identified 4,013 patients aged 18 or older with cervical cancer who had no additional primary cancer diagnosis within 1 year of the index diagnosis. We excluded patients who were diagnosed at death (N=51), died within one month of diagnosis (N=25), had a non-epithelial cervical cancer histology (N=44), were missing stage of cancer at diagnosis, or were stage IVB or stage 0 carcinoma in situ (N=373). Lastly, to be eligible, patients had to be continuously enrolled in a Medicaid, Medicare, and/or private insurance plan 3 months before through 6 months after the diagnosis of cervical cancer (N=2521). This continuous enrollment criterion meant that patients in our analytic cohort were more likely to be older, on Medicare, residing in a rural area, and diagnosed at an earlier stage compared to those who were not continuously enrolled. Our final cohort contained 999 patients.

Dependent Variable

We defined guideline-concordant care using guidelines set by the National Comprehensive Cancer Network [17]. Cervical cancer treatments were identified using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) codes. Because claims data do not permit evaluation of pathologic or radiologic results that would tailor treatment, two authors, one a board-certified gynecological oncologist (WRB) and the other a board-certified radiation oncologist (MV), used their expert clinical judgment to apply these guidelines by stage and other tumor factors (Table 1). Outcomes included binary indicators identifying which components of guideline-concordant care a patient received: surgery, chemotherapy, external beam radiation therapy (EBRT), or brachytherapy. Broadly, patients with stage IA, IA1, and IA2 cervical cancer who underwent primary operative management were considered to have received guideline-concordant care. For patients with IB1 or IB2 cancer, receipt of either surgery or radiotherapy was considered guideline-concordant. Lastly, patients with stage IIA-IVA had to receive three types of treatment to be defined as having received guideline-concordant care: concomitant chemotherapy and EBRT followed by brachytherapy.

Independent Variables

The main independent variable was distance to *nearest* treatment facility. Distance to nearest treatment center (versus chosen treatment center) was utilized because patients who travel long distances for care may be more affluent and less hindered by travel distance [18–19]. We calculated four separate distances using the combined multi-payer claims data to identify each universe of treating providers; distances to nearest facility providing cervical surgery, chemotherapy, EBRT, and brachytherapy. We measured distance from the geographic centroid of patients' residential zip code at diagnosis to the treatment facility's physical address using the straight-line method [20]. To determine treatment facilities' locations, we used insurance claims to identify all surgical, medical, and gynecological oncologists who provided either cervical surgery or chemotherapy. Similarly, we identified all radiation oncologists who provided EBRT or cervical brachytherapy. For each treatment, we linked the facility addresses associated with each provider. Similar to previous studies, distance measures were categorized as: <5 miles, 5-<15 miles, and ≥15 miles [16].

Other covariates were based on the Andersen model of health care utilization [21]. First, we examined patient- and tumor-level characteristics shown to influence receipt of guideline-concordant cervical cancer care including: year of diagnosis, American Joint Commission on Cancer stage (stage I; stage II; stage III; stage IV), age at diagnosis (<60 years; 60–70 years; >70 years), race (non-white; white), insurance status at diagnosis (Medicaid only; Medicare only; any private; dual--Medicare and Medicaid), and residence (urban; rural). The non-white category included black, Hispanic, Asian, and Native American patients; we coded race as a binary variable because 90% of non-white subjects were black. We determined urban/rural residence using the rural-urban continuum codes (RUCC) and delineated urban/rural status based on the United States Department of Agriculture's (USDA) classification scheme. We used RUCC because it accounts for both population levels and proximity to an urban area when determining urban/rural status. We measured comorbidity using a modified version of the Charlson Comorbidity Index that accounted for conditions during the study period. Second, to account for geographic and neighborhood characteristics that may affect receipt of health care services and guideline-concordant care [3], we examined the following county-level sociodemographic characteristics: mean number of generalist physicians, mean percent unemployed, and median household income.

Statistical Methods

After describing our cohort, we used χ^2 tests and t-tests to examine whether differences in patient-, tumor-, and county-level characteristics were associated with receiving guideline-concordant care. In multivariable analyses, we used modified Poisson regression to estimate risk ratios (RRs) and 95% confidence intervals (CI) for whether guideline-concordant care was received [22]. We used this approach since our outcomes occurred in more than 10% of the study population; using logistic regression would have upwardly biased our results [23]. Models included the full sample and were also stratified by urban/rural residence. Models were stratified since, conceptually, other variables included in our models may also behave differently by rural/urban residence. Because guideline-concordant care is stage-specific, multivariable analyses only included clinically-appropriate patients. For example, only patients with stage IA1-IB2 were included in multivariable analyses examining the influence of distance to surgical management of cervical cancer. Patients with stage IIA-IVA were included to evaluate the influence of distance on receipt of EBRT, chemotherapy, and brachytherapy. Because patients often must travel to different treatment facilities to receive chemotherapy, EBRT, and brachytherapy, we examined distances to each facility separately. Additionally, while surgery is often the preferred treatment for stage IA1-IB2 cervical cancer patients, EBRT is preferred when surgeries are high risk. Consequently, to ensure the validity of our findings, we also examined receipt of EBRT among these patients as well. All analyses were conducted using SAS version 9.4 software (SAS Institute, Inc., Cary, NC).

