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ORIGINAL ARTICLE

Proximity to cancer rehabilitation and exercise oncology by geography, race, and socioeconomic status

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Abstract

Background: Cancer rehabilitation and exercise oncology (CR/EO) have documented benefits for people living with and beyond cancer. The authors examined proximity to CR/EO programs across the United States with respect to population density, race and ethnicity, socioeconomic status, and cancer incidence and mortality rates.

Methods: This cross-sectional study was conducted in 2022–2023. Online searches were initiated to identify CR/EO programs. Geocoding was used to obtain latitudinal and longitudinal geospatial coordinates. Demographic data were abstracted from the 2020 5-year American Community Survey. Cancer incidence and mortality data were obtained from the Centers for Disease Control and Prevention. US 2013 Rural-Urban Continuum Code (RUCC) classification was used to define counties as either urban (RUCC 1–3) or rural (RUCC 4–9). Multivariable logistic regression was used to evaluate the association between being far from a program and census-tract level factors.

Results: In total, 2133 CR/EO programs were identified nationwide. The distance from a program increased with decreasing population density: rural tracts were 17.68 ± 0.24 miles farther from a program compared with urban tracts ($p < .001$). Program proximity decreased as the neighborhood deprivation index increased ($p < .001$). Exercise oncology programs were less common than cancer rehabilitation programs in tracts with a larger proportion of minority residents ($p < .001$).

Conclusions: Prior research has documented that underrepresented populations have worse cancer-related symptoms and higher cancer mortality. Herein, the authors document their findings that these same populations are less likely to have proximity to CR/EO programs, which are associated with improved cancer-related symptoms and cancer mortality outcomes. To realize the positive outcomes from

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CR/EO programming, efforts must focus on supporting expanded programming and sustainable payment for these services.

KEYWORDS
exercise, equality, health equity, oncology, rehabilitation, social determinants of health

INTRODUCTION

Evidence increasingly supports the use of cancer rehabilitation and exercise oncology (CR/EO) to address multiple symptoms and side effects in people living with and beyond cancer.[1–4] For the purpose of this article, we define *cancer rehabilitation* as services provided by licensed medical providers (e.g., physical or occupational therapists, physical medicine and rehabilitation physicians) that are generally impairment based and covered under Medicare and by most private insurers. By contrast, *exercise oncology* services, defined as addressing physical function and symptoms for patients who do not require cancer rehabilitation services, generally are not covered by third-party payers.

High-quality, randomized controlled trial evidence supports the use of CR/EO during and after cancer treatment to address cancer-related fatigue, quality of life, physical function, body composition, sleep, bone health, anxiety, depression, and breast cancer-related lymphedema.[1–3] The most recently published guideline, from the American Society of Clinical Oncology,[3] states that medical oncology clinicians *should* refer patients to exercise oncology programming to address common symptoms and side effects during treatment. Furthermore, the National Accreditation Program for Breast Centers has recently approved new standards that include a requirement for breast programs to establish a protocol to recommend that patients undergoing chemotherapy perform exercise.[5] Finally, the implementation of exercise interventions within the context of rehabilitation services is consistent with published standards from the American College of Surgeons' Commission on Cancer.[6]

Vulnerable people, including those living in rural settings, racial and ethnic minorities, and those with lower socioeconomic status, disproportionately experience higher incidence rates of cancer[7,8] and increased symptoms and side effects from cancer treatments.[9–13] This higher symptom burden may contribute to poor clinical outcomes and greater unplanned health care use (e.g., hospitalizations, emergency department visits) among these vulnerable populations.[11] These same vulnerable populations experience higher cancer-specific mortality.[14] Efforts to address cancer treatment-related symptoms and side effects could address these observed disparities and have the potential to reduce unplanned health care use and excess mortality for vulnerable people living with and beyond cancer.

Because major medical organizations are calling for patients to have consistent and convenient access to CR/EO programming, it is appropriate to examine whether the availability of such services to patients across the United States is geographically equitable. We acknowledge frameworks describing access to care that include concepts of approachability, acceptability, availability and accommodation, affordability, and appropriateness, among others.[15] Our objective was to report on efforts of the Moving Through Cancer Task Force[16] to identify the geographic proximity of CR/EO programming across the United States and to discern whether geographic proximity is equitably available according to population density, socioeconomic status, and race and ethnicity. The Moving Through Cancer Task Force has created a directory of programs that is available online and includes all of the programming identified for this report (August 5, 2024. https://www.exerciseismedicine.org/eim-in-action/moving-through-cancer/exercise-program-registry/). Geographic proximity is important to understand because most programs meet in person over the course of weeks or months (e.g., LiveStrong at the YMCA).