Results

Among the 999 cervical cancer patients, 620 (62%) received guideline-concordant care. The majority of our cohort was white (68%), had no comorbidities (66%), and lived in an urban area (63%; Table 2). Most patients had private insurance (30%) or only Medicare (37%). In general, patients who received guideline-concordant care were younger, had private insurance, and were less likely to have comorbid conditions than those who did not receive guideline-concordant care. Patients who received guideline-concordant care were more likely to be diagnosed at a later cancer stage.

In multivariable analyses among all patients with stage IA-IB2 cervical cancer, greater distance (i.e., ≥15 miles) to cervical surgery was associated with lower risk of receiving guideline-concordant surgery (RR: 0.81, 95% CI: 0.68–0.96; Figure 1). In stratified analyses of urban residents only, ≥15 miles to the nearest surgical facility was associated with lower receipt of cervical surgery compared to those <5 miles from nearest facility (RR: 0.77, 95% CI: 0.60–0.98). In contrast, in stratified analyses among rural residents, distance to surgical facility was not significantly associated with lower receipt of surgery. Additionally, across the full and urban/rural stratified samples, having private insurance (compared to having Medicare only; RR: 1.77, 95% CI: 1.21–2.60) or one comorbid condition (compared to having zero comorbid conditions; RR: 1.39, 95% CI: 1.07–1.80) was associated with a higher likelihood of receiving cervical surgery (Supplementary Table S1). Urban, non-white residents were less likely to receive cervical surgery compared to urban, white residents (RR: 0.71, 95% CI:0.58–0.88). While distance was not predictive of receipt of cervical surgery among patients residing in rural areas, those older than 70 years were less likely to receive cervical surgery (RR: 0.57, 95% CI:0.35–0.93) compared to rural patients less than 60 years old.

In the full sample, distance to brachytherapy facility was not significantly associated with receipt of brachytherapy among patients diagnosed with stage IIA-IVA cervical cancer (Figure 2A). Distance to brachytherapy facility was also not associated with receipt of brachytherapy among urban residents only. However, rural residents living farther from brachytherapy facilities had a higher likelihood of receiving brachytherapy. Patients living 5 to <15 miles or ≥15 miles from brachytherapy facilities were more likely to receive brachytherapy compared to patients who resided <5 miles from brachytherapy facilities (RR 5-<15 miles vs. <5 miles: 1.43, 95% CI: 0.92–2.22; RR ≥15 miles vs. <5 miles: 1.71, 95% CI: 1.14–2.58). In the full sample and among urban residents only, patients with one comorbid condition were more likely to receive brachytherapy than those without comorbidities (Supplementary Table S2). Lastly, in both the full sample and among rural residents only, older age was associated with a lower likelihood of receiving brachytherapy; in particular, patients in rural areas between ages 60–70 were less likely to receive brachytherapy than those less than 60 years old (RR:0.72, 95% CI: 0.53–0.97), and patients older than 70 years old were also less likely to undergo brachytherapy (RR: 0.65, 95% CI: 0.49–0.87).

Distance to nearest chemotherapy facility was not associated with receipt of chemotherapy for urban or rural patients with stage IIA-IVA cervical cancer in multivariable analyses (Figure 2B). Specifically, among rural patients only, those ≥15 miles to treatment had a higher, though not statistically significant, likelihood of receiving concurrent chemotherapy (RR: 1.19; 95% CI: 0.86–1.65). Patients dually enrolled in Medicaid and Medicare were less likely to receive chemotherapy compared to patients enrolled in only Medicare (RR: 0.84, 95% CI: 0.70–1.00; Supplementary Table S3). Similar to the results above, patients over 70 years old residing in rural areas were less likely to receive chemotherapy compared to patients less than 60 years old (RR: 0.62, 95% CI: 0.45–0.85).

Distance to nearest EBRT facility was also not associated with receipt of EBRT among urban and rural cancer patients with stage IIA-IVA cervical cancer (Figure 2C). In the full and urban/rural stratified samples, no other factors other than year of diagnosis was associated with receipt of EBRT (Supplementary Table S4). Additionally, in sensitivity checks which included patients with IA2-IVA cervical cancer, multivariable analyses also showed that distance to nearest treatment facility was not associated with receipt of EBRT.