MATERIALS AND METHODS

Program identification

To identify relevant CR/EO programming across the United States, internet searches were conducted from November 13, 2022, through July 11, 2023. To identify and verify programs, we searched Google, LinkedIn (for individual practitioners), and Google Maps (M.C., R.S., A. V.). The following search terms were used: *exercise oncology*, *oncology rehabilitation*, *cancer rehabilitation*, *exercise rehabilitation for cancer*, *cancer exercise*, *fitness for cancer*, *cancer exercise trainer*, *exercise physiologist + cancer*, *physical activity for cancer survivorship*, and *cancer fitness*. Search terms were applied by state, cities with a population of 50,000, and all counties in the United States. If no programming was identified within a given county in the United States, we identified the most populous city within that county and repeated the searches for that locale. Programs were contacted to verify key components of a viable program (M.C.). It was established that: (1) the program was open to enrollment; and (2) the exercise/rehabilitation providers had oncology-specific training, e.g., licensed physical therapists or occupational therapists with specialty oncology training (such as ReVital Cancer Rehabilitation training or American Physical Therapy Association Oncology board certification, American College of Sports Medicine Cancer Exercise Trainer certification, or Cancer Exercise Training Institute certification) or a well defined local certification process (e.g., the Maple Tree Cancer Alliance training program). Finally, we clarified the delivery method of the program (e.g., group, unsupervised, one-on-one, online, outpatient cancer rehabilitation). In case of questionable answers, a second author was consulted (K.H.S.). Verified programs were included.

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To assess completeness of the directory, the results for Colorado were reviewed by a local not-for-profit organization (Cancer Support Community). Their review yielded no additional programs. In addition, two co-authors repeated the searches for a total of 10 states (M. K., J.G.); this blinded secondary search revealed no new programs.

Geospatial data sources

The geographic coordinates of the population center for each 2020 US census tract were obtained from the 2020 US census.[17] By using data from the 2020 American Community Survey,[18] we identified the percentage of the population that identified as non-Hispanic minority or Hispanic within each tract; and each tract was assigned to one of the following cutoff points: 0%–20%, 21%–40%, 41%–60%, and 61%–80%, or 81%–100%. Population density and the neighborhood deprivation index (NDI) were determined for each 2020 census tract.[19,20] The population density (people per square mile) estimates for each tract were assigned into the following four categories: ≥10,001, 1001–1000, 101–1000, and 0–100 population per square mile. The NDI consists of 13 indicators related to neighborhood socioeconomic status.[21] These are reported as quintiles across all US census tracts: least deprived (0%–20%), below average deprivation (21%–40%), average deprivation (41%–60%), above average deprivation (61%–80%), and most deprived (81%–100%). The urban-ruralness of each tract was determined based on the county-level 2013 Rural-Urban Continuum Code (RUCC) classification[22]; tracts contained within counties that had codes 1–3 or 4–9 were considered *urban* or *rural*, respectively. The county-level, age-adjusted cancer incidence and mortality from 2016 to 2020 were obtained from the Centers for Disease Control and Prevention's *US Cancer Statistics*.[23] Quartiles based on the distribution of these rates were determined. County-level incidence data were not available for five states because of state legislation (Kansas and Minnesota) or incomplete data (Indiana, Nevada, and Virginia). The distribution of these characteristics across the 2020 US census tracts is presented in Table S1.

Statistical analysis

For each 2020 US census tract, the minimum distance (in miles), based on great-circle distance, from a program to the population center of the tract was computed using the *sf* package in R (R Foundation for Statistical Computing).[24] We also determined whether there was at least one program from the population center for each tract within 10 miles. By using the *spdep* package in R,[24] local Getis-Ord Gi* statistics (Esri)[25] were used to identify areas of positive spatial autocorrelation and clusters based on the distance from each 2020 census tract population center to a CR/EO program, and a tract was considered to belong to a cluster if it had a Benjamini–Hochberg false discovery rate < 0.05 (i.e., tracts that clustered given their similar minimum distance from a program). Significant clusters were considered *deserts* (e.g., areas that lacked proximity to a program), whereas tracts that did not belong to a cluster were considered to have a proximal program. The distribution of census tract-level characteristics (e.g., population density, percentage of non-Hispanic minority or Hispanic individuals, and NDI) that were either within 10 miles of or farther than 10 miles from a program or that did or did not belong to a cluster was determined among all tracts, and the population (and the percentage of the population) was also computed.

Our primary outcomes were: (1) the minimum distance between a program and the population center (continuous), (2) programs that belonged to a cluster with lack of proximity (binary), and (3) programs farther than 10 miles from the population center for a tract (binary). For all analyses, tracts were the unit of observation. Generalized additive models were used to examine the association between minimum distance from a program to a population center (outcome) and census tract-level characteristics (predictors) and allowed us to include a smoothed term (based on geographic coordinates) to account for spatial autocorrelation. Association estimates and standard errors were extracted from these models. Logistic regression models were used to examine the association between (1) programs farther than 10 miles from the population center or (2) programs that belonged to a cluster with lack of proximity and the census tract-level characteristics. Odds ratio (ORs) and 95% confidence intervals (CIs) were obtained from the association estimates. All models were adjusted for a dichotomous urban-rural county variable (2013 RUCC: urban, 1–3; rural, 4–9), percentage minority race/ethnicity (categorical; five cutoff points), NDI (categorical; five cutoff points), and density (categorical; four levels). In addition, we conducted a sensitivity analysis among the tracts in the contiguous United States. Then, we compared the distributions of census tract-level characteristics between CR/EO programs and evaluated the associations using the Pearson χ^2 test. All analyses were performed in R version 4.1.3.