To account for potential measurement bias, we performed sensitivity analyses in which distance included the additional categories 15–<20 miles and ≥20 miles. In all multivariate models, results using this distance categorization were similar to those presented above.

Discussion

We examined the influence of distance on guideline-concordant care for patients with cervical cancer. We found that the relationship between distance and receipt of guideline-concordant care varied urban/rural residence and by type of treatment. Among cancer patients living in urban areas, individuals living farther from nearest surgical treatment facilities were *less* likely to undergo cervical surgery than those living closer to surgical treatment centers. In contrast, among cancer patients living in rural areas, those living farther from brachytherapy treatment centers were *more* likely to receive brachytherapy than those living closer to brachytherapy treatment centers. Distance was not significantly associated with receipt of EBRT or chemotherapy, overall or in the stratified rural/urban samples.

Compared to other breast and prostate cancer patients [24–25], cervical cancer patients have less often received non-guideline-concordant care. Smith et al. found that only 44% of women diagnosed with advanced cervical cancer received appropriate care [26]. A recent study among stage IB-IIA cervical cancer patients found that only 47% received guideline-concordant care [27]. In our study, we found early stage cervical cancer patients were much less likely to receive guideline-concordant care than those with late stage cervical cancer, a result that has also been found among colorectal cancer patients. Potential explanations for these findings are that early stage cancer patients are more likely to be incorrectly staged at presentation and to be inappropriately referred for treatment [28–29].

Contrary to past urban/rural disparity studies, early stage cervical cancer patients residing in urban areas may find distance more burdensome than previously appreciated. This difference in urban and rural residents who live far from treatment may be explained by the diverse resources available to these patients. For example, rural residents are generally accustomed to traveling longer distances [30] and are more likely to have their own personal transportation, a predictor of health care utilization [31]. Private cars are the dominant mode of transportation in rural areas, regardless of age, SES, or race [32] In contrast, urban residents may rely on public transportation. In a study of urban, low-income adults in Atlanta, using public transportation to access medical care was associated with not having a regular source of care, with delayed medical care [33], and a higher likelihood of missed medical appointments [34]. Travel can be burdensome and complex even in urban areas for vulnerable cancer patients [3–4].

A previous study found that among breast cancer patients diagnosed in 2003–2005, distance to care was associated with lower receipt of radiation therapy among urban residents [14]. This contrasts with our finding that chemotherapy and EBRT are less susceptible to distance barriers in the cervical cancer population. Our study of cancer patients, in the years 2004–2013, represented a period during which there was a dramatic increase in the number of radiotherapy and chemotherapy facilities. Additionally, there is evidence showing a substantial increase over time in the number of medical oncologists serving rural areas [35]. Considering the growth in the radiation oncology workforce in recent years [36], radiation oncologists may also be establishing more practices closer to less urbanized locations, thereby mitigating the effect of distance on these types of treatment.

There are a few explanations for why patients farther from care are *more* likely to receive brachytherapy. Despite the substantial growth in radiotherapy facilities, few are equipped to provide cervical brachytherapy due to the complex technical planning and required specialized equipment that are generally available only at tertiary cancer centers. Patients requiring radiotherapy as part of their treatment undergo four to six weeks of EBRT and concurrent chemotherapy followed immediately by one to two weeks of brachytherapy. Because radiotherapy requires daily treatment for long periods, patients who reside farther from care may decide to obtain temporary housing in close proximity to cancer treatment centers that provide both EBRT and brachytherapy. While these patients likely face logistical and financial issues related to living in temporary accommodations, the transition from undergoing EBRT to brachytherapy would be relatively seamless. In contrast, patients who initially received EBRT from a facility in close proximity to their residence and then brachytherapy from a separate, distantly-located facility may experience a larger and more substantial disruption to their treatment process.

Two potential implications can be drawn from our findings. First, cervical cancer patients treated primarily by surgery would benefit from targeted distance to care interventions. Efforts should focus on expanding the use of cancer outreach programs and services, especially among the urban cancer population. For example, the American Cancer Society's Road to Recovery provided over 340,000 free rides to treatment for cancer patients in 2017 [37]; however, these programs report that only 28% of these rides were for patients living in urban counties [38]. Providing access to a private car through volunteer programs may be an effective, low-cost strategy to increase access to cancer care for low-income urban residents. Second, a better understanding is needed of the challenges faced by, and benefits afforded to, patients who obtain temporary housing while undergoing long-term treatments such as chemotherapy and radiotherapy. For example, cancer patients reported financial strain due to temporarily relocating while undergoing radiotherapy treatment [39]. In a mixed-methods study of patients undergoing bone marrow transplantation for hematological cancers, housing challenges included affordability, lack of insurance coverage, and full or long waiting lists for free or discounted housing [40]. Future research should focus on identifying the benefits and challenges associated with temporary housing in addition to whether temporary housing influences patient health outcomes.