RESULTS

Overall, we identified 2123 programs across the United States, of which 1363 were exercise oncology programs and 760 were cancer rehabilitation programs. The distribution of distance from the nearest CR/EO program to the population center of each 2020 US census tract is illustrated in Figure 1. After computing the minimum distance between the population center of each 2020 US census tract and the nearest program (n = 84,144 tracts), 53,439 tracts (64%) and 30,975 tracts (36%) were located within 10 miles of or farther than 10 miles from a program, respectively (see Figure S1).

When we evaluated the association between the distance from a program and census tract-level characteristics, the distance from a program increased with decreasing population density ($p < .001$; e.g., programs were more scarce in rural areas), and areas that had <100 population per square mile (± standard error) were 17.13 ± 0.36 miles farther from a program compared with areas that had >10,000

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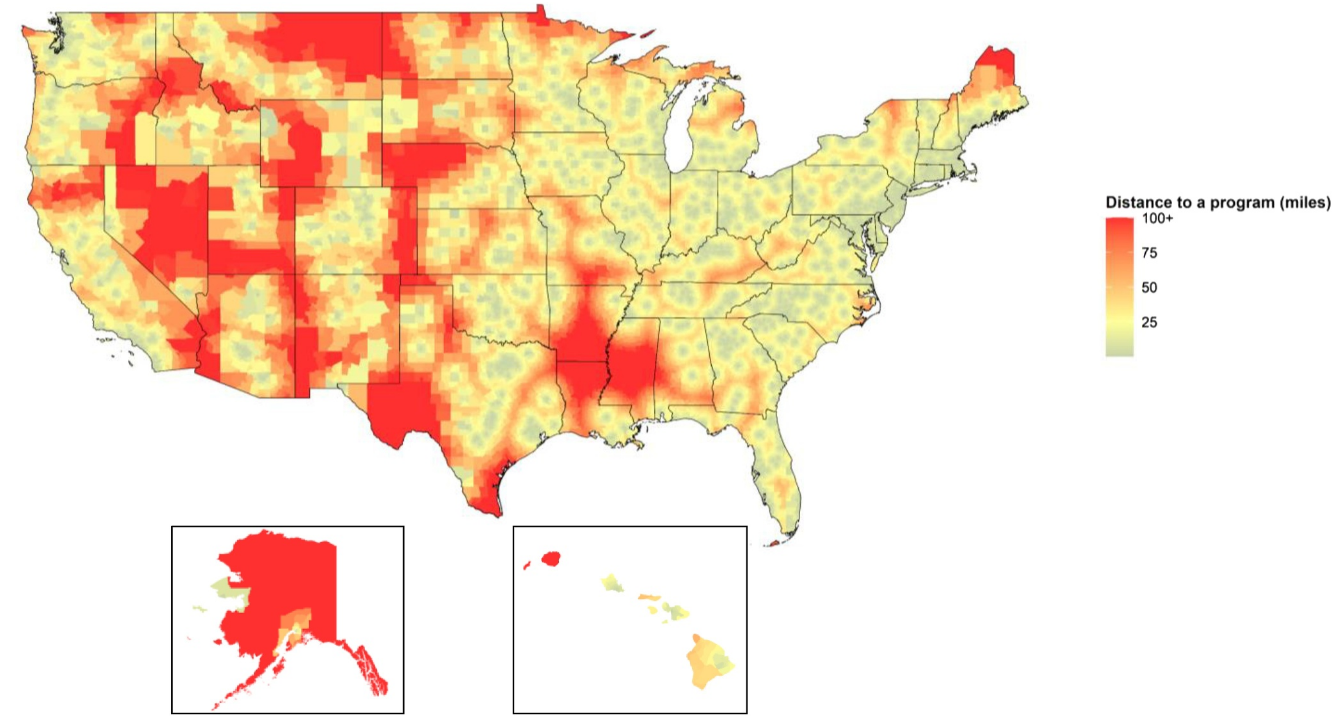

FIGURE 1 Distance (miles) between the nearest exercise oncology or cancer rehabilitation program and the population center in each 2020 US census tract (n = 84,144).

population per square mile (Table 1). Tracts in rural areas were 17.68 ± 0.24 miles farther from a program compared with tracts in urban areas ($p < .001$; Table 1). The distance from a program increased as the NDI increased ($p < .001$; Table 1). The distance to programs increased as cancer incidence increased (2.05 ± 0.32 miles) and as cancer mortality increased (5.93 ± 0.36 miles; $p < .001$ for both comparisons; Table 1). The patterns continued to be observed when we restricted the analyses to the contiguous United States (see Table S2).

The odds of being farther than 10 miles from a CR/EO program increased ($p < .001$) with decreasing population density (e.g., programs are more scarce in rural areas; see Table S3). For rural RUCC areas (codes 4–9), the odds of being farther than 10 miles from a program were 6.70-fold higher (95% CI, 6.29–7.14) compared with urban RUCC areas (codes 1–3; $p < .001$). The odds of being farther from a program were lower (0.84; 95% CI, 0.78–0.90) for census tracts with a high proportion of non-Hispanic minority or Hispanic individuals. The odds of being farther than 10 miles from a program were 3.65-fold higher (95% CI, 3.40–3.91) among residents living in census tracts in the highest quintile of deprivation compared with census tracts with the least deprivation measured with the NDI.