This study has several limitations. First, our sample size is relatively small, limiting our ability to identify associations between certain factors and outcomes. Second, although we used established guidelines for defining guideline-concordant care, without pathologic and radiologic results, clinical judgment by experts was required. Third, we employed the straight-line method to measure distance instead of road-network distance. However, similar to previous studies, we found a high correlation between road-network distance and straight-line distance, and our conclusions from analyses using road-network distance were the same. Fourth, individuals' unmeasured factors (e.g., socioeconomic status) may confound the relationship between distance to and receipt of treatment. Finally, our cohort only included insured patients. Thus, we cannot generalize our findings to uninsured patients who often face the greatest challenges overcoming access barriers to care. Despite these limitations, this study is novel in that is examines how distance and urban/rural residence influences multiple types of treatment. This is a critical step for developing effective interventions since, as our findings illustrate, the burden imposed by distance among urban and rural residence varies by type of treatment.

Understanding the diverse access barriers and resources in urban and rural areas will likely improve rates of guideline-concordant care over time. Our findings provide further evidence that the urban-rural paradox exists for patients with cervical cancer. This paradox suggests that strategies to address access barriers to care may need to be targeted differently in urban versus rural settings. For urban residents, providing patients with access to private transportation may be of most importance whereas for rural residents, providing patients with temporary free or subsidized housing while undergoing longer-term treatment may be their highest priority.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding

This research was supported by a National Research Service Award Post Doctoral Traineeship from the Agency for HealthCare Research and Quality sponsored by The Cecil G. Sheps Center for Health Services Research, The University of North Carolina at Chapel Hill, Grant No. T32-HS000032. Support was also provided by the UNC Lineberger Comprehensive Cancer Center's Developmental Funding Program supported by the University Cancer Research Fund and by the National Center for Advancing Translational Sciences (NCATS), National Institutes of Health, through Grant Award Number UL1TR002489. Finally, data programming, analytic, and systems support were provided by the Cancer Information and Population Health Resource, a UNC Lineberger Comprehensive Cancer Center resource funded by the State of North Carolina through the University Cancer Research Fund.

References

1. Mayadev J, Klapheke A, Yashar C, et al. Underutilization of brachytherapy and disparities in survival for patients with cervical cancer in California. Gynecol Oncol (in press)
2. Rauh-Hain JA, Melamed A, Schaps D, et al. Racial and ethnic disparities over time in the treatment and mortality of women with gynecological malignancies. Gynecol Oncol 2018;149:4–11. [PubMed: 29605048]
3. Singh GK, Miller BA, Hankey BF, et al. Persistent area socioeconomic disparities in US incidence of cervical cancer, mortality, stage, and survival, 1975–2000. Cancer 2004;101:1051–1057. [PubMed: 15329915]
4. Singh GK, Siahpush M. All-cause and cause-specific mortality of immigrants and native born in the United States. Am J Public Health 2001;91:392–399. [PubMed: 11236403]
5. Pfaendler KS, Chang J, Ziogas A, et al. Disparities in adherence to National Comprehensive Cancer Network treatment guidelines and survival for stage IB-IIA cervical cancer in California. Obstet Gynecol 2018;131:899–908. [PubMed: 29630020]
6. Ramondetta LM, Meyer LA, Schmeler KM, et al. Avoidable tragedies: disparities in healthcare access among medically underserved women diagnosed with cervical cancer. Gynecol Oncol 2015;139:500–505. [PubMed: 26498912]
7. Ramondetta LM, Sun C, Hollier L, et al. Advanced cervical cancer treatment in Harris county: pilot evaluation of factors that prevent optimal therapy. Gynecol Oncol 2006;103:547–553. [PubMed: 16730784]
8. Simard EP, Fedewa S, Ma J, et al. Widening socioeconomic disparities in cervical cancer mortality among women in 26 states, 1993–2007. Cancer 2012;118:5110–5116. [PubMed: 22707306]
9. Akers AY, Newmann SJ, Smith JS. Factors underlying disparities in cervical cancer incidence, screening, and treatment in the United States. Curr Probl Cancer 2007;31:157–181. [PubMed: 17543946]
10. Meilleur A, Subramanian SV, Plascak JJ, et al. Rural residence and cancer outcomes in the United States: issues and challenges. Cancer Epidemiol Biomarkers Prev 2013;22:1657–1667. [PubMed: 24097195]

11. Haggerty JL, Roberge D, Levesque JF, et al. 2014 An exploration of rural-urban differences in health-care seeking trajectories: implication for measures of accessibility. Health Place 2014;28:92–98. [PubMed: 24793139]
12. Wheeler SB, Kuo T, Durham D, et al. Effects of distance to care and rural or urban residence on receipt of radiation therapy among North Carolina Medicare enrollees with breast cancer. NC Med J 2014;75:239–246.
13. Mokdad AH, Dwyer-Lindgren L, Fitzmaurice C, et al. Trends and patterns of disparities in cancer mortality among US counties, 1980–2014. JAMA 2017;317:388–406. [PubMed: 28118455]
14. Dwyer-Lindgren L, Bertozzi-Villa A, Stubbs RW, et al. US county-level trends in mortality rates for major causes of death, 1980–2014. JAMA 2016;316:2385–2401. [PubMed: 27959996]
15. Meyer AM, Olshan AF, Green L et al. Big data for population-based cancer research: the integrated cancer information and surveillance system. N C Med J 2014;75:265–269. [PubMed: 25046092]
16. Wheeler SB, Kuo T, Goyal R, et al. Regional variation in colorectal cancer testing and geographic availability of care in a public insured population. Health Place 2014;29:114–123. [PubMed: 25063908]
17. National Comprehensive Cancer Network. NCCN guidelines clinical practice guidelines in oncology: cervical cancer, 2017 https://www.tri-kobe.org/nccn/guideline/gynecological/english/cervical.pdf.
18. Lamont EB, Hayreh D, Pickett KE, et al. Is patient travel distance associated with survival on phase II clinical trials in oncology? J Natl Cancer Inst 2003;95(18):1370–5. [PubMed: 13130112]
19. Lenhard RE, Enterline JP, Crowley J, Ho GY. The effects of distance from primary treatment centers on survival among patients with multiple myeloma. J Clin Oncol 1987;5(10):1640–5. [PubMed: 3655862]
20. Sparling AS, Song E, Klepin HD, et al. Is distance to chemotherapy an obstacle to adjuvant care among the N.C. Medicaid-enrolled colon cancer patients? J Gastrointest Oncol 2016;7:336–344. [PubMed: 27284464]
21. Andersen R, Davidson P. Improving access to care in America: individual and contextual indicators. In: Andersen R, Rice T, Kominski J, eds. Changing the U.S. Health Care System:Key Issues in Health Services Policy and Management San Francisco, CA: Jossey-Bass;2007:3–31.
22. Zou G A modified Poisson regression approach to prospective studies with binary data. Am J Epidemiol 2004;159:702–706. [PubMed: 15033648]
23. Zhang J, Yu KF. What's the relative risk? a method of correcting the odds ratio in cohort studies of common outcomes. JAMA 1998;280:1690–1691. [PubMed: 9832001]
24. Hamilton AS, Fleming ST, Wang D, Goodman M, Wu XC, Owen JB, et al. Clinical and demographic factors associated with receipt of non guideline-concordant initial therapy for nonmetastatic prostate cancer. Am J Clin Oncol 2016;39(1):55–63. [PubMed: 24390274]
25. Wu XC, Lund MJ, Kimmick GG, Richardson LC, Sabatino SA, Chen VW, et al. Influence of race, insurance, socioeconomic status, and hospital type on receipt of guideline-concordant adjuvant systemic therapy for locoregional breast cancers. J Clin Oncol 2012;30(2):142–50. [PubMed: 22147735]
26. Smith GL, Jiang J, Giordano SH, et al. Trends in the quality of treatment for patients with intact cervical cancer in the United States, 1999 through 2011. Int J Radiat Oncol Biol Phys 2015;92:260–267. [PubMed: 25968823]
27. Pfaendler KS, Chang J, Ziogas A, Bristow RE, Penner KR. Disparities in Adherence to National Comprehensive Cancer Network Treatment Guidelines and Survival for Stage IB-IIA Cervical Cancer in California. Obstet Gynecol 2018;131(5):899–908. [PubMed: 29630020]
28. Zulilig LL, Carpenter WR, Provenzale D, et al. Examining potential colorectal cancer care disparities in the Veterans Affairs Health Care System. J Clin Oncol 2013 10 1; 31(28):3579–3584 [PubMed: 24002515]
29. Baxter NN, Virnig DJ, Rothenberger DA, Morris AM, Jessurun J, Virnig BA. Lymph node evaluation in colorectal cancer patients: a population-based study. Journal of the National Cancer Institute 2005;97(3):219–25. [PubMed: 15687365]