We identified 18 clusters in the contiguous United States that lacked proximity to a program (based on local Getis-Ord Gi* statistics and a false discovery rate < 0.05), and 2183 tracts (3% of tracts) were contained in these clusters, which we labeled as *program deserts* (Figure 2 and Table 2). Program deserts were more likely to occur in less dense, rural census tracts (OR, 2.31; 95% CI, 2.05–2.60); in census tracts with a larger proportion of residents who identified as non-Hispanic minority or Hispanic (OR range, 2.15–10.31; all $p < .001$); and in census tracts with greater NDI (OR range, 2.38–3.31; all $p < .001$). We observed that tracts within counties that had higher cancer mortality were 1.15-fold more likely (95% CI, 1.00–1.33) to belong to areas that lacked proximity to a program, whereas tracts within counties that had higher cancer incidence were more proximal to a program (OR, 0.53; 95% CI, 0.46–0.61).

We sought to evaluate whether geographically determined demographic and socioeconomic disparities existed between the type of program (n = 2123) in the United States, comparing exercise oncology programs (N = 1363; charity or self-pay) and outpatient cancer rehabilitation programs (eligible to receive insurance payment; N = 760; Table 3). A comparison of the availability by program type indicated that exercise oncology programs were statistically less common than cancer rehabilitation programs in census tracts that had a larger proportion of non-Hispanic minority or Hispanic residents (p = .0018). There were also fewer exercise oncology programs in census tracts that had higher cancer incidence compared with cancer rehabilitation programs ($p < .001$). Figure 2 also illustrates the locations of cancer rehabilitation programs compared with exercise oncology programs.

DISCUSSION

CR/EO referrals are increasingly considered to be standard practice for those living with and beyond cancer, based on guidelines and standards from the American College of Sports Medicine, the

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TABLE 1 Relation between distance from an exercise oncology or cancer rehabilitation program and geographically determined demographic and socioeconomic characteristics.

Characteristic	Minimum distance to a program[a] Median (IQR)	Unadjusted model[b] β ± SE[d]	Unadjusted model[b] p[e]	Adjusted model[c] β ± SE[d]	Adjusted model[c] p[e]
Density, persons per square mile			< .001		< .001
>10,001	2.6 (1.5–4.4)	Reference		Reference	
1001–10,000	4.3 (2.4–8.5)	3.32 ± 0.26		4.33 ± 0.26	
101–1000	11.0 (5.6–24.9)	12.57 ± 0.30		10.31 ± 0.31	
0–100	27.4 (15.6–45.4)	25.63 ± 0.33		17.13 ± 0.36)	
Rural-urban classification			< .001		< .001
Urban: RUCC 1–3	4.8 (2.5–10.5)	Reference		Reference	
Rural: RUCC 4–10	32.0 (19.4–50.3)	25.68 ± 0.21		17.68 ± 0.24	
Percentage of non-Hispanic minority or Hispanic individuals			< .001		< .001
0–20	10.3 (4.2–25.2)	Reference		Reference	
21–40	5.1 (2.5–14.6)	−5.02 ± 0.22		0.81 ± 0.21	
41–60	4.7 (2.4–13.6)	−5.68 ± 0.26		0.91 ± 0.25	
61–80	4.6 (2.5, 11.7)	−6.46 ± 0.29		0.32 ± 0.29	
81–100	4.4 (2.5–8.9)	7.01 ± 0.27		−0.48 ± 0.32	
Neighborhood deprivation index			< .001		< .001
Least deprived: 0%–20%	3.6 (1.9–6.6)	Reference		Reference	
Below average deprivation: 21%–40%	5.3 (2.7–11.8)	4.03 ± 0.25		2.59 ± 0.23	
Average deprivation: 41%–60%	8.1 (3.5–21.9)	8.79 ± 0.25		4.65 ± 0.24	
Above average deprivation: 61%–80%	10.9 (3.9–28.6)	11.12 ± 0.25		5.52 ± 0.25	
Most deprived: 81%–100%	7.1 (3.1–28.1)	9.98 ± 0.25		7.19 ± 0.28	
Cancer mortality, per 100,000			< .001		< .001
<147	4.6 (2.4–9.7)	Reference		Reference	
147–162	6.1 (2.8–17.5)	5.61 ± 0.22		2.75 ± 0.20	
163–179	9.3 (3.5–25.0)	9.74 ± 0.26		1.99 ± 0.25	
≥180	26.4 (11.4–46.5)	23.30 ± 0.34		5.69 ± 0.34	
Cancer incidence, per 100,000[f]			< .001		< .001
<415	6.5 (3.2–20.9)	Reference		Reference	
415–455	5.0 (2.5–12.9)	−2.77 ± 0.29		−0.97 ± 0.25	
456–485	5.7 (2.8–16.4)	0.77 ± 0.32		0.35 ± 0.29	
≥486	9.4 (3.7–25.7)	5.93 ± 0.36		2.05 ± 0.32	

Abbreviations: IQR, interquartile range; RUCC, Rural-Urban Continuum Code; SE, standard error.

[a]Distance (in miles) between the nearest exercise oncology or cancer rehabilitation program and the population center of each 2020 US census tract (n = 84,414).

[b]The association between the distance from a program and each factor (categorized) with latitude/longitude as a smoothed interaction term to account for spatial autocorrelation.

[c]Associations between distance from a program and these characteristics were evaluated using a generalized additive model that adjusted for density, rural-urban county, the percentage of non-Hispanic minority or Hispanic individuals, and the neighborhood deprivation index as categorical variables and with latitude/longitude as a smoothed interaction term to account for spatial autocorrelation.

[d]Association estimates and standard errors were extracted from a generalized additive model.

[e]All p values were extracted from a likelihood-ratio test comparing the model with and without the factor of interest.

[f]County-level incidence data from 2016 to 2020 obtained from US Cancer Statistics were not available for five states because of state legislation (Kansas and Minnesota) or incomplete data (Indiana, Nevada, and Virginia).

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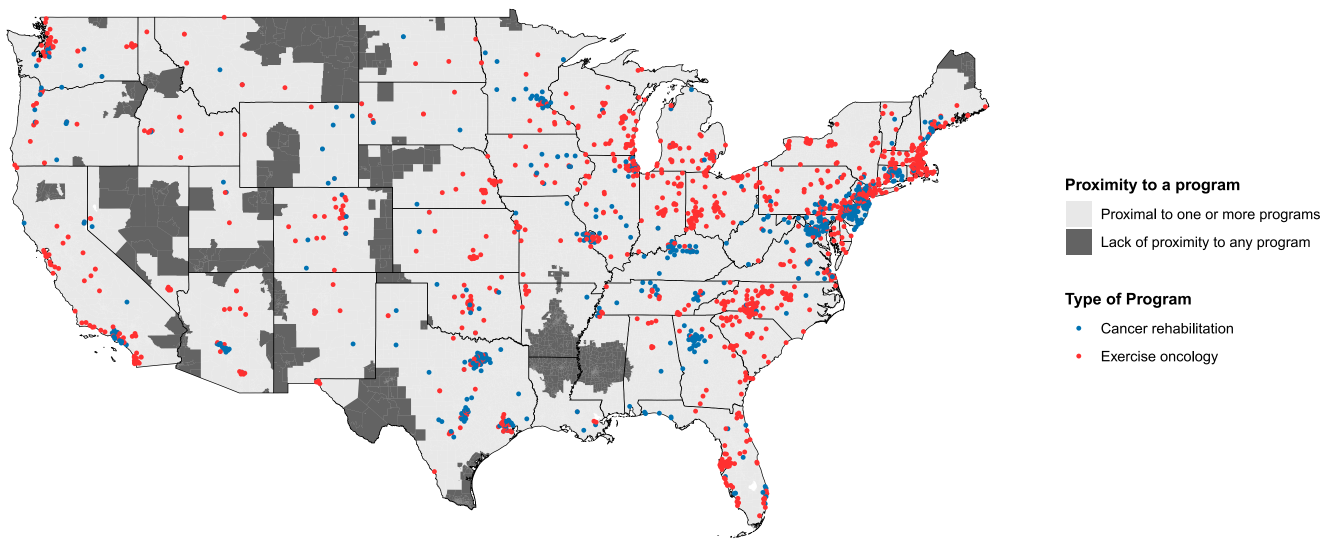

FIGURE 2 Areas with a lack of proximity to any exercise oncology or cancer rehabilitation program identified by spatial clustering. The local Getis-Ord Gi* statistic (Esri) was used to identify spatial clustering based on the distance from 2020 census tract population centers to exercise oncology or cancer rehabilitation programs. Dark gray denotes areas with lack of proximity to any exercise oncology program (false discovery rate < 0.05; i.e., tracts that cluster given their similar minimum distance from a program). In total, 2183 census tracts were contained in these clusters. Blue and red dots represent the location and type (cancer rehabilitation and exercise oncology) of all programs in the database.

American Society of Clinical Oncology, the National Accreditation Program for Breast Centers, and the American College of Surgeons' Commission on Cancer.[1,5,26,27] The underlying assumption with these referrals is that there are programs geographically proximal to patients when and where they need them. Despite clinical agreement regarding the value of CR/EO programming, disparities in geographic proximity were quantifiable, including an OR of 6.7 for the likelihood of being distant from programming in rural versus urban areas and an OR of 3.65 for the most compared versus the least economically deprived census tracts. There is also evidence that areas with higher cancer mortality rates have 55% higher odds of being geographically distant from CR/EO programming. This last finding is consistent with Anderson et al.,[14] who noted differences in exercise opportunities in geographic areas with excess breast cancer mortality.

Furthermore, these disparities are exacerbated for exercise oncology programs compared with cancer rehabilitation programs. Outpatient cancer rehabilitation programs, which are covered by Medicare and most private insurers, are more likely than exercise oncology programs to be geographically located in settings with a large proportion of minority residents. These same settings are documented to have individuals with an excessive burden of the very same symptoms that rehabilitation and exercise are documented to address.[10] The burden of raising charity funds or for self-payment for exercise oncology programming may disincentivize opening exercise oncology programs in these more vulnerable geographic settings. More sustainable and predictable financial support for exercise oncology programs (including payment for services through Medicare and private insurers) may allow these programs to geographically expand. There are well documented, positive effects of exercise on symptom burden,[1,26] and the benefits for health care use are emerging.[28–34] In addition, observational evidence supports the hypothesis that regular exercise will reduce the risk of cancer-specific mortality among breast, prostate, and colon cancer survivors by 30%–33%.[35] Lack of CR/EO is not the only cancer-related disparity across geography, race and ethnicity, and socioeconomic status[9–13]; however, given the documented benefits of exercise for people living with and beyond cancer, these findings are consistent with the hypothesis that a lack of proximity to services that improve and optimize function and physical activity could contribute to the observed differences in symptom burden and cancer-specific mortality. To realize this goal, research is needed to understand the factors that facilitate or inhibit the effective use of current programs, including patient referrals, uptake by patients, maintenance of program participation, and cost barriers to maintaining programs.