30. Probst JC, Ladtika SB, Wang J, et al. Effects of residence and race on burden of travel for care: cross sectional analysis of the 2001 US National Household Travel Survey. BMC Health Serv Res 2007;7:40. [PubMed: 17349050]
31. Arcury TA, Preisser JS, Gesler WM, et al. Access to transportation and health care utilization in a rural region. J Rural Health 2005;21:31–38. [PubMed: 15667007]
32. Pucher J, Renne JL. Rural mobility and mode choice: evidence from the 2001 National Household Travel Survey. Transportation 2005;32:165–186.
33. Rask KJ, Williams MV, Parker RM, et al. Obstacles predicting lack of a regular provider and delays in seeking care for patients at an urban public hospital. JAMA 1994;271:1931–1933. [PubMed: 8201737]
34. Silver D, Blustein J, Weitzman BC. Transportation to clinic: findings from a pilot clinic-based survey of low-income suburbanites. J Immigr Minor Health 2012;14:350–355. [PubMed: 22512007]
35. Gruca TS, Nam I, Tracy R. Trends in medical oncology outreach clinics in rural areas. J Oncol Pract 2014;10:e313–320. [PubMed: 25052498]
36. Shah C Expanding the number of trainees in radiation oncology: has the pendulum swung too far? Int J Radiat Oncol Biol Phys 2013;85:1157–1158. [PubMed: 23391815]
37. American Cancer Society Vital Statistics, 2018 https://www.mysocietysource.org/Resources/American%20Cancer%20Society%20Vital%20Statistics.pdf
38. Sellers JB, Carlson ML. Community cancer needs assessment: standard 3.1 Chapel Hill, NC: University of North Carolina Lineberger Cancer Center 2017 https://unclineberger.org/unccn/patient-navigation/CCNAfinal.pdf
39. Martin-McDonald K, Rogers-Clark C, Hegney D, et al. Experiences of regional and rural people with cancer being treated with radiotherapy in a metropolitan centre. Int J Nurs Pract 2003;9:176–182. [PubMed: 12801249]
40. Preussler JM, Mau LW, Majhail NS et al. Patient housing barriers to hematopoietic cell transplantation: results from a mixed-methods study of transplant center social workers. Support Care Cancer 2016;24:1167–74. [PubMed: 26275767]

Highlights

- Over 1/3 of cervical cancer patients do not received guideline-concordant care.
- Distance was not associated with receipt of EBRT or chemotherapy for cervical cancer patients.
- In urban areas, patients living farther from treatment were less likely to receive operative management.
- In rural areas, patients living farther from treatment were more likely to receive brachytherapy.