Integrating effective referrals into oncology care is a complex issue underpinned by multiple barriers. To increase the likelihood that people can access rehabilitation and exercise programming during and after cancer, expansion of current programming is required.[36] Specifically, more affordable options need to be made available within a reasonable distance. In addition, a recent policy review documented the crucial importance of triage and referral efforts to implement this programming, especially as it relates to determining which patients may need CR/EO programming.[37] Systems need to be created to allow for the implementation of triage and referral efforts.[16] To accomplish increased referrals and expanded programming, an appropriately trained CR/EO workforce needs to be available to provide high-quality care for patients with varying levels of complexity. This level of training will need to be recognized and trusted by medical professionals to increase referrals to CR/EO professionals. Physicians,

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TABLE 2 Relation between lack of proximity to any exercise oncology or cancer rehabilitation programs and geographically based demographic and socioeconomic characteristics within the contiguous United States.

	No. (%)					
	Proximal to one or more programs: $n = 81{,}298$ tracts, $n = 316{,}834{,}357$ population		Lack of proximity to any program: $n = 2183$ tracts, $n = 7{,}577{,}887$ population		Lack of proximity versus proximal[a]	
Characteristic	Tracts	Population[b]	Tracts	Population[b]	OR [95% CI][c]	p[d]
Density, persons per square mile						< .001
10,001[e]	10,095 (12.4)	40,465,845 (12.8)	5 (0.2)	20,004 (0.3)	1.00	
1001–10,000	42,231 (51.9)	171,578,976 (54.2)	892 (40.9)	3,394,865 (44.8)	77.79 [32.26–187.60]	
101–1000	16,710 (20.6)	67,319,780 (21.2)	546 (25.0)	2,027,470 (26.8)	170.02 [70.15–412.06]	
0–100	12,262 (15.1)	37,469,756 (11.8)	740 (33.9)	2,135,548 (28.2)	252.08 [103.71–612.73]	
Rural-urban classification						< .001
Urban: RUCC 1–3	68,436 (84.2)	273,977,880 (86.5)	1321 (60.5)	4,886,233 (64.5)	1.00	
Rural: RUCC 4–10	12,859 (15.8)	42,842,200 (13.5)	862 (39.5)	2,691,654 (35.5)	2.31 [2.05–2.60]	
Percentage of non-Hispanic minority or Hispanic individuals						< .001
0–20	29,304 (36.3)	109,163,332 (34.5)	517 (23.9)	1,700,957 (22.4)	1.00	
2–40	19,060 (23.6)	76,237,983 (24.1)	411 (19.0)	1,440,710 (19.0)	2.15 [1.87–2.46]	
41–60	12,050 (14.9)	49,094,677 (15.5)	305 (14.1)	1,052,504 (13.9)	2.78 [2.39–3.24]	
61–80	8906 (11.0)	36,941,514 (11.7)	288 (13.3)	1,057,343 (14.0)	4.14 [3.51–4.88]	
81–100	11,509 (14.2)	45,396,851 (14.3)	646 (29.8)	2,326,373 (30.7)	10.31 [8.79–12.09]	
Neighborhood deprivation index						< .001
Least deprived: 0%–20%	16,348 (20.4)	68,318,667 (21.7)	78 (3.7)	303,520 (4.0)	1.00	
Below average deprivation: 21%–40%	16,085 (20.1)	65,731,211 (20.8)	253 (11.8)	948,890 (12.6)	2.38 [1.84–3.08]	
Average deprivation: 41%–60%	16,036 (20.0)	62,492,201 (19.8)	404 (18.9)	1,435,921 (19.1)	2.78 [2.17–3.56]	
Above average deprivation: 61%–80%	15,997 (20.0)	60,679,657 (19.2)	542 (25.4)	1,845,805 (24.6)	2.81 [2.20–3.60]	
Most deprived 81%–100%	15,710 (19.6)	58,256,425 (18.5)	859 (40.2)	2,983,917 (39.7)	3.13 [2.44–4.02]	
Cancer mortality, per 100,000						< .001
<147	36,889 (45.4)	152,430,159 (48.1)	865 (40.0)	3,196,292 (42.3)	1.00	
147–162	22,221 (27.3)	86,687,896 (27.4)	461 (21.3)	1,606,341 (21.2)	0.72 [0.64–0.81]	
163–179	15,819 (19.5)	56,442,778 (17.8)	404 (18.7)	1,363,935 (18.0)	0.71 [0.62–0.81]	
180[e]	6321 (7.8)	2,1167,174 (6.7)	434 (20.1)	1,393,995 (18.4)	1.15 [1.00–1.33]	
Cancer incidence, per 100,000[f]						< .001
<415	19,546 (26.3)	81,061,148 (27.9)	924 (43.2)	3,308,256 (44.3)	1.00	
415-455	24,159 (32.5)	94,849,987 (32.7)	319 (14.9)	1,152,612 (15.4)	0.34 [0.30–0.39]	
456-485	18,737 (25.2)	70,599,516 (24.3)	602 (28.1)	2,041,626 (27.4)	0.80 [0.71–0.90]	
486[e]	11,901 (16.0)	43,684,336 (15.1)	295 (13.8)	957,889 (12.8)	0.53 [0.46–0.61]	
US region						
Northeast: CT, MA, ME, NH, RI, VT	3658 (4.5)	14,757,005 (4.7)	23 (1.1)	64,754 (0.9)		
Middle Atlantic: NJ, NY, PA	11,013 (13.5)	41,195,152 (13.0)	0 (0.0)	0 (0.0)		
South Atlantic: DC, DE, FL, GA, MD, NC, SC, WV	16,531 (20.3)	65,201,753 (20.6)	10 (0.5)	33,555 (0.4)		
East North Central: IL, IN, MI, OH, WI	12,615 (15.5)	46,869,214 (14.8)	0 (0.0)	0 (0.0)		
East South Central: AL, KY, MS, TN	4955 (6.1)	17,860,427 (5.6)	362 (16.6)	1,248,814 (16.5)		

(Continues)

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TABLE 2 (Continued)

Characteristic	No. (%) Proximal to one or more programs: n = 81,298 tracts, n = 316,834,357 population: Tracts	Population[b]	Lack of proximity to any program: n = 2183 tracts, n = 7,577,887 population: Tracts	Population[b]	Lack of proximity versus proximal[a]: OR [95% CI][c]	p[d]
West North Central: AR, LA, OK, TX	5829 (7.2)	21,122,624 (6.7)	75 (3.4)	227,888 (3.0)		
West South Central: IA, KS, MN, MO, ND, NE, SD	9023 (11.1)	35,697,214 (11.3)	1264 (57.9)	4,564,059 (60.2)		
Mountain: AZ, CO, ID, MT, NM, NV, WY	5876 (7.2)	23,330,196 (7.4)	374 (17.1)	1,204,755 (15.9)		
Pacific: AK, CA, HI, OR, WA	11,798 (14.5)	50,800,772 (16.0)	75 (3.4)	234,062 (3.1)		

Abbreviations: CI, confidence interval; OR, odds ratio; RUCC, Rural-Urban Continuum Codes.

[a]Logistic regression model (lack of access vs. accessible) was adjusted for urban-rural county (2013 RUCC: urban, 1–3; rural, 4–9), the percentage of non-Hispanic minority or Hispanic individuals, NDI, and density.

[b]Population estimates were obtained from the 5-year 2020 American Community Survey.

[c]ORs and 95% CIs were obtained through association estimates from a logistic regression model.

[d]All p values were obtained from a likelihood-ratio test.

[e]For the distribution of census tracts and population estimates for the entire United States, see Table S1.

[f]County-level incidence data from 2016 to 2020 obtained from US Cancer Statistics were not available for five states because of state legislation (Kansas and Minnesota) or incomplete data (Indiana, Nevada, and Virginia).

TABLE 3 Geographically determined demographic and socioeconomic factors among all programs and by type of program.

Variable	No. (%) All programs, n = 2123	Cancer rehabilitation programs, n = 760	Exercise oncology programs, n = 1363	p
Density, persons per square mile				.82
≥10,001	171 (8.1)	58 (7.6)	113 (8.3)	
1001–10,000	1156 (54.5)	420 (55.3)	736 (54.0)	
101–1000	547 (25.8)	198 (26.1)	349 (25.6)	
0–100	249 (11.7)	84 (11.1)	165 (12.1)	
Rural-urban: RUCC classification				.15
Urban: RUCC 1–3	1900 (89.5)	690 (90.8)	1210 (88.8)	
Rural: RUCC 4–9	223 (10.5)	70 (9.2)	153 (11.2)	
Percentage of non-Hispanic minority or Hispanic individuals				.0018
0–29	936 (44.2)	290 (38.3)	646 (47.4)	
20–39	613 (28.9)	241 (31.8)	372 (27.3)	
40–59	310 (14.6)	127 (16.8)	183 (13.4)	
60–79	153 (7.2)	60 (7.9)	93 (6.8)	
80–100	108 (5.1)	39 (5.2)	69 (5.1)	
Neighborhood deprivation index				.45
Least deprived: 0%–20%	730 (34.5)	258 (34.2)	472 (34.7)	
Below average deprivation: 21%–40%	477 (22.6)	186 (24.6)	291 (21.4)	
Average deprivation: 41%–60%	433 (20.5)	154 (20.4)	279 (20.5)	
Above average deprivation: 61%–80%	291 (13.8)	97 (12.8)	194 (14.3)	
Most deprived: 81%–100%	183 (8.7)	60 (7.9)	123 (9.1)	

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TABLE 3 (Continued)