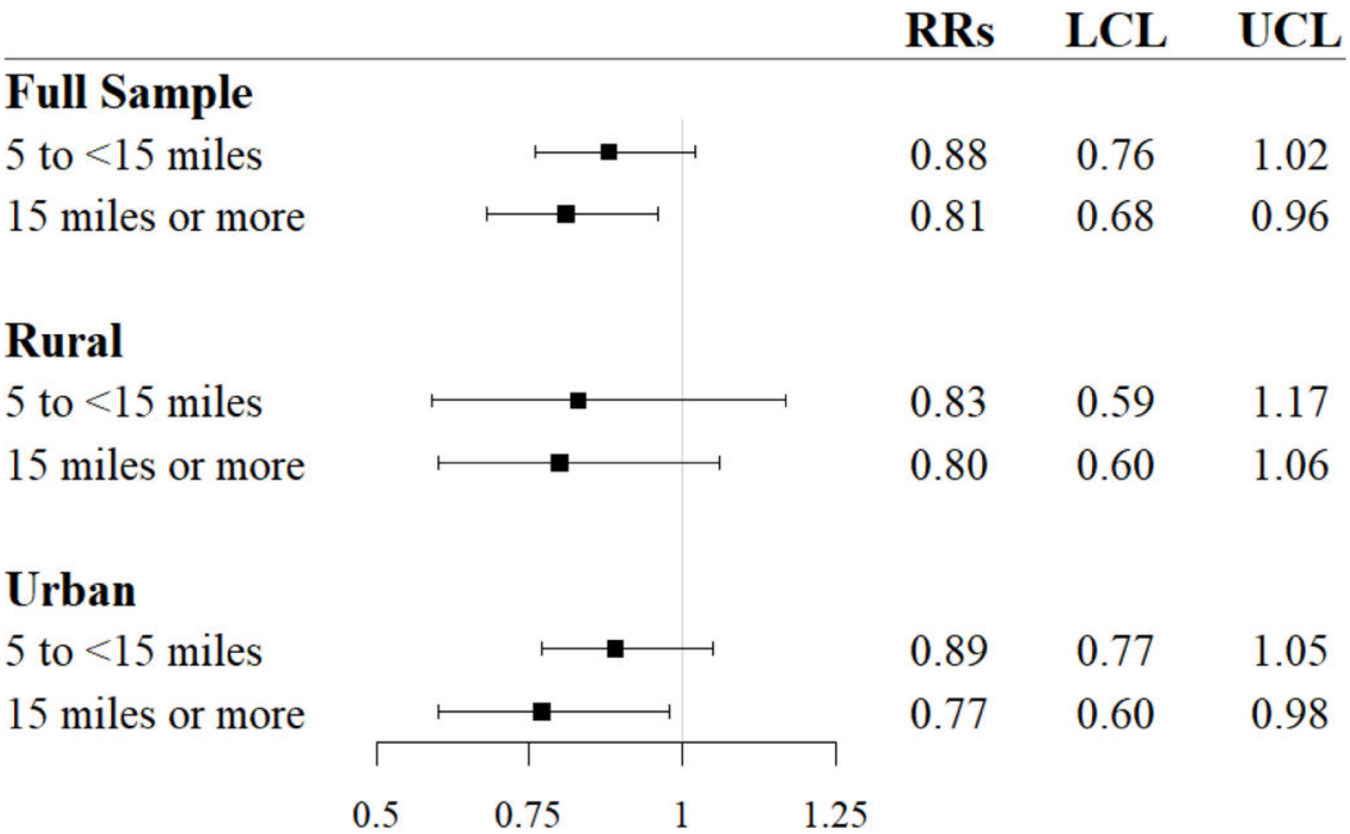

Figure 1.

Forest plot of risk ratios (RRs) and 95% confidence intervals (CIs) for distance covariates (reference group is <5 miles) associated with receipt of definitive surgery among the full sample of women diagnosed with stage IA-IB2 cervical cancer and stratified by urban/rural residence location. All regression model includes covariates for age at diagnosis categories, race, insurance status, Charlson cormobidity index, year of diagnosis, median household income (county-level), mean percent unemployed (country-level), and mean number of generalist (county-level). The full sample analysis also includes residence location. LCL, lower 95% confidence limit; RRs, risk ratios; UCL, upper 95% confidence limit.

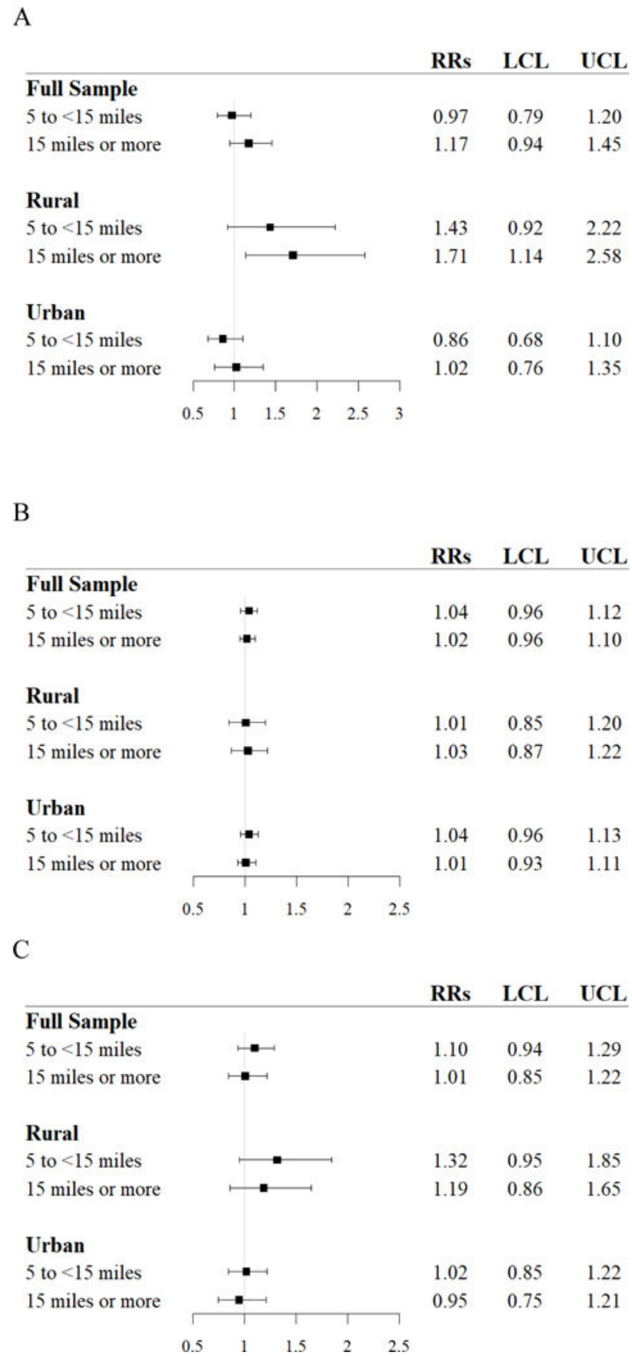

Figure 2.

Forest plots of risk ratios (RRs) and 95% confidence intervals (CIs) for distance covariates (reference group is <5 miles) associated with receipt of (A) brachytherapy, (B) chemotherapy, (C) EBRT among women diagnosed with stage II-IVA cervical cancer and stratified by urban/rural residence location. All regression model includes covariates for age at diagnosis categories, race, insurance status, Charlson cormobidity index, year of diagnosis, median household income (county-level), mean percent unemployed (country-level), and mean number of generalist (county-level). The full sample analysis also includes residence location. LCL, lower 95% confidence limit; RRs, risk ratios; UCL, upper 95% confidence limit.