Variable	No. (%) All programs, $n = 2123$	Cancer rehabilitation programs, n = 760	Exercise oncology programs, $n = 1363$	p
Cancer mortality, per 100,000				.17
<147	955 (45.0)	351 (46.2)	604 (44.3)	
147–162	707 (33.3)	254 (33.4)	453 (33.2)	
163–179	363 (17.1)	114 (15.0)	249 (18.3)	
≥180	98 (4.6)	41 (5.4)	57 (4.2)	
Cancer incidence, per 100,000[b]				< .001
<415	345 (18.0)	126 (18.9)	219 (17.5)	
415–455	682 (35.6)	209 (31.4)	473 (37.8)	
456–485	562 (29.3)	186 (27.9)	376 (30.1)	
≥486	328 (17.1)	145 (21.8)	183 (14.6)	
US region				< .001
Northeast: CT, MA, ME, NH, RI, VT	188 (8.9)	50 (6.6)	138 (10.1)	
Middle Atlantic: NJ, NY, PA	333 (15.7)	163 (21.4)	170 (12.5)	
South Atlantic: DC, DE, FL, GA, MD, NC, SC, WV	439 (20.7)	164 (21.6)	275 (20.2)	
East North Central: IL, IN, MI, OH, WI	343 (16.2)	59 (7.8)	284 (20.8)	
East South Central: AL, KY, MS, TN	99 (4.7)	51 (6.7)	48 (3.5)	
West North Central: AR, LA, OK, TX	195 (9.2)	82 (10.8)	113 (8.3)	
West South Central: IA, KS, MN, MO, ND, NE, SD	210 (9.9)	108 (14.2)	102 (7.5)	
Mountain: AZ, CO, ID, MT, NM, NV, WY	130 (6.1)	36 (4.7)	94 (6.9)	
Pacific: AK, CA, HI, OR, WA	186 (8.8)	47 (6.2)	139 (10.2)	

Abbreviations: OR, odds ratio; RUCC, Rural-Urban Continuum Code.

[a]All p values were obtained from the Pearson χ^2 test comparing the type of program and the factor of interest.

[b]County-level incidence data from 2016 to 2020 obtained from US Cancer Statistics were not available for five states because of state legislation (Kansas and Minnesota) or incomplete data (Indiana, Nevada, and Virginia).

nurses, and their patients also must be made more aware of the value of rehabilitation and exercise to assure that all people living with and beyond cancer who would benefit from these services receive appropriate referrals. In summary, there is a need for expanded programming, workforce, triage and referral, policies, and provider and patient awareness of the value of exercise and policies that support enacting these services.[4,38]

Expansion of online programming may assist in addressing these disparities; there have been recent efforts to make cancer rehabilitation more available through telehealth and mHealth.[39] This is helpful, because it is estimated that 40%–60% of people living with and beyond cancer should be appropriately triaged to cancer rehabilitation programming.[40,41] Online options will need to address well described challenges with digital literacy,[42,43] particularly for rural populations that may have limited internet access.

There are potential limitations to the methodology used for this analysis. First, it is possible that there are CR/EO programs that do not have any online presence. A not-for-profit organization with community connections reviewed the listing of programs in Colorado as a face validity check, and additional programs were identified based on this expert review. Second, it is possible that there are additional search terms that might have been attempted. However, terms trigger back-end–associated terms from the search algorithm. Finally, we only included programs that verified they were enrolling patients and that had adequately trained personnel. It is possible that our methods to reach existing programs were incomplete. The Moving Through Cancer Task Force updates the directory on a monthly basis to ensure that the online version of the directory remains up to date.

In summary, published guidelines suggest that people living with and beyond cancer should be referred to CR/EO programming to address common symptoms and side effects.[1,2,26] Observational evidence also supports the use of exercise to reduce the risk of cancer-specific mortality for breast, colon, and prostate cancer.[35] Proximity to CR/EO programming varies based on geographic density, ethnic diversity, and socioeconomic status. Addressing this unequal proximity may contribute to addressing previously observed disparities in symptom burden and cancer-specific mortality by geography, race, ethnicity, and socioeconomic status.[9–14] Efforts are needed to increase

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patient and provider awareness of the value of exercise, expansion of both programming and the associated workforce, and enactment of policies to support exercise programming.[16,37] These efforts are consistent with the American Cancer Society's commitment to ensuring that everyone has an equal opportunity to live a healthy life.

AUTHOR CONTRIBUTIONS

Kathryn H. Schmitz: Conceptualization, investigation, funding acquisition, writing–original draft, validation, writing–review and editing, supervision, data curation. **Kathryn Demanelis**: Writing–original draft, formal analysis, and writing–review and editing. **Mary E. Crisafio**: Conceptualization, investigation, writing–review and editing, project administration, and data curation. **Mary A. Kennedy**: Writing–review and editing and data curation. **Anna L. Schwartz**: Writing–review and editing. **Anna Campbell**: Writing–review and editing. **Jessica Gorzelitz**: Writing–review and editing and data curation. **Kelley C. Wood**: Writing–review and editing. **Christopher M. Wilson**: Writing–review and editing and writing–original draft. **Raymond L. Scalise**: Data curation and writing–review and editing. **Alex Vincent**: Writing–review and editing and data curation

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CONFLICT OF INTEREST STATEMENT

Kelley C. Wood receives a salary from Select Medical. The remaining authors disclosed no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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