Table 1.

Guideline-concordant care by cervical cancer stage (adapted from the *National Comprehensive Cancer Network*)

Stage	Guideline-concordant care
Stage IA	Received primary operative management (i.e., conization, LEEP, trachelectomy, simple hysterectomy, or radical hysterectomy)
Stage IA1	Received primary operative management (i.e., conization, LEEP, trachelectomy, simple hysterectomy)
Stage IA2	Received primary operative management (i.e., trachelectomy, simple hysterectomy, or radical hysterectomy) Received radiotherapy
Stage IB1	Received primary operative management (i.e., radical hysterectomy) Received radiotherapy
Stage IB2	Received primary operative management (i.e., radical hysterectomy) Received primary operative management (i.e., radical hysterectomy) and radiotherapy Received primary operative management (i.e., radical hysterectomy) and CCRT[a]
Stages IIA-IIVA	Received CCRT Received primary operative management (i.e., radical hysterectomy) and CCRT[a]

[a]Chemoradiotherapy was defined as concurrent if initiated radiotherapy and chemotherapy within 14 days of one another.

Note. LEEP, loop electrosurgical excision procedure; EBRT, external beam radiation therapy; CCRT, concurrent chemoradiotherapy.

Table 2.

Characteristics of insured women diagnosed with cervical cancer, 2004–2013

	Full sample (N=999)		Received GC care (N=620)		Did not receive GC care (N=379)		*P*
	N(%) or mean/(SD)		N(%) or mean/(SD)		N(%) or mean/(SD)		
Patient characteristics							
Age at diagnosis							<.001
<60	475	(48)	342	(72)	133	(28)	
60–70	240	(24)	151	(63)	89	(37)	
>70	284	(28)	127	(45)	157	(55)	
Race							0.90
White	683	(68)	423	(62)	260	(38)	
Non-white	316	(32)	197	(62)	119	(38)	
Insurance status							<.001
Medicare only	374	(37)	211	(56)	163	(44)	
Medicaid only	128	(13)	92	(72)	36	(28)	
Any private	298	(30)	218	(73)	80	(27)	
Medicare and Medicaid	199	(20)	99	(50)	100	(50)	
Charlson comorbidity index							0.01
0	661	(66)	428	(65)	233	(35)	
1	198	(20)	120	(61)	78	(39)	
2+	140	(14)	72	(51)	68	(49)	
Location of residence							0.57
Rural	366	(37)	223	(61)	143	(61)	
Urban	633	(63)	397	(63)	236	(63)	
Tumor characteristics							
Year of diagnosis							0.002
2004	117	(12)	59	(50)	58	(50)	
2005	119	(12)	68	(57)	51	(43)	
2006	137	(14)	82	(60)	55	(40)	
2007	101	(10)	64	(63)	37	(37)	
2008	99	(10)	81	(82)	18	(18)	
2009	88	(09)	58	(66)	30	(34)	
2010	93	(09)	59	(63)	34	(37)	
2011	96	(10)	57	(59)	39	(41)	
2012	91	(09)	57	(63)	34	(37)	
2013	58	(06)	35	(60)	23	(40)	
AJCC stage at diagnosis							<.001
Stage I	572	(57)	303	(53)	269	(47)	
Stage II	176	(18)	136	(77)	40	(23)	
Stage III	227	(23)	169	(74)	58	(26)	
Stage IV	24	(2)	12	(50)	12	(50)	

	Full sample (N=999)		**Received GC care (N=620)**		**Did not receive GC care (N=379)**		***P***
	N(%) or mean/(SD)		**N(%) or mean/(SD)**		**N(%) or mean/(SD)**		
Histology							0.044
Squamous	688	(69)	436	(63)	252	(37)	
Adenocarcinoma	212	(21)	134	(63)	78	(37)	
Unknown	99	(10)	50	(51)	49	(49)	
Tumor Grade							0.004
Well differentiated	123	(12)	77	(63)	46	(37)	
Moderately differentiated	289	(29)	184	(64)	105	(36)	
Poorly differentiated	319	(32)	216	(68)	103	(32)	
Unknown/anaplastic	268	(27)	143	(53)	125	(47)	
County characteristics							
Median household income	$40487	(7434)	$40557	(7573)	$ 40370	(7210)	0.70
Mean % unemployed	5	(1)	5	(1)	6	(1)	0.30
Mean number of generalists	8	(9)	8	(9)	8	(10)	0.93

Note. GC, guideline-concordant; AJCC, American Joint Committee on Cancer